THE CAPITAL ASSET PRICING MODEL AND THE THREE FACTOR MODEL OF FAMA AND FRENCH REVISITED IN THE CASE OF FRANCE

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Abstract. Size and book to market ratio are both highly correlated with the average returns of common stocks. Fama and French (1993) argue that these effects are proxies for factors of risk. In this study, we try to test the three factor model of Fama and French and the Capital Asset Pricing Model on the French Stock Market. We use returns on the six Fama and French portfolios sorted by size and book to market ratio. The sample is taken from July 1976 to June 2001. Our results show that the three factor model explains better the common variation in stock returns than the capital asset pricing model. Moreover, both the CAPM and the three factor model do a good job in explaining the cross section of stock returns. We test the three factor model with a set of market portfolios and we show that all market portfolios capture the common variation in stock returns. However, only the value-weight market portfolio can explain the cross-section in the stock returns. Finally, we test the January effet in the French case and we show that there is no January effect for both the dependent variable (stock portfolios) and the explanatory variables (the market, HML and SMB).

Introduction

The Capital Asset Pricing Model CAPM (Sharpe 1964 [9], Lintner 1965 [13] and Mossin 1966 [14])is the first model in asset pricing. It is the most widely used model because of its simplicity. It assumes that investors respect the Markowitz mean-variance criterion in choosing their portfolios. The beta revolution has had significant impact on the academic and non-academic financial community. Other factor pricing models attempted to explain the cross-section of average asset returns [The Inter-temporal Capital Asset Pricing Model (Merton 1973), The Arbitrage Pricing Model (Ross 1976) and the inter-temporal capital asset pricing model based on consumption (Rubinstein 1976, Lucas 1978, Breeden 1979, Mehra and Prescott 1985 among others [1])].

The well-known conclusion of the CAPM is that the expected excess return on an asset equals the β of the asset times the expected excess return on the market portfolio, where the β is the covariance of the asset's return with the return on the market

Key words and phrases. Asset Pricing, Size effect, Book to market ratio, Risk factors, The Fama and French Unconditional Model and Anomalies.

This study is directed by M. Jacques HAMON from The University of Paris Dauphine.

[1] J. H. Cochrane (2001) [10]documented that: ≪...all factor models are derived as specializations of the consumption-based model. Many authors of factor model papers disparage the consumption-based model, forgetting that their factor model is the consumption-based model plus extra assumptions that allow one to proxy for marginal utility growth from some other variables.≫ p151

portfolio divided by the variance of the market return. Roll (1977) [21] argued that the model can not be tested because the tests involve a joint hypothesis on the model and the choice of the market portfolio. On the other hand, many patterns emerge from empirical studies which are not explained by the CAPM; such as: expected returns and earnings to price ratio have a positive relation (Basu 1977,1983), small capitalisations have higher expected returns than big capitalisations (Banz 1981), there is a positive relation between the level of debt and stock returns (Bhandari 1988) and the book to market ratio is considered as an explanatory variable in stock returns (Chan, Hamao and Lakonishok 1991 [18] and Fama and French 1992 [4] on Japanese and American markets respectively).

In our study, we will attempt to compare the CAPM and the three factor asset pricing model of Fama and French(1993) [5] in explaining stock returns in the case of France. Fama and French argue that stock returns can be explained by three factors: market, book to market ratio and size. Their model summarizes earlier results (Banz (1981), Huberman and Kandel (1987), Chan and Chen (1991) [17]). However, it is much debated: To be a compensation for risk in a multi-factor version of Merton's (1973) Inter-temporal Capital Asset Pricing Model (ICAPM) or Ross's (1976) Arbitrage Pricing Theory (APT), factors must be related to state variables which justify a risk premium.

There are many explications for size and book to market anomalies. They can be summarized in the following points: The premium of the financial distress is irrational (Lakonishok, Shleifer and Vishny (1994); Haugen (1995) and MacKinlay (1995)). Three arguments justify it: It can express an over-reaction of the investors. The second argument is relative to the empirical observation of low stock return of firms with distressed financial situation, but not necessarily during period of low rate of growth of GNP [2] or of low returns of all stocks. Lastly, diversified portfolios of stocks with, as well high as low, ratio book to market; have the same variance of returns.

Other researchers documented other arguments [3] which can replace the premium of the financial distress and validate the CAPM: *(a) Survivor bias*(Kothari, Shanken and Sloan (1995) [22]): But it should be noted that even if the critic of the survivor biais is true, it is not necessarily in favor of the CAPM (Kim (1997) [2], Barber and Lyon (1997) [1]). *(b) Data-snooping*(Black (1993), Lo and MacKinlay (1995)): An extrapolation of data can lead to false conclusions, that's why we need the *out-of-sample*tests. Fama and French (1996) [7] [6] reject this biais [4]. Moreover, the relation between stock returns and the book to market ratio was confirmed by: Davis (1994)

[2]Gross National Product: Chen (1991) [19] advance that the expected stock returns are negatively correlated with the present rate of growth of GNP and positively correlated with its future rate of growth.

[3]we limit the presentation to three biais related to the use of the data but there exists others; such as errors of corresponding market and countable data or *look ahead bias*.

[4]Fama and French (1996) [7] [6] advance four arguments: the premium of the financial distress is not special to a particular sample since it is checked for different periods. It was also the subject of many studies made on international data. The size, book to market equity, earning to price and cash flow ratios, indicators of expected incomes (Ball 1978), have a great utility to test models of asset pricing like the CAPM. And in fourth point, the limited number of the anomalies excludes the assumption of*data-mining*.

on data over a long period; Chan, Hamao and Lakonishok (1991) [18] on Japanese data and Barber and Lyon (1997) [1] on data on the financial institutions [5], among others. *(c) Bad market proxies* : Indeed, according to this argument, the model of asset pricing to be retained is that of the CAPM and because we don't know the market portfolio we have anomalies. This is why, the "real" βs are not observed. This problem is called *errors-in-variables*(Kim (1995, 1997) [2]).

This paper tests the capital asset pricing model and the three factor model of Fama and French (1993) in France for a quarter of a century period. Our study extends the asset pricing tests in three ways: (a) We expand the test of the three factor model to the French market for a long period. Even it would exist such a test, this is the first study that considers twenty five years. So our results are useful because they are an out of sample test of the three factor model. The main result says that the three factor model explains better the common variation and the cross-section of stock returns than the one factor model, the CAPM. (b) We also expand the set of explanatory variables in ordre to answer the question of bad market proxies. Indeed, we test the three factor model with different market portfolios. Our result is easy to summarize. All market portfolios capture the common variation in stock returns but only one market portfolio, the value-weight portfolio, can explain the cross-section in returns. (c) We test the January effect, documented in the US-market, in the French market. As found in many studies, we obtain no January effect with French stocks.

In the next section, we expose the theoretical framework of our study. Methodology used and database considered are then discussed in the second part of the paper. In section three, we summarize results and conclude.

1. Theoretical framework: The Three factor Model

The basic idea of Fama and French (1993) [5] is: the size and book to market ratio are considered as factors of risk that we must remunerate. The unconditional version [6]of the model is expressed in the following equation:

$$E(R_i) - R_f = \beta_i(E(R_M) - R_f) + s_i E(SMB) + h_i E(HML)$$

with:

$E(R_i)$: expected stock return.

R_f: risk free rate.

$E(R_M)$: expected return of market portfolio.

$E(SMB)$: *Small Minus Big*: is the difference between the equal-weight averages of the returns on the three small stock portfolios and the three big stock portfolios.

$E(HML)$: *High book to market Minus Low book to market*: is the difference between the return on a portfolio of high book to market stocks and the return on a portfolio of low book to market stocks, sorted be neutral with respect to size.

[5]Barber and Lyon (1997) confirmed the relation between the size, the book to market ratio and the stock returns, published by Fama and French (1992) [4], for the financial institutions (Fama and French considered only the non-financial firms).

[6]The conditional version of the model authorizes a temporal variation of the rate of stock returns and coefficients of the factors of risk.

$\ss_i, s_i, h_i$: are factor loadings.

Indeed, on the basis of two criterion, size and book to market (BE/ME), Fama and French construct twenty five portfolios, from a sample of the stocks of the NYSE, AMEX and NASDAQ over a 366 month period (From June 1963 to December 1993). Monthly stock returns show a superiority of the stocks of small capitalizations and high book to market ratio, compared to the stocks of big capitalizations and low book to market ratio. This is why, they made the following regression:

$$R_i - R_f = \alpha_i + \ss_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i$$

The results show that the coefficient α_i is:(i) negative for portfolios located in the extreme quantiles of the stocks of small capitalizations and low ratio book to market and (i) positive for portfolios located in the extreme quantiles of the stocks of big capitalizations and high book to market ratio. In addition to these results on the extremes, the coefficient α_i is not significantly different from zero; which makes it possible to affirm that the three factor model explains cross-section stock returns.

2. Database and methodology

2.1. **Database.** We study monthly returns on stock portfolios for France. Portfolios use all French stocks with the relevant Datastream data[7]. We start with 428 stocks: 157 stocks of the *Premier Marché*, 236 of the *Second Marché* and 35 of the *Nouveau Marché*. Only the stocks with available market and countable data are used; so that our sample is reduced to 294 stocks[8]. After eliminating stocks with negative book to market and/or monthly returns for only one year, we obtain our sample of 274 firms: 142 from the *Premier Marché*, 116 from the *Second Marché* and 16 from the *Nouveau Marché* (Table 1). We consider the period from July 1976 to June 2001 (300 months)[9].

In our study, we used the Fama and French(1993) methodology: (i)*A classification of ratio book to market*: 30% of the stocks are grouped in the class of high ratio B/M, 40% of the stocks in the class of medium ratio B/M and 30% of the stocks in the class of low ratio B/M. We consider book to market ratio of December of the year $(t-1)$ for the formation of the portfolios for the period from July of year (t) to June of year $(t+1)$. Book to market ratio is calculated as being the reverse of the variable *Market Value To Book* which appears in the database of Datastream[10]. Unlike Fama and French who used the breakpoints of the ranked values of book to market for NYSE stocks to group NYSE, Amex and NASDAQ stocks, we use the breakpoints of the whole sample (*Premier Marché*, *Second Marché* and *Nouveau Marché*) to make our classification. Like Fama and French, we do not use negative

[7]Appendix II summarizes results of the tests made on only the *Premier Marché* stocks. As for the whole French market, we obtain consistent conclusions.

[8]We have 148 stocks of the *Premier Marché*, 124 stocks of the *Second Marché* and 22 stocks of the *Nouveau Marché* with monthly return, market value and book to market ratio

[9]Returns are calculated from July 1974 however the sample of risk free rate starts in July 1976, so that our sample start date is July 1976.

[10]Market value to Book divides the Market Value by the Net Book Value (Net Tangible Asset). For companies which have more than one classe of equity capital, both market value and net tangible asset are expressed according to the individual issue.

TABLE 1

Descriptive statistics for stocks of French stock market

The sample is composed of 274 French stocks. All variables are from the database of Datastream. Market value to Book divides the Market Value by the Net Book Value (Net Tangible Asset). For companies which have more than one classe of equity capital, both market value and net tangible asset are expressed according to the individual issue. Market Value is defined as the share price multiplied by the number of ordinary shares issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change. The table shows: the average market value used to form size groups, the average market to book value used to form book to market groups, the number of stocks on the whole period and the periods covered.

	Premier Marché	*Second Marché*	*Nouveau Marché*
Market Value	2071.72	160.75	91.67
Market to Book Value	4.35	5.64	6.83
Number of Stocks	142	116	16
Period	July1974/June2001	July1989/June2001	July1998/June2001

book to market firms. (ii)*A classification of size*: The stocks are grouped in two classes: the stocks of small capitalizations and the stocks of big capitalizations. We consider the capitalization[11] of June of year (t) for the formation of portfolios for the period from July of year (t) to June of year ($t+1$). Unlike Fama and French who used the median NYSE size to split NYSE, Amex and NASDAQ stocks (their two size groups contain disproportionate numbers of stocks), we use the median size of the whole sample (*Premier Marché*, *Second Marché* and *Nouveau Marché*) to make our classification. The splits (three book to market groups and two size groups) are arbitrary. However Fama and French (1993) [5] argued that there is no reason for tests to be sensitive to this choice.

Six portfolios (HS, HB, MS, MB, LS, and LB) are formed with the intersection of the two preceding classifications, made independently. The monthly returns of each portfolio correspond to the value-weight monthly returns of the stocks:

$$R_{p,t} = \sum_{i=1}^{n} \omega_{i,t} * R_{i,t}$$

With:

$R_{p,t}$: is the value-weight monthly return of portfolio p in month t.

$R_{i,t}$: is the monthly return of stock i of portfolio p in month t.

$\omega_{i,t}$: is the ratio of market value of stock i on total value market of portfolio p in month t.

n: is the number of stocks of portfolio p.

In our study, the risk free interest rate used is the monthly equivalent rate to: Short term interest rate for the period from July 1976 to January 1981, Money

[11]Market Value is defined as the share price multiplied by the number of ordinary shares issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change.

market, one month, rate from February 1981 to January 1987, PIBOR from February 1987 to December 1998 and EURIBOR from January 1999 to June 2001.

2.2. **Variables.** From the equation of the three factor model of Fama and French, we have three explanatory variables: Market, HML and SMB:

$$R_i - R_f = \alpha_i + ß_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i$$

Two portfolios, HML and SMB, are formed from the six portfolios presented above. Indeed, the monthly stock returns of portfolio HML correspond to the difference between the average monthly stock returns of the two portfolios of high B/M ratio (HS and HB) and the average monthly stock returns of the two portfolios of low B/M ratio (LS and LB): $HML = \{(HS + HB) - (LS + LB)\}/2$.

As for the monthly stock returns of portfolio SMB, it corresponds to the difference between the average monthly stock returns of the three portfolios of small capitalization (HS, MS and LS) and the average monthly stock returns of the three portfolios of high capitalization (HB, MB and LB): $SMB = \{(HS + MS + LS) - (HB + MB + LB)\}/3$.

Six market portfolios were considered: the arithmetic mean of returns of all the stocks; the value-weight returns of all the stocks (stocks are weighted by their market value); indices CAC40, SBF80, SBF120 and SBF250. We use different market portfolios in order to check the dependence or not of results to such a choice of the market portfolio (*Bad market proxies*).

For the dependent variable of our time-series regressions, we consider stock portfolio returns. Indeed, we regress monthly returns of the following portfolios: the six portfolios HS, HB, MS, MB, LS and LB, a portfolio with high B/M ratio (*high B/M equity portfolio*) which corresponds to the average of returns of two portfolios of high B/M ratio (HS and HB), or $HB/M = (HS + HB)/2$ and a portfolio with low B/M ratio (*low B/M equity portfolio*) which corresponds to the average of returns of two portfolios of low B/M ratio(LS and LB), or $LB/M = (LS + LB)/2$.

To obtain our multiple linear regression, we use the step by step method. This methodology consists of introducing or eliminating successively, one at a time, the explanatory variables according to a criterion based on the marginal contribution of each variable in the regression. It determines, if it is necessary, among the explanatory variables already in the regression equation which to eliminate because it becomes superfluous following the addition of other variables at the preceding stage. The selection finishes when no explanatory variable can be or added or eliminated from the regression equation (see Appendix I).

Table 2 shows that the portfolios in the smallest size and the lowest book to market group and these in the biggest size and the highest book to market group contain, on average, less stocks than other portfolios. Like table 1 in Fama and French(1993) [5], in the smallest (biggest) size class, the number of stocks increases (decreases) from lower to higher book to market portfolios. Table 1 shows that stocks of *Second Marché* and *Nouveau Marché* have, on average, the smallest market value and the highest market to book value. This pattern has as a consequence that these stocks tend to be in the small and low B/M portfolio. Most stocks of big and high

Table 2

Descriptive statistics for six stock portfolios formed from independent sorts on size and book to market: From July 1976 to June 2001 (300 months)

The sample is composed of 274 French stocks. The six size-book to market portfolios are formed using the Fama and French methodology: (i)*A classification of ratio book to market*: 30% of the stocks are grouped in the class of high ratio B/M, 40% of the stocks in the class of medium ratio B/M and 30% of the stocks in the class of low ratio B/M. We consider book to market ratio of December of the year $(t-1)$ for the formation of the portfolios from July of year (t) to June of year $(t+1)$. Book to market ratio is calculated as being the reverse of the variable *Market Value To Book* which appears in the database of Datastream. Like Fama and French, we do not use negative book to market firms. (ii)*A classification of size*: The stocks are grouped in two classes: the stocks of small capitalizations and the stocks of big capitalizations. We consider the capitalization of June of year (t) for the formation of portfolios from July of year (t) to June of year $(t+1)$. Capitalisation is the Market Value, defined as the share price multiplied by the number of ordinary shares, of Dtastream.

	Book to Market equity quintiles		
Size	L	M	H
	Average of annual averages of firm size		
S	128.44	132.78	106.66
B	2366.71	1743.05	1346.68
	Average of annual Book to Market ratios		
S	0.083	0.571	1.353
B	0.138	0.545	1.268
	Average of annual number of firms in portfolio		
S	11.1	20.8	22.4
B	21.1	22.4	10.2

B/M portfolio are from *Premier Marché* because they have, on average, the biggest market value and the lowest market to book value.

Table 3 summarizes returns of the dependent and explanatory variables in the time series regressions. The average excess returns of the eight stock portfolios considered range from 0.83% to 1.33% per month. Unlike Molay (1999) [3][12], the positive relation between average returns and book to market equity is confirmed in the smallest size group because average returns increase with book to market ratio. Like Molay (1999) [3], in every book to market class but the medium, average returns tend

[12]In a study on the French market (204 stocks) for the period from July 1992 to June 1997, Molay (1999) [3] confirms the negative relation between size and average return, however he does not found any relation between book to market ratio and average return. Standard deviation of excess stock portfolio returns in his study are less than these of our sample.

Table 3

Summary statistics for the monthly dependent and explanatory returns (in percent): From July 1976 to June 2001 (300 months)

The sample is composed of 274 French stocks. The six size-book to market portfolios are formed using the Fama and French methodology, as described in table 2. For the dependent variables, we consider excess monthly returns of the following portfolios: the six portfolios HS, HB, MS, MB, LS and LB, a portfolio with high B/M ratio which corresponds to the average of returns of two portfolios of high B/M ratio (HS and HB), or $HB/M = (HS + HB)/2$ and a portfolio with low B/M ratio which corresponds to the average of returns of two portfolios of low B/M ratio(LS and LB), or $LB/M = (LS + LB)/2$. The table gives average monthly excess returns, standard deviation and t-statistic for means (to test wether mean is different ro not from zero) of these eight portfolios. We have three explanatory variables: Market, HML and SMB. Indeed, the monthly stock returns of portfolio HML correspond to: $HML = \{(HS + HB) - (LS + LB)\}/2$. As for the monthly stock returns of portfolio SMB, it corresponds to: $SMB = \{(HS+MS+LS)-(HB+MB+LB)\}/3$. The market portfolio is the value-weight returns of all the stocks. The table gives correlations, average monthly returns, standard deviation and t-statistic for means of these three explanatory variables.

Dependent variables: excess returns per month (in percent)

	Mean	*Standard Deviation*	*t-Statistic*
SL	0.91	8.37	1.893
SM	1.03	6.95	2.585
SH	1.33	7.12	3.251
BL	0.87	6.65	2.288
BM	1.22	6.29	3.383
BH	0.87	7.69	1.966
LB/M	0.89	6.73	2.306
HB/M	1.10	6.73	2.845

Explanatory variables: correlation and excess returns per month (in percent)

Correlations

	Mktpond.	HML	SMB
Mktpond.	1.00		
HML	-0.015	1.00	
SMB	-0.131	-0.243	1.00

Explanatory returns

	Mktpond.	HML	SMB
Mean	1.045	0.208	0.103
Standard Deviation	6.17	4.95	4.06
t-statistic for means	2.932	0.729	0.442

to decrease with the size which confirms evidence that there is a negative relation between size and average return. All excess returns of portfolios have high standard deviations (greater than 6% per month). The low (high) book to market portfolio has an average annual return of 11.31% (14.10%). Fama and French (1998) [8][13] documented an annual excess returns of 9.46% and 17.10% for, respectively, low and high book to market portfolios in the case of France. All portfolios, but SL and BH (which have the smallest number of stocks), produce average excess returns that are more than two standard errors from zero.

Table 3 shows also average values of explanatory variables. These values give the average risk premiums for the common factors in returns. The average value of excess returns of market portfolio is 1.045% per month with 2.932 t-statistic. This is large compared to Fama and French (1993) in the US-case (only 0.43% with 1.76 standard errors from zero) and Molay (1999) in the French case (only 0.31%). However, Fama and French (1998) documented an average annual value for the market portfolio in the French case about 11.26% (0.89% per month) and Heston, Rouwenhorst and Wessels (1999) [11] [14]about 1.21% per month. The average HML return is only 0.208% per month with a marginal 0.729 standard errors from zero. The size factor SMB produces an average premium of 0.103% per month, however the t-statistic is less than two (0.442).

Like Fama and French (1993), Table 3 shows that HML portfolio returns have negative correlation with excess market and SMB portfolio returns (-0.015 and -0.243 respectively). Unlike Fama and French (1993), SMB and market portfolio have negative correlation. Molay (1999) documented that this negative correlation between SMB portfolio and market portfolio can be explained by the fact that market portfolio is value weighted. When we consider an equal weighted portfolio, this correlation become positive (and it is about 0.165 for our sample and 0.13 in Molay's study).

3. Results

3.1. **Portfolio returns.**

In our time-series regressions, we consider slopes and R^2 to compare the explanatory power of the CAPM and that of the three factor model. We regress monthly excess returns of the eight stock portfolios on: (i)monthly excess returns of the market portfolio: $R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + \epsilon_i$; (ii)monthly returns of the three variables: Market, HML and SMB according to the following regression: $R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i$. For the period from July 1976 to June 2001, only the market portfolio, defined as being the value-weight of monthly returns of all the stocks, was considered. All the results are presented in table 4.

[13] Fama and French (1998) [8] study the case of France for the period from July 1975 to June 1995. There sample has, on average, 108 stocks

[14] Heston, Rouwenhorst and Wessels (1999) [11] study the case of France (among 12 European countries) for the period from 1978 to 1995. There sample has 418 stocks

TABLE 4

Regressions of monthly excess returns of portfolios formed from independent sorts on size and book to market: From July 1976 to June 2001 (300 months)

The sample is composed of 274 French stocks. The six size-book to market portfolios are formed using the Fama and French methodology, as described in table 2. The monthly returns of each portfolio corresponds to the value-weight monthly returns of the stocks:$R_{p,t} = \sum_{i=1}^{n} \omega_{i,t} * R_{i,t}$. We have three explanatory variables: Market, HML and SMB, as described in table 3. The risk free interest rate used is the monthly equivalent rate to: Short term interest rate for the period from July 1976 to January 1981, Money market, one month, rate from February 1981 to January 1987, PIBOR from February 1987 to December 1998 and EURIBOR from January 1999 to June 2001. The following table presents, for each portfolio, the slopes and their t statistics (between brackets), and R^2 adjusted of time-series regressions. We regressed monthly returns of eight portfolios according to:

$$CAPM : R_i - R_f = \alpha_i + ß_i(R_M - R_f) + \epsilon_i.$$

$$FF3FM : R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i.$$

	CAPM			***FF3FM***				
Ptf.	α	β	Adj. R^2	α	β	s	h	Adj. R^2
SL	-0.000	0.912	0.451	-0.001	0.989	0.970	-0.538	0.844
	(-0.105)	*(15.701)*		*(-0.551)*	*(31.589)*	*(19.764)*	*(-13.471)*	
SM	0.000	0.943	0.699	-0.001	1.012	0.773	0.256	0.893
	(0.237)	*(26.399)*		*(-1.151)*	*(47.038)*	*(22.932)*	*(9.353)*	
SH	0.004	0.881	0.582	0.000	0.971	0.950	0.633	0.948
	(1.544)	*(20.423)*		*(0.967)*	*(63.103)*	*(39.418)*	*(32.274)*	
BL	-0.001	1.012	0.882	-0.000	0.991	-0.209	-0.277	0.928
	(-1.342)	*(47.383)*		*(-0.738)*	*(58.590)*	*(-7.881)*	*(-12.866)*	
BM	0.002	0.964	0.896	0.001	0.973	0.091	0.076	0.901
	(1.858)	*(50.842)*		*(1.598)*	*(51.976)*	*(3.110)*	*(3.195)*	
BH	-0.001	1.019	0.668	-0.002	1.009	-0.189	0.553	0.821
	(-0.737)	*(24.525)*		*(-1.448)*	*(32.751)*	*(-3.919)*	*(14.075)*	
LB/M	-0.001	0.962	0.777	-0.000	0.990	0.381	-0.407	0.953
	(-0.583)	*(32.298)*		*(-1.071)*	*(71.317)*	*(17.497)*	*(-23.033)*	
HB/M	0.001	0.950	0.759	-0.000	0.990	0.381	0.593	0.952
	(0.582)	*(30.712)*		*(-1.071)*	*(71.317)*	*(17.497)*	*(33.506)*	

On the basis of the adjusted R^2 criterion, we can affirm that the three factor model, compared with the CAPM, captures, better, common variation in stock returns. Indeed, for the eight portfolios, we obtained an adjusted R^2 (The average adjusted R^2 is 90.5%) higher with the three factor model than the CAPM (The average adjusted R^2 is 71.4%). Our results are better than these of Molay (1999) who obtained an average adjusted R^2 of 79.7% with the three factor model.

The market βs are all more than 15 standard errors from zero in the case of the CAPM and adjusted R^2 ranges from 45.1% to 89.6%. With the three factor model, the market βs are all more than 31 standard errors from zero and adjusted R^2 ranges from 82.1% to 95.3%. Moreover, even the lowest three factor adjusted R^2, 82.1% for BH portfolio, is much larger than the 66.8% generated by the CAPM regression. Like Fama and French (1993), adding HML and SMB to the time series regressions collapses the βs toward 1. Fama and French explain, the move up of low βs and the move down of high βs, by the correlation between the market and SMB or HML. However in our case, these correlations are low (table 3: -0.015 with HML and -0.131 with SMB). Although SMB and HML are correlated (-0.243), our step by step methodology to obtain our multiple linear regression keep the three factor model for all the portfolios.

Indeed, adding HML and SMB to the CAPM regression increases R^2. Moreover, HML slopes are related to book to market ratio. For both big and small capitalisations, they increase from negative values for the lowest book to market class to positive values for the highest book to market class. Their t-statistics are greater than three. Similarly, SMB slopes are related to size. In every book to market group, they decrease from small to big capitalisation. They are more than three standard errors from zero.

3.2. **The cross-section of portfolio returns.** Results in table 4 allow us to establish that Market, SMB and HML capture common variation in stock portfolio returns. In this part, we are interested in explaining the cross-section of average returns. Fama and French (1993) argue that the multi-factor asset pricing models of Merton (1973) and Ross (1976) imply a simple test of whether the set of explanatory variables suffice to describe the cross-section of average returns: intercepts of time-series regressions should be close to zero.

In all cases, intercepts are below two standard errors from zero[15]. In the time-series regressions of the CAPM, the intercepts of the small portfolios exceed these of the big portfolios, in low and high book to market classes. As Fama an French (1993) has mentioned, this shows the size effect of Banz (1981). However, intercepts are related to the book to market ratio only in the case of small capitalisations because they increase with book to market ratio. We can see this pattern also with low and high book to market portfolios. In fact, when the market portfolio is the only explanatory variable, intercept of high book to market portfolio (-0.001) is higher than that of low book to market portfolio (0.001). Adding HML and SMB to the regressions, the two intercepts become equal and are indistinguishable from zero.

[15]Molay (1999) obtains two regressions of the three factor model out of nine where intercepts are more than two standard errors from zero.

To sum up our results, we can say that the regressions of the three factor model absorb common time-series variation in returns (slopes and adjusted R^2 values). Moreover, because of intercepts which are close to zero, they explain the cross-section of average returns.

3.3. **Market Portfolio.** We consider six market portfolios: the equal-weight returns of all the stocks; the value-weight returns of all the stocks; indices CAC40, SBF80, SBF120 and SBF250. We use different market portfolios in order to check the dependence or not of results to such a choice of the market portfolio (*Bad market proxies*). Table 5 shows that the six market portfolios are highly correlated. So our time-series regressions should give us similar results. We use only High and Low book to market portfolios as dependent variables. All results are summarized in table 6. Not surprisingly, the slopes on HML of the high book to market portfolio are greater than these of the low book to market portfolio. Moreover, the HML slopes decrease from positive value to negative value. This pattern shows that HML is related to book to market ratio.

TABLE 5

Correlations between Excess Monthly Market Portfolios: July 1991/June 2001

We consider six market portfolios: the equal-weight returns of all the stocks (Mkt); the value-weight returns of all the stocks (Mktpond.); indices CAC40, SBF80, SBF120 and SBF250. The risk free interest rate is: PIBOR (July 1991/December 1998) and EURIBOR (January 1999/June 2001). The table shows Pearson bilateral correlations between monthly excess returns of market portfolios. All correlations are significant at 1%.

Correlations

	Mkt.	Mktpond.	CAC40	SBF80	SBF120	SBF250
Mkt.	1.00	0.831	0.781	0.891	0.821	0.841
Mktpond.		1.00	0.980	0.901	0.989	0.988
CAC40			1.00	0.866	0.992	0.984
SBF80				1.00	0.910	0.923
SBF120					1.00	0.997
SBF250						1.00

High book to market equity portfolio: For the period from July 1991 to June 2001 (120 months), we regress monthly excess returns of the portfolio on the three explanatory variables. Table 6 shows that the three factors capture strong common variation in stock returns for all market portfolios. The adjusted R^2 ranges between 80.8% (with SBF80 as the market portfolio) and 94% (with the value-weight returns of all the stocks as the market portfolio). The market *beta*s are all more than 21% standard errors from zero. The t-statistics on the HML slopes are greater than 8 and the SMB slopes are more than five standard errors from zero. The largest adjusted R^2 is given by the value-weight returns of all the stocks as the market portfolio. Not surprisingly, the second large value is given by the SBF250 (90.7%).

TABLE 6

Monthly Excess Return Regressions of Portfolios: July 1991/June 2001

The sample is composed of 274 French stocks. We use the Fama and French methodology, as described in table 2. The monthly returns of each portfolio are the value-weight monthly returns of the stocks. We have three explanatory variables: Market, HML and SMB, as described in table 3. Six market portfolios are considered: the equal-weight returns of all the stocks (Mkt); the value-weight returns of all the stocks (Mktpond.); indices CAC40, SBF80, SBF120 and SBF250. The risk free interest rate is: PIBOR (July 1991/December 1998) and EURIBOR (January 1999/June 2001). The high (low) B/M portfolio is the average return of two portfolios of high (low) B/M ratio. The following table shows the slopes and their t statistics (between brackets), and adjusted R^2 of regressions. We regress monthly excess returns according to the three factor model: $R_i - R_f = a_i + ß_i(R_M - R_f) + s_iSMB + h_iHML + \epsilon_i$.

Market Portfolio	High B/M equity Portfolio				
	$a(t)$	$\beta(t)$	$s(t)$	$h(t)$	Adjusted R^2
Mkt	0.007 *(4.949)*	1.032 *(30.755)*	-0.189 *(-5.326)*	0.272 *(8.513)*	0.895
Mktpond.	0.000 *(0.165)*	1.071 *(41.561)*	0.516 *(16.009)*	0.636 *(23.391)*	0.940
CAC40	0.006 *(3.963)*	0.979 *(28.134)*	0.570 *(11.988)*	0.619 *(15.968)*	0.878
SBF80	0.006 *(3.192)*	0.930 *(21.489)*	0.136 *(2.672)*	0.499 *(10.716)*	0.808
SBF120	0.006 *(4.222)*	1.019 *(32.147)*	0.508 *(12.418)*	0.612 *(17.875)*	0.903
SBF250	0.006 *(4.524)*	1.037 *(32.847)*	0.454 *(11.580)*	0.599 *(17.940)*	0.907

Market Portfolio	Low B/M equity Portfolio				
	$a(t)$	$\beta(t)$	$s(t)$	$h(t)$	Adjusted R^2
Mkt	0.007 *(4.949)*	1.032 *(30.755)*	-0.189 *(-5.326)*	-0.728 *(-22.741)*	0.938
Mktpond.	0.000 *(0.165)*	1.071 *(41.561)*	0.516 *(16.009)*	-0.364 *(-13.414)*	0.964
CAC40	0.006 *(3.963)*	0.979 *(28.134)*	0.570 *(11.988)*	-0.381 *(-9.830)*	0.927
SBF80	0.006 *(3.192)*	0.930 *(21.489)*	0.136 *(2.672)*	-0.501 *(-10.750)*	0.886
SBF120	0.006 *(4.222)*	1.019 *(32.147)*	0.508 *(12.418)*	-0.388 *(-11.349)*	0.943
SBF250	0.006 *(4.524)*	1.037 *(32.847)*	0.454 *(11.580)*	-0.401 *(-12.035)*	0.945

In short, the regression slopes and R^2 establish that all market portfolios considered, with SMB and HML portfolios, capture common variation in stock returns. However, the only intercept close to zero is that of the time-series regression with the value-weight market portfolio. Only the value-weight market portfolio, with SMB and HML, explain, well, the cross-section of average stock returns.

Low B/M equity portfolio: Similarly, for the ten years period (July 1991 to June 2001), we regress monthly excess returns of the low B/M equity portfolio on the three factors, Market, HML and SMB. Table 6 says that the three factors capture strong common variation in stock returns for all market portfolios. The adjusted R^2 ranges between 88.6% (with SBF80 as the market portfolio) and 96.4% (with the value-weight returns of all the stocks as the market portfolio). The market *beta*s are all more than 21% standard errors from zero. The t-statistics on the HML slopes are greater than nine and the SMB slopes are more than two standard errors from zero. As for the high book to market portfolio, the largest adjusted R^2 is given by the value-weight returns of all the stocks as the market portfolio. Not surprisingly, the second large value is given by the SBF250 (94.5%). Because market portfolios are highly correlated, the regression slopes and R^2 establish that all of them, with SMB and HML portfolios, capture common variation in stock returns. However, the only intercept close to zero is that of the time-series regression with the value-weight market portfolio. Only the value-weight market portfolio, with SMB and HML, explain, well, the cross-section of average stock returns.

3.4. **January effect.** The preceding tables do not distinguish whether our results are stable throughout the year or whether they have a seasonal pattern. Previous researches show that January average returns are higher than these of other months, particularly for small capitalisations. In this subsection, we examine the January effect in French stock returns.

Table 7 shows summary statistics for the monthly excess returns of portfolios for January and non-January months. For the market portfolio, the January average monthly return (1.46%) is higher than that of other months (1.00%). In every book to market class, big capitalisations have higher average monthly returns in January than in other months of the year. However, it is not the case for small capitalisations because we obtain an average monthly excess return higher for January in only the low book to market quintile. Moreover, in all book to market classes, but one, big capitalisations have, on average, a January excess return higher than small capitalisations, which can explain why the average January return of SMB portfolio is negative (-5.7%). The size effect is not confirmed in January for French market. Similarly, average January return of HML portfolio is negative (-5.3%) because high book to market portfolio has less average return than low book to market portfolio in January. The book to market effect is not confirmed in January for French stocks.

To study the significance of the January effect, we use regressions with a dummy variable that is one in January and zero in other months. Table 8 summarizes results for the eight excess portfolio returns and the three factor explanatory returns. Fama and French (1993) have documented that the regression intercepts measure average

Table 7

Summary statistics for the monthly dependent and explanatory returns (in percent): January vs other months

The sample is composed of 274 French stocks for the period from July 1976 to June 2001. The six size-book to market portfolios are formed using the Fama and French methodology, as described in table 2. We consider excess monthly returns of eight stock portfolios and we have three explanatory variables: Market, HML and SMB; as described in table 3. The table gives average monthly excess returns for January, non-January months and the whole sample. For each portfolio, we have 25 January excess monthly returns and 275 non-January excess monthly returns.

Dependent variables: Mean excess return per month (in percent)

	Non-January Months	*January*	*Total sample*
SL	0.86	1.45	0.91
SM	1.07	0.69	1.03
SH	1.41	0.48	1.33
BL	0.83	1.32	0.87
BM	1.17	1.80	1.22
BH	0.84	1.22	0.87
LB/M	0.85	1.39	0.89
HB/M	1.12	0.85	1.10

Explanatory variables: Mean excess return per month (in percent)

	Non-January Months	*January*	*Total sample*
Mktpod.	1.00	1.46	1.45
HML	0.27	-0.53	0.20
SMB	0.16	-0.57	0.10

returns for non-January months and the slopes on the dummy variable are differences between average returns in January and in other months[16].

The table shows that all slopes on January dummy are less than 0.3% per month and less than two standard errors from zero. Unlike Fama and French (1993), we have no January effect for our excess stock returns and our three factor explanatory returns[17].

4. Others researches

In our study, we are not testing the validation of asset pricing models although we are comparing two asset pricing models. The testability of asset pricing theory has

[16] It can be easily verified by comparing results in tables 6 and 7.

[17] Like Fama and French (1993), we make regressions of the three factor standardized and unstandardized residuals on the January dummy. For of all portfolios, slopes on the dummy variable are less than two standard errors from zero. Results are available upon request.

Table 8

Tests for January effect in the dependent returns and explanatory returns: July 1976/June 2001

The sample is composed of 274 French stocks. We use the Fama and French methodology, as described in table 2. We regress monthly excess returns according to the following regression:$R_t - R_f = a + bJAN(t) + \epsilon$ where $JAN(t)$ is a dummy variable that is one in January and zero in other months. The portfolios and explanatory variables are described in more details in preceding tables.

	a(t)	*b(t)*	$Adjusted R^2$
Stock Portfolio		Excess Stock Returns	
SL	0.008 *(1.713)*	0.005 *(0.337)*	-0.003
SM	0.010 *(2.546)*	-0.003 *(-0.259)*	-0.003
SH	0.014 *(3.291)*	-0.009 *(-0.627)*	-0.002
BL	0.008 *(2.085)*	0.004 *(0.352)*	-0.003
BM	0.011 *(3.097)*	0.006 *(0.476)*	-0.003
BH	0.008 *(1.810)*	0.003 *(0.240)*	-0.003
LB/M	0.008 *(2.094)*	0.005 *(0.383)*	-0.003
HB/M	0.011 *(2.776)*	-0.002 *(-0.195)*	-0.003
Factor		Three factor explanatory returns	
Mktpond.	0.010 *(2.699)*	0.004 *(0.357)*	-0.003
HML	0.002 *(0.925)*	-0.008 *(-0.787)*	-0.001
SMB	0.001 *(0.674)*	-0.007 *(-0.872)*	-0.001

many limitations as the market portfolio identification (Roll 1977 [21]). Moreover, both the CAPM and the three factor model suppose a linear relation between the return and the factor(s) of risk. As Roll (1977) [21] has mentioned, this hypothesis poses two empirical difficulties: (a) we have an idea about the form of the cross-sectional relation but not about the parameters values; (b) our methodology of portfolio grouping returns can omit individual asset deviations from exact linearity which are related to other factors.

Fama and French (1993) explain that the empirical experience is the motivation of the choice of size and book to market factors. They recognize that their choice is somewhat arbitrary, with the absence of a theoretical framework which specifies the exact form of factors. However, they show that their model can be used in many applications. They list selecting portfolios, evaluating portfolio performance, measuring abnormal returns in event studies and estimating the cost of capital. These applications can be justified by the fact that the three factor model provides a good description of the cross-section of averages stock returns.

However, the Fama and French methodology is much debated. Knez and Ready (1997) [20] argue that the Fama and French results are not false but not very rich. Their results can be summarized as follows: the size effect is due to the extreme values (representing less than 1% of monthly data base). However, while controlling the size, the Book to Market effect is not affected by the extreme values.

A competing model of the three factor model of Fama and French is the model of the characteristics of the firm of Daniel and Titman (1997) [16]. Indeed, Daniel and Titman give a different interpretation for the relation between book to market ratio and stock returns. They reject the assumption of "factor of risk" in favor of the model "of the characteristics of the firm": A low book to market ratio, which is one of the characteristics of the large firms, causes a low stock returns which does not necessarily correspond to a risk. They show the superiority of their model [18] in comparison to that of three factors of Fama and French. However, Davis, Fama and French (2000) [15] show that this interpretation is specific to the period of study and confirm the results of the three factor model. In the same way, Lewellen(1999) [12] confirms the superiority of the model of Fama and French (1993) compared to the model of Daniel and Titman (1997).

5. Conclusion

In this study, we test the capital asset pricing model and the three factor model of Fama and French (1993) on the French stock market. The test is made on a sample of 274 stocks for a period of a quarter of a century (300 months). One of the motivations of this study is to show whether the previous validations of the three factor model are specific to a sample and/or to a period. Our results can be summarized in the following three points. First, the three factor model explain better the common variation in the stock returns than the capital asset pricing model. In the French case, adding HML and SMB portfolio returns to the market excess return as explanatory variables of stock returns gives better results (for slopes and adjusted R^2). Moreover, intercepts of stock portfolio regressions on Market, HML and SMB, which are close to zero say that the three factor model explains the cross-section of average stock returns. Second, in order to check whether our results depend on the choice of the market portfolio, we consider six market portfolios: the equal-weight returns of the stocks; the value-weight returns of the stocks; indices CAC40, SBF80, SBF120 and SBF250. All market portfolios explain common variation in stock returns, with the two other explanatory variables HML and SMB. However, only the value-weight market portfolio does a good job in explaining the cross-section of stock returns. Third, there is no January effect in the French case. Both the

[18] The authors form two sorts of portfolios: (1) factor balanced portfolio (FB): it consists in the purchase of portfolio of stocks of high ratio B/M and low sensitivity to factor HML β_{hml} and the sale of portfolio of stocks of low ratio B/M and of the same sensitivity to factor HML β_{hml} and (2) characteristic balanced portfolio (CB): this portfolio has a high sensitivity to factor HML. It consists in the purchase and the sale of stocks of high ratio B/M (the purchase and the sale are made for the same amount). The behavior of these portfolios, with null investment, differs according to the model considered: the results show that the average returns of portfolio CB is null and its coefficient α_i is positive; while the portfolio FB has a positive average stock returns. These results corroborate the thesis of the model of the characteristics of the firm.

three explanatory returns and the stock portfolio returns show no difference between average January returns and average returns in other months. In this study, we have compared the three factor model with the most famous model of asset pricing, the CAPM. In futur work, we will compare the Fama and French model with other competing models, such as the model of the characteristic of firme of Daniel and Titman (1997).

6. Appendix I

We explain how we obtain our multiple linear regression using the "step by step" methodology for two portfolios; high and low book to market portfolios. As mentioned in the paper, the "step by step" methodology consists of introducing or eliminating successively, one at a time, the explanatory variables according to a criterion based on the marginal contribution of each variable in the regression. It determines, if it is necessary, among the explanatory variables already in the regression equation which one to eliminate because it becomes superfluous following the addition of other variables at the preceding stage. The selection finishes when no explanatory variable can be or added or eliminated from the regression equation. Results for high and low book to market portfolios are summarized in tables 9 and 10, respectively. Tables show that HML is related to book to market ratio. Indeed, it is not surprising that the slopes on HML of the high book to market portfolio are greater than these of the low book to market portfolio. Moreover, the HML slopes decrease from positive values to negative values.

High book to market equity portfolio: For the period from July 1976 to June 2001 (300 months), table 2 shows that the average annual excess return of the high book to market portfolio is 14.10% with 2.84 standard errors from zero. Table 9 summarizes regressions of the monthly excess returns of the high B/M equity portfolio on three explanatory variables: Market as the value-weight returns of all stocks, HML and SMB. In the three time-series regressions; the one factor regression (The market), the two factor regression (The market and HML) and the three factor regression (The market, HML and SMB), intercepts are close to zero with less than two standard errors from zero. Three regressions explain the cross-section of stock returns.

Table 9 shows, not surprisingly, that the excess return on the market portfolio is the first explanatory variable in the time-series regression. The market captures the common variation in stock returns. However, the adjusted R^2 is only about 0.759 which shows the important fact that it might exist other factors that can explain common variation of stock returns. Moreover, the beta is 0.950 and it is 30.712 standard errors from zero. The second explanatory variable to be added to the regression is HML. In this case, the slope on the market move up to 0.956 and its t statistic becomes 48.852. The adjusted R^2 increases also and becomes more than 0.9. The last step is to add SMB to the regression as an explanatory variable. Not surprisingly, the three factor regression captures common variation in stock returns. We obtain an adjusted R^2 about 0.952. The market beta become more close to one (0.990) and more significant (the t statistic is 71.317). To sum up our results, we can confirm that adding HML and SMB to the regression increases R^2 and collapses the market beta toward 1.

Table 9

Regressions of monthly excess returns of high book to market equity portfolio: From July 1976 to June 2001 (300 months)

The high B/M equity portfolio corresponds to the average return of two portfolios of high B/M ratio (HS and HB), or $HB/M = (HS + HB)/2$. We use the step by step methodology to obtain our multi-linear regression with three explanatory variables: Market as the value-weight returns of all stocks, HML and SMB. All variables are described in tables 1 to 6. The general version of our regression is the following:

$$R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i.$$

Model	α_i	β_i	h_i	s_i	Adjusted R^2
1	0.001	0.950			0.759
	0.582	*30.712*			
2	-0.000	0.956	0.516		0.904
	-0.013	*48.852*	*21.149*		
3	-0.000	0.990	0.593	0.381	0.952
	-1.071	*71.317*	*33.506*	*17.497*	

1 Explanatory Variables: Intercept, Excess value-weight market portfolio

2 Explanatory Variables: Intercept, Excess value-weight market portfolio, HML

3 Explanatory Variables: Intercept, Excess value-weight market portfolio, HML, SMB

Dependent Variable: Excess monthly return of high book to market portfolio.

Low book to market equity portfolio: For twenty five years (July 1976/June 2001), the average annual excess return of the low book to market portfolio is 11.31% with 2.30 standard errors from zero (see table 2). Table 10 summarizes regressions of the monthly excess returns of the low B/M equity portfolio on three explanatory variables: Market as the value-weight returns of all stocks, HML and SMB. In all cases; the one factor regression (The market), the two factor regression (The market and HML) and the three factor regression (The market, HML and SMB), intercepts are close to zero with less than two standard errors from zero. Three regressions explain the cross-section of stock returns.

Similarly, the excess return on the market portfolio is the first explanatory variable in the time-series regression (Table 10). The market captures the common variation in stock returns. However, the adjusted R^2 is only about 0.777; so it might exist other factors that can explain common variation of stock returns. Moreover, the market beta is about 0.962 and it is 32.298 standard errors from zero. The second explanatory variable added to the regression is HML. In this two factor regression, the slope on the market decreases (0.956) however its t statistic becomes 48.852. The adjusted R^2 increases also and becomes more than 0.9. Like the case of high book to market portfolio, the last step is to add SMB to the regression as an explanatory variable. Similarly, the three factor regression captures common variation in stock returns. We obtain an adjusted R^2 about 0.953. The market beta become more close to one (0.990) and more significant (the t statistic is 71.317). We can confirm that adding HML and SMB to the regression increases R^2 and collapses the market beta toward 1.

Table 10

Regressions of monthly excess returns of low book to market equity portfolio: From July 1976 to June 2001 (300 months)

The low B/M equity portfolio corresponds to the average return of two portfolios of low B/M ratio (LS and LB), or $LB/M = (LS + LB)/2$. We use the step by step methodology to obtain our multi-linear regression with three explanatory variables: Market as the value-weight returns of all stocks, HML and SMB. All variables are described in tables 1 to 6. The general version of our regression is the following:

$$R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i.$$

Model	α_i	β_i	h_i	s_i	Adjusted R^2
1	-0.001	0.962			0.777
	-0.583	*32.298*			
2	-0.000	0.956	-0.484		0.904
	-0.013	*48.852*	*-19.833*		
3	-0.000	0.990	-0.407	0.381	0.953
	-1.071	*71.317*	*-23.033*	*17.497*	

1 Explanatory Variables: Intercept, Excess value-weight market portfolio

2 Explanatory Variables: Intercept, Excess value-weight market portfolio, HML

3 Explanatory Variables: Intercept, Excess value-weight market portfolio, HML, SMB

Dependent Variable: Excess monthly return of low book to market portfolio.

7. Appendix II

This Appendix summarizes tests on monthly excess stock returns of portfolios from only the *Premier Marché*. As for the whole market, portfolios contain all stocks with the relevant Datastream data. After keeping only the stocks with available market and countable data and eliminating these with negative book to market and/or monthly returns for only one year, we pass from 157 to 142 stocks. We consider the period from July 1976 to June 2001 (300 months).

As we have mentioned in the paper, we used the Fama and French(1993) methodology to sort portfolios. Six portfolios (HS, HB, MS, MB, LS, and LB) are formed with the intersection of the size and the book to market classifications, made independently. The monthly returns of each portfolio corresponds to the value-weight monthly returns of the stocks. The risk free rate is the monthly equivalent rate to: short term interest rate for the period from July 1976 to January 1981; Money market one month rate from February 1981 to January 1987; PIBOR from February 1987 to December 1998 and EURIBOR from January 1999 to June 2001.

For the dependent variable of our time-series regressions, we consider stock returns of the eight portfolios: HS, HB, MS, MB, LS and LB, the high B/M equity portfolio and the low B/M equity portfolio. We have three explanatory variables: Market, HML and SMB. All variables are described in the paper.

Table 11 summarizes returns of the dependent variables. The average excess returns of the eight stock portfolios considered range from 0.82% to 1.26% per month. The positive relation between average returns and book to market equity is confirmed in the smallest size class because average returns increase with book to market ratio. In every book to market group but the medium, average returns tend to decrease with the size which confirms evidence that there is a negative relation between size and average return. The low (high) book to market portfolio has an average monthly return of 0.93% (1.02%).

In our time-series regressions, we regress monthly excess returns of the eight stock portfolios on: (i) monthly excess returns of the market portfolio: $R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + \epsilon_i$; (ii) monthly returns of the three variables: Market, HML and SMB according to the following regression: $R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i$. For the period from July 1976 to June 2001, only the value-weight of monthly returns of all the stocks is considered as the market portfolio. All the results are summarized in table 11. On the basis of the adjusted R^2 criterion, we can affirm that the three factor model, compared with the CAPM, captures better common variation in stock returns. Indeed, for the eight portfolios, we obtained an adjusted R^2 (The average adjusted R^2 is 90.1%) higher with the three factor model than the CAPM (The average adjusted R^2 is 73.6%).

In the case of the CAPM, the market βs are all more than 19 standard errors from zero and adjusted R^2 ranges from 55.4% to 89.2%. With the three factor model, the market βs are all more than 33 standard errors from zero and adjusted R^2 ranges from 82.9% to 95.7%. After adding HML and SMB to the time-series regressions, low βs (less than one) move up and high βs move down. Moreover, HML slopes are related to book to market ratio. For, as big as small, capitalisations; they increase from negative values for the lowest book to market quintile to positive values for the highest book to market quintile. Except the MS portfolio, their t-statistics are greater than eight. Similarly, SMB slopes are related to size. In every book to market group, they decrease from small to big capitalisation. For all portfolios but the MS, they are more than six standard errors from zero.

TABLE 11

Regressions of monthly excess returns of portfolios formed from independent sorts on size and book to market: From July 1976 to June 2001 (*Premier Marché*)

The sample is composed of 142 French stocks of the *Premier Marché*. The six size-book to market portfolios are formed using the Fama and French methodology, as described in table 2. The monthly returns of each portfolio corresponds to the value-weight monthly returns of the stocks. We have three explanatory variables: Market, HML and SMB, as described in table 3. The risk free interest rate used is the monthly equivalent rate to: Short term interest rate for the period from July 1976 to January 1981, Money market, one month, rate from February 1981 to January 1987, PIBOR from February 1987 to December 1998 and EURIBOR from January 1999 to June 2001. The following table shows, for each portfolio, the average monthly excess return and its standard deviation. It summarizes also the results of the time-series regressions: the slopes and their t statistics (between brackets), and R^2 adjusted. We regressed monthly excess returns of eight portfolios according to:

$$CAPM : R_i - R_f = \alpha_i + ß_i(R_M - R_f) + \epsilon_i.$$

$$FF3FM : R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_iSMB + h_iHML + \epsilon_i.$$

	Mean	***Std. Deviation***	***CAPM***			***FF3FM***				
Ptf.			α	β	Adj. R^2	α	β	s	h	Adj. R^2
SL	0.010	0.078	0.000	0.941	0.554	-0.000	1.009	0.848	-0.468	0.829
			(0.055)	*(19.289)*		*(-0.517)*	*(33.178)*	*(16.984)*	*(-11.340)*	
SM	0.010	0.069	0.000	0.927	0.690	-0.000	0.985	0.755	0.273	0.872
			(0.330)	*(25.831)*		*(-0.611)*	*(42.313)*	*(19.752)*	*(8.634)*	
SH	0.012	0.073	0.002	0.916	0.600	0.000	0.989	0.973	0.627	0.950
			(0.991)	*(21.202)*		*(0.360)*	*(64.497)*	*(38.639)*	*(30.112)*	
BL	0.008	0.066	-0.001	1.015	0.892	-0.001	1.002	-0.178	-0.264	0.930
			(-1.480)	*(49.767)*		*(-1.290)*	*(60.338)*	*(-6.524)*	*(-11.710)*	
BM	0.012	0.063	0.002	0.955	0.880	0.002	0.960	0.056	0.054	0.881
			(2.046)	*(46.785)*		*(1.938)*	*(46.903)*	*(1.680)*	*(1.953)*	
BH	0.008	0.079	-0.002	1.047	0.666	-0.002	1.021	-0.303	0.641	0.839
			(-0.986)	*(24.459)*		*(-1.421)*	*(34.043)*	*(-6.158)*	*(15.755)*	
LB/M	0.009	0.066	-0.000	0.978	0.838	-0.001	1.005	0.335	-0.366	0.952
			(-0.553)	*(39.282)*		*(-1.368)*	*(74.069)*	*(15.029)*	*(-19.863)*	
HB/M	0.010	0.069	0.000	0.982	0.770	-0.001	1.005	0.335	0.634	0.957
			(0.009)	*(31.629)*		*(-1.368)*	*(74.069)*	*(15.029)*	*(34.428)*	

In the regressions of the CAPM, we can see the size effect because the intercepts of the small portfolios exceed these of the big portfolios in low and high book to market classes. Moreover, intercepts are related to the book to market ratio only in the case of small capitalisations because they increase with the book to market ratio. We can see this pattern also with low and high book to market portfolios. In all cases but one (MB portfolio), intercepts are below two standard errors from zero. By adding HML and SMB to the regressions, all intercepts become less than two standard errors from zero. To sum up our results, we can say that the regressions of the three factor model absorb common time-series variation in returns (slopes and adjusted R^2 values). Moreover, because of intercepts which are close to zero, they explain the cross-section of average returns.

As for the whole market, we test the three factor model with six different market portfolios for the period from July 1991 to June 2001. These portfolios are: the equal-weight returns of all the stocks; the value-weight returns of all the stocks; indices CAC40, SBF80, SBF120 and SBF250. We use only High and Low book to market portfolios as dependent variables. All results are summarized in table 12. It is not surprising that the slopes on HML of the high book to market portfolio are greater than these of the low book to market portfolio. Moreover, the HML slopes decrease from positive value to negative value. This pattern shows that HML is related to book to market ratio.

High book to market equity portfolio: For the period from July 1991 to June 2001 (120 months), we regress monthly excess returns of the portfolio on the three explanatory variables. Table 12 shows that the three factors capture strong common variation in stock returns for all market portfolios. The adjusted R^2 ranges between 86.1% (with SBF80 as the market portfolio) and 95.3% (with the value-weight returns of all the stocks as the market portfolio). The market *beta*s are all more than 25% standard errors from zero. The t-statistics on the HML slopes are greater than 11 and the SMB slopes are more than four standard errors from zero (except with the SBF80 as the market portfolio where the t statistic of SMB slope is less than two). The largest adjusted R^2 is given by the value-weight returns of all the stocks as the market portfolio. The second large value is given by the SBF250 (93.1%). In short, the regression slopes and R^2 establish that all market portfolios considered but one (SBF80), with SMB and HML portfolios, capture common variation in stock returns. However, the only intercept close to zero is that of the time-series regression with the value-weight market portfolio. Only the value-weight market portfolio, with SMB and HML, explain, well, the cross-section of average stock returns.

Low B/M equity portfolio: Similarly, for the ten years period (July 1991 to June 2001), we regress monthly excess returns of the low B/M equity portfolio on the three factors, Market, HML and SMB. Table 12 shows that the three factors capture strong common variation in stock returns for all market portfolios. The adjusted R^2 ranges between 89.1% (with SBF80 as the market portfolio) and 96.3% (with the value-weight returns of all the stocks as the market portfolio).

TABLE 12

Monthly Excess Return Regressions of High and Low Portfolios: July 1991/June 2001

The sample is composed of 142 French stocks from the *Premier Marché*. We use the Fama and French methodology, as described in table 2. The monthly returns of each portfolio are the value-weight monthly returns of the stocks. We have three explanatory variables: Market, HML and SMB, as described in table 3. Six market portfolios are considered: the equal-weight returns of all the stocks (Mkt); the value-weight returns of all the stocks (Mktpond.); indices CAC40, SBF80, SBF120 and SBF250. The risk free interest rate is: PIBOR (July 1991/December 1998) and EURIBOR (January 1999/June 2001). The high (low) B/M portfolio is the average return of two portfolios of high (low) B/M ratio. The following table shows the slopes and their t statistics (between brackets), and adjusted R^2 of regressions. We regress monthly excess returns according to the three factor model: $R_i - R_f = a_i + ß_i(R_M - R_f) + s_i SMB + h_i HML + \epsilon_i$.

Market Portfolio	High B/M equity Portfolio				
	$a(t)$	$\beta(t)$	$s(t)$	$h(t)$	Adjusted R^2
Mkt	0.005 *(3.588)*	1.043 *(35.216)*	-0.183 *(-4.923)*	0.365 *(11.080)*	0.921
Mktpond.	-0.000 *(-0.282)*	1.104 *(46.448)*	0.489 *(14.788)*	0.672 *(24.851)*	0.953
CAC40	0.005 *(3.774)*	1.027 *(31.473)*	0.556 *(11.375)*	0.662 *(17.067)*	0.903
SBF80	0.005 *(3.134)*	1.006 *(25.623)*	0.008 *(0.178)*	0.620 *(13.486)*	0.861
SBF120	0.005 *(4.059)*	1.066 *(36.233)*	0.472 *(11.327)*	0.662 *(19.422)*	0.925
SBF250	0.005 *(4.460)*	1.088 *(37.952)*	0.409 *(10.457)*	0.656 *(20.133)*	0.931

Market Portfolio	Low B/M equity Portfolio				
	$a(t)$	$\beta(t)$	$s(t)$	$h(t)$	Adjusted R^2
Mkt	0.005 *(3.588)*	1.043 *(35.216)*	-0.183 *(-4.923)*	-0.635 *(-19.269)*	0.938
Mktpond.	-0.000 *(-0.282)*	1.104 *(46.448)*	0.489 *(14.788)*	-0.328 *(-12.139)*	0.963
CAC40	0.005 *(3.774)*	1.027 *(31.473)*	0.556 *(11.375)*	-0.338 *(-8.717)*	0.924
SBF80	0.005 *(3.134)*	1.006 *(25.623)*	0.008 *(0.178)*	-0.380 *(-8.250)*	0.891
SBF120	0.005 *(4.059)*	1.066 *(36.233)*	0.472 *(11.327)*	-0.338 *(-9.927)*	0.941
SBF250	0.005 *(4.460)*	1.088 *(37.952)*	0.409 *(10.457)*	-0.344 *(-10.563)*	0.946

The market *beta*s are all more than 25 standard errors from zero. The t-statistics on the HML slopes are greater than eight and the SMB slopes are more than two standard errors from zero (except for the SBF80). As for the high book to market portfolio, the largest adjusted R^2 is given by the value-weight returns of all the stocks as the market portfolio and the second large value is given by the SBF250 (94.6%). The intercept close to zero is only that of the time-series regression with the value-weight market portfolio. Only the value-weight market portfolio, with SMB and HML, explain well the cross-section of average stock returns.

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