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Empirical tests of the Fama-French five-factor model in Indonesia and Singapore

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Abstract: We examine the performance of the Fama-French three-factor (FF3) and five-factor (FF5) models in Indonesia and Singapore markets. We also investigate whether the book-to-market factor (HML) is redundant in both markets if profitability and investment factors are present. Different from previous studies, our empirical findings highlight that FF5 does not perform better than FF3 in explaining excess portfolio returns in both markets. Unlike the US market, we find that HML factor is not redundant in both markets. The results are robust for equally-weighted and value-weighted portfolios and also for various factor construction methods.

Keywords: asset pricing; five-factor; Indonesia; Singapore.

Reference to this paper should be made as follows: Ekaputra, I.A. and Sutrisno, B. (2020) 'Empirical tests of the Fama-French five-factor model in Indonesia and Singapore', *Afro-Asian J. Finance and Accounting*, Vol. 10, No. 1, pp.85–111.

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1 Introduction

Sharpe (1964), Lintner (1965), Mossin (1996) and Black et al. (1972) are the pioneers of the capital asset pricing model (CAPM). It has an essential contribution to the understanding of the risk and return relationship, both for academicians and practitioners. The systematic risk (beta) is the sole factor explaining the variation in stock returns. CAPM predicts that the expected return of a risky asset is positively related to beta.

Along with the development of the CAPM, other studies have found that other risk factors can explain stock returns other than market beta. Fama and French (1993) developed the three-factor asset pricing model. This three-factor model includes market factor (excess market return), size factor [small minus big (SMB)] and book-to-market factor [high minus low (HML)]. SMB is the return of small-stock portfolio minus the return of big-stock portfolio, while HML is the return of value-stock portfolio minus the return of growth-stock portfolio.

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

Following their three-factor model, Fama and French (2015) introduced a five-factor asset pricing model. The five-factor asset pricing model is motivated by the development of dividend discount model and previous empirical findings, that much of variation in average returns related to profitability and investment is left unexplained by the three-factor model. Hence, they augment two additional factors that can capture average returns: profitability and investment factors. Fama-French five-factor model takes the following form:

$$R_{it} - R_{ft} = a_i + b_i\left(R_{mt} - R_{ft}\right) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it} \quad (1)$$

where R_{it} is the return on security or portfolio i for period t, R_{ft} is the risk-free rate. The first three factors $R_{mt} - R_{ft}$, SMB_t and HML_t, are the market, size and value factors, respectively, introduced in Fama and French (1993). RMW_t is the return difference between diversified portfolios of stocks with robust and weak profitability, CMA_t is the return difference between diversified portfolios of stocks with low and high investment and e_{it} is the error term.

Fama and French (2015) find that the five-factor model performs better than the three-factor model in explaining average returns in the US market. They also conclude that the book-to-market factor becomes redundant in describing average returns in the presence of the profitability and investment factors.

Some studies investigate the performance of the Fama-French five-factor model in different countries. For instance, Nichol and Dowling (2014) provide evidence for the UK; Nguyen et al. (2015) offer evidence for Vietnam; Chiah et al. (2016) give evidence for Australia; Guo et al. (2017) test the model in China; and Kubota and Takehara (2018) examine the model in Japan. These studies overall find that the five-factor model performs better than the three-factor model in explaining average returns. Additionally, Fama and French (2017) offer the empirical evidence on the performance of the five-factor model in 23 developed markets. They find that the five-factor model is better than the three- and four-factor models in describing average returns. Furthermore, they also document that global models are inferior to local models.

As one of emerging countries in Asia, Indonesia operates one stock exchange which begins to grow among other Asian countries. The Indonesia stock exchange's market capitalisation is $431.81 billion as of March 2018. Unfortunately, Indonesia stock market is thinly traded, hence non-trading and non-synchronous trading problems tend to exist (Dimson, 1979; Lo and MacKinlay, 1990). On the other hand, Singapore stock market is more liquid than Indonesia. Total market capitalisation value of stocks listed on the Singapore exchange is $680.08 billion in March 2018. Although the two markets differ in size, they are both relatively small compared to other developed markets in terms of market capitalisation and number of listed stocks.

Prior studies that examine the performance of the Fama-French three- and five-factor asset pricing models are conducted in one country or a group of countries with the same characteristics. To the best of our knowledge, this study is the first to compare Fama-French models in two countries with different market development level within the same region, namely Indonesia and Singapore. This study sheds lights on the external validity of the Fama-French models in relatively small emerging and developed markets in Asia. As an emerging market, Indonesia has less liquidity and higher market volatility compared to Singapore. This study also investigates whether the book-to-market factor (HML) is redundant in describing average returns in both markets.

Different from previous studies in other countries, our main findings show that the five-factor model does not perform better than the three-factor model in explaining excess portfolio returns in both Indonesia and Singapore markets. Different from Fama and French (2015), we find that the book-to-market factor is not redundant when profitability and investment factors are included in the model. Our results are robust for value-weighted and equally-weighted portfolios and for various factor construction methods.

The remainder of this paper is organised as follows. Section 2 describes data and methodology. Section 3 presents and discusses the empirical results. Section 4 concludes the paper.

2 Data and methodology

2.1 Data

The data is obtained from the Datastream database. Our data source is not affected by the survivorship bias because the Datastream sample includes not only active firms but also dead firms (Cakici et al., 2013). The sample period is from July 2000 to June 2015. This study utilises closing price, the number of outstanding shares, stock price index, the book value of equity, risk-free rate, operating income, interest expense and total assets.

Following Fama and French (2015), we only include non-financial sector stocks as our sample. All stocks with a negative book value of equity are also omitted from the sample. Also, stocks must have data on operating income, interest expense and book value of equity in the previous year (t – 1). The selected stocks must also have data on total assets in year t – 2 and t – 1.

The number of stocks included in the sample differs between the two countries and it increases over time. In 2000 there are 118 stocks included from Indonesia and 165 stocks from Singapore. In 2014 there are 353 stocks included from Indonesia and 469 stocks from Singapore. The risk-free rates used in this study are monthly data of ninety days Sertifikat Bank Indonesia (SBI) for Indonesia and three-month treasury bill rate for Singapore.

2.2 Methodology

We conduct a time-series test to assess the performance of the Fama-French three- and five-factor models. We construct 25 portfolios using Indonesia and Singapore stock data for each year. We form three portfolios based on:

1 size and book-to-market ratio (Size-B/M)

2 size and operating profitability (Size-OP)

3 size and investment (Size-Inv).

To form the 25 Size-B/M portfolios, at the end of June every year, we rank the stock data by market capitalisation and divide the sample into five equal-Size portfolios. Independently, we compute the book-to-market ratio for each stock in the sample and divide them into five equal-B/M portfolios. The 25 Size-B/M portfolios are the combinations of five portfolios formed based on size and five portfolios formed based on the book-to-market ratio. The 25 Size-OP (25 Size-Inv) portfolio is constructed in similar fashion, except that the second sort variable is operating profitability (OP) (investment). After building all three portfolios, we calculate the portfolios' value-weighted monthly returns. The excess portfolio return is the portfolio return minus the risk-free rate. The portfolio will be rebalanced every end of June each year.

We construct the asset pricing factors based on 2 × 3 sorts. Market factor (excess market return) is the difference between the market return and the risk-free rate. Following Fama and French (2015), SMB is the average return on the nine small stock portfolios minus the average return on the nine big stock portfolios. HML is the average return on the two value portfolios minus the average return on the two growth portfolios. Robust minus weak (RMW) is the average return on the two robust OP portfolios minus the average return on the two weak OP portfolios. Conservative minus aggressive (CMA) is the average return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios. We employ the value-weighted method to compute monthly factor returns. The following equations are the measures of asset pricing factors.

$$SMB = \frac{SMB_{(B/M)} + SMB_{(OP)} + SMB_{(INV)}}{3} \tag{2}$$

$$HML = \frac{(Small\ value + big\ value)}{2} - \frac{(Small\ growth + big\ growth)}{2} \tag{3}$$

$$RMW = \frac{(Small\ robust + big\ robust)}{2} - \frac{(Small\ weak + big\ weak)}{2} \tag{4}$$

$$CMA = \frac{(Small\ conservative + big\ conservative)}{2} - \frac{(Small\ aggressive + big\ aggressive)}{2} \quad (5)$$

We employ both the Fama-French three- and five-factor models to compare their performance. The three- and five-factor models are as follows.

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

$$R_{pt} - R_{ft} = a_p + b_p\left(R_{mt} - R_{ft}\right) + s_p SMB_t + h_p HML_t + r_p RMW_t + c_p CMA_t + e_{pt} \quad (7)$$

where $R_{pt} - R_{ft}$ is the excess portfolio return, R_{ft} is the risk-free rate, $R_{mt} - R_{ft}$ is market factor, SMB_t is size factor, HML_t is book-to-market factor, RMW_t is profitability factor, CMA_t is investment factor and e_{pt} is the error term.

This study employs ordinary least squares adjusted for the Newey and West (1987) heteroscedasticity-consistent covariance matrix. We use some criteria in examining the performance of the Fama-French three- and five-factor models in both Indonesia and Singapore. Following Merton (1973), a well-specified asset pricing model produces an intercept that is insignificantly different from zero. We test this by computing the F-statistic of GRS test (Gibbons et al., 1989). The formula to calculate the GRS statistic is as follows:

$$GSR = \left(\frac{T}{N}\right)\left(\frac{T-N-L}{T-L-1}\right)\left[\frac{\alpha' \sum^{-1} \alpha}{1+\mu'\Omega^{-1}\mu}\right] \sim F(N, T-N-L) \quad (8)$$

where T is the number of observations, N is the number of portfolios to be explained, L is the number of asset pricing factors, α is a vector of regression intercepts, $\sum$ is an unbiased estimate of the residual covariance matrix, μ is a vector of the factor portfolios' sample mean and 'Ω is the sample covariance matrix of the asset pricing factors. Under the null hypothesis that all regression intercepts are equal to zero, the GRS test statistic has an F distribution with N and $T - N - L$ degrees of freedom.

We also employ the Sharpe ratio as recommended by Lewellen et al. (2010) to compare the Fama-French models. The Sharpe ratio takes the following equation.

$$SR(\alpha) = (\alpha' S^{-1} \alpha)^{1/2} \quad (9)$$

where α is the column vector of the 25 regression intercepts estimated by each model and S is the covariance matrix of the associated regression residuals. The smaller the Sharpe ratio, the better the model. We also compare the average adjusted R^2, the average absolute value of the intercepts and the average standard error of the intercepts to suggest which model is better.

To examine whether the book-to-market factor (HML) is redundant or not in explaining the excess portfolio returns in both Indonesia and Singapore, we regress HML on the other four factors. If the intercept of HML is close to zero and insignificant, this means that HML has little or no information about average returns not captured by the other factors of the four-factor model. Standard asset pricing theory then tells us that HML is redundant in describing average returns.

We check the robustness of our main regression results by using equally-weighted portfolios and alternative factor construction methods. We employ equally-weighted portfolios to calculate asset pricing factors and excess portfolio returns and 2 × 2 and 2 × 2 × 2 × 2 sorts on asset pricing factors to check the robustness of the results.

3 Empirical results

3.1 Descriptive statistics

Table 1 reports descriptive statistics and time-series correlations between the factors. Panel A shows that only size factor has a significant positive mean return in Indonesia. This indicates that small-cap stocks generate superior returns compared to big-cap stocks. Meanwhile, Panel B indicates that size and profitability factors have significant positive mean returns in Singapore. This suggests that small stocks outperform big stocks and stocks with higher OP generate higher returns than stocks with lower OP. In Indonesia (Panel A), size and profitability factors are negatively correlated with the market factor, while value and investment factors show positive correlations with the market factor. Value and investment factors are negatively correlated with size factor. Value factor is negatively correlated with profitability factor and positively correlated with investment factor. In Singapore (Panel B), profitability and investment factors are negatively associated with the market factor, while value factor displays a positive correlation with the market factor. Value and investment factors are negatively correlated with size factor, while profitability factor is positively correlated with size factor. Moreover, profitability and investment factors are positively correlated with value factor.

We report the characteristics of each set of the 25 portfolios in Indonesia and Singapore in Tables 2 and 3 respectively. Panel A of Table 2 shows that the highest number of stock generally is in the smallest size portfolios. Panel B of Table 2 indicates that size is well controlled across book-to-market, OP and investment portfolios. Panel C of Table 2 demonstrates that the percentage of market capitalisation allocated to each size portfolio is consistent with the definition of their quintiles. Panel D, E and F of Table 2 report the average book-to-market, OP and investment in each set of the 25 portfolios, respectively. Stocks with low OP have higher book-to-market ratio compared to stocks with high OP. The negative relationship between book-to-market ratio and OP is consistent with Novy-Marx (2013). Stocks with low book-to-market ratio invest aggressively and stocks with high book-to-market ratio invest conservatively. Stocks with low investment have lower OP than stocks with high investment. Panel A, B and C of Table 3 exhibit the similar characteristics to Panel A, B and C of Table 2. Panel D, E and F of Table 3 depict that stocks with low book-to-market ratio tend to show higher investment than stocks with high book-to-market ratio. Stocks with high OP tend to invest more aggressively than stocks with low OP.

Average monthly excess returns for each set of the 25 portfolios are presented in Table 4. Panel A and B display the results for Indonesia and Singapore, respectively. In Panel A, 25 Size-B/M portfolios reveal that average excess return decreases from small stocks to big stocks for the first three column of B/M. This finding indicates that the size effect exists. For the other two portfolios in the highest B/M column, the average excess return increases from small stocks to big stocks. The value effect appears in the last two Size quintiles in which the average excess return increases with B/M. For 25 Size-OP portfolios, the extremely high OP portfolio has higher average excess return than extreme low OP portfolios, except for the last two Size quintiles. The extreme high OP shows that the average excess return decreases from small stocks to big stocks. There is a size effect in the extremely high OP. In the highest Inv quintile, average excess return falls from small stocks to big stocks. This finding indicates that the size effect is also found in the highest Inv quintile. In Panel B, 25 Size-B/M portfolios show that there is only a size effect in the lowest B/M quintile. The value effect only appears in the big Size quintile. For 25 Size-OP portfolios, the size effect exists in the extremely high OP. In the smallest Size quintile, the average excess return rises with OP. The size effect exists in the two highest Inv quintiles.

Table 1 Descriptive statistics and correlations between the factors

Panel A: Indonesia					
Descriptive statistics for factor returns					
	$R_m - R_f$	*SMB*	*HML*	*RMW*	*CMA*
Mean (%)	0.62	0.05	0.03	0.02	0.00
Std dev. (%)	6.52	0.26	0.58	0.26	0.30
t-statistic	1.27	2.43	0.59	1.14	–0.07
Correlations					
	$R_m - R_f$	SMB	HML	RMW	CMA
$R_m - R_f$	1.00	–0.34	0.26	–0.14	0.16
SMB	–0.34	1.00	–0.64	0.19	–0.38
HML	0.26	–0.64	1.00	–0.14	0.41
RMW	–0.14	0.19	–0.14	1.00	–0.08
CMA	0.16	–0.38	0.41	–0.08	1.00
Panel B: Singapore					
Descriptive statistics for factor returns					
	$R_m - R_f$	*SMB*	*HML*	*RMW*	*CMA*
Mean (%)	0.33	0.03	0.01	0.03	–0.01
Std dev. (%)	5.32	0.08	0.12	0.16	0.10
t-statistic	0.83	4.32	0.98	2.32	–1.08
Correlations					
	$R_m - R_f$	SMB	HML	RMW	CMA
$R_m - R_f$	1.00	–0.08	0.00	–0.25	–0.05
SMB	–0.08	1.00	–0.34	0.14	–0.17
HML	0.00	–0.34	1.00	0.30	0.10
RMW	–0.25	0.14	0.30	1.00	0.12
CMA	–0.05	–0.17	0.10	0.12	1.00

Notes: We construct factor returns from 2 × 3 sorts. The factors are $R_m - R_f$ (market excess return), SMB, HML B/M, RMW OP and conservative minus aggressive (CMA) inv.

Table 2 Characteristics of each set of the 25 portfolios in Indonesia

	Size-B/M portfolios					Size-OP portfolios					Size-Inv portfolios				
	Low	*2*	*3*	*4*	*High*	*Low*	*2*	*3*	*4*	*High*	*Low*	*2*	*3*	*4*	*High*
Panel A: Number of stocks															
Small	3.60	3.40	6.13	12.53	21.07	14.87	13.60	10.73	4.67	3.33	14.67	10.80	8.40	7.13	5.40
2	4.27	5.80	9.80	13.33	12.07	11.27	11.00	10.67	7.13	6.07	11.33	11.33	8.27	7.27	7.93
3	8.93	8.80	11.60	9.53	7.47	9.80	8.47	9.27	10.73	8.20	9.27	9.07	9.80	8.93	9.13
4	9.93	13.07	11.40	8.07	3.73	6.93	7.67	8.47	11.67	11.20	6.20	8.40	9.73	10.13	11.80
Big	19.80	14.60	6.87	2.60	1.93	3.93	5.47	7.27	11.40	18.27	5.07	6.07	9.80	12.80	12.47
Panel B: Market capitalisation (Rp billion)															
Small	46	68	63	60	56	54	60	61	64	68	56	57	60	63	65
2	237	245	246	232	232	235	239	238	249	235	240	227	231	252	249
3	762	755	763	706	664	702	710	728	769	740	674	773	736	711	741
4	2,115	2,226	2,212	2,077	2,006	2,097	2,164	2,124	2,280	3,104	2,141	2,066	2,111	2,156	2,207
Big	30,422	16,895	9,701	5,953	5,810	6,525	7,864	8,970	14,602	36,014	17,186	21,539	23,755	25,897	13,755
Panel C: Percentage of market capitalisation (%)															
Small	0.02	0.03	0.04	0.09	0.12	0.19	0.08	0.07	0.04	0.03	0.08	0.07	0.05	0.05	0.05
2	0.10	0.16	0.25	0.30	0.25	0.27	0.24	0.24	0.19	0.15	0.27	0.25	0.19	0.19	0.20
3	0.60	0.59	0.77	0.56	0.46	0.58	0.50	0.65	0.67	0.63	0.58	0.59	0.67	0.61	0.59
4	1.68	2.40	2.08	1.42	0.61	1.15	1.46	1.39	2.52	2.70	1.18	1.58	1.66	1.79	2.16
Big	55.20	21.70	7.39	1.43	1.76	2.37	3.89	7.09	14.54	58.37	5.92	9.00	19.73	32.49	20.03
Panel D: B/M															
Small	0.14	0.53	0.87	1.48	5.14	3.58	3.18	2.13	1.53	1.10	1.94	5.15	2.65	2.60	1.85
2	0.23	0.66	0.87	1.46	3.36	1.73	1.86	1.50	1.23	0.81	1.54	1.56	1.78	1.36	1.47
3	0.23	0.52	0.87	1.40	3.29	1.57	1.43	1.22	1.03	0.68	1.06	1.24	1.70	1.06	0.88
4	0.29	0.53	0.83	1.40	3.45	1.63	1.41	1.24	0.76	0.54	1.13	1.07	1.03	0.81	0.94
Big	0.23	0.50	0.77	1.25	3.17	0.94	1.13	0.91	0.59	0.36	0.97	0.71	0.85	0.54	0.57
Panel E: OP															
Small	–38.01	–0.36	–0.05	0.02	–0.03	–5.69	–0.001	0.08	0.19	0.57	–0.46	–8.64	0.04	0.06	0.16
2	–2.78	0.09	–0.03	0.06	–0.03	–1.44	–0.004	0.09	0.19	0.43	–0.61	–0.60	–0.08	0.12	0.14
3	–1.10	0.10	0.10	0.04	–0.02	–1.53	0.0004	0.09	0.19	0.51	–1.51	–0.06	0.03	0.19	0.20
4	–0.95	0.15	0.13	0.04	–0.03	–2.90	–0.001	0.08	0.19	0.44	–1.24	–0.06	0.15	0.26	0.18
Big	–1.02	0.19	0.12	0.05	0.03	–3.51	0.004	0.09	0.19	0.52	–2.87	0.16	0.22	0.23	0.26
Panel F: Inv															
Small	0.02	0.15	0.06	0.08	0.05	–0.01	0.07	0.12	0.16	0.23	–0.16	0.004	0.09	0.19	0.67
2	0.40	0.16	0.07	0.11	0.15	0.04	0.20	0.16	0.17	0.29	–0.13	0.02	0.09	0.19	0.87
3	1.90	0.39	2.55	0.20	0.23	2.65	0.19	0.17	1.57	0.34	–0.14	0.01	0.09	0.19	4.64
4	0.45	0.32	0.38	0.22	0.42	0.35	0.90	0.20	0.22	0.24	–0.12	0.01	0.09	0.19	1.22
Big	0.38	2.53	3.83	0.14	0.09	1.54	3.76	0.26	0.20	0.27	–0.15	0.01	0.09	0.19	3.99

Table 3 Characteristics of each set of the 25 portfolios in Singapore

	Size-B/M portfolios					*Size-OP portfolios*					*Size-Inv portfolios*				
	Low	*2*	*3*	*4*	*High*	*Low*	*2*	*3*	*4*	*High*	*Low*	*2*	*3*	*4*	*High*
Panel A: Number of stocks															
Small	8.80	12.47	14.07	17.80	25.33	33.27	17.27	13.93	7.60	6.87	27.53	17.27	11.87	11.00	10.80
2	10.60	12.33	15.27	20.13	19.33	18.87	16.87	17.53	13.67	10.33	17.73	15.80	16.60	15.27	12.73
3	11.40	16.07	19.13	16.73	14.33	13.47	14.33	15.13	20.20	14.47	14.87	15.27	15.20	16.60	15.40
4	16.27	19.53	15.80	14.20	12.47	8.67	17.40	14.67	17.07	19.93	10.60	14.93	15.87	17.20	19.20
Big	31.33	17.40	13.33	8.60	7.20	4.00	12.33	16.60	16.93	26.40	7.73	14.53	18.40	17.67	19.93
Panel B: Market capitalisation (S$ million)															
Small	18	17	17	17	16	16	17	18	17	18	17	17	18	17	17
2	41	39	38	40	38	38	40	38	40	40	39	39	39	39	40
3	76	76	77	73	74	73	75	75	77	76	73	76	133	75	77
4	159	163	163	158	158	157	156	164	160	160	161	150	165	159	164
Big	3,828	2,653	1,727	1,265	912	1,589	1,193	2,882	3,501	2,419	2,658	2,771	3,201	2,463	1,747
Panel C: Percentage of market capitalisation (%)															
Small	0.08	0.11	0.11	0.14	0.17	0.24	0.13	0.11	0.07	0.07	0.20	0.15	0.10	0.09	0.09
2	0.20	0.21	0.28	0.37	0.33	0.34	0.29	0.31	0.25	0.19	0.32	0.27	0.30	0.27	0.23
3	0.41	0.56	0.66	0.55	0.48	0.46	0.50	0.51	0.69	0.50	0.48	0.53	0.51	0.57	0.55
4	1.21	1.40	1.13	1.00	0.94	0.63	1.24	1.05	1.23	1.40	0.81	1.01	1.17	1.23	1.43
Big	50.60	20.56	10.04	5.65	2.81	3.39	6.57	22.64	29.10	28.10	9.46	18.56	27.24	19.25	15.17
Panel D: B/M															
Small	0.30	0.66	1.01	1.42	3.83	1.25	2.07	2.39	1.56	2.83	1.45	1.89	1.69	2.43	2.04
2	0.30	0.66	1.00	1.41	2.76	1.22	1.62	1.52	1.26	1.11	1.36	1.53	1.47	1.44	1.05
3	0.30	0.66	0.97	1.41	2.59	1.03	1.66	1.39	1.09	0.87	1.08	1.42	2.22	1.19	0.96
4	0.33	0.65	0.98	1.42	2.46	0.88	1.41	1.35	1.03	0.69	1.16	1.36	1.16	1.00	0.84
Big	0.31	0.65	0.98	1.40	2.55	0.83	1.36	1.15	0.88	0.50	0.87	0.97	1.04	0.79	0.70
Panel E: OP															
Small	–1.72	–0.22	–0.11	–0.03	–0.01	–0.79	–0.01	0.05	0.12	0.31	–0.76	–0.07	–0.01	0.03	0.04
2	–0.63	0.01	0.03	0.03	0.03	–0.54	–0.01	0.05	0.12	0.30	–0.37	–0.13	0.05	0.07	0.05
3	–0.29	0.08	0.07	0.05	0.03	–0.49	–0.01	0.05	0.12	0.27	–0.29	0.04	0.11	0.10	0.10
4	–0.56	0.10	0.08	0.05	0.03	–1.80	–0.03	0.05	0.13	0.27	–0.97	0.06	0.07	0.13	0.10
Big	0.25	0.12	0.08	0.05	0.06	–0.29	0.00	0.06	0.12	0.39	0.01	0.21	0.18	0.14	0.15
Panel F: Inv															
Small	0.23	0.12	0.03	0.04	0.03	–0.05	0.07	0.06	0.47	0.21	–0.22	–0.03	0.05	0.16	0.86
2	0.16	0.21	0.11	0.10	0.02	0.11	0.07	0.09	0.13	0.18	–0.21	–0.03	0.05	0.16	0.74
3	0.38	2.15	0.22	0.19	0.05	–0.01	0.48	2.08	0.18	0.30	–0.23	–0.03	0.10	0.16	3.04
4	0.44	0.27	0.25	0.09	0.09	0.11	0.28	0.10	0.26	0.36	–0.20	–0.02	0.05	0.16	0.94
Big	0.38	0.19	0.20	0.13	0.37	0.60	0.56	0.20	0.17	0.29	–0.18	–0.02	0.05	0.16	1.06

Table 4 Average monthly excess returns for each set of the 25 portfolios in Indonesia and Singapore

Panel A: Indonesia						*Panel B: Singapore*					
	Low	*2*	*3*	*4*	*High*		*Low*	*2*	*3*	*4*	*High*
Size-B/M portfolios						*Size-B/M portfolios*					
Small	2.50	2.24	0.84	0.42	0.26	Small	0.29	0.26	0.33	0.13	0.18
2	0.70	1.08	0.26	0.29	0.48	2	0.25	0.09	0.11	0.12	0.12
3	0.39	0.44	0.36	0.54	0.44	3	0.07	0.07	0.05	0.08	0.11
4	0.20	0.22	0.29	0.38	0.74	4	–0.01	0.03	0.11	0.01	0.08
Big	0.15	0.20	-0.33	0.63	0.89	Big	–0.02	0.06	0.06	0.18	0.24
Size-OP portfolios						*Size-OP portfolios*					
Small	0.56	0.51	0.28	1.73	1.08	Small	0.08	0.16	0.24	0.30	0.71
2	0.22	0.37	0.53	0.54	0.98	2	0.12	0.09	0.07	0.11	0.25
3	0.39	0.50	0.76	0.85	0.99	3	0.03	0.17	0.04	0.04	0.15
4	0.78	0.46	0.47	0.26	0.26	4	–0.14	0.06	0.01	0.03	0.04
Big	0.86	0.27	0.31	0.20	0.15	Big	–0.39	–0.01	0.07	0.04	0.03
Size-Inv portfolios						*Size-Inv portfolios*					
Small	0.39	0.56	0.60	0.56	0.84	Small	0.13	0.18	0.18	0.24	0.37
2	0.35	0.56	0.68	0.70	0.71	2	0.09	0.14	0.11	0.10	0.22
3	0.69	0.36	0.37	0.41	0.39	3	0.00	0.05	0.07	0.06	0.13
4	0.48	0.47	0.37	0.41	0.39	4	0.05	–0.02	0.02	0.06	0.06
Big	0.74	0.49	0.26	0.19	0.16	Big	0.05	0.01	0.03	0.03	0.05

Notes: At the end of each June, we allocate stocks into five size groups (small to big) using the Indonesia stock exchange or Singapore exchange market capitalisation breakpoints. Stocks are allocated independently to five B/M groups (low to high) using the Indonesia stock exchange or Singapore exchange book-to-market ratio breakpoints. The intersections of the two sorts result in 25 Size-B/M portfolios. The 25 Size-OP and 25 Size-Inv portfolios are constructed in the same way, except that the second variable is operating profitability or investment. The excess returns are expressed in percent.

3.2 Regression results

3.2.1 25 Size-B/M portfolios

Tables 5 and 6 present the regression results for the 25 Size-B/M portfolios in Indonesia and Singapore. Panel A and B show the results for the three- and five-factor models in each table. For brevity, we only report the intercepts for the three-factor model, but we report the intercepts and coefficients of each factor for the five-factor model. Additionally, we present the average adjusted R^2, the GRS statistic, the Sharpe ratio of the intercepts, the average absolute value of the intercepts and the average standard error of the intercepts for both models.

Panel A of Table 5 shows that the regression intercepts (α) are statistically significant in 16 out of 25 portfolios. This suggests that the three-factor model is unable to capture all the variation in the excess portfolio returns.

Table 5 Regression results for the 25 Size-B/M portfolios in Indonesia

B/M →	*Low*	*2*	*3*	*4*	*High*
Panel A: FF3					
Small	2.12**	1.47***	0.62	0.27***	0.20***
2	0.28	0.54**	0.12	0.16***	0.26***
3	0.29*	0.27**	0.06	0.40***	0.20*
4	0.11**	0.10*	0.20***	0.23**	0.45
Big	0.13***	0.14	–0.60	0.04	0.32
Adj R^2	0.25	$\lvert\alpha\rvert$	0.38		
GRS	2.86***	$s(\alpha)$	0.26		
$SR(\alpha)$	0.71				
Panel B: FF5					
Small	2.15**	1.36***	0.62	0.26***	0.20***
2	0.22	0.61***	0.13	0.16***	0.27***
3	0.28*	0.28**	0.06	0.44***	0.22**
4	0.13**	0.11**	0.19***	0.24**	0.45
Big	0.13***	0.15	–0.61	0.08	0.39
Small	0.31**	0.32**	0.04	0.07***	0.06***
2	0.38***	0.21***	0.09***	0.08***	0.11***
3	0.09***	0.10***	0.11***	0.11***	0.11***
4	0.10***	0.08***	0.11	0.11***	0.34***
Big	0.06***	0.14***	0.32***	0.66***	0.62***

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and *c* are the market ($R_m – R_f$), size (SMB), value (HML), OP and investment (Inv) slopes, respectively. Adj R^2 is the average adjusted R2, GRS is the GRS statistic, $SR(\alpha)$ is the Sharpe ratio for the intercepts, $\lvert\alpha\rvert$ 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 * denote significance at the 1%, 5% and 10% levels, respectively.

Table 5 Regression results for the 25 Size-B/M portfolios in Indonesia (continued)

B/M →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
Small	4.66	9.10**	2.85	1.94**	0.61
2	3.28	8.46***	1.44***	1.38***	2.80**
3	1.37	1.65*	5.13**	1.07	3.14***
4	0.48	1.11***	0.18	0.91**	–1.52
Big	–0.51**	–0.49	0.68	3.62	0.71
Small	–1.00	2.89	2.27	0.76***	0.09
2	0.58	0.45	0.56***	0.69***	1.34***
3	–0.37	1.13***	0.85**	0.79	1.35***
4	0.15	0.50***	0.20	1.41***	5.37
Big	–0.12	-0.21	1.80	1.30	6.88***
Small	–1.66	8.15	–0.17	0.51	–0.18
2	3.47	–3.03*	–0.28	0.00	–0.71
3	–0.07	–0.51	–0.93**	–1.63**	–1.15***
4	–0.64***	–0.39**	0.58	–0.48*	0.45
Big	0.24***	–0.70	0.07	–2.35	–4.37*
Small	–0.46	–5.09*	–0.95	0.03	–0.09
2	0.36	–2.81*	–0.35	–0.01	–0.13
3	1.83	–0.82*	2.92*	–1.00**	0.09
4	–0.11	–0.61***	–0.35	–0.13	–1.32
Big	–0.09	–0.19	0.89	0.25	0.62
Adj R^2	0.27	$\|\alpha\|$	0.39		
GRS	2.90***	$s(\alpha)$	0.26		
$SR(\alpha)$	0.72				

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and *c* are the market $(R_m – R_f)$, size (SMB), value (HML), OP and investment (Inv) slopes, respectively. Adj R^2 is the average adjusted R2, GRS is the GRS statistic, $SR(\alpha)$ 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 * denote significance at the 1%, 5% and 10% levels, respectively.

Panel B of Table 5 reports the performance of the five-factor model to compare with the three-factor model in explaining the 25 Size-B/M portfolios in Indonesia. As shown in Panel B of Table 4, 16 intercepts (out of 25) are statistically significant for the five-factor model. Only two out of 25 market slopes (b) are insignificant. The SMB coefficients (s) are significant in 12 out of 25 portfolios. The SMB slopes decrease with size in the growth portfolios. Meanwhile, HML slopes (h) tend to increase with size in the value portfolios. There is no clear pattern for RMW slopes (r) and CMA slopes (c). The profitability and investment factors show a small effect in explaining the excess portfolio returns in Indonesia. These findings are inconsistent with the results documented by Fama and French (2015) and Chiah et al. (2016).

Table 6 Regression results for the 25 Size-B/M portfolios in Singapore

B/M →	*Low*	*2*	*3*	*4*	*High*
Panel A: FF3					
			α		
Small	–0.01	0.09	0.09	0.04	0.11***
2	0.09	0.03	0.02	0.03	0.01
3	–0.03	–0.03	–0.02	–0.02	0.01
4	–0.07**	–0.03	0.03	–0.05	–0.01
Big	0.02	0.08**	0.03	0.08	0.09
Adj. R^2	0.26	$\|\alpha\|$	0.04		
GRS	2.14***	$s(\alpha)$	0.05		
$SR(\alpha)$	0.63				
Panel B: FF5					
			α		
Small	0.01	0.10	0.15*	0.05*	0.12***
2	0.10	0.04	0.03	0.04	0.02
3	–0.02	–0.02	–0.02	–0.01	0.01
4	–0.07*	–0.02	0.02	–0.05	0.00
Big	0.02	0.09**	0.03	0.09	0.09
			b		
Small	0.06*	0.02	0.02	0.03***	0.01
2	0.05**	0.03**	0.03***	0.02	0.03***
3	0.04**	0.02*	0.02	0.02**	0.04***
4	0.04***	0.02	0.03*	0.03***	0.04***
Big	0.01**	0.02*	0.04**	0.08***	0.13***
			s		
Small	12.03***	6.96***	10.57**	3.22***	3.36***
2	7.57***	2.90*	3.68***	3.82***	4.13***
3	4.65***	3.96***	2.98***	3.70***	3.62***
4	2.28***	2.62***	2.34**	2.32***	2.85***
Big	–0.74*	–0.62	0.58	2.97**	3.64*

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and *c* are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) slopes, respectively. Adj. R^2 is the average adjusted R^2, GRS is the GRS statistic, $SR(\alpha)$ 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 * denote significance at the 1%, 5% and 10% levels, respectively.

Table 6 Regression results for the 25 Size-B/M portfolios in Singapore (continued)

B/M →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
Small	–2.77	–0.69	1.75	–0.05	0.28
2	–4.36***	–2.49***	–0.14	–0.08	–0.15
3	–3.04***	–0.90	–0.28	0.24	–0.02
4	–1.06*	–0.60	–1.42	–1.25	–0.39
Big	–1.18***	–1.66**	–0.99*	0.10	1.25
			r		
Small	–1.08	–0.92	–3.18*	–0.41	–0.96**
2	–1.27	–1.08	–0.75	–0.89***	–0.72**
3	–0.44	–0.70	–0.49	–0.70*	–0.82
4	–0.54	–0.74	0.57	–0.26	–0.14
Big	–0.66*	–0.30	0.58	–0.47	0.12
			c		
Small	1.20	–0.11	4.21	–0.12	0.40
2	–0.46	–1.64*	0.08	0.09	0.09
3	1.62	–0.71	0.18	–0.11	–1.62***
4	–0.49	–0.21	–1.14	–0.70	0.11
Big	–0.18	–0.28	0.61	0.20	0.45
Adj. R^2	0.28	$\lvert\alpha\rvert$	0.05		
GRS	2.15***	$s(\alpha)$	0.05		
$SR(\alpha)$	0.63				

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and *c* are the market ($R_m – R_f$), size (SMB), value (HML), OP and investment (Inv) slopes, respectively. Adj. R^2 is the average adjusted R^2, GRS is the GRS statistic, $SR(\alpha)$ is the Sharpe ratio for the intercepts, $\lvert\alpha\rvert$ 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 * denote significance at the 1%, 5% and 10% levels, respectively.

The average adjusted R^2 on the 25 Size-B/M portfolios in Indonesia is 0.25 for the three-factor model and 0.27 for the five-factor model. The GRS statistic rejects the null hypothesis that all of the 25 intercepts are jointly equal to zero in both the three- and five-factor models. The Sharpe ratio is slightly lower for the three-factor model, indicating that the three-factor model performs better than the five-factor model. Table 5 demonstrates that the three- and five-factor models show similar performance in describing the excess portfolio returns of the 25 Size-B/M portfolios in Indonesia.

Panel A of Table 6 shows that only three out of 25 portfolios from the three-factor model have significant intercepts in Singapore. This indicates that the three-factor model performs well in describing the excess returns of the 25 Size-B/M portfolios. The average adjusted R^2 for the three-factor model is 0.26. Meanwhile, Panel B of Table 6 shows that the intercepts are significant in five out of 25 portfolios. This result indicates that the three-factor model is slightly better than the five-factor model in describing the excess portfolio returns in Singapore.

The market slopes show a significant positive effect on the excess returns in more than half of the portfolios (19 out of 25). The SMB slopes have significant positive effect in 13 out of 25 portfolios. The pattern of SMB slopes in high growth (B/M-Low) and mid-growth (B/M-3) portfolios show the presence of size effect. In the biggest size quintile, HML slopes tend to increase with B/M, indicating that the value effect exists. There is no clear pattern for RMW and CMA coefficients. As can be seen in Panel B of Table 5, the profitability and investment factors have a small effect in describing the excess portfolio returns in Singapore. The average adjusted R^2 for the five-factor model (0.28) is slightly higher than the three-factor model (0.26). The GRS statistic is significant at 1% level for the three- and five-factor models, which suggests that the intercepts are not jointly equal to zero. The Sharpe ratio is similar for the three- and five-factor models. Table 6 shows that the performance for the three- and five-factor models are quite similar in explaining the excess returns of the 25 Size-B/M portfolios in Singapore.

3.2.2 25 Size-OP portfolios

Tables 7 and 8 present the regression results for the 25 Size-OP portfolios in Indonesia and Singapore. Panel A of Table 7 shows the results from the three-factor model in Indonesia. The regression intercepts are significantly different from zero in 20 out of 25 portfolios. This result tends to show that the three-factor model does not appropriately describe the returns of 25 Size-OP portfolios. Panel B of Table 7 reports the results from the five-factor model. The regression intercepts are statistically significant in 21 out of 25 portfolios. All 25 of the Size-OP portfolios load positively and significantly on market factor. The SMB coefficients are significant for more than half portfolios (16 out of 25). The HML slopes are positive and statistically significant in 12 out of 25 portfolios, but there is no clear pattern on the SMB and HML factors.

In the lowest OP quintile, RMW slopes have strong negative values as size increases. The pattern on the CMA slopes cannot be observed well. The profitability and investment factors have a small effect in describing the excess portfolio returns in Indonesia.

The GRS statistic is statistically significant at 1% level for the three- and five-factor models. The Sharpe ratio for the five-factor model (0.68) is slightly lower than the three-factor model (0.69). The average adjusted R^2 is 0.24 for both the three- and five-factor models. Hence, Table 7 shows that the three- and five-factor models perform similarly in explaining the excess return of the 25 Size-OP portfolios in Indonesia.

Panel A of Table 8 shows the results from the three-factor model in Singapore stock market. The intercepts show significant values only in six out of 25 portfolios. Hence, the three-factor model performs well in explaining the returns of 25 Size-OP portfolios in Singapore. Similiar to the three-factor model, Panel B of Table 8 also shows that only six intercepts are statistically significant for the five-factor model in Singapore. All market slopes are positive and 18 portfolios show significant values. The SMB slopes have strong positive values in the smallest size quintile and increase with OP. In contrast, the SMB coefficients decline in the biggest size quintile. The HML slopes do not have a clear pattern, but most of them are negative and eight of them are significant. Low OP (OP Low and OP-2) portfolios show consistent negative RMW slopes. There is no clear pattern on the CMA slopes. The profitability and investment factors show a small effect in explaining the excess portfolio returns in Singapore.

Table 7 Regression results for the 25 Size-OP portfolios in Indonesia

OP →	*Low*	*2*	*3*	*4*	*High*
Panel A: FF3					
			α		
Small	0.50**	0.32***	0.17**	1.02**	0.62**
2	0.07	0.20***	0.25*	0.36**	0.77***
3	0.26**	0.09	0.30	0.67*	0.70**
4	0.74**	0.28***	0.34***	0.17***	0.20***
Big	0.52	0.06	0.24**	0.18**	0.14***
Adj. R^2	0.24	$\lvert\alpha\rvert$	0.37		
GRS	2.66***	s(α)	0.18		
SR(α)	0.69				
Panel B: FF5					
			α		
Small	0.52***	0.32***	0.17**	0.90*	0.63**
2	0.08	0.21***	0.28**	0.36**	0.75***
3	0.28***	0.11	0.31	0.65*	0.70**
4	0.78**	0.28***	0.35***	0.17***	0.20***
Big	0.63*	0.09	0.23**	0.17**	0.14***
			b		
Small	0.07***	0.08***	0.09***	0.31***	0.19***
2	0.08***	0.10***	0.13***	0.13***	0.15***
3	0.10***	0.22***	0.19***	0.14***	0.20***
4	0.21***	0.13***	0.12***	0.08***	0.08***
Big	0.32***	0.23***	0.17***	0.12***	0.07***
			s		
Small	0.37	2.68*	0.89**	8.31**	5.96***
2	1.76***	1.94*	3.74**	1.49*	2.30
3	1.80*	4.72***	6.97***	1.54	3.24**
4	–1.51	1.82***	0.84*	0.65**	0.13
Big	2.87	0.81	–0.65	–1.05	–0.72*

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and c are the market ($R_m – R_f$), size (SMB), value (HML), OP and investment (Inv) 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, $\lvert\alpha\rvert$ is the average absolute value of the intercepts and s(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 7 Regression results for the 25 Size-OP portfolios in Indonesia (continued)

OP →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
Small	–0.18	0.82**	0.31*	2.77*	2.21***
2	0.76***	0.79**	1.29	0.88**	–0.02
3	0.07	2.03***	1.54***	0.98	0.22
4	–0.17	0.90***	0.30	0.35**	0.26
Big	1.44	1.80***	–0.15	–0.01	–0.18
			r		
Small	–0.81	–0.12	–0.11	8.29*	–0.29
2	–0.34	–0.27	–1.85	0.48	1.45
3	–1.29***	–0.74	–1.34*	0.84	0.55
4	–2.35	–0.34	–0.19	–0.09	0.02
Big	–5.88***	–1.76*	0.17	0.62*	0.39**
			c		
Small	–0.91	1.39	–0.51*	–3.93*	–0.84
2	0.13	–0.20	–1.28	–0.45	0.05
3	1.40*	–1.41*	2.93**	–0.41	–0.61
4	0.36	–0.14	–0.32	–0.31*	–0.06
Big	–0.30	0.96	0.39	0.06	–0.20
Adj. R^2	0.24	|α|	0.37		
GRS	2.59***	s(α)	0.18		
SR(α)	0.68				

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and c are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) 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, |α| is the average absolute value of the intercepts and s(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

The average adjusted R^2 for the three- and five-factor models are 0.22 and 0.26 respectively. The GRS statistic is significant at 1% level for both the three- and five-factor models, which suggests that the intercepts are not jointly equal to zero. The Sharpe ratios for both models are similar (0.63). Hence, we tend to conclude that the three- and five-factor models perform similarly in explaining the excess returns of the 25 Size-OP portfolios in Singapore.

Table 8 Regression results for the 25 Size-OP portfolios in Singapore

OP →	*Low*	*2*	*3*	*4*	*High*
Panel A: FF3					
			α		
Small	–0.01	0.06	0.10**	0.16*	0.48**
2	0.05	–0.02	–0.02	–0.01	0.14**
3	–0.07	0.03	–0.05	–0.03	0.06
4	–0.29	0.00	–0.11*	–0.02	–0.01
Big	–0.24	–0.06	0.07**	0.05	0.03
Adj. R^2	0.22	|α|	0.09		
GRS	2.15***	s(α)	0.07		
SR(α)	0.63				
Panel B: FF5					
			α		
Small	0.01	0.06	0.11**	0.18*	0.43**
2	0.06*	0.00	–0.01	0.00	0.14**
3	–0.05	0.05	–0.05	–0.02	0.06
4	–0.26	0.00	–0.14	–0.03	0.00
Big	–0.06	–0.05	0.07**	0.05	0.02
			b		
Small	0.01*	0.02*	0.03***	0.03	0.08**
2	0.02**	0.03*	0.02**	0.03**	0.02
3	0.03	0.06***	0.03***	0.01	0.03*
4	0.04*	0.03***	0.02	0.04**	0.01
Big	0.06	0.04***	0.02*	0.02***	0.02***
			s		
Small	4.11***	3.94***	5.65***	5.93***	7.92***
2	3.67***	4.50***	3.38***	4.35***	4.22***
3	4.69***	5.08***	3.35***	2.83***	3.21***
4	7.40***	2.22***	3.26***	1.54	2.38**
Big	2.44	2.23*	–0.09	–0.25	–0.33
Small	–0.24	–0.04	–0.62	0.04	–7.55
2	–1.58***	–0.38	–1.48**	–0.48	–1.08*
3	–1.17*	0.03	–0.29	–0.77	–1.23
4	–1.04	–0.55	–1.45	–1.29*	–1.07
Big	–1.31	–1.77	–1.04**	–1.17***	–0.76*

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and c are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) 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, |α| is the average absolute value of the intercepts and s(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 8 Regression results for the 25 Size-OP portfolios in Singapore (continued)

OP →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
			r		
Small	–0.92	–0.34	–0.91**	–1.00	3.96
2	–1.22**	–0.91*	–0.21	–0.86	–0.42
3	–1.29	–0.86*	–0.43	–0.56	0.05
4	–2.99**	–0.33	2.37	0.33	-0.66
Big	–15.33***	–0.65	–0.05	0.01	0.87*
			c		
Small	1.14**	–0.13	0.30	1.43	–0.03
2	0.18	0.79	–0.48	–0.89*	–1.36**
3	0.57	0.25	-0.47	–0.50	–1.04
4	–0.22	–0.42	0.57	–1.23	–0.55
Big	–2.30	0.39	–0.07	–0.43	0.75
Adj. R^2	0.26	$\|\alpha\|$	0.08		
GRS	2.15***	s(α)	0.07		
SR(α)	0.63				

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and *c* are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) 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(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

3.2.3 25 Size-Inv portfolios

Tables 9 and 10 present the regression results for the 25 Size-Inv portfolios in Indonesia and Singapore. Panel A of Table 9 shows that 18 out of 25 intercepts from the three-factor model in Indonesia are statistically different from zero. This result indicates that the three-factor model is unable to capture all the variation of returns in Indonesia market comprehensively. Consistent with the results for the three-factor model, Panel B of Table 9 shows that 18 intercepts are statistically significant for the five-factor model. The results confirm that the Fama-French three- and five-factor models are unable to capture the variation of returns in Indonesia fully. All market slopes are significantly positive at 1% level. The SMB slopes have no clear pattern to be observed. In the highest investment quintile, the HML slopes tend to decrease as size increases. There is no clear pattern for the RMW and CMA slopes. The profitability and investment factors have a small effect in describing the excess return of the 25 Size-Inv portfolios.

The average adjusted R^2 on the 25 Size-Inv portfolios is 0.28 for the five-factor model and 0.26 for the three-factor model. This result suggests that the five-factor model performs better than the three-factor model in explaining the excess portfolio returns. However, the GRS statistics for both models are significant at 1% level, indicating that jointly all intercepts are not equal to zero. The Sharpe ratio for the three-factor model is similar to the five-factor model. Table 9 shows that the three- and five-factor models perform similarly in explaining the excess returns of the 25 Size-Inv portfolios in Indonesia.

Table 9 Regression results for the 25 Size-Inv portfolios in Indonesia

Inv →	*Low*	*2*	*3*	*4*	*High*
Panel A: FF3					
			α		
Small	0.27***	0.48**	0.33**	0.46**	0.24
2	0.16	0.44**	0.33	0.33	0.28
3	0.08	0.20*	0.25***	0.21**	0.22
4	0.39**	0.35***	0.26**	0.33***	0.28***
Big	0.54**	0.37***	0.21*	0.19***	0.12**
Adj. R^2	0.26	$\lvert\alpha\rvert$	0.29		
GRS	3.11***	s(α)	0.15		
SR(α)	0.74				
Panel B: FF5					
			α		
Small	0.27***	0.49***	0.33**	0.46**	0.18
2	0.16	0.44**	0.31	0.35	0.33
3	0.08	0.20*	0.26***	0.23***	0.26
4	0.40**	0.37***	0.27**	0.32**	0.28***
Big	0.51**	0.36***	0.22*	0.18***	0.12***
			b		
Small	0.06***	0.09***	0.12***	0.10***	0.32***
2	0.15***	0.12***	0.21***	0.24***	0.21***
3	0.13***	0.10***	0.09***	0.09***	0.21***
4	0.11***	0.12***	0.14***	0.14***	0.10***
Big	0.33***	0.21***	0.13***	0.10***	0.10***
			s		
Small	1.53***	0.78	3.62**	0.36	7.03***
2	1.97***	1.22*	3.85***	4.13*	5.45***
3	11.56**	1.89**	1.22***	2.04***	–0.01
4	0.04	1.11	0.35	–0.31	0.61
Big	–0.95	–0.31	–0.79*	–1.17**	–0.42
Small	0.46***	–0.06	1.31***	0.72**	1.88***
2	0.28	0.03	1.41***	0.76	1.50**
3	1.92***	0.76**	0.36*	2.11**	1.02*
4	1.25***	0.36	0.44	0.26	0.55**
Big	1.90**	0.19	0.17	–0.18	–0.09

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and c are the market ($R_m – R_f$), size (SMB), value (HML), OP and investment (Inv) 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, $\lvert\alpha\rvert$ is the average absolute value of the intercepts and s(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 9 Regression results for the 25 Size-Inv portfolios in Indonesia (continued)

Inv →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
			r		
Small	–0.24	–0.66	-0.38	0.17	3.94*
2	–0.01	–0.36	1.03	–0.58	–2.41
3	–1.91**	–0.15	–0.37*	–0.96**	–1.48
4	–0.85	–1.43*	–0.19	0.78	0.28
Big	0.56	0.80	-0.43	0.52**	0.03
			c		
Small	0.19	–0.11	0.69	–1.12**	–1.79
2	–0.04	0.18	0.51	–1.28	–2.88**
3	7.86**	0.76	–0.21	–1.02**	–2.96***
4	–0.33	0.43	–0.54	–0.41	0.13
Big	2.12	0.85*	0.29	–0.24	–0.25
Adj. R^2	0.28	$\|\alpha\|$	0.29		
GRS	3.06***	$s(\alpha)$	0.15		
SR(α)	0.74				

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and c are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) 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(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

3.3 Is book-to-market factor (HML) redundant?

Table 11 reports the results of redundancy test for the book-to-market factor in both Indonesia and Singapore markets. The result for Indonesia is similar to Singapore. With the presence of profitability and investment factors, the book-to-market factor is not redundant in explaining excess portfolio returns in both markets. In other words, the book-to-market factor is an important factor in pricing Indonesia and Singapore equities. This finding supports Nguyen et al. (2015), Chiah et al. (2016), Guo et al. (2017) and Kubota and Takehara (2017).

One possible reason for this result is the low correlations found among HML, RMW and CMA (Panel A and B of Table 1). The correlations among those factors are different from the US evidence (Fama and French, 2015). Barillas and Shanken (2017) imply that if a factor is redundant in a given period, the factor does not help explain average returns during that period, even when the redundancy is a result of chance.

Table 10 Regression results for the 25 Size-Inv portfolios in Singapore

Inv →	*Low*	*2*	*3*	*4*	*High*
Panel A: FF3					
			α		
Small	0.02	0.08**	0.06	0.07	0.14*
2	0.02	0.04	0.02	0.03	0.10*
3	-0.10	–0.04	-0.01	–0.02	0.03
4	-0.04	–0.10***	-0.06	0.00	0.02
Big	0.07	0.05	0.03	0.06*	0.03
Adj. R^2	0.25	$\|\alpha\|$	0.05		
GRS	2.18***	$s(\alpha)$	0.05		
SR(α)	0.64				
Inv →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
			α		
Small	0.04	0.08**	0.08	0.08	0.14**
2	0.04	0.06	0.03	0.03	0.11*
3	–0.09	–0.03	–0.01	–0.02	0.03
4	–0.03	–0.10***	-0.06	0.00	0.02
Big	0.09	0.06**	0.03	0.06*	0.03
			b		
Small	0.01*	0.03***	0.03**	0.02	0.05***
2	0.03***	0.03	0.03***	0.01	0.03
3	0.03*	0.03**	0.02	0.02	0.04***
4	0.06***	0.03***	0.02	0.03***	0.03*
Big	0.06***	0.01	0.02**	0.04***	0.02**
Small	5.04***	3.82***	5.37***	6.26***	9.01***
2	3.57***	4.55***	3.77***	3.46***	4.68***
3	4.62***	3.77***	2.98***	3.24***	3.59***
4	3.67***	2.87***	3.04***	2.29***	1.88*
Big	0.65	-0.42	0.01	-1.23*	0.79
			h		
Small	–0.43	0.08	0.06	0.84	–1.85*
2	–1.74**	–1.41*	–0.57	–1.33	–1.18
3	–1.99*	–0.75	–0.22	–1.04	–0.25
4	–0.79	–0.63	–0.95	–0.74	–1.38
Big	–2.34	–1.03***	–0.83**	–2.12**	–0.97**

Notes: α is the regression intercept, while b, s, h, r and c are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) 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 * denote significance at the 1%, 5% and 10% levels, respectively.

Table 10 Regression results for the 25 Size-Inv portfolios in Singapore (continued)

Inv →	*Low*	*2*	*3*	*4*	*High*
Panel B: FF5					
			r		
Small	–1.04**	–0.64	–1.41**	–0.92	–0.64
2	–1.29*	–1.29*	–0.65**	–0.76	–0.74
3	–0.54	–0.74	–0.44	–0.50	–0.56
4	–1.23	–0.27	0.22	–0.36	–0.63
Big	–0.05	–1.47***	0.11	0.24	–0.54*
			c		
Small	2.04***	0.31	0.94	–0.85	–1.19
2	0.02	0.49	0.13	–1.38**	–1.55*
3	0.66*	0.88	–0.26	–0.99	–0.82*
4	–0.05	–0.85	0.13	–0.78*	–0.76
Big	6.46***	–0.70*	0.45	–1.07***	–1.28***
Adj. R^2	0.29	|α|	0.05		
GRS	2.44***	s(α)	0.05		
SR(α)	0.68				

Notes: α is the regression intercept, while *b*, *s*, *h*, *r* and *c* are the market ($R_m - R_f$), size (SMB), value (HML), OP and investment (Inv) 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, |α| is the average absolute value of the intercepts and s(α) is the average standard error of the intercepts. The intercepts are expressed in percent. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 11 Test of redundancy for the HML factor in Indonesia and Singapore

Panel A: Indonesia	*Int*	$R_m - R_f$	*SMB*	*RMW*	*CMA*	R^2
Coefficient	0.00*	0.00	–1.26***	–0.03	0.36*	0.45
t-statistic	1.84	0.51	–3.79	–0.17	1.67	
Panel B: Singapore	*Int*	$R_m - R_f$	*SMB*	*RMW*	*CMA*	*R2*
Coefficient	0.00**	0.00	–0.57***	0.28***	–0.01	0.25
t-statistic	2.13	0.89	–3.28	4.13	–0.06	

Note: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

3.4 Robustness checks

3.4.1 Equally-weighted portfolio

The first robustness check is the use of an equally-weighted method to calculate asset pricing factors and excess portfolio returns. Our findings show that the GRS statistics are significant for both models, except for the five-factor model for Size-Inv portfolios in Singapore. The Sharpe ratio also indicates that the five-factor model does not perform better than the three-factor model in both Indonesia and Singapore markets. The results are reported in Table 12.

Table 12 Robustness check (equally-weighted method)

	FF3					*FF5*				
	GRS	*SR(α)*	*|α|*	*s(α)*	*Adj. R^2*	*GRS*	*SR(α)*	*|α|*	*s(α)*	*Adj. R^2*
Panel A: Indonesia										
Size-B/M	2.32***	0.63	0.95	0.56	0.43	3.18***	0.75	1.10	0.57	0.45
Size-OP	2.85***	0.69	1.03	0.67	0.38	2.47***	0.66	1.13	0.68	0.41
Size-Inv	1.84**	0.56	1.02	0.63	0.40	2.30***	0.64	1.15	0.64	0.42
Panel B: Singapore										
Size-B/M	2.04***	0.63	0.57	0.62	0.24	1.96***	0.66	0.78	0.56	0.38
Size-OP	3.25***	0.79	0.75	0.66	0.21	2.24***	0.71	0.71	0.59	0.36
Size-Inv	1.83**	0.59	0.60	0.63	0.22	1.15	0.51	0.76	0.56	0.38

Notes: Adj. R^2 is the average adjusted R^2, GRS is the GRS statistic, SR(α) is the Sharpe ratio for the intercepts, |α| is the average absolute value of the intercepts and s(α) is the average standard error of the intercepts. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

3.4.2 Alternative factor construction

To explore whether the specifics of factor construction are important in tests of asset pricing models, we employ 2 × 2 and 2 × 2 × 2 × 2 sorts. The GRS tests are statistically significant at 1% level for all models. The Sharpe ratio for the five-factor model is slightly lower or higher than the three-factor model. The results are reported in Table 13. As in Fama and French (2015), these findings confirm the results based on 2 × 3 sorts presented in Tables 5 to 10.

Table 13 Robustness check (alternative factor construction)

	FF3					*FF5*				
	GRS	*SR(α)*	*|α|*	*s(α)*	*Adj. R^2*	*GRS*	*SR(α)*	*|α|*	*s(α)*	*Adj. R^2*
Panel A: Indonesia										
2 × 2 sorts:										
Size-B/M	2.88***	0.71	0.41	0.26	0.25	2.87***	0.72	0.27	0.41	0.26
Size-OP	2.75***	0.70	0.38	0.18	0.24	2.76***	0.70	0.38	0.18	0.26
Size-Inv	3.26***	0.76	0.31	0.15	0.25	3.16***	0.75	0.31	0.15	0.27

Table 13 Robustness check (alternative factor construction) (continued)

	Panel A: Indonesia									
	FF3					*FF5*				
	GRS	*SR(α)*	$\lvert\alpha\rvert$	*s(α)*	*Adj. R^2*	*GRS*	*SR(α)*	$\lvert\alpha\rvert$	*s(α)*	*Adj. R^2*
2 × 2 × 2 × 2 sorts:										
Size-B/M	3.18***	0.73	0.49	0.28	0.22	2.75***	0.70	0.42	0.27	0.23
Size-OP	3.17***	0.73	0.45	0.19	0.21	2.68***	0.69	0.40	0.18	0.23
Size-Inv	3.40***	0.76	0.37	0.15	0.22	2.89***	0.72	0.32	0.15	0.23
	Panel B: Singapore									
	FF3					*FF5*				
	GRS	*SR(α)*	$\lvert\alpha\rvert$	*s(α)*	*Adj. R^2*	*GRS*	*SR(α)*	$\lvert\alpha\rvert$	*s(α)*	*Adj. R^2*
2 × 2 sorts:										
Size-B/M	2.15***	0.63	0.05	0.05	0.28	2.18***	0.64	0.05	0.05	0.31
Size-OP	2.40***	0.66	0.10	0.07	0.23	2.31***	0.65	0.09	0.07	0.28
Size-Inv	2.54***	0.68	0.05	0.05	0.27	2.62***	0.70	0.05	0.05	0.31
2 × 2 × 2 × 2 sorts:										
Size-B/M	2.37***	0.65	0.09	0.05	0.20	2.32***	0.65	0.06	0.05	0.33
Size-OP	2.31***	0.64	0.10	0.07	0.18	2.31***	0.65	0.33	0.08	0.07
Size-Inv	2.35***	0.65	0.09	0.05	0.20	2.20***	0.64	0.06	0.05	0.33

4 Conclusions

This study aims to examine the performance of the Fama-French three- and five-factor models in describing average returns in Indonesia and Singapore. To gauge the performance, we refer to GRS statistic, Sharpe ratio for the intercepts, average adjusted R^2, average absolute value of the intercepts and average standard error of the intercepts from the two models. This study also tests whether the book-to-market factor is redundant in explaining average returns in Indonesia and Singapore, in the presence of profitability and investment factors.

Different from previous studies, our results show that the Fama-French three-factor is not inferior to five-factor models in describing the excess portfolio returns in both Indonesia and Singapore markets. The profitability and investment factors do not seem to have additional explanatory power to portfolio excess return in both markets. Furthermore, the addition of the profitability and investment factors does not make the book-to-market factor redundant in explaining portfolio excess returns in both markets. The regression results are robust for both value-weighted and equally-weighted portfolios and various factor construction methods. Based on parsimonious principle, we conclude that the Fama-French three-factor model is more suitable for Indonesia and Singapore markets.

Following Lam and Tam (2011) and Abeysekera and Nimal (2017), further research in Indonesia and Singapore markets may look at the impact of adding momentum and liquidity factors to Fama-French factors. The results may shed lights on which factors will lead to better asset pricing models for both markets. Better asset pricing models will be beneficial for both finance practitioners and academics.

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