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Implementation of Capm, Fama-French Three-Factor, and Five-Factor in Indonesia Stock Exchange and Cement Industry Sector

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ABSTRACT

Weighting Average Cost of Capital (WACC) plays a critical role as a discounting factor of the corporate valuation process's estimated future free cash flow by highly influencing the valuation process. It consists of three components, namely cost of debt, cost of equity, and proportion of capital structure. Costs of debt and capital structure are easily calculated due to data stability and less volatility. Meanwhile, the cost of equity is difficult to determine due to assumption, the period taken, the method applied, and complexity. Many assets pricing methods are used to determine the required rate of return in equity, namely CAPM, Fama French Three-Factor (FF3F), and Fama French Five-Factor (FF5F). These three asset pricing models are used to determine the models with strong explanatory factors on equity return to portfolios developed from sorting FF5F factors and individual equity of four cement companies publicly listed in the Indonesia Stock Exchange (IDX).

Keywords: Valuation, WACC, Cost of Equity, CAPM, Fama-French Three Factors, Fama-French Five Factors
JEL Classifications: D46, D53

1. INTRODUCTION

The Weighting Average Cost of Capital (WACC) is a critical part of the Discounted Cash Flow valuation process. It is described as a company's discounting factor for a stream of projected future free cash flow, which directly influences the valuation result. WACC consist of the cost of debt, cost of equity, and weight based on a firm's capital structure. Costs of debt and capital structure are easily determined due to data availability and less volatility. In contrast, the cost of equity Ri is more difficult because of the selection and application of various options or methods. Besides, it is commonly calculated by using the Asset Pricing Theory.

The CAPM model initially used to determine the return of equity was proposed by Sharpe (1964), Lintner (1965), and Mossin (1966). Then many modified models were introduced to provide better asset pricing model. The most widely used was Three Factors Model by Fama and French (1992) by adding 2 factors, namely the size and price to book ratio to cover its weaknesses. The proposed model is known as the three-factor (FF3F), comprising of SMB (Small Minus Big) and HML (High Minus Low). Fama French (2015) improved the modeling of Asset Pricing by designing a five-factor model (FF5F) with 2 additional attributes, namely the Profitability and Investment Factors.

Several studies have been carried out to investigate the capability and validity of the asset pricing models application in many countries. These models were testing and comparing to obtain the most suitable procedure used to calculate the expected return on equity, E(Ri), representing its cost. The most widely used methods are Capital Asset Pricing Model (CAPM), Fama and French Three Factors Model (FF3F), and Fama and French Five Factors Model (FF5F). Satrio (2015), and Karp and Van Vuuren (2017), compared the performance of the CAPM and Fama French Three-Factor

(FF3F) Model. It was concluded that FF3F outperforms CAPM, and these studies were carried out using Indonesian and South African stock exchanges, respectively.

Sutrisno and Ekaputra (2016) compared the Fama-French three-factor (FF3F) and five-factor (FF5F) effects on the Indonesia Stock Exchange (IDX). Conversely, Jiao and Lilti (2017) conducted a similar study in the Chinese A-share stock market and obtained a similar result. In Indonesia, FF5F was discovered to be slightly better than FF3F in explaining the excess return of stock portfolios. However, in China, it does not properly explain the average excess stock returns compared to FF3F. Based on both studies, it was discovered that profitability and investment factors have a weak effect on excess return.

Erdinc (2018) analyzed the Turkish Stock Exchange using the 3 models, namely CAPM, FF3F, and FF5F. It was concluded that the FF5F model has better performance than others. Djamaluddin et al. (2017) conducted study on member LQ-45 companies in the Indonesian Stock Exchange and obtained similar results. Sembiring (2018) carried out a study on the Indonesian Stock Exchange and market overreaction under special conditions and discovered that FF3F is better than FF5F in explaining the excess return.

In accordance with previous studies, the effect of asset pricing models is differentiated based on time, places, and samples. This study investigated the implementation and comparison of the 3 asset pricing models in the Indonesian Stock Exchange and the cement industry.

2. LITERATURE REVIEW

The asset pricing model plays a critical role in company valuation through WACC, regarded as a discounted factor in DCF, of which return on equity is one of its components. This is realized through several methods, besides, Damodaran (2006) proposed 3 approaches, first is the Discounted Cash Flow (DCF), where the value of firm is the present value (PV, Present Value) of the projected cash flows in the future. Second is the relative valuation approach which estimates an asset's value by comparing its price with a common variable such as income, cash flow, book value, or sales. The third valuations of contingent claims use the option pricing model to measure the value of assets with similar characteristics.

Weighting Average Cost of Capital (WACC), simply known as cost of capital, used as discounting factor stream free cash flow projection (n periods). Subsequently, when the result was combined with the present terminal value (n+1), the company value was realized. WACC is calculated using the following mathematical equation

$$WACC = \left(\left(\frac{d}{d+e}\right).k_d\right)(1-t) + \left(\left(\frac{e}{d+e}\right).k_e\right) \quad (1)$$

Where
d=total debt
e =total equity
kd =Cost of debt
t=tax rate
ke=Cost of equity

WACC is calculated by obtaining the values of its components, such as cost and weight of debt and equity. Cost of debt, k_d is determined by dividing the yearly interest expense by the interest-bearing debt. This calculation is applied when historical data serves as a basis for forecasting and calculating the cost of debt alternatively in accordance with risk-free rate plus a spread. This is determined by the lender, based on the risk assessed toward each company. The weight of debt or equity is calculated in accordance with the portion of either of these two divided by the total employed capital. In this study, the cost of equity was determined with 3 methods, namely CAPM, FF3F, and FF5F.

The CAPM proposed by Sharpe (1964) and modified by Mossin (1965) and Lintner (1966) is stated as follows.

$$E(R_{it}) = Rf_t + \beta_i\,(E(Rm_{t)} - Rf_t)) \quad (2)$$

In 1992 Fama and French added 2 factors, namely size and price to book ratio factors, to cover the weakness of this model. Furthermore, it is also known as the 3-factor model designed by Fama and French. These two factors, namely SMB (Small Minus Big) and HML (High Minus Low), were included in the CAPM model. The mathematical equation is stated as follows

$$E(R_{it}) - R_{ft} = a_i + b_i\,(E(R_{mt}) - R_{ft}) + s_i SMBt + h_i HMLt + e_{it} \quad (3)$$

Fama French (2015) improved the modeling of Asset Pricing using a five-factor model with 2 additional factors, namely the Profitability and Investment Factors.

This method was introduced using the following mathematical equation:

$$R_{it} - R_{ft} = a_i + b_i\,(R_{mt} - R_{ft}) + s_i SMBt + h_i HMLt + r_i RMW_t + ciCMAt + e_{it} \quad (4)$$

Where
R_{it}: Return on security or portfolio i in period t,
R_{ft}: Risk-free rate in period t,
R_{mt}: Return on the market portfolio in period t,
SMB_t: Size Factor (Small Minus Big) in period t,
HML_t: Book to-market (High Minus Low) in period t,
RMW_t: Profitability factor (Robust Minus Weak) in period t,
CMA_t: Investment factor (Conservative Minus Aggressive) in period t,
e_{it}: Error term of security or portfolio i during period t.
a_i: Intercept
$b_{i,}$ $s_{i,}$ $h_{i,}$ $_{RI,}$ c_i: Coefficient of factors.

3. METHODS

The 3 methods were tested to ascertain the regression of the portfolio and equity toward the asset pricing model factors. The dependent variable is the excess return of portfolio or

equity *i* in time *t* (R_{it}-RFT). Meanwhile, the independent ones are factors of CAPM, FF3F, and FF5F. Several statistical tests were conducted to ensure that the regression process results are BLUE (Best Linear Unbiased Estimation). This aimed to ascertain that the regression model does not have stationarity, multicollinearity, heteroscedasticity, or autocorrelation-related problems. The existence of these 4 problems led to inaccurate and biased processes. According to Juanda (2009), the problem of heteroscedasticity is determined using the Weighted Least Square Method. Presently, the development of computing technology has made it easier for all these problems to be detected by various statistical applications in computer programs.

The Fischer Phillip Peron test was used to analyze the problem of non-stationary data for each independent and dependent variable. Meanwhile, the Variance Inflation Factors (VIF) method was adopted to determine the existence of multicollinearity between the independent variables. However, assuming it is detected, several procedures that aids to overcome it are recommended (Juanda, 2009) including utilizing previous information to either add or remove independent variables, exclude those with high collinearity, perform transformations with the first form of differentiation for time series data, and including new ones, as well as using the principal component regression.

The heteroscedasticity problem is tested using several methods, namely the Breusch-Pagan-Godfrey, Goldfeld-Quandt, and the White tests. In accordance with this study, the Breusch-Pagan-Godfrey method was adopted by considering a large amount of data and was reported to be better than the other 2. The Durbin Watson test was used to detect the autocorrelation problem, and when detected, the regression analysis was performed using the Newey-West method.

Approximately 3 methods were used to perform the regression process, namely the Common Effect (CE), the Fixed Effect (FE), and the Random Effect (RE). The best method for this analysis is determined by comparison. Chow, Hausman, and Lagrange Multiplier tests were used to compare CE and FE, FE and RE, and CE and RE, respectively.

In order to determine whether the factors added to either FF3F or FF5F are redundant, a spanning factor test as used by Fama and French (2017) was adopted. Subsequently, a spanning factor test involving where one factor is regressed with others was performed. However, the test was unable to be performed due to the fact that only 1 factor is involved in the CAPM method. The FF3F method was carried out by alternately regressing 1 factor against the other 2. Similarly, for the FF5F, 1 factor is regressed against the other 4 and comparisons were made by regressing various portfolios that cover all sorts of stocks, listed on the IDX.

In this study, stock samples consisted of all stock in IDX excluding those of finance companies and banks, illiquid or non-moving stocks, stocks of negative Book to Market Companies, and ROE. Fortunately, 312 stocks met the qualifications out of a total of 625 listed in IDX. Sorting of stocks was developed based on Size-B/M, Size-OP, and Size-Inv, thereby leading to the generation of 18 portfolios. Meanwhile, its excess return was regressed to one of the factors in CAPM, FF3F, and FF5F. The result of the analyzed regression model to determine which asset pricing model involved the use of IDX for a certain duration, in this case, it is the study period.

Excess return on individual equity, from cement companies (SMGR, INTP, SMCB, and SMBR), to the CAPM, FF3F, and FF5F factors were analyzed to determine the most suitable model to be applied. The strong relations between the excess return in equity, dependent and independent variables, consisting of CAPM, FF3F, and FF5F factors had similar regression analysis results compared to the excess return of portfolios previously explained.

4. RESULTS

4.1. Spanning Factor Test

The regression results in Table 1, shows that the HML has the closest intercept value to zero. This means that HML can be fully explained by both independent variables and other factors, such as Rm-Rf and SMB. Furthermore, it indicates that HML was redundant in terms of explaining the rate of return of an equity or portfolio in the study period taken. Similarly, this is also proven by a t-statistic of −0.9648 which is less than the t-table of 1.9935 and this simply indicates that the intercept is insignificant in the HML regression. Meanwhile, for the t-statistic values of Rm-Rf and SMB both showed significant intercepts in the regression process of the spanning factors test. Based on the test results, the addition of 2 factors from CAPM to FF3F proved that the HML is redundant, while the SMB is less redundant because the intercept is relatively far from zero.

Intercepts in the Rm-Rf regression analysis of the other 2 independent variables shows an extremely high value compared to those of SMB and HML, either individually or combined. This shows that Rm-Rf is the dominant factor in the FF3F method, therefore, the study on IDX carried out from 2014 to 2020, shows that the addition of 2 factors, namely SMB and HML to this model does not add significant explanatory abilities compared to the CAPM.

Table 2 shows result for FF5F model that the intercept value of the HML regression for the other 4 factors is much lower than the others and this indicates that it is redundant. This shows that the study carried out on the Indonesian Stock Exchange (IDX) is

Table 1: Spanning factors test for FF3F model

Methods		FF3F				
Portfolio\ Factors		α	Rm-Rf	SMB	HML	R^2
FF3F	Rm-Rf					
	Coefficient	−0.0552		−0.3897	0.0426	0.1530
	t-stat	−12.0482		−2.7171	0.4769	
	SMB					
	Coefficient	−0.0158	−0.2480		−0.2871	0.3302
	t-stat	−2.5681	−2.7171		−4.5919	
	HML					
	Coefficient	−0.0104	0.0771	−0.8153		0.2610
	t-stat	−0.9648	0.4769	−4.5919		

consistent with that performed by Fama and French (2015; 2017). The RMW and CMA factors shows the lowest intercept values, although, this is 10 times more than that of the HML. The t-statistic also shows that only Rm-Rf and SMB had values greater than the t-table (df=67, α=0.05 t_{table}=1.998) while HML, RMW, and CMA are insignificant because their values are less than the t-table.

4.2. Portfolio Regression on CAPM, FF3F, dan FF5F

Tables 3-5 show the results of 18 portfolios regressed against 3 factors of the asset pricing models, namely CAPM, FF3F, and FF5F. The entire portfolio was all grouped into 3, namely Size-BM, Size-OP, and Size-Inv. Size-BM is grouped on the basis of variations in the company size (small or big) of market capitalization, and in the ratio of book to market value (high, neutral, or low). In addition, 6 portfolios were included in this group. Size-OP has 6 portfolios classified based on size (small or big) and profitability (robust or weak) variations. On the contrary, Size-Inv also has 6 portfolios grouped based on the combination of size variations and the amount of investment made by the company (conservative or aggressive).

Table 3 shows that 6 of the portfolios were realized due to a combination of company size in terms of market capitalization, and the book and market values ratio stated as follows.

- FF3F is a better model for combining variations in stock sizes and the ratio of book to market value (Size-BM). This was discovered in the small size (market capitalization) companies and all (high, medium, and low) BM firms.
- Big market capitalization companies with low BM show similar results with small-cap firms, and it was also proven that FF3F is the best model. Meanwhile, for big caps with medium and high BMs, FF5F is the most appropriate model.
- The larger the market capitalization, the lower the ratio of market to book values, and the higher the ability of the factors to explain portfolio returns.
- For the Size-BM portfolio group, companies with large market capitalization or big cap ones and medium market to book value ratios shows that the factors in all models, namely CAPM, FF3F and FF5F clearly explained the portfolio returns, irrespective of the fact that FF5F has been proven to be the best.

The findings from the analysis of Table 4 show that 6 portfolios were obtained due to the combination of varying company sizes in terms of market capitalization and Profitability (High, Medium, and Low) stated as follows

- FF5F has been proven to be the best by all 6 Size-OP regressions compared to CAPM and FF3F.

Table 2: Spanning factors test for FF5F model

Methods		FF5F						
Portfolio\Factors		α	Rm-Rf	SMB	HML	RMW	CMA	R^2
FF5F	Rm-Rf							
	Coefficient	−0.05		−0.51	0.12	−−0.06	0.03	0.20
	t-stat	−12.14		−3.74	1.61	−0.64	0.70	
	SMB							
	Coefficient	−0.02	−0.34		−0.02	0.08	0.08	0.25
	t-stat	−2.74	−3.74		−0.37	1.12	2.35	
	HML							
	Coefficient	0.00	0.31	−0.09		0.00	−0.11	0.05
	t-stat	0.04	1.61	−0.37		0.03	−1.55	
	RMW							
	Coefficient	−0.01	−0.11	0.23	0.00		0.00	−0.01
	t-stat	−0.49	−0.64	1.12	0.03		−0.01	
	CMA							
	Coefficient	0.01	0.23	0.90	−0.31	0.00		0.07
	t-stat	0.36	0.70	2.35	−1.55	−0.01		

Table 3: Regression of portfolio toward factors on CAPM, FF3F, and FF5F for a group of portfolio Size-BM

Asset Pricing Method		CAPM			FF3F					FF5F						
Portfolio/ Factors		α	Rm-Rf	adj. R^2	α	Rm-Rf	SMB	HML	adj. R^2	α	Rm-Rf	SMB	HML	RMW	CMA	adj. R^2
Size-BM	S/L	−0.008	0.743	0.186	0.006	1.120	0.821	−0.238	0.465	−0.005	0.959	0.295	−0.508	−0.270	−0.133	0.388
	t-stat	−0.660	4.150		0.595	7.101	4.156	−2.030		−0.436	5.377	1.357	−4.525	−2.067	−1.989	
	SNbm	−0.012	0.640	0.242	−0.003	0.737	0.636	0.348	0.395	−0.005	0.748	0.578	0.170	−0.187	−0.070	0.366
	t-stat	−1.354	4.864		−0.337	5.774	3.974	3.667		−0.529	5.412	3.432	1.957	−1.840	−1.343	
	SH	−0.016	0.712	0.341	−0.007	0.746	0.619	0.505	0.626	−0.012	0.680	0.248	0.342	−0.019	0.002	0.486
	t-stat	−1.924	6.146		−1.066	7.865	5.207	7.158		−1.611	5.780	1.729	4.614	−0.224	0.053	
	BL	−0.003	0.673	0.367	−0.010	0.633	−0.512	−0.384	0.569	−0.009	0.615	−0.403	−0.235	−0.026	0.068	0.513
	t-stat	−0.421	6.500		−1.663	6.809	−4.398	−5.558		−1.378	5.884	−3.161	−3.569	−0.337	1.743	
	BNbm	0.006	1.046	0.677	0.004	0.964	−0.101	0.127	0.703	−0.001	0.846	−0.325	0.165	−0.174	0.079	0.774
	t-stat	1.072	12.250		0.715	10.831	−0.907	1.915		−0.188	10.288	−3.243	3.191	−2.883	2.568	
	BH	0.011	1.434	0.383	0.003	1.006	−0.310	0.873	0.743	−0.002	0.894	−0.355	0.916	−0.277	−0.067	0.778
	t-stat	0.722	6.710		0.270	6.710	−1.652	7.827		−0.219	6.064	−1.977	9.868	−2.561	−1.215	
	adj.R^2			0.366					0.584							0.551

Table 4: Regression of portfolio toward factors on CAPM, FF3F, and FF5F for a group of portfolio Size-OP

Asset Pricing Method		CAPM			FF3F					FF5F						
Portfolios/ Factors		α	Rm-Rf	adj. R^2	α	Rm-Rf	SMB	HML	adj. R^2	α	Rm-Rf	SMB	HML	RMW	CMA	adj. R^2
Size-OP	SR	−0.013	0.644	0.152	0.000	0.809	0.861	0.380	0.307	−0.002	0.830	0.383	0.136	0.532	−0.063	0.343
	t-stat	−1.075	3.707		0.015	4.740	4.026	2.999		−0.178	4.719	1.787	1.231	4.128	−0.961	
	SNrmw	−0.007	0.783	0.258	−0.005	0.691	0.203	0.450	0.387	−0.008	0.639	0.214	0.390	−0.407	−0.029	0.472
	t-stat	−0.610	5.073		−0.452	4.528	1.060	3.969		−0.826	4.266	1.173	4.136	−3.705	−0.510	
	SW	0.005	0.980	0.306	0.014	1.066	0.628	0.370	0.383	0.009	1.002	0.592	0.194	−0.627	−0.060	0.523
	t-stat	0.418	5.680		1.209	6.035	2.835	2.813		0.836	6.094	2.952	1.879	−5.202	−0.970	
	BR	0.013	1.143	0.728	0.012	1.086	−0.014	0.142	0.745	0.010	1.039	−0.193	0.165	0.067	0.078	0.765
	t-stat	2.248	13.833		2.097	12.497	−0.133	2.199		1.801	11.773	−1.798	2.962	1.029	2.370	
	BNrmw	0.024	1.278	0.560	0.019	1.098	−0.277	0.225	0.629	0.010	0.902	−0.670	0.292	−0.144	0.068	0.709
	t-stat	2.603	9.556		2.108	8.232	−1.655	2.271		1.271	7.211	−4.396	3.704	−1.572	1.452	
	BW	0.014	1.193	0.361	0.012	1.131	−0.089	0.083	0.350	−0.001	0.867	−0.402	0.106	−0.774	0.075	0.615
	t-stat	1.055	6.416		0.870	5.552	−0.348	0.546		−0.059	5.226	−1.989	1.019	−6.367	1.204	
Adj.R^2 (Average)				0.394					0.467							0.571

Table 5: Regression of portfolio toward factors on CAPM, FF3F, and FF5F for a group of portfolios Size-INV

Asset Pricing Method		CAPM			FF3F					FF5F						
Portfolio/ Factor		A	RM-RF	ADJ. R^2	A	RM-RF	SMB	HML	ADJ. R^2	A	RM-RF	SMB	HML	RMW	CMA	ADJ. R^2
Size-INV	SC	−0.006	0.552	0.005	−0.012	0.524	−0.427	−0.338	−0.012	0.029	1.213	1.419	0.334	−0.342	1.318	0.815
	Tt-stat	−0.179	1.153		−0.342	1.000	−0.650	−0.866		1.919	5.110	4.906	2.237	−1.966	14.827	
	SNinv	−0.006	0.821	0.152	0.003	0.783	0.685	0.765	0.355	−0.003	0.718	0.411	0.603	−0.263	0.042	0.319
	St-stat	−0.416	3.701		0.183	3.728	2.602	4.893		−0.191	3.143	1.476	4.196	−1.571	0.488	
	SA	−0.005	0.802	0.230	0.003	0.799	0.546	0.536	0.383	0.001	0.822	0.624	0.329	−0.250	−0.228	0.478
	S t-stat	−0.390	4.718		0.252	4.833	2.635	4.361		0.117	5.107	3.181	3.249	−2.118	−3.786	
	BC	−0.001	0.927	0.146	0.001	0.938	0.114	0.079	0.123	−0.019	0.509	−1.160	0.139	−0.108	0.435	0.370
	tt-stat	−0.052	3.620		0.039	3.328	0.322	0.375		−1.193	2.014	−3.764	0.872	−0.584	4.599	
	BNinv	0.017	1.311	0.680	0.014	1.167	−0.142	0.258	0.749	0.008	1.038	−0.364	0.299	−0.196	0.062	0.798
	B t-stat	2.267	12.317		1.978	11.393	−1.102	3.379		1.263	10.698	−3.080	4.894	−2.749	1.715	
	BA	0.018	1.136	0.569	0.014	1.022	−0.207	0.113	0.594	0.009	0.900	−0.364	0.144	−0.201	−0.019	0.648
	tt-stat	2.211	9.725		1.713	8.302	−1.342	1.235		1.115	7.422	−2.463	1.886	−2.255	−0.417	
adj.R^2 (Average)				0.297					0.365							0.571

- Big cap companies have factors in CAPM, FF3F, and FF5F that are more capable of explaining the portfolio return than small-cap firms.
- In the Size-OP portfolio group, big-cap companies with robust profits have factors in CAPM, FF3F, and FF5F that are capable of clearly explaining the portfolio returns.
- Among small-cap companies, those with robust profitability have the least explanation power for portfolio regression. Meanwhile, a big cap with robust profitability has the highest explanation power among such firms.

Based on Table 5, the analysis of 6 portfolios Size-Inv are as follows

- In the Size-Inv group, a strong relationship exists between 3 factors and the BNinv portfolio, which consisted of big-cap companies with a moderate annual increase in investment.
- FF5F has the best capability to explain portfolios returns compared to CAPM and FF5F.
- Small caps with conservative investment (SC) exhibit the highest strength in explaining return on the portfolio in FF5F, on the contrary, it had the least strength in CAPM and FF3F.

Tables 3-5 show that FF5F was the most appropriate model applied in the IDX in determining the portfolio return. This is because a strong relationship exists between the factors and portfolios of the 2 groups, namely Size-OP and Size-Inv, although for Size_BM, it was proven that the FF3F is the most appropriate model. Meanwhile, the CAPM is the weakest in terms of the independent variable or factor's ability to explain the portfolio return in the 3 groups. For t-statistics indicate that the Market Premium Risk Factor (Rm-Rf) is the most important variable in determining the return of the portfolio. This is in accordance with the exceptions of BH in the Size-BM group, which shows that HML is more significant than Rm-Rf in both FF3F and FF5F. It simply means that the return is highly influenced by the ratio of book to market values in big-cap companies. The large companies (big caps)

with relatively low profits (BW) show that profitability is more decisive on portfolio returns than market factors. The group of small companies with medium investment growth (SNinv) returns implies that it is influenced by the ratio of book to market value than by its associated factors. Meanwhile, the large group of companies with low investment levels determined by the FF5F model shows that the level of portfolio return is influenced by the amount of reinvestment and the industry's size compared to market factors.

By referring to the analysis of Tables 3-5, the asset pricing model that is most suitable for the Indonesian stock market is the FF5F. It was selected based on the fact that the 2 portfolio groups, namely Size-OP and Size-INV, were used to determine that it was the best. The Size-BM group was used to prove that the FF3F model is the best in determining portfolio returns. This is because FF5F has no perfect superiority compared to the others, especially FF3F. However, these 3 models were used and analyzed in the subsequent stage.

The next phase is the study on individual equity, which involves each of the 4 cement manufacturing companies and not their portfolios (groups). A regression of the individual firms (Ri) was carried out and further analyzed and compared. Subsequently, regression analysis was carried out on the 3 asset pricing models, namely CAPM, FF3F, and FF5F.

4.3. Regression on Equity return R_i

The cost of equity and debt needs to be calculated in determining the cost of capital. The cost of equity is usually obtained based on the return on equity (Ri). Meanwhile, the cost of debt is calculated in accordance with the interest costs incurred by the company compared to its average loan rate within a certain period. This is also determined based on the applicable loan interest rate.

Several ways can be used to calculate the value of Ri, although 3 of these approaches, namely CAPM, Fama and French 3-factor Method (FF3F), and Fama and French 5-Factor Method (FF5F), were evaluated and compared in this study. Therefore, it is hoped that Ri results are more reliable. The most suitable method is selected by regressing the premium rate of cement company equity (Ri-Rf) return to the factors in CAPM, FF3F, and FF5F.

Regression was carried out both on the dependent and independent variables from July 2014 to June 2020. Table 6 shows that 4 companies' return on equity premium was regressed against asset pricing factors regarded as the independent factors for the dependent variable. Meanwhile, several statistical tests were carried out as prerequisites to ensure that the regression model results were BLUE. Furthermore, the first test ensures the normality of the residuals, while testing on Eviews is carried out using the Jarque-Bera formula. This was carried out individually for each company, and the results are shown in Table 7.

Table 7 shows that only INTPs met the requirements of the normality tests and their residual values with Jarque-Bera value < 2 and probability > 0.05. Meanwhile, for the other 3 companies, the residual data was abnormal because when the size was analyzed, it was discovered that the SMCB had the most abnormal characteristics. This implies that SMCB stock price trend often shows extreme deviations from the market movements. A similar incident was recorded in the cases of SMBR and SMGR stocks on a smaller scale. The normality test is only aimed at regression models with a small amount of data.

Based on the normality test results, efforts are needed to normalize the residual data. One of the methods applied was to eliminate outliers during observation, besides several theories are related to the normality test. Pallant (2003; 2016), and Ghasemi et al. (2012), stated that the data size is large as >30 does not require a normality test. However, Gujarati (2004) did not specifically state that the data limit needs to be small. A sample size of less than 100 was emphasized, furthermore, the normality of the residual data is important, compared to large information. In this study, data were collected every month, thereby ascertaining that each independent variable was initially observed 72 times during the study. However, it was reduced to approximately 45 to 65 observational data per variable after cleaning the outlier data.

After filtering, the outlier data was removed, and the regression model was tested again, as shown in Table 8. It is evident that all regression models of equity met the normality rule. Heteroscedasticity, autocorrelation, and multicollinearity tests were also performed to ensure a valid result.

Overall, it was concluded that the FF5F model has factors that are able to explain the equity returns of the 4 cement companies than the FF3F and CAPM. This is indicated by its adj. R-square value, which is presumably higher than the other 2. However, for each company, different results were obtained, the adj. R-square of the CAPM was obtained to have the highest value, and this shows that the influence of Rm-Rf in this case, the market risk premium determines the return of the SMGR security stock. The factors added by Fama-French include firm size, the ratio of book to market value, profitability, and reinvestment, which are less influential. Interestingly, different attributes are found in both SMCB and INTP where the highest value of adj.R-square was determined in FF5F, which shows that the 4 factors added by Fama-French contributed to the risk-free return on the equity of the 2 companies. As for SMBR, the highest value of adj.R-square was realized in FF3F, indicating that the profitability and reinvestment rates of companies listed on the IDX have less influence on the risk-free rate of return for SMBR's security stock.

4.4. Analysis of FF5F Model by Company

Based on the regression analysis of various portfolios and the returns of the 4 companies on asset pricing factors, FF5F was considered the most appropriate model in this study. Therefore, a more detailed analysis of the Ri regression focusing on this model was carried out by comparing the results of the 4 companies.

Based on the results of data analysis shown in Table 9, it was concluded that

- For a good fit model, it is evident that the SMGR is most suitable and the least suitable is SMCB. Furthermore, when the Adjusted R Square value was carefully examined, it was

Table 6: Dependent and independent variables in equity regression of the factors

Dependent variables	Independent variables/Factors								
	CAPM	FF3F			FF5F				
$Ri\text{-}R_{fsmgr}$	Rm-Rf	Rm-Rf	SMB	HML	Rm-Rf	SMB	HML	RMW	CMA
$Ri\text{-}R_{fintp}$	Rm-Rf	Rm-Rf	SMB	HML	Rm-Rf	SMB	HML	RMW	CMA
$Ri\text{-}R_{fsmcb}$	Rm-Rf	Rm-Rf	SMB	HML	Rm-Rf	SMB	HML	RMW	CMA
$Ri\text{-}R_{fsmbr}$	Rm-Rf	Rm-Rf	SMB	HML	Rm-Rf	SMB	HML	RMW	CMA

Table 7: Normality test using Jarque-Bera formula

Asset Pricing Method		CAPM		FF3F		FF5F	
Portfolios/Factors		Jarque-Bera	Probability	Jarque-Bera	Probability	Jarque-Bera	Probability
Normality Test	Ri_SMGR	28.705	0.000	23.307	0.000	16.873	0.000
	Ri_INTP	0.760	0.684	1.507	0.471	1.256	0.534
	Ri_SMCB	546.429	0.000	508.081	0.000	557.590	0.000
	Ri_SMBR	78.978	0.000	93.133	0.000	42.381	0.000

Table 8: Normality test using Jarque-Bera formula (after outliers are removed)

Asset Pricing Method		CAPM		FF3F		FF5F	
Portfolios\Factors		Jarque-Bera	Probability	Jarque-Bera	Probability	Jarque-Bera	Probability
Normality Test	Ri_SMGR	1.317	0.518	2.403	0.301	0.622	0.733
	Ri_INTP	0.760	0.684	1.507	0.471	1.256	0.534
	Ri_SMCB	0.396	0.820	0.817	0.665	0.598	0.742
	Ri_SMBR	3.154	0.207	1.436	0.488	0.214	0.899

Table 9: Regression Ri of four companies to CAPM, FF3F, and FF5F factors

Asset Pricing Method	Portfolio/ Factors	Ri_ SMGR	Ri-SMGR t-stat	Ri_ INTP	Ri_INTP t-stat	Ri_ SMCB	Ri_SMCB t-stat	Ri_ SMBR	Ri_SMBR t-stat	adj.R^2 (Average)
CAPM	α	0.03	1.95	0.01	0.75	0.03	0.88	0.11	2.46	
	Rm-Rf	1.57	6.83	1.30	5.24	1.52	3.31	2.58	4.00	
	adj.R^2	0.39		0.27		0.12		0.17		0.24
FF3F	α	0.04	2.04	0.02	0.86	0.02	0.67	0.08	1.72	
	Rm-Rf	1.65	6.51	1.45	5.41	1.37	2.71	2.23	3.32	
	SMB	0.32	0.61	0.08	0.25	−0.31	−0.49	−2.19	−2.60	
	HML	−0.01	−0.06	−0.31	−1.55	0.11	0.30	−1.16	−2.32	
	adj.R^2	0.38		0.29		0.11		0.24		0.25
FF5F	α	0.04	2.30	0.02	1.17	0.02	0.44	0.06	1.31	
	Rm-Rf	1.77	6.63	1.57	5.57	1.20	2.24	1.63	2.44	
	SMB	0.55	1.69	0.34	0.99	−0.47	−0.72	−2.61	−3.20	
	HML	−0.07	−0.43	−0.34	−1.92	0.19	0.57	−0.57	−1.35	
	RMW	−0.15	−0.75	0.17	0.82	−0.45	−1.15	−1.19	−2.43	
	CMA	−0.09	−0.91	−0.07	−0.74	0.06	0.29	0.33	1.31	
	adj.R^2	0.39		0.29		0.10		0.33		0.28

discovered that the 4 companies had a value of <0.5 which means that the variation of the dependent variable is only less than 50% and is collectively explained by all the independent factors. Consequently, most of the variation causes in the dependent variable are unknown.

- The independent variables affect the premium rate of return on equity as the dependent, thereby indicating different conditions for each company. In SMGR, the dominant market premium variable determines the dependent factor with a coefficient value of 1.449509. At the same time, other attributes, namely SMB, HML, RMW, and CMA, have little or no effect because the coefficient is far below. This is in line with the findings obtained when comparing asset pricing models, where for SMGR, the use of the CAPM is better than the 2 Fama and French models, namely the three-factor and the five-factor models. Furthermore, the market risk premium has a significant effect on of equity risk, which shows that the JCI (IDX index) performance has a dominant influence on the stock price of SMGR.
- The independent variables in the FF5F model from INTP show that Market Risk Premium (Rm-Rf) has a dominant influence on the dependent factor, Return on Equity Premium (Ri-Rf). Conversely, the independent variables RMB and CMA are relatively small. At the same time, HML and SMB are bigger than the previous 2, although this is not too significant compared to the Market Risk Premium. It was concluded that for INTP, the JCI movement tends to affect its stock. This means that market performance significantly influences the performance of INTP shares.
- The FF5F model for SMCB shows that Market Risk Premium (Rm-Rf) has a significant influence on the dependent variable, Return on Equity Premium (Ri-Rf). On the contrary, 2 other independent variables, SMB and RMW, have a relatively insignificant effect on the dependent than Market Risk

Premium. Meanwhile, the independent variables HML and CMA have an insignificant effect on the dependent (Ri-Rf). Market performance has a large enough influence on the performance of SMCB shares, while the 3 attributes SMB, HML, and RMW combined have an insignificant influence over market factors.

- The FF5F model to determine SMBR shows that the independent variable SMB has a greater influence than the effect of the Market Risk Premium (Rm-Rf) on the dependent factor, namely Return on Equity Premium (Ri-Rf). Conversely, the independent variable RMW also has a greater influence than the Market Risk Premium (Rm-Rf). Furthermore, only CMA and HML had a relatively insignificant effect. Based on the regression results, it was concluded that the difference in returns between small and large-cap stocks is more influential on the return of SMBR stocks than the market factors. This was determined during the observation period that the stock price movement of SMBR is often not the same as that of the JCI.

4.5. Analysis of the Comparison Results of CAPM, FF3F, and FF5F Models

Based on various analyses involving the comparison of the 3 methods, several findings were obtained to select the most suitable procedure. The Spanning factor analysis was used to test for redundant factors added to the CAPM, FF3F, and FF5F. The test results show that the ratio of market to book value (HML) is redundant in explaining the risk-free rate of return of a portfolio on the Indonesia Stock Exchange. Meanwhile, the SMB factor in FF3F shows a larger intercept than HML, although it is much smaller than MRP (Market Risk Premium, Rm-Rf). In the FF5F test, it appears that the HML is consistently redundant where the intercept value is much lower than the others.

The FF5F model is better for portfolios when carrying out the analysis included in the combined groups such as firm size, profitability, and investment. However, the relationship between the factors in FF5F and the portfolio return is much stronger than the FF3F and CAPM models. In the portfolio, the combination of firm size and the ratio of market to book value, determined with the FF3F method, shows that it has a slightly stronger relationship than the FF5F.

In the equity test of the portfolio, it was determined that, on the average, FF5F shows better results than CAPM and FF3F. However, in this study, it is evident that each company shows different preferences for asset pricing models for individual equity levels. This tends to occur because when viewed from the shares' movement of each company, a different result was obtained. INTP has a slightly different movement from both the market and other factors. This is because its performance is based on organic growth. In addition, this is inconsistent with SMGR and SMCB where for SMGR there was an increase in stock prices whose pattern was quite different from the JCI due to their acquisition of SMCB, and this resulted in increased performances and values of the 2 companies although it did not last long with a relatively slight impact. In the SMBR case, movements that were entirely different from the market when a production capacity expansion plan were experienced, although, when the realization was not as expected, there was a correction.

Based on the comparison results of the asset pricing model, the required rate of return Ri was calculated using the five-factor method proposed by Fama and French (FF5F). However, by determining that the results were unclear, a more superior method was applied than the others. Subsequently, of the 4 companies studied, 2 showed different results, namely, SMGR was better with CAPM and SMBR was more in line with FF3F. Therefore, both of them still need to be used as comparisons for further analysis in the follow-up process.

The results of the Ri calculation are used to determine the weighted cost of capital (WACC). This is obtained by considering the average proportion of equity and debt for a certain period. Besides, the cost of equity is obtained from that of Ri, which is calculated using the FF5F method. Conversely, the cost of debt is obtained by calculating the company's interest. WACC is the discounting factor for free cash flow in the DCF valuation method.

5. CONCLUSION

In conclusion, the spanning factor test was employed to investigate whether any redundancies existed in FF3F and FF5F models. This involved the regression of 1 factor by the other 2 in FF3F and in FF5F, which was regressed by the other 4. In FF3F it was discovered that the intercept of HML as a redundancy factor was close to null. This means that its existence tends to be replaced by Rm-Rf, and SMB. The elimination of HML does not impact FF3F when applied in the Indonesian stock market, IDX. Market Risk Premium (Rm-Rf) was identified as the significant factor. SMB is relatively more significant than HML although, it is much less significant than MRP.

A similar result was discovered when the spanning factor test applied FF5F model, which ascertained that HML is a redundancy factor. It is based on the intercept value obtained as a result of the regression model. The significant factor is MRP (Rm-Rf) although, SMB is relatively more significant than RMW, CMA, and HML. In the t-statistic result, only 2 factors were categorized as significant, MRP and SMB.

The regression analysis results shown in Table 10 indicate that FF5F is the most suitable model that needs to be applied in the IDX in determining the portfolio return. Overall, it offers the strongest explanation power compared to CAPM and FF3F. Table 10 shows that the coefficient of determination (adj. R^2) was used to prove that FF5F has the highest value. A detailed explanation shows that all 3 groups have the highest value, the 2 Size-OP, and Size-Inv, which shows that FF5F was used to estimate the portfolio return appropriately. In another group, namely Size_BM, it shows that the FF3F model was the most appropriate.

Meanwhile, when the three models were applied to the 4 cement manufacturing companies, the regression analysis result shows that, in average, the FF5F is the best estimation model. However, the adj. R^2 value of 27% is relatively low until it is 30% which

Table 10: Comparison of coefficient of determination (adj. R^2) on portfolios regression in Indonesia Stock Exchange (IDX)

Group of Portfolios	CAPM	FF3F	FF5F
	adj.R^2	adj.R^2	adj.R^2
Size-BM	0.3661	0.5835	0.5509
Size-OP	0.3943	0.4669	0.5712
Size-Inv	0.2968	0.3652	0.5714
adj.R^2 (overall)	0.3524	0.4719	0.5645

Table 11: Comparison of coefficient of determination (adj. R^2) on equity regression on cement industry sector

Asset Pricing Method	CAPM	FF3F	FF5F
adj.R^2 (Average)	0.2670	0.2750	0.2968

simply means variation of return of security or equity is explained by factors with values less than 30%. Unfortunately, those related to other factors are not yet identifiable.

This study used 3 asset pricing models, namely CAPM, FF3F, and FF5F, to examine the Indonesia Stock Exchange (IDX) and cement industries. The result showed that the FF5F is the best model used to effectively explain return on portfolio and security, as shown in Tables 10 and 11. It also provides a better prediction of return on equity or portfolio compared to the FF3F and CAPM. But due to the relatively low coefficient of determination (adj.R^2) which is less than 57% in portfolio regression analysis and less than 30% in equity. The factors are not strong enough to explain the return on portfolio or security to improve the model. It was further suggested that the data acquisition period be extended, and additional or determinant factors be included in subsequent study.

REFERENCES

Damodaran, A. (2006), Damodaran on Valuation: Security Analysis for Investment and Corporate Finance. 2nd ed. New Jersey. John Wiley and Sons, Inc.

Damodaran, A. (2012), Investment Valuation: Tools and Techniques for Determining the Value of Any Asset. 3rd ed. Hoboken, New Jersey. John Wiley and Sons, Inc.

Djamaluddin, S., Rofii, A., Djumarno. (2017), Fama and French five-factors pricing model testing in Indonesia. International Journal of Business and Management Invention, 6(9), 75-90.

Erdinç, Y. (2018), Comparison of CAPM, three-factor Fama-French model and five-factor Fama-French model for the Turkish stock market. In: Financial Management from an Emerging Market Perspective. London: IntechOpen. p69-92.

Fama, E.F., French, K.R. (2015), A five factor asset pricing model. Journal of Financial Economic, 116, 1-22.

Fama, E.F., French, K.R. (2017), International test of a five factor asset pricing model. Journal of Financial Economics, 123, 441-463.

Gujarati, D.N. (2004), Basic Econometrics. 4th ed. New York: The McGraw-Hill Companies.

Indonesia Stock Exchange. (2020), IDX Stock Index Handbook. Indonesia: Indonesia Stock Exchange.

Jiao, W., Lilti, J.J. (2017), Wether profitability and investment factors have additional explanatory power comparing with Fama-French three factor model: Empirical model on Chinese a-share stock market. China Finance and Economic Review, 5, 7-14.

Juanda, B. (2009), Ekonometrika: Pemodelan dan Pendugaan. Bogor, Indonesia: IPB Press.

Karp, A., Van Vuuren, G. (2017), The capital asset pricing model and Fama-French three factor model in an emerging market environment. International Business and Economics Research Journal, 16(4), 231-256.

Lintner, J. (1965), Security prices, risk, and maximal gains from diversification. The Journal of Finance, 20(4), 587-615.

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.

Mossin, J. (1966), Equilibrium in a capital asset market. Econometrica, 34(4), 768-783.

Pallant, J. (2016), SPSS Survival Manual: A Step by Step Guide to Data Analysis Using IBM SPSS. 6th ed. New York: Open University Press, McGraw Hill Education. p227.

Satrio, A.B. (2015), CAPM and three factor model: Empirical testing from emerging market. Research Journal of Finance and Accounting, 6, 1-10.

Sembiring, F.M. (2018), Three-factor and five-factor models: implementation of Fama and French model on market overreaction conditions. Journal of Finance and Banking Review Review, 3(4), 77-83.

Sharpe, W.F. (1964), Capital asset prices: A theory of market equilibrium under conditions of risk. The Journal of Finance, 19(3), 425-442.

Sutrisno, B., Ekaputra, I.A. (2016), Uji Empiris model asset pricing lima-Faktor Fama-French di Indonesia. Jurnal Keuangan dan Perbankan, 20(3), 343-357.