ISSN: 2835-3196 Website: econferenceseries.com

USING CAPM AND FAMA-FRENCH THREE-FACTOR MODEL TO EXPLAIN STOCK PERFORMANCE IN RUSSIA

Berdiyorov Bekzod Shoymardonovich,
Assistant Lecturer Department of "Management, Economics and Humanitarian" subjects Turin Polytechnic University in Tashkent
, Email: bekzod.berdiyorov@polito.uz, Tel: +998(71) 246 1018

Abstract

Almost all investors want to be able to predict stock returns that will occur in the future. This will enable them to make focused bets and earn higher returns in comparison to those who do not possess this information. To this end, investors can rely on different asset pricing models and two of the most popular choices made are the capital asset pricing model (or the CAPM) and the Fama-French three-factor model. This study tries to compare the CAPM with the three-factor model for individual securities using panel data from 2018 to 2023 on the common shares of 114 companies listed on the Russian stock exchange.

Key words: predict stock returns, the CAPM, Fama-French model, Russian stock exchange.

Introduction

Almost all active stock investors are interested in predicting how different stocks or groups of stocks will perform over the next month, quarter, year and so forth, depending on their investment horizon. This information is extremely valuable because it can assist active investors to get the highest possible return from asset allocation and security selection given the constraints they face. However, to be able to explain and/or forecast the returns of common stocks, users typically rely on popular models used in the industry rather than constructing their own models (Fabozzi, 2007). In this respect, there are several alternative models that investors or managers can choose from.

Two of the most popular models in the investment industry are the CAPM and the Fama-French three-factor model; the outperformance of the three-factor model relative to the CAPM in portfolios is well documented, implying active portfolio managers can generally rely on the Fama-French model in asset allocation.

However, the evidence is mixed when it comes to the returns on single stocks, which can make investors puzzled. The reason is merely knowing which group of stocks offers higher (absolute or relative) returns does not suffice, for there can be hundreds of common shares fitting the criteria. Hence, the knowledge of how individual stocks will behave is of the essence too.

Which return-generating model should stock investors use to be able to better predict future stock performance? This paper tries to identify whether a typical investor with limited knowledge of econometrics and little funds is better off using costlier (both in terms of time and money) method of Fama and French (1993; 1996). The methodology employed is not the best one from an econometric point of view, but it is simple enough so that financiers can replicate it and comprehensive enough to address many complexities surrounding the asset pricing.

Literature Review

CAPM. One of the most prominent and widely used models in stock markets is surely the capital asset pricing model, also known as the CAPM. The model is based on the Modern Portfolio Theory proposed by Markowitz (1952) and Tobin's two-fund separation theorem (1958) and was independently built by several researchers, including William Sharpe (1964), John Lintner (1965) and Jan Mossin (1966).

The main implication of the CAPM is that investors invest in risky securities only if those securities offer commensurate returns. Mathematically, the model is specified as follows:

$$E(R_i) = R_f + \beta_i E(R_M - R_f)$$

where $E(R_i)$ stands for expected return on stock i, R_M is the return of the overall market and R_f represents the risk-free rate, which is the return to investor for deferring consumption; $R_M - R_f$ is, thus, the compensation for bearing the market risk and β_i gauges the systematic risk of that security for which an investor is compensated, technically defined as the ratio of the covariance between market returns and a single stock's return to the market return variance.

All three papers (Sharpe, 1964; Lintner, 1965; Mossin, 1966) derive the above equation for the case of a perfectly competitive market that is in equilibrium, but they utilize different approaches to achieve this end. Sharpe, in his analysis, breaks down the return on any security into two components: systematic risk — the risk that remains even in efficient portfolios and mainly due to economy-wide

ISSN: 2835-3196 Website: econferenceseries.com

fluctuations—and unsystematic risk, which can be eliminated through diversification.

The seemingly very different three papers have much in common in terms of assumptions. The assumptions concern not only the behavior of investors but also the structure of the market.

1. Investors are thought to be rational, risk averse and utility-maximizing.
2. All individuals have the same estimates of the means, variances and covariances of stock returns (i.e., homogeneity of expectations).
3. Market is informationally efficient and no investor has access to private information.
4. Investment decisions are made for a single holding period.
5. Markets are perfectly competitive and frictionless: transaction costs and taxes are assumed away.
6. Investors can invest in all securities in any amounts (Lintner even allows for short-selling); it is possible to borrow or lend at the same risk-free rate.

Although the model is robust to slight to moderate violations of first three assumptions, the violation of the last three can render the CAPM predictions biased (Bodie, Kane and Marcus, 2014; CFA Institute, 2017a).

The main advantage of the CAPM is its drawback as well (Fama and French, 2004). As was pointed out in earlier sections, the model has a single variable that should fully, in theory, explain all the variation in stock returns and postulates that no other aspects of stocks should be relevant in asset pricing. Hence, the CAPM cannot explain some of the widely cited anomalies—abnormal returns on stocks unrelated to their systematic risk—which are found both in and outside the U.S. For example, it was found that stock returns are positively correlated with the ratio of a company's book equity to its market equity (Rosenberg, Reid and Lanstein, 1985; Chan, Hamao and Lakonishok, 1991) and financial leverage (Bhandari, 1988), and negatively related to firm size (Banz, 1981; Basu, 1983; Keim, 1983) and price-to-earnings ratio (Basu, 1977; 1983). These relationships were statistically significant even when the researchers controlled for the systematic risk of common shares, with the implication being that either the CAPM has been tested incorrectly or it omits relevant explanatory variables and produces biased results (Banz, 1981; Basu, 1983).

Three-factor model by Fama and French. Based on the mounting evidence of anomalies mentioned above, Eugene Fama and Kenneth French (1992) built a model

ISSN: 2835-3196 Website: econferenceseries.com

that extended the CAPM in the following way. They introduced different combinations of E/P ratio, firm size (measured by market capitalization), B/M ratio and leverage along with s of the financial instruments under investigation. What they found was that not every newly added variable had explanatory power when introduced together with others, for all of the four variables could be treated as different ways of scaling stock prices and of extracting the information about the risk and expected return of a particular stock (Keim, 1988). However, their most controversial and surprising finding was that for the period between 1963 and 1990, the betas of common stocks in the U.S. market did not have the CAPM-proposed positive relation with average stock returns after controlling for a firms' size and B/M ratio. This paper triggered an enormous interest among the academics and resulted in a series of studies that expanded the knowledge of asset pricing models.

As is the case with any study, however, the research by Fama and French (1992) is not flawless. The main shortcomings of the model are its design and lack of theoretical background. In other words, the way the model is specified resembles data mining techniques.

To address the critique that Fama and French (1992) results are sample specific, Fama and French (1993; 1996) developed a three-factor portfolio model that has been used most widely in the literature. The original model was reformulated to yield

$R_p - R_f = \alpha_p + \beta_i (R_M - R_f) + s_p\, SMB + h_p\, HML + e_p$.

In this model, R_p, R_f, R_M and β_i represent the return on a portfolio, risk-free rate, overall market return and the sensitivity of a portfolio's return to that of the market, respectively (the same as in the CAPM); α_p is Jensen's alpha or the excess return of a portfolio relative to its systematic risk(s), SMB is the return on a size factor or the difference between small-stock portfolios and big-stock portfolios, and HML is a value factor or the difference between high BE/ME and low BE/ME portfolios.

Fama-French (1993; 1996) model has been extensively used against the CAPM to test the relationship between mean return and the three explanatory variables in North America, numerous European economies, developing Asian countries and Japan. The results of those studies can be classified into four broad categories. The first group includes studies that found the Fama-French model superior to the CAPM in that both size premium and value premium were confirmed (Blanco, 2012; Charitou and Constantinidis, 2003; Fama and French, 2006); the second group consists of works which established the relevance of size but did not support that of the BE/ME ratio (Bruni, Campisi, and Rossi, 2006; Djajadikerta and Nartea, 2005; Lamber and Hubner, 2014; Silvestri and Veltri, 2011); the third group finds a strong value premium but a weak/no size premium (Fama and French, 2012; Zaremba and Konieczka, 2017; Zhao, 2014). Finally, the fourth category of studies shows that the three-factor model does not perform better than the CAPM (Lam, 2005; Malin and Veeraraghavan, 2004; Panta et al., 2016).

Methodology

The study aims to test empirically whether the Fama-French model is superior to the CAPM in the Russian stock market. For this task, I will employ panel data on the 114 current or former constituent firms of Russian Broad Market Index over six years from 2018 to 2023, with 54-month β estimation period, a one-year horizon for checking the usefulness of models and a six-month prediction timescale.

Market Index. The indexes used in tests of any asset pricing model are very important because they purport to represent the overall market return earned by all investable assets. Another important aspect is the efficiency consideration. Unless the index is mean-variance efficient in the sense it offers the highest return for a given level of risk and has the lowest risk for given expected return, the test of the CAPM is not reliable. In addition, the lower the efficiency of an index, the higher the so-called benchmark error, which biases the results against the CAPM, and the lower the validity of the second-pass regressions used (Bodie, Kane and Marcus, 2014).

Therefore, the author has taken the value-weight returns of the 114 shares analyzed and used them as market returns. Henceforward, those value-weighted returns are referred to as returns on the modified Broad Market Index (the modified BMI in short) or returns on the author's index. Even though using the term author' index is a misnomer (because the index was not constructed but weighted-average returns were used), this will make it clear that the focus is on all common shares rather than on a subset of them.

Total returns. Monthly returns on stocks are calculated manually by using the formula 1 if the Yahoo! Finance's dividend-adjusted prices are available, and by employing the formula 2 otherwise.

ISSN: 2835-3196 Website: econferenceseries.com

$$TR_t = \frac{AP_t - AP_{t-1}}{AP_{t-1}} \quad (1) \qquad\qquad TR_t = \frac{P_t + D_t - P_{t-1}}{P_{t-1}} \quad (2)$$

where TR_t is the total return on a stock, AP_t and AP_{t-1} are the prices adjusted for dividends and splits, P_t and P_{t-1} are the prices adjusted for splits only, and D_t is the amount of dividend paid on a stock, with subscripts showing the months.

Having found the total returns, we annualized them using the compound interest formula. The reason for compounding returns is that 875 observations of 7742 had a monthly return of –10% or lower. Using the simple method of annualization (multiplying monthly returns by 12) will illogically suggest that with those 875 observations investors faced an annual loss of more than 100%, which is impossible in the absence of leverage.

Risk-free rate. The risk-free rate in this analysis is defined as the one-month Russian government bond yield, which is obtained from Investing.com.

SMB and HML. Estimating these factor returns is the same as that of Fama and French (1993; 1996).

The Estimation of β and Factor Sensitivities. For each stock, the beta for the CAPM is estimated in the first-pass regressions by running (5) regressions and beta and sensitivities for the Fama-French model by (6) regressions. These estimated parameters are then used as inputs in the second-pass regressions to check the usefulness of the models. [Note: For the estimation of parameters in the first-pass regressions, we stipulated that at least 30 observations of monthly returns should be available. The betas and sensitivities estimated with fewer-than-30 observations were not included into the second-pass regression. This criterion is imposed to fairly ensure the accuracy of inputs in the second-pass regression and 30 is chosen because it is the sample size that is on the verge of being large. In literature, other sample sizes, such as 24 and 48, have also been used.]

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{Mt} - R_{ft}) + e_{it} \quad (5)$$

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{Mt} - R_{ft}) + s_i SMB_t + h_i HML_t + e_{it}. \quad (6)$$

where R_{it} is the return on stock i at month t, R_{ft} is the risk-free rate at month t, R_{Mt} is the return on the index used, SMB_t is the average outperformance of small stocks relative to big stocks and HML_t is the excess returns of value stocks over growth stocks.

The Second-Pass Regression. The second-pass or main regression requires pooling all observations and regressing monthly returns on the estimated betas for the test of the CAPM and on the betas and factor sensitivities for checking the validity of the Fama-French model. The form of this regression will be as (7) for the CAPM and (8) for the three-factor model.

$$R_{it} - R_{ft} = \gamma_1 + \gamma_2 \overline{\beta_{it}} + e_{it} \quad (7)$$

$$R_{it} - R_{ft} = \gamma_1 + \gamma_2 \overline{\beta_{it}} + \gamma_3 \overline{S_{it}} + \gamma_4 \overline{h_{it}} + e_{it} \quad (8)$$

where $\overline{\beta_{it}}$, $\overline{S_{it}}$ and $\overline{h_{it}}$ are the parameters of each security estimated from the first-stage regressions, γ_1 is the intercept or average pricing error of a model, γ_2, γ_3 and γ_4 are market risk premium, size premium and value premium, respectively.

Results and Discussion

If the CAPM is correct, then the intercept term of the second-pass regression (7) should be insignificant and the coefficient of betas, market risk premium, should be significant and positive. On the other hand, the Fama-French model is more suitable if it produces a less significant intercept and significant and positive premiums associated with size and value. According to the results of Fama and Macbeth (1973) tests for the CAPM and the Fama-French model for 18 months and the overall checking period. None of the coefficients are significant at 5%, no matter which index or model is employed. In addition to being insignificant, the coefficients vary greatly from one month to another, suggesting the presence of some problems. Stated otherwise, the performed analysis did not produce any reliable results and the roots of the issue should be examined.

One possible cause of the inadequate models may be the presence of outliers in the data. After examining the data closely, the author indeed found abnormally high and low returns. Table 6 shows the descriptive statistics for cases when the annual return is higher than its 97th percentile and lower than 3th percentile. Mean returns for these two groups are 82174% and –94.99%, respectively. These substantially high and low results have probably biased the estimated beta coefficients in the first-pass regressions and made the second-pass regressions less meaningful, for the OLS parameters are sensitive to the presence of outliers.

ISSN: 2835-3196 Website: econferenceseries.com

To rectify the situation, the author dropped the observations having top 3% or bottom 3% of returns. After this procedure the annual returns seem more realistic: mean annual return (standard deviation of return) decreased from 2538% (134417%) to 71.77% (215%). Even though the lowest return has not changed much, the maximum observed return has been reduced substantially. Factor portfolios were formed once again and the market value-weighted returns were recalculated. What the author found was that after the revised data were used for forming the size and BE/ME portfolios, the previously observed superiority of small and/or value shares has disappeared, with medium-size stocks outperforming both small and large shares in all cases and value stocks underperforming growth shares in two of the three size portfolios.

The Fama and MacBeth Test with the Revised Data. Comparing the results between the two indexes, the reader can notice that the index constructed by the author gives better results for both the CAPM and the three-factor model. The CAPM market risk premium, although imprecise, is significant at 5% (it is not the case with the international index) and the model has a smaller mean intercept (0.57) under the modified BMI index compared to 0.83 when the global index is used. The Fama-French model also performs better with the modified BMI index. Market risk premium is significant and size and value premiums are insignificant at 5% under both indexes, but the author's index has a smaller and insignificant average pricing error of 0.32, half as big as the statistically significant intercept of the MSCI Index. The relatively poor performance of the global index is caused by its deficiencies relative to the modified BMI index. The central shortcoming is that the MSCI Index weighs the returns of different stock markets by the corresponding GDP's; hence, the weight of emerging markets is only 11% in the index (Riedl, 2015). The implied weight of Russian equities is even smaller and, that is why, most of the stocks under our investigation did not share the movements of the international index. (The average betas over the sample that are estimated with the CAPM and the Fama-French model were 0.26 and 0.29, respectively.) Additionally, the effect of inappropriately chosen index may have been further exacerbated because of the tracking error of the exchange traded fund we chose. Therefore, it seems a sensible idea to continue the analysis with the author's index only.

The choice between the CAPM and the three-factor model is also evident. Under the modified BMI, the intercept of the CAPM is 79% larger than that of the three-factor model, which is in line with the results obtained by Fama and French (1993; 1996), among others.

Conclusions

Little can be said about the usefulness and validity of the two asset pricing models based on the research conducted. All conclusions are conditional (some are speculative too) and probably can be challenged by the reader. Despite this, we will list some general notes that are presented in the same order as the research objectives set at the very beginning of the study.

First of all, the test of the CAPM as well as of the three-factor model is sensitive to the presence of significantly high and low returns in the sample. When the outliers were present, we found that the data supports neither of the two models. However, after the sample had been cleared from extreme outcomes, the results supported the superiority of the three-factor model because it produced considerably smaller average pricing errors (i.e., intercepts).

The outcome of the forecast was that simple momentum strategies can produce considerably more accurate predictions than the well-specified but illogical fixed-effects model. This ability of past stock returns to predict future stock returns was also documented by Jegadeesh and Titman (1993), Carhart (1997) and Fama and French (2012). That is why our previous finding is not unusual and may suggest that Russian stock investors were better off following those simple momentum strategies over the forecast horizon rather than bothering with the CAPM or the Fama-French model.

The search for studies performed on single securities in lieu of portfolios shows that the author's results are not unique. After the seminal study by Fama and French (1992), little research has been done for stocks and many of the conducted ones resulted in controversial results. Thus, the general conclusion is straightforward: neither the CAPM nor the Fama-French model performs well for individual stocks and this study accentuated that the poor performance is even more evident when stock prices fluctuate wildly.

References:

1. Carhart, M. (1997). On persistence in mutual fund performance. The Journal of Finance, 52 (1), 57-82.
2. Fabozzi, F. J. (2007). Fixed Income Analysis, 2nd ed. New Jersey: John Wiley & Sons, Inc.
3. Fama, E. and French, K. (1993). Common risk factors in the returns on stock and bonds. Journal of Financial Economics, 33 (1), 3-56.
4. Fama, E. and French, K. (1996). Multifactor explanations of asset pricing anomalies. Journal of Finance, 51 (1), 55-84.
5. Fama, E. and French, K. (2015). A five-factor asset pricing model. Journal of Financial Economics, 116 (1), 1-22.
6. Jegadeesh, N. and Titman, S. (1993). Returns to buying winners and selling losers: implications for stock market efficiency. The Journal of Finance, 48 (1), 65-91.
7. Kampman, T. (2011). Explaining stock returns: the CAPM, Fama-French three factor model and Carhart's four factor model. Tilburg: Tilburg University.
8. Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. The Review of Economics and Statistics, 47 (1), 13-37.
9. MacKinlay, A. (1995). Multifactor models do not explain deviations from the CAPM. Journal of Financial Economics, 38 (1), 3-28.
10. Mossin, J. (1966). Equilibrium in a capital asset market. Econometrica, 34 (4), 768-783.
11. Sharpe, W. F. (1964). Capital asset prices: a theory of market equilibrium under conditions of risk. The Journal of Finance, 19 (3), 425-442.