Constructing Fama and French (1993) Three-factor Model: Evidence from Conventional and Shariah-compliant Portfolios in Bursa Malaysia.

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Abstract:

The main objective of this research is to test whether the style factors employed by the Fama and French (1993) three-factor model adequately explain the performance of the conventional sub-portfolios sorted by market values and their Shariah-compliant counterparts in Bursa Malaysia over the examination period from 1 December 2005 to 30 November 2017. The test was conducted by regressing the monthly excess returns of the conventional and Shariah sub-portfolios on the monthly returns of the Fama and French (1993) factors, which are the market risk premium, the small-cap risk premium, and the value risk premium. The results revealed that the Fama and French (1993) three-factor model can significantly explain the performance of the four conventional sub-portfolios sorted by market value and their Shariah-compliant counterparts.

Abbreviations:

BVTMV:	Book Value-To-Market Value Ratio.
CAPM:	Capital Asset Pricing Model.
CP:	Conventional Portfolio.
FF3F:	Fama and French (1993) three-factor model.
FF5F:	Fama and French (2015) five-factor model.
HML:	High BVTMV return minus Low BVTMV return.
MRP:	Market return minus Risk-free return.
MV:	Market Value.
SC:	Securities Commission of Malaysia.
SCP:	*Shariah*-Compliant Portfolio.
SMB:	Small-cap return minus Large-cap return.

1. Introduction:

One of the well-known models in the financial field is the capital asset pricing model CAPM, which was separately pioneered by Sharpe (1964), Lintner (1965) and Mossin (1966). The CAPM is estimated by investors to determine the risk-adjusted return of an asset by applying the beta coefficient as an adequate risk measure. Investors should focus on the risk and return of portfolios as a whole rather than each stock since the impact of a stock risk is substantially reduced once this stock is held in a portfolio. Therefore, constructing a well-diversified portfolio can eliminate that part of the risk that is related to stock (unsystematic risk), while the sensitivity to movements in market portfolio (systematic risk) could not be mitigated via diversification, and hence, investors deserve to receive an excess return for the part of the systematic risk. The CAPM also indicates that: (1) there is a linear relationship between beta and expected return; and (2) beta is a sufficient factor in explaining the portfolio expected return. However, there is some criticism concerning the CAPM. For instance, Fama and MacBeth (1973) and Reinganum (1981) assert that there is no relationship between beta and the expected stock return, so a higher beta does not necessarily give a higher return. While Brennan (1970) contends that the dividend yield should be added to the CAPM equation.

Fama and French introduced their three-factor model in 1993. The authors claim that the CAPM did not achieve notable success in explaining the stock performance when it was tested and applied. They emphasise that the size and value anomalies are considered possible risks in portfolios and investors should compensate for investing in size and value stocks (Hsieh, 2010). Thus, Fama and French (1993) construct and add two factors mimicking portfolios that represent the size effect and the value effect to the CAPM factor (market risk premium, MRP). These two factors are (1) the small-cap risk premium (SMB), which is a mimicking portfolio of the risk factor that is related to the size and represents the difference in return between small-cap stocks and large-cap stocks; and (2) the value risk premium (HML), which is a mimicking portfolio of the risk factor that is related to the value and represents the difference in return between stocks with high book value-to-market value BVTMV (value stocks) and stocks with low BVTMV (growth stocks). It is worth mentioning that the return of small-cap stocks is generally higher than the return of large-cap stocks (Banz, 1981; Maulina and Nuzula, 2018; Arnaya and Purbawangsa, 2020), while the return of the value stocks is also generally higher compared to the return of the growth stocks (Fama & French, 1993; Black, Mao and McMillan, 2009; Cao, Chen and Datar, 2017).

With regards to *Shariah*-compliant portfolio, it differs from conventional portfolio in that it must comply with Islamic law named as *Shariah*. *Shariah*-compliant portfolio (whether the investors are Muslim or not) may not include investments in companies that trade in or produce against *Shariah* such as liquor, pork, tobacco, pornography and gambling, or investments in financial products that have fixed interest such as bonds, preferred stocks and options, or any other practice deemed immoral. The motivateon for choosing Bursa Malaysia in this study is because it consists of conventional and Islamic capital markets working in parallel, and it is a well-regulated market that offers a wide range of financial and investment facilities with data availability. Bursa Malaysia is also a well-known market for *Shariah*-compliant since the majority of stocks listed on it are *Shariah*-compliant. There were 746 *Shariah*-compliant stocks out of a total of 936 stocks listed on Bursa Malaysia, representing around 80% of the total number of securities as at May 2021 (SC, 2021a). The total market value of the Islamic capital market is RM2,253.96 billion, Malaysian Ringgit(1), which represents more than 65% of the Malaysian capital market as at the end of July 2021 (SC, 2021b). Also, choosing one country to conduct the analyses helps to reduce the bias that derives from the variety of national characteristics present if the study used different countries.

Therefore the main objectivees of this research is to investigate whether the style factors employed by the Fama and French (1993) three-factor model (FF3F) adequately explain the performance of the conventional sub-portfolios (CPs) sorted by market values and their *Shariah*-compliant counterparts (SCPs) on Bursa Malaysia over an extensive examination period of 12 years, from 1 December 2005 to 30 November 2017. The other objective is to examine the investment style attribution that drives the performance of the both kinds of portfolios by applying FF3F over the same examination period.

2. Literature Review:

Over time, the CAPM was employed by investors to explain the returns of their portfolios. However, researchers found that other unsystematic risks are affecting the portfolio return that the CAPM did not recognise. For example, after studying the impact of the P/E of stocks in their performance on the NYSE between 1957 and 1971, Basu (1977) concluded that the lower P/E stocks achieved a superior return and abnormal return accompanied by a lower beta coefficient than the high P/E stocks. Banz (1981) asserted the existence of the size effect on the expected returns, after examining stocks in the NYSE over the period from 1936 to 1975. The author states that when companies are separated according to their market capitalisation, the average returns of companies with small market capitalisations are higher than the average returns of companies with a large market capitalisation.

Fama and French published their valuable paper in 1992, which has been one of the most influential studies published on asset pricing (Faff, 2003). Their study aimed to find what additional factors affected stock returns over the 1963-1990 examination period. They examined the beta, size, BVTMV, leverage and P/E in the USA markets (AMEX, NASDAQ and NYSE). Fama and French (1992) found that the beta alone was unable adequately to explain the returns of the stocks, and the size and BVTMV factors played a significant role in explaining the cross-section of stock return compared to leverage and the P/E. However, Black (1993) claimed that the Fama and French (1992) was affected by data mining. In a similar vein, Kothari, Shanken and Sloan (1995) stated that the Fama and French (1992) was affected by survivorship and selection biases, the authors also concluded that the relationship between the return and the BVTMV is not strong as Fama and French claimed.

Based on their results in 1992, Fama and French (1993) introduced their three-factor model (FF3F) after studying the AMEX, NASDAQ and NYSE from 1963 to 1991. They argued that including the size and value factors along with the beta factor explains portfolio performance much better than using the beta alone. Comparing with the CAPM, the *R*-squared[(2)] of the portfolios' regressions in the FF3F, was between 0.83 and 0.97, where 21 of the *R*-squared are bigger than 0.90, while it was between 0.61 and 0.92 in the CAPM, but only two of the *R*-squared are bigger than 0.90. Thus, the FF3F has a higher ability to explain portfolio performance compared to the CAPM. Therefore, the FF3F became desirable to many researchers to explain portfolio return in different countries, such as O'Brien (2007) in Australia; Lawrence, Geppert and Prakash (2007) in the USA; Su and Taltavull (2021) in Spain; Atodaria, Shah and Nandaniya (2021) in India; Al-Mwalla and Karasneh (2011) in Jordan; Allen and Cleary (1998), Drew and Veeraraghavan (2002), Lai and Lau (2010) and Shaharuddin, Lau and Ahmad (2017) in Malaysia.

On the other hand, the FF3F could not explain some anomalies related to profitability and investment. Hence, in response to this critique, Fama and French (2015) added two additional factors that reflect profitability and investment in their FF3F. The new two factors are the profitability factor (RMW), which is the difference in return between the most profitable companies and the least profitable, and the investment factor (CMA), which is the difference in return between a low-investment portfolio and a high-investment portfolio. Therefore, the five factors are the MRP, the SMB, the HML, the RMW and the CMA. The FF5F proved that small, profitable and value stocks with no significant growth prospects are expected to have the highest return. However, despite the criticisms of the FF3F, Hodrick and Zhang (2001:329) state that it became "*the workhorse for risk adjustment in academic circles*".

To compare between different asset pricing model, Foye (2018) conducted a study in 18 countries to investigate whether the FF5F would have a better return explanation power than the FF3F for stocks listed in different markets from December 1996 to June 2016. The study applied the standard regression approach. While the FF5F offered a better return explanation in Eastern Europe and Latin America, the evidence revealed that the FF5F did not offer a better return explanation in Asia where the FF3F was a better option.

Su and Taltavull (2021) tested the FF3F in the real estate investment trusts in Spain from Q3-2007 to Q2-2017 by applying the autoregressive distributed lag model. Based on the study's results, the researchers concluded that FF3F is adequate model to explain the performance of the real estate investment trusts in Spain compared to Carhart four-factor model and CAPM. Also, another study by Atodaria, Shah and Nandaniya (2021) aimed to analysis the CAPM and FF3F for the NIFTY 50 companies – Nifty 50 is one of the two main stock indices used in India- in the equity market of India over the period from April 2014 to March 2019. The authors found that CAPM is less performance than the FF3F in explainning the performance of the companies

Shaharuddin et al. (2017) tested the explanatory power of the FF3F in respect of the returns of *Shariah*-compliant stocks on Bursa Malaysia from May 2006 to May 2011. The sample included all *Shariah*-compliant stocks listed on the FTSE Bursa Malaysia KLSE. The results confirmed that the model adequately explained the performance of the *Shariah*-compliant stocks on Bursa Malaysia. On the contrary, Bakar and Rosbi (2019) studied a sample of 16 *Shariah*-compliant initial public offering stocks listed on Bursa Malaysia between January 2016 and December 2018, to evaluate the performance of stocks using the FF3F. After applying the regression analysis, the results showed a negative abnormal return (-3.399), and hence, the portfolio performed worse than the market, while the MRP, SMB and HML could only explain 46.67% of the portfolio excess returns. Accordingly, other factors better accounted for the returns of the *Shariah*-compliant initial public offering listed on Bursa Malaysia.

Generally speaking, the FF3F has improved the explanation of stock returns compared to the CAPM in various studies conducted in different markets, such as the USA, Asia, and Europe. Therefore, it was considered useful to test the FF3F in Malaysia, one of the countries among emerging markets that have exhibited rapid economic growth. However, most of the previous studies did not test for the unit root, heteroskedasticity and autocorrelation biases, therefore, their results might be unreliable. To ensure that the regression results of this study are unbiased estimations, tests for unit root, heteroskedasticity and autocorrelation bias were conducted on the regression variables with appropriate corrections employed if any biases were detected. Other differences between this research and previous studies lie in the size and number of the hypothetical portfolios, and the examination period, since over an extensive period from 1 December 2005 to 30 November 2017, this research employs a large number of hypothetical portfolios where each portfolio includes a relatively large number of stocks.

3. Methodology:

This research is based on published secondary data. The data was obtained mainly from the database accessed through subscription from the Taiwan Economic Journal (TEJ). The research employs monthly data, since using monthly data instead of daily and weekly data avoids high market fluctuations over the study period. The return of a stock is estimated by calculating the return on investment (ROI), which is obtained directly from the TEJ database. To determine whether a stock in the database is *Shariah*-compliant or not, this research uses the *Shariah*-compliant securities list report issued by the security commission of Malaysia (SC). Any company registered on this list is considered *Shariah*-compliant, while any company not registered is considered non-*Shariah* compliant. During the study period from 1 December 2005 to 30 November 2017, this report was issued at the end of May and November, except for 2006, when it was issued at the end of April and October.

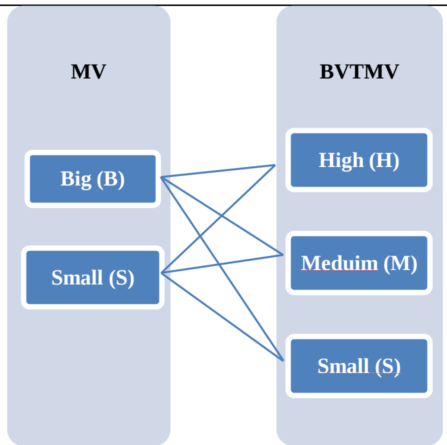
Each conventional and *Shariah*-compliant stock is ranked according to market value (MV) on the portfolio rebalancing dates, which are on 1 June and 1 December immediately after the *Shariah*-compliant lists were released. Four equally weighted quarterly portfolios within both kinds of stocks are constructed. The Q1 represents stocks in the bottom quarterly portfolio with the smallest MV, while the Q4 represents stocks in the top quarterly portfolio with the largest MV. Table 1 presents the number of stocks in each sub-portfolio sorted by MV. The table shows also the starting and ending number of stocks in the conventional sub-portfolios sorted by MV and their *Shariah*-compliant counterparts over the examination period.

Table 1 : Number of Stocks in the Sub-portfolios Sorted by MV

	Sub-portfolios Sorted by MV				
	Start	**End**		**Start**	**End**
CP:			**SCP:**		
Q1(Small)	96	159	**Q1(Small)**	84	122
Q2	95	159	**Q2**	84	121
Q3	95	159	**Q3**	84	122
Q4 (Big)	95	159	**Q4 (Big)**	84	121

To construct the Fama and French factors, the stocks are divided into two groups according to their market value (MV), whereby the small portfolio (S) consists of the smallest 50% of stocks with respect to MV; and the big portfolio (B) consists of the biggest 50% of stocks with respect to MV. At the same time, stocks are divided into three categories according to their book BVTMV as follows: (1) the low portfolio (L), which consists of the lowest 30% of the stocks with regards to BVTMV; (2) the medium portfolio (M), which consists of the middle 30%–70% of the stocks in respect of BVTMV; and (3) the high portfolio (H), which consists of the highest 30% of the stocks with regards to BVTMV. According to Fama and French (1993), the reason for separating MV into two portfolios and BVTMV into three portfolios is because BVTMV better explains the portfolio return compared to MV. Afterward, the six-factor benchmarks required to calculate the small-cap risk premium (SMB) and the value risk premium (HML) samples are constructed by intersecting the two MV portfolios with the three BVTMV portfolios, as shown in Figure 1 below.

Figure 1: Fama and French Factor Benchmarks



Hence, the six portfolios constructed are: (1) B&H contains stocks that are simultaneously grouped in the big MV and the high BVTMV portfolios; (2) B&M contains stocks that are simultaneously grouped in the big MV and the medium BVTMV portfolios; (3) B&L contains stocks that are simultaneously grouped in the big MV and the low BVTMV portfolios; (4) S&H contains stocks that are simultaneously grouped in the small MV and the high BVTMV portfolios; (5) S&M contains stocks that are simultaneously grouped in the small MV and the medium BVTMV portfolios; and (6) S&L contains stocks that are simultaneously grouped in the small MV and the low BVTMV portfolios. The SMB factor is the difference in the average return between the three small-cap portfolios (S&H, S&M and S&L) and the three big-cap portfolios (B&H, B&M and B&L), as follows in Equation 1:

$$SMB = \frac{S\&H+S\&M+S\&L}{3} - \frac{B\&H+B\&M+B\&L}{3} \quad \ldots\ldots(1)$$

On the other hand, the HML factor is the difference in the average return between the two high BVTMV portfolios (B&H and S&H) and the two low BVTMV portfolios (B&L and S&L), as follows in Equation 2:

$$HML = \frac{B\&H+S\&H}{2} - \frac{B\&L+S\&L}{2} \quad \ldots\ldots(2)$$

The equation of the FF3F is estimated by regressing the excess return of portfolio x in period t on the returns of the MRP, SMB and HML risk Factors, as follows in Equation 3:

$$(r_{x,t} - r_{f,t}) = a_x + b_{x,m}.MRP_t + b_{x,s}.SMB_t + b_{x,v}.HML_t + \varepsilon_{x,t} \quad ..(3)$$

Where,

$(r_{x,t} - r_{f,t})$	: is the excess return of portfolio *x* in period *t*.
a_x	: is the alpha coefficient that represents the abnormal return of portfolio *x*;
MRP_{t}	: is the market risk premium in month *t*;
$b_{x,m}$	: is the factor loading on the MRP, measures the sensitivity of the portfolio x excess return to the movement in the MRP;
SMB_t	: is the small-cap risk premium in month *t*;
$b_{x,s}$	: is the factor loading on the SMB, measures the sensitivity of the portfolio *x* excess return to the movement in the SMB;
HML_t	: is the value risk premium in month *t*;
$b_{x,v}$	: is the factor loading on the HML, measures the sensitivity of the portfolio *x* excess return to the movement in the HML; and
$\varepsilon_{x,t}$	: is the regression error term, represents an unsystematic risk for portfolio x in month *t*.

A positive factor loading on the SMB indicates a small-cap bias, while a negative factor indicates a large-cap bias. Likewise, a positive factor loading on the HML represents a value bias, while a negative factor denotes a growth bias.

To ensure that this research is free from the look-ahead bias, which is the mismatch between the time of constructing the portfolio and the availability of some data, the values of the attributes used to construct the portfolios are lagged by six months before the portfolio returns are computed. Employing a lag of six months is conservative and agrees with Fama and French (1992) argument. Moreover, to ensure the decrement in the time series variation, all attributes used to construct the variables in the model are logged before conducting the regression. Also, the following tests were conducted before running the regressions, to ensure that the results of this research are unbiased:

1. The unit root: if the time-series has unit roots, the time-series is not covariance stationary (DeFusco *et al*., 2015, p.516). To test whether the time series has a unit root or not, this research applies the Augmented Dickey-Fuller (1981) test (ADF). The *STATA 12* statistical analysis software presents three kinds of ADF test (1) the ADF with intercept (constant) and trend; (2) the ADF with intercept (constant) only; and (3) the ADF with no intercept (constant) and no trend. The null hypothesis for this test is H_0: the time series has a unit root, whereas the alternative hypothesis of the ADF test is H_1: the time-series has no unit root. Only variables that are statistically significant under the ADF test at a 5% level are accepted in the regression analysis.

2. The heteroskedasticity: DeFusco *et al*. (2015, p.445) clarify that heteroskedasticity bias occurs once the variance of the error terms changes through the observations. Thus, heteroskedasticity appears when the residuals of the regression in general, grow much larger with each increase in the independent variables' size. Heteroskedasticity could exhibit a statistically significant relationship between variables where there is no relation. To test whether the residuals are heteroskedastic or not, this research applied the Breusch-Pagan (1979) test. The significance of this test is at a 10% level, where the null hypothesis is H_0: the residuals of the regression are not heteroskedastic against the alternative hypothesis of H_1: the residuals of the regression are heteroskedastic.

3. The autocorrelation (serially correlated): The autocorrelation bias occurs when the residuals of the regression are correlated through observations, and it might cause a wrong standard error of the regression (DeFusco *et al*., 2015, p.450). The autocorrelation bias in this research is examined by applying Durbin's alternative test (Durbin, 1970). The significance of this test is at a 10% level, where the null hypothesis is H_0: the residuals of the regression are not serially correlated, while the alternative hypothesis is H_1: the residuals of the regression are serially correlated.

Therefore,the regressions which are employed in this research are (1) the OLS regression, if the residuals have no heteroskedasticity and no autocorrelation biases; (2) the robust standard errors regression, if the residuals only have heteroskedasticity bias; and (3) the Newey-West (1987) standard errors regression, if the residuals only have autocorrelation bias, or have heteroscedasticity and autocorrelation biases simultaneously. The Newey-West (1987) standard errors regression can correct the standard errors of the coefficients if residuals have heteroscedasticity and autocorrelation biases simultaneously. According to Greene (2002, p.226), many studies used the following equation to determine the lags for the Newey-West (1987) standard errors regression $L \approx T^{1/4}$, where T is the number of observations over the study period. This equation is also employed in this research. It is worth mentioning that the *R*-squared and adjusted *R*-squared for the Newey-West (1987) standard errors regression are derived from the OLS regression. At the same time, the adjusted *R*-squared for the robust standard errors regression is also derived from the OLS regression.

Finally, to detect the size effect in the value and growth portfolios, as well as the value effect in the large and small-cap portfolios, this research employyed the three famous risk-adjusted return measures, namely, the Sharpe ratio, Treynor measure and Jensen’s alpha. Furthermore, in terms of choosing the market proxy, Hsieh and Hodnett (2011) argue that constructing a market proxy from available sample stocks is essential to conduct a fair evaluation of portfolios that are constructed from the same pool of sample stocks. Therefore, the return of the equally weighted portfolio of all conventional stocks is employed as a market proxy for all conventional sub-portfolios, while the return of the equally weighted portfolio of all *Shariah*-compliant stocks is employed as a market proxy for all *Shariah*-compliant sub-portfolios. At the same time, the 3-month Bank

Negara Treasury bills rate and the 3-month Islamic interbank rates are employed as a risk-free proxy for all conventional sub-portfolios and *Shariah*-compliant sub-portfolios, respectively.

4. Results:

- **Descriptive Analysis:**

Table 2 presents the results of the risk and return characteristics (average return, standard deviateon, and beta coefficient) and the three risk-adjusted performance (Sharpe Ratio, Treynor Measure, and Jensen's Alpha) of the Fama and French factor benchmarks derived from the FF3F over the 1 December 2005-30 November 2017 examination period.

Table 2 : Performance Statistic Results for Fama and French Factor Benchmarks

	B&H	B&M	B&L	S&H	S&M	S&L
Return	1.218%	0.802%	0.687%	1.245%	0.608%	0.024%
Std. Dev.	6.084%	4.807%	4.152%	5.010%	4.180%	4.685%
β	1.273	1.056	0.905	1.081	0.897	0.933
Sharpe Ratio	0.159	0.115	0.105	0.199	0.086	-0.047
Treynor Measure	0.007	0.005	0.004	0.009	0.004	-0.002
Jensen's Alpha	0.002	-0.000	0.000	0.003	-0.001	-0.007

Size effect:

In the value category (B&H vs. S&H), the small-cap portfolio (S&H) earns a higher return of 1.245% than the return earned by the large-cap portfolio (B&H) of 1.218%. The small-cap portfolio (S&H) achieved a higher return with a lower standard deviation of 5.010% and a significantly lower beta coefficient of 1.081 compared to the standard deviation of 6.084% and the beta coefficient of 1.273 for the large-cap counterpart (B&H). This is reflected in the risk-adjusted performance as the small-cap portfolio (S&H) outperforms the large-cap counterpart (B&H) in all three risk-adjusted performance measures. On the other hand, the return of the large-cap portfolio (B&L) of 0.687% is significantly higher than the return of the small-cap portfolio

(S&L) of 0.024% in the growth category (B&L vs. S&L). The large-cap portfolio (B&L) has a lower risk measured by the standard deviation of 4.152% and a lower risk measure by the beta coefficient of 0.905 compared to the standard deviation of 4.685% and a beta coefficient of 0.933 for the small-cap counterpart (S&L). Since the large-cap portfolio (B&L) has a higher return and a lower risk than the small-cap portfolio (S&L), the large-cap portfolio (B&L) outperforms the small-cap counterpart (S&L) in all three risk-adjusted performance measures.

Value Effect:

In the large-cap category (B&H, B&M, and B&L), the return of the value portfolio (B&H) of 1.218% outperforms the return of the growth portfolio (B&L) of 0.687%. Concerning the risk, the growth portfolio (B&L) is safer than the value portfolio (B&H), since it has a lower standard deviation of 4.152% and a lower beta coefficient of 0.905, while the standard deviation and beta coefficient for the value portfolio (B&H) are 6.084% and 1.273, respectively. The risk-adjusted performance results indicate that the value portfolio (B&H) outperforms the growth portfolio (B&L) in all three risk-adjusted performance measures. The return of the value portfolio (S&H) of 1.245% exhibits a higher return than the return exhibited by the growth portfolio (S&L) of 0.024% in the small-cap category (S&H, S&M, and S&L). The higher return of the value portfolio (S&H) is accompanied by a higher standard deviation of 5.010% and the beta coefficient of 1.081 compared to the standard deviation of 4.685% and the beta coefficient of 0.933 for the growth portfolio (S&L). Also, the value portfolio (S&H) enjoys a higher Sharpe ratio of 0.199, Treynor ratio of 0.009, and Jensen's alpha of 0.003 compared to the Sharpe ratio of -0.047, Treynor ratio of -0.002, and Jensen's alpha of -0.007 for the growth counterpart (S&L).

Therefore, the size effect exists only in the value category, while in the growth category, the size effect does not exist. On the other hand, the value effect exists in the large-cap and small-cap categories. It is also noted that the return of the S&H

is the highest compared to other factor benchmarks. This is consistent with the Fama and French (1993) rationale.

Performance Attribution for Sub-portfolios Sorted by MV:

• Unit Root, Heteroskedastic and Autocorrelation Tests:

Panel (a) in Table 3 shows the results of the three kinds of ADF test for the excess returns of the conventional sub-portfolios sorted by MV and their *Shariah*-compliant counterparts, for the entire examination period. While Panel (b) displays the results of the Breusch-Pagan (1979) test and the Durbin's alternative test for the same sub-portfolios. Where the p-values of the Breusch-Pagan (1979) test or Durbin's alternative test are significant at a level of 10%, they are highlighted in bold in the table.

Table 3: Unit Root, Heteroskedastic and Autocorrelation test Results for Sub-portfolios Sorted by MV

Panel (a)	ADF Tests					
	Intercept only		Intercept and Trend		No Intercept and No Trend	
	Critical Value 5%	ADF Test stat.	Critical Value 5%	ADF Test stat.	Critical Value 5%	ADF Test stat.
Excess return of MV Sub-portfolios						
CPs:						
Q1(Small	-2.887	-11.244	-3.444	-11.245	-1.950	-11.148
Q2	-2.887	-11.901	-3.444	-11.889	-1.950	-11.855
Q3	-2.887	-11.423	-3.444	-11.440	-1.950	-11.398
Q4 (Big)	-2.887	-10.276	-3.444	-10.390	-1.950	-10.220
SCPs:						
Q1(Small)	-2.887	-11.066	-3.444	-11.080	-1.950	-10.986
Q2	-2.887	-11.667	-3.444	-11.668	-1.950	-11.638
Q3	-2.887	-11.319	-3.444	-11.322	-1.950	-11.303
Q4 (Big)	-2.887	-10.431	-3.444	-10.487	-1.950	-10.397

	Breusch-Pagan (1979) Test		Durbin's Alternative Test	
Panel (b)	**Chi^2**	**Probability**	**Chi^2**	**Probability**
Excess return of MV Sub-portfolios				
CP:				
Q1(Small)	**23.860**	**0.000***	1.781	0.182
Q2	**12.560**	**0.000***	0.656	0.418
Q3	**8.400**	**0.004***	0.123	0.726
Q4 (Big)	**4.630**	**0.031***	0.078	0.780
SCP:				
Q1(Small)	**27.350**	**0.000***	2.629	0.105
Q2	**13.690**	**0.000***	**3.271**	**0.071***
Q3	**2.950**	**0.086***	0.312	0.577
Q4 (Big)	0.000	0.957	0.004	0.948

*** significant at 10**

The results from Panel (a) indicate that the ADF absolute values of all sub-portfolios are bigger than their respective critical values at a 5% level. Thus, the alternative hypothesis cannot be rejected, which means that the data has no unit root and the time series is stationary. These results might be because of logging all variables before conducting this test, which helps to diminish the time series variation. Concerning Panel (b), the results of the Breusch-Pagan (1979) test indicate that the p-values of all sub-portfolio are less than 10%, except for the *Shariah*-compliant Q4 sub-portfolio. Thus, only the *Shariah*-compliant Q4 sub-portfolio accepts the null hypothesis, and its residuals are not heteroskedastic, while other sub-portfolios accept the alternative hypothesis and their residuals are heteroskedastic. The results from Durbin's alternative test demonstrate that the p-values of all sub-portfolios are bigger than 10%, except for the *Shariah*-compliant Q2 sub-portfolio, since its p-value is less than 10%. Thus, only the *Shariah*-compliant Q2 sub-portfolio accepts the alternative hypothesis and its residuals are serially correlated, while other sub-portfolios accept the null hypothesis, and their residuals are not serially correlated.

- **Portfolio Performance Attribution:**

Table 4 presents the performance attribution results for the conventional sub-portfolios sorted by MV and their *Shariah*-compliant counterparts. Following the results from Table 3, the regressions employed in this section are:

1. the OLS regression is employed only for the *Shariah*-compliant Q4 sub-portfolio, since it has no heteroskedasticity and no autocorrelation biases.

2. the robust standard errors regression is estimated for all conventional sub-portfolios as well as the *Shariah*-compliant Q1 and Q3 sub-portfolios, since these sub-portfolios only have heteroskedasticity biases.

3. the Newey-West (1987) standard errors regression is used for the *Shariah*-compliant Q2 sub-portfolio, since it has heteroscedasticity and autocorrelation biases simultaneously.

As mentioned, the lags for the Newey-West (1987) standard errors regression are determined according to Greene (2002), $L \approx T^{1/4}$, where T is the number of months over the study period. Accordingly, the number of lags in this research are $L = 144^{1/4} \approx 3.46$. Therefore, this research employs 4 lags.

Table 4: Performance Attribution for Sub-portfolios Sorted by MV

Panel (a) Conventional Sub-portfolios

	Q1 (Small)	Q2	Q3	Q4 (Big)
Prob > F	0.000	0.000	0.000	0.000
R^2	0.956	0.962	0.976	0.979
Adj -R^2	0.956	0.961	0.976	0.979
Intercept	-0.001	0.000	**-0.002**	0.001
t-Stat	-0.730	-0.520	**-2.460**	1.090
P. Value	0.467	0.606	**0.015****	0.280
b_MRP	0.953	1.006	1.021	0.982
t-Stat	42.32	48.55	55.72	64.29
P. Value	0.000***	0.000***	0.000***	0.000***
b_SMB	0.707	0.192	-0.229	-0.781
t-Stat	10.93	3.370	-6.590	-22.44
P. Value	0.000***	0.001***	0.000***	0.000***
b_HML	0.390	0.005	-0.032	-0.331
t-Stat	6.180	0.080	-0.900	-9.430
P. Value	0.000***	0.934	0.372	0.000***

Panel (b) *Shariah*-compliant Sub-portfolios

	Q1 (Small)	Q2	Q3	Q4 (Big)
Prob > F	0.000	0.000	0.000	0.000
R^2	0.937	0.947	0.967	0.979
Adj -R^2	0.935	0.946	0.966	0.979
Intercept	0.000	-0.001	-0.001	0.000
t-Stat	-0.210	-0.810	-1.110	0.200
P. Value	0.830	0.417	0.267	0.845
b_MRP	0.968	0.955	1.050	0.990
t-Stat	36.77	45.03	41.15	67.82
P. Value	0.000***	0.000***	0.000***	0.000***
b_SMB	0.699	0.122	-0.202	-0.759
t-Stat	8.490	1.770	-3.670	-22.66
P. Value	0.000***	0.079*	0.000***	0.000***
b_HML	0.348	0.017	-0.087	-0.287
t-Stat	3.930	0.260	-1.980	-8.790
P. Value	0.000***	0.797	0.049**	0.000***

***** Factor loading significantly at 1%, ** factor loading significantly at 5%, and * factor loading significantly at 10%.**

It is observed from the results that the lowest *R*-squared of the conventional and *Shariah*-compliant sub-portfolios is 0.937 with all sub-portfolios having p-values equal to 0. Hence, at least 93.7% of the variation in all sub-portfolios excess return can be explained by the variation in the three risk factors (MRP, SMB, and HML), statistically significant at a 1% level. Moreover, the adjusted *R*-squared values are the same or close to the *R*-squared values for both types of sub-portfolios, so there are no multicollinearity problems and the regressions are sound. Regarding the abnormal return (alpha coefficient), it is noted that only the conventional Q3 sub-portfolio has a statistically significant negative abnormal return at a 5% level (p-value = 0.015). Accordingly, only the conventional Q3 sub-portfolio significantly underperforms the market. The *Shariah*-compliant Q3 sub-portfolio also underperforms the market but is statistically not significant. However, only the conventional Q4 sub-portfolio outperforms the market (alpha is positive) but is also statistically not significant. The other sub-portfolios either underperform the market (alpha is negative) or do not have abnormal returns, but are statistically not significant.

Concerning the MRP factor, the results show that the beta coefficients of all conventional and *Shariah*-compliant sub-portfolios are positive around a value of 1 with p-values equal to 0. Therefore, all sub-portfolios move significantly at a 1% level in tandem with the market. These results affirm that the MRP is a crucial risk factor that systematically drives the performance of conventional and *Shariah*-compliant sub-portfolios sorted by MV. In detail, the beta coefficients for the conventional Q2 and Q3 sub-portfolios, as well as the *Shariah*-compliant Q3 sub-portfolio, are bigger than 1. Thus, these sub-portfolios have a higher systematic risk than the market, while the beta coefficients of other sub-portfolios are less than 1 and, therefore, these sub-portfolios have a lower systematic risk than the market.

With regards to the factor loading on SMB, it is observed that the slopes for the conventional and *Shariah*-compliant

In terms of the factor loading on HML, the results indicate that the conventional and *Shariah*-compliant Q1 sub-portfolios have statistically significant positive slopes at a 1% level (p-values = 0). Therefore, the performance of these sub-portfolios is strong with respect to the performance of the value stocks. The conventional and *Shariah*-compliant Q2 sub-portfolios also have positive slopes, but they are not significant since their p-values are 0.934 and 0.797, respectively. Thus, the performance of these sub-portfolios is mildly (statistically insignificant) toward the performance of the value stocks. On the contrary, the slopes for the HML for the conventional and *Shariah*-compliant Q3 and Q4 sub-portfolios are negative. Hence, the performance of the Q3 and Q4 sub-portfolios is driven by the performance of the growth stocks, but only significant at a 1% level for the conventional and *Shariah*-compliant Q4 sub-portfolios, and significant at a 5% level for the *Shariah*-compliant Q3 sub-portfolio (p-value = 0.049), but not statistically significant for the conventional Q3 sub-portfolio

Q1 and Q2 sub-portfolios are significantly positive at a 1% level (p-values = 0), except for the *Shariah*-compliant Q2 sub-portfolio, where it is statistically significant at a 10% level (p-value = 0.079). Thus, the performance of these sub-portfolios is strongly towards the performance of the small-cap stocks. This result is expected since the Q1 and Q2 sub-portfolios represent portfolios with small-cap stocks. In contrast, the slopes for the conventional and *Shariah*-compliant Q3 and Q4 sub-portfolios are negative with p-values equal to 0. Thus, the performance of these sub-portfolios has a strong statistical significance at a 1% level in respect of the performance of the large-cap stocks. This is also expected since the Q3 and the Q4 sub-portfolios represent portfolios with large-cap stocks. Thus, the results emphasise that the SMB is also a critical factor, after the MRP, that drives the performance of the conventional sub-portfolios, sorted by MV and their *Shariah*-compliant counterparts.

(p-value = 0.372). Therefore, the HML to some degree, is also considered as a crucial risk factor that drives the performance of the conventional sub-portfolios sorted by MV and their *Shariah*-compliant counterparts.

The results of this section are in line with Fama and French (1993) in terms of the insignificance of the abnormal return for the majority of the sub-portfolios. Moreover, when taking into account the *R*-squared as well as the adjusted *R*-squared, it is shown that the FF3F appropriately explains the performance of the conventional sub-portfolios sorted by MV and their *Shariah*-compliant counterparts. The results also suggest that (1) the performance of the conventional Q1 sub-portfolio and its *Shariah*-compliant counterpart is driven by the performance of the small-cap and value stocks; (2) the performance of the conventional Q2 sub-portfolio and its *Shariah*-compliant counterpart is only driven by the performance of the small-cap stocks; (3) the performance of the conventional Q3 sub-portfolio is only driven by the performance of the large-cap stocks; and (4) the performance of the conventional Q4 sub-portfolio and *Shariah*-compliant Q3 and Q4 sub-portfolios is driven by the performance of the large-cap and growth stocks.

5. Conclusion:

This research aimed (1) to investigate whether the style factors employed by the Fama and French (1993) three-factor model adequately explain the performance of the *Shariah*-compliant portfolios (SCPs) and conventional portfolios (CPs) over the examination period from 1 December 2005 to 30 November 2017; and (2) to examine the investment style attribution that drives the performance of *Shariah*-compliant portfolios and conventional portfolios by applying the Fama and French (1993) three-factor model over the same examination period. The test was conducted by regressing the monthly excess returns of differrent kinds of portfolios on the monthly returns of the Fama and French (1993) factors (MRP, SMB, and HML).

It is evident from the results that the FF3F significantly explains the performance of the conventional sub-portfolios sorted by market values and their *Shariah*-compliant counterparts since the *R*-squared was between 0.937 and 0.979 with all sub-portfolios having p-values equal to 0. Also, the presence of the abnormal returns of all regressions is mostly insignificant. Further, the results of this section suggest that (1) the investments in the conventional and *Shariah*-compliant Q1 sub-portfolios are exposed to the small-cap and value risks; (2) the investments in the conventional and *Shariah*-compliant Q2 sub-portfolios are only exposed to the small-cap risks; (3) the investments in the conventional Q3 sub-portfolio are only exposed to the large-cap risks; and (4) the investments in the *Shariah*-compliant Q3 and Q4 sub-portfolios, as well as the conventional Q4 sub-portfolio are exposed to the large-cap and growth risks.

Notes:

1. 1 dollar equals 4.19 Malaysian Ringgit as it in 28 September 2021
2. R-squared of the regression shows the variation of dependent variables that can be explained by the variation of the independent variable or variables

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