# Is the Fama and French model a good indicator of market sectoral performance?:

Study of the relationship between excess industry returns and the Fama and French three factor model

by

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# Is the Fama and French model a good indicator of market sectoral performance?

**Abstract**

The Fama and French three factor model has been used widely in explaining the returns of equity securities. Certain studies have shown that it has superior predictive ability compared to the capital asset pricing model. In my research I attempt to study the explanatory power of the Fama and French model on individual industry returns in the U.S. from 1927 – 2006. I look separately at the relationship of excess industry returns to each of the three factors in the model – excess market return, size factor and book-to-market equity factor.

The excess market return is the most significant variable in explaining the cross-section of average industry returns. The other two factors, while being statistically significant, have varying effects on different industries, and are not consistent in their effect on an industry over different periods. A large part of the variance in these factors' effects is explained by differences in the relevant firm characteristic of average industry firm market capitalization and book-to-market equity. In summary, the Fama and French model is successful in explaining the excess industry returns across the entire time period as well as over individual sub-time periods.

## I. Motivation

Based on the premise that different industries have different points in the economic cycle where they peak and fall, the markets have attempted to profit from this information by using economic cycle indicators to direct investment decisions among various sector

groups. Investment banks such as Credit Suisse, RBC Capital Markets, Nomura, Deutsche Bank and many others regularly release research reports that recommend investment strategies based on sector investing. Recommendations are based upon indicators such as economic growth, industry performance and technical analysis, coupled with different factors that individual analysts rely upon.

The reason for the large focus on sector investing has been the relatively low correlation among returns across different industry groups. The traditional method of efficient diversification was to invest in stocks from different countries, however as countries' returns are becoming more correlated, the diversification gain there is diminishing. Globalization has made the world markets into an interrelated mass, where a shock in one part causes immediate blips throughout the structure. This was evident during the Asian Financial Crisis as well as the attacks of September 11, 2006. Even a relatively insignificant event such as an increased capital gains tax in China caused a stock sell-off in Shanghai on February 27, 2007 that resonated throughout the world's capital markets. The Dow shed roughly 400 points that day, its seventh largest point drop ever, with markets in Asian countries such as Japan, South Korea, Hong Kong and India recording significant plunges in value as well.

In his book *Stocks for the Long Run*, Jeremy J. Siegel writes, "The decreased correlation between sectors may be caused by the reduction in business cycle fluctuations."[1] This allows investors to focus their concentration away from the health of the entire economy, towards individual firm and industry characteristics. Siegel notes or suggests that country

[1] *Stocks for the Long Run* 3rd Edition, Jeremy J. Siegel, McGraw-Hill. Page 174.

diversification is still important as it matters where a company is domiciled and where its stock trades. However, as globalization advances, it is possible that we will see that "investment allocations are made on the basis of economic sector diversification".

To show how mainstream the sector focused investing strategy has become a number of mutual funds and exchange-traded funds such as XTF Sector Rotation ETF, MFS Sector Rotational Fund and Rydex Sector Rotation Fund have been introduced that replicate certain sector rotation strategies. On the other hand, there are the regular 'Sector ETFs & mutual funds' that invest solely in one sector and change their portfolio by merely shifting around company holdings in that particular sector. These include funds such as Fidelity Select Technology FSPTX, Vanguard Health Care VGHCX, Vanguard Energy VGENX, iShares S&P Global Energy Index Fund IXC and iShares Goldman Sachs Semiconductor Index Fund IGW. There exists a sector fund to satisfy the personal taste of almost every investor. Some of the sector funds incorporate additional variables and factors into their decision making such as momentum, relative P/E, yield curves, etc. along with the traditional economic cycle indicators.

## II. Prior Literature

In a landmark study, Fama and French (1992), "Common Risk Factors in the returns on stocks and bonds" identified three stock market factors: an overall market factor and factors relating to firm size and book-to-market equity (BE/ME) that are able to capture a significant amount of variation in excess returns for stocks. Firms that have high BE/ME tend to exhibit low earnings on their assets which persist for a five year time period

before and after the measurement, however they have higher stock returns than their peers. Additionally, controlling for BE/ME, firms that are smaller in market capitalization seem to have higher earnings on their assets as well as higher stock returns, compared to large firms. Fama and French, split NYSE and AMEX stocks (1963-1991), and NASDAQ stocks (1972-1991) into six portfolios based on the intersections of three BE/ME and two size groups (S/L, S/V, S/H. B/L, B/M, B/H). For example, the B/H portfolio contains stocks in the large size group and high BE/ME group. A SMB portfolio is constructed based on the monthly difference between the simple average of the returns of the big and small size portfolios. Similarly a HML portfolio is constructed to imitate the risk factor in returns related to BE/ME and represents the monthly difference between the simple average of the returns of the high and low BE/ME portfolios. The proxy used for the market factor is the excess market return over the one month T-bill rate. By run a regression of the three factors against the excess stock returns, they provided a good description of the cross-section of average returns. The Fama-French three factor model provides a good alternative to the CAPM, especially in isolating the firm-specific components of risk.

An important early study by Chen, Roll and Ross (1986) found that certain macro-economic factors play a significant role in explaining security returns. They identified these factors as surprises in inflation; surprises in GNP as indicted by an industrial production index; surprises in investor confidence due to changes in default premium in corporate bonds; and surprise shifts in the yield. Their observations on the effect of these macro-economic factors can be combined with other firm and market factors, and used in

an arbitrage pricing model, as a substitute for the CAPM.[2] The effect of traditional market return predictor variables, recognized initially by earlier researchers, such as default spread, term spread, commercial paper-T bill spread, aggregate dividend yield, ex ante real rate of interest, and expected inflation were studied by Beller, Kling and Levinson (1998).[3] By lagging the predictors by one quarter, they observed that industry stock returns were significantly predictable, and a regression model could be used to gain excess portfolio returns. Jain and Rosett (2001) observed that the single macroeconomic variable of expected growth in real GDP shows the most stable association over 1952-2000, out of all the macroeconomic factors they considered, with the economy wide E/P ratio.[4] They divided their data into three sub-periods (1952-1972, 1973-1982, 1983-2000) based on different economic and regulatory conditions in the sub-periods. They ignore the results from the second sub-period, 1973-1982, as they state it was an incredibly volatile period for stock returns and provided spurious results in the research. A consistent negative association was seen between E/P and growth over the first and third sub-period. In a surprising piece of recent research, Ritter (2004) found the worldwide correlation between real stock returns and per capita GDP growth over 1900-2002 to be negative. The results he obtained are contrary to common perception and challenge research done on returns and macro-economic data covering shorter time periods.

Literature on Testing the Fama and French model

The Fama-French three factor model has been tested in various different capital markets around the world. Connor and Sehgal (2001) examined the viability of the three factor

[2] The APT theory was 1st initiated by Stephen Ross in 1976
[3] Fama and French 1989; Ferguson and Harvey 1991; Whitelaw1994.
[4] E/P Ratio = Inverse price/earnings ratio.

model in the Indian equity markets from June 1989 to March 1999, and found it was able to capture the cross-section of average returns that the standard CAPM had missed. They found evidence of the effect of market, book-to-market equity and size in Indian stock returns. Fama and French (2003) found in another study that the CAPM is highly inefficient in predicting a correct cost of equity for a firm. It predicts a too high cost of equity for high beta stocks and a too low cost of equity for low beta stocks. Additionally, when the CAPM is used to judge a fund's performance, it is observed that funds that pick low beta stocks, small stocks or value stocks produce greater positive abnormal returns. In a study examining the Fama-French model in Australia, Gaunt (2004), extends research done in a prior paper from 1981-1991, by adding 10 years more of data till 2000.[5] He finds the Fama-French model has significant explanatory power over the CAPM in addressing the excess returns of Australian equities. However, Gaunt observes that the majority of this explanatory power comes from one variable, namely size. This may alert observers to the need to modify the CAPM as it is applied to different markets across the world. Qi (2004) conducted a recent comparison of the predictive power of the CAPM vs. the Fama-French three factor model in the United States, using data extending back 80 years.[6] He compared both models to historical data from 12 different industry groups and found that no model had a clear advantage over the other in predicting overall sector returns. He concluded that both have similar predictive power, with the CAPM being marginally better in predicting sector returns.

[5] Prior study by Halliwell, Heaney and Sawicki (1999), studied the Fama-French model in Australia.
[6] Howard Qi is an MBA student at Syracuse University.

## III. Data Description

The data I am using consists of three primary parts. The first is related to US Gross Domestic Product. The data is in the form of real and nominal quarterly GDP levels, covering the post-World War II period from 1947-2006. I have converted the data based on levels to a measure of the quarterly change in GDP. I have obtained the GDP data from the U.S. Department of Commerce: Bureau of Economic Analysis.[7] Converting the data to quarterly changes leaves us with 239 observations. The GDP data has also been seasonally adjusted in order to factor in the regular seasonal increases and dips in the GDP level figures.

The second primary data set is the industry stock returns. Each industry's return figures are based upon a value-weighted average of the various companies that exist in that sector. The division of the returns is into 12 industry groups based on Kenneth R. French's division criteria. Each industry group consists of companies that belong to a particular SIC code that has been allocated to each individual group. Each NYSE, AMEX and NASDAQ stock is assigned to an industry group based on its four-digit SIC code as of the end of June each year. The two sources of information on the SIC codes are CRSP and Compustat. The returns are quarterly returns and are available from 1927-2006.

[7] It can be accessed from the US economic database, FRED© on the St. Louis Fed's website.

**TABLE 1**

| Industry Group Acronym | Description | SIC Codes |
|---|---|---|
| **NoDur** | Consumer NonDurables - Food, Tobacco, Textiles, Apparel, Leather, Toys | 0100-0999 \| 2000-2399 \| 2700-2749 \| 2770-2799 \| 3100-3199 \| 3940-3989 |
| **Durbl** | Consumer Durables - Cars, TV's, Furniture, Household Appliances | 2500-2519 \| 2590-2599 \| 3630-3659 \| 3710-3711 \| 3714-3714 \| 3716-3716 \| 3750-3751 \| 3792-3792 \| 3900-3939 \| 3990-3999 |
| **Manuf** | Manufacturing - Machinery, Trucks, Planes, Off Furn, Paper, Com Printing | 2520-2589 \| 2600-2699 \| 2750-2769 \| 3000-3099 \| 3200-3569 \| 3580-3629 \| 3700-3709 \| 3712-3713 \| 3715-3715 \| 3717-3749 \| 3752-3791 \| 3793-3799 \| 3830-3839 \| 3860-3899 |
| **Enrgy** | Oil, Gas, and Coal Extraction and Products | 1200-1399 \| 2900-2999 |
| **Chems** | Chemicals and Allied Products | 2800-2829 \| 2840-2899 |
| **BusEq** | Business Equipment - Computers, Software, and Electronic | 3570-3579 \| 3660-3692 \| 3694-3699 \| 3810-3829 \| 7370-7379 |
| **Telcm** | Telephone and Television Transmission | 4800-4899 |
| **Utils** | Utilities | 4900-4949 |
| **Shops** | Wholesale, Retail, and Some Services (Laundries, Repair Shops) | 5000-5999 \| 7200-7299 \| 7600-7699 |
| **Hlth** | Healthcare, Medical Equipment, and Drugs | 2830-2839 \| 3693-3693 \| 3840-3859 \| 8000-8099 |
| **Money** | Finance | 6000-6999 |
| **Other** | Mines, Constr, BldMt, Trans, Hotels, Bus Serv, Entertainment | - |

**Source**: *Kenneth R. French Data Library*. Based on industry data from CRSP and Compustat.

Relating to the Fama-French three factor model, I will be using data on the three factors of market risk premium, firm size and market-to-book equity. The firm size and market-to-book equity factors are represented in the regression equation by the portfolios of SMB and HML that are described earlier. Like my other data sets, I have obtained the Fama-French factors for quarterly intervals, and the time period of the data set extends

from 1927-2006. I will also be using the actual market capitalization and BE/ME of the individual sectors to relate it to the results obtained from the Fama-French three factor model. The data on these two variables for the various sectors covers the period from 1927-2006. The source for the figures on the Fama-French model is Kenneth R. French's online data library.

## IV. Hypothesis & Methodology

I will study the relationship between the Fama-French three factor model and stock returns in various sectors in the economy. I compare quarterly returns of the various sectors to the quarterly figures for the three factors of the model. I use the three factor model as proposed by Eugene F. Fama and Kenneth R. French in their research paper, "Common Risk Factors in the returns on stocks and bonds" (1992):

$$R(t) - RF(t) = \alpha + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t)$$

*R* = stock return
*RF* = one-month Treasury bill rate
*RM* = value-weighted monthly percentage return of the market
*SMB* = difference between returns of small-stock and big-stock portfolios
*HML* = difference between returns of high and low book-to-market equity portfolios

Note, that in my variant of the Fama-French three factor model I will be replacing *R* (stock return) with *RI* (industry return). This is a valid assumption, as Fama and French

use the three factor model to explain not only individual stock returns but also the returns of entire portfolios.[8]

$$RI(t) - RF(t) = \alpha + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t) \quad (1)$$

As a second test, I will add a new predictor variable to the Fama-French model, which is the quarterly change in the real gross domestic product. I then repeat the same test by replacing real GDP growth with nominal GDP growth. It will be interesting to note whether this additional macroeconomic variable will add any predictive power to the model.

$$RI(t) - RF(t) = \alpha + b[RM(t) - RF(t)] + sSMB(t) + hHML(t) + gGDP + e(t) \quad (2)$$

*GDP* = real/nominal GDP change

It will be important to note the statistical significance of the two tests. An important observation to be made is if, there is a noteworthy increase in the R-square from adding the real GDP data to the regression. The significance of each factor, represented by the T-statistic and p-value is another measure that needs to be taken into consideration in order to observe which predictor has the most explanatory power in regard to the industry excess return. In addition, I will break up the data into four sub-periods, similar along the lines as done by Jain and Rosett (2001). Time period division based on different economic and regulatory conditions in the sub-periods

[8] "Common Risk Factors in the returns on stocks and bonds" by Eugene F. Fama and Kenneth R. French (1992)

The next step of my analysis will be the comparison of the Fama-French factor coefficient with the relevant firm characteristic. The results *h* coefficient will be compared with the industry BE/ME and *s* coefficient will be compared with average firm market capitalization data for each industry, to see if Fama and French's observation, that firms which have high BE/ME and smaller market capitalization tend to exhibit high earnings, hold up. A correlation test will be run on this data to obtain a Pearson correlation, thereby allowing me to judge the strength of the relationship as well as its direction. It is important to note the p-value of the Pearson correlation obtained for each set of relationships to judge whether there is any statistical significance to the results obtained.

## V. Results Explained

A.1. Fama-French three factor model: Complete Period **[TABLE 2]**

The first regression I examine uses the three Fama-French factors to explain industry returns. The entire observations in this data set are 320 and extend from 1927-2006. The three factors related to excess market return, size and book-to-market equity are regressed against each individual industry return to get coefficients for each factor applying to each individual industry. The three factor model appears to work well in explaining the industry security returns. The regression equations are statistically significant as they show low standard errors and have an average $R^2$ of 64%.

## TABLE 2

| *Regression 1 = RI(t) - RF(t) = α + b[RM(t) – RF(t)] + sSMB(t) + hHML(t) + e(t)*<br>*Time period = 1927 - 2006*<br>*(320 Observations)* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **b** | **T(b)** | **p(b)** | **s** | **T(s)** | **p(s)** | **h** | **T(h)** | **p(h)** | **R-sq** | **se** |
| **NoDur** | 0.63963 | 17.04 | 0 | 0.12293 | 2.23 | 0.027 | 0.04634 | 0.99 | 0.322 | 63.20% | 0.061444 |
| **Durbl** | 0.90113 | 16.24 | 0 | 0.34893 | 4.27 | 0 | 0.3298 | 4.77 | 0 | 68.10% | 0.090867 |
| **Manuf** | 0.94746 | 22.68 | 0 | 0.24671 | 4.01 | 0 | 0.33039 | 6.35 | 0 | 78.90% | 0.068401 |
| **Enrgy** | 0.63518 | 12.15 | 0 | -0.11478 | -1.49 | 0.137 | 0.15439 | 2.37 | 0.018 | 42.20% | 0.085579 |
| **Chems** | 0.88435 | 21.3 | 0 | -0.00494 | -0.08 | 0.936 | 0.12859 | 2.49 | 0.013 | 70.50% | 0.067992 |
| **BusEq** | 1.13175 | 22.39 | 0 | 0.10454 | 1.4 | 0.161 | -0.00395 | -0.06 | 0.95 | 72.50% | 0.08276 |
| **Telcm** | 0.62539 | 16.66 | 0 | -0.25057 | -4.53 | 0 | 0.04275 | 0.91 | 0.361 | 51.80% | 0.061474 |
| **Utils** | 0.71428 | 15.22 | 0 | -0.34019 | -4.92 | 0 | 0.33146 | 5.67 | 0 | 53.00% | 0.076837 |
| **Shops** | 0.80229 | 17.52 | 0 | 0.20107 | 2.98 | 0.003 | -0.01604 | -0.28 | 0.779 | 64.60% | 0.074967 |
| **Hlth** | 0.79888 | 17.56 | 0 | -0.02096 | -0.31 | 0.754 | -0.14919 | -2.63 | 0.009 | 57.90% | 0.074474 |
| **Money** | 0.99627 | 20.28 | 0 | -0.12241 | -1.69 | 0.091 | 0.31331 | 5.12 | 0 | 68.90% | 0.080422 |
| **Other** | 0.96826 | 20.82 | 0 | 0.04912 | 0.72 | 0.474 | 0.39611 | 6.84 | 0 | 73.80% | 0.076146 |
| **AVERAGE** | 0.837073 | 18.32167 | 0 | 0.160596 | 2.385833 | 0.21525 | 0.18686 | 3.206667 | 0.204333 | 0.637833 | 0.075114 |

x = coefficient of Fama and French model factor

T(x) = T-statistics of factor

p(b) = p-value of factor

R-sq = $R^2$ of individual regression

se = standard error of individual regression

*The market factor*: Out of all three factors the excess market return, [RM(t) – RF(t)] appears to explain the cross-section in average industry returns better than the other factors. This is evident from the high T-statistic for the excess market return coefficient (average absolute T-statistic value = 18.32). Additionally, the p-value of the coefficient was 0 for every industry regression. The range of the coefficient for [RM(t) – RF(t)] is from a low of 0.62539 for the Telecom Industry to a high of 1.13175 for Business Equipment. The value of the coefficient signifies the relationship between market return and the return one can expect on the portfolio. It is extremely similar to the *Beta* coefficient that is obtained for the CAPM model. A higher coefficient signifies a riskier

stock, i.e. one that has a significant upside if the market goes up, but also a significant downside if the market takes a turn for the worst.

*SMB and HML factors:* The factors relating to size and book-to-market equity seem to have explanatory power in relation to industry returns. The HML factor seems to show a marginally greater explanatory power than the SMB factor as it has a lower p-value and higher average absolute value for the industry regression T-statistic. The average absolute T-statistic value for HML is 3.21, compared to 2.39 for SMB. An interesting thing to neither of the two factors shows a consistent better explanatory power than the other over all the industries. Additionally, for certain industries, sometimes one of the factors does not appear to be statistically significant in explaining returns.

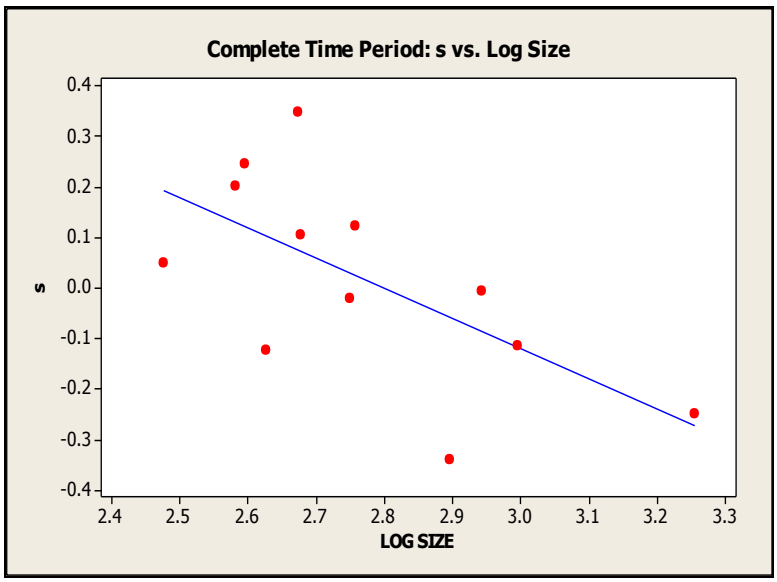
A.2. Fama-French three factor model with GDP growth adjustment: Complete Period

As GDP quarterly growth data is accurately available from 1947-2006, I use that time period for my analysis. The addition of the factor of GDP growth, both real and nominal, to the regression does not appear to add any explanatory power to the Fama and French model. This shows that no additional information is captured by GDP growth on excess industry returns. $R^2$ in most cases is unchanged or increases marginally with both the GDP variables. The p-value of the GDP factor is on the higher side in almost all the individual industry regressions.

A.3. Firm size and book-to-market equity comparison: Complete Period **[TABLE 3]**

The comparison of the average firm size[9] against the *s* coefficient yields a negative correlation value of -0.642. This is a relatively strong relationship and also exhibits an extremely low p-value of 0.024, which implies that it is statistically significant. From this relationship we can understand that as the size of a firm increases, the *s* coefficient decreases in value. To understand what impact this negative relationship has on industry returns, we need to observe the average SMB portfolio return for the period. As it is positive, we can conclude that as firm size increases, and the *s* coefficient decreases, the SMB value in the equation would decrease, thereby lowering industry returns. **(See CHART 1)**

**CHART 1**

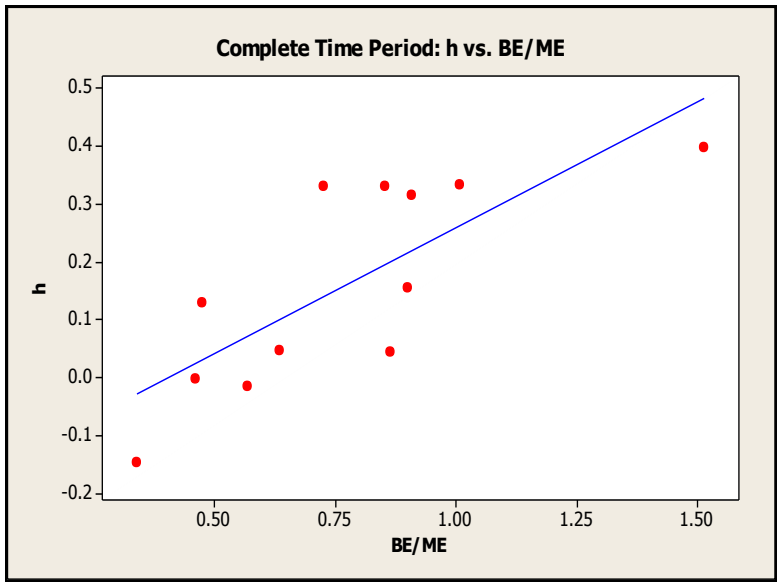



The *h* coefficient appears to show a stronger relationship with the book-to-market equity than the SMB factor did. The correlation is 0.774 with a p-value of 0.003. The positive correlation implies that higher book-to-market equity firms have a higher *h* coefficient

[9] Represented by log size in Pearson correlation analysis

value than lower book-to-market equity firms. To understand the impact this relationship has on industry returns, we conduct the same test we did for the SMB factor. The average HML portfolio return for the period is positive, and therefore as BE/ME rises, the *h* coefficient will increase, causing the HML value in the equation to increase and industry returns to increase. **(See CHART 2)**

**CHART 2**




The analysis of the complete period data supports Fama and French's observations that small capitalization stocks outperform large capitalization stocks, and high book-to-market equity stocks outperform firms that have a lower book-to-market equity. The relationship between the SMB and HML factors and the firm characteristics that are related to them, appear to be consistent throughout the 12 different industry groups.

**TABLE 3**

| Rank on Size | | | | | Rank on BE/ME | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Industry | Average Firm Size | LOG Firm Size | s | Rank | Industry | BE/ME | h |
| 1 | Telcm | 1799.648 | 3.2552 | -0.2506 | 1 | Other | 1.5151 | 0.39611 |
| 2 | Enrgy | 991.692 | 2.9964 | -0.1148 | 2 | Utils | 1.0090 | 0.33146 |
| 3 | Chems | 877.055 | 2.9430 | -0.0049 | 3 | Money | 0.9085 | 0.31331 |
| 4 | Utils | 788.569 | 2.8968 | -0.3402 | 4 | Enrgy | 0.8990 | 0.15439 |
| 5 | NoDur | 571.320 | 2.7569 | 0.1229 | 5 | Telcm | 0.8651 | 0.04275 |
| 6 | Hlth | 561.238 | 2.7491 | -0.0210 | 6 | Manuf | 0.8535 | 0.33039 |
| 7 | BusEq | 475.419 | 2.6771 | 0.1045 | 7 | Durbl | 0.7262 | 0.3298 |
| 8 | Durbl | 470.482 | 2.6725 | 0.3489 | 8 | NoDur | 0.6346 | 0.04634 |
| 9 | Money | 422.474 | 2.6258 | -0.1224 | 9 | Shops | 0.5677 | -0.01604 |
| 10 | Manuf | 394.350 | 2.5959 | 0.2467 | 10 | Chems | 0.4735 | 0.12859 |
| 11 | Shops | 381.968 | 2.5820 | 0.2011 | 11 | BusEq | 0.4600 | -0.00395 |
| 12 | Other | 298.793 | 2.4754 | 0.0491 | 12 | Hlth | 0.3379 | -0.14919 |

B.1. Fama-French three factor model: Sub-Time Periods **[TABLE 4.A and 4.B]**

The four time periods are 1927 – 1946 (Depression – World War II End); 1947 – 1972 (World War II End – JR 1 End); 1973 – 1982 (JR 2) and 1983 – 2000 (JR 3).[10] I perform the same regression test I had done for the complete period to the individual sub-periods. As a result, I obtain separate relationships between the three factors and industry returns for each of the periods. The average $R^2$ is high for periods 1 and 3 at about 70%; however, it is not considerably lower for the other periods being 57% in periods 2 and 4. The regressions therefore, across the various time periods are statistically significant.

*The market factor*: Over each and every sub-time period, the excess market return, [RM(t) – RF(t)] appears to best explain the cross-section in average excess industry returns. The T-statistic for the excess market return coefficient is much higher than those for the other

[10] JR stands for sub-time period breakdown done by Jain and Rosett (2001).

factors on a consistent basis, and the p-value is 0 in all but one single industry regression.[11]

## TABLE 4.A

***Regression 1*** *= RI(t) - RF(t) = α + b[RM(t) – RF(t)] + sSMB(t) + hHML(t) + e(t)*
*Time period = 1927 - 1946 (Depression - WW2 End)*
*(80 Observations)*

| | b | T(b) | p(b) | s | T(s) | p(s) | h | T(h) | p(h) | R-sq | se |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NoDur** | 0.62266 | 8.77 | 0 | 0.10218 | 1.14 | 0.259 | 0.04214 | 0.46 | 0.648 | 75.90% | 0.07138 |
| **Durbl** | 1.0321 | 7.99 | 0 | 0.4584 | 2.81 | 0.006 | 0.05 | 0.3 | 0.765 | 76.70% | 0.129833 |
| **Manuf** | 0.9618 | 9.28 | 0 | 0.2518 | 1.92 | 0.059 | 0.3721 | 2.78 | 0.007 | 83.60% | 0.104217 |
| **Enrgy** | 0.5457 | 5.3 | 0 | 0.0565 | 0.43 | 0.666 | 0.1387 | 1.04 | 0.301 | 56.60% | 0.103504 |
| **Chems** | 1.03047 | 10.64 | 0 | 0.0288 | 0.23 | 0.815 | -0.0838 | -0.67 | 0.506 | 78.10% | 0.0974 |
| **BusEq** | 1.1404 | 9.95 | 0 | -0.0594 | -0.41 | 0.683 | 0.2027 | 1.37 | 0.176 | 79.00% | 0.11523 |
| **Telcm** | 0.66018 | 9.62 | 0 | -0.33772 | -3.89 | 0 | 0.03497 | 0.39 | 0.695 | 68.30% | 0.069028 |
| **Utils** | 0.9856 | 8.67 | 0 | -0.538 | -3.74 | 0 | 0.1468 | 1 | 0.322 | 65.50% | 0.114324 |
| **Shops** | 0.83634 | 8.5 | 0 | 0.047 | 0.38 | 0.707 | 0 | 0 | 1 | 71.70% | 0.09888 |
| **Hlth** | 0.78353 | 8.26 | 0 | 0.0632 | 0.53 | 0.6 | -0.1407 | -1.15 | 0.255 | 67.20% | 0.095373 |
| **Money** | 1.1072 | 9.15 | 0 | -0.3537 | -2.31 | 0.024 | 0.3743 | 2.39 | 0.019 | 75.30% | 0.121646 |
| **Other** | 0.8903 | 8.41 | 0 | -0.2982 | -2.22 | 0.029 | 0.7951 | 5.8 | 0 | 81.50% | 0.106492 |
| **AVERAGE** | 0.883023 | 8.711667 | 0 | 0.216242 | 1.6675 | 0.320667 | 0.198443 | 1.445833 | 0.391167 | 0.732833 | 0.102276 |

***Regression 2*** *= RI(t) - RF(t) = α + b[RM(t) – RF(t)] + sSMB(t) + hHML(t) + e(t)*
*Time period = 1947 - 1972 (WW2 End - JR Period 1 End)*
*(104 Observations)*

| | b | T(b) | p(b) | s | T(s) | p(s) | h | T(h) | p(h) | R-sq | se |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NoDur** | 0.60899 | 11.77 | 0 | 0.46386 | 6.19 | 0 | 0.00778 | 0.09 | 0.925 | 71.80% | 0.034031 |
| **Durbl** | 0.88283 | 9.02 | 0 | 0.1441 | 1.02 | 0.312 | 0.4406 | 2.82 | 0.006 | 52.80% | 0.064353 |
| **Manuf** | 0.87027 | 13.53 | 0 | 0.40004 | 4.29 | 0 | 0.3449 | 3.36 | 0.001 | 74.20% | 0.042305 |
| **Enrgy** | 0.84453 | 9.23 | 0 | -0.1526 | -1.15 | 0.252 | 0.5134 | 3.51 | 0.001 | 52.00% | 0.060191 |
| **Chems** | 0.8183 | 10.8 | 0 | 0.0171 | 0.16 | 0.876 | 0.1291 | 1.07 | 0.288 | 57.70% | 0.049824 |
| **BusEq** | 0.95591 | 11.36 | 0 | 0.3978 | 3.26 | 0.002 | -0.3136 | -2.33 | 0.022 | 65.30% | 0.055375 |
| **Telcm** | 0.44112 | 6.51 | 0 | -0.05746 | -0.58 | 0.56 | 0.0588 | 0.54 | 0.588 | 31.70% | 0.044609 |
| **Utils** | 0.50549 | 7.45 | 0 | -0.04414 | -0.45 | 0.654 | 0.012 | 0.11 | 0.912 | 37.80% | 0.044655 |
| **Shops** | 0.63437 | 8.41 | 0 | 0.4288 | 3.92 | 0 | 0.0268 | 0.22 | 0.825 | 55.00% | 0.04965 |
| **Hlth** | 0.8287 | 8.79 | 0 | 0.1978 | 1.45 | 0.151 | -0.3492 | -2.32 | 0.022 | 50.60% | 0.062 |
| **Money** | 0.78374 | 10.76 | 0 | 0.2514 | 2.38 | 0.019 | 0.0529 | 0.45 | 0.65 | 61.20% | 0.047895 |
| **Other** | 0.84204 | 12.37 | 0 | 0.70092 | 7.11 | 0 | 0.4264 | 3.92 | 0 | 75.90% | 0.044795 |
| **AVERAGE** | 0.751358 | 10 | 0 | 0.271335 | 2.663333 | 0.2355 | 0.222957 | 1.728333 | 0.353333 | 0.571667 | 0.049974 |

x = coefficient of Fama and French model factor

T(x) = T-statistics of factor

p(b) = p-value of factor

R-sq = $R^2$ of individual regression

se = standard error of individual regression

*SMB and HML factors:* Glancing at the SMB and HML factor coefficients gives us some interesting insights. Similar to the results I got for the complete period; neither of the two factors shows a consistent better explanatory power over each and every industry and the

[11] Period 3 – Energy industry regression shows a negligible p-value of 0.002 for [RM(t) – RF(t)].

explanatory power of the factors with regard to industry returns, is not always statistically significant for both - In certain industries, sometimes one of the factors does not appear to be significant in explaining returns.

## TABLE 4.B

***Regression 3*** *= RI(t) - RF(t) = α + b[RM(t) – RF(t)] + sSMB(t) + hHML(t) + e(t)*
*Time period = 1973 - 1982 (JR Period 2)*
*(40 Observations)*

| | b | T(b) | p(b) | s | T(s) | p(s) | h | T(h) | p(h) | R-sq | se |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NoDur** | 0.8466 | 7.68 | 0 | 0.2674 | 1.74 | 0.09 | 0.1552 | 1.01 | 0.321 | 77.30% | 0.054471 |
| **Durbl** | 0.8333 | 5.9 | 0 | 0.5306 | 2.7 | 0.011 | 0.3579 | 1.81 | 0.079 | 71.70% | 0.069892 |
| **Manuf** | 0.9107 | 7.57 | 0 | 0.3325 | 1.98 | 0.055 | 0.0976 | 0.58 | 0.566 | 77.90% | 0.059519 |
| **Enrgy** | 0.6385 | 3.35 | 0.002 | -0.43 | -1.62 | 0.114 | -0.5978 | -2.24 | 0.031 | 43.90% | 0.094213 |
| **Chems** | 0.813 | 7.9 | 0 | 0.1578 | 1.1 | 0.278 | -0.0401 | -0.28 | 0.782 | 77.90% | 0.050887 |
| **BusEq** | 0.9695 | 6.77 | 0 | 0.1705 | 0.86 | 0.398 | 0.0911 | 0.45 | 0.652 | 70.80% | 0.07084 |
| **Telcm** | 0.5457 | 5.67 | 0 | 0.0266 | 0.2 | 0.844 | 0.3696 | 2.74 | 0.009 | 58.30% | 0.047554 |
| **Utils** | 0.599 | 6.74 | 0 | -0.0929 | -0.75 | 0.458 | 0.1956 | 1.57 | 0.125 | 63.40% | 0.043972 |
| **Shops** | 0.9943 | 6.22 | 0 | 0.6107 | 2.75 | 0.009 | 0.2647 | 1.18 | 0.245 | 73.80% | 0.079016 |
| **Hlth** | 0.8134 | 5.99 | 0 | -0.1392 | -0.74 | 0.466 | -0.1592 | -0.84 | 0.408 | 63.00% | 0.067174 |
| **Money** | 0.9248 | 8.3 | 0 | 0.1951 | 1.26 | 0.216 | 0.0657 | 0.42 | 0.676 | 79.10% | 0.055061 |
| **Other** | 0.8454 | 6.9 | 0 | 0.5877 | 3.45 | 0.001 | -0.1295 | -0.75 | 0.455 | 80.40% | 0.060559 |
| **AVERAGE** | 0.811183 | 6.5825 | 0.000167 | 0.295083 | 1.595833 | 0.245 | 0.210333 | 1.155833 | 0.362417 | 0.697917 | 0.062763 |

***Regression 4*** *= RI(t) - RF(t) = α + b[RM(t) – RF(t)] + sSMB(t) + hHML(t) + e(t)*
*Time period = 1983 - 2000 (JR Period 3)*
*(72 Observations)*

| | b | T(b) | p(b) | s | T(s) | p(s) | h | T(h) | p(h) | R-sq | se |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **NoDur** | 0.9923 | 7.57 | 0 | -0.1168 | -0.62 | 0.538 | 0.4016 | 2.98 | 0.004 | 49.70% | 0.067997 |
| **Durbl** | 1.1474 | 8.12 | 0 | 0.2961 | 1.46 | 0.15 | 0.6845 | 4.71 | 0 | 58.30% | 0.073232 |
| **Manuf** | 0.96714 | 10.91 | 0 | 0.1876 | 1.47 | 0.146 | 0.32997 | 3.62 | 0.001 | 72.20% | 0.045974 |
| **Enrgy** | 0.7182 | 5.09 | 0 | 0.0239 | 0.12 | 0.906 | 0.4679 | 3.23 | 0.002 | 32.20% | 0.073142 |
| **Chems** | 1.0752 | 9.96 | 0 | -0.148 | -0.95 | 0.344 | 0.5113 | 4.6 | 0 | 62.40% | 0.055991 |
| **BusEq** | 0.981 | 7.11 | 0 | 0.3988 | 2.01 | 0.048 | -0.294 | -2.07 | 0.042 | 67.70% | 0.071544 |
| **Telcm** | 0.9185 | 7.26 | 0 | -0.357 | -1.96 | 0.054 | 0.0156 | 0.12 | 0.905 | 51.20% | 0.0656 |
| **Utils** | 0.5729 | 4.77 | 0 | -0.2778 | -1.61 | 0.112 | 0.5593 | 4.53 | 0 | 30.40% | 0.062278 |
| **Shops** | 1.1006 | 8.72 | 0 | 0.319 | 1.76 | 0.083 | 0.2353 | 1.81 | 0.074 | 65.70% | 0.065424 |
| **Hlth** | 0.9172 | 6.6 | 0 | -0.4041 | -2.02 | 0.047 | -0.0948 | -0.66 | 0.509 | 49.00% | 0.072068 |
| **Money** | 1.1748 | 10.09 | 0 | 0.1245 | 0.74 | 0.46 | 0.6487 | 5.42 | 0 | 66.10% | 0.060386 |
| **Other** | 1.07168 | 11.83 | 0 | 0.2404 | 1.85 | 0.069 | 0.33528 | 3.6 | 0.001 | 76.00% | 0.046945 |
| **AVERAGE** | 0.969743 | 8.169167 | 0 | 0.241167 | 1.380833 | 0.246417 | 0.381521 | 3.1125 | 0.128167 | 0.567417 | 0.063382 |

x = coefficient of Fama and French model factor

T(x) = T-statistics of factor

p(b) = p-value of factor

R-sq = $R^2$ of individual regression

se = standard error of individual regression

Over the 1st three periods, based on average absolute T-statistic the size factor appears to have a greater explanatory power; however, in the last period, the book-to-market equity factor has a significantly higher absolute T-statistic than the size factor, signifying greater

predictive power in the book-to-market equity factor from 1983 - 2000. In some cases the regression results show that for a particular industry, the dominant Fama-French factor sometimes changes from one to another over the different sub-periods. Additionally, I noticed that the *s* and *h* coefficient values over the different time periods do not remain stable for each industry. For some of the industries there even appear to be wide swings in the value of the two coefficients. These shifts could probably be explained by the changing characteristics of the industry with relation to the Fama-French factors. **(See CHART 3 and CHART 4)** I will address this in the next section by running the same correlation comparison for *s* and *h* coefficients with the relevant firm characteristic that I did for the complete period data.

**CHART 3**

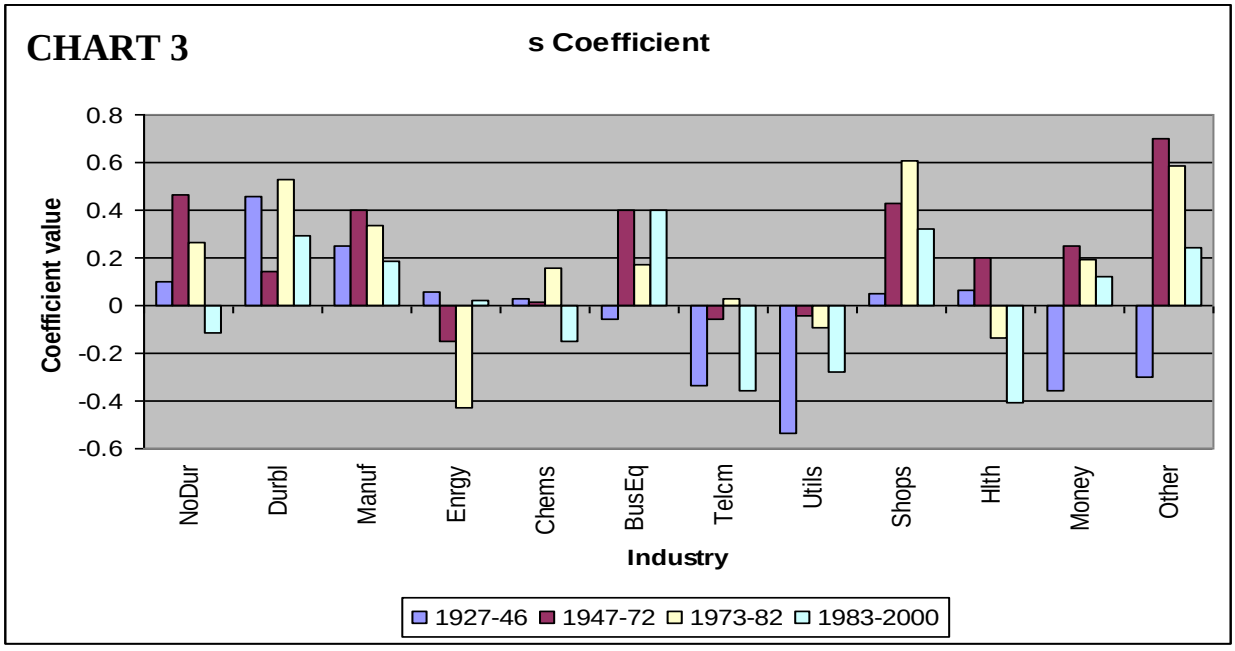
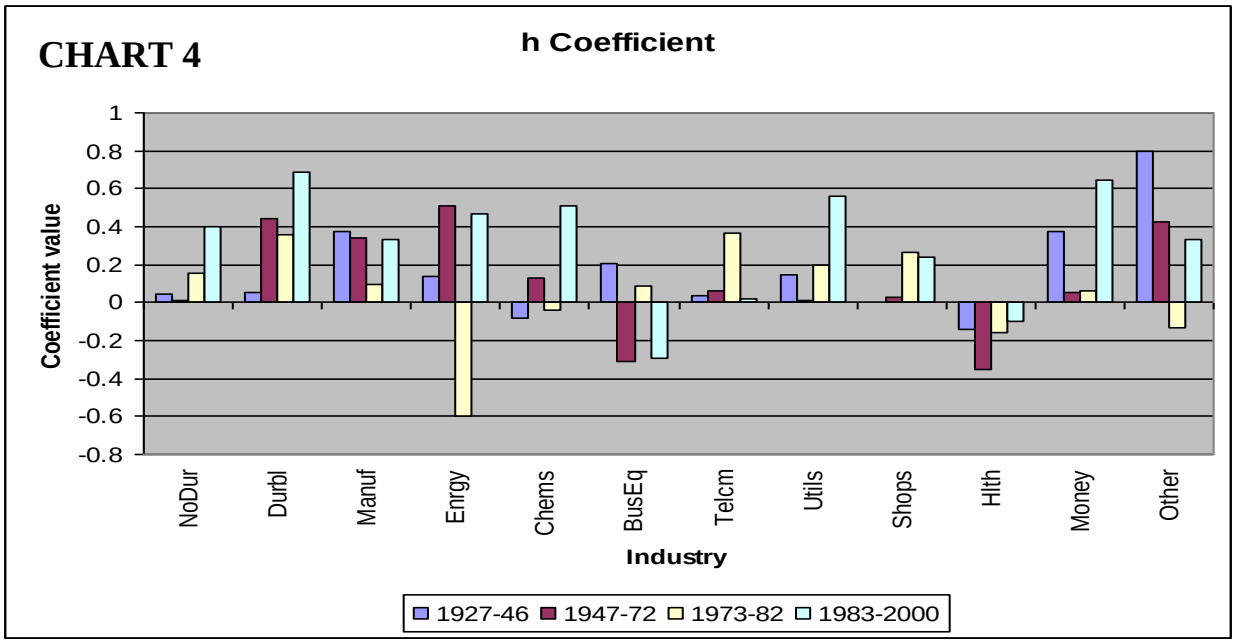


**CHART 4**




B.2. Firm size and book-to-market equity comparison: Sub-Time Periods **[TABLE 5]**

The relationship between the *s* coefficient and size is negative across all periods. The correlation is extremely strong across the last three periods.[12] In the 2nd period, the Pearson correlation is -0.862 with a p-value of 0, showing a significant robust negative correlation between the two variables. The relationship between firm size and the *s* coefficient is weak in the 1st period, with a low negative correlation and a high p-value, showing that the coefficient for the various industries in this period is not explained by the difference among the market capitalization of the average firm in the industry.

[12] Represented by log size in Pearson correlation analysis.

# TABLE 5

*1927 - 1946*

| Rank on Size | | | | | Rank on BE/ME | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Industry | Average Firm Size | LOG Firm Size | s | Rank | Industry | BE/ME | h |
| 1 | Telcm | 613.417 | 2.78775569 | -0.33772 | 1 | Other | 2.8575 | 0.7951 |
| 2 | Utils | 111.419 | 2.04695747 | -0.538 | 2 | Enrgy | 1.3395 | 0.1387 |
| 3 | Chems | 101.191 | 2.005141351 | 0.0288 | 3 | Money | 1.3240 | 0.3743 |
| 4 | Enrgy | 92.276 | 1.965086799 | 0.0565 | 4 | Manuf | 1.3010 | 0.3721 |
| 5 | BusEq | 86.371 | 1.936370043 | -0.0594 | 5 | Utils | 1.2685 | 0.1468 |
| 6 | Durbl | 64.265 | 1.807977609 | 0.4584 | 6 | Telcm | 0.9350 | 0.03497 |
| 7 | Shops | 41.382 | 1.616816286 | 0.047 | 7 | NoDur | 0.8255 | 0.04214 |
| 8 | Hlth | 40.627 | 1.608817872 | 0.0632 | 8 | Shops | 0.6615 | 0 |
| 9 | Other | 39.704 | 1.598831072 | -0.2982 | 9 | BusEq | 0.6340 | 0.2027 |
| 10 | Manuf | 37.106 | 1.56944219 | 0.2518 | 10 | Durbl | 0.6175 | 0.05 |
| 11 | NoDur | 36.740 | 1.56514063 | 0.10218 | 11 | Chems | 0.4700 | -0.0838 |
| 12 | Money | 31.707 | 1.501155153 | -0.3537 | 12 | Hlth | 0.4055 | -0.1407 |

*1947 - 1972*

| Rank on Size | | | | | Rank on BE/ME | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Industry | Average Firm Size | LOG Firm Size | s | Rank | Industry | BE/ME | h |
| 1 | Telcm | 1362.721 | 3.134406875 | -0.05746 | 1 | Other | 1.6004 | 0.4264 |
| 2 | Enrgy | 603.380 | 2.780590749 | -0.1526 | 2 | Telcm | 0.8219 | 0.0588 |
| 3 | Utils | 421.484 | 2.624781265 | -0.04414 | 3 | Enrgy | 0.7385 | 0.5134 |
| 4 | Chems | 355.954 | 2.551393651 | 0.0171 | 4 | Manuf | 0.7212 | 0.3449 |
| 5 | Hlth | 315.295 | 2.498716951 | 0.1978 | 5 | Money | 0.7104 | 0.0529 |
| 6 | Durbl | 313.406 | 2.496107298 | 0.1441 | 6 | Utils | 0.6581 | 0.012 |
| 7 | BusEq | 275.581 | 2.440248757 | 0.3978 | 7 | NoDur | 0.6542 | 0.00778 |
| 8 | Manuf | 150.170 | 2.176582254 | 0.40004 | 8 | Shops | 0.5577 | 0.0268 |
| 9 | Money | 123.493 | 2.091642386 | 0.2514 | 9 | Durbl | 0.5373 | 0.4406 |
| 10 | Shops | 121.808 | 2.085675401 | 0.4288 | 10 | Chems | 0.3850 | 0.1291 |
| 11 | NoDur | 107.467 | 2.031273778 | 0.46386 | 11 | BusEq | 0.3723 | -0.3136 |
| 12 | Other | 89.815 | 1.953347014 | 0.70092 | 12 | Hlth | 0.3212 | -0.3492 |

*1973 - 1982*

| Rank on Size | | | | | Rank on BE/ME | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Industry | Average Firm Size | LOG Firm Size | s | Rank | Industry | BE/ME | h |
| 1 | Telcm | 1048.945 | 3.020752614 | 0.0266 | 1 | Telcm | 1.3280 | 0.3696 |
| 2 | Enrgy | 686.747 | 2.836796824 | -0.43 | 2 | Utils | 1.3210 | 0.1956 |
| 3 | Chems | 434.576 | 2.638066155 | 0.1578 | 3 | Money | 1.1260 | 0.0657 |
| 4 | Hlth | 391.863 | 2.593133705 | -0.1392 | 4 | Durbl | 0.9910 | 0.3579 |
| 5 | Utils | 347.291 | 2.540693737 | -0.0929 | 5 | Manuf | 0.9800 | 0.0976 |
| 6 | Durbl | 304.340 | 2.483359155 | 0.5306 | 6 | Other | 0.9780 | -0.1295 |
| 7 | BusEq | 241.930 | 2.383688828 | 0.1705 | 7 | Enrgy | 0.9020 | -0.5978 |
| 8 | Manuf | 180.160 | 2.255657971 | 0.3325 | 8 | NoDur | 0.8160 | 0.1552 |
| 9 | NoDur | 156.248 | 2.193814467 | 0.2674 | 9 | Shops | 0.7950 | 0.2647 |
| 10 | Money | 139.769 | 2.145412153 | 0.1951 | 10 | Chems | 0.7160 | -0.0401 |
| 11 | Shops | 118.469 | 2.073603195 | 0.6107 | 11 | BusEq | 0.5340 | 0.0911 |
| 12 | Other | 75.890 | 1.880181691 | 0.5877 | 12 | Hlth | 0.4050 | -0.1592 |

*1983 - 2000*

| Rank on Size | | | | | Rank on BE/ME | | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Industry | Average Firm Size | LOG Firm Size | s | Rank | Industry | BE/ME | h |
| 1 | Telcm | 2907.352 | 3.463497615 | -0.357 | 1 | Utils | 1.1128 | 0.5593 |
| 2 | Chems | 1654.235 | 3.218597193 | -0.148 | 2 | Durbl | 0.8822 | 0.6845 |
| 3 | Enrgy | 1430.197 | 3.155395719 | 0.0239 | 3 | Enrgy | 0.7678 | 0.4679 |
| 4 | Utils | 1393.397 | 3.144074969 | -0.2778 | 4 | Money | 0.7589 | 0.6487 |
| 5 | NoDur | 1125.906 | 3.051502194 | -0.1168 | 5 | Telcm | 0.6456 | 0.0156 |
| 6 | Durbl | 904.541 | 2.956428355 | 0.2961 | 6 | Manuf | 0.6072 | 0.32997 |
| 7 | Hlth | 881.497 | 2.945220902 | -0.4041 | 7 | Other | 0.5611 | 0.33528 |
| 8 | Manuf | 785.930 | 2.895384071 | 0.1876 | 8 | Chems | 0.5194 | 0.5113 |
| 9 | BusEq | 764.094 | 2.883146779 | 0.3988 | 9 | Shops | 0.4406 | 0.2353 |
| 10 | Money | 694.119 | 2.84143395 | 0.1245 | 10 | BusEq | 0.4100 | -0.294 |
| 11 | Shops | 624.672 | 2.795651711 | 0.319 | 11 | NoDur | 0.3894 | 0.4016 |
| 12 | Other | 408.311 | 2.610990657 | 0.2404 | 12 | Hlth | 0.2744 | -0.0948 |

Looking at the *h* coefficient we see, similarly to the *s* coefficient, that three of the periods exhibit a significant correlation between the *h* coefficient and book-to-market equity. During the 1st period, the HML factor is very closely related to the difference in book-to-market equity across firms and has a positive correlation of 0.923 with a p-value of 0. The relationship across all periods between the two variables is positive, showing that as book-to-market equity increases, the *h* coefficient rises as well.

The basic Fama and French observations that small capitalization stocks outperform large capitalization stocks, and high book-to-market equity stocks outperform firms that have a lower book-to-market equity, hold across all the individual time periods, except in one instance. The average HML portfolio return for each and every period is positive, and coupled with the significant positive relationship between the *h* coefficient and book-to-market equity, supports the claim regarding the outperform of high book-to-market equity stocks. One can see that an industry with a higher BE/ME has a higher *h* coefficient, which causes the HML factor to rise; this results in increased industry returns. The average SMB portfolio return is positive for three out of the four periods; in the last period it is negative. Therefore, in the first three periods, as market capitalization increases, the *s* coefficient decreases and return is lower. However, in the last period, the negative SMB portfolio return implies that firms with a lower *s* coefficient, i.e. large market capitalization firms outperform small market capitalization firms. The size comparison results for this period is an anomaly to the Fama and French observation that small firms outperform large firms.

## VI. Conclusion

My research is aimed at answering three questions: (a) Does the Fama and French model successfully explain industry returns? (b) Is there any additional explanatory power in the macroeconomic variable of GDP growth added to the Fama and French model? (c) Is there a distinguishable consistent relationship between the Fama and French model factors and the relevant firm characteristics?

[RM(t) – RF(t)] and the two factors discovered by Fama and French, SMB and HML, successfully explain the cross section of excess industry returns. The excess market return has an average absolute T-statistics of 18.32 for all the industries, and is statistically significant in explaining every industry's excess return. The SMB and HML factors have average absolute T-statistics of 2.39 and 3.21 respectively, which show they are able to explain the variation in industry returns to a reasonable amount. However, neither of the factors shows a consistent superior ability to explain excess returns for all industries. Also, the addition of GDP growth as a fourth factor, does not add any predictive power to the Fama and French model.

The relationship between the SMB and HML factor coefficients and the related firm characteristics can be seen on observing **CHART 1** and **CHART 2.** Taking into account that the average SMB and HML portfolio returns are positive, we see that the relationships between the coefficients and firm characteristics support Fama and French's observations that small capitalization stocks outperform large capitalization stocks, and high book-to-market equity stocks outperform firms that have a lower book-to-market

equity. As size of a firm increases, the *s* coefficient decreases causing industry returns to fall as well. On the other hand, as book-to-market equity increases, the *h* coefficient increases causing the industry returns to rise. There is however a single sub-time period anomaly from 1983 – 2000, where the average SMB portfolio return is negative. The relationship between the *s* coefficient and firm size is still negative, and this implies that industries with a larger average firm size experienced greater returns than the industries that had a smaller average market capitalization for the firms in them.

Application

The results I obtained show that the Fama and French three factor model can be effectively used in any system that would require the estimation of future expected stock and industry returns. Making investment decisions merely on the basis of individual firms or undertaking sector investing could be analyzed by estimating the exposure of one's portfolio to the three factors in the model. The model similarly, can be used to evaluate a portfolio manager's performance by observing whether he can beat the market by using information to generate returns greater than those that would be generated by the similar returns for the three risk factors. The Fama and French three factor model is a tool that can be used in cost of capital calculations, as it has been shown in prior research in different countries, to have significant power over the capital asset pricing model (CAPM) in predicting stock returns.[13][14] The exposure of a firm to the three risk factors can be estimated by regressing the observed past excess returns of the firm on the three Fama

[13] Prior literature dealing with superiority of Fama and French three factor model over CAPM is mentioned in 'Literature Review' section of my thesis.
[14] CAPM was created by William Sharpe and John Lintner and is also known as the one-factor Sharpe-Lintner model.

and French model variables. This can be used to predict the present expected return of the firm, and help judge its cost of capital.

Further Research

The Fama and French model, like any other area in finance, is one that can never be exhausted of further research. The mere passage of time creates information and data that proves useful in the continued study of the relevance of this model and its superiority (or inferiority) over other asset pricing models. I have identified a few areas where additional research would be extremely beneficial in the further understanding and application of the model. The reasons behind the out performance of small capitalization and high book-to-market equity stocks are an extremely interesting area for future study. The reasons could possibly be related to factors governing profitability, risk and growth. One may probably expect to find small sized firms have greater growth prospects, or that high book-to-market equity stocks are generally troubled companies having greater inherent risk, and therefore demanding higher returns.

An additional area that could be looked at is ways to mold and tweak the Fama and French three factor model: This could be done along two lines. (a) Improve the explanatory power of the Fama and French model in international markets application. For instance, the CAPM was modified, by adding a country risk premium and lambda, to suit international markets. (b) Mold and tweak the Fama and French model to see if there are any other variables that could increase its explanatory power, and capture the variation in excess returns that the model is unable to predict. I wish researchers, who

undertake these or other future research in regard to the Fama and French model, all the best.

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