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Is More Always Better?
An Empirical Investigation of the CAPM and the Fama-French Three-factor Model in Indonesia

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Abstract

This study investigates the performance of the CAPM and the Fama-French three-factor model in Indonesia. This research employs time-series regression with monthly data from 2005 to 2015. The results reveal that the Fama-French three-factor model performs better than the CAPM in describing the excess return of stock portfolios in Indonesia. This result is robust to the equally-weighted method and the impact of the global financial crisis. Although the Fama-French three-factor model is superior to the CAPM, the results indicate that there are other factors to consider in determining asset pricing models that better capture stock return variations in the Indonesian stock market. This research implies that the investors should consider Fama-French factors when making their investment decisions. Furthermore, the investors should evaluate another factor impact the average returns.

Keywords: Asset pricing, CAPM, Three-factor model, Size factor, Book-to-market factor, JEL Code: G12

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1. Introduction

Sharpe (1964), Lintner (1965), Mossin (1966), and Black (1972) introduced the Capital Asset Pricing Model (CAPM). It contributes significantly to the understanding of risk relationships with returns for academia and practitioners. The asset return in the CAPM is determined only by systematic risk, i.e., beta. The expected return on risky assets is predicted to be positively related to beta. The primary purpose of CAPM is to determine the required rate of return on investment.

Initially, empirical tests support the argument that beta is the only predictor of cross-sectional differences in stock portfolio returns [15]. However, later empirical findings

suggest that not only the beta can explain stock returns, but other factors can explain stock returns variation and eventually develop other asset pricing models. A number of studies have found that firm characteristics may be a significant explanatory factor on average returns, such as firm size (Banz, 1981; [31]), earnings to price ratio [2], leverage [3], or book-to-market equity ratio [8, 32, 34].

Encouraged by the above findings, an article that has a significant impact on systematic risk validity as a measure of stock risk is Fama and French (1992). They generate two primary results. Firstly, when the beta is allowed to vary unrelated to size, the positive linear relationship between beta and return will disappear as opposed to CAPM prediction. Secondly, because the beta is not good at explaining returns, Fama and French (1992) compare the explanatory power of size, leverage, earnings to price ratio, and book-to-market equity ratio. Fama and French (1992) conclude that the size and the ratio of book-to-market equity are the variables that have the most substantial relationship with the return and can explain the cross-section of the average stock return well. However, some researchers assume that the results of Fama and French research occur due to data snooping [6, 25].

In their subsequent research, Fama and French (1993) try to develop the previous study using a time-series regression approach to US stock data for the period 1963 to 1991. Fama and French (1993) propose a three-factor asset pricing model. The three-factor model includes market factor (excess market return), size factor (SMB), and book-to-market factor (HML). The Fama and French's study is interesting because it can show that the premium return associated with size and the book-to-market ratio is compensated for risk, in line with the spirit of the Intertemporal Capital Asset Pricing Model [27].

Subsequent studies show that a three-factor model can explain the cross-section of stock returns well. These include Fama and French (1996, 1998), Liew and Vassalou (2000), Griffin and Lemmon (2002), Lettau and Ludvigson (2001), and Petkova (2006). Therefore, the three-factor model of Fama and French has become a reference model in asset pricing literature.

Some previous studies compared the performance of the CAPM and the Fama-French three-factor model. Gaunt (2004) in Australia, Bhatnagar and Ramlogan (2012) in UK, Mio and Yi (2013) in US document that the Fama-French three-factor model performs better than the CAPM. According to those results, this study examines further the performance of the CAPM and the Fama-French three-factor model in a developing country, namely Indonesia.

2. Literature Review

2.1. Capital asset pricing model

CAPM is a theory-based model. The coefficient of beta in CAPM indicates market sensitivity. Beta shows how the systematic risk level of the market. CAPM is based on a model developed by Markowitz (1952). This theory explains the relationship between risk and the rate of return on the assets demanded when those assets are in a well-diversified portfolio. Based on the Markowitz model, each investor is assumed to diversify the portfolio and choose an optimal portfolio based on its preference.

Mathematically, the CAPM equation is:

$$R_{it} - R_{ft} = a_i + b_i \left(R_{mt} - R_{ft} \right) + e_{it} \tag{1}$$

where R_{it} is the return of securities or portfolio i for period t, R_{ft} is the risk-free rate for period t, R_{mt} is market portfolio return for period t, and e_{it} is error term of securities or portfolio i of period t.

Many studies support CAPM and do not support CAPM. Prior research that supports CAPM such as Graham and Harvey (2001) suggest that 73.5% of CFOs uses CAPM to estimate the cost of equity. Brounen et al. (2004) used a similar survey of 313 companies in Europe and about 45% used CAPM. Black et al. (1972) tested CAPM employing the return of cross-section and time-series. They conclude that the intercept is near zero. The results documented that the relationship between the average of portfolio returns and beta is linear. The following year, Fama and MacBeth (1973) researched on the New York Stock Exchange between 1926 and 1968. Fama and MacBeth (1973) claim that their study supports CAPM. They found that there is a linear relationship between the average returns and beta.

The research against CAPM begins with Roll criticism (1977) who argues that CAPM cannot be tested unless the market portfolio of all assets is used in empirical tests. Basu (1977) also shows exciting anomalies from CAPM. Basu is the first to test the idea that variables associated with values can explain CAPM violations. Basu (1977) found a significant positive relationship between earnings to price ratio and the average return for US stocks that cannot be described by CAPM. Banz (1981) criticizes CAPM by showing that size can explain better than beta about cross-sectional variation in average returns on some essential assets. Bhandari (1988) also found an anomaly where stock returns with leverage (debt to equity ratio).

2.2. Fama-french three-factor model

Banz (1981) has initiated research and states the size is inversely related to expected return. Fama and French (1992) evaluated beta, size, and the book-to-market ratio by testing all stock return data from NYSE, AMEX, and NASDAQ, with the period 1962-1989. But they do not include financial companies as data in research. The methodology used by Fama and French in determining the value of beta is identical to the methodology of Fama and MacBeth (1973), which is a cross-sectional regression by controlling the size and book-to-market variables as a way of selecting samples. The conclusion of Fama and French (1992) research is that size and book-to-market equity can capture cross-sectional variation in stock returns.

The three-factor model of Fama-French (1993) can be expressed in the following model:

$$R_{it} - R_{ft} = a_i + b_i \left(R_{mt} - R_{ft} \right) + s_i SMB_t + h_i HML_t + e_{it} \tag{2}$$

where R_{it} is return of securities or portfolio i for period t, R_{ft} is the risk-free rate for period t, R_{mt} is market portfolio return for period t, SMB_t is size factor (Small Minus Big) for period t, HML_t is book-to-market factor (High Minus Low) for period t, and e_{it} is error term of securities or portfolio i of period t.

The Fama-French three-factor model is the extended version of the CAPM, by adding size (SMB) and book-to-market (HML) factors into the CAPM. SMB is a risk measure of the company, where the stock of small companies is expected to be more sensitive. On the other hand, HML represents a higher risk exposure for stocks of firms with high book value-to-market ratios (value stocks) and lower for firm stocks with low book-to-market ratios (growth stocks).

3. Research Methods

3.1. Data

Data employed in this study are secondary data which collected from the Datastream database. The use of the Datastream database helps with survivorship bias because Datastream samples include active and non-active companies [7]. The research period is July 2005-June 2015. This study uses monthly data. The data used in this study include the stock closing price, the number of shares outstanding, the Indonesian capital market Composite Stock Price Index, the book value of equity, and the risk-free interest rate using monthly data of 90 days of Bank Indonesia Certificates.

The criteria for determining the sample follow Fama and French (1992, 1993). This study excludes stocks that fall within the financial sector. This study excludes stocks in the financial sector because high leverage is common to financial firms, but that does not apply to non-financial companies, where high leverage would indicate financial difficulties. This study also drops stocks with negative equity because negative equity may also suggest that a company is experiencing financial difficulties.

4. Research Variables

The independent variables in this research are asset pricing factors that include market, size (SMB), and book-to-market (HML). The calculation of return of each asset pricing factor is determined using the value-weighted method. Explanation of each factor is described as follows.

1. Market factor (R_m - R_f)

   Market factor represents the difference of each market's return on the risk-free interest rate.

2. Size factor (SMB)

   SMB (*Small Minus Big*) is intended to illustrate the risk factors associated with firm size. SMB represents the difference of each month of average returns on three portfolios over small share capitalization with average returns on three portfolios with large share capitalization. SMB calculation is formulated as follows.

$$SMB = \frac{(\text{Small Value} + \text{Small Neutral} + \text{Small Growth})}{3} \\ - \frac{(\text{Big Value} + \text{Big Neutral} + \text{Big Growth})}{3} \quad (3)$$

3. Book-to-market factor (HML)

   HML (High Minus Low) is meant to capture the risk factors associated with the book-to-market ratio. HML is the monthly difference between the average returns on two portfolios that have high book-to-market ratios with average returns on two portfolios with low book-to-market ratios. The HML calculation uses the following formula.

$$HML = \frac{(\text{Small Value} + \text{Big Value})}{2} - \frac{(\text{Small Growth} + \text{Big Growth})}{2} \quad (4)$$

This study calculates the excess return from portfolio 25 Size-B/M as the dependent variable. Portfolio 25 Size-B/M, formed at the end of every June, is the interaction of

five portfolios formed on the size (market capitalization) with five portfolios formed on the book-to-market ratio. Size for June of year t is the multiplication of stock price in June year t with the number of shares outstanding in June of year *t*. B/M for June in year *t* is the book value of equity at the end of fiscal year *t-1* on market capitalization in December year *t-1*. The calculation of portfolio return using the value-weighted method. The portfolio will be rebalanced annually at the end of June year *t*.

5. Empirical Models

The empirical models used in this study are the CAPM and the Fama-French three-factor model, as described below.

$$R_{pt} - R_{ft} = a_p + b_p \left(R_{mt} - R_{ft} \right) + e_{pt} \tag{5}$$

$$R_{pt} - R_{ft} = a_p + b_p \left(R_{mt} - R_{ft} \right) + s_p SMB_t + h_p HML_t + e_{pt} \tag{6}$$

where $R_{pt} - R_{ft}$ is portfolio excess return, $R_{mt} - R_{ft}$ is market factor (market excess return), SMB_t is size factor, HML_t is value factor, and e_{pt} is error term.

This research employs time-series regression with ordinary least square estimation method (OLS). Before conducting the multiple regression testing, this study applies stationarity test.

6. Comparison of Asset Pricing Models

This study uses several criteria in comparing the CAPM and the Fama-French three-factor model in Indonesia. Following Merton (1973), a well-estimated asset pricing model produces an insignificant intercept. This study tested this by computing the F-statistic of the GRS test [17]. The formula for calculating the GRS test is as follows.

$$\text{GRS} = \left(\frac{T}{N} \right) \left(\frac{T - N - L}{T - L - 1} \right) \left[\frac{\alpha' \sum^{-1} \alpha}{1 + \mu'^{-1} \mu} \right] \sim F(N, T - N - L) \tag{7}$$

where *T* is the number of observations, N is the number of described portfolios, L is the number of explanatory factors, α is the vector of the intercept of regression, Σ is the covariance matrix of the residual of regression, μ is the vector of the mean of explanatory, and Ώ is the covariance matrix of explanatory factors. The null hypothesis states that all the regression intercepts are zero, GRS test statistics has the F distribution with degrees of freedom N and T-N-L.

Following the recommendation of Lewellen et al. (2010), this study also calculates Sharpe Ratio (SR (α). The formula for calculating Sharpe Ratio is as follows.

$$SR(\alpha) = \left(\alpha' S^{-1} \alpha\right)^{1/2} \tag{8}$$

where α is the column vector of 25 regression intercepts produced by each model when applying the Size-B/M portfolio, and S is the covariance matrix of the residual regression. The smaller the Sharpe Ratio value, the better the asset pricing model. This study also compares the average adjusted R^2, the mean absolute value of the intercept, and the average standard error of the intercept to indicate which model is better.

7. Robustness Tests

Robustness checks need to be done to see if the regression estimation result using the value-weighted method is consistent with the different techniques. We conduct two robustness tests. First, we employ the equally-weighted method in calculating the asset pricing factors and excess stock returns of the 25 Size-B/M portfolios. Second, we address the impact of the 2007-2009 financial crisis on the two empirical models. We construct a dummy variable *Crisis* which equals one during the 2007-2009 period and zero otherwise.

8. Results and Discussion

8.1. Summary statistics

The statistical summary for each independent variable (asset pricing factor) during the period of July 2005 - June 2015 (120 observations) is presented in Table 1. The monthly average of market factor (R_m - R_f) is 0.69%, the average of the size factor (SMB) is 0.06% per month, and the average of the book-to-market (HML) factor per month is 0.01%. All factors have positive average values. It means that that the market, size, and book-to-market factors have the premium to compensate for risk.

The correlation between factors is shown in Table 2. The size factor is negatively correlated with the market factor, while the book-to-market factor is positively correlated with the market factor. The book-to-market factor is negatively correlated with the size factor.

TABLE 1: Summary statistics for monthly factor percent returns.

	$R_m - R_f$	SMB	HML
Mean	0.69	0.06	0.01
Median	1.33	0.04	0.01
Maximum	19.37	1.40	3.90
Minimum	-32.19	-0.72	-1.50
Std. dev.	6.42	0.28	0.56

TABLE 2: Correlation between asset pricing factors.

	$R_m - R_f$	SMB	HML
$R_m - R_f$	1	-0.25	0.14
SMB	-0.25	1	-0.56
HML	0.14	-0.56	1

Table 3 shows the average monthly excess return (the excess return of the Bank Indonesia Certificates monthly interest rate) for a 25 value-weighted portfolio of independently sorted of stocks into 5 Size groups and 5 Book-to-Market groups (B/M). In each of the B/M columns of Table 4.3, the average excess return decreases from the stocks in the small market capitalization group to the stocks in the large market capitalization group. This result shows the size effect. The average relationship of return with B/M, called the value effect, is only indicated by stocks in the Size 4 group where the average excess return increases from 0.22% to 0.83%. The value effect is found to be inconsistent with the size effect.

TABLE 3: Average monthly percent excess returns for 25 Size-B/M portfolios.

Average Excess Return					
	Low	2	3	4	5
Small	2.60	1.41	0.72	0.52	0.24
2	0.92	1.31	0.28	0.31	0.48
3	0.58	0.53	0.48	0.42	0.33
4	0.22	0.32	0.31	0.43	0.83
Big	0.10	0.19	0.31	0.60	-0.18

8.2. Regression results for the CAPM

The regression estimation results for the CAPM and the Fama-French three-factor model are shown in Table 4. Panel A describes the regression results for the CAPM. There are twenty statistically significant intercepts, while five intercepts are insignificant. These findings indicate that the CAPM cannot account for all the variations in

the excess return of the stock portfolio. In other words, there are other factors to consider in determining the right asset pricing model for the Indonesian stock market. An interesting finding is that the intercept of a large-capitalized portfolio of stocks is almost insignificant, indicating that large-cap stocks can better explain the excess return portfolio than small capitalized stocks.

All coefficients of market factors are positive, which indicate that market factors have a positive effect on the excess return of the stock portfolios. There are only two coefficients of the insignificant market factor. Market factors can capture almost all the variations of excess return of stock portfolios in Indonesia. The coefficients of market factors tend to be smaller for smaller capitalized stocks.

The adjusted values of the R^2 range from 1% to 83%. The average adjusted R^2 value for the CAPM is 18%. GRS statistics are significant at 1% level, indicating that 25 intercepts simultaneously are not equal to zero. The Sharpe ratio for the CAPM is 1.36. The average absolute values of the intercept and the average standard error of intercepts are 0.53 and 0.29, respectively.

8.3. Regression results for the Fama-french three-factor model

Panel B of Table 4 displays the regression results for the Fama-French three-factor model. There are eighteen statistically significant intercepts, while the remainder (seven intercepts) are insignificant. This result is not in line with Merton's criterion (1973), where most of the intercept of 25 portfolios are significant. The Fama-French three-factor model cannot capture all the variations of the excess return of the stock portfolio.

All coefficients of market factors are positive, indicating that market factors have the positive effect on the excess return of stock portfolios. There are only three coefficients of insignificant market factors. That is, market factors can capture almost all variations of excess return on the stock portfolios. The coefficient of market factors tends to be smaller for smaller capitalized stocks. This finding is consistent with Halliwell et al. (1999) but inconsistent with Fama and French (1993).

This study finds eleven coefficients of size factor (SMB) are statistically significant, either at the level of 1%, 5%, or 10%. That is, almost half of the SMB coefficients on the Size-B/M 25 portfolios can explain the excess return on the stock portfolios. There is no apparent pattern that can be observed from the SMB coefficients.

There are eleven coefficients of the book-to-market factor (HML) that are statistically significant. This result indicates that the HML factor can explain the excess

return on the stock portfolio almost half of the 25 Size-B/M portfolios. Similar to the coefficient of SMB, there is no clear pattern of observable HML coefficients.

The adjusted values of the R^2 range from 1% to 82%. The average adjusted R^2 for the Fama-French three-factor model is 26%. GRS statistics are significant at the 1% level, which indicates that the intercepts simultaneously are not equal to zero. Sharpe ratio for the Fama-French three-factor model is 1.33. The average absolute values of the intercept and the average standard errors of intercepts are 0.43 and 0.25, respectively.

8.4. Comparison of asset pricing models

As shown in Table 4, the average adjusted R^2 value for the Fama-French three-factor model is higher than the CAPM. This result supports the superiority of the Fama-French three-factor model. The average absolute value of the intercept and the average standard error of intercepts for the Fama-French three-factor model are lower than the CAPM. This finding also supports the superiority of the Fama-French three-factor model. When referring to GRS statistic, both models produce F-statistic which is significant at 1% level. However, the GRS statistic value for the Fama-French three-factor model is smaller than the CAPM, which may be interpreted that the Fama-French three-factor model performs better than the CAPM. The Sharpe ratio for the Fama-French three-factor model is lower than the CAPM, where these findings confirm the superiority of the Fama-French three-factor model compared with the CAPM. Overall, the results of this study prove that the Fama-French three-factor model is better than the CAPM in explaining the variation of excess return of stock portfolios in Indonesia.

8.5. Robustness tests

The first robustness check is the use of the equally-weighted method in calculating the asset pricing factors and excess return of 25 Size-B/M portfolios. Table 5 shows that the regression results using the equally-weighted method remain consistent with the main regression results. We further investigate whether the main regression results are altered by including a dummy variable *Crisis* into the two empirical models. As presented in Table 6, the performance of two asset pricing models is not impacted by the global financial crisis.

9. Conclusions

The findings show that the Fama-French three-factor model is better in explaining the excess return of stock portfolios in Indonesia than the CAPM. This finding supports Fama and French (1993). This result is robust when tested using equally method in calculating asset pricing factor and excess return portfolio. Although the Fama-French three-factor model is superior to the CAPM, the results suggest that there are other factors to consider in determining asset pricing models that better capture stock return variations in the Indonesian stock market.

The implication of this study is that the investors need to consider the three-factors of Fama-French in their investment decisions. Additionally, the investors can evaluate other risk factors affecting the average returns in Indonesia to obtain the optimal return on their investment. Future studies may search for a better asset pricing model, especially in Indonesia. Another suggestion is the use of different techniques to compare asset pricing models.

TABLE 4: Regression results for the CAPM and the Fama-French three-factor model.

B/M →	Low	2		3	4	High
Panel A: CAPM						
			α			
Small	2.56*	1.33***		0.69***	0.50***	0.22***
2	0.81**	1.23**		0.24**	0.27***	0.43***
3	0.53**	0.48**		0.42**	0.38***	0.27***
4	0.16**	0.27***		0.27***	0.35**	0.69
Big	0.08***	0.09		0.14	0.07	-0.01
			b			
Small	0.05	0.11*		0.05	0.04*	0.04***
2	0.15*	0.11***		0.07***	0.06***	0.08***
3	0.08**	0.07***		0.08***	0.07***	0.08***
4	0.08***	0.07***		0.07***	0.11***	0.21**
Big	0.04***	0.14**		0.25***	0.78***	0.88***
Adj R^2	0.18	|α|	0.53			
GRS	6.98***	s(α)	0.29			
SR(α)	1.36					
Panel B: FF3						
			α			
Small	2.38*	0.88***		0.49**	0.37***	0.18***
2	0.64*	0.70**		0.17**	0.22***	0.27***
3	0.51**	0.40**		0.14	0.26***	0.14

B/M →	Low	2		3	4	High
4	0.12*	0.18***		0.26***	0.29**	0.54
Big	0.08***	0.07		0.2	-0.2	-1.1
			b			
Small	0.11	0.17*		0.08	0.05*	0.04***
2	0.19*	0.21***		0.08***	0.06***	0.10***
3	0.09***	0.07***		0.11***	0.08***	0.09***
4	0.09***	0.08***		0.07***	0.11***	0.14
Big	0.04***	0.15**		0.24***	0.78***	0.82***
			s			
Small	2.78	6.82		2.97	1.84*	0.59***
2	2.58**	8.07*		1.11**	0.65*	2.34*
3	0.24	1.18		4.22	1.7	1.97***
4	0.68*	1.29**		0.17	0.87*	2.2
Big	0	0.3		-0.9	4.02	4.71
			h			
Small	-2.37	1.13		0.44	0.63**	0.13
2	-0.51	-0.62		0.3	0.27**	1.00*
3	-0.54	0.84*		1.25	0.67**	0.75***
4	0.15	0.52**		0.17**	1.33***	7.84**
Big	0.01	-0.08		0.39	3.16	8.96***
Adj R^2	0.26	$|\alpha|$	0.43			
GRS	6.09***	$s(\alpha)$	0.25			
SR(α)	1.33					

α is the regression intercept, while b, s, and h are the market (R_m - R_f), size (SMB), and value (HML) slopes, respectively. Adj R^2 is the average adjusted R^2, GRS is the GRS statistic, SR(α) is the Sharpe ratio for the intercepts, $|\alpha|$ is the average absolute value of the intercepts, and $s(\alpha)$ is the average standard error of the intercepts. The intercepts are expressed in percent. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

TABLE 5: Equally-weighted method Table 6 Impact of the global financial crisis.

	Adj R^2	GRS	SR(α)	$|\alpha|$	$s(\alpha)$
CAPM	0.23	4.64***	0.88	0.47	0.61
FF3	0.35	4.16***	0.69	0.41	0.53
	Adj R^2	GRS	SR(α)	$|\alpha|$	$s(\alpha)$
CAPM	0.19	6.77***	1.39	0.54	0.31
FF3	0.27	6.11***	1.34	0.45	0.27

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