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Ginanjar Dewandaru and Rumi Masih and Obiyathulla I. Bacha and A. Mansur M. Masih

Aston University, Lancaster University

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The Role of Islamic Asset Classes in the Diversified Portfolios: Mean Variance Spanning Test

Ginanjar Dewandaru*[1], Rumi Masih[2], Obiyathulla Ismath Bacha[1], A. Mansur. M. Masih[1]

[1]INCEIF, The Global University of Islamic Finance
Lorong University A, 59100 Kuala Lumpur, Malaysia

[2]Bank of New York Mellon Asset Management
One Wall Street, New York, NY 10286, USA

Abstract

This study investigates both conventional and Islamic investors' problems as to whether the inclusion of Islamic and conventional asset classes may expand the frontier of their respective portfolios. Our sample covers the global U.S. portfolios and Malaysian portfolios with multiple asset classes, as well as the portfolios with a specific asset class in several regions. This study uses the recent mean-variance spanning test in multiple regimes, which not only accounts for tail risk but also identifies the source of value added (tangency portfolio or global minimum variance).

For intra-asset allocation, our findings show that both Islamic and conventional fund managers of a specific asset class can benefit from conventional and Islamic asset classes, respectively, in several regimes. For inter-asset allocation, conventional institutional investors cannot obtain any value added from Islamic asset classes. On the contrary, the U.S. Islamic institutional investors can expand their tangency portfolio by investing in U.S. TIPSs and REITs, and reduce their global minimum variance by allocating on U.S. high-yield bonds. Moreover, the Malaysian Islamic institutional investors can obtain risk reduction by investing in conventional bonds only in the high term premium regime. For the remaining asset classes, the opportunity sets are sufficient for Islamic investors to invest complying with Shariah rules. We provide some policy implications for the global Islamic financial industry.

*Corresponding Author: Ginanjar Dewandaru, INCEIF, The Global University of Islamic Finance, Lorong University A, 59100 Kuala Lumpur, Malaysia. Phone: +60142657731
Email: gdewandaru@yahoo.com

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1. Introduction

Asset allocation is a central issue for the entire asset management industry in order to achieve the best possible risk-return profile. Its application is predominantly post the advent of Modern Portfolio Theory (Markowitz, 1952) that accentuates on the importance of diversification (Brinson et al., 1986). As the current trend shifts from intra-asset allocation to inter-asset allocation, the variety of asset classes becomes a key driver in determining the overall performance of a diversified portfolio. The rationale is that each asset class conceals its unique dimensions of risk, where a mixture of multiple asset classes may expand an investment opportunity set. This leads global investors to adopt a niche approach in order to achieve positive-sum games.

The increasing importance of asset classes has substantially driven innovation in the financial industry from traditional assets (i.e. equity and fixed income) into a broader range of traditional alternative assets (private equity, real estate, commodities, currency) and modern alternative assets (hedge fund and managed futures). Many prior studies reaffirmed that the inclusion of each new asset class into a traditional portfolio enhances its risk-return profile (Abanomey and Mathur, 1999; Anson, 1999; Byrne and Lee, 2005; Schmidt, 2006; Pézier and White, 2008; Shapiro and Thomas, 2011; Das et al., 2013; and so on).

Despite the variety of asset classes, they may deliver the benefits of return enhancement and risk diversification, some studies mention its negative consequences in the form of externalities and systemic risks in the crisis period (Ibragimov et al, 2011). The rationale is that each financial firm, which holds a particular risk class with its idiosyncratic risk, is allowed to form a joint mutual market portfolio with the other financial firms. In that case, the interconnectedness of financial firms' risk portfolios may increase the risk of systemic failure, albeit the individual firms can eliminate the idiosyncratic risk in their individual portfolios (Shaffer, 1994). Many studies discussed multiple mechanisms to propagate the contagion via externality, where the failure of some financial institutions triggers the failure of others[1]. The most recent study showed the tradeoff between the benefits of risk sharing (diversification) and the social costs created by financial firms' failure (Ibragimov et al, 2011). The diversification threshold at this point depends on a number of distinct asset classes, as well as their correlations and tails of the joint distribution. Hence, the recent interest of investors is to explore additional asset class that provides a unique risk-return profile, accounting for the presence of tail risk.

This study is motivated by the above stated investors' problem, taking into consideration the Islamic investment universe as a central contribution of our study. The first objective is to address the conventional investors' problem as to whether any asset class from the Islamic investment universe may deliver value added to a well-diversified conventional portfolio, even in the presence of tail risk. The unique risk-return profile may be explained intuitively by the Shariah rules imposed on each Islamic asset class. For example, in case of equity asset class, the qualitative Shariah screening excludes firms with any non-compliant activity (i.e. liquor, gambling, interest-based financial institutions, etc.) while the quantitative Shariah screening strictly imposes a certain limit of interest-based leverage[2] (Derigs and Marzban, 2008). The Islamic equities therefore may

[1] e.g. interbank lending market (Rochet and Tirole, 1996); bank run (Allen and Gale, 2000); wealth effects from losses on trader portfolios (Kyle and Xiong, 2001); synchronized portfolio rebalancing actions due to informational shocks (Kodes and Pritsker, 2002); a flight to safety due to uncertainty and ambiguity aversion (Caballero and Krishnamurthy, 2008); and a string of margin calls (Brunnermeier and Pedersen, 2009).

[2](i) a company's debt financing is not more than 33 percent of its capital, (ii) interest-related income of a company is not more than 10 percent of its total income, (iii) the composition of account receivables and liquid assets (cash at

have less exposure to leverage effects (Hamada, 1972; Rubenstein, 1973; Christie, 1982; Mandelker and Rhee, 1984), especially during economic downturn. As to the bond asset class, sukuk is structured by way of bankruptcy remote using SPV in order to park it in the off balance sheet items as contingent claims. Thus, its risk-return profile should reflect the true generation process of both revenue and ownership risk in its underlying asset, depending on the type of Islamic financial contract, e.g. murabaha, ijara, musharaka, and so on.

There are two implications from our first objective. First, if the inclusion of Islamic assets into conventional portfolios, either intra-asset or inter-asset allocation, may improve their opportunity set, this will encourage conventional investors to consider Islamic asset classes as a complement in their asset allocation decision. Second, if there is no value added through allocation to Islamic asset classes, this encourages both policy makers and practitioners in the Islamic financial industry to structure Islamic assets purely according to the Shariah rules rather than merely mimicking conventional assets via *helah* (legal tricks).

Meanwhile, the second objective of our study focuses on addressing the Islamic investors' problem as to whether any conventional asset class may deliver value added to a well-diversified Islamic portfolio, accounting for the presence of tail risk. This is attributable to the nature of the investable Islamic asset classes, which mainly consist of Islamic equity, sukuk, and commodity. While only a few number of Islamic REITs exist predominantly in Malaysia, the number of established private equity funds is negligible. Moreover, the presence of Islamic hedge fund and managed futures remains controversial due to the prohibition of short-selling and derivatives. Motivated by the current condition of Islamic markets, this study identifies whether Islamic inter-asset allocation is a disadvantage. The prior studies in Islamic portfolio merely investigated the performance of a specific Islamic asset class or mutual fund against its conventional counterpart, without taking into account a mixture of multiple asset classes. Their findings provide less meaningful information for institutional investors whose primary concern is the opportunity set of multiple asset classes.

There are two implications from our second objective. First, if the opportunity set of Islamic asset classes is similar to that of their conventional counterparts, there is no way for Islamic investors to blame any limitation in any Islamic market as the source of their underperformance. The opportunity set at this point should be clearly distinguished from the skills of fund managers. The recent study by Kamil, et al. (2014) discovered that Malaysian Islamic equity funds do not outperform market benchmarks. When their performance is superior, only 1.95% of funds are genuinely skilled, whereas 47% of the observed positive fund alpha is statistically due to luck.

For the second implication, if a particular conventional asset class can expand the Islamic opportunity set, this may encourage both policy makers and practitioners in the Islamic financial industry to structure an Islamic asset class that capture the same risk-return profile.

Our study addresses the objectives using the recent mean-variance spanning test by Kan and Zhou (2012). The advantage of this recent method is not only to capture the presence of tail risk but also to identify whether the source of expanding opportunity set comes from tangency portfolio or global minimum variance. This study is organized as follows. Section 2 outlines literatures on conventional asset classes, along with its empirical evidences. We also discuss literature on prior studies in Islamic investment. Section 3 is a brief illustration of data and samples, as well as our methodology. Section 4 states our empirical results for both intra-asset and inter-asset classes We conclude in Section 5 and we provide policy implications in Section 6..

banks and marketable securities) compared to total assets is minimum at 51 percent while a few cite 33 percent as an acceptable ratio.

2. Literature review

2.1. The contribution of conventional asset classes

This sub-section discusses a number of studies that document a significant contribution of a new asset class to expand the available opportunity set either from return enhancement or risk reduction (diversification). The traditional stock-bond portfolio is considered as a standard menu of asset classes in asset allocation decision. Expanding the variety of traditional assets may achieve optimal portfolio, i.e. TIPS (Cartea et al., 2012), high-yield bond, emerging-market equity (Kortas et al., 2005), and so on.

More recently, many studies showed that the inclusion of a large menu of alternative asset classes into traditional T-bills, bonds, and stocks, also enhance the risk-return profile of the traditional portfolio. The rationale is that each alternative not only generates its unique sustainable premium but also offers an isolation across risks that the traditional portfolio are commonly sensitive to. In other words, alternative asset classes may provide return enhancement and risk reduction in the traditional portfolio. The alternative comprises two categories, which are (i) traditional alternative, i.e. commodity, real estate, private equity, and currency; and (ii) modern alternative, i.e. hedge fund and managed futures.

For the inclusion of commodity, this asset conceals a unique dimension of risk because the factors that determine its prices (i.e. weather and geopolitical conditions, supply constraints in the physical production, and event risk) are different from those in the traditional asset classes (Geman, 2005). The commodity portrays weak correlations with both traditional and the other alternative asset classes, which indicate a potential risk reduction in the portfolio. Some studies reaffirmed the additional benefit of adding commodity into a well-diversified portfolio (Satyanarayan and Varangis, 1996; Abanomey and Mathur, 1999; Conover et al., 2010; Georgiev, 2001). A further study by Shapiro and Thomas (2011) concerned on gold as a subset of commodities, where their finding showed the gold as a better inflation hedging tool as compared to the other commodities. Gold as a risk diversifier still receives a positive strategic allocation even at a low level of expected return.

As to the inclusion of real estate, this asset portrays a distinct premium which is driven by long-term population growth, uniqueness of the property, government planning and regulations, and disposable income (Case and Shiller, 2003; Schneeweis et al., 2010). Since the correlations between real estate and the other asset classes are moderate, the benefit of adding this asset to a diversified portfolio primarily comes from return enhancement rather than risk reduction. The findings so far confirmed the inclusion of real estate to achieve optimal portfolio (Lee and Stevenson, 2006; Sa-Aadu, Shilling and Tiwari, 2006; Anderson et al., 2005; Byrne and Lee, 2005).

The other studies put the importance of private equity since it generates superior long-term returns attributable to illiquid and risky investments. The asset provides a distinct risk-return profile that is derived from a variety of forms, i.e. angel investing, venture capital, mezzanine finance, mature or pre-IPO, etc. While the correlations between private equity and the other equity sensitive assets (i.e. equity, real estate, and hedge fund) are high, its correlations with non-equity based assets are substantially low. Hence, this asset class offers both return enhancement and risk diversification. Some findings documented the additional benefit of adding private equity in the inter-asset allocation decision (Schmidt, 2006; Lamm and Ghaleb-Harter, 2001; Cornelius, 2011).

Finally, modern alternative asset classes such as hedge fund and managed futures also offer sustainable premium. The correlations between hedge fund and the other asset classes depend on its strategy because its performance is sensitive to the underlying movement of securities (i.e. high correlations can be observed between equity long-short and equity index, convertible arbitrage and high-yield bond index, etc.). Therefore, the role of hedge fund is viewed as a return enhancer rather than as a risk diversifier. Some studies found that adding either hedge funds or managed futures to a diversified portfolio of ordinary assets have increased its Sharpe ratio (Edwards and Liew, 1999; Pézier and White, 2008; and so on).

To the best of our knowledge, there is no study that investigated as to whether Islamic asset classes can be considered as alternative assets to expand the conventional opportunity set, originated from either return enhancement or risk reduction. Our attempt to fill this gap is a central contribution of our study.

2.2. Islamic portfolio performance

This sub-section discusses a number of empirical studies in Islamic investment. Prior studies merely investigated the performance of Islamic investment, either as a specific asset class or mutual fund, against its conventional counterpart without taking into account a mixture of multiple asset classes. For example, Hakim and Rashidian (2002) used a CAPM and documented that the DJIMI performs well as compared to the Dow Jones World Index (DJW) but underperforms the Dow Jones Sustainability World Index (DJS). By capturing the effects of industry, size, economic conditions, and performance measures, some studies also showed that Islamic indices outperform during bull period while underperform during bear period, with the reasons of investing in growth and small-cap firms (Hussein 2004, 2005; Girard and Hassan, 2005). Al-Zoubi and Maghyereh (2007) applyied the Risk Metrics, Student-t APARCH and skewed Student-t APARCH, and found that the DJIM (Dow Jones Islamic Market index) is less risky than its respective benchmark.

A few empirical researches investigated the Islamic mutual funds' performance. They discovered that Islamic funds perform averagely similar to their conventional counterparts, and even are subject to multiple regimes (Hassan, Antoniou, and Paudyal, 2005; Elfakhani, Hassan, and Sidani, 2005; Hassan and Antoniou, 2006; Abdullah, Hassan, and Mohamad, 2007). Hoepner, Rammal, and Rezec (2011) also showed that Islamic funds from Malaysia or GCC neither significantly underperform their respective benchmarks nor are significantly affected by small-size stocks.

To the best of our knowledge, there is no study that investigated the role of conventional asset classes in a diversified Islamic portfolio, accounting for the mixture of multiple asset classes. Our attempt to fill this gap is our contribution to provide an insight for both policy makers and practitioners in the Islamic financial industry.

3. Data and methodology

Our study deals with intra-asset and inter-asset allocations for both the U.S. and Malaysian investors. We focus on the U.S. portfolios since the U.S. market is considered as one of the top financial markets which covers a large variety of asset classes. Moreover, this market belongs to the top priorities for the global Muslim investors to invest their wealth. Our study considers Malaysian portfolios since the Malaysian Islamic markets are relatively more developed, with

respect to the variety and the number of Islamic asset classes, as compared to those in the other countries.

For the U.S. investors, we cover a standard menu of a well-diversified asset allocation for them to invest in both domestic and global markets across different asset classes. The sample period is from January 1998 to June 2013, due to the inception date of all the U.S. Islamic indices, with daily observations. We use DIFX-HSBC global sukuk index instead of Dow Jones global sukuk index since the Dow Jones completely uses theoretical prices instead of true prices. For the Malaysian investors, our study covers only asset classes that are investable in Malaysia, since Malaysian investors mostly invest in the domestic market. The observations start from April 2007 to November 2013, due to the inception date of Malaysian sukuk indices, with daily observations. In addition, we also perform our spanning tests for a specific asset class according to the availability of Islamic assets in a few regions, which include DIFX-HSBC GCC sukuks (October 2005 to November 2013), BPAM Malaysian sukuks (April 2007 to November 2013), Malaysian REITs (August 2006 to October 2013), and nine sectors of Islamic equities in emerging countries (October 2003 to October 2013). Table 1 and Table 2 present the list of Islamic and conventional asset classes, respectively.

Table 1. List of conventional Islamic asset classes

No	Asset Classes	Proxies
1	Islamic U.S. equity	S&P Dow Jones U.S. equity index
2	Islamic developed markets equity	S&P Dow Jones developed mkts equity index
3	Islamic emerging markets equity	S&P Dow Jones emerging mkts equity index
4	Global sukuk	DIFX HSBC global sukuk index
		sovereign sukuk
		corporate sukuk
5	Islamic REITs	Equal weighted average Islamic REITs
6	Islamic Malaysian equity	Hijrah equity index
7	Malaysian sukuk	BPAM Malaysian sukuk index
		sovereign sukuk
		corporate sukuk AAA,AA,A,BBB
8	Islamic REITs	Equal weighted average Islamic M-REITs
9	Islamic emerging markets sectoral index	14 sectors S&P Dow Jones Islamic emerging market equity indices
10	Islamic Malaysian riskless	Islamic Interbank

Table 2. List of conventional asset classes

No	Asset Classes	Proxies
1	Riskless asset	Citigroup 3 month T-bill
2	Conventional U.S. equity	S&P 500 composite equity index
3	Conventional developed markets equity	MSCI EAFE equity index
4	Conventional emerging markets equity	MSCI EM equity index
5	U.S. corporate bond	Dow Jones corporate bonds aggregate index
6	U.S. high yield bond	Credit Suisse high yield index
7	U.S. TIPS	United States government TIPS bonds 10 Years
8	Global bond	JPM global aggregate bond Index
9	Conventional U.S. REITs	FTSE EPRA/NAREIT U.S.
10	Private equity	LPX private equity index
11	Hedge Fund	HFRX composite index
12	Commodity	S&P GSCI Commodity
13	Gold	CMX gold futures
14	Conventional Malaysian equity	FTSE KLCI equity index
15	Malaysian bond	BPAM Malaysian bond index *sovereign bond* *corporate bond AAA,AA,A,BBB*
16	Conventional Malaysian REITs	Equal weighted average M-REITs
17	GCC bond	DIFX HSBC GCC bond index *corporate bond* *financial services senior bond* *financial services subordinate bond*
18	Conventional emerging markets sectoral index	9 sectors S&P Dow Jones emerging market equity indices

For our methodology, we use the recent method of mean-variance spanning test by Kan and Zhou (2012). The advantage of this recent method is not only to capture the presence of tail risk but also to identify whether the source of expanding opportunity set comes from tangency portfolio or global minimum variance.

3.1. Mean-variance spanning test

The concept of mean-variance spanning test was introduced by Huberman and Kandel (1987). The main idea is that a set of K risky assets spans a larger set of $N + K$ risky assets if the minimum-variance frontier of the K assets is similar to that of the $K + N$ assets. K is often defined as the benchmark assets, and N represents the test assets. If we allow the existence of a riskless asset with unlimited lending and borrowing at the riskless rate, investors who care about their portfolio's mean and variance are only interested in the tangency portfolio of the risky assets which maximizes the Sharpe ratio. In other words, the major concern of investors is whether the tangency portfolio from using K benchmark risky assets is similar to that from using all $N+K$ risky assets. On the other hand, when there is no presence of riskless asset or when the riskless lending and borrowing rates are different, investors are interested in whether the two minimum-variance frontiers are similar.

Huberman and Kandel (1987) formalized the spanning as a statistical test. Suppose, $R_t = [R'_{1t}, R'_{2t}]'$ is the raw returns on $N + K$ risky assets at time t, where R_{1t} denotes a K-vector of the

returns of the K benchmark assets while R_{2t} represents an N-vector of the returns of the N test assets. We can define the expected returns of the $N + K$ assets as follow:

$$\mu = E[R_t] = \begin{bmatrix}\mu_1 \\ \mu_2\end{bmatrix}, \quad (1)$$

, and we define the covariance matrix of the $N + K$ risky assets as follow:

$$V = Var[R_t] = \begin{bmatrix}V_{11} & V_{12} \\ V_{21} & V_{22}\end{bmatrix} \quad (2)$$

, where we assume that V is nonsingular. We project R_{2t} on R_{1t}, and we have:

$$R_{2t} = \alpha + \beta R_{1t} + \varepsilon_t \quad (3)$$

, where $E[\epsilon_t] = 0_N$ and $E[\epsilon_t R'_{1t}] = 0_{N\times K}$. The 0_N is an N-vector of zeros and $0_{N\times K}$ is an N-by-K matrix of zeros. We can show that α and β are given by $\alpha = \mu 2 - \beta\mu 1$ and $\beta = V_{21}V_{11}^{-1}$. Let $\delta = 1_N - \beta 1_K$, with 1_N denotes an N-vector of ones. Huberman and Kandel (1987) provided the necessary and conditions for spanning with respects to the restrictions on α and δ as:

$$H_0: \ \alpha = 0_N, \ \delta = \ 0_N \quad (4)$$

If the above restriction holds, then for every test assets, we can find a particular portfolio of the K benchmark risky assets which has the same mean, since $\alpha = 0_N$ and $\beta 1_K = 1_N$, but a lower variance than the test asset, since $R1t$ and ϵt are uncorrelated while Var[ϵ_t] is positive definite. Therefore, the K benchmark assets dominate the N test assets. The two conditions above also can be explained further by referring to Merton (1972) and Roll (1977), where $\alpha = 0_N$ represents a test of whether the tangency portfolio has zero weights in the test assets, while $\delta = 0_N$ represents a test of whether the global minimum-variance portfolio has zero weights in the N test assets.

For multivariate tests of mean-variance spanning, we can consider the equation (3) as:

$$Y = XB + E, \quad (5)$$

, and Y is a $T \times N$ matrix of R_{2t}, X is a $T \times (K + 1)$ matrix with $[1, R'_{1t}]$, $B = [\alpha, \beta]'$ as its row, and E is a $T \times N$ matrix with ϵ'_t as its row. We assume that $T \geq N + K + 1$ and $X'X$ is nonsingular. To obtain exact distributions of the test statistics, the assumption is that, conditional on R_{1t}, the disturbances ϵ_t are i.i.d. (independent and identically distributed as multivariate normal with mean zero and variance Σ). The likelihood test of condition (4) compares the likelihood functions, where the unconstrained maximum likelihood estimators of B and Σ are as follow:

$$\hat{B} = \left[\hat{\alpha}, \hat{\beta}\right]' = (X'X)^{-1}(X'Y), \quad (6)$$

$$\hat{\sum} = \frac{1}{T}(Y - X\hat{B})'(Y - X\hat{B}) \quad (7)$$

We define $\Theta = [\alpha, \delta]'$, the null hypothesis of condition (4) is written as $H_0 : \Theta = 0_{2\times N}$. As $\Theta = AB + C$ with:

$$A = \begin{bmatrix} 1 & 0'_K \\ 0 & -1'_K \end{bmatrix}, \tag{8}$$

$$C = \begin{bmatrix} 0'_N \\ 1'_N \end{bmatrix}, \tag{9}$$

The maximum likelihood estimator of Θ is given by $\Theta \equiv [\ \hat{\alpha},\ \hat{\delta}\ ]' = A\hat{B} + C$. We further define:

$$\hat{G} = TA(X'X)^{-1}A' = \begin{bmatrix} 1 + \hat{\mu}_1' \hat{V}_{11}^{-1}\hat{\mu}_1 & \hat{\mu}_1' \hat{V}_{11}^{-1}1_K \\ \hat{\mu}_1' \hat{V}_{11}^{-1}1_K & 1_K' \hat{V}_{11}^{-1}1_K \end{bmatrix}, \tag{10}$$

, and we can define:

$$\hat{H} = \hat{\theta}\hat{\sum}^{-1}\hat{\theta}' = \begin{bmatrix} \hat{\alpha}'\hat{\sum}^{-1}\hat{\alpha} & \hat{\alpha}'\hat{\sum}^{-1}\hat{\delta} \\ \hat{\alpha}'\hat{\sum}^{-1}\hat{\delta} & \hat{\delta}'\hat{\sum}^{-1}\hat{\delta} \end{bmatrix} \tag{11}$$

By denoting $\lambda 1$ and $\lambda 2$ as the two eigenvalues of HG^{-1}, with $\lambda 1 \geq \lambda 2 \geq 0$, we can have $1/U = (1 + \lambda 1)(1 + \lambda 2)$.

As asymptotic tests can be grossly misleading in finite samples, Kan and Zhou (2012) provided finite sample distribution of the test statistics. For the geometry of test statistics, they introduce three constants, $\hat{a} = \hat{\mu}'\hat{V}^{-1}\hat{\mu}$, $\hat{b} = \hat{\mu}'\hat{V}^{-1}1_{N+K}$, $\hat{c} = 1'_{N+K}\hat{V}^{-1}1_{N+K}$. While H represents the marginal contribution of the test assets to the efficient set of the K benchmark assets, Kan and Zhou (2012) used these three constants to define:

$$U = \frac{1}{|I_2 + \hat{H}\hat{G}^{-1}|} = \frac{|\hat{G}|}{|\hat{G}+\hat{H}|} = \frac{(1+\hat{a}_1)\hat{c}_1 - \hat{b}_1^2}{(1+\hat{a})\hat{c} - \hat{b}^2} = \frac{\hat{c}_1 + \hat{d}_1}{\hat{c}+\hat{d}} = \left(\frac{\hat{c}_1}{\hat{c}}\right)\left(\frac{1+\frac{\hat{d}_1}{\hat{c}_1}}{1+\frac{\hat{d}}{\hat{c}}}\right), \tag{12}$$

, where $\hat{d} = \hat{a}\hat{c} - \hat{b}^2$ and $\hat{d}_1 = \hat{a}_1\hat{c}_1 - \hat{b}_1^2$. Hence, the F-test is written as:

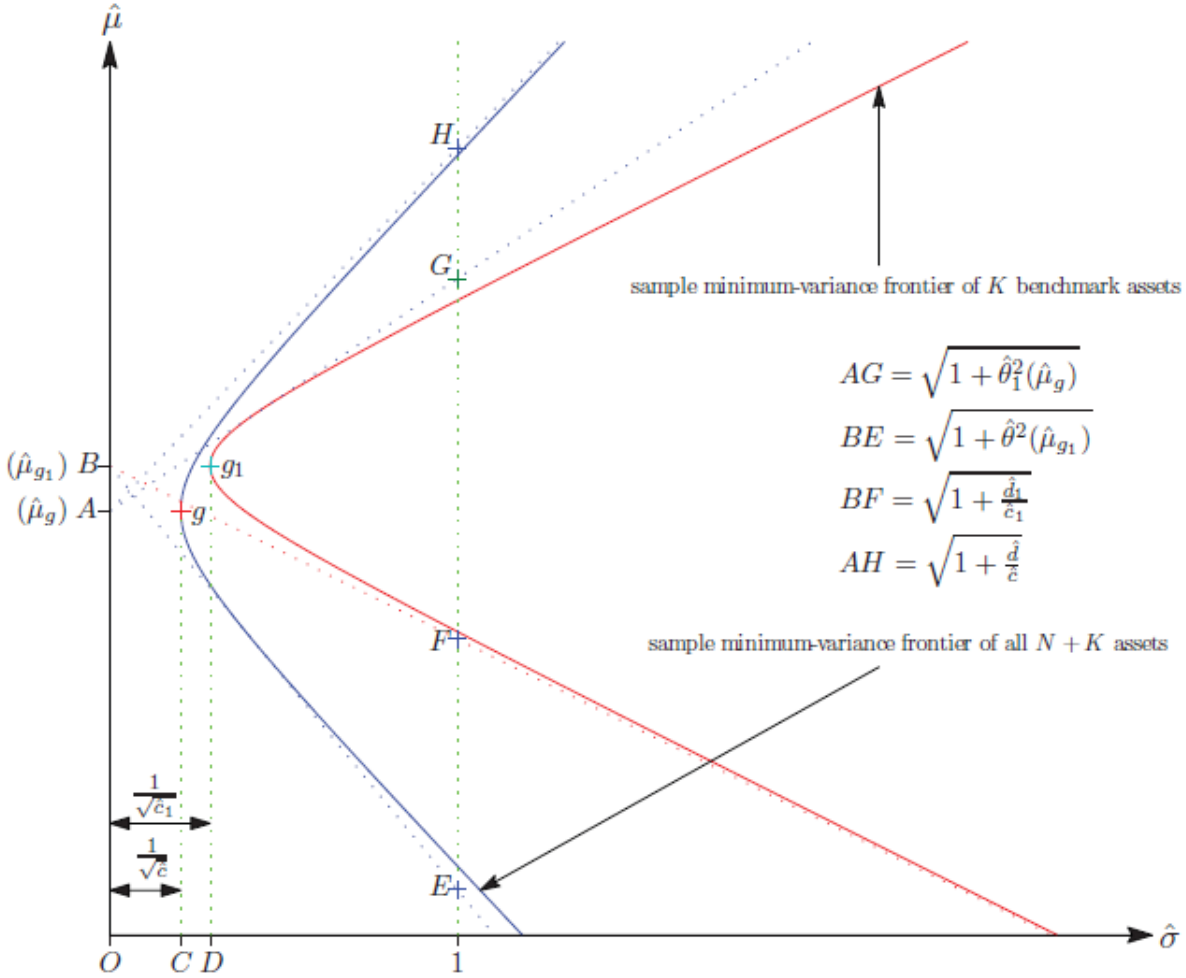
$$F = \left(\frac{T-K-N}{N}\right)\left(\frac{1}{U^{\frac{1}{2}}} - 1\right) = \left(\frac{T-K-N}{N}\right)\left[\left(\frac{\sqrt{\hat{c}}}{\sqrt{\hat{c}_1}}\right)\left(\frac{\sqrt{1+\frac{\hat{d}}{\hat{c}}}}{\sqrt{1+\frac{\hat{d}_1}{\hat{c}_1}}}\right) - 1\right] \tag{13}$$

Kan and Zhou (2012) showed the geometry of mean-variance spanning tests, where Figure 1 presents the ex post minimum-variance frontier of the K benchmark assets and of all the $N + K$ assets in the space $(\hat{\sigma},\hat{\mu})$. We denote g_1 as the ex-post global minimum-variance portfolio of the K risky assets while g as the ex-post global minimum-variance portfolio of all the $N + K$ risky assets. The F-test can be geometrically represented as:

$$F = \left(\frac{T-K-N}{N}\right)\left[\left(\frac{OD}{OC}\right)\left(\frac{AH}{BF}\right) - 1\right] \tag{14}$$

The null hypothesis states that the two minimum-variance frontiers are ex-ante identical, so that the two ratios $\sqrt{\hat{c}}/\sqrt{\hat{c}_1}$ and $\sqrt{1+\frac{\hat{d}}{\hat{c}}}\Big/\sqrt{1+\frac{\hat{d}_1}{\hat{c}_1}}$ should be close to one and the *F*-statistic should be close to zero. We reject the null hypothesis of spanning when we get a large *F*-statistic coming from either the slopes of the asymptotes to the two hyperbolae are very different or *g1* is far enough from *g*.

Figure 1. The geometry of mean-variance spanning tests



Kan and Zhou (2012) further mentioned that the above test relies heavily on the distance between the standard deviations of the two global minimum-variance portfolios instead of the distance between the two tangency portfolios, due to the joint test of (4). They argued that the spanning tests should accommodate the economic importance of the departure from the spanning hypothesis by examining the two components ($\alpha = 0_N$ *and* $\delta = 0_N$) individually instead of jointly. They at this point proposed a step-down procedure in a sequential test. The first test is $\alpha = 0_N$, and the second test is $\delta = 0_N$ but conditional on the constraint $\alpha = 0_N$. To test $\alpha = 0_N$, the *F*-test is as follows:

$$F_1 = \left(\frac{T-K-N}{N}\right)\left(\frac{|\tilde{\Sigma}|}{|\hat{\Sigma}|} - 1\right) = \left(\frac{T-K-N}{N}\right)\left(\frac{\hat{a}-\hat{a}_1}{1+\hat{a}_1}\right), \quad (15)$$

While to test $\delta = 0_N$ but conditional on the constraint $\alpha = 0_N$, the *F*-test is:

$$F_2 = \left(\frac{T-K-N+1}{N}\right)\left(\frac{|\tilde{\Sigma}|}{|\hat{\Sigma}|} - 1\right) = \left(\frac{T-K-N+1}{N}\right)\left[\left(\frac{\hat{c}+\hat{d}}{\hat{c}_1+\hat{d}_1}\right)\left(\frac{1+\hat{a}_1}{1+\hat{a}}\right) - 1\right], \quad (16)$$

The benefit of this step-down approach is the economic significance of rejecting the null. If the rejection comes from the first test, it means the two tangency portfolios are statistically different. If the rejection comes from the second test, it means the two global minimum-variance portfolios are statistically different.

Finally, Kan and Zhou (2012) proposed the spanning test under non-normality, accounting for the presence of tail risk. When ϵ_t portrays conditional heteroskedasticity, the earlier test statistics are no longer be asymptotically χ^2_{2N} distributed under the null hypothesis. They used GMM as the viable alternative which relies on the moment conditions of the model. In addition, they examined the case when the returns have a multivariate elliptical distribution. The returns with the multivariate elliptical distribution can be motivated both empirically and theoretically (Mandelbrot, 1963; Fama, 1965; Blatteberg and Gonedes, 1974; Richardson and Smith, 1993; Zhou, 1993), where stock returns tend to exhibit excess kurtosis. As most of the members in the elliptical distribution, e.g. the multivariate Student-*t* distribution, can have excess kurtosis, we can better capture the fat-tail feature of the returns with the assumption of a multivariate elliptical distribution. Kan and Zhou (2012) documented, theoretically, the use of multivariate elliptical distribution since it is the largest class of distributions for which the analysis of mean-variance is consistent with expected utility maximization. With the presence of excess kurtosis, they propose GMM step-down test. For the first step-down test, the GMM Wald test is:

$$W^e_{a1} = \frac{T\hat{\alpha}'\hat{\Sigma}^{-1}\hat{\alpha}}{1+(1+\hat{\kappa})\hat{\alpha}_1} = \frac{T(\hat{\alpha}-\hat{\alpha}_1)}{1+(1+\hat{\kappa})\hat{\alpha}_1} \sim \chi^2_N, \quad (17)$$

, and its *F*-test accounting for excess kurtosis as follows:

$$F^e_{a1} = \left(\frac{T-K-N}{N}\right)\frac{W^e_{a1}}{T} \sim F_{N,T-K-N} \quad (18)$$

For the second step-down test, the GMM Wald test is:

$$W^e_{a2} = \frac{T\left(\frac{\hat{c}+\hat{d}}{1+\hat{\alpha}} - \frac{\hat{c}_1+\hat{d}_1}{1+\hat{\alpha}_1}\right)}{(1+\hat{\kappa})\left(\frac{\hat{c}_1+\hat{d}_1}{1+\hat{\alpha}_1}\right) - \frac{\hat{\kappa}\,\hat{b}_1^2}{(1+\hat{\alpha}_1)^2}} \sim \chi^2_N \quad (19)$$

, and its *F*-test accounting for excess kurtosis as follows:

$$F^e_{a2} = \left(\frac{T-K-N-1}{N}\right)\frac{W^e_{a2}}{T} \sim F_{N,T-K-N-1} \quad (20)$$

To interpret the two tests in our study, the first test identifies whether the inclusion of any Islamic asset improves the tangency of a conventional portfolio. This means that the Islamic asset

provide return enhancement and risk reduction since the tangency portfolio maximize the Sharpe ratio by enhancing the portfolio return with the same level of risk. On the other hand, the second test examines whether the inclusion of Islamic asset reduces the global minimum variance of a conventional portfolio. This implies that the Islamic asset offers risk reduction for conventional investors who are interested in the global minimum-variance portfolio. The two tests account for both the assumption of normality as well as the existence of tail risk.

3.2. Factor regimes

Our study performs the spanning tests not only for those investors who are interested in investing in the long term but also for those who use dynamic strategies across multiple regimes. A strand of literatures mentioned the importance of both macroeconomic and factor premium regimes. For the macroeconomic regimes, the dynamics of macro-driving variables drive the behavior of each asset class over different cycles, i.e. recession, expansion, etc. (Fama and French, 1986; Gosling, 2010). Many empirical studies further showed that the returns of various asset classes follow a complicated process with multiple macroeconomic regimes, along with a very different distribution of asset returns (Ang and Bekaert, 2002a; Honda, 2003; Detemple et al., 2003; Calvet and Fisher, 2005; and Lettau et al., 2005).

As to the factor regimes, a strand of literatures documented the superiority of factor-based asset allocation relative to asset-classes-based asset allocation (Clarke, de Silva, and Murdock, 2005; Bender, Briand, Nielsen, and Stefek, 2010; Bender et al., 2010; Page and Taborsky, 2011). The rationale is that the factor-based allocation concentrates on factors that carry risk premium as multiple distinct sources of returns. A number of distinct premiums across multiple asset classes may include equity premium, term structure premium, default premium, exchange rate premium, funding premium, and so on (Pástor and Stambaugh, 2000; Lustig, Roussanov, and Verdelhan, 2011; Asl and Etual, 2012; Adrian, Etula, and Muir, 2012;). Since each factor premium varies in different points in time (Arshanapalli, Coggin, and Doukas, 1998; Oertmann, 1999; Ahmed, Lockwood and Nanda, 2002; Amenc, Malaise, Martellini and Sfeir, 2003), the use of either dynamic or tactical strategies may capture the advantage of market pricing anomalies in order to improve the risk-return profile of the overall portfolio (Anson, 2004; Fridson and Mcleod-Salmon, 2011; Amenc et al., 2010; Wang and Kochard, 2012; Qian, 2003; and so on).

The above findings motivate our study to perform our spanning tests across multiple macroeconomic and factor regimes. The rationale is that the shape of classical mean-variance frontier (MVF) and the location of efficient portfolios change drastically across multiple regimes (Sch¨ottle and Werner, 2006). The investors at this point may use dynamic strategies by systematically adjusting allocations according to the state-dependent mean variance frontiers.

For the macroeconomic regimes, our study uses the business cycle phase for the U.S. which is determined by the NBER (National Bureau of Economic Research) dating panel. For Malaysia, we use the business cycle dating determined by Malaysian Economic Indicator, Department of Statistics of Malaysia. For the factor regimes, we concern on equity premium, term structure premium, and default premium, based on the above literatures. We use the Markov regime switching model to estimate each factor premium's mean and variance in different regimes. This method has been extensively used in the regime-based asset allocation (Garcia and Perron, 1996; Gray, 1996; Whitelaw, 2001; Perez-Quiros and Timmermann, 2000; Ang and Bekaert, 2002a,b; Ang and Chen, 2002c; Guidolin and Timmermann, 2005a,b, 2006a–c; Guidolin and Timmermann, 2007). We use the switching model with two regimes, where investors may shift their allocation

when the available factor premium exhibit a high or low return. Following Guidolin and Timmermann (2007), our study estimates factor excess returns as follow:

$$y = \mu(s_t) + u_t \tag{21}$$

$$u_t|s_t \sim NID(0, \sum(s_t)) \tag{22}$$

, where we follow Krolzig (1997) that the model can be estimated with regime shifts in the mean as well as the error variance, $\sum$. We can define a Markov Chain as:

$$P\{s_t = j|s_{t-1} = k, \ldots\} = P\{s_t = j|s_{t-1} = i\} = P_{ij} \tag{23}$$

, where P_{ij} denotes the probability that a variable s_t state i (regime i) will be followed by state j (regime j), so that $P_{i1}+P_{i2}+\ldots..+P_{in}=1$. A transition matrix is estimated by:

$$P = \begin{bmatrix} P_{11} & P_{12} & \ldots & P_{1n} \\ P_{21} & P_{11} & \ldots & P_{11} \\ P_{n1} & P_{n2} & \ldots & P_{nn} \end{bmatrix} \tag{24}$$

4. Empirical results

This section presents our empirical results according to different scenarios. First, we perform the spanning tests for those investors who are interested in holding the U.S. portfolios. It is common for the U.S. portfolios to invest domestically and globally. Our study uses the spanning tests for both intra-asset and inter-asset allocations, dealing with the objectives of conventional and Islamic investors. Second, we perform the spanning tests for a specific asset class in a few regions. The final part is to perform the tests for the Malaysian portfolios.

4.1. Mean-variance spanning tests for the U.S. portfolios

4.1.1. Regimes in factor premium

We determine the regimes which allows us to perform the spanning tests of the long-term mean variance as well as the state-dependent mean variance. From the start of our observations in 1998, a number of recession periods from the NBER dating panel are from March 2001 to November 2001, and from December 2007 to June 2009. For our factor premium, the equity premium is computed by SandP 500 Composite index return minus three-month U.S. T-bill rate; the term structure premium is calculated by 20-year U.S. Treasuries yield minus 3-month U.S. Treasuries yield; and the high-yield spread is Barclays Capital U.S. Corporate High-Yield index return minus U.S. Corporate AAA index return. A higher high-yield spread indicates a lower default premium, and vice versa. These are common measures for the premiums in the factor-based asset allocation (see for example, Clarke, de Silva, and Murdock (2005), Bender, Briand, Nielsen, and Stefek (2010), Bender et al. (2010), Page and Taborsky (2011)).

Figure 2 shows the graphs for both macroeconomic and factor regimes. Table 3, Table 4, and Table 5, present the estimation results using the Markov regime switching model for equity premium, term structure premium, and high-yield spread. We can notice that the Davies linearity tests for the three premiums strongly reject the null hypothesis, which means that the non-linearity

of each factor premium is statistically significant. The first and second regimes indicate the bullish and bearish periods for each factor premium.

Figure 2. Regimes in factor premium in the U.S.

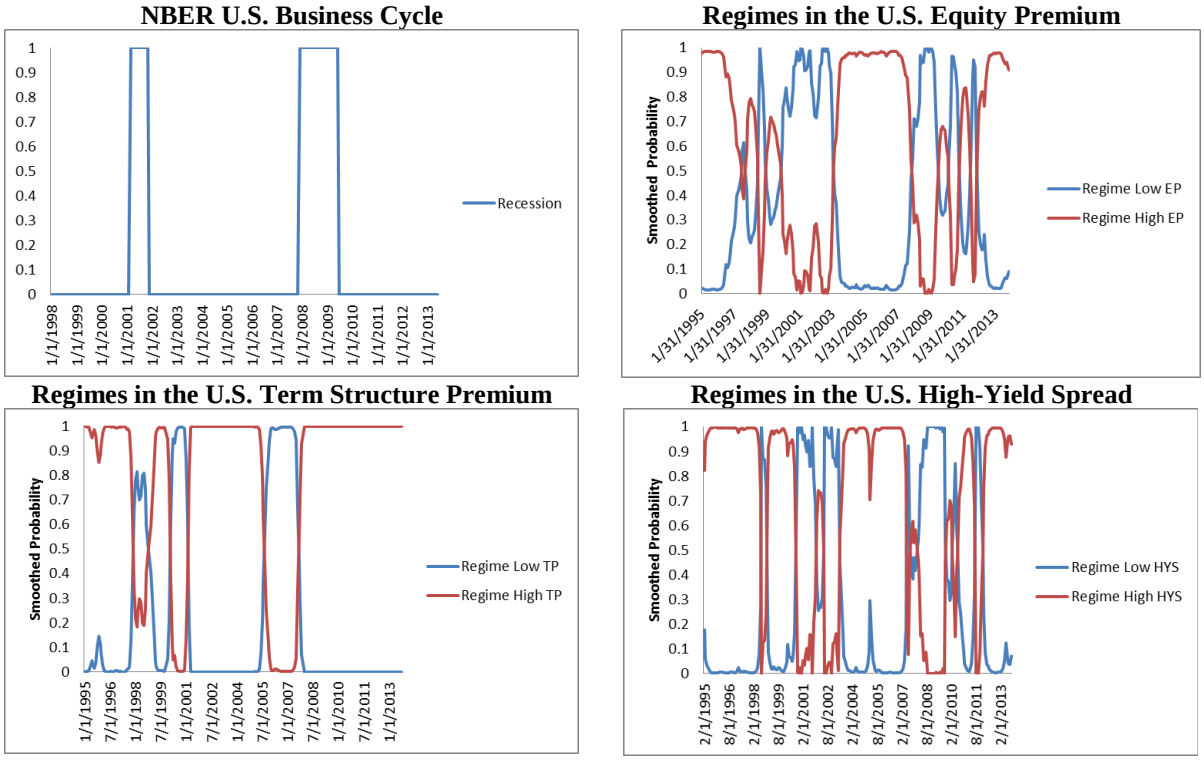


Table 3. Markov switching for the U.S. equity premium (switching variance)

	Coefficient	Std.Error	t-stat	p-value
Intercept (0)	-0.0093	0.0052	-1.7800	0.0740
Intercept (1)	0.0073	0.0021	3.4900	0.0010
sigma (0)	0.0586	0.0066	8.9300	<0.001
sigma (1)	0.0303	0.0033	9.1500	<0.001
p_{0|0}	0.8963	0.0885	10.1000	<0.001
p_{0|1}	0.0603	0.0257	2.3500	0.0190

log-likelihood	1058.09521		
no. of observations	599	no. of parameters	6
AIC.T	-2104.19043	AIC	-3.51283877
mean(EP)	0.00118391	var(EP)	0.00191278

Linearity LR-test Chi^2(4) = 66.819 **

Transition probabilities p_{i|j} = P(Regime i at t+1 | Regime j at t)

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.89627	0.060309
Regime 1,t+1	0.10373	0.93969

Table 4. Markov switching for the U.S. term structure premium (switching variance)

	Coefficient	Std.Error	t-stat	p-value
Intercept (0)	0.000187	0.000103	1.810000	0.0710
Intercept (1)	0.001963	0.000103	19.100000	<0.001
sigma (0)	0.000522	0.000037	14.100000	<0.001
sigma (1)	0.000786	0.000045	17.400000	<0.001
p_{0|0}	0.502130	0.085570	5.870000	<0.001
p_{0|1}	0.033257	0.010160	3.270000	0.0010

log-likelihood 4026.793

no. of observations 717 no. of parameters 6

AIC.T -8041.586 AIC -11.2156011

mean(Trans Prob) 0.00134007 var(Trans Prob) 1.21608e-006

Linearity LR-test Chi^2(4) = 322.89 ***

Transition probabilities p_{i|j} = P(Regime i at t+1 | Regime j at t)

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.50213	0.033257
Regime 1,t+1	0.49787	0.96674

Table 5. Markov switching for the U.S. high-yield spread (switching variance)

	Coefficient	Std.Error	t-stat	p-value
Intercept (0)	0.0011	0.00062	1.7900	0.0725
Intercept (1)	0.0057	0.0012	4.8900	<0.001
sigma (0)	0.0452	0.0057	7.9700	<0.001
sigma (1)	0.0124	0.0012	10.2000	<0.001
p_{0|0}	0.8786	0.0733	12.0000	<0.001
p_{0|1}	0.0524	0.0249	2.1000	0.0370

log-likelihood 552.985561

no. of observations 225 no. of parameters 6

AIC.T -1093.97112 AIC -4.86209388

mean(DP) 0.0043233 var(DP) 0.000735136

Linearity LR-test Chi^2(4) = 121.02 ***

Transition probabilities p_{i|j} = P(Regime i at t+1 | Regime j at t)

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.87862	0.052411
Regime 1,t+1	0.12138	0.94759

Looking at Table 3, the bearish equity premium has a negative average return and a high volatility, while the bullish premium has a positive return and a low volatility. The bearish regime covers the periods of August 1998 to December 1998, December 1999 to February 2003, December 2007 to August 2009, March 2010 to October 2010, and August 2011 to November 2011. This is understandable as these periods can be linked to a few major events such as the Russian' default in August 1998, the dot-com bubble burst in 1999 to 2001, the Enron's collapse in 2002, the U.S. subprime crisis in 2007, and the Euro crisis in 2010.

While analyzing Table 4, we can notice that the low term premium comes with its low volatility, and vice versa. The bearish regime exhibits a low yet positive average return, which covers the periods of January 1998 to October 1998, February 2000 to February 2001, and November 2005 to August 2007. This is a regime when an average of yield difference between long-term and short-term treasuries is lower relative to that in another regime. For example, the period of 2005 to 2007 is understandable as the yields at longer maturities stayed at surprisingly low rates despite of the rising short-term interest rates from a series of policy tightening by the Federal Reserve started in 2004.

Table 5 shows that the bearish regime of high-yield spread exhibits a low yet positive average return, which covers the periods of August 1998 to November 1998, September 2000 to November 2001, May 2002 to April 2003, June 2007 to October 2009, March 2010 to July 2010, and August 2011 to January 2012. Again, these periods can be related to a few crises, which are similar to our findings in the equity premium. This can be understood since a lower high-yield spread indicates a higher default premium in the market (Clarke, de Silva, and Murdock, 2005).

4.1.2. Complement and substitute tests for the U.S. portfolios: Intra-asset classes

This sub-section performs our spanning tests for the U.S. portfolios, concerning only on each specific asset class or intra-asset allocation. We conduct both complement and substitute tests in order to satisfy the objectives of conventional and Islamic investors. Table 6 and Table 7 present the details of our complement and substitute tests, respectively.

For our complement test in a particular asset class, we identify whether the inclusion of Islamic assets into a conventional portfolio may deliver value added. The test also investigates the source of value added in the conventional portfolio, originated from either improving its tangency portfolio (TP) or reducing its global minimum variance (GM). For the example of the equity asset class, the prior portfolio is a conventional equity portfolio which comprises conventional equity indices in the U.S., developed markets, and emerging markets. We perform the spanning tests by including each Islamic equity index one by one, as well as all the Islamic equity indices, into the prior portfolio. The results are useful for conventional investors not only to know which Islamic assets that can be considered as a complement in their portfolio, but also to know the source of expanding opportunity set.

Table 6. Complement tests for the U.S. conventional portfolios: intra-asset classes

Test	Prior Portfolio	Complement Test	Outcome	
		Inclusion of asset		
1	All conventional equities	1. Islamic U.S. equity 2. Islamic developed markets equity 3. Islamic emerging markets equity 4. All Islamic equities	Whether the inclusion of Islamic asset may add value when it is included in conventional portfolio	If yes, whether Islamic improves tangency or global minimum variance of conventional portfolio
2	All conventional bonds	1. Global sukuk		

For our substitute test in a particular asset class, we identify whether Islamic assets can replace their conventional counterparts in a conventional portfolio. For the example of the equity asset class, the prior portfolio comprises the U.S. Islamic equity index, as well as conventional equity indices in developed and emerging markets. We perform our spanning test by including the U.S. conventional equity index into the prior portfolio. If the result is statistically significant, it means that the U.S. Islamic equity index can be considered as a substitute for the U.S. conventional equity index in the conventional equity portfolio. This is useful for Islamic investors who still invest completely in conventional assets. In particular, our result may encourage them to be consistent with the Shariah rules by investing only in Islamic assets, justified by the opportunity set.

Table 8 presents a sample of our complete empirical results only for the equity asset class in the long term. The complete empirical results for all tests are presented in the appendices of our study[3]. For the example of interpreting our results in Table 8, a complement test for the emerging markets' Islamic equities shows that statistically significant results can be found only in the global minimum variance for both normal distribution and *t*-distribution. This means that the inclusion of these Islamic equities into the conventional equity portfolio for long-term investment can reduce its global minimum variance, even accounting for tail risk, but does not improve its tangency portfolio. For all sections of our study, we only show the summary of our tests for each asset class in the long term as well as in multiple regimes. We define TP as the improvement in tangency portfolio while GM as the reduction in global minimum variance.

[3] Appendices are available upon request to the author since it contains 100 pages of tables

Table 7. Substitute tests for the U.S. conventional portfolios: intra-asset classes

Test	Prior Portfolio	Substitute Test Inclusion of asset	Outcome	
1	**Islamic U.S. equity** Conventional developed markets equity Conventional emerging markets equity	Conventional U.S. equity	Whether the inclusion of conventional equity may add value when it is included in the prior equity portfolio	(1) If yes, whether conventional improves tangency or global minimum variance of prior equity portfolio (2) If no, Islamic equity can be a substitute for corresponding conventional equity
2	Conventional U.S. equity **Islamic developed markets equity** Conventional emerging markets equity	Conventional developed markets equity		
3	Conventional U.S. equity Conventional developed markets equity **Islamic emerging markets equity**	Conventional emerging markets equity		
4	**All Islamic equities**	All conventional equities		
5	**Global sukuk** U.S. high yield bond U.S. TIPS U.S. corporate bond	Global bond	Whether the inclusion of conventional bond may add value when it is included in the prior bond portfolio	(1) If yes, whether conventional improves tangency or global minimum variance of prior bond portfolio
6	Global bond **Global sukuk** U.S. TIPS U.S. corporate bond	U.S. high yield bond		
7	Global bond U.S. high yield bond **Global sukuk** U.S. corporate bond	U.S. TIPS		(2) If no, Islamic equity can be a substitute for corresponding conventional bond
8	Global bond U.S. high yield bond U.S. TIPS **Global sukuk**	U.S. corporate bond		
9	**Global sukuk**	All conventional bonds		

Table 8. Results of complement tests for equity portfolios (long-term horizon)

Test	Inclusion	Long-term									
		Complement					Substitute				
			Tangency Portfolio		Global Min. Variance			Tangency Portfolio		Global Min. Variance	
		Normal		t-dist	Normal	t-dist	Normal		t-dist	Normal	t-dist
		Ft (p-value)	*F1(p-value)*	*Fe1(p-value)*	*F2(p-value)*	*Fe2(p-value)*	*Ft (p-value)*	*F1(p-value)*	*Fe1(p-value)*	*F2(p-value)*	*Fe2(p-value)*
1	Islamic U.S. equity	0.410	0.815	0.814	0.004	0.001					
		0.664	0.367	0.367	0.948	0.977					
	Conventional U.S. equity						**30.494*** **	0.657	0.656	**60.336*** **	**12.120*** **
							0.000	0.418	0.418	0.000	0.001
2	Islamic developed market equity	0.608	1.023	1.022	0.193	0.038					
		0.545	0.312	0.312	0.660	0.846					
	Conventional developed market equity						**119.211*** **	1.173	1.172	**237.239*** **	**46.341*** **
							0.000	0.279	0.279	0.000	0.000
3	Islamic emerging market equity	**19.352*** **	0.253	0.253	**38.458*** **	**8.436*** **					
		0.000	0.615	0.615	0.000	0.004					
	Conventional emerging market equity						0.431	0.820	0.820	0.041	0.009
							0.650	0.365	0.365	0.839	0.924
4	All Islamic equities	**6.749*** **	0.438	0.437	**13.093*** **	**2.993** **					
		0.000	0.726	0.726	0.000	0.030					
	All conventional equities						**41.716*** **	0.579	0.578	**84.103*** **	**19.224*** **
							0.000	0.629	0.629	0.000	0.000

Table 9. Summary of complement tests for equity portfolios

Test	Inclusion (normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Islamic U.S. equity	No	**GM**	**GM**	**GM**	No	**TP**	**GM**	**GM**	**GM**
2	Islamic developed mkt equity	No	**GM**	**GM**	No	No	**TP**	**GM**	**GM**	**GM**
3	Islamic emerging mkt equity	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	No	No	**GM**
4	All Islamic equities	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Islamic U.S. equity	No	**GM**	**GM**	**GM**	No	**TP**	**GM**	**GM**	**GM**
2	Islamic developed mkt equity	No	**GM**	No	No	No	**TP**	**GM**	**GM**	No
3	Islamic emerging mkt equity	**GM**	No	**GM**	**GM**	**GM**	**GM**	No	No	**GM**
4	All Islamic equities	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**

Table 10. Summary of substitute tests for equity portfolios

Test	Inclusion (normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Conv. U.S. equity	**GM**	**GM**	**GM**	**GM**	**GM**	**TP**	**GM**	**GM**	No
2	Conv. developed mkt equity	**GM**	**GM**	**GM**	**GM**	**GM**	**TP**	**GM**	**GM**	**GM**
3	Conv. emerging mkt equity	No	**GM**	**GM**	No	No	No	No	**GM**	**GM**
4	All conventional equities	**GM**	**GM**	**GM**	**GM**	**GM**	**TP**	**GM**	**GM**	**GM**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Conv. U.S. equity	**GM**	**GM**	No	**GM**	**GM**	**TP**	**GM**	**GM**	No
2	Conv. developed mkt equity	**GM**	**GM**	**GM**	**GM**	**GM**	**TP**	**GM**	**GM**	**GM**
3	Conv. emerging mkt equity	No	**GM**	**GM**	No	No	No	No	**GM**	No
4	All conventional equities	**GM**	**GM**	**GM**	**GM**	**GM**	**TP**	**GM**	**GM**	**GM**

In regards to the equity asset class, Table 9 and Table 10 shows the summary of our complement tests and substitute tests, respectively. From our complement tests, taking into account for tail risk, we notice that only the emerging markets' Islamic equities can be considered as a complement for conventional investors in the long term. Even though both the U.S. Islamic equities and the developed markets' Islamic equities can add value in several regimes, they do not expand the frontier of conventional portfolios in the long term. This is attributable to the period of low equity premium for the U.S. Islamic equities, as well as the periods of recession, low equity premium, and high default premium for the developed markets' Islamic equities. Our findings at this point imply that the major contribution of the emerging markets' Islamic equities for the long-term conventional investors comes during economic downturn and market turbulence. This evidence is confirmed by the source of value added originated from reducing the global minimum variance of the conventional portfolios. There are at least two reasons to explain this evidence.

The first is leverage effect. The theory mentions that the levered equity beta is decomposed into a business risk and a financial risk components (Hamada, 1972; Rubenstein, 1973; Christie, 1982; Mandelker and Rhee, 1984). A fixed financial commitment out of uncertain revenues increases the risk of the cash flow to equity ratio. The decreasing cash flow at this point raises the debt to equity ratio, which subsequently increases stock volatility borne by equity holders. As a result, a depressed equity price will deteriorate expected cash flow, raise financing cost, lower credit rating, and increase a chance of bankruptcy of the firm (Leland and Toft, 1996).

We can link this theory to the nature of emerging markets' firm and economy. We may explain with the example of the Asian region during market turbulence in United States. When any financial turmoil occurred in United States, like the U.S. subprime crisis, any Asian country with a low exposure to U.S. subprime mortgages still absorbed contagious effects, attributable to the deepening financial integration. In that case, Brana and Lahet (2010) discovered that credit spreads in Asia considerably increased even higher than those in United States and Europe. The spillover effects were transmitted via global and region-specific risk pricing factors because the Asian markets were heavily subject to herding asymmetry as an overreaction of investors to bad news (Kim, Loretan, and Remolona, 2010; Chiang and Zheng, 2010). This triggered a substantial drop in the Asian equity prices. The major implication of this evidence is a different risk-return profile between Islamic and conventional equities. Most of the Asian firms have a high level of interest-based debt. Many stocks therefore are excluded from the Islamic investment universe by screening criteria. When there is a massive drop in stock prices, Islamic equities are less exposed to leverage effect, which further exhibit lower volatility relative to their conventional counterparts. It may implies that Islamic equities in emerging markets offer the benefit of risk reduction for U.S. investors during the U.S. crisis period, even accounting for the presence of tail risk.

For the second reason of risk diversification, we can observe from the constituent lists of Islamic and conventional indices in emerging markets. The emerging markets' Islamic equities exclude financial sector, put lower weight on oil and gas sector, and allocate more on industrial and technology sectors. Hence, due to the exclusion of financial sector, Islamic stocks are less sensitive to any external shock transmitted via financial integration. They absorb the least impact of excessive contagion in financial markets, which is transmitted from the U.S. via sentiment shift of investors, unrelated to fundamental linkages (Eichengreen et al., 1996; Forbes and Rigobon, 2002; Bae et al., 2003). In addition, the lower allocation on oil and gas sector results in less exposures of Islamic equities to the fluctuation in the global oil market driven by the U.S.-Iraq war, the global crisis in 2008, and Arab spring. A further explanation, including the important role

of industrial sector, will be comprehensively elaborated in our complement tests in the next sub-section.

For both the U.S. and the developed markets' Islamic equities, our findings show the value added of including the two into the conventional portfolios in some certain regimes, mostly via reducing the global minimum variance. The U.S. Islamic equities still provide the benefit of risk reduction in the periods of recession and high default premium. The two Islamic indices even can expand the tangency portfolio in the period of high term structure premium. This is understandable as Islamic indices in the western markets put higher allocation mostly on technology and industrials sectors, which perform better during a high inflationary regime.

From our substitute tests, considering for tail risk, Table 10 shows that only the emerging markets' Islamic equities that can be considered as a substitute of their conventional counterparts for Islamic investors in the long term. Again, we can see their main role in the periods of market turbulence and high default premium. For the remaining indices, Islamic investors still need to invest in conventional equities in some certain regimes to reduce the global minimum variance. Even Islamic investors need to invest in conventional assets in the period of high term structure premium to improve the tangency portfolio.

Our overall findings in the equity asset class show that the conventional equity investors may take Islamic equities to minimize the global minimum variance of their portfolio. For the conventional equity investors who are only interested in improving their Sharpe ratio by way of tangency portfolio, the advantage is limited to Islamic equities in the U.S. and developed markets in the period of high term premium. On the other hand, the long-term Islamic equity investors should not take conventional equities in emerging countries since there is completely no value added. The Islamic equity investors may consider conventional equities to minimize the global minimum variance in some certain regimes. However, for the Islamic equity investors who only concern on improving their Sharpe ratio, they can benefit from conventional equities in the U.S. and developed markets only during the high term premium regime. For the remaining periods, the Islamic opportunity sets are sufficient for the Islamic equity investors to invest purely in Islamic equities. Our findings may encourage the Islamic equity investors to be completely consistent with Shariah rules that are imposed on their way of investing.

Table 11 and 12 present our complement and substitute tests for the bond asset class. Without accounting for tail risk, Table 11 shows that the inclusion of global sukuks can expand the tangency of conventional bond portfolios in the long term as well as in all the regimes, except in the period of low term premium.

Table 11. Summary of complement tests for bond portfolios

Test	Inclusion (normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Sukuk									
1	Global sukuk	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**GM**	**TP**	**TP**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Sukuk									
1	Global sukuk	No	No	No	No	No	No	No	No	No

Table 12. Summary of substitute tests for bond portfolios

Test	Inclusion (normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Bond									
1	Global bond	No	No	No	No	No	No	No	No	No
2	U.S. high yield bond	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
3	U.S. TIPS	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
4	U.S. corporate bond	**TP**	No	No	No	No	No	No	No	**TP**
5	All conventional bonds	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Bond									
1	Global bond	No	No	No	No	No	No	No	No	No
2	U.S. high yield bond	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
3	U.S. TIPS	**TP**	**TP**	**TP**	**GM**	**TP**	**TP**	**TP**	**GM**	**TP**
4	U.S. corporate bond	No	No	No	No	No	No	No	No	No
5	All conventional bonds	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

This evidence can be explained by looking at the constituent lists of our global sukuk index. The DIFX global sukuk index covers sukuks that are issued mostly in Muslim countries around the world. However, the index imposes a relatively stricter rule with respects to a Shariah-compliant structure in which any listed sukuk should be approved by at least one Middle East-based Shariah scholar. This condition leads the index to exclude many sukuks issued in Malaysia which has a variety, with a huge amount, of sukuk issuances. The reason is because Malaysia allows the application of *bay-al-inah* and *bay-ad-dayn*. While the former allows any debt-generated sukuk to be structured with a buy-back mechanism, the later allows any debt-generated sukuk to be traded at discount or premium. The major implication of this strict filtering process is that the index represents sukuks issued mostly in Middle East and a few Muslim countries. Particularly, a large number of these sukuks are issued to finance infrastructures, oil and gas sector, and real estates in the last ten years. It seems that the sukuks in these growing economies, specific only to some certain sectors, may provide a return enhancement for a conventional bond portfolio.

However, we should notice that when we are aware of tail risk, the inclusion of global sukuks does not deliver any value added for the conventional bond investors. We argue that this evidence is attributable to the sukuks listed in Middle East countries. Their sukuks are issued to finance infrastructures, real estates, and any commercial activities, related to oil-generating businesses. Therefore, their sukuks' risk-return profile is heavily sensitive not only to the global supply-demand of oil but also to the U.S. economy, since Arab countries and United States belong to the top supplier and consumer of oil in the world. The example is the default of Dubai state-enterprise Nakheel at $4Billion in December 2009, which substantially hit the sukuk markets around the world.

For our substitute tests in the bond asset class, Table 12 shows that, accounting for tail risk, global sukuks can be considered as a substitute for global bonds and U.S. bonds for Islamic investors. We argue that this might be due to the structure of sukuk instrument. Specifically, sukuk

is structured in bankruptcy remote using SPV in order to set it aside in off balance sheet structure as contingent claims. Since most of the sukuks are issued to finance infrastructures and real estates, their combined risk-return profiles exhibit the profiles of asset-based project financing, infrastructure financing, and real estate financing. Their unique profile is further blended with the nature of growing Arab economies which is mainly driven by oil booms. Combining with a few sukuks in the other Muslim countries (i.e. Indonesia, Malaysia, etc.), this may create a risk-return profile which may compensate the profile of those two conventional bonds. Nonetheless, our global sukuks cannot replace the role of TIPS and high-yield bonds, even considering for tail risk. This is understandable as sukuks are mostly structured using *ijara* contract, which portrays a fixed-income nature. In addition, any sukuk with a poor rating or junk sukuk is excluded from the index. Therefore, Islamic investors may consider these two bonds if they want improve their tangency portfolio but they should forgo both global bonds and U.S. bonds since their opportunity sets are sufficient.

4.1.3. Complement and substitute tests for the U.S. portfolios: Inter-asset classes

In this sub-section, we perform both complement and substitute tests, considering a mixture of different asset classes or inter-asset classes. This is useful for institutional investors who concern on multiple asset classes rather than only a particular asset class. Table 13 presents the detail of our complement tests while Table 14 and Table 15 present the detail of our substitute tests. The prior portfolio comprises all asset classes. We perform our tests of including equity asset class and bond asset class into the prior portfolio.

Table 13. Complement tests for the U.S. portfolios: inter-asset classes

Prior Portfolio	**Complement Test**	Outcome	
	Inclusion of asset		
All asset classes in conventional portfolio	1. Islamic U.S. equity 2. Islamic developed markets equity 3. Islamic emerging markets equity 4. All Islamic equities 5. Global sukuk 6. All Islamic equities and global sukuk	Whether the inclusion of Islamic asset may add value when it is included in conventional portfolio	If yes, whether Islamic improves tangency or global minimum variance of conventional portfolio

Table 14. Substitute tests for the U.S. portfolios: inter-asset classes

Test	Prior Portfolio	Substitute Test: Inclusion of asset	Outcome	
1	U.S. T-bill 3 month			
2	Conventional U.S. equity			
3	Conventional developed markets equity			(1) If yes, whether conventional EM equity improves tangency or global minimum variance of prior equity portfolio
4	**Islamic emerging markets equity ==>**	**Conventional emerging markets equity**		
5	U.S. corporate bond		Whether the inclusion of conventional equity may add value when it is included in the prior equity portfolio	
6	U.S. TIPS			
7	U.S. high-yield bond			
8	Global bond			
9	U.S. REITs			
10	Private equity			(2) If no, Islamic EM equity can be a substitute for corresponding conventional EM equity
11	Hedge fund			
12	Commodity			
13	Gold			

Table 15. Asset substitution

No	Islamic asset class	Substitute to conventional asset class
1	Islamic U.S. equity ==>	Conventional U.S. equity
	Islamic developed mkt equity ==>	Conventional developed mkt equity
	Islamic emerging mkt equity ==>	Conventional emerging mkt equity
	All Islamic equities ==>	All conventional equities
2	Global sukuk ==>	Global bond
	Global sukuk ==>	All conventional bonds
3	All Islamic equities and Global sukuk ==>	All conventional equities and bonds

Table 16. Summary of complement tests for including equity asset class

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Islamic U.S. equity	**GM**	No	**GM**	No	No	**GM**	**TP**	No	No
2	Islamic developed mkt equity	No	No	No	No	No	No	**TP**	No	No
3	Islamic emerging mkt equity	No	No	No	**TP**	No	No	No	No	No
4	All Islamic equities	No	No	No	No	No	No	No	No	No

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Islamic U.S. equity	No	No	No	No	No	No	No	No	No
2	Islamic developed mkt equity	No	No	No	No	No	No	No	No	No
3	Islamic emerging mkt equity	No	No	No	No	No	No	No	No	No
4	All Islamic equities	No	No	No	No	No	No	No	No	No

Table 17. Summary of substitute tests for including equity asset class

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Conv. U.S. equity	**GM**	No	**GM**	**TP**	No	**GM**	No	No	No
2	Conv. developed mkt equity	**GM**	**GM**	**GM**	No	**GM**	**GM**	No	No	**GM**
3	Conv. emerging mkt equity	**GM**	**GM**	No	**GM**	**GM**	**GM**	No	**GM**	No
4	All conventional equities	**GM**	**GM**	No	No	**GM**	**GM**	No	**GM**	**GM**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Equity									
1	Conv. U.S. equity	No	No	No	No	No	No	No	No	No
2	Conv. developed mkt equity	**GM**	No	**GM**	No	**GM**	**GM**	No	No	**GM**
3	Conv. emerging mkt equity	No	No	No	No	No	No	No	No	No
4	All conventional equities	No	No	No	No	No	No	No	No	No

Table 16 and Table 17 presents the inclusion of the equity asset class into the prior portfolio for both complement and substitute tests. For our complement tests, accounting for tail risk, we notice that the inclusion of any Islamic equity into the conventional portfolio does not deliver any value added in the long term as well as in all the regimes. It means that Islamic equities do not expand the frontier of the conventional portfolio with multiple conventional asset classes. We argue that the risk-return profile produced by a mixture of conventional asset classes can compensate for the role of individual Islamic equities. This is understandable as the current Islamic equities do not represent the ideal equities according to the Shariah rules. Ideally, pure Islamic equities should be financed completely by equity financing. The prohibition of debt trading (*bay-ad-dayn*) except at par value discourages Islamic firms to put any debt-generated instrument (like murabaha, salam, etc.) in their liabilities structure. Even if Islamic firms still insist to use this instrument, the amount of financing is limited to the real assets that they generate. For another instrument, although Islamic firms are allowed to trade *ijara* sukuk at discount or premium, this instrument is structured in bankruptcy remote in off balance sheet structure. The implication may lead the pure Islamic equities to produce such a unique risk-return profile. In the contrary, the

current Shariah screening still allows a certain level of tolerance in several components, i.e. the limits for interest-based debt, interest-related income, composition of account receivables and liquid assets. This is mainly to come up with some investable Islamic equities in the market since only a small number of today's listed firms fit into the ideal requirement.

For our substitute tests, considering for tail risk, Table 17 shows that Islamic equities in United States and emerging markets can be considered as substitutes for their conventional counterparts. Although the developed markets' conventional equities can reduce the global minimum variance, the combination of all conventional equities do not add value. Therefore, Islamic investors who still invest in all conventional asset classes should replace all conventional equities with all Islamic equities, justified by their opportunity sets.

For the inclusion of global sukuks into the prior portfolio, Table 18 shows our complement tests, where global sukuks can be considered as a complement to improve the global minimum variance for the long-term conventional investors, accounting for tail risk. It seems that the risk-return profile of global sukuks, discussed earlier, can offer a risk diversifier when they are blended with multiple conventional asset classes for long-term investment. As to our substitute tests, taking care of tail risk, Table 19 shows that global sukuks can be treated as a substitute for global bonds but not for the combination of all conventional bonds. This can be attributable to the unique role of TIPS and high-yield bonds as discussed earlier. In other words, Islamic investors who still invest in all conventional asset classes should stick to global sukuks but can consider TIPS and high-yield bonds to improve their tangency portfolio.

Table 18. Summary of complement tests for including bond asset class

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Sukuk									
1	Global sukuk	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	No	**GM**	**GM**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Sukuk									
1	Global sukuk	**GM**	No	No	No	No	No	No	No	No

Table 19. Summary of substitute tests for including bond asset class

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Bond									
1	Global bond	**TP**	**TP**	**TP**	**TP**	No	No	No	**TP**	No
2	All conventional bonds Global bond U.S. high yield bond U.S. TIPS U.S. corporate bond	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Bond									
1	Global bond	No	No	No	No	No	No	No	No	No
2	All conventional bonds Global bond U.S. high yield bond U.S. TIPS U.S. corporate bond	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

Finally, we perform our complement and substitute tests for the inclusion of both equity and bond asset classes. Considering for tail risk, Table 20 shows our complement tests that the combination of Islamic equities and global sukuks do not add value for conventional investors. This implies that the risk-return profile of a mixture of conventional asset classes can compensate for the unique risk-return profile of each individual Islamic asset class. In the contrary, our substitute tests in Table 21 suggest that the combination of Islamic equities and sukuks cannot play as a substitute for their conventional counterparts. This is attributable to the role of TIPS and global bonds as we have explained in our earlier results. To justify this evidence, we investigate the contribution of each conventional asset class in the Islamic portfolio in the next sub-section.

Table 20. Summary of complement tests for including equity and bond asset classes

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	All assets Islamic equity and sukuk asset classes	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**	No	**GM**	**GM**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	All assets Islamic equity and sukuk asset classes	No	No	No	No	No	No	No	No	No

Table 21. Summary of substitute tests for including equity and bond asset classes

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	All assets Conventional equity and bond asset classes	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	All assets Conventional equity and bond asset classes	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

4.1.4. The contribution of conventional asset classes to the U.S. Islamic portfolios: inter-asset classes

This sub-section focuses on the objective of Islamic investors who are committed to invest in all Islamic asset classes. We identify whether the inclusion of any conventional asset class into their Islamic portfolio can deliver value added. Table 22 presents the list of Islamic asset classes in our Islamic portfolio. We also include Islamic REITs which are listed in Malaysia and Singapore since only these assets are available with longer observations to represent Shariah-compliant REITs. They include Al-Aqar, Al-Hadharah, Axis Islamic, and Sabana Shari'a. As there is only a very few number of them, we construct an equally weighted index for Islamic REITs. For risk-less asset, we still use the 3-month U.S. T-bill since we do not have the global Islamic T-bill (3-month) which covers the length of our observations. The establishment of IILM (International Islamic Liquidity Management) is very recent from 2010.

Looking at Table 24 to account for tail risk, we notice that only TIPS, high-yield bonds, and conventional REITs that deliver value added in the Islamic portfolio. TIPS even improves the tangency portfolio in the long term and in all regimes. This is understandable that, as discussed earlier, the Islamic investment universe needs an asset class that captures inflation premium but still maintains the risk-return profile of fixed-income instruments. As mentioned by Duarte (2013), inflation has a negative price in the U.S. equity market. The negative premium is related to the inflation illusion hypothesis, where higher inflation today, perceived as bad states of the economy, may predict low growth in future real consumption. In that case, investors are willing to pay the insurance by way of lower mean returns when they hold an inflation-mimicking portfolio (Duarte, 2013; See, 2010). This may work as well for the other equity-type asset classes. Therefore, any asset which provide inflation protection may add value in the portfolio.

Table 22. List of assets in the U.S. Islamic portfolio

	List of assets in Islamic portfolio
1	T-bill 3 months
2	Islamic U.S. equity
3	Islamic developed markets equity
4	Islamic emerging markets equity
5	Global sukuk
6	Islamic REITs
7	Commodity
8	Gold

Table 23. Contribution of conventional assets in Islamic portfolio: inter-asset classes (normal distribution)

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Conventional asset classes									
1	U.S. equity	No	No	No	No	No	No	No	No	No
2	Developed market equity	No	No	No	No	No	No	**GM**	No	No
3	Emerging market equity	No	**GM**	No	**GM**	No	No	**TP**	No	**GM**
4	U.S. corporate bond	**GM**	**GM**	**TP**	**GM**	No	No	**GM**	**GM**	No
5	U.S. TIPS	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
6	U.S. High yield bond	**GM**	**TP**	**TP**	**TP**	**GM**	**GM**	**GM**	**TP**	**TP**
7	Global bond	No	No	No	No	No	No	No	No	No
8	REITs	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
9	Private equity	No	No	**TP**	No	No	No	No	**TP**	No
10	Hedge fund	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
11	**All conventional assets**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

Table 24. Contribution of conventional assets in Islamic portfolio: inter-asset classes (t-distribution)

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium		Default Premium	
			Expansion	Recession	High	Low	High	Low	Low	High
	Conventional asset classes									
1	U.S. equity	No	No	No	No	No	No	No	No	No
2	Developed market equity	No	No	No	No	No	No	No	No	No
3	Emerging market equity	No	No	No	No	No	No	No	No	No
4	U.S. corporate bond	No	No	No	No	No	No	No	No	No
5	U.S. TIPS	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**
6	U.S. High yield bond	**GM**	**GM**	**TP**	**GM**	**GM**	**GM**	**GM**	**GM**	**GM**
7	Global bond	No	No	No	No	No	No	No	No	No
8	REITs	**TP**	**TP**	**TP**	**GM**	**TP**	**TP**	**GM**	**GM**	**TP**
9	Private equity	No	No	No	No	No	No	No	No	No
10	Hedge fund	No	No	No	No	No	No	No	No	No
11	**All conventional assets**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**	**TP**

For high-yield bonds, these mostly reduce the global minimum variance of our Islamic portfolio. As discussed earlier, any junk sukuk is excluded from the global sukuk index. For those Islamic investors who concern on improving their Sharpe ratio, they may forgo this asset class. On the other hand, Islamic investors may consider to include conventional REITs as this asset class mostly improve the tangency of our Islamic portfolio. This is reasonable since the Islamic investment universe only have a very few Islamic REITs listed predominantly in Malaysia. The

inclusion of the REITs asset class is very essential since it portrays a distinct premium driven by long-term population growth, uniqueness of the property, government planning and regulations, etc. (Case and Shiller, 2003; Schneeweis et al., 2010). Our result of expanding the tangency portfolio is in line with previous findings which documented that the benefit of adding this asset class comes from return enhancement (Lee and Stevenson, 2006; Sa-Aadu, Shilling and Tiwari, 2006; Anderson et al., 2005; Byrne and Lee, 2005).

We also notice that, without accounting for tail risk, the inclusion of hedge funds can expand the tangency of our Islamic portfolio. This is in line with previous studies which found the role of hedge fund as a return enhancer. Their findings documented that adding this asset class to a diversified portfolio of ordinary assets increases its Sharpe ratio (Edwards and Liew, 1999; Pézier and White, 2008; and so on). However, our results show no value added of this asset class if we are aware of tail risk. The reason can be linked to prior studies which mentioned that hedge funds are accused of destabilizing the financial system. Hedge funds are not imposed by mandated leverage restrictions. Since their primary activities emphasize on high risk trading and derivatives, the overly levered hedge fund defaults are more likely to occur, especially during market turmoil (Danielsson et al., 2005; Titman, 2010). The implication of our findings is that Islamic investors may forgo hedge funds despite of the current trend to create Shariah-compliant hedge funds using *helah* (legal tricks).

4.2. Complement tests: Intra-asset classes in different regions

In this sub-section, we perform our complement tests for both Islamic and conventional investors who focus on a specific asset class in the other regions. Table 25 presents the list of assets in Islamic and conventional portfolios for each asset class, while Table 26 shows the details of our complement tests.

Table 27 presents the summary of our complement tests for each asset class. In regards to the bond asset class in GCC, accounting for tail risk, sukuk investors can expand their tangency portfolio by including the GCC conventional senior-bonds from financial services. This is reasonable as some bonds from major financial institutions are not issued in the form of sukuk. Since financial sector plays as a backbone of the GCC economy, investing in their issued bonds can deliver return enhancement. In the contrary, any sukuk does not expand the frontier of the conventional bond portfolio. It seems that the GCC sukuks do not portray such a unique risk-return profile relative to that of their conventional counterparts. The reason is because some of the current sukuks are not structured completely in line with the ideal Shariah rules. For example, many *ijara* sukuks are designed with a sell-lease-buy back mechanism, which falls under the prohibition of *bay-al-wafa* (Al-Amien, 2008). Their risk-return profile may not fully represent the generated-revenues and ownership risk of their underlying asset. For some *musharaka* and *mudaraba* sukuks, instead of delivering irregular stream of revenue for sukuk holders, they are structured to distribute profits of their enterprises at fixed percentages benchmarking to LIBOR. To justify this practice, the contract mentions that if the actual profits exceed the predetermined rates, the amount of excess will be paid to the enterprise manager as an incentive to manage effectively. If the actual profits are less, the manager may pay out the difference (Usmani, 2008; Maurer, 2010). In addition, several sukuks also guarantee the return of principal to sukuk holders at maturity by way of binding promise. For some sukuks, their holders cannot recourse to the underlying assets (Usmani, 2008). The major implication is that the sukuks may not deliver such a unique risk-return profile derived directly from their underlying contract.

Table 25. List of assets in conventional and Islamic portfolios

No	List of assets in conventional portfolio	List of assets in Islamic portfolio
1	**GCC Bond**	
	GCC bond corporate	GCC sukuk corporate
	GCC bond senior financial services	GCC sukuk financial services
	GCC bond sub-ordinate fin. Services	
2	**Malaysian equity**	
	Conventional Malaysian equity	Islamic Malaysian equity
3	**Malaysian REITs**	
	Conventional Malaysian REITs	Islamic Malaysian REITs
4	**Malaysian Bond**	
	Malaysian bond government	Malaysian sukuk government
	Malaysian bond corporate AAA	Malaysian sukuk corporate AAA
	Malaysian bond corporate AA	Malaysian sukuk corporate AA
	Malaysian bond corporate A	Malaysian sukuk corporate A
	Malaysian bond corporate BBB	Malaysian sukuk corporate BBB
5	**Emerging markets equity**	
	9 sectors of conventional emerging markets equity	14 sectors of Islamic emerging markets equity

Table 26. Complement tests: Intra-asset classes in different regions

Test	Prior Portfolio	**Complement Test** — **Inclusion of asset**	Outcome	
1	Conventional portfolio in particular asset class	1. Individual Islamic asset in particular asset class 2. All Islamic assets in particular asset class	Whether the inclusion of Islamic asset may add value when it is included in conventional portfolio	If yes, whether Islamic improves tangency or global minimum variance of conventional portfolio
2	Islamic portfolio in particular asset class	1. Individual conventional asset in particular asset class 2. All conventional assets in particular asset class	Whether the inclusion of conventional asset may add value when it is included in Islamic portfolio	If yes, whether conventional improves tangency or global minimum variance of Islamic portfolio

Table 27. Summary of complement tests: Intra-asset classes in different regions

Test	Inclusion	Complement for conventional investor		Complement for Islamic investor	
		Normal	t-dist	Normal	t-dist
	GCC Bond				
1	GCC sukuk corporate	GM	**No**		
2	GCC sukuk financial services	GM	**No**		
3	All GCC sukuks	GM	**No**		
4	GCC bond corporate			GM	**No**
5	GCC bond senior financial services			TP	**TP**
6	GCC bond sub-ordinate fin. Services			GM	**No**
7	All GCC bonds			TP	**TP**
	Malaysian equity				
1	Islamic Malaysian equity	GM	**No**		
2	Conventional Malaysian equity			GM	**GM**
	Malaysian REITs				
1	Islamic Malaysian REITs	GM	**GM**		
2	Conventional Malaysian REITs			GM	**GM**
	Malaysian Bond				
1	Malaysian sukuk government	GM	**No**		
2	Malaysian sukuk corporate AAA	No	**No**		
3	Malaysian sukuk corporate AA	TP	**No**		
4	Malaysian sukuk corporate A	TP	**No**		
5	Malaysian sukuk corporate BBB	No	**No**		
6	All Malaysian sukuks	TP	**No**		
7	Malaysian bond government			GM	**No**
8	Malaysian bond corporate AAA			TP	**TP**
9	Malaysian bond corporate AA			TP	**TP**
10	Malaysian bond corporate A			TP	**TP**
11	Malaysian bond corporate BBB			TP	**TP**
12	All Malaysian bonds			TP	**TP**

Test	Inclusion	Complement for conventional investor		Complement for Islamic investor	
		Normal	t-dist	Normal	t-dist
	Islamic emerging markets equity				
1	Automobiles and parts	No	**No**		
2	Basic resources	No	**No**		
3	Basic materials	GM	**GM**		
4	Travel and leisure	GM	**No**		
5	Chemicals	GM	**GM**		
6	Consumer services	GM	**No**		
7	Foods and beverages	GM	**GM**		
8	Industrials	TP	**TP**		
9	Media	TP	**TP**		
10	Consumer goods	GM	**GM**		
11	Retail	GM	**No**		
12	Technology	No	**No**		
13	Telecommunications	GM	**GM**		
14	Utilities	GM	**GM**		
15	All Islamic emerging markets sectors	GM	**GM**		
	Conventional emerging markets equity				
1	Financials			GM	**GM**
2	Telecommunications			No	**No**
3	Energy			GM	**GM**
4	Technology			No	**No**
5	Basic materials			GM	**No**
6	Consumer services			TP	**TP**
7	Industrials			GM	**GM**
8	Consumer goods			TP	**TP**
9	Utilities			No	**No**
10	All conventional emerging markets sectors			TP	**GM**

As to the equity asset class in Malaysia, accounting for tail risk, we notice that Islamic equities do not add value for the conventional equity investors while conventional equities can reduce the global minimum variance of the Islamic equity portfolio. This is reasonable because our study uses the Hijrah, instead of Emas, Islamic equity index which has a stricter screening criteria. The criteria uses the debt to equity ratio that is in line with the Shariah standard overseas. Nonetheless, Islamic equity investors only gain risk reduction from investing in conventional equities.

For the REITs asset class in Malaysia, conventional and Islamic investors can reduce their global minimum variance by investing in Islamic and conventional REITs, respectively. This can be understood since conventional REITs only have 17 assets while Islamic REITs have three assets. A small number of assets within the same asset class may deliver risk diversification between each other.

As to the bond asset class in Malaysia, considering for tail risk, we can clearly see that all types of sukuk do not add value for the conventional bond investors. The rationale is due to the structure of Malaysian sukuks. As we discussed earlier, most of the Malaysian sukuks are structured using *bay-al-inah*, which involves a buy-back mechanism. By allowing the practice of *bay-ad-dayn*, which permits the trading of this debt-generated instrument at discount or premium, the combination of the two produces the sukuks' risk-return profile which is similar to that of conventional bonds. Although the current trend shifts to *ijara* sukuk, its mechanism still purely uses *bay-al-wafa*. The no value added of sukuks is further justified by a larger shares of conventional bonds, as compared to that of sukuks, in the Malaysian bond market. In the contrary, we notice that sukuk investors can benefit from investing in all types of conventional bond, except for sovereign sukuk, to expand their tangency portfolio. The only plausible reason maybe that the Malaysian Islamic market is mainly driven by the government's initiative and effort in creating a hub for the global Islamic finance. To achieve their objective, Malaysian government has a large issuances of sovereign sukuks which further dominate the Malaysian sukuk market.

Finally, we compare between 9 sectors of Islamic equities and 14 sectors of conventional equities in emerging markets. We notice that the conventional equity investors can obtain risk reduction from investing in Islamic equities in basic materials, chemicals, foods and beverages, consumer goods, telecommunication, and utilities, while they can expand their tangency portfolio from industrials and media. On the other hand, the Islamic equity investors can reduce their global minimum variance from Islamic equities in financials, energy, and industrials, while they may improve their Sharpe ratio from consumer goods and consumer services. We can see generally that the value added of tangency portfolio for Islamic equities comes from production-related sectors while the value added of conventional equities is originated from consumption-related sectors. This is reasonable if we look at the nature of emerging economies. In particular, the emerging economies are driven by consumption. The consumption-related companies therefore play an important role in these countries, where they are experiencing an expansionary mode along with rising economic growth in the last decade. Since emerging countries' stock markets are less developed relative to their banking industry, the consumption-related firms mostly raise their financing from banks and debt markets. The major implication is that the Islamic indices will exclude many of these firms due to their excess leverage beyond a certain limit in the Shariah screening criteria. In other words, the emerging markets' conventional equity index is better to capture the growing consumption sector in emerging economies.

On the other hand, the production sector of strong emerging economies is driven by companies that serve both domestic and the global markets, which further creates the global manufacturing power house. As the Dow Jones emerging equity indices is heavily skewed to firms from China, South Korea, Taiwan, India, and Brazil, it seems that Islamic indices provide a filtering process related to financial strength. As documented by previous studies, an equity portfolio which is constructed based on financial strength, including leverage scores as the main component, has outperformed relative to the value portfolios (Piotroski, 2000; Piotroski and So, 2012). In other words, the emerging markets' Islamic equity index is better to capture some strong companies in the growing production sector in emerging economies.

4.3. Mean-variance spanning tests for the Malaysian portfolios

4.3.1. Regimes in factor premium

We determine both macroeconomic and factor regimes in Malaysia. From the year of 1996, a number of recession periods from Malaysian Economic Indicators are from January 1998 to January 1999, August 2000 to February 2002, and January 2008 to March 2009. As we discussed earlier that our observations for Malaysia begin from the period of April 2007 to June 2013, we only concern on the recession period of 2008.

Figure 3. Regimes in factor premium in Malaysia

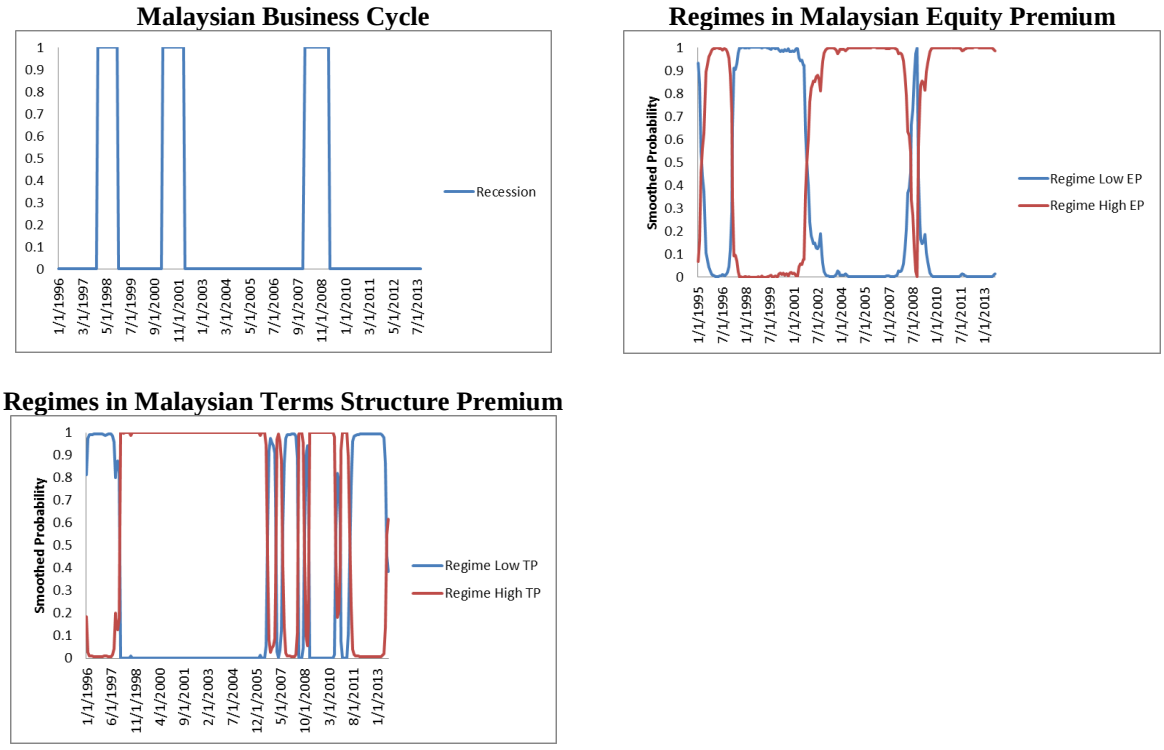


Table 28. Markov Switching Malaysian Equity Premium (Switching variance)

	Coefficient	Std.Error	t-stat	p-value
Constant(0)	-0.0063	0.0100	-0.6290	0.5300
Constant(1)	0.0090	0.0030	2.9800	0.0030
sigma(0)	0.1102	0.0081	13.7000	<0.001
sigma(1)	0.0386	0.0028	13.8000	<0.001
p_{0|0}	0.9548	0.0207	46.0000	<0.001
p_{0|1}	0.0246	0.0125	1.9700	0.0500

log-likelihood 450.911231

no. of observations 332 no. of parameters 6

AIC.T -889.822462 AIC -2.68018814

mean(EP) 0.00307304 var(EP) 0.00569223

Linearity LR-test Chi^2(4) = 128.00 ***

Transition probabilities p_{i|j} = P(Regime i at t+1 | Regime j at t)

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.95478	0.024621
Regime 1,t+1	0.045224	0.97538

Table 29. Markov Switching Malaysian Term Structure Premium (Switching variance)

	Coefficient	Std.Error	t-stat	p-value
Constant(0)	0.0008	0.000026	29.9000	<0.001
Constant(1)	0.0022	0.0001	17.7000	<0.001
sigma(0)	0.0002	0.0000	4.1600	<0.001
sigma(1)	0.0010	0.0001	14.7000	<0.001
p_{0|0}	0.5022	0.0941	5.3400	<0.001
p_{0|1}	0.0413	0.0185	2.2300	0.0270

log-likelihood 1245.98614

no. of observations 213 no. of parameters 6

AIC.T -2479.97229 AIC -11.6430624

mean(TS) 0.00170262 var(TS) 1.05687e-006

Linearity LR-test Chi^2(4) = 165.52 ***

Transition probabilities p_{i|j} = P(Regime i at t+1 | Regime j at t)

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.50224	0.041285
Regime 1,t+1	0.49776	0.95872

For calculating factor premiums, we only take equity premium and term structure premium since the length of observations for default premium from 2007 is not sufficient to use the Markov switching model. Looking at Table 28 and Table 29, we can reject the null of the Davies linearity tests, which means that the non-linearity of each factor premium is statistically significant. Focusing only on our observations from 2007 onwards, the bearish regime of equity premium covers the period of June 2008 to October 2008, while the low term premium regime is from the period of July 2007 to May 2008, October 2008 to January 2009, August 2010 to November 2010, and July 2011 to November 2013. In addition, we notice from Table 28 that the statistically significant result for equity premium in the first (bearish) regime comes from the switching variance rather than the mean. It means that the bearish market is driven by extreme volatility.

4.3.2. Mean variance spanning tests for Malaysian portfolios: Inter-asset classes

Similar to what has been studied for the U.S. market, we perform our complement and substitute tests for inter-asset classes in Malaysia. Table 30 presents the list of asset classes in our prior portfolio. Table 31 and Table 32 show the summary of our complement and substitute tests.

For our complement tests, we notice that Islamic equities and Malaysian sukuks can improve the tangency of conventional portfolios during market turbulence, which is due to their less leverage effect. Nonetheless, if we are aware of tail risk, conventional investors do not get any value added from investing in any Islamic asset class. The reasons have been discusses in our earlier section. It means that the Malaysian conventional investors do not need to invest in any Islamic asset if they are only concerned about the existence of fat tails in their asset allocation decision. Our substitute tests is for the Malaysian Islamic investors who invest fully in all conventional asset classes. Accounting for tail risk, we find that each Islamic asset class can be considered as a substitute for its conventional counterpart, except for the conventional bonds in the period of high term premium which can reduce their global minimum variance. It implies that each Islamic asset class performs well when it is blended with the other conventional asset classes.

Finally, we identify the contribution of each conventional asset class to a well-diversified Islamic portfolio in Malaysia. Looking at Table 33, we find that the Islamic long-term investors can forgo each conventional asset class if they consider for fat tails in their allocation. The exceptions are the reduction of global minimum variance for conventional REITs only in the period of recession, as well as conventional bonds only in the regime of high term premium. These findings generally are in the contrary to our previous findings which focus only on each specific asset class in Malaysia. Our results here suggest the important role of blending all Islamic asset classes to be not at disadvantage relative to their conventional counterparts. In other words, Islamic investors in Malaysia should construct a well-diversified Islamic portfolio (comprising all Islamic asset classes, commodity, and gold) in order for them to be committed to Shariah rules for their way of investing.

Table 30. List of assets in the conventional portfolio

No	List of assets in conventional portfolio
1	KLIBOR 1 month
2	Conventional Malaysian equity
3	Malaysian bond (government,corporate)
4	Conventional Malaysian REITs
5	Commodity
6	Gold

Table 31. Summary of complement tests: inter-asset classes

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium	
			Expansion	Recession	High	Low	High	Low
	Islamic asset classes							
1	Islamic Malaysian equity	No	**GM**	No	No	**TP**	No	No
2	Malaysian sukuk	No	No	No	No	**TP**	No	No
3	Islamic Malaysian REITs	No	No	No	No	No	No	No
4	All Islamic asset classes	No	No	No	No	**TP**	No	No

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium	
			Expansion	Recession	High	Low	High	Low
	Islamic asset classes							
1	Islamic Malaysian equity	No	No	No	No	No	No	No
2	Malaysian sukuk	No	No	No	No	No	No	No
3	Islamic Malaysian REITs	No	No	No	No	No	No	No
4	All Islamic asset classes	No	No	No	No	No	No	No

Table 32. Summary of substitute tests: inter-asset classes

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium	
			Expansion	Recession	High	Low	High	Low
	Islamic asset classes							
1	Conventional Malaysian equity	**TP**	**GM**	No	No	No	No	No
2	Malaysian bond	**TP**	**TP**	No	**TP**	No	**GM**	No
3	Conventional Malaysian REITs	No	No	**GM**	No	**GM**	No	No
4	All conventional asset classes	**TP**	No	No	**TP**	No	**GM**	No

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium	
			Expansion	Recession	High	Low	High	Low
	Islamic asset classes							
1	Conventional Malaysian equity	No	No	No	No	No	No	No
2	Malaysian bond	No	No	No	No	No	**GM**	No
3	Conventional Malaysian REITs	No	No	No	No	No	No	No
4	All conventional asset classes	No	No	No	No	No	No	No

Table 33. Contribution of conventional assets in Islamic portfolio: inter-asset classes

Test	Inclusion (Normal distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium	
			Expansion	Recession	High	Low	High	Low
	Conventional asset classes							
1	Conventional Malaysian equity	**TP**	**GM**	No	No	No	No	No
2	Malaysian bond	**TP**	**TP**	No	**TP**	No	**GM**	No
3	Conventional Malaysian REITs	**TP**	**GM**	**GM**	No	**GM**	No	**TP**
4	**All conventional Malaysian assets**	**TP**	No	No	**TP**	No	**GM**	No

Test	Inclusion (t-distribution)	Long-term	Business Cycle		Equity Premium		Term Structure Premium	
			Expansion	Recession	High	Low	High	Low
	Conventional asset classes							
1	Conventional Malaysian equity	No	No	No	No	No	No	No
2	Malaysian bond	No	No	No	No	No	**GM**	No
3	Conventional Malaysian REITs	No	No	**GM**	No	No	No	No
4	**All conventional Malaysian assets**	No	No	No	No	No	**GM**	No

5. Concluding remarks

This study is motivated by the recent interest of investors in pursuit of additional asset classes which provide a unique risk-return profile, accounting for the presence of tail risk. We consider the Islamic investment universe as a central contribution of our study. The main objective serves both conventional and Islamic investors' problems as to whether the inclusion of Islamic and conventional asset classes may expand the frontier of their respective portfolios. We take into account intra-asset allocation for fund managers, and inter-asset allocation for institutional investors. Our sample covers the U.S. and Malaysian portfolios, as well as a specific asset class in a few regions such as the GCC bond, Malaysian bond, Malaysian REITs, Malaysian equity, and

emerging markets' equity. This study uses the recent mean-variance spanning test. The overall analyses focus on the expanding opportunity set in the presence of tail, and identify the source of value added either from tangency portfolio or from global minimum variance.

For the U.S. conventional investors, we find that the long-term equity investors can explore the emerging markets' Islamic equities to minimize their global minimum variance. The dynamic equity investors can also benefit from investment in Islamic equities according to different regimes for risk reduction. For those who are only interested in improving their Sharpe ratio, the advantage is limited to Islamic equities in the U.S. and developed markets in the period of high term premium. We also find that bond investors do not gain any value added from the inclusion of global sukuks into their portfolio. Similarly, the combination of both Islamic equities and global sukuks do not deliver any value added for the conventional institutional investors in the long term and all regimes.

For the U.S. Islamic investors who still invest completely in conventional asset classes, the long-term equity investors can replace the emerging markets' Islamic equities with its Islamic counterparts. However, they still need to invest in conventional equities in the U.S. and developed markets to minimize their global minimum variance in the long term as well as some certain regimes. For those who focus on improving their Sharpe ratio, they can benefit from conventional equities in the U.S. and developed markets only in the period of high term premium. In the remaining periods, the Islamic opportunity sets are sufficient for the Islamic equity investors to invest purely in Islamic equities. Our findings also show that sukuk investors can replace the U.S. corporate bonds and global bonds with global sukuks in all regimes. However, both sukuk investors and the Islamic institutional investors still have to consider the conventional TIPS and high-yield bonds mainly to improve their Sharpe ratio.

For the U.S. Islamic institutional investors who invest completely in all Islamic asset classes, there are only TIPS, conventional REITs, and high-yield bonds that deliver value added to the Islamic portfolio. The first two improve the tangency of Islamic portfolio while the third asset reduces the global minimum variance. On the other hand, they can forgo the remaining conventional asset classes since their opportunity set is sufficient. Although hedge funds can play as a return enhancer in the Islamic portfolio, they do not deliver any value added if we are aware of tail risk.

Our study also addresses the investors who focus only on a specific asset class in the other regions. In GCC, bond investors do not gain any value added from any GCC sukuk while sukuk investors can improve their Sharpe ratio by investing in the GCC conventional senior-bonds from financial services. In Malaysia, Islamic equities do not add value for the conventional equity investors while conventional equities can reduce the global minimum variance of the Islamic equity portfolio. As to the Malaysian REITs, conventional and Islamic investors can reduce their global minimum variance by investing in Islamic and conventional REITs, respectively. In emerging countries, the emerging markets' conventional equity index is better in capturing the growing consumption sector while its Islamic counterpart plays an important role in selecting some strong companies within the growing production sector.

In Malaysian markets, the conventional institutional investors do not get any value added from investing in any Islamic asset class (equities, sukuks, REITs). Similarly, the Islamic institutional investors can forgo all conventional asset classes, except for conventional REITs during recession, and for conventional bonds in the period of high term premium.

6. Policy implications

To this end, this study provides some policy implications for the global Islamic financial industry. First, the industry should come up with Islamic asset classes which portray the risk-return profile of TIPS and high-yield bonds. It is justified by the fact that most of the sukuks are structured using *ijara* contract can be structured by periodically resetting the rental payment. Hence, the substantial increase of their issuances may enhance the opportunity set of Islamic portfolio. For the high-yield bonds, there is a large number of high-risk sukuks which are unrated by the global rating agencies. Due to an increasing appetite for risk among global investors in the recovery period, the role of the global rating agencies is very essential to improve the credibility of these sukuks. Moreover, the industry also need to create a high-yield sukuk index, as a proper benchmark for the global Islamic investors, in order to strengthen its high-yield market. The confidence in high-yield sukuks can significantly increase the number of Islamic private equities since it may create the Shariah-compliant mezzanine bridge financing.

Second, the substantial number of Shariah-compliant REITs in the global market is indispensable. There are only very few Islamic REITs available mostly in Malaysia. As the Islamic financial markets are well-developed mainly in Muslim countries, the Islamic financial industry can benefit from a considerable growth in their real estate market. For example, the concept of Islamic Tower REITs can boost the number of Islamic REITs from Middle East.

Third, the global sukuk industry should reduce its heavy reliance on Middle East market due to its high sensitivity to the global oil market. In that case, the other Muslim countries need to develop their sukuk markets. The objective is to boost the number of global sukuk issuances with different risk profiles. The issuances from non-Muslim countries can expand the frontier albeit they may take longer time to solve some specific issues, i.e. taxes, ownership of underlying assets, etc. We also encourage the industry in each country to structure their sukuks according to a single international standard, i.e. AAOIFI, in order to avoid any segmentation within the global sukuk market. Again, the role of global rating agencies is very critical in enhancing the attractiveness of corporate sukuks since some countries still rely heavily on the large issuances of their sovereign sukuks. The policy makers also should increase the sukuk issuances from some major firms that play as a backbone of the economy, i.e. the GCC sukuks financial services, and so on.

Fourth, our findings show no value added of hedge funds if we are aware of tail risk. Since the Shariah principle of investing is to mitigate extreme losses as best as possible, the Islamic financial industry can forgo the efforts in creating Islamic hedge funds using *helah* or legal tricks, i.e. a minority view in accepting the sale of a stock on the basis of future delivery (Salam) to replicate a short selling activity, the use of *bay-al-urbun* to replicate the economic effect of a conventional short sale, the use of *bay-al-istijrar* to replicate the Asian and barrier options, allowing both short selling and derivatives along with a substantial leverage using *murabaha* or *ijara*, and so on.

Fifth, although the Islamic fund managers of a specific asset class can benefit from some certain types of conventional assets in particular regimes, our findings show that the U.S. Islamic institutional investors are not at disadvantage when they invest in all Islamic asset classes, except for TIPS, high-yield bonds, and REITs. Even the long-term Malaysian Islamic institutional investors can forgo any conventional asset classes. Therefore, we encourage Islamic institutional investors to be fully Shariah-compliant in their asset allocation decision, justified by the available opportunity set. The Islamic investors cannot blame any limitation in Islamic markets as the source

of their underperformance since the opportunity set should be clearly distinguished from the investment skills.

Finally, although the conventional fund managers of a specific asset class can benefit from Islamic assets in particular regimes, our results show that the conventional institutional investors cannot benefit from the combination of all Islamic asset classes. This encourages both policy makers and practitioners in the Islamic financial industry to structure Islamic assets purely according to the Shariah rules rather than merely mimicking conventional assets via *helah* (legal tricks). The structure of a variation of sukuks (*ijara, mudaraba, musharaka,* etc.) and its implementation in the industry should fully comply with the Shariah rules. In that case, the generated revenue and ownership risk of sukuks will completely represent their underlying assets. We also encourage more innovations in the sukuks' structure with irregular streams of revenues rather than being dictated by a fixed-income nature in the conventional industry, i.e. *muzara'a* sukuk, RORE-linked sukuks (rate of return of the economy), and so on. The risk-return profile produced by any unique Islamic asset class will be rewarded, instead of being penalized, by institutional investors since it satisfies their main objective of expanding their opportunity set. The global rating agencies, again, have to come up with a new rating methodology for the new type of sukuks in order to enhance their credibility.

For the equity asset class, the Islamic financial industry should improve the process of Shariah screening beyond the criteria related to *halal* activities and interest or *riba* (interest income, interest-based debt, cash-equivalent assets). Many Shariah principles have not been incorporated in the screening process, especially related to business activities, i.e. Islamic marketing, Islamic human resources management, *maqasid Shariah* for firms' activities, and so on. As to the capital structure, the practice of *bay-ad-dayn* should be strictly prohibited so that it discourages Islamic firms in using any debt-generated instrument since it cannot be traded in the market. The prohibition of *bay-al-wafa* is very critical to ensure that the Islamic firm raises financing only for new assets, thereby automatically creating the upper limit of leverage for productive businesses. The underlying assets also should be completely kept out of the firm's balance sheet. Without the implementation of binding *wa'd* or purchase undertaking, the capital structure of Islamic firm will be driven primarily by operational leverage, which further reduce the firms' beta as the firm is completely financed by equity. As a result, the combination of the improved screening criteria and capital structure will produce such a unique risk-return profile of Islamic equity.

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