Clientele Effect in Sovereign Bonds: Evidence from Malaysia *

Minxia Chen† Joseph Cherian‡ Ziyun Li§ Yuping Shao¶ Marti G. Subrahmanyam‖

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Abstract

The demand for Malaysian Islamic bonds (*Sukuk*), in the largest and most active Islamic market in the world, comes from two sources: conventional and Islamic investors, with the latter group holding only Islamic bonds by mandate. Surprisingly, Malaysian Islamic sovereign bonds have a 4.8 bps *higher* yield than their conventional counterparts, *ceteris paribus*. We attribute this spread to foreign institutional investors participating actively in the conventional market, but not as much in the Islamic market. Using transaction-level data, we document four pieces of evidence that point towards clientele effects, particularly for foreign investors, which affect the yield spread.

JEL classification: G11, G12, G18

Keywords: clientele effect, liquidity, credit risk, sovereign *Sukuk*, Islamic sovereign bond, conventional sovereign bond, Ramadan, sovereign repo market

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†INSEAD, 1 Ayer Rajah Ave, Singapore 138676; tel: +65 9036 0355; email: minxia.chen@insead.edu.

‡NUS Business School, Mochtar Riady Building, 15 Kent Ridge Drive, Singapore 119245; tel: +65 6516 5991; email: bizjc@nus.edu.sg.

§Singapore Exchange Ltd., SGX Centre Office, 2 Shenton Way, #02-02 SGX Centre 1, Singapore 068804; tel: +65 8223 3071; email: ziyun.li@u.nus.edu.

¶Société Générale; tel: +65 9878 0648; email: yuping.shao@u.nus.edu.

‖New York University, Stern School of Business and NYU Shanghai, 44 West Fourth Street, Room 9-68, New York, NY 10012; tel: +1 212 998 0348; email: msubrahm@stern.nyu.edu.

1. Introduction

The Malaysian sovereign bond market provides an interesting experiment of demand, supply and equilibrium in two closely related markets: the markets for sovereign Islamic bonds (or *Sukuk*) and conventional sovereign bonds issued by the Malaysian government. Malaysia has the world's largest and most liquid *Sukuk* market. Malaysia was ranked third in Asia by The World Bank (2020) in terms of bond market development. The World Bank also reported that Malaysia's *Sukuk* and conventional bond markets had a combined size of approximately 98% of the country's gross domestic product. Additionally, Islamic institutions, be they Islamic asset managers, asset owners or government funds, are generally constrained by mandate to invest only in *Sukuk*. Since conventional investors do not face such constraints–they can invest in both Malaysian government *Sukuk* and their conventional counterparts–we should, therefore, expect *Sukuk* to have a higher price (or lower yield) than their conventional counterparts from this additional demand, *ceteris paribus*. It would be surprising if this were not the case, especially after adjusting for market microstructure and other effects, such as liquidity, trading activity, bond characteristics and credit risk. It is essential, therefore, to disentangle the clientele effects, such as those due to supply/demand factors, regulatory and issuance policy, tax considerations, and investor preferences, from market microstructure and other effects, especially when the two subsets of otherwise identical bonds issued by the same authority exhibit different behavior.

The yield curves for different subsets of the bond market could certainly vary, with the yield spread between the various bond categories, within the same country and currency, being driven by liquidity, maturity, credit risk and tax considerations, in addition to clientele effects. It has been a challenge for researchers, thus far, to separate these competing considerations and focus purely on clientele effects. Fortuitously for academic researchers, a complete and comprehensive sovereign bond transaction database exists in Malaysia, due to the diligent efforts of the Bank Negara Malaysia (BNM), the central bank of Malaysia. Therefore, the Malaysian sovereign bond market provides a unique and ideal laboratory for the study of such factors, as both sovereign *Sukuk* and conventional sovereign bonds are issued by the Malaysian government, i.e., these two subsets of bonds have the same credit risk exposure.[1] In this case, after controlling for maturity differentials, liquidity effects, "specialness" in the repo market for bonds, which influence yields, and other bond characteristics, the residual yield spread, if any, is likely to be due to clientele effects, such as investor supply/demand factors.

Since 2005, the Malaysian bond market, particularly its Islamic bond (*Sukuk*) segment, has shown significant development in terms of increasing issuance volume, market size, and trading activity. Figure 1 provides a timeline of notable events in the development of the Malaysian sovereign bond market. For example, the new Fully Automated System for Issuing/Tendering (FAST) was launched in July 2005, and providing greater transparency to its members and the investing public. The percentage of foreign holdings, relative to all institutional holdings in the Malaysian sovereign bond market, reportedly increased from 5% in 2005 to approximately 35% in 2016. Furthermore, Islamic bonds or *Sukuk* have always been an important component of the Malaysian bond market, as well as in the global Islamic context. Indeed, Islamic investors are mandated to consider only these types of bonds, whereas conventional investors have no such restriction, and can purchase both *Sukuk* and their conventional counterparts. Malaysia issued the world's first *Sukuk* in 2000, and is currently the largest issuer of *Sukuk*, with over half of the *Sukuk* issued worldwide denominated in Malaysian Ringgit (MYR). A more detailed background of the Malaysian bond market and its *Sukuk* segment is provided in Appendix B.

[Insert Figure 1 about here]

Are Islamic bonds (*Sukuk*) different from conventional bonds? Some researchers claim that *Sukuk* are sufficiently different, given that including *Sukuk* in a portfolio has the potential to increase its diversification and reduce its Value at Risk (VaR).[2] Others believe that *Sukuk* returns are, for most intents and purposes, structured to imitate features of conventional bonds.[3] Indeed, most bond traders in Malaysia view government-issued *Sukuk* as similar to conventional sovereign bonds, especially in terms of effective cash flows, issuance structure, and legal status. A series of FAQs

[1] *Sukuk* are also commonly referred to as "Islamic bonds" or "Shariah-compliant bonds." In this paper, we use "*Sukuk*" and "Islamic bonds" interchangeably. In addition, the term "profit rate" is adopted for Islamic bonds, which is comparable to the "coupon rate" of conventional bonds. See Appendix B for details.

[2] For example, Raei and Cakir (2007).

[3] For example, Wilson (2008).

and articles found on the website of Bank Negara Malaysia appears to confirm this conjecture (see Internet Appendix Table IA-1 for details).

As a consequence, an important question is whether government-issued *Sukuk* and their conventional counterparts have the same yield levels, *ceteris paribus*? If they do not, what are the determinants of the yield spread? Some preliminary evidence from independent sources suggests that *Sukuk* have higher yields (or lower prices) than the corresponding conventional sovereign bonds. This is surprising since, as was pointed out, Islamic investors are constrained to hold *Sukuk* by mandate and, hence, cannot participate in conventional bonds, whereas conventional investors face no such restriction and can participate in both bond markets. All other factors being equal, *Sukuk* should consequently face an upwardly shifted demand curve. According to Reuters, however, the average yield of the government-issued *Sukuk* in Malaysia is 8 basis points higher than that of conventional sovereign bonds.[4] Yet, no rigorous academic research has been conducted to analyze this yield spread. To the best of our knowledge, we are the first to systematically quantify and explain the higher average yield of *Sukuk* as compared to their conventional counterparts by using the most comprehensive transaction database of the Malaysian sovereign bond market that has been assembled to date.

In this paper, we focus on the Malaysian sovereign bond market and examine whether government-issued *Sukuk* have higher or lower yields than their conventional counterparts, *ceteris paribus*.[5] In addition, we investigate whether the yield spread is explained by liquidity effects.[6] Finally, in the case where the yield spread remains significantly positive after controlling for liquidity, we attempt to discern other potential factors. These include clientele effects, as reflected by particular government-issued *Sukuk*'s addition to global bond indices, which tends to increase demand for such bonds by foreign institutional investors and, hence, their price. It is also possible that Islamic clientele demand effects, driven by religious or other related considerations, could drive the price of *Sukuk* up during certain periods. Additionally, lower bond "specialness" in the repo market for

[4] http://www.reuters.com/article/islamic-finance-adb/Sukuk-issuance-costs-still-above-conventional-bonds-in-asia-adb-idUSL5N0ML00D20140324.

[5] Constraining our sample to the Malaysian *sovereign* bond market should alleviate the concern of credit risk. In any case, there is no *differential* credit risk between the two types of bonds.

[6] It is possible that the yield spread survives after controlling for liquidity effects, due to microstructure as well as other factors that potentially remain unmeasured within our analysis.

Sukuk, as compared to their conventional counterparts, will tend to decrease the former's price (or increase their yield) due to the "convenience yield" factor (or the lack thereof) available in repo markets.[7] These effects, especially foreign institutional investors' differential demand for conventional bonds versus their Islamic counterparts, could potentially explain the *Sukuk*/conventional yield spread over and above liquidity effects.

Our paper contributes to the literature in many important ways. First, we study a unique market with a tick-by-tick bond dataset that the BNM has assembled and maintained since 2005. We believe that this database is of the quality and depth of the Trade Reporting and Compliance Engine (TRACE), the Financial Industry Regulatory Authority (FINRA)-sponsored platform in the U.S. Second, Malaysia is the largest Islamic bond market in the world.[8] Interestingly, from the perspective of researchers, the Islamic banking system operates in parallel with the conventional one in Malaysia. The country has one of the larger sovereign bond markets among emerging economies, and also enjoys a good credit rating (A- from S&P). Third, most of the Islamic finance papers in the literature are either exploratory studies or are analyzing other aspects of Islamic finance. Our comprehensive econometric analysis on the tick-by-tick bond dataset, on the other hand, controls for various bond fixed effects, but most importantly, liquidity effects. While market liquidity has been accounted for in many prior papers concerning other markets, the incorporation of detailed repo market effects is completely new, from a methodological perspective. To the best of our knowledge, no previous paper has conducted such a detailed empirical analysis incorporating repo market effects into the analysis of bond yield spreads in any market.

Fourth, our database captures tick-by-tick repo market trading data as well, which allows us to conduct additional liquidity tests relating to sovereign bonds, incorporating theory developed in the context of the convenience yield of U.S. Treasury bonds. As mentioned, conventional Malaysian sovereign bonds have a more active repo market with greater bond "specialness," which allows market participants to benefit from holding conventional bonds as special collateral, thus causing them to trade "rich" relative to their Malaysian Sovereign Islamic counterpart, *ceteris paribus*.

[7] See Cherian, Jacquier, and Jarrow (2004) for details on how repo market activity can affect an underlying bond's liquidity and price.

[8] The Malaysian *Sukuk* market had about US$219 billion in amount outstanding at the end of 2018, which is close to half of the total amount of *Sukuk* outstanding in the world. It is also the largest *Sukuk* issuer in the world, accounting for over 50 percent of global issuances.

Prior empirical papers on bonds, including those studying U.S. Treasury bonds ("on-the-runs", "off-the-runs", etc.) have been unable to conduct such a comprehensive and systematic empirical analysis of bond yields that includes repo effects, primarily because of the difficulty in obtaining tick-by-tick repo market data. Fifth, the unique circumstances and active trading in the Malaysian sovereign bond market, both conventional and Islamic, allow us to study and understand liquidity and clientele effects in an advanced emerging bond market situation, after controlling for various confounding factors and characteristics.

Our database, comprising of only Malaysian sovereign bonds, enables us to automatically control for credit differentials between the two subsets of bonds. We employ a variety of liquidity proxies, some that are commonly used, and others that are novel to the literature. This is necessary as we are among the first to measure liquidity in the context of an emerging sovereign bond market, with a very rich bond transaction database to boot. Our results enable us to analyze the differences between government-issued *Sukuk* and their conventional counterparts. Our sample covers the entire Malaysian sovereign bond market from January 2005 to December 2017. We use all traded sovereign bond prices reported in Malaysian ringgit (MYR) by Bank Negara Malaysia, along with the associated bond characteristics as well as trading and repo activity variables. To the best of our knowledge, our combined database is the most comprehensive one of the Malaysian sovereign bond market that has been assembled to date, and comprises 37,686 bond-week observations (675 weeks) in total. Our analysis explores both the cross-sectional and time series differences in the yields between the two subsets of Malaysian sovereign bonds using a variety of well-established econometric methodologies in the finance literature.[9]

In our data sample, there are, on average, 55 bonds traded every week, among which 35 are conventional sovereign bonds and 20 are government-issued *Sukuk*. For each bond, an average number of approximately 12 trades occur every week, which add up to MYR284.12 million or USD71.03 million equivalent. The average yield of conventional bonds (3.396%) is slightly higher than that of *Sukuk* (3.361%), mainly due to the fact that *Sukuk* typically have a shorter tenure and lower age. Principal component analysis of liquidity suggests that conventional bonds, in general,

[9] Note that we focus exclusively on the Malaysian sovereign bond market with no reference to corporate bonds in this paper.

have slightly better liquidity than *Sukuk*. This is also consistent with the anecdotal evidence provided by Malaysian bond traders.

We also compare the yields of conventional bonds and *Sukuk* with similar maturity, and find that *Sukuk* have a higher average yield for almost all maturity groups. Our Fama-MacBeth regressions with a Newey-West correction show that, on average, *Sukuk* trade at a yield of 4.8 basis points higher than conventional bonds, other factors being equal.[10] Moreover, the analysis using a Nelson-Siegel Three-Factor Model also confirms the higher yield of *Sukuk*, and that such a phenomenon is not specific to any particular maturity bucket, since the yield curves are approximately parallel to each other.

We found four pieces of evidence that point towards clientele effects by using a structural break test, an index inclusion exercise, demand proxies for the Islamic clientele, and finally, repo market "specialness." First, in the structural break test, we find the mean of the yield spread dropped dramatically from 4.4 basis points before July 2007 to 0.3 basis points after July 2007, and then recovered to 5.9 basis points after July 2009. This timeline coincides with the start and end of the Global Financial Crisis (GFC). This could be explained by the "sell-down" in Malaysian conventional sovereign bonds, along with other emerging market securities, by foreign investors during the GFC. On the other hand, *Sukuk*, which are mainly held by local institutions, are less affected by the GFC. As a consequence of this "clientele effect," the yield spread narrowed between mid-2007 to mid-2009.

Second, in an index inclusion exercise on 19 August 2016, we focus on the announcement that added two Malaysian *Sukuk* to the J.P. Morgan Government Bond Index-Emerging Markets (JPM GBI-EM). This event provides an additional natural experiment to study how shifting investor or clientele demand affects the yield spread between conventional sovereign bonds and *Sukuk*. The Malaysian *Sukuk* have a higher yield of 8.2 basis points against their conventional counterparts during the full sample subperiod. As the results indicate, around the index inclusion announcement, there is no significant difference in yield between the two chosen *Sukuk* included in the JPM GBI-EM compared to other *Sukuk*. However, the two chosen *Sukuk* experience a significant decline in

[10] We also conduct the regression analysis using the yield spread between these two bond subsets as a dependent variable. For this purpose, we first compute the interpolated yield curves in order to match the maturity buckets between the two bonds, and then calculate the yield spread between these two types of bonds.

yield of approximately 7.6 basis points to 10.2 basis points after the announcement. This result suggests that the addition of the two *Sukuk* into the JPM GBI-EM index shifts foreign investors' demand curve which, in turn, increased foreign holdings, thus pushing prices up, and eliminating almost all of the yield spread between the two chosen *Sukuk* and the corresponding conventional sovereign bonds. To further buttress this conclusion, we conduct a standard event study based on cumulative abnormal returns (CARs) and check the foreign holdings around the announcement as well. Among the two chosen *Sukuk*, the remaining *Sukuk* group and the conventional sovereign bond group, we are only able to detect a significant positive CAR of 0.547 basis points for the two chosen *Sukuk* within a three-day event window. Upon further investigation, Bloomberg's quarterly holdings data for the two chosen *Sukuk* indicate that their foreign holdings increase over two times and seven times, respectively, from the second quarter of 2016 to the third quarter of 2016.

Third, via quantifying demand proxies for the Islamic clientele, we identified three proxies for the demand side: Ramadan Dummy, Currencies and Oil Prices.[11] Due to multicollinearity between the oil and currency factors, we exclude Oil Prices in our main regression and find the remaining two proxies explain around 50% of the weekly average yield spread in the time series. Since full holdings data at the individual bond level are not available, we are not able to provide direct evidence of our conjectured "foreign clientele effect." We therefore use the identified proxies for demand changes in the two subsets of Malaysian sovereign bonds. In general, the new results align with our hypothesis of foreign clientele effects in Malaysian sovereign bond markets. First, during the Ramadan weeks, yield spreads decrease by about 2.3 bps, on average, and the results are robust to controlling for bond characteristics, liquidity, oil price and currency effects. Liquidity changes point to (marginally) more trading in Islamic sovereign bonds during the Ramadan month. Second, when the currencies of Islamic countries strengthen against the Malaysian Ringgit (MYR), the yield spread again narrows. Third, in a supplementary exercise, when oil prices (quoted in USD) are in the high oil price regime or increasing oil price regime, the yield spread narrows, suggesting higher demand for *Sukuk*. The fourth and last evidence lies in repo market activity. In the final section of our paper, we analyze the Malaysian repo market, which remains a relatively active segment of

[11] The Ramadan dummy is defined as 1 if the observation is from a Ramadan week, and 0 if it is from a non-Ramadan week.

the overall Malaysian sovereign bond market.

Three main results are found in this section. First, focusing purely on the sovereign repo market itself, we find that Malaysian conventional sovereign bonds have a lower special repo rate, on average, than Malaysian sovereign *Sukuk*. This means that investors are able to borrow at a lower rate in the repo market using conventional sovereign bonds as collateral, as opposed to sovereign *Sukuk*, given the same repo tenure. This leads to the conjecture that the yield spreads between the two bond subsets would widen, when there is an active repo market. The rationale behind this conjecture is that investors would require an even higher yield to be willing to hold sovereign *Sukuk*, since conventional sovereign bonds offer an incremental benefit by enabling the investors to borrow at a lower rate in the repo market. Our second main finding is consistent with our expectation, and we find that the average yield spread between the two bond subsets increases significantly from 4.8 basis points to 7.01 basis points during the repo-active weeks, and further rises to 9.8 basis points if the underlying bonds go on "special" themselves. Third, we investigate whether the yield spread remains significantly positive, after controlling for the repo rate differential. In general, we find that a 1% increase in the special repo rate would, on average, increase the yield in the Malaysian conventional and *Sukuk* bond market by 10.2 basis points. Furthermore, this yield would be 17.5 basis points higher, on average, for Malaysian sovereign *Sukuk*.

The remainder of the paper is organized as follows: In Section 2, we provide a review of the literature. We describe our database and present the summary statistics in Section 3. Section 4 presents our main empirical results, and Section 5 identifies three demand-side proxies for the Islamic clientele. Section 6 extends our analysis to the Malaysian sovereign bond repo market, and Section 7 concludes.

2. Literature Review

A vast literature exists for conventional bonds, especially in developed financial markets. First, in terms of the conventional sovereign bond markets, some earlier papers focus on the direct impact of liquidity on bond yields and prices. Chakravarty and Sarkar (1999) investigate the liquidity in the U.S. Treasury bond market using data from the National Association of Insurance Commissioners, while Fleming (2003) studies the same issue using a different dataset called GovPX. Pelizzon, Subrahmanyam, Tomio, and Uno (2016) examine the dynamic relation among market liquidity, credit risk, and other risk factors, such as global systemic risk, market volatility, and the funding liquidity risk of market makers. They focus on the Italian sovereign bond market during the eurozone crisis and the subsequent European Central Bank (ECB) interventions. Their results show that credit risk can constitute one of the main driving forces in determining the liquidity of the bond market.

Second, since the inception of the Trade Reporting and Compliance Engine (TRACE) database in July 2012, there has been a growing body of literature focusing on the liquidity effects in the U.S. corporate bond market. Some earlier papers in this area focus on the effect of post-trade transparency on corporate bond transaction costs, and find that there is a significant decline in bid-ask spreads after the introduction of TRACE, for example, Bessembinder, Maxwell, and Venkataraman (2006); Edwards, Harris, and Piwowar (2007). More recent research points out that liquidity can be an issue for corporate bonds, particularly during periods of financial distress. Friewald, Jankowitsch, and Subrahmanyam (2012), as well as Dick-Nielsen, Feldhütter, and Lando (2012) focus on market-level liquidity, and demonstrate that transaction costs increased significantly during the recent financial crisis, especially for bonds with high credit risk. In contrast, Jankowitsch, Nagler, and Subrahmanyam (2014) focus on liquidity at the security level, and analyse the recovery rates of defaulted bonds.

However, very little research has been conducted with respect to Islamic bonds (*Sukuk*) and emerging market bonds. Although several papers by academics and practitioners exist that have compared *Sukuk* and their conventional counterparts on a generalized basis, few of them use rigorous econometric analysis in their research. Ariff and Safari (2012) find that the mean yield of government-issued *Sukuk* is 6.86 basis points higher than that of conventional sovereign bonds, while Alam, Hassan, and Haque (2013) examine the differences between Islamic and conventional corporate bonds by looking at the stock market reactions to their issuance in an international setting. A more recent paper by Azmat, Skully, and Brown (2017) investigates whether the credit rating determinants are similar between conventional bonds and *Sukuk*. More specifically, they ask whether there is a significant impact of religious compliance (Shariah-compliant) factors on any credit rating differentials between conventional bonds and *Sukuk*. Their results show that "traditional" firm characteristics, such as debt and firm size, are the common credit rating drivers for both conventional bonds and *Sukuk*. However, it is not clear whether the Islamic features have a significant impact on credit ratings, and they find very few differences between conventional bonds and *Sukuk* apart from Islamic structural differences.

In contrast to looking at the bond-level comparison, a broad practitioner literature on Islamic banks has been developed; however, academic papers are few, and even these have been largely neglected by researchers. Here, we cite a few papers, which mainly focus on the comparison between the Islamic and conventional banking systems with somewhat higher impact factors in terms of citation counts and journal quality. A highly cited book by Beck, Demirgüç-Kunt, and Merrouche (2010) studies the most common Islamic banking products in the context of agency problems, and then compares the business orientation, efficiency, asset quality and stability between conventional banks and Islamic ones, using the data from Bankscope. The authors conclude that although the equity-like nature of Islamic financial products suggests a potential mitigation of agency problems and, hence, significant deviation of Islamic banks from the conventional ones, the data indicates no significant difference between the two. Ariss (2010) compares Islamic banks versus conventional ones using a sample of banks in 13 countries during the period from 2000 to 2006. The results show no consistently significant differences in profitability levels between Islamic and conventional banks. As far as we know, the previous papers that focus on the Malaysian market have not attracted much attention. Yet, as mentioned above, Malaysia provides the most ideal setting for comparing these two financial systems; therefore, we believe that our paper makes a significant contribution to the literature.

As opposed to the extant literature, whose focus has been on credit-sensitive corporate bonds, we focus exclusively on the Malaysian sovereign bond market. On the one hand, the dual financial system in Malaysia provides a comprehensive laboratory for us to investigate comparatively the Islamic and conventional bond markets. On the other hand, the exclusion of corporate bonds from our analysis should alleviate concerns of differential credit risk. In addition, we apply well-established econometric methodologies (e.g., Fama-MacBeth regressions and the Nelson-Siegel factor model) to investigate both the cross-sectional and time series variations in the yield spread between government-issued *Sukuk* and conventional sovereign bonds.

Finally, our paper is related to the literature dealing with the liquidity effects on bond prices. Most of the extant liquidity measures are examined in the context of developed corporate and sovereign bond markets instead of emerging markets.[12] In the more recent corporate bond literature, several alternative liquidity measures have been proposed at the individual bond level, including estimators of transaction costs, turnover rates, and market impact. Jankowitsch, Nashikkar, and Subrahmanyam (2011) propose measuring liquidity by *price dispersion*, which is based on the dispersion of the transaction prices of an asset around its consensus valuation by market participants. The *zero-return* measure is constructed on the number of unchanged sequential prices, while the *no-trade* measure is based on the number of periods with no trading activity (Chen, Lesmond, and Wei, 2007). Amihud (2002) measures liquidity using the relative price impact of a trade to its trading volume. Roll (1984) posits that the autocovariance in price changes provides for a simple liquidity measure, commonly referred to as the *Roll* measure, and interprets the subsequent prices as arising from the "bid-ask bounce." Friewald, Jankowitsch, and Subrahmanyam (2017) examine the liquidity effects in the U.S. fixed income structured product market, using some of the liquidity proxies mentioned above. In our paper, we first test the relevance of the existing liquidity measures, and then attempt to develop novel liquidity measures that adapt better to emerging markets (e.g., the Malaysian sovereign bond market).

Even though the existing evidence suggests that *Sukuk*, *ceteris paribus*, deliver a higher yield (or have a lower price) than their corresponding conventional bonds, despite the former facing an upwardly shifted demand curve from both Islamic and conventional investors, our unique database and robust methodologies, which enable us to disentangle the clientele effects from microstructure and other effects, produce more reliable results while automatically controlling for macroeconomic factors and credit risk differentials. In summary, we fill the gap in the current literature by (1) quantifying and explaining the potential yield spread between *Sukuk* and conventional bonds; (2) examining the existing liquidity measures in the context of an emerging market; (3) developing novel liquidity measures which are better adapted to emerging markets; and (4) providing indirect

[12] A few examples of papers examining market liquidity in the emerging markets include Dittmar and Yuan (2008), Hund and Lesmond (2008), and Ammer and Cai (2011)

yet supporting evidence that any residual spread has to be due to the effect of foreign institutional investors' different levels of participation in these two Malaysian sovereign bond markets.

3. Data and Summary Statistics

Our bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM). It is of the calibre of the FINRA-developed vehicle, the Trade Reporting and Compliance Engine (TRACE), which facilitates the mandatory reporting of over-the-counter secondary market transactions in eligible fixed income securities in the U.S. The BNM Bond Info Hub's transaction-level data are available from 1996 to present, and updated daily. The universe of fixed income issuances is obtained from BNM's Fully Automated System for Issuing/Tendering (FAST), the single platform for the issuance of all debt securities and money market instruments approved by BNM and/or relevant authorities, which are either issued via tender or on a private placement basis. Our sample period is from January 2005 to December 2017.

3.1. Data Description

The instruments in our database can be grouped into asset-backed securities (ABS), corporate bonds, sovereign securities, commercial paper, Bank Negara Malaysia securities, and medium-term notes. To exclude the impact of credit risk differentials, we focus exclusively on Malaysian sovereign bonds, and restrict our sample to six types of bonds: Bank Negara Bills (BNB), Bank Negara Monetary Notes–Discount Based (BNMN-DB), Bank Negara Monetary Notes–Islamic Discount Based (BNMN-IDB and BNMN-IDM), GII (Government Investment Issues), and Malaysian Government Securities (MGS). The list of included and excluded Malaysian sovereign bond instruments is available in Internet Appendix C, along with their corporate bond counterparts.

We find that the cash flows and price/yield calculation conventions of *Sukuk* are the same as for conventional bonds, which we confirmed with the Malaysian financial regulators and industry practitioners. BNM calculates the yield to maturity according to the U.S. "street convention," self-styled as the BNM convention. In the U.S. street convention, yield is compounded over the bond coupon period (usually semi-annually), including the fractional first period (Henrard, 2013).

The "dirty" price (at the standard settlement date) is related to the yield to maturity as follows:

$$dirty\ price = \left(1 + \frac{y}{m}\right)^{-w} \left(\sum_{i=1}^{n^c} \frac{c_i}{(1 + \frac{y}{m})^{i-1}} + \frac{F}{(1 + \frac{y}{m})^{n^c-1}} \right), \tag{1}$$

where y is the annualized yield to maturity; m is the number of coupon payments each year; w is the fraction of the first period from the standard settlement date to the next coupon payment date; n^c is the total number of coupon payments; c_i is the coupon payment each period; and F is the notional face value of the bond.

If the standard settlement date is within the final coupon period ($n^c = 1$), the U.S. market's final period convention is used:

$$dirty\ price = \left(1 + w\frac{y}{m}\right)^{-1}(c_{n^c} + F). \tag{2}$$

Our estimated yield to maturity sometimes can be slightly different from the yield reported in the standard databases. This discrepancy can be attributed to several factors. Bonds with a missing coupon rate, and sometimes despite official classification as a zero-coupon bond, are not necessarily zero-coupon bonds. They can have fixed returns. In addition, the periodic cash flows of *Sukuk* may not be called "coupon payments." Instead, they are called "fixed returns." These bonds could also be classified as zero-coupon bonds on the Bond Info Hub web portal, although they are more similar to coupon bonds. Other reasons for the yield discrepancy could be an unusual interest payment structure, an embedded option, a floating rate feature, or simply a data entry error.[13]

To make our price/yield estimation as accurate as possible, we further restrict our sample to fixed-rate "straight" instruments without optionality, and eliminate suspicious data points using the following six filters.

- *Identity information filter:* We delete the observation if its instrument type, stock description, issuer, and maturity date are all missing.

- *Price information filter:* We apply this filter to ensure the price/yield information is available

[13] The government-issued *Sukuk* in Malaysia typically have maturities shorter than 10 years, while the conventional sovereign bonds have maturities up to 20 years. Thus, we exclude the conventional sovereign bonds with maturities longer than 10 years from our sample, since they do not have comparable counterparts.

and accurate.

- *Extreme price, yield, and volume filter:* We omit outliers, which we define as price, yield, and volume observations that are below the 0.1^{th} percentile or above the 99.9^{th} percentile.

- *Duplicated reports filter:* We remove duplicate reports with the same bond code, bond description, trade date, trade time, price, yield, and amount. We believe that these observations are duplicates, rather than these reports randomly just happening to be the same. This is because we observe such cases repeatedly for specific bonds only.

- *Price median filter:* The median filter eliminates any transaction in which the price deviates by more than 10% from the daily median, or from a nine-day median centered on the trading day. (The 10% level is determined to be a good threshold based on our data.)

- *Price reversal filter:* The price reversal filter eliminates any transaction with an absolute price change deviating from the lead, lag and average lead/lag price change by at least 10%.

To further reduce the noise in our transaction-level data, we aggregate the data points into bond-week observations, following Friewald, Jankowitsch, and Subrahmanyam (2012). In other words, if there is more than one transaction for one bond during the same week, we take the dollar-volume weighted average over the week. The volume-weighted average yield can be calculated as follows:

$$y_{jt} = \frac{\sum_i y_{jt}^i \times Q_{jt}^i}{\sum_i Q_{jt}^i}, \tag{3}$$

where y_{jt} is the volume-weighted average yield of bond j in week t, y_{jt}^i is the yield corresponding to the i^{th} trade of bond j in week t, and Q_{jt}^i is the volume for the i^{th} trade of bond j in week t. However, there are two exceptions, *Number of Trades* and *Amount Traded*, for which we take the summation of all of the trades for one bond during the same week, instead of the volume-weighted average.

Our final sample contains 37,686 bond-week observations (675 weeks). Our filtering process results in 432,633 transactions, which represents 68.81% of the total number of transactions in the raw data.[14] A more detailed illustration of how each filtering step affects our sample can be found in Appendix A.

3.2. Summary Statistics

Table 1 reports the summary statistics for the main variables in our empirical analysis, including the price, yield, bond characteristics, and liquidity proxies. *Maturity* is calculated as the number of years between the trading date and the maturity date. *Duration* is the modified duration of the bond. *Age* is the number of years between the bond issue date and the trading date. The *coupon rate* is directly reported in the database. *Number of Trades* and *Amount Traded* are counted for each bond within one week. *Time Interval* is, for each bond, the number of days since the last day the bond was traded. The *Amihud Ratio* measures the price impact of trades. For each transaction, we divide the absolute value of its return, measured in basis points, by its dollar trading volume, measured in hundred million Malaysian ringgit (MYR). A higher *Amihud Ratio* reflects lower liquidity (i.e., higher illiquidity). The *Amihud Ratio* is calculated as the average of all observed trades within the same week:

$$Amihud\ Ratio_t = \frac{1}{Number\ of\ Trades_t} \times \sum_j \frac{|Return_j|}{Dollar\ Trading\ Volume_j}. \tag{4}$$

The *Price Dispersion* measure is constructed following Jankowitsch et al. (2011). It measures how the transaction price differs from the market-wide valuation, and can thus be considered as a proxy for the transaction cost for a trade. A higher dispersion around the valuation indicates higher transaction costs and, therefore, lower liquidity (i.e., higher illiquidity). As we are not able to obtain the market-wide valuation for all Malaysian bonds in our database, we use the volume-weighted average price as a substitute. Hence the *Price Dispersion* measure is defined as:

$$Price\ Dispersion_t = \sqrt{\frac{1}{\sum_k v_k} \sum_k (p_k - vwap_t)^2 v_k}, \tag{5}$$

where p_k is the price of trade k; v_k represents its corresponding traded volume; and $vwap_t$ is

[14] The raw database from *Bond Info Hub* contains 628,710 transactions during the sample period of January 2005 to December 2017.

the volume-weighted average price of all of the trades for the same bond in week t. To obtain a valid *Price Dispersion* measure, we also require that the bond has at least two trades within the week. The *Zero Return Dummy* is set to one, if there is no price change from the previous trade, and zero, otherwise. Constant unchanged price information could indicate low liquidity (or high illiquidity).

[Insert Table 1 about here]

One concern about using the aforementioned traditional liquidity proxies in an illiquid emerging bond market is that they may be quite noisy, given that most bonds are infrequently traded. Each liquidity proxy may also be capturing one dimension of liquidity (e.g., trading activity, price impact or transaction cost). Including all of them in the analysis may make it difficult to capture the overall effect of liquidity. In addition, some of the liquidity proxies may be highly correlated, which will reduce the power of the test, due to multicollinearity, and thus underestimate the significance of the liquidity effect. For example, the correlation between the *Number of Trades* and the *Amount Traded* is as high as 0.759. As a result, we compute the first principal component of all the liquidity proxies and use it as our main liquidity proxy.

All of the variables are winsorized at the 99% confidence interval. The cross-sectional summary statistics are first calculated for each week, and then the time series average of each statistic is reported. Summary statistics for the combined sample, conventional bonds only, and Islamic bonds (*Sukuk*) only, are reported in Panels A, B, and C in Table 1, respectively. The results reveal that, on average, 55 bonds are traded every week: 35 conventional sovereign bonds and 20 government-issued *Sukuk*. The average yield of all of the traded bonds is 3.375%. Conventional bonds have a higher yield of 3.396%, while *Sukuk* have a yield of 3.361%, yielding an average spread of 3.5 basis points. With respect to bond characteristics, *Sukuk* have a lower maturity (2.939 years vs. 4.224 years), shorter age (1.291 years vs. 2.937 years) and lower coupon rate (2.317% vs. 2.780%).

The weekly average *Number of Trades* for each bond is 12.452, which corresponds to a total amount of MYR284.120 million, or approximately USD71.03 million. The average *Time Interval* between two trades for the same bond is 5.911 days. As for the *Amihud Ratio*, the mean is 1912.210 basis points per MYR100 million, or equivalently 76.488 basis points per USD1 million. This implies that trading USD1 million in a particular Malaysian sovereign bond could shift its price by 76.488 basis points. By way of comparison, Friewald et al. (2012) reported that for the U.S. corporate bond market, the weekly average *Number of Trades* and total *Traded Amount* for each bond was 17.35 trades ($= 3.47\ trades \times 5\ days$) and USD6.75 million($= USD1.35M \times 5\ days$), respectively. The average *Time Interval* and *Amihud Ratio* are 4.46 days and 78.38 basis points per USD1 million, respectively. Overall, the evidence suggests that the liquidity of the Malaysian sovereign bond market is comparable to that of the U.S. corporate bond market.

If we focus on the liquidity differences between conventional sovereign bonds and sovereign *Sukuk*, we can see that *Sukuk* have a lower *Number of Trades*, a lower *Traded Amount*, a higher *Time Interval*, and a higher frequency of an unchanged price, but a lower *Amihud Ratio*, and a lower *Price Dispersion*. Although the first principal component analysis of liquidity seems to imply that conventional bonds have slightly better liquidity overall, the mixed results indicate that no firm conclusion can be drawn regarding whether conventional bonds are more liquid than *Sukuk*. Finally, the summary statistics in Table 1 also show that the conventional and Islamic sovereign bonds in our sample are similar, except for the Shariah compliance requirements of the latter. Thus, it is reasonable to analyze and study the yield difference between these two subsets of bonds.

Table 2 presents the correlation matrix of the main variables, which are price, yield, various bond characteristics, liquidity measures, and the first principal component of the liquidity proxies. To construct the matrix, we first compute the cross-sectional pairwise correlations for each week, and then take the time series averages of the correlation coefficients. The primary determinants, maturity and duration, have fairly high correlation coefficients with yield (0.917 and 0.943, respectively). In general, the two trading activity measures, *Number of Trades* and *Amount Traded*, are negatively correlated with illiquidity measures such as *Time Interval*, *Amihud Ratio*, and *Zero Return Dummy*. The only exception is the *Price Dispersion* measure, which has an unexpected positive correlation with the trading activity measures, but is negatively correlated with the *Time Interval* and *Zero Return Dummy*. The correlations are quite low for certain pairs of liquidity proxies. For example, the correlation coefficient between the *Zero Return Dummy* and *Amihud Ratio* is only 0.069, while *Time Interval* has a correlation coefficient of -0.252 with *Number of Trades*. This evidence is consistent with the findings in Friewald et al. (2012) that liquidity proxies have substantial idiosyncratic movements and, thus, may capture somewhat different aspects of liquidity. Consequently, we use the first principal component of the various liquidity proxies as our main liquidity measure. As shown in the last row of the table, the first principal component has the highest correlation of 0.857 with the *Number of Trades*, followed by a correlation of 0.796 with the *Amount Traded*.

[Insert Table 2 about here]

4. Empirical Results

4.1. Actual (Data-based) Yields by Maturity

In our first step, we compare the actual (data-based) yields between the Malaysian government-issued *Sukuk* and their conventional counterparts simply by grouping the observations into 17 different maturity groups for each week.[15] Table 3 reports the descriptive statistics for these bond yields by different maturity groups. Since the government-issued *Sukuk* in our sample have maturities shorter than 10 years, we only compare the yields within each maturity group, which range between 3 and 120 months. The cross-sectional descriptive statistics are averaged over the 675 weeks. In the case of *Sukuk*, the average yield goes from 2.938% to 4.026%, as the maturity increases. *Sukuk* have a higher average yield than conventional bonds for almost all the maturity groups. This suggests that the yield difference between these two types of bonds is uniformly widespread, and not specific to any particular maturity group.

[Insert Table 3 about here]

Figure 2 presents the time-trend of actual (data-based) yield levels at different maturities for both subsets of bonds. In general, their yields co-move during the sample period. The 2007-2008 Global Financial Crisis (GFC) affects the Malaysian sovereign bond market from 2008:Q1 to 2010:Q2. The average yields across different maturities fell by around 1.75% during a 9-month period, from about 4.25% in June 2008 to about 2.5% in March 2009, for both types of bonds. Figure 3 shows the

[15] We pick 17 commonly-used maturities (in months): 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 48, 60, 72, 84, 96, 108, and 120.

time-trend of actual (data-based) yield spreads at different maturities. In general, a positive yield spread exits between the two subsets of bonds: sovereign *Sukuk* have, on average, higher yields than conventional sovereign bonds. However, we also notice that the average yield spread flipped from positive to negative during the GFC period, which is potentially due to the large scale selling of conventional sovereign bonds by the foreign clienteles.

[Insert Figures 2 and 3 about here]

4.2. Fama-MacBeth Cross-sectional Regressions

We next investigate whether there is a significant yield spread between the two bond subsets, holding other factors equal. To overcome the problem of heteroscedasticity and serial correlation, we use the Fama-MacBeth regression with a Newey-West correction as our main methodology. In the following model, Malaysian sovereign bond yields are regressed on an *Islamic Dummy*, various bond characteristics, and the first principal component of liquidity proxies:

$$\begin{aligned} Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Maturity_{i,t} + \alpha_3 \times Maturity_{i,t}^2 \\ + \alpha_4 \times Coupon\ Rate_{i,t} + \alpha_5 \times Age_{i,t} + \alpha_6 \times 1^{st}\ PC\ of\ Liquidity_{i,t} \end{aligned}. \tag{6}$$

The key variable in which we are interested, the *Islamic Dummy*, takes the value of one, if it is a government-issued *Sukuk*, and zero otherwise. The regression result using the combined sample is reported in Panel A. Regression results separating the database into conventional and Islamic (*Sukuk*) samples (with the *Islamic Dummy* omitted) are reported in Panels B and C of Table 4. On average, *Sukuk* traded at a yield 4.8 basis points higher than conventional bonds, *ceteris paribus*. In other words, government-issued *Sukuk* are cheaper in price than their conventional counterparts. An increase in maturity from one year to two years would, on average, leads to a 0.153 % ($=[0.168 \times 2] - [0.005 \times 4] - [0.168 \times 1] + [0.005 \times 1]$) rise in yield. The coupon rate has a positive effect on yield, which is consistent with the expectation that bonds with a larger coupon tend to be less liquid and thus less expensive. This significant positive effect remains after controlling for liquidity. A typical bond with a 3% coupon paid semi-annually would have a 2.4 basis points higher yield than a zero-coupon discount bond, other factors held constant. Although we expect recently issued bonds (i.e., those with a lower age) to be "on-the-run" and hence more liquid, the empirical results suggest that age, after controlling for liquidity and other bond characteristics, does not have any additional or significant impact on yield. Bonds with higher liquidity appear to have lower yields. A one standard deviation increase in liquidity decreases the yield by 1.027 basis points (-0.007×1.467), all else being constant. The evidence implies that the illiquidity premium in the Malaysian sovereign bond market is relatively low.

[Insert Table 4 about here]

To better understand the Islamic (*Sukuk*) premium among different bond instrument types, we add three instrument-type dummies to the Fama-MacBeth regression, one for *Sukuk* (*Is_BNMN_ID*) and two for conventional bonds (*Is_BNMN_DB* and *Is_MGS*). *Is_BNMN_ID* is defined as one, if the bond traded belongs to Bank Negara Monetary Notes-Islamic Discount Based (BNMN-IDB and BNMN-IDM), and zero, otherwise. Other instrument type dummies are defined similarly. The remaining two instrument types, GII and BNB, are used as the base group for *Sukuk* and conventional bonds respectively.

The regression results are reported in Table 5. After controlling for the instrument type fixed effect, we find that the Islamic (*Sukuk*) premium increases from 4.8 basis points to 9.8 basis points, which is both statistically and economically significant. Moreover, we do not observe a significant difference between the two Islamic bond groups (BNMN-ID and GII), while within the conventional bond category, BNMN-DB and MGS traded at a yield 2.9 and 7 basis points higher than BNB, respectively. This result seems to indicate that investors prefer short-term Malaysian sovereign bonds for reasons other than the credit, interest rate and liquidity differences. This is possibly due to a liquidity term premium.[16]

[Insert Table 5 about here]

[16] Propensity Score Matching (PSM) could be an alternative methodology to compare the yields of these two bond subsets. However, given the trading frequency of the Malaysian sovereign bond market, the sample size would be rather small after matching the two bond subsets by maturities, coupon rates, ages, and liquidity.

4.3. Nelson-Siegel Three-Factor Model

In order to better capture the nonlinear relation between bond yields and maturities, we fit our data with a Nelson-Siegel three-factor model. Following Diebold and Li (2006), we fit the weekly yield curves of the Islamic (*Sukuk*) and conventional sovereign bonds separately, using the following three-factor model:

$$y_t(\tau) = \beta_{1t} + \beta_{2t}X_{2t} + \beta_{3t}X_{3t}; X_{2t} = \frac{1-e^{-\lambda_t\tau}}{\lambda_t\tau}, X_{3t} = \frac{1-e^{-\lambda_t\tau}}{\lambda_t\tau} - e^{-\lambda_t\tau}, \tag{7}$$

where the three factors are β_{1t}, β_{2t}, and β_{3t}, the corresponding factor loadings are a constant (1), X_{2t}, and X_{3t}, and τ denotes the maturity. λ_t is the decaying factor and we fix $\lambda_t = 0.0609$.

Diebold and Li (2006) interpret β_{1t}, β_{2t}, and β_{3t} as three latent dynamic factors. β_{1t} can be viewed as a long-term factor (i.e., the level of the yield curve) because it has a loading of 1, a constant that does not decay to zero in the limit. β_{2t} can be viewed as a short-term factor (i.e., the slope of the yield curve) because the associated factor loading, $X_{2t} = \frac{1-e^{-\lambda_t\tau}}{\lambda_t\tau}$ starts at 1 but decays quickly to zero. β_{3t} can be viewed as a medium-term factor (i.e., the curvature of the yield curve) because the loading $X_{3t} = \frac{1-e^{-\lambda_t\tau}}{\lambda_t\tau} - e^{-\lambda_t\tau}$ starts at 0, increases (and thus is medium-term) and then decays to zero.

For each week t, we regress the yield $y_t(\tau)$ on three factor loadings (a constant 1, X_{2t}, and X_{3t}) cross-sectionally, providing us with a time series of the three estimated factors. Table 6 reports the time series mean of the three estimated factors. The yield curve is jointly determined by the values of the three factors.[17] The results show that, government-issued *Sukuk* have higher estimated values, on average, for both long-term and medium-term factors (i.e., β_{1t}, and β_{3t}), and slightly lower estimated value for the short-term factor (i.e., β_{2t}). The long-term component (level) of the yield curve for government-issued *Sukuk* is 4.405% while that for conventional sovereign bonds is 4.373%.

[Insert Table 6 about here]

Figure 4 shows both actual (data-based) and fitted (model-based) average yield curves for government-

[17] The three factors are a constant 1 , X_{2t}, and X_{3t}.

issued *Sukuk* and their conventional counterparts. The fitted (model-based) average yield curves are obtained by evaluating the Nelson-Siegel model at the time series mean of the three estimated factors, as reported in Table 6. As we can see, *Sukuk* have higher actual (data-based) average yields than conventional ones across various maturities. In addition, the interpolated Nelson-Siegel curve of the government-issued *Sukuk* exhibits an upward shift (5 to 8 basis points in general) from that of their conventional counterparts. In order to alleviate the concern that the distribution of the time series of the estimated factors might be biased, we also show the median, 25th, and 75th percentile fitted (model-based) yield curves in Figure 5. The median, 25th and 75th percentile yield curves are obtained by evaluating the Nelson-Siegel model at those percentile values for the three estimated factors from Table 6, respectively. All three pairs show a consistent pattern–the fitted yield curve of government-issued *Sukuk* lies above that of conventional sovereign bonds. Additional details of the fitted Nelson-Siegel curves are reported in Internet Appendix A.

[Insert Figures 4 and 5 about here]

4.4. Macro Environment Conditions and Multiple Structural Breaks

In Subsections 4.1 to 4.3, we inspect the average yield spreads between Malaysian sovereign *Sukuk* and conventional sovereign bonds by examining the raw yield spreads across maturity buckets, i.e., the residual yield spreads after controlling for bond characteristics, trading activity and liquidity measures using Fama-Macbeth regressions, and at the estimated yield curves using a three-factor Nelson-Siegel model, respectively. Due to the lack of accurate holdings data at a reasonable frequency, we are not yet able to show *direct* evidence of the clientele effect on these spreads. However, in Subsections 4.4 to 4.5, we attempt to provide supporting evidence that foreign institutional investors have a role to play in explaining the residual yield spread. Taking the residual yield spreads from Subsection 4.2 as an example, the collective evidence indicates that, on average, Malaysian sovereign *Sukuk* have a significantly higher yield, of 4.8–9.8 bps, than their conventional counterparts. As our sample period spans longer than 10 years, it is reasonable to assume that various macro-environmental conditions during this period could have led to multiple structural breaks in both the direction and the level of the yield spread between the two sovereign bond subsets.

Therefore, in this subsection, we aim to first investigate whether we are able to statistically detect any structural breaks, then collect as many representative events as possible during our sample period, and finally relate the breakpoints (i.e., dates) detected statistically to market-wide events.

There are two main purposes for this subsection. On the one hand, if there does exist any structural break or multiple breaks in our data, the results from Subsections 4.1 to 4.3 would be biased if the breaks were simply ignored. On the other hand, it enables us to examine how the yield spread direction and level are altered by one or more events of impact in the Malaysian sovereign bond market, and furthermore, to provide supportive evidence of our clientele effect hypothesis. In particular, if any relevant event triggers an increase or decrease with respect to foreign and local holdings on both subsets of bonds, and thus potentially leading to a wider, narrower, or even flipped yield spread.

In the literature researching structural changes, one commonly-used framework is the F-statistic-associated tests, including the Chow test (Chow, 1960) and the *supF* test (Andrews and Ploberger, 1994). However, the framework based on the F-statistic assumes that there is only one break in the data, or that the breakpoints (dates) are known in advance. Bai and Perron (1998, 2003) extend this approach to a multiple structural break framework, and Zeileis, Kleiber, Krämer, and Hornik (2003) summarize this in a more concrete context.

Following Bai and Perron (2003) and Zeileis et al. (2003), we first collect a time series of the coefficients of *Islamic Dummy* from the Fama-MacBeth regressions in Subsection 4.2, and then apply the multiple structural break approach to the time series. The coefficients of *Islamic Dummy* can be interpreted as the average yield spread between Malaysian sovereign *Sukuk* and conventional sovereign bonds, after controlling for liquidity as well as bond characteristics such as maturity, coupon rate and age. In general, we are testing whether the mean of the yield spread changes over time, i.e., we fit our data with a constant.[18] As shown in Figure 6, we have statistically detected four break points (dates), splitting our data into five different subperiods. The first structural change occurs immediately after the start of our sample period, potentially due to the limited supply of Malaysian sovereign *Sukuk*. The second break in July 2007, and the third break in July

[18]We initially included the lagged yield spread, i.e., the coefficient on *Islamic Dummy* on the right hand side; however, since it did not lead to different results, we did not include it here.

2009, coincide with the start and end of the Global Financial Crisis (GFC) period. The mean of the yield spread drops dramatically from 4.4 basis points pre-GFC to 0.3 basis points during the GFC, and then recovers to 5.9 basis points post-GFC. One explanation could be that a "selldown" by foreign investors took place during the crisis, resulting in an increase in the average yield of conventional sovereign bonds.[19] However, the sovereign *Sukuk* are less affected as the majority of *Sukuk* is held by local institutions, leading to a narrowing of the yield spread, from 4.4 basis points to 0.3 basis points. The last structural change is detected near the end of our sample period.

[Insert Figure 6 about here]

4.5. Inclusion of *Sukuk* in J.P. Morgan's Emerging Markets Indices

On 19 August 2016, J.P. Morgan announced the inclusion of two Malaysian sovereign *Sukuk* maturing in 2023 and 2026 in its J.P. Morgan Government Bond Index-Emerging Markets (JPM GBI-EM), starting from 31 October 2016.[20] In June 2005, J.P. Morgan launched this index, which is among the first to provide a comprehensive benchmark for investors focusing closely on local emerging markets, while searching for greater diversification and higher yield. As compared to J.P. Morgan's other emerging markets indices, JPM GBI-EM is the most narrow, replicable and restrictive series. It only includes countries that are truly accessible, and with no investment impediments for foreign investors.

As reported by Reuters in 2016, Malaysia was the only country with its local currency *Sukuk* added into J.P. Morgan's GBI-EM index.[21] Both *Sukuk* are Government Investment Issues (GII). One of the chosen *Sukuk* was issued in January 2016 and will mature in July 2023 with a profit rate of 4.39%, while the other was issued in March 2016 and will mature in September 2026 with a profit rate of 4.07%. In addition, there are two conventional sovereign bonds, which are likely to be issued for the same purposes as the two chosen *Sukuk*.[22] One of the two conventional sovereign

[19] Approximately half of Malaysian conventional sovereign bonds are held by foreign investors, while more than 90% of Malaysian sovereign *Sukuk* are held by local investors.

[20] To the best of our knowledge, the earliest public announcement was published by Reuters on 19 August 2016. The relevant web link is https://uk.reuters.com/article/uk-jpmorgan-sukuk-index-idUKKCN10U08D.

[21] We are unable to identify the local stock codes for these two Sukuk directly from any public source. What we hence did was to search the entire database for all Sukuk maturing in 2023 and 2026. Our search revealed that the local stock codes for the two chosen Sukuk are "GL160001" and "GO160003".

[22] The local stock codes of the two conventional sovereign bonds are "ML160001" and "MO160003," and the corresponding ISIN numbers are "MYBML1600014" and "MYBMO1600034."

bonds was issued in February 2016 with a coupon rate of 3.80%, while the other was issued in May 2016 with a coupon rate of 3.90%. Both of the conventional bonds have earlier issue dates, the same term to maturity, and lower coupon rates than the two *Sukuk* included in J.P. Morgan's GBI-EM index. In this section, we investigate whether the two chosen *Sukuk* behave differently from the remaining ones after 19 August 2016, which is when J.P. Morgan announced its addition of the two *Sukuk* into its GBI-EM index.

There is a stream of literature studying the effects of stocks being included in global indices. Lynch and Mendenhall (1997) investigate stock price and volume changes after being added to or deleted from the S&P 500 during the sample period of March 1990 to April 1995. Their results show that there exists a significant positive (cumulative) abnormal return during the announcement day, and during the following period from the day after the announcement until the day before the effective change. Furthermore, the stock price experiences a significant decrease after the addition itself. In a more recent paper by Bena, Ferreira, Matos, and Pires (2017), the authors study the long-term effects of foreign holdings on a sample of publicly-listed firms in 30 countries from 2001 to 2010. Using the addition (deletion) of a firm's stock to (from) the MSCI All Country World Index (MSCI ACWI) as an instrument, the paper finds that foreign institutional ownership benefits the firm in the long run. However, to the best of our knowledge, there are few papers in the literature focusing on the effect of bonds being included in global indices, especially in the context of the sovereign bond market. Our finding fills the gap and makes a contribution to this literature.

In the following subsection, we adopt two alternative methodologies to investigate the effect of the two Malaysian sovereign *Sukuk* being included in the JPM GBI-EM index. In Subsection 4.5.1, we conduct separate tests on the average yields of the two *Sukuk* within pre- and post-announcement windows, respectively. In Subsection 4.5.2, which serves as a robustness check, we apply the "classical" event study method in the context of bonds, by using the cumulative mean abnormal return (CAR) around the announcement.

4.5.1. Average yield spread pre- and post- the announcement

One way to study whether the two chosen *Sukuk* behave differently after their inclusion in the JPM GBI-EM index is to test whether the average yield difference between the two *Sukuk* and the remaining *Sukuk* changes dramatically after the announcement. In order to obtain a proper and coherent measure of the yield spread, we modify the Fama-MacBeth regression model in Section 4 Subsection 4.2 by adding another dummy variable, *JPM Dummy*. We define the *JPM Dummy* as 1, if the bond traded is one of the chosen *Sukuk*, and as 0, if it belongs to the remaining group of *Sukuk*. Similar to the first step in the Fama-MacBeth methodology, we first run the following cross-sectional regressions every week from 24 March 2016 to 31 December 2017, and then collect the time series of each of the eight coefficients, including the intercept (i.e., α_j for $j = 0, 1, ..., 7$).[23]

$$\begin{aligned} Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times JPM\ Dummy_{i,t} + \alpha_3 \times Maturity_{i,t} \\ + \alpha_4 \times Maturity^2_{i,t} + \alpha_5 \times Coupon\ Rate_{i,t} + \alpha_6 \times Age_{i,t} + \alpha_7 \times 1^{st}\ PC\ of\ Liquidity_{i,t} \end{aligned} . \tag{8}$$

In the second step, instead of computing the mean of each coefficient (i.e., α_j for $j = 0, 1, ..., 7$) using the entire time series, we first split the time series into pre- and post-announcement periods, and then perform separate tests on the two time-series means. The variable of interest here is *JPM Dummy*, which measures the average yield differences between the two chosen *Sukuk* and the remaining *Sukuk* after controlling for maturity, coupon rate, age and liquidity. The corresponding results are shown in Table 7. The first column reports the time-series mean of each coefficient through the full subsample window.[24] The second column presents the results of Fama-MacBeth coefficients within the 5-week pre-event window, while the third column shows the results within the 5-week post-event window. Similarly, the fifth (seventh) and sixth (eighth) columns report the results with a longer estimation window – 10 (15) weeks pre- and post-announcement.[25] As we can see from the first column in Table 7, the Malaysian sovereign *Sukuk* have a higher yield of 8.2 basis

[23] One of the chosen *Sukuk* was issued on 7 January 2016, while the other was issued on 24 March 2016. We only retain weeks when both of the chosen *Sukuk* are available in the market.

[24] The full subsample window in this section is from 24 March 2016 to 31 December 2017.

[25] Our data are weekly, and we define every Thursday (every next Wednesday) as the start (end) of each week. The announcement date is on Friday, 19 August 2016, and the event window is defined as the week around the announcement from Thursday, 18 August to Wednesday, 24 August 2016. The 5-week pre-event window is from Thursday, 14 July to Wednesday, 17 August 2016, *excluding* the announcement week. The 5-week post-event window is from Thursday, 18 August to Wednesday, 21 September 2016, *including* the announcement week. Similarly, the 10-week (15-week) pre-event window is from Thursday, 9 June (5 May) to Wednesday, 17 August 2016, while the 10-week (15-week) post-event window is from Thursday, 18 August to Wednesday, 26 October (30 November) 2016.

points than their conventional counterparts, and there are no significant yield differences between the two chosen *Sukuk* and the remaining *Sukuk* during the full subsample window from 24 March 2016 to 31 December 2016. In addition, the coefficients of *JPM Dummy* are insignificantly different from zero, within two out of the three pre-event windows: Before J.P. Morgan's announcement about adding the two *Sukuk* into the GBI-EM index, there are no significant yield differences between the chosen *Sukuk* and the remaining ones. However, within all three post-event windows, the two chosen Malaysian sovereign *Sukuk*, as compared to other *Sukuk*, experience a significantly lower yield, of around 7.6-10.2 basis points, on average, at a significance level of 1%. The results are consistent with our hypothesis that the yield spread between the two Malaysian *Sukuk* and their conventional counterparts is narrower as compared to the remaining *Sukuk*, due to a significant increase in foreign holdings on the two chosen *Sukuk*.

[Insert Table 7 about here]

4.5.2. Cumulative abnormal return (CAR) around the announcement

In this section, we implement an alternative method to test whether the two *Sukuk* behave differently from other *Sukuk* after the announcement date by using the cumulative abnormal return (CAR) analysis. In order to undertake a closer examination of the immediate response of the two *Sukuk* around the announcement, we examine the CARs within a shorter window (i.e., within one week) using daily data. The CAR is calculated by taking the differences between the realized return and the predicted return from a market model. Market model parameters are estimated over a period of one year prior to the event window. We choose the S&P Malaysian Sovereign Bond Index as our market model benchmark. Furthermore, we divide our bonds into three different groups: conventional sovereign bonds, the two chosen *Sukuk* by J.P. Morgan, and the remaining *Sukuk* excluding those two *Sukuk*. We are able to detect a substantially significant positive CAR of 0.547 basis points for the two chosen *Sukuk* during the event window of one day before and one day after the announcement. However, the CARs of both the remaining sovereign *Sukuk* and the conventional sovereign bonds are indifferent from zero. The results are consistent with our hypothesis as well as those from Subsection 4.5.1. That is, the prices of the two chosen *Sukuk*, as compared to the remaining *Sukuk* and the conventional sovereign bonds, experience a significant increase after the announcement by J.P. Morgan. In Subsection 4.5.3, we provide some supplementary evidence which could potentially explain the positive (negative) price (yield) response of the two chosen *Sukuk* by J.P. Morgan.

4.5.3. Supplementary evidence: increase of foreign holdings

Do foreign holdings of the two chosen *Sukuk* truly increase after the announcement? In this section, we aim to provide some supportive evidence. Unfortunately, the holdings data at the individual bond level in the available databases are only disclosed quarterly. Due to the frequency mismatch, we are not able to conduct any formal analysis of the holdings. Instead, we first hand-collect the quarterly holdings data on the two chosen *Sukuk* from Bloomberg, and then plot the time-trend of holdings by both foreigners and local investors. As the announcement is on 19 August 2016, which is situated in the middle of the third quarter, we are interested to determine if foreign holdings on both *Sukuk* increase dramatically from the second quarter to third quarter of 2016. As shown in Figure 7, the holdings position by foreigners on one *Sukuk* "GL160001" increases to 168,644 units in the third quarter of 2016, which is over 7 times the foreign holdings of 23,200 units in the second quarter, while that on the other *Sukuk* "GO160003" increases to 979,880 units, about 2 times the foreign holdings of 515,518 units in the previous quarter. The results are supportive of our hypothesis that foreign holdings on the two Malaysian *Sukuk* increase after their inclusion in the global bond index, which would, in turn, reduce the clientele effect differentials, and thus narrow the yield spread between the two *Sukuk* and their conventional counterparts.[26]

[Insert Figure 7 about here]

5. Demand-side Proxies for Sovereign *Sukuk*

In this section, we identify three demand-side proxies for Malaysian sovereign *Sukuk*, including a currency factor, Ramadan month, and oil price factor. As we observe in the data, the oil price factor and currency factor are highly correlated. In order to avoid multicollinearity, we exclude the

[26] We are not able to precisely identify supply-side factors in this paper due to the lack of research-quality data on individual bond holdings. For example, the dollar amount of bonds outstanding or bond "free-float" data, at the individual bond level, are not available to our knowledge.

oil price factor from our main regression analysis, and instead provide descriptive evidence on the oil price factor at the end of this section.

As mentioned previously, there is the potential for foreign investors' under-participation in the Malaysian *Sukuk* market, whose familiarity and preference for the more established and liquid conventional sovereign bonds, purchase more of the latter than the former. As a consequence, the yield spread between sovereign *Sukuk* and conventional bonds remains positive over time, and is not arbitraged away. The close analogy, in the case of U.S. Treasury bonds, is the observed spread between otherwise identical on-the-run and off-the-run Treasury bonds, which is not arbitraged away either despite the U.S. Treasury bond market being the most liquid bond market in the world. In fact, we discuss a similar on-the-run and off-the-run effect in Malaysian sovereign bond markets in the section on special repo rates and yield spreads.

However, among all the institutional investors in the Malaysian sovereign bond market, Islamic funds in general favor *Sukuk* and other Shariah-compliant securities over conventional ones. Hence, we conjecture that any event or economic factor that directly or indirectly drives the demand for Malaysian sovereign *Sukuk* will influence prices and yields as well. We, therefore, identify three Islamic finance-driven demand-side proxies – oil prices, strength in the currency of Islamic nations against the U.S. dollar, what we refer to as the Ramadan effect.[27]

5.1. The Ramadan Effect

During the months of Ramadan, which are the holiest months in the Muslim calendar, it is possible that activities with a religious mandate are carried out with greater fervor leading to higher demand for Islamic bonds. According to Almudhaf (2012), there is a statistically significant seasonal Islamic calendar effect in the stock markets of Jordan, Kuwait, Pakistan and Turkey. In this subsection, we explore if similar calendar effects exist in the Malaysian sovereign *Sukuk* market during the holy months of Ramadan.

As a preliminary check, we investigate whether the two bond subsets behave differently during Ramadan versus non-Ramadan months. Panel B of Table 8 shows that Islamic sovereign bonds tend

[27]We thank the Editor-in-Chief for suggesting the entire analysis in this section, including testing for the Ramadan, currency, oil price factor and other Islamic-induced effects.

to have a higher (unadjusted) yield, longer maturity, and higher coupon rate on average during the Ramadan months, while no significant difference is found for conventional bonds. The results imply that Ramadan appears to only affect the Islamic sovereign bond market but not the conventional one. However, the results of liquidity comparisons during Ramadan and non-Ramadan months are mixed, as shown in Panel A of Table 8. Some evidence shows that sovereign *Sukuk* are traded more actively during the Ramadan months, but the magnitude is rather marginal. It is worthwhile noting that the yields in Table 8 are not adjusted for bond characteristics, trading activities, and liquidity measures.

[Insert Table 8 about here]

In Figure 8, we plot the time series of the adjusted average yield spreads, and the graph shows that the yield spreads, adjusted for maturity differentials, tend to shrink by about 2 bps on average during the months of Ramadan. The results are robust after controlling for bond characteristics, trading activities, liquidity measures, and oil price and currency effects. As a robustness check, we replace the levels of exchange rates by taking the first difference on the right-hand side, and the results remain qualitatively the same, and shown in Figure 9.[28]

[Insert Figures 8 and 9 about here]

5.2. The Currency Factor

As mentioned above, international Islamic government funds are among the major foreign institutional buyers of sovereign *Sukuk* issued by Malaysia. Therefore, we conjecture that the demand for Malaysian sovereign *Sukuk* should be driven by the strength of these Islamic countries' currencies against the Malaysian Ringgit (MYR). The stronger these countries' currencies are with respect to the MYR, the more likely they are to purchase *Sukuk*. Our hypothesis is that a strengthening Islamic currency – or rising cross-exchange rate in MYR per Islamic Currency Unit – would enable international Islamic government funds to purchase more *Sukuk* denominated in MYR.

[28]The results are controlled for currency factors. We discuss the construction of currency factors in detail in the next subsection.

We conduct the empirical test by selecting cross-exchange rates for seven key Islamic countries against the Malaysian Ringgit: Indonesia, Brunei, Saudi Arabia, United Arab Emirates (UAE), Kuwait, Iran and Turkey. We further classify these countries into two categories: (i) USD-denominated oil exporting Islamic countries and (ii) non-oil exporting and non-USD denominated oil exporting Islamic countries. For ease of definition, we abbreviate the two groups as oil exporting Islamic countries and non-oil exporting Islamic countries.[29] As shown in Table 9, we construct two ex-ante defined currency factors by conducting a principal component analysis (PCA) on the currency categories (i.e., oil exporting and non-oil exporting Islamic country currencies). We perform PCA on the first difference of currency exchange rates to avoid autocorrelations in currency levels.

In general, the currencies in the oil exporting Islamic countries are highly correlated with the USD, with correlation coefficients ranging from 0.641 to 0.904. This is not suprising as the government fund revenues in these countries are highly correlated with oil price, which is usually quoted in USD. For example, the currencies of UAE and Saudi Arabia are fixed at 3.75 units to the USD, while those of Brunei and Kuwait in MYR terms are highly correlated to the MYR/USD pair. The high correlation between the oil exporting country currency factor and oil price factor is also the reason why we exclude the oil price factor from our main regression analysis, which is shown in the next subsection.

On the other hand, the non-oil exporting Islamic countries show low correlation with the MYR/USD. Turkey and Indonesia are very low exporters of oil – the former only produces 66,308 barrels per day (bpd) whereas the latter only produces 825K bpd, and consumes most of it. These pale in comparison to Saudi Arabia's 12.1 million bpd. Due to multiple sanctions over the years, Iran works mostly in the oil black market and in non-USD currencies. Hence, fluctuations in the US dollar price of oil do not have a direct impact on its exchange rate.

[Insert Table 9 about here]

[29] Oil exporting Islamic countries including Brunei, Saudi Arabia, United Arab Emirates (UAE) and Kuwait. Non-oil exporting and non-USD denominated oil exporting Islamic countries include Indonesia, Turkey and Iran.

5.3. Ramadan Dummy and Currency Factors as Explanatory Variables

Having established two potential proxies that affect the demand for Malaysian sovereign *Sukuk* by foreign institutions, we formally analyze their effects on the average yield spread between Islamic and conventional bonds, by running a time-series regression with the dependent variable being the Islamic dummy coefficients collected from the Fama-MacBeth regressions in Table 4. Given the fact that there is only one Ramadan month versus eleven non-Ramadan months within a year, which would overweight the observations from non-Ramadan weeks and potentially generate biased results, we take a truncated 2-week sample centering around the month of Ramadan for each year during our sample period from January 2005 through December 2017.

In the following model specification, $\alpha_{1,t}$, is a time series of coefficients on *Islamic Dummy* from Model 1 in Table 4, which measures the residual yield spread after controlling for maturity and maturity squared. The Ramadan dummy is defined as 1 if the observation is from a Ramadan week, and 0 if it is from a non-Ramadan week. We control for *Coupon Rate*, *Age*, and *Liquidity* in the time-series regression by taking the weekly average of *Coupon Rate*, *Age*, and 1^{st} *PC of Liquidity* for both Islamic and conventional bonds.

$$
\begin{aligned}
\alpha_{1,t} = \beta_0 &+ \beta_1 \times Ramadan\ Dummy_t + \beta_2 \times 1^{st}\ PC\ of\ \Delta Currency - Oil\ Exporting\ Countries_t \\
&+ \beta_3 \times 1^{st}\ PC\ of\ \Delta Currency - Non\ Oil\ Exporting\ Countries_t \\
&+ \beta_4 \times 1^{st}\ PC\ of\ Liquidity\ Islamic_t + \beta_5 \times 1^{st}\ PC\ of\ Liquidity\ Conventional_t \\
&+ \beta_6 \times Coupon\ Rate_t + \beta_7 \times Age_t
\end{aligned} \tag{9}
$$

The results in Table 10 demonstrate the overall significance for the two demand-side proxies, i.e., currency strength and Ramadan effect. Model 7 in Table 10 shows that these two proxies are able to explain 50.3%, in total, of the variation of the yield spread between Malaysian sovereign *Sukuk* and their conventional counterparts. On average, the yield spread of *Sukuk* over conventional bonds declines by 2.3 basis points in Ramadan weeks, as compared to non-Ramadan weeks. This indicates that for *Sukuk* bonds, the yield in Ramadan weeks is lower (i.e., the *Sukuk* is more expensive) as compared to alternative days. Put differently, the demand for *Sukuk* during the Ramadan months is higher, hence yielding a higher price for these bonds.

There is also a significant currency effect on *Sukuk* yield spreads. All else being equal, a one standard deviation increase in the common component of oil exporting Islamic country currencies *decreases Sukuk*'s yield by 1.3 basis points ($= 0.010 \times 1.30$), ceteris paribus.[30] In other words, *Sukuk* becomes more expensive when the Malaysian Ringgit is relatively cheaper and the demand for Malaysian sovereign *Sukuk* is high. However, we do no find such significant results for both non-oil exporting Islamic countries such as Turkey and Indonesia, and the sole non-USD denominated oil exporting Islamic country in our sample, Iran.

[Insert Table 10 about here]

5.4. Supplementary Evidence: Oil Price Factor

As many Islamic countries are net exporters of oil, an increase in the price of oil could potentially translate to higher revenues for their central bank reserves management and government funds. This drives up the demand for Malaysian sovereign *Sukuk*. Hence, we conjecture that the yield spread between Malaysian sovereign *Sukuk* and conventional sovereign bonds narrows when the oil price rises. In order to test this, we select the top three oil price benchmark indices – the sweet BRENT crude for oil produced in the North Sea, the West Texas Intermediate (WTI) crude, which is the main oil benchmark for North America, and the Dubai-Oman crude, which is the primary benchmark for oil delivered to Asian refineries from the Middle East. For completeness, we also include the Malaysian light-sweet TAPIS index. The oil index is measured in USD per barrel. A principal component analysis is conducted on these four highly correlated oil price indices to extract the main driver of the variation in oil prices. The first principal component (1^{st} PC) of oil prices explains 98.77% of the variation, which serves as our proxy for oil prices in the following analysis. As a preliminary check, Table 11 shows that the yield spreads are lower when the oil price is higher. This is true for almost all the maturity buckets.

[Insert Table 11 about here]

[30] As shown in Table 9, the first principal components are negatively correlated with the individual currency for both oil exporting and non-oil exporting Islamic countries.

In Table 12, we present the quadrant analysis by splitting the sample into four regimes: a) low oil price and decreasing oil price, b) low oil price and increasing oil price, c) high oil price and decreasing oil price, and d) high oil price and increasing oil price. In general, both high oil price regime and increasing oil price regime witness a lower average yield spread. This is consistent with our hypothesis that higher/increasing oil prices drives up the demand for Malaysian sovereign *Sukuk*, and narrows down the yield spreads between the two bond subsets.

[Insert Table 12 about here]

The results in this section indicate that there is a significant foreign clientele effect, where the price of oil, the strength of Islamic countries' currencies and excess trading activities in Islamic securities during the Muslim month of Ramadan, have an impact on the average yield spread.

6. Special Repo Rates and Yield Spreads

So far, all our results are conducted in the Malaysian sovereign bond cash market, with no reference to the Malaysian repo market, which remains a fairly active one. Most analyses of sovereign bond yields including those of developed markets, ignores the effects of repo markets. Thus, we are among the first to explicitly consider this interaction in *any* market. In this section, we extend our analysis to the sovereign repo market and investigate if the documented yield spread remains significantly positive under this context. According to the Asian Development Bank (2016), the Malaysian repo market consists of two segments: an interbank (OTC) market segment, and the bilateral repo segment. The bilateral repo is transacted between Bank Negara Malaysia (BNM) and the primary dealers appointed by BNM, and is mostly employed by BNM to manage or provide liquidity to financial markets through open market operations. As conveyed by the market participants, most repo transactions are between BNM and their appointed primary dealers. Accordingly, the bilateral repo segment dominates the Malaysian repo market. Yet both the interbank and the bilateral repo segments are governed by BNM and follow its Policy Document on Repurchase Agreement Transactions.[31] Furthermore, BNM requires that all repo transactions be reflected in its Electronic

[31] The Policy Document on Repurchase Agreement Transaction was issued by Bank Negara Malaysia (BNM) in December 2014. See http://www.bnm.gov.my/guidelines/01_banking/04_prudential_stds/Repurchase_Agreement_Transactions.pdf for more details.

Trading Platform (ETP) within 10 minutes of execution.

The earliest repo market activities in Malaysia can be traced back to 1980s. While the only type of collateral initially was hold-in-custody repo (HIC), it has now extended to include both sovereign bonds and private debt securities (PDS). As shown in the repo summary section on the Bond Info Hub web portal, sovereign bond repo transactions account for over 80% of the total volume in the Malaysian repo market.[32] Based on the report issued by the Asian Development Bank (2016), repo transaction volume witnessed a significant increase in 2005 and peaked at MYR665 billion in 2016. Since then, BNM has taken active use of repo as a monetary policy instrument, and it is reported that 15% of the monetary operations by BNM were implemented via repo and this percentage is expected to rise according to the authorities.

6.1. Special repo rate differential between Malaysian sovereign *Sukuk* and conventional sovereign bonds

In this subsection, we focus purely on the repo market for Malaysian sovereign bonds, where we compare the special repo rates between Malaysian sovereign *Sukuk* and conventional sovereign bonds. In Table 13, we compute the average special repo rates of these two bond subsets at different repo tenures. We first pool the special repo transactions into 9 fixed repo tenure buckets.[33] For each repo tenure bucket, we calculate the mean of the repo rate (volume) cross-sectionally, and then report the time-series average. As we can see from Table 13, Islamic bonds have a higher special repo rate, on average, than their conventional counterparts, for all the 9 repo tenure buckets. In addition, the repo volumes are higher for conventional bonds than Islamic bonds for 8 out of the 9 repo tenures.[34] This shows that for collateral with the same repo tenure, government bond investors will be able to borrow at a lower special repo rate using conventional sovereign bonds as collateral. In Table 14, we report the Fama-MacBeth regression models explaining the repo rate based on weekly averages of all variables:

[32] See `http://bondinfo.bnm.gov.my/portal/server.pt?open=514&objID=41920&parentname=CommunityPage&parentid=2&mode=2` for details.

[33] The 9 repo tenure buckets are one day, two days, one week, two weeks, three weeks, one month, two months, three months, and six months.

[34] The only exception is the three-month repo, and further investigation is needed to explain this.

$$Repo\ Rate_{i,t} = \alpha_0 + \alpha_1 \times Repo\ Tenure_{i,t} + \alpha_2 \times Islamic\ Dummy_{i,t} + \alpha_3 \times Controls. \quad (10)$$

The results show that Islamic sovereign bonds still exhibit a higher special repo rate of 18.5 to 56.7 basis points, on average, after controlling for repo tenure, as well as the bond characteristics. We also notice that the repo rate spread (*Islamic Dummy*) drops significantly after we add liquidity as a control variable in the regression. This is due to the high level of correlation between the special repo rates and the liquidity proxies, which would potentially cause multicollinearity if both variables are included in the same regression.

[Insert Tables 13 and 14 about here]

6.2. Re-examining the yield spread when both bonds go "on special"

As we concluded from our main results in Table 4, the average yield spread between Malaysian sovereign *Sukuk* and conventional sovereign bonds is estimated at around 4.8 basis points, after controlling for bond characteristics and liquidity. However, in order to include the special repo rate as an explanatory variable for bond yield in the following analysis, our sample has to be constrained to those bonds that go "on special" in the repo market. Thus, we have to first investigate whether the average yield spread is significantly different from 4.8 basis points, when there is an active repo market. The results from Table 14 show that conventional sovereign bonds have a significantly lower special repo rate of 18.5 to 56.7 basis points. This implies that investors who hold Malaysian conventional sovereign bonds would be able to borrow at a lower rate in the repo market as compared to those who hold Malaysian sovereign *Sukuk*. All else held constant, one would expect investors to value Malaysian sovereign *Sukuk* at a lower price than the corresponding conventional bonds given the former commands a lower collateral value (or a lower "convenience yield" in commodity finance terminology) as compared to the latter, which are manifested through their different special repo borrowing rates. If this holds true, the yield spread between the two bond subsets would widen when there is an active repo market.

In Table 15 Panel A, we re-examine the main results in Table 4 and ask whether the yield spread becomes wider in repo-active weeks by regressing the estimated coefficients of *Islamic Dummy* from Eq. (6).[35] As shown in Table 15 Panel A, the average yield spread between the two bond subsets increases significantly, by 1.38 to 2.83 basis points during the repo-active weeks. In particular, during the weeks when at least one conventional sovereign bond and one sovereign *Sukuk* go "on special," the average yield spread widens from 4.8 basis points to 5.73 and 7.01 basis points ($4.35\ basis\ points + 1.38\ basis\ points = 5.73\ basis\ points$ and $4.46\ basis\ points + 2.55\ basis\ points = 7.01\ basis\ points$). Furthermore, Panel B in Table 15 investigates whether the yield spreads would go up even higher when both bonds go "on special" themselves as compared to the remaining bonds during the same week. The results show that the yield spreads, on average, increase to 7.8-9.8 basis points ($5.9\ basis\ points + 1.9\ basis\ points = 7.8\ basis\ points$ and $7\ basis\ points + 2.8\ basis\ points = 9.8\ basis\ points$), when both underlying bonds go "on special" during the week.

6.3. Special repo rate as an explanatory variable for bond yield

According to Duffie (1996), and Jordan and Jordan (1997), which serves as empirical evidence for the former, the special repo rates and the bond prices in the cash market are closely related. Buraschi and Menini (2002) investigate the collateral value of treasury bonds based on the German sovereign bond repo market. While their findings are related to Jordan and Jordan (1997), they nevertheless find that a) current forward spreads overestimate changes in future specialness, and b) liquidity risk is significantly priced in the repo market. In addition, Cherian et al. (2004) posit that the yield spread between otherwise identical on-the-run and off-the-run Treasury securities is a so-called "convenience yield" driven by the profit opportunities available in the Treasury special versus general collateral repo market. They develop an arbitrage-free bond pricing model for the on-the-run (or more liquid) securities, in which both interest rates and special repo rates are stochastic. Their model generates yield spreads that are consistent with the prior empirical evidence. Some more recent papers examine the dynamic relation among these determinants (e.g., credit risk and liquidity) of bond yields. In this subsection, we investigate whether the yield spread in the cash

[35] In order to be coherent with our main analysis, which adopts Fama-MacBeth regressions, we are not able to combine the two regressions into one.

market between these two bond subsets would disappear after controlling for the repo effect. The specification is as below:

$$
\begin{aligned}
Yield_{i,t} = {} & \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Repo\ Rate\ Residual_{i,t} + \alpha_3 \times Maturity_{i,t} \\
& + \alpha_4 \times Maturity^2_{i,t} + \alpha_5 \times Coupon\ Rate_{i,t} + \alpha_6 \times Age_{i,t} + \alpha_7 \times 1^{st}\ PC\ of\ Liquidity_{i,t}
\end{aligned}
. \quad (11)
$$

Islamic Dummy and *Repo Rate Residual* are the two variables of interest here. The former takes the value of one if it is a government-issued *Sukuk*, and zero otherwise. The latter is estimated by first regressing the special repo rate on the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies, and then taking the residual term.[36] Regression results from the above specification are reported in Table 15. In general, the average yield spread between the two bond subsets remains significantly positive after controlling for the special repo rate (residual). In addition, consistent with the prior literature, a higher special repo rate (residual) corresponds to a lower price and a higher yield in the cash market. As we see from Model 6 in Table 16, a 1% increase in the special repo rate (residual) would increase the bond yield in the cash market by 10.2 basis points. Furthermore, Malaysian sovereign *Sukuk* have 17.5 basis points higher yield, on average, than their conventional counterparts, after controlling for the repo rate differentials.

[Insert Tables 15 and 16 about here]

7. Conclusion

In this paper, we use a unique transaction-level database that contains both government-issued *Sukuk* and conventional bonds in the Malaysian bond market and examine whether there is a yield spread between the two. We are among the first to investigate the pricing of Islamic (*Sukuk*) versus conventional bonds by using a comprehensive research-quality database and rigorous academic methodologies. We find that, on average, Islamic sovereign bonds (government-issued *Sukuk*) have

[36] We observe that the special repo rates are highly correlated with the the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. Thus, the estimators would be biased if we include both variables in the same regression.

a higher yield than conventional sovereign bonds, *ceteris paribus*. At first blush, therefore, *Sukuk* appear to be a "good deal" for investors. But, this bears closer scrutiny.

In the first part of the paper, we quantify and attempt to explain the higher yields of *Sukuk* as compared with their conventional counterparts. The unique setting of the Malaysian sovereign bond market allows us to study the yield difference between the two bond subsets without considering credit risk differentials. However, we find that the yield spread between government-issued *Sukuk* and conventional sovereign bonds cannot be fully explained by bond characteristics and liquidity effects, as the yield spread remains significantly positive after controlling for these variables. The evidence, therefore, suggests that the residual yield spread of 4.8 basis points has to be attributed to clientele effects.

Due to the lack of holdings data, we are not yet able to show direct evidence of the clientele effects. However, three supporting sets of evidence regarding clientele effects are documented in the second part of our paper. First, we observe significant selling of Malaysian conventional sovereign bonds by foreign clientele during the Global Financial Crisis period, narrowing the average yield spread to nearly zero. Second, foreign holdings rise and the yield spread falls when Malaysian Islamic sovereign bonds are added to the J.P. Morgan global bond index, once again suggesting clientele effects. Third, the yield spread narrows during Ramadan months, when the oil price is higher and when Malaysian Ringgit (MYR) is weaker. Fourth, there is a more active repo market with higher bond "specialness" for Malaysian conventional sovereign bonds, which allows its market participants to benefit from the "rents" or "convenience yield" provided by these markets, thus lowering the yields of conventional bonds and augmenting the documented yield spread.

However, we cannot reach a firm conclusion regarding what kind of clientele effects lead to such an economically-significant yield spread. It seems unlikely to be due to tax reasons, as we do not find any significant difference in the tax treatment between the two bond subsets. One piece of anecdotal evidence from industry practitioners is that foreign institutional investors participate actively in the Malaysian conventional sovereign bond market, while the Islamic sovereign bond market is still heavily dominated by domestic institutional investors, due to reasons of "familiarity" or investment mandate – domestic Islamic funds are constrained by policy to only buy Islamic financial securities. This implies that the yield spread could be partially explained by demand/supply factors. In any case, the clientele effect that potentially explains the yield difference between the two bond subsets needs to be further explored and taken into consideration along with holdings information, ownership structure, and other granular data concerning the key participants in the Malaysian financial system.

A valid question to ask is why isn't the yield spread between otherwise identical conventional and Islamic sovereign bonds in Malaysia arbitraged away. A potential explanation can be drawn from the U.S. Treasury bond market experience: otherwise identical Treasury "on-the-run" bonds trade at a higher price than the corresponding "off-the-run" bonds. The argument provided by traders and institutional bond investors alike is that the collateral value of the on-the run bonds is much higher than that of the off-the-run bonds. A similar argument has been given in the case of Malaysian conventional sovereigns versus *Sukuk*. As in the case of the U.S. Treasury market, the special repo borrowing rate for investors and traders is lower when conventional sovereign bonds are used as collateral as opposed to when *Sukuk* are. This added collateral value translates to a higher price for Malaysian conventional sovereign bonds.

This paper not only helps to uniquely separate the competing effects on the yield spread between various bond categories within the same country and currency being driven by liquidity, maturity, credit risk, clientele effects, repo trading and other considerations, but also improves our understanding of how the Islamic bond market works, what affects the pricing of Islamic bonds (*Sukuk*), and whether they are priced efficiently as compared to conventional bonds. This is imperative since the Islamic bond market is a nascent and fast-growing financial sector, and Malaysia represents the largest issuer of *Sukuk*, with over half of the *Sukuk* issued worldwide denominated in Malaysian ringgit. Our analysis also has implications for industry practitioners, who are interested in reducing their liquidity risks and transaction costs. Finally, we hope our study will inform regulators in their efforts to develop a healthier and more efficient Islamic bond market.

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Figures and Tables

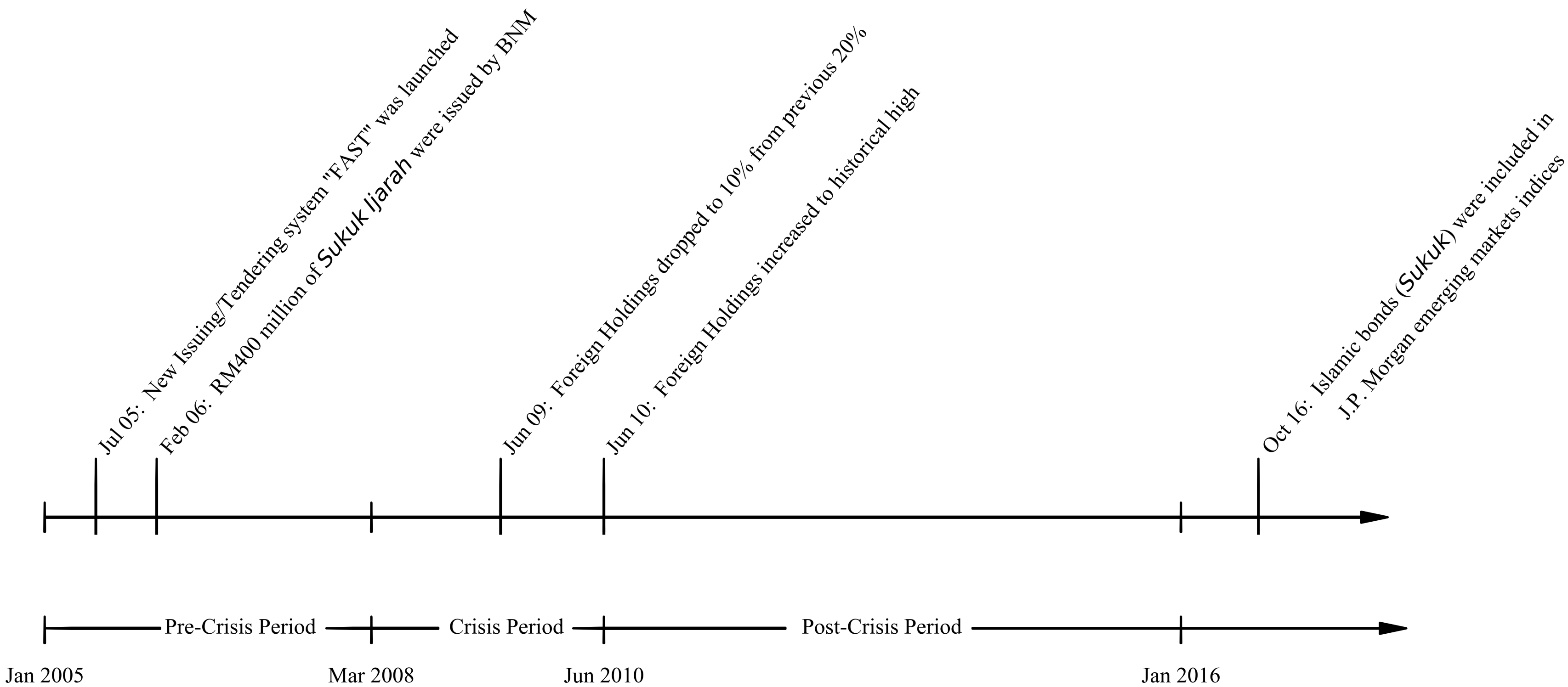


Figure 1 Event Timeline
This timeline shows notable events in the Malaysian sovereign bond market since January 2005. Based on these events, we identified three different regimes: the pre-crisis period between January 2005 and March 2008, the period when Malaysia is influenced by the 2007-2008 Global Financial Crisis (GFC) from June 2009 to June 2010, and the post-crisis period that started in June 2010.

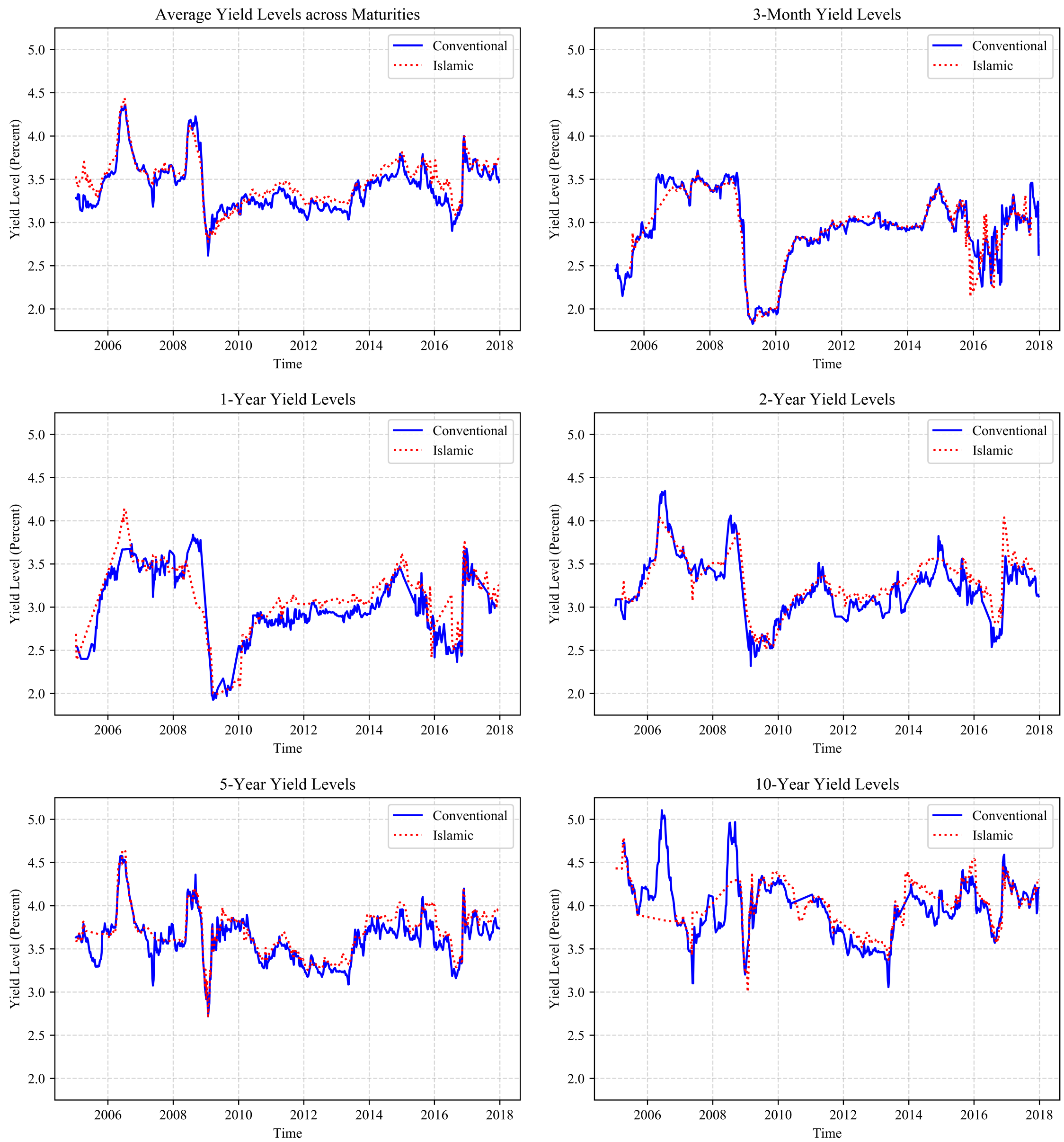


Figure 2 Time-trend of Actual (data-based) Yield Levels
This figure shows the time-trend of actual (data-based) yield levels at different maturities for Islamic and conventional sovereign bonds on the same plot. For each week, we first pool observations (transactions) into 17 maturity buckets, and then calculate the average yield for each maturity during that week (i.e., the average of the average yields at 17 maturities). In addition, we compute the average yields across the 17 maturities: 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 48, 60, 72, 84, 96, 108, and 120 months. The dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks), aggregated for Malaysian sovereign bonds traded over the January 2005 to December 2017 period. The first plot reports the time-trend of the average yield levels across the 17 maturities. The other plots show the time-trend of yield levels at the maturity of 3 months, 1 year, 2 years, 5 years, and 10 years. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

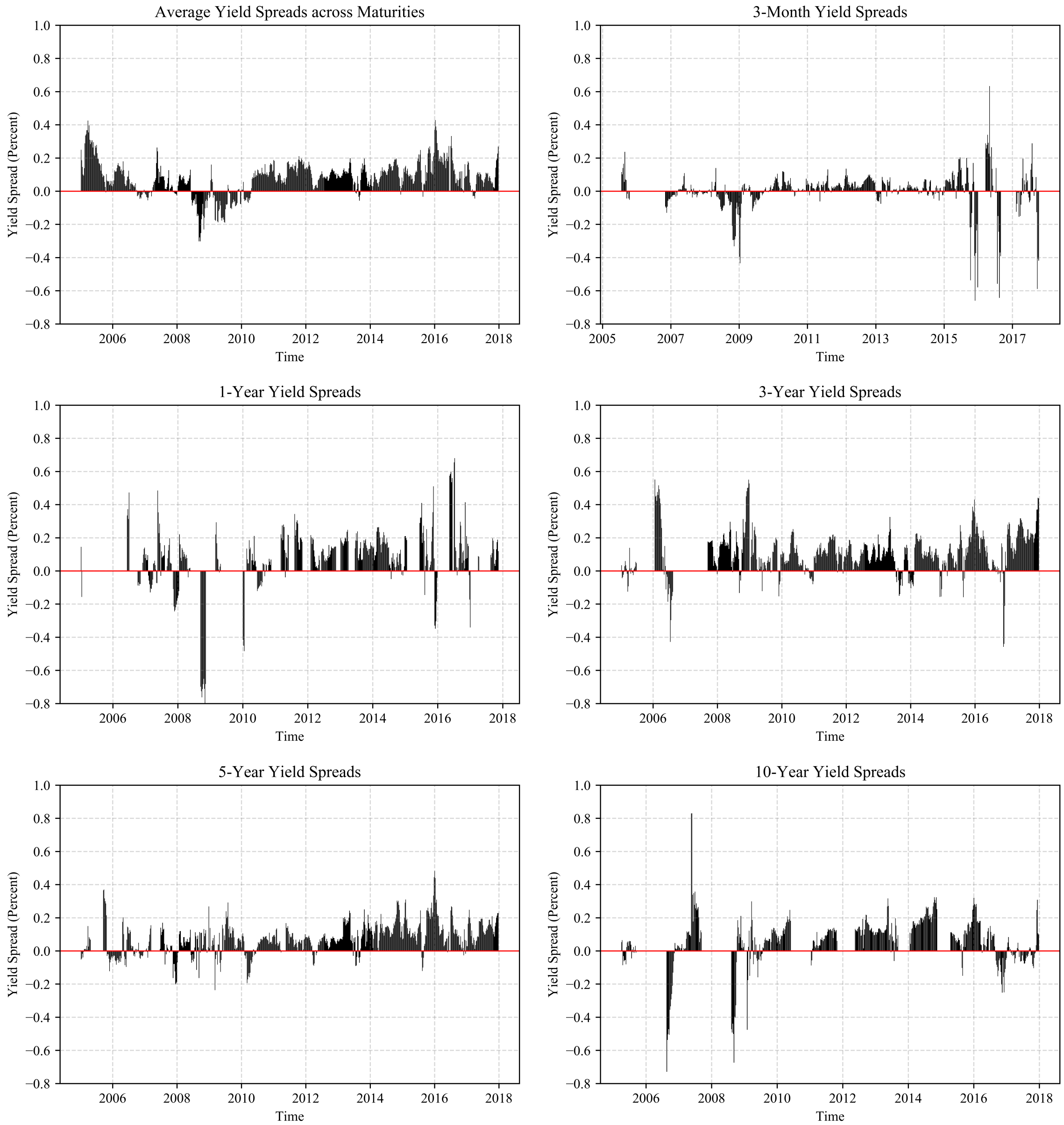


Figure 3 Time-trend of Actual (data-based) Yield *Spreads*

This figure shows the time-trend of actual (data-based) yield spreads between Islamic and conventional sovereign bonds at different maturities. For each week, we first pool observations (transactions) into 17 maturity buckets, and then calculate the average yield for each maturity during that week. In addition, we compute the average yields across the 17 maturities: 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 48, 60, 72, 84, 96, 108, and 120 months. The yield spread is calculated by subtracting the average yield of *Sukuk* from that of conventional bonds. The dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks), aggregated for Malaysian sovereign bonds traded over the January 2005 to December 2017 period. The first plot reports the time-trend of the average yield spreads across the 17 maturities. The other plots show the time-trend of yield spreads at the maturity of 3 months, 1 year, 2 years, 5 years, and 10 years. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

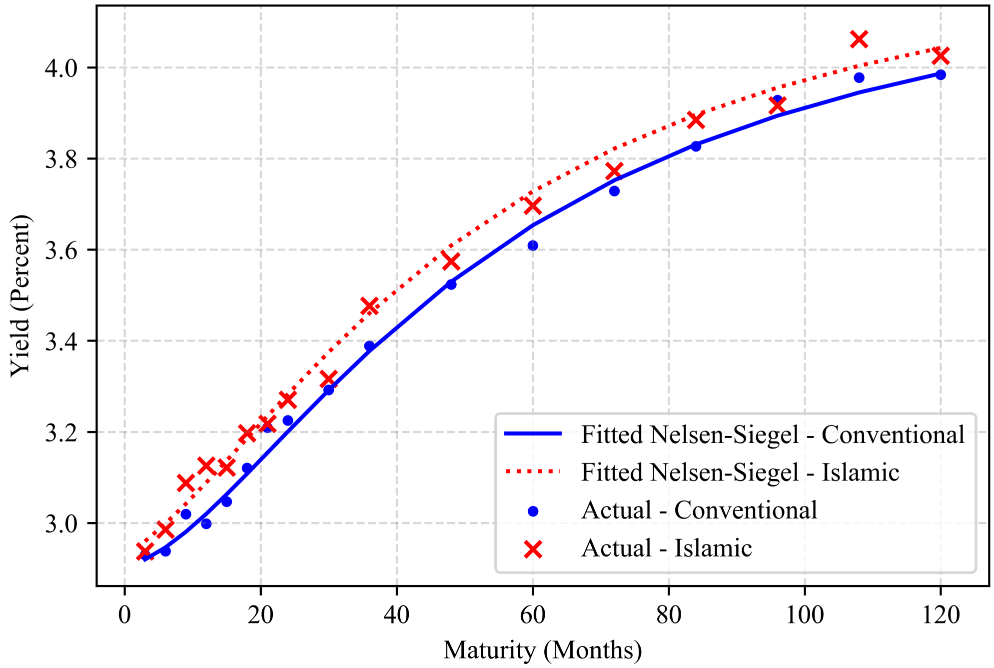


Figure 4 Actual (data-based) and Fitted (model-based) Average Yield Curves
This figure presents the actual (data-based) average yield curves and the fitted (model-based) average yield curves, respectively. The fitted (model-based) average yield curves are obtained by estimating the Nelson-Siegel model at the mean values of the time series of three estimated factors (i.e., $\widehat{\beta}_1$, $\widehat{\beta}_2$, and $\widehat{\beta}_3$) from Table 6. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. We present the average yield curves for both Islamic and conventional sovereign bonds. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

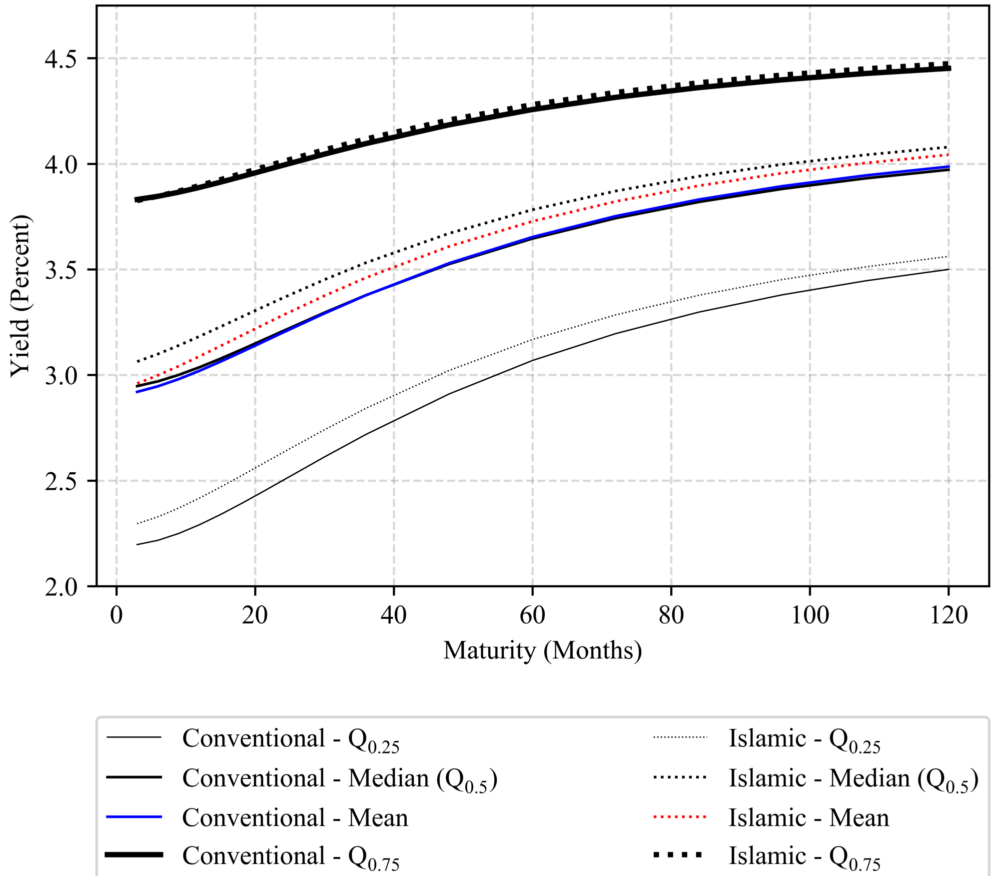


Figure 5 Nelson-Siegel Fitted Yield Curves
This figure presents the median (mean, 25th, and 75th percentile) yield curves fitted by the Nelson-Siegel model. The median (mean, 25th , and 75th percentile) yield curves are obtained by evaluating the Nelson-Siegel model at the median (mean, 25th, and 75th percentile) values of the time series of three estimated factors (i.e., $\widehat{\beta}_1$, $\widehat{\beta}_2$, and $\widehat{\beta}_3$) from Table 6. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. We report the median (mean, 25th, and 75th percentile) yield curves for both Islamic and conventional sovereign bonds. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

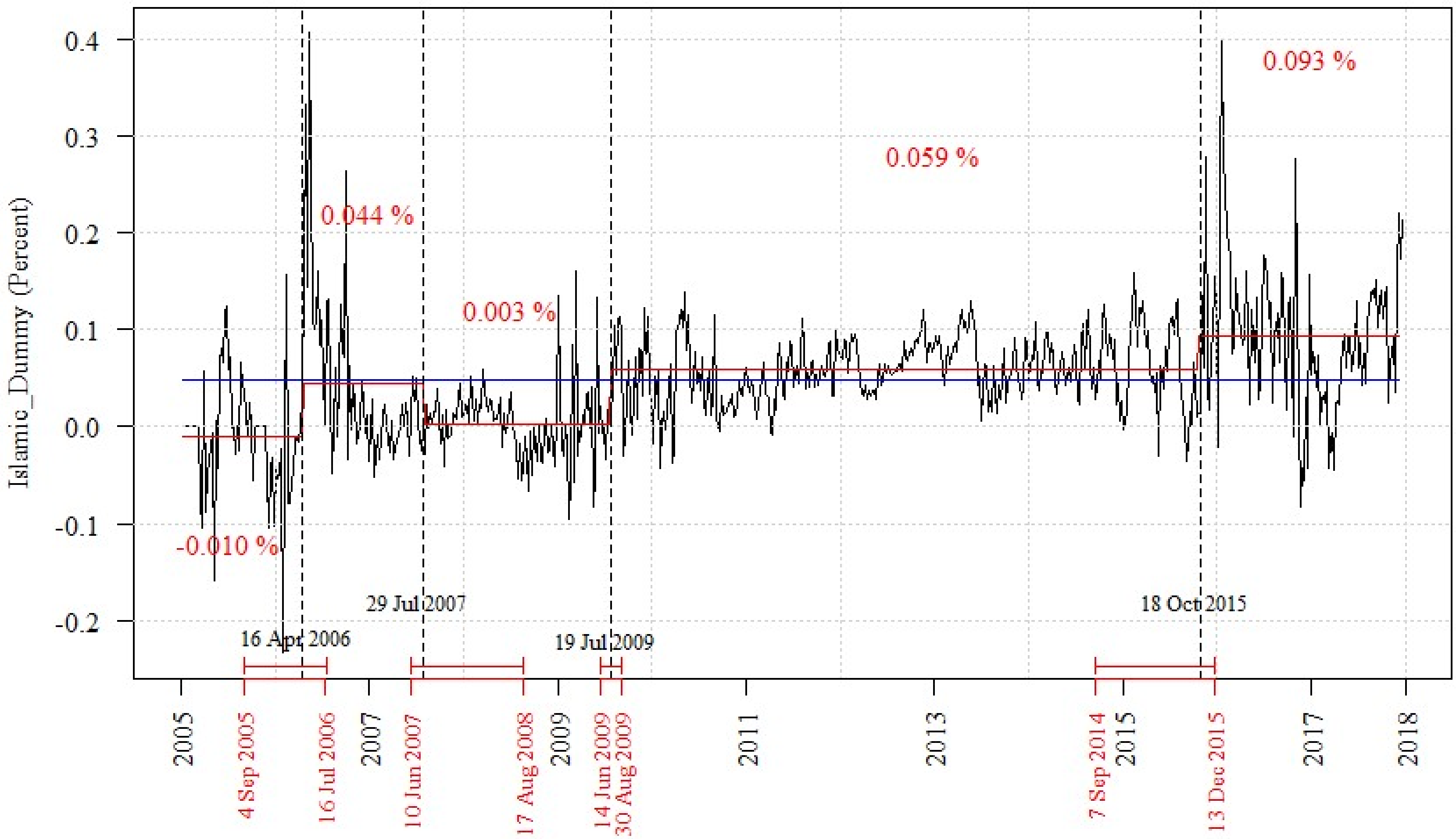
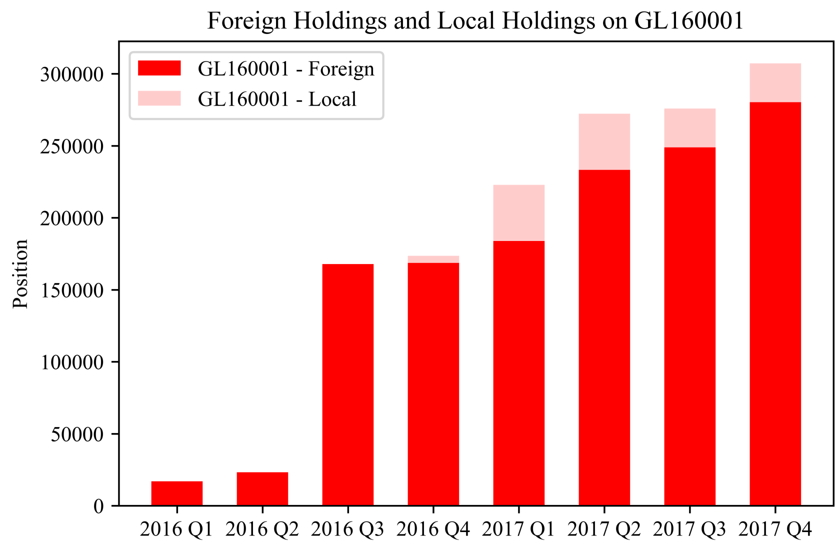
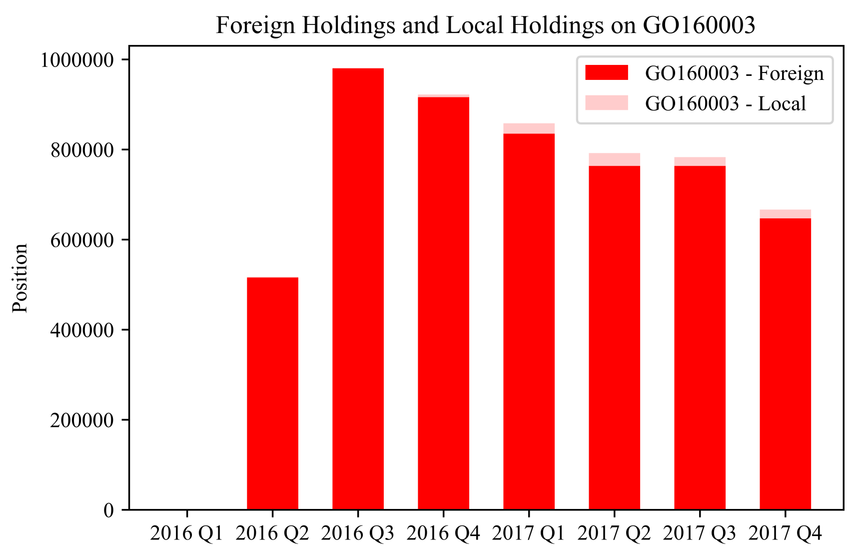


Figure 6 Multiple Structural Break Tests on the Coefficients of *Islamic Dummy*

This figure shows the structural break test results on the coefficients on *Islamic Dummy*, which we obtained by running Fama-MacBeth regressions in Table 4 Model 6. We adopt the multiple structural break framework by Zeileis et al. (2003). The dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks) after aggregating for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).



Source: Bloomberg, L.P.



Source: Bloomberg, L.P.

Figure 7 Foreign Holdings and Local Holdings of Malaysian Islamic Sovereign Bonds
The two figures show the holding positions by both foreign investors and local investors on the two Malaysian sovereign *Sukuk* included in J.P. Morgan's GBI-EM index. The local stock codes for the two chosen *Sukuk* are "GL160001" and "GO160003," and the corresponding ISIN numbers are "MYBGL1600016" and "MYBGO1600036." The issue dates of the two *Sukuk* are on 7 January 2016 and 24 March 2016, respectively. The quarterly holdings data for each of the two *Sukuk* are hand-collected from Bloomberg. Our bond dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks) after aggregating for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

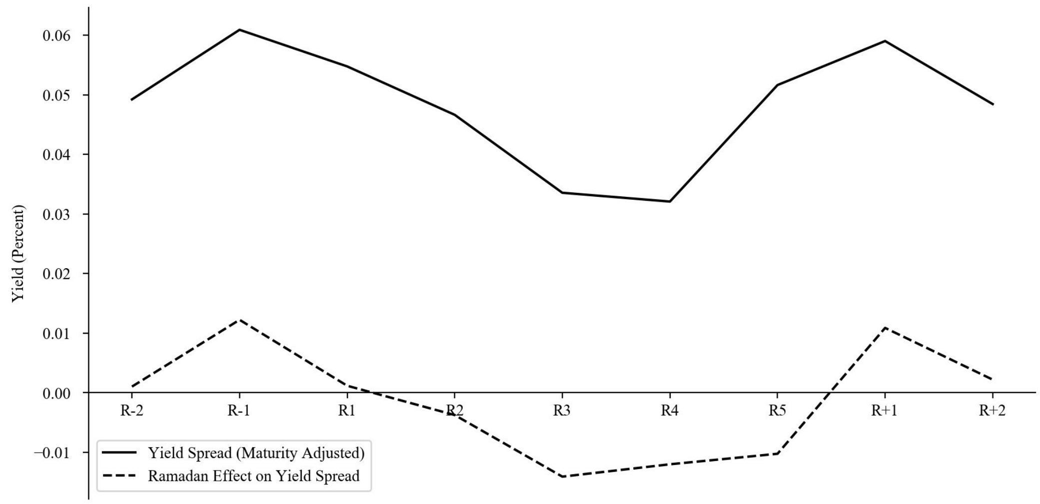


Figure 8 Ramadan Effects on Yield Spreads (with Currency Controls using Levels)
This figure presents the yield spread attributable to the Islamic effect and the Ramadan effect respectively, during Ramadan and non-Ramadan weeks. R1 to R5 represents the 5 weeks of Ramadan and R-2, R-1, R+1 and R+2 represents 2 weeks prior, 1 week prior, 1 week after and 2 weeks after Ramadan. The yield spread attributable to the Islamic effect around Ramadan weeks, α_1, is obtained by running the regression in Table 4 Model 1 from 2005 to 2017.

$$Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Controls_{i,t}$$

The yield spread attributable to the Ramadan effect is obtained by subtracting controls from α_1. The principal component analysis on currency factors is performed on exchange rates levels. The effects of controls are obtained via the fitted value of the following regression:

$$\begin{aligned}\alpha_{1,t} = \beta_0 &+ \beta_1 \times 1^{st}\ PC\ of\ \Delta\ Currency - Oil\ Exporting\ Countries_t \\ &+ \beta_2 \times 1^{st}\ PC\ of\ \Delta\ Currency - Non\ Oil\ Exporting\ Countries_t \\ &+ \beta_3 \times 1^{st}\ PC\ of\ Liquidity\ Islamic_t + \beta_4 \times 1^{st}\ PC\ of\ Liquidity\ Conventional_t \\ &+ \beta_5 \times Coupon\ Rate_t + \beta_6 \times Age_t\end{aligned}$$

The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from Bank Negara Malaysia's Bond Info Hub web portal.

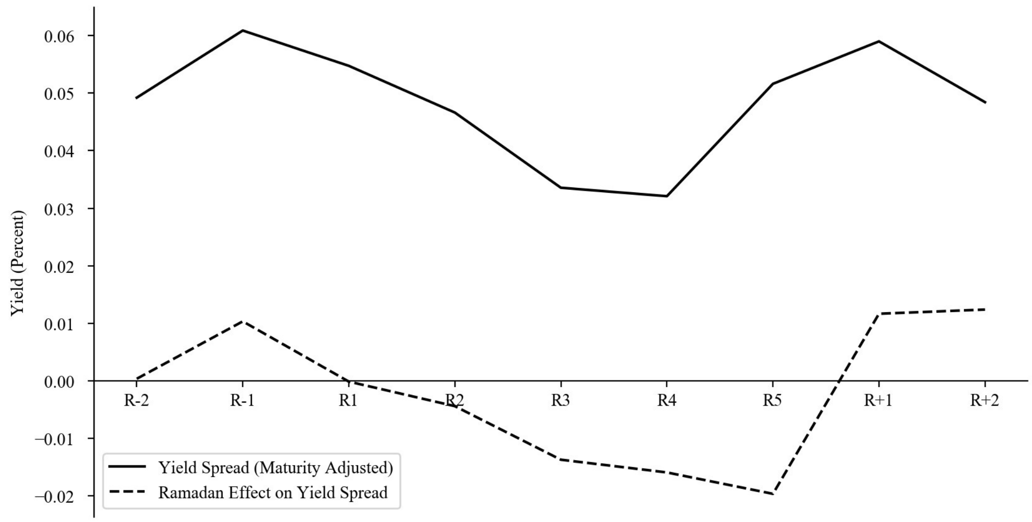


Figure 9 Ramadan Effects on Yield Spreads (with Currency Controls using First Differences)

This figure presents the yield spread attributable to the Islamic effect and the Ramadan effect respectively, during Ramadan and non-Ramadan weeks. R1 to R5 represents the 5 weeks of Ramadan and R-2, R-1, R+1 and R+2 represents 2 weeks prior, 1 week prior, 1 week after and 2 weeks after Ramadan. The yield spread attributable to the Islamic effect around Ramadan weeks, α_1, is obtained by running the regression in Table 4 Model 1 from 2005 to 2017.

$$Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Controls_{i,t}$$

The yield spread attributable to the Ramadan effect is obtained by subtracting controls from α_1. The principal component analysis on currency factors is performed after obtaining first differences on exchange rates. The effects of controls are obtained via the fitted value of the following regression:

$$\begin{aligned}\alpha_{1,t} = \beta_0 &+ \beta_1 \times 1^{st}\ PC\ of\ \Delta\ Currency - Oil\ Exporting\ Countries_t \\ &+ \beta_2 \times 1^{st}\ PC\ of\ \Delta\ Currency - Non\ Oil\ Exporting\ Countries_t \\ &+ \beta_3 \times 1^{st}\ PC\ of\ Liquidity\ Islamic_t + \beta_4 \times 1^{st}\ PC\ of\ Liquidity\ Conventional_t \\ &+ \beta_5 \times Coupon\ Rate_t + \beta_6 \times Age_t\end{aligned}$$

The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from Bank Negara Malaysia's Bond Info Hub web portal.

Table 1   Descriptive Statistics

This table reports the cross-sectional descriptive statistics (number of observations, mean, median, standard deviation, 10th, 25th, 75th and 90th percentiles) for the price, yield, bond characteristics and liquidity proxies. Price is the clean price of the trades reported in Malaysian ringgit (MYR) by Bank Negara Malaysia. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. The bond characteristics include *Maturity*, *Duration*, *Age* and *Coupon Rate*. The liquidity proxies are classified into three groups: trading activity variables (*Number of Trades*, *Amount Traded* and *Time Interval* between trades), liquidity measures (*Amihud Ratio*, *Price Dispersion Measure* and *Zero Return Dummy*) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. We first calculate the descriptive statistics cross-sectionally in each week and then report the time series average of each statistic. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. Panel A reports the descriptive statistics of the combined sample of conventional and Islamic trades, while Panels B and C report them separately. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

Panel A: Combined

	# of obs	Mean	Median	Std. dev.	$Q_{0.10}$	$Q_{0.25}$	$Q_{0.75}$	$Q_{0.90}$
Price (MYR)	55.801	100.536	99.987	2.720	98.263	99.272	101.412	103.559
Yield (%)	55.807	3.375	3.252	0.453	2.905	3.024	3.675	4.037
Maturity (year)	55.831	3.720	1.796	4.664	0.227	0.645	5.152	10.116
Duration (year)	55.397	2.992	1.651	3.288	0.219	0.612	4.498	7.967
Age (year)	55.831	2.447	1.078	3.340	0.132	0.403	3.130	7.255
Coupon Rate (%)	55.403	2.595	2.319	1.936	0.619	0.901	4.195	4.876
# of Trades	55.831	12.452	4.387	24.663	1.067	1.850	10.859	29.723
Amount Traded (million MYR)	55.807	284.120	124.060	433.890	9.445	36.417	344.110	772.690
Time Interval (day)	55.327	5.911	1.801	12.845	0.224	0.620	5.463	14.510
Amihud Ratio (bps per hundred million MYR)	55.311	1912.210	115.020	7390.370	4.632	20.008	618.540	3283.030
Price Dispersion Measure (MYR)	43.064	0.065	0.032	0.093	0.003	0.010	0.082	0.173
Zero Return Dummy	54.538	0.487	0.535	0.293	0.037	0.252	0.749	0.798
1^{st} *PC of Liquidity*	42.071	0.016	-0.300	1.467	-1.296	-0.903	0.576	1.740

Panel B: Conventional

	# of obs	Mean	Median	Std. dev.	$Q_{0.10}$	$Q_{0.25}$	$Q_{0.75}$	$Q_{0.90}$
Price (MYR)	35.530	100.712	100.110	3.146	97.904	99.145	101.814	104.372
Yield (%)	35.536	3.396	3.280	0.474	2.897	3.023	3.716	4.090
Maturity (year)	35.559	4.224	2.137	5.139	0.261	0.743	5.902	11.530
Duration (year)	35.530	3.333	1.963	3.523	0.253	0.709	5.049	8.766
Age (year)	35.559	2.937	1.380	3.702	0.173	0.526	4.112	8.754
Coupon Rate (%)	35.536	2.780	2.851	2.002	0.570	0.909	4.301	5.094
# of Trades	35.559	13.788	5.373	25.128	1.193	2.344	12.799	34.644
Amount Traded (million MYR)	35.536	313.592	146.714	456.110	8.558	38.261	395.330	860.150
Time Interval (day)	35.381	4.619	1.512	9.190	0.226	0.572	4.402	11.934
Amihud Ratio (bps per hundred million MYR)	35.364	2670.990	237.210	8686.240	14.049	55.870	1142.730	5599.800
Price Dispersion Measure (MYR)	28.747	0.079	0.043	0.101	0.007	0.017	0.103	0.201
Zero Return Dummy	35.040	0.429	0.459	0.287	0.026	0.180	0.683	0.770
1^{st} *PC of Liquidity*	28.333	0.212	-0.086	1.427	-1.107	-0.699	0.750	1.910

Panel C: Islamic

	# of obs	Mean	Median	Std. dev.	$Q_{0.10}$	$Q_{0.25}$	$Q_{0.75}$	$Q_{0.90}$
Price (MYR)	20.301	100.106	99.914	1.244	98.925	99.424	100.633	101.643
Yield (%)	20.301	3.361	3.261	0.388	2.983	3.085	3.589	3.921
Maturity (year)	20.303	2.939	1.723	3.299	0.420	0.785	4.084	7.623
Duration (year)	19.896	2.733	1.849	2.579	0.827	1.092	3.739	6.247
Age (year)	20.303	1.291	0.783	1.459	0.139	0.327	1.777	3.486
Coupon Rate (%)	19.896	2.317	1.914	1.439	1.152	1.324	3.366	4.016
# of Trades	20.303	11.418	5.818	17.904	1.935	2.447	14.137	26.812
Amount Traded (million MYR)	20.301	239.450	136.460	311.670	25.830	51.350	321.830	606.450
Time Interval (day)	19.976	7.974	3.029	13.999	0.330	0.907	8.967	21.938
Amihud Ratio (bps per hundred million MYR)	19.976	437.620	38.340	1205.630	3.287	8.591	261.600	1131.050
Price Dispersion Measure (MYR)	14.338	0.037	0.019	0.051	0.003	0.006	0.050	0.105
Zero Return Dummy	19.527	0.595	0.679	0.262	0.208	0.447	0.789	0.809
1^{st} *PC of Liquidity*	13.758	-0.373	-0.602	1.273	-1.520	-1.147	0.208	1.151

Table 2 Correlation Matrix

This table presents the correlation matrix of Price, Yield, bond characteristics (*Maturity*, *Duration*, *Age* and *Coupon Rate*), trading activity variables (*Number of Trades*, *Amount Traded* and *Time Interval* between trades), liquidity measures (*Amihud Ratio*, *Price Dispersion Measure* and *Zero Return Dummy*), and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. Price is the clean price of the trades reported in Malaysian ringgit (MYR) by Bank Negara Malaysia. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. The bond characteristics include *Maturity*, *Duration*, *Age* and *Coupon Rate*. The liquidity proxies are classified into three groups: trading activity variables (*Number of Trades*, *Amount Traded* and *Time Interval* between trades), liquidity measures (*Amihud Ratio*, *Price Dispersion Measure* and *Zero Return Dummy*) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. We first calculate the pairwise correlations cross-sectionally in each week, and then report the time series average of the correlation coefficients. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. Panel A reports the correlation of the combined sample of conventional and Islamic trades, while Panels B and C report them separately. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

Panel A: Combined

	Price	Yield	Maturity	Duration	Age	Coupon Rate	# of Trades	Amount Traded	Time Interval	*Amihud Ratio*	*Price Dispersion Measure*	*Zero Return Dummy*	1^{st} *PC of Liquidity*
Price	1.000												
Yield	0.177	1.000											
Maturity	0.179	0.917	1.000										
Duration	0.173	0.943	0.989	1.000									
Age	0.444	0.077	0.044	0.061	1.000								
Coupon Rate	0.536	0.603	0.559	0.597	0.613	1.000							
# of Trades	0.073	0.201	0.179	0.216	-0.042	0.207	1.000						
Amount Traded	-0.025	-0.052	-0.051	-0.040	-0.112	-0.045	0.759	1.000					
Time Interval	0.008	-0.043	-0.052	-0.066	0.033	-0.062	-0.252	-0.267	1.000				
Amihud Ratio	0.131	0.324	0.357	0.354	0.158	0.246	-0.090	-0.167	0.152	1.000			
Price Dispersion Measure	0.113	0.571	0.603	0.620	0.062	0.391	0.272	0.052	-0.159	0.338	1.000		
Zero Return Dummy	-0.092	-0.138	-0.136	-0.162	-0.030	-0.189	-0.574	-0.505	0.405	0.069	-0.332	1.00	
1^{st} *PC of Liquidity*	0.057	0.163	0.162	0.189	-0.053	0.151	0.857	0.796	-0.524	-0.075	0.373	-0.79	1.0

Panel B: Conventional

	Price	Yield	Maturity	Duration	Age	Coupon Rate	# of Trades	Amount Traded	Time Interval	*Amihud Ratio*	*Price Dispersion Measure*	*Zero Return Dummy*	1^{st} *PC of Liquidity*
Price	1.000												
Yield	0.166	1.000											
Maturity	0.160	0.923	1.000										
Duration	0.153	0.948	0.988	1.000									
Age	0.459	0.090	0.028	0.051	1.000								
Coupon Rate	0.545	0.570	0.527	0.564	0.653	1.000							
# of Trades	0.065	0.170	0.140	0.179	-0.062	0.202	1.000						
Amount Traded	-0.041	-0.097	-0.095	-0.087	-0.144	-0.078	0.748	1.000					
Time Interval	0.003	-0.036	-0.021	-0.037	0.023	-0.105	-0.308	-0.301	1.000				
Amihud Ratio	0.127	0.367	0.377	0.381	0.139	0.267	-0.128	-0.211	0.212	1.000			
Price Dispersion Measure	0.090	0.606	0.613	0.635	0.025	0.389	0.241	0.000	-0.145	0.324	1.000		
Zero Return Dummy	-0.077	-0.118	-0.083	-0.115	-0.003	-0.211	-0.599	-0.501	0.499	0.141	-0.262	1.000	
1^{st} *PC of Liquidity*	0.041	0.150	0.128	0.160	-0.090	0.153	0.873	0.795	-0.561	-0.136	0.328	-0.784	1.0

Panel C: Islamic

	Price	Yield	Maturity	Duration	Age	Coupon Rate	# of Trades	Amount Traded	Time Interval	*Amihud Ratio*	*Price Dispersion Measure*	*Zero Return Dummy*	1^{st} *PC of Liquidity*
Price	1.000												
Yield	0.327	1.000											
Maturity	0.347	0.938	1.000										
Duration	0.337	0.950	0.996	1.000									
Age	0.306	-0.014	-0.023	0.071	1.000								
Coupon Rate	0.605	0.755	0.748	0.766	0.441	1.000							
# of Trades	0.148	0.282	0.294	0.320	-0.142	0.261	1.000						
Amount Traded	0.004	0.012	0.029	0.034	-0.175	-0.005	0.759	1.000					
Time Interval	-0.029	-0.048	-0.067	-0.070	0.232	-0.035	-0.390	-0.387	1.000				
Amihud Ratio	0.153	0.364	0.361	0.322	0.057	0.288	-0.041	-0.190	0.256	1.000			
Price Dispersion Measure	0.249	0.548	0.553	0.540	-0.124	0.449	0.484	0.228	-0.220	0.358	1.00		
Zero Return Dummy	-0.129	-0.192	-0.205	-0.152	0.253	-0.107	-0.597	-0.537	0.389	0.022	-0.47	1.000	
1^{st} *PC of Liquidity*	0.104	0.187	0.200	0.195	-0.261	0.131	0.812	0.752	-0.618	-0.061	0.52	-0.829	1.0

Table 3 Actual Yields by Maturities

This table reports the descriptive statistics (mean, standard deviation, minimum, median and maximum) for actual (data-based) yields at different maturities. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Maturity* is computed by differencing between the maturity date and trading date and is given in years. We pool the observations into fixed maturities of 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 48, 60, 72, 84, 96, 108 and 120 months. For each maturity, we first calculate the descriptive statistics cross-sectionally in each week and then report the time series average of each statistic. In addition, the 3^{rd} (10^{th}) column reports the difference of mean (median) yields between Islamic sovereign bonds and conventional sovereign bonds. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Mean			Std. dev.		Minimum		Median			Maximum	
	Conventional	Islamic	*diff(I-C)*	Conventional	Islamic	Conventional	Islamic	Conventional	Islamic	*diff(I-C)*	Conventional	Islamic
3	2.930	2.938	0.008	0.425	0.424	1.813	1.825	2.966	3.000	0.034	3.815	3.575
6	2.938	2.986	0.048	0.447	0.444	1.905	1.800	2.978	3.035	0.057	3.802	3.822
9	3.019	3.088	0.069	0.411	0.368	1.830	1.875	3.000	3.063	0.063	3.952	3.950
12	2.998	3.126	0.128	0.403	0.384	1.926	1.990	2.943	3.100	0.157	3.878	4.141
15	3.047	3.122	0.075	0.393	0.299	1.952	2.047	2.970	3.142	0.172	4.145	3.715
18	3.121	3.197	0.076	0.423	0.332	1.920	2.100	3.070	3.174	0.105	4.205	4.039
21	3.209	3.218	0.009	0.390	0.386	2.445	2.060	3.160	3.210	0.050	4.520	4.340
24	3.225	3.270	0.045	0.361	0.287	2.317	2.489	3.215	3.270	0.055	4.345	4.100
30	3.292	3.317	0.025	0.332	0.298	2.444	2.400	3.271	3.293	0.023	4.462	4.447
36	3.389	3.477	0.088	0.305	0.302	2.693	2.887	3.360	3.436	0.076	4.538	4.480
48	3.524	3.574	0.051	0.274	0.250	2.630	2.744	3.527	3.589	0.062	4.624	4.690
60	3.609	3.697	0.088	0.278	0.284	2.637	2.722	3.630	3.687	0.057	4.592	4.644
72	3.729	3.772	0.044	0.238	0.263	3.132	3.090	3.737	3.772	0.034	4.500	4.420
84	3.827	3.885	0.058	0.305	0.246	2.990	3.343	3.833	3.922	0.089	4.930	4.337
96	3.928	3.916	-0.012	0.325	0.304	2.763	3.190	3.935	3.930	-0.005	4.936	5.040
108	3.978	4.062	0.084	0.360	0.293	2.926	3.158	3.983	4.080	0.097	5.100	5.000
120	3.984	4.026	0.042	0.350	0.290	3.056	3.002	4.008	4.069	0.061	5.105	4.789

Table 4 Fama-MacBeth Regressions

This table reports the Fama-MacBeth regression models explaining the yield to maturity based on weekly averages of all variables:

$$
\begin{aligned}
Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Maturity_{i,t} + \alpha_3 \times Maturity^2_{i,t} \\
+ \alpha_4 \times Coupon\ Rate_{i,t} + \alpha_5 \times Age_{i,t} + \alpha_6 \times 1^{st}\ PC\ of\ Liquidity_{i,t}
\end{aligned}
$$

The yield to maturity is explained by the *Islamic Dummy*, bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Yield* is the yield to maturity and is given in percentage points. For bonds with multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. For each week t, we regress *Yield* on the six regressors shown above. We then report the time series average of the estimated coefficients. The t-statistics are given in parentheses and are calculated from Newey and West (1987). standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. Panel A reports the Fama-MacBeth regression results by using the combined sample of conventional and Islamic trades, while Panels B and C report the results by using conventional or Islamic trades separately (with *Islamic Dummy* omitted). The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

Panel A: Combined

	Model 1	Model 2	Model 3	Model 4
Intercept	2.897***	2.875***	2.875***	2.862***
	(77.19)	(77.05)	(76.79)	(74.13)
Islamic Dummy	0.052***	0.049***	0.048***	0.048***
	(11.56)	(11.30)	(11.20)	(11.15)
Maturity	0.166***	0.161***	0.161***	0.168***
	(17.75)	(18.17)	(18.19)	(17.34)
Maturity^2	-0.005***	-0.005***	-0.005***	-0.005***
	(-11.28)	(-11.41)	(-11.32)	(-10.19)
Coupon Rate		0.009***	0.010***	0.011***
		(5.28)	(4.07)	(3.32)
Age			0.000	-0.001
			(-0.36)	(-1.09)
1^{st} *PC of Liquidity*				-0.007***
				(-8.24)
R^2	0.930	0.939	0.940	0.948
N	37,670	37,381	37,381	28,153
# of Weeks	675	675	675	675

Panel B: Conventional

	Model 1	Model 2	Model 3	Model 4
Intercept	2.904***	2.883***	2.881***	2.866***
	(77.51)	(77.14)	(76.60)	(74.24)
Maturity	0.163***	0.159***	0.161***	0.169***
	(17.34)	(17.98)	(18.17)	(17.48)
Maturity^2	-0.005***	-0.005***	-0.005***	-0.005***
	(-10.74)	(-11.18)	(-11.25)	(-10.28)
Coupon Rate		0.008***	0.004	0.006
		(4.15)	(1.61)	(1.67)
Age			0.002***	0.001
			(3.40)	(1.76)
1^{st} *PC of Liquidity*				-0.008***
				(-6.45)
R^2	0.934	0.943	0.944	0.949
N	23,987	23,972	23,972	19,120
# of Weeks	675	675	675	675

Panel C: Islamic

	Model 1	Model 2	Model 3	Model 4
Intercept	2.938***	3.040***	3.036***	3.059***
	(72.50)	(60.46)	(60.03)	(55.85)
Maturity	0.218***	0.187***	0.171***	0.083
	(8.11)	(6.65)	(4.59)	(1.13)
Maturity^2	-0.014***	-0.002	0.018	0.039
	(-3.21)	(-0.22)	(0.66)	(0.98)
Coupon Rate		-0.217	-0.682	-0.062
		(-1.18)	(-1.11)	(-0.25)
Age			-0.001	-0.081
			(-0.09)	(-1.24)
1^{st} *PC of Liquidity*				0.002
				(0.23)
R^2	0.935	0.945	0.943	0.960
N	13,683	13,409	13,409	9,033
# of Weeks	675	675	675	675

Table 5 Fama-MacBeth Regressions with Instrument Dummies

This table reports the Fama-MacBeth regression models explaining the yield to maturity based on weekly averages of all variables:

$$Yield_i = \alpha_0 + \alpha_1 \times Islamic\ Dummy_i + \alpha_2 \times Maturity_i + \alpha_3 \times Maturity_i^2 + \alpha_4 \times Coupon\ Rate_i + \alpha_5 \times Age_i + \alpha_6 \times 1^{st}\ PC + \sum_{j=1}^{3} \beta_j \times Bond\ Type\ Dummy_j$$

The yield to maturity is explained by the *Islamic Dummy*, bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. *Is_BNMN_ID* is defined as 1 if the bond traded is Bank Negara Monetary Notes–Islamic Discount Based, and 0 otherwise. *Is_BNMN_DB* and *Is_MGS* are defined similarly, with *BNMN_DB* standing for Bank Negara Monetary Notes–Discount Based and MGS standing for Malaysian sovereign Securities. For each week t, we regress *Yield* on the six regressors shown above. We then report the time series average of the estimated coefficients. The t-statistics are given in parentheses and are calculated from Newey and West (1987) standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Model 1	Model 2	Model 3	Model 4
Intercept	2.891***	2.837***	2.833***	2.803***
	(76.50)	(72.23)	(71.20)	(65.73)
Islamic Dummy	0.094***	0.085***	0.099***	0.098***
	(14.99)	(13.53)	(10.68)	(9.05)
Maturity	0.159***	0.159***	0.158***	0.166***
	(17.86)	(17.68)	(17.84)	(16.67)
Maturity^2	-0.004***	-0.005***	-0.004***	-0.005***
	(-10.95)	(-10.65)	(-10.72)	(-9.64)
Coupon Rate		0.016***	0.014***	0.019***
		(7.20)	(3.87)	(4.53)
Age			0.001	0.000
			(0.89)	(0.13)
1^{st} *PC of Liquidity*				-0.006***
				(-7.34)
Is_BNMN_ID	-0.036***	-0.010	-0.010	0.014
	(-5.20)	(-0.96)	(-0.98)	(1.49)
Is_BNMN_DB	0.004	0.051***	0.054***	0.070***
	(0.58)	(4.41)	(4.28)	(5.87)
Is_MGS	0.023***	0.015***	0.028***	0.029***
	(3.97)	(2.75)	(3.30)	(3.01)
R^2	0.943	0.945	0.946	0.952
N	37,670	37,381	37,381	28,153
# of Weeks	675	675	675	675

Table 6 Estimated Nelson-Siegel Factors

This table presents descriptive statistics (mean, standard deviation, median and autocorrelations) for the estimated Nelson-Siegel factors $\widehat{\beta_1}$, $\widehat{\beta_2}$ and $\widehat{\beta_3}$. We fit the three-factor Nelson-Siegel model using actual (data-based) yields, with exponential decay factor (λ_t) fixed at 0.0609. The model is expressed as follows:

$$y_t(\tau) = \beta_{1t} + \beta_{2t} X_{2t} + \beta_{3t} X_{3t}; X_{2t} = \frac{1 - e^{-\lambda_t \tau}}{\lambda_t \tau}, X_{3t} = \frac{1 - e^{-\lambda_t \tau}}{\lambda_t \tau} - e^{-\lambda_t \tau}, \tag{12}$$

The dependent variable $y_t\ (\tau)$ is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. τ is maturity in years and computed by differencing between the maturity date and trading date. The factor loading X_{2t} (X_{3t}) is calculated by substituting the value of τ and λ_t into the equation above. For each week t, we regress the yield $y_t(\tau)$ on two factor loadings (X_{2t} and X_{3t}) cross-sectionally, giving us a time series of the estimated factors. We then report the mean, standard deviation, median and autocorrelations for the time series obtained. The t-statistics are reported in the parentheses for the sample mean of the time series, and calculated from Newey and West (1987)) standard errors. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. The last three columns contain autocorrelations at displacements of 1, 12 and 30 weeks ($\widehat{\rho_1}$, $\widehat{\rho_{12}}$ and $\widehat{\rho_{30}}$). The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Mean		Std. dev.		Median		$\widehat{\rho_1}$		$\widehat{\rho_{12}}$		$\widehat{\rho_{30}}$	
	Conventional	Islamic	Conventional	Islamic	Conventional	Islamic	Conventional	Islamic	Conventional	Islamic	Conventional	Islamic
$\widehat{\beta_1}$	4.373*** (125.879)	4.405*** (127.399)	0.462	0.458	4.350	4.420	0.971	0.979	0.530	0.529	0.204	0.293
$\widehat{\beta_2}$	-1.469*** (-24.492)	-1.477*** (-24.638)	0.787	0.787	-1.415	-1.386	0.989	0.988	0.801	0.837	0.478	0.488
$\widehat{\beta_3}$	-1.364*** (-22.097)	-1.18*** (-17.825)	0.845	0.914	-1.359	-1.114	0.916	0.915	0.544	0.247	0.283	0.338

Table 7   Fama-MacBeth Coefficient Tests Pre- and Post- the Announcement

This table reports the Fama-MacBeth coefficient test results pre- and post- the J.P. Morgan's announcement to add two of the Malaysian sovereign *Sukuk* into its GBI-EM index. The local stock codes of the two chosen *Sukuk* are "GL160001" and "GO160003," and the corresponding ISIN numbers are "MYBGL1600016" and "MYBGO1600036." The two *Sukuk* are issued on 7 January 2016 and on 24 March 2016, respectively. The full window ranges from 24 March 2016 to 31 December 2017, and the announcement date is on 19 August 2016. The pre-event period is defined from 24 March 2016 to 19 August 2016, and the post-event is defined from 20 August 2016 to 31 December 2017.

$$Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times JPM\ Dummy_{i,t} + \alpha_3 \times Maturity_{i,t} + \alpha_4 \times Maturity^2_{i,t} + \alpha_5 \times Coupon\ Rate_{i,t} + \alpha_6 \times Age_{i,t} + \alpha_7 \times 1^{st}\ PC\ of\ Liquidity_{i,t}$$

The yield to maturity is explained by the *Islamic Dummy*, *JPM Dummy*, bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *JPM Dummy* is defined as 1 if the bond traded is one of the chosen *Sukuk* by J.P. Morgan, and 0 if it belongs to one of the remaining Malaysian sovereign *Sukuk*. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. For each week t, we regress *Yield* on the seven regressors shown above. We then report the time series average of the estimated coefficients during the corresponding time window. The t-statistics are given in parentheses and are calculated from Newey and West (1987) standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. The dataset consists of 4,237 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	full window	5 weeks		10 weeks		15 weeks	
		pre-event	post-event	pre-event	post-event	pre-event	post-event
Intercept	2.851***	2.311***	2.72***	2.409***	2.544***	2.543***	2.687***
	(43.17)	(81.30)	(86.01)	(36.26)	(18.39)	(22.81)	(18.27)
Islamic Dummy	0.082***	0.116***	0.121***	0.116***	0.101***	0.108***	0.084***
	(8.09)	(6.56)	(15.26)	(6.84)	(8.27)	(7.80)	(3.73)
JPM Dummy	-0.002	-0.002	-0.083***	-0.008	-0.076***	-0.023*	-0.102***
	(-0.10)	(-0.12)	(-4.85)	(-0.75)	(-5.06)	(-1.85)	(-4.61)
Maturity	0.015***	0.155***	0.151***	0.151***	0.156***	0.148***	0.151***
	(39.10)	(51.50)	(142.70)	(40.25)	(35.31)	(40.17)	(32.66)
Maturity^2	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***
	(-25.47)	(-35.41)	(-59.54)	(-38.14)	(-10.46)	(-44.22)	(-15.88)
Coupon Rate	0.032***	0.0625***	-0.072***	0.061***	-0.011	0.053***	0.02
	(3.17)	(5.49)	(-8.94)	(8.39)	(-0.25)	(5.73)	(0.48)
Age	-0.004**	-0.015***	0.012***	-0.015***	0.004	-0.016***	0.001
	(-1.96)	(-5.10)	(10.30)	(-6.02)	(0.88)	(-8.54)	(0.26)
1^{st} *PC of Liquidity*	-0.018***	-0.022***	-0.018***	-0.018***	-0.018***	-0.015***	-0.018***
	(-7.77)	(-13.14)	(-7.77)	(-6.77)	(-7.77)	(-5.50)	(-7.77)
R^2	0.9446	0.9413	0.9284	0.9463	0.9206	0.9453	0.893
N	4,237	299	301	450	541	694	783
# of Weeks	21	5	5	10	10	15	15

Table 8 Comparisons during Ramadan and non-Ramadan Months

This table reports the average liquidity measures, yield, maturity, coupon rate and age for conventional and Islamic bonds during Ramadan and non-Ramadan months. The average difference between Ramadan and non-Ramadan months for each bond category is calculated. To test for significance of the difference, a t-test for unequal sample size and unequal variance is implemented. The t-statistics are given in parentheses. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

Panel A: Liquidity Comparisons between Ramadan and Non-Ramadan Weeks

		1^{st} *PC of Liquidity*	# of Trades	Amount Traded	Time Interval	*Amihud Ratio*	*Price Dispersion*	*Price Dispersion Alt.*	*Zero Return Dummy*
Conventional	Non-Ramadan	0.20	12.71	310.37	4.80	2799.49	0.07	0.08	0.42
	Ramadan	0.22	12.67	316.55	4.56	2118.23	0.06	0.07	0.43
	Difference	*0.02*	*-0.04*	*6.18*	*-0.24*	*-681.26****	*-0.01****	*-0.01***	*0.01*
		(0.42)	(-0.07)	(0.51)	(-0.84)	(-2.68)	(-2.96)	(-2.42)	(0.89)
Islamic	Non-Ramadan	-0.42	8.22	238.00	8.71	454.37	0.02	0.03	0.59
	Ramadan	-0.31	9.64	249.98	8.16	355.76	0.03	0.04	0.58
	Difference	*0.11**	*1.42*	*11.98*	*-0.55*	*-98.61*	*0.01**	*0.01***	*-0.01*
		(1.78)	(1.55)	(0.76)	(-0.81)	(-0.99)	(1.79)	(2.00)	(-0.75)

Panel B: Yield and Other Comparisons between Ramadan and Non-Ramadan Weeks

		Yield	Maturity	Maturity^2	Coupon Rate	Age
Conventional	Non-Ramadan	3.39	4.31	50.28	2.66	2.77
	Ramadan	3.40	4.30	50.72	2.65	2.78
	Difference	*0.01*	*-0.01*	*0.44*	*-0.01*	*0.01*
		(0.87)	(-0.03)	(0.16)	(-0.04)	(0.16)
Islamic	Non-Ramadan	3.29	2.64	21.62	1.90	1.26
	Ramadan	3.33	2.92	25.41	2.12	1.32
	Difference	*0.04****	*0.28***	*3.79**	*0.22****	*0.06*
		(2.81)	(2.18)	(1.70)	(3.51)	(1.08)

Table 9 Correlation Matrix of the Ex-ante defined Currency Factors

This table presents the correlation matrix of the currency factor of Islamic countries versus the first principal component of these currency factors and the USD factor. The currency factor of each country is determined by taking the first difference of its currency exchange rate against the Malaysian Ringgit from 2005 - 2017.
Panel A reports the correlation matrix of the currency factors of Ex-ante defined oil exporting Islamic countries. Panel B reports the correlation matrix of currency factors of the Ex-ante defined non oil exporting Islamic countries.

Panel A: oil exporting Islamic Countries

	BND	SAR	AED	KWD	USD	1^{st} PC
Brunei Dollar (BND)	1.000					
Saudi Riyal (SAR)	0.693	1.000				
UAE Dirham (AED)	0.690	0.990	1.000			
Kuwaiti Dinar (KWD)	0.719	0.947	0.940	1.000		
United States Dollar (USD)	0.641	0.902	0.904	0.856	1.000	
1^{st} PC of Currency (Oil-exporting)	-0.816	-0.977	-0.974	-0.969	-0.888	1.0

Panel B: Non-oil exporting Islamic Countries

	IDR	IRR	TRY	USD	1^{st} PC
Indonesian Rupiah (IDR)	1.000				
Iranian Rial (IRR)	0.136	1.000			
Turkish Lira (TRY)	0.137	-0.023	1.000		
United States Dollar (USD)	0.358	0.279	0.055	1.000	
1^{st} PC of Currency (Non-oil-exporting)	-0.791	-0.524	-0.530	-0.388	1.0

Table 10 Ramadan Dummy and Currency Factors as Demand-side Proxies

This table re-examines the main results in Table 4 by running the following two steps of regressions. First,

$$Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Controls_{i,t}$$

which is the same specification as Model 1 in Table 4. The yield to maturity is explained by the Islamic Dummy and the control variables including maturity and square of maturity. Yield is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. Islamic Dummy is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. Maturity is given in years. For each week t, we regress Yield on the three regressors (i.e., Islamic Dummy plus maturity and maturity squared). The time series average of the estimated coefficients are reported in Table 4 Model 1. Second,

$$\begin{aligned}\alpha_{1,t} = \beta_0 &+ \beta_1 \times Ramadan\ Dummy_t + \beta_2 \times 1^{st}\ PC\ of\ \Delta\ Currency - Oil\ Exporting\ Countries_t + \beta_3 \times 1^{st}\ PC\ of\ \Delta\ Currency - Non\ Oil\ Exporting\ Countries_t \\ &+ \beta_4 \times 1^{st}\ PC\ of\ Liquidity\ Islamic_t + \beta_5 \times 1^{st}\ PC\ of\ Liquidity\ Conventional_t + \beta_6 \times Coupon\ Rate_t + \beta_7 \times Age_t\end{aligned}$$

where $\alpha_{1,t}$ is a time series of coefficients of the Islamic Dummy Model 1 in Table 4. The Ramadan dummy is defined to be 1 if it is a Ramadan week, and 0 if it is a non-Ramadan week. The 1^{st} PC of Currency Changes (oil exporting Countries) and the 1^{st} PC of Currency Changes (Non-oil exporting Countries) are from the principal component analysis of the ex-ante defined currency factors of Islamic countries. The currency factor is determined by taking the first difference of each country's currency exchange rate against the Malaysian Ringgit. Additionally, we control for liquidity, coupon rate and age in the regression.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	0.048***	0.047***	0.047***	0.061***	0.058***	-0.027	-0.033*
	(7.38)	(7.19)	(7.2)	(5.36)	(4.78)	(-1.31)	(-1.78)
Ramadan Dummy				-0.021	-0.025*	-0.024**	-0.023**
				(-1.48)	(-1.87)	(-2.11)	(-2.19)
1^{st} PC of Currency (Oil-exporting)		0.008	0.008*	0.009*	0.013***	0.011**	0.01**
		(1.58)	(1.65)	(1.86)	(2.58)	(2.54)	(2.48)
1^{st} PC of Currency (Non-oil-exporting)			-0.003	-0.003	-0.004	0	-0.001
			(-0.73)	(-0.75)	(-0.94)	(-0.1)	(-0.25)
1^{st} PC of Liquidity (Islamic)					0.015*	0.01	0.015**
					(1.96)	(1.57)	(2.48)
1^{st} PC of Liquidity (Conventional)					0.038*	0.027	0.015
					(1.79)	(1.42)	(0.83)
Coupon Rate						0.033***	0.078***
						(4.88)	(6.06)
Age							-0.043***
							(-3.97)
R^2	0	0.031	0.037	0.064	0.201	0.395	0.503
# of weeks	81	81	81	81	81	81	81

Table 11 Oil Price Effect on Yield Spread by Maturity

This table reports the effect of oil price on the yield spreads at different maturities. Yield spread, denoted by diff(Isl-Conv) represents the difference between Islamic and conventional bonds. Diff in diff(Isl-Conv) represents the difference between the yield spreads of Islamic bonds over conventional bonds during periods of high and low oil price. It is calculated by subtracting Low Oil Price (1st Quintile) from High Oil Price (5th Quintile) periods. Yield is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. Maturity is computed by differencing between the maturity date and trading date and is given in years. We pool the observations into fixed maturities of 3, 6, 9, 12, 15, 18, 21, 24, 30, 36, 48, 60, 72, 84, 96, 108 and 120 months.

For each maturity, we first calculate the descriptive statistics cross-sectionally in each week and then report the time series average of each statistic. Next, the difference of mean yields between Islamic sovereign bonds and conventional sovereign bonds is obtained for each maturity bucket. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Mean		*diff (Isl minus Conv)*			*diff-in-diff (Isl minus Conv)*
	Conventional	Islamic	Full Sample	High Oil Price (5th Quintile)	Low Oil Price (1st Quintile)	(5th Quintile minus 1st Quintile)
3	2.93	2.938	0.001	0.016	0.012	0.004
6	2.938	2.986	0.082	0.028	0.148	-0.121
9	3.019	3.088	0.137	0.094	0.212	-0.119
12	2.998	3.126	0.114	0.133	-0.01	0.143
15	3.047	3.122	0.084	0.083	0.283	-0.200
18	3.121	3.197	0.109	0.155	0.233	-0.078
21	3.209	3.218	0.024	0.195	0.057	0.138
24	3.225	3.27	0.019	0.065	0.127	-0.062
30	3.292	3.317	0.029	0.063	0.102	-0.04
36	3.389	3.477	0.067	0.024	0.15	-0.126
48	3.524	3.574	0.032	0.02	0.112	-0.092
60	3.609	3.697	0.068	0.03	0.165	-0.135
72	3.729	3.772	0.100	0.057	0.101	-0.044
84	3.827	3.885	0.103	0.058	0.143	-0.086
96	3.928	3.916	-0.048	-0.029	0.057	-0.086
108	3.978	4.062	0.027	-0.084	0.071	-0.155
120	3.984	4.026	-0.044	-0.059	-0.028	-0.030

Table 12 Quadrant Analysis for Oil Price Factor

This table examines the yield spread attributable to the Islamic factor with regards to its performance during periods of low, high, decreasing and increasing oil prices from 2005 to 2017. The yield spread attributable to the Islamic effect around Ramadan weeks, α_1, is obtained by running the regression in Table 4.

$$Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Controls_{i,t}$$

The yield spread,α_1, is then split into four quadrants based on the oil price characteristics for each week. The oil price is considered "Low" when the 1^{st} PC of Oil in that week is lower than the median level from 2005 - 2017, and considered "High" when the 1^{st} PC of Oil is higher than the median level from 2005 - 2017. The 1^{st} PC of Oil is taken from the principal component analysis of the Brent, WTI, Dubai-Oman and Malaysian TAPIS oil price indexes. The oil price is considered "Decreasing" when the first difference of the representative Brent index is negative, and considered "Increasing" when the first difference of the Brent index is positive. Panel A reports the yield spreads with controls from Table 4 Model 1. Panel B reports the yield spreads from Table 4 Model 3.

Panel A: Maturity-adjusted Yield Spreads

	Low Oil Price	High Oil Price	*diff (High minus Low)*	*t-value*
Decreasing Oil Price	0.063	0.051	-0.012*	(-1.678)
Increasing Oil Price	0.052	0.044	-0.008	(-1.352)
diff (Increasing minus Decreasing)	-0.011	-0.007*		
t-value	(-1.251)	(-1.79)		

Panel B: Yield Spreads adjusted by Maturity, Coupon Rate, and Age

	Low Oil Price	High Oil Price	*diff (High minus Low)*	*t-value*
Decreasing Oil Price	0.072	0.055	-0.018**	(-2.536)
Increasing Oil Price	0.061	0.046	-0.015**	(-2.436)
diff (Increasing minus Decreasing)	-0.011	-0.008**		
t-value	(-1.257)	(-2.229)		

Table 13 Repo Rate Differentials by Repo Tenures

This table reports the average repo rate and the average repo volume at different repo tenures for both sovereign *Sukuk* and conventional sovereign bonds. *Repo Rate* is the historical repo rate reported by Bank Negara Malaysia (BNM) and is given in percentage points. Repo volume is the amount traded in million Malaysian Ringgit (million MYR). *Repo Tenure* is computed by differencing the repo maturity date and the trading date. We pool the observations into fixed repo tenure buckets of one day, two days, one week, two weeks, three weeks, one month, two months, three months, and six months. For each repo tenure bucket, we first calculate the mean of the repo rate and repo volume cross-sectionally and then report the time series average of the cross-sectional mean. In addition, the 3^{rd} (6^{th}) column reports the difference of the average repo rate (volume) between sovereign *Sukuk* and conventional sovereign bonds. The dataset consists of 56,509 repo transactions and 10,521 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Average Repo Rates (%)			Average Repo Volumes (million MYR)		
	Conventional	Islamic	*diff (Isl minus Conv)*	Conventional	Islamic	*diff (Isl minus Conv)*
One-day	3.055	3.298	0.242	325.790	114.901	-210.889
Two-day	3.053	3.335	0.282	171.312	69.798	-101.514
One-week	2.902	3.002	0.100	93.144	42.742	-50.402
Two-week	2.460	2.925	0.466	106.203	74.857	-31.346
Three-week	2.957	3.037	0.081	119.292	103.089	-16.203
One-month	2.893	3.186	0.293	240.571	117.559	-123.012
Two-month	3.037	3.162	0.125	437.816	275.324	-162.492
Three-month	3.179	3.331	0.152	271.391	664.671	393.281
Six-month	3.127	3.300	0.173	289.071	248.091	-40.980

Table 14 Repo Rate Differentials using Fama-MacBeth Regressions

This table reports the Fama-MacBeth regression models explaining the repo rate based on weekly averages of all variables:

$$Repo\ Rate_{i,t} = \alpha_0 + \alpha_1 \times Repo\ Tenure_{i,t} + \alpha_2 \times Islamic\ Dummy_{i,t} + \alpha_3 \times Controls$$

Control variables include bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Repo Rate* is the historical repo rate reported by Bank Negara Malaysia (BNM) and is given in percentage points. *Repo Tenure* is computed by differencing the repo maturity date and the trading date. For bonds having multiple trades in a week, we estimate the repo rate from individual repo trades by calculating a repo volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. For each week t, we regress repo rate on repo tenure, *Islamic Dummy* and five control variables shown above. We then report the time series average of the estimated coefficients during the corresponding time window. The t-statistics are given in parentheses and are calculated from Newey and West (1987) standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. In order for bond i to enter into the regression, it has to go "on special" during week t. The final sample consists of 3,252 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Model 1	Model 2	Model 3	Model 4
Intercept	2.522***	2.568***	2.541***	3.113***
	(25.23)	(13.56)	(11.48)	(6.7)
Repo Tenure	4.08***	3.544***	2.969***	0.274
	(5.08)	(4.8)	(4.45)	(0.26)
Islamic Dummy	0.379***	0.416***	0.567***	0.185*
	(4.79)	(3.55)	(3.63)	(1.88)
Maturity	YES	YES	YES	YES
Maturity^2	YES	YES	YES	YES
Coupon Rate		YES	YES	YES
Age			YES	YES
1^{st} *PC of Liquidity*				YES
R^2	0.449	0.483	0.491	0.537
N	3,252	3,157	3,157	2,732
# of Weeks	197	197	197	197

Table 15 Re-examine Main Results with Constrained Samples

Panel A in this table re-examines the main results in Table 4 by running the following two steps of regressions. First,

$$Yield_{i,t} = \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Controls_{i,t},$$

which is the same specification as in Table 4. The yield to maturity is explained by the *Islamic Dummy* and a number of control variables including maturity, square of maturity, coupon rate, age, and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. For each week t, we regress *Yield* on the six regressors (i.e., *Islamic Dummy* plus the other five control variables). The time series average of the estimated coefficients are reported in Table 4. Second,

$$\alpha_{1t} = \beta_0 + \beta_1 \times Repo\ Week\ Dummy_t,$$

where α_1 is a time series of coefficients of the *Islamic Dummy* taken from the first step. *Repo Week Dummy* is defined as 1 if at least one conventional sovereign bond and one sovereign *Sukuk* go "on special" during week t, and 0 otherwise. Instead of taking the time series average of α_1, we regress it on the *Repo Week Dummy* and report the estimated coefficients in Panel A. Model 1 only include maturity and square of maturity as control variables, while coupon rate, age, and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies are added sequentially into Model 2, 3 and 4. The t-statistics are given in parentheses and are calculated from Newey and West (1987) standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

Panel A: Full Sample with Repo Week Dummy

	Model 1	Model 2	Model 3	Model 4
Intercept	0.0446***	0.0408***	0.0404***	0.0435***
	(15.858)	(10.396)	(10.102)	(10.483)
Repo Week Dummy	0.0255***	0.0283***	0.0265***	0.0138*
	(4.898)	(3.668)	(3.491)	(1.816)
R^2	0.033	0.044	0.039	0.009
N	37,670	37,381	37,381	28,153
# of Weeks	675	675	675	675

Panel B in this table reports the Fama-MacBeth regression models within the constrained samples, explaining the yield to maturity based on weekly average of *Islamic Dummy*, *Repo Dummy*, and a number of control variables:

$$
\begin{aligned}
Yield_{i,t} = \alpha_0 + \alpha_1 \times Repo\ Dummy_{i,t} + \alpha_2 \times Islamic\ Dummy_{i,t} \\
+ \alpha_3 \times Repo\ Dummy_{i,t} \times Islamic\ Dummy_{i,t} + \alpha_4 \times Controls_{i,t}
\end{aligned}
$$

Control variables include bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. The yield to maturity is explained by the *Islamic Dummy*, *Repo Dummy*, bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *Repo Dummy* is defined as 1 if the bond traded goes on special in week t, and 0 otherwise. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. For each week t, we regress *Yield* on the eight regressors shown above (i.e., *Islamic Dummy*, *Repo Dummy*, the interaction term of the two dummies, and the other five control variables). We then report the time series average of the estimated coefficients. The t-statistics are given in parentheses and are calculated from Newey and West (1987). standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. In order for week t to enter into the regression, we require that both Islamic and conventional bonds have at least one reported special repo trade during that week. The final sample consists of 10,488 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

Panel B: Constrained Sample with Repo Dummy

	Model 1	Model 2	Model 3	Model 4
Intercept	3.048***	3.008***	3.008***	2.984***
	(55.7)	(53.49)	(52.78)	(47.16)
Islamic Dummy	0.074***	0.07***	0.067***	0.059***
	(6.56)	(6.92)	(6.81)	(5.76)
Repo Dummy	-0.005	-0.013**	-0.014***	-0.014**
	(-0.53)	(-2.32)	(-2.58)	(-2.03)
Islamic Dummy * Repo Dummy	0.023*	0.028**	0.028**	0.019*
	(1.75)	(2.41)	(2.49)	(1.87)
maturity	0.132***	0.131***	0.13***	0.129***
	(11.49)	(11.76)	(11.91)	(11.9)
Maturity^2	-0.003***	-0.003***	-0.003***	-0.003***
	(-7.33)	(-7.48)	(-7.41)	(-7.25)
coupon_rate		0.014***	0.016***	0.027***
		(4.26)	(3.53)	(3.62)
age			-0.002	-0.004**
			(-1.22)	(-2.29)
1^{st} *PC of Liquidity*				-0.01***
				(-5.33)
R^2	0.902	0.911	0.913	0.919
N	1,0488	1,0454	1,0454	8,241
# of Weeks	197	197	197	197

Table 16 Special Repo Rates and Bond Yields

This table reports the Fama-MacBeth regression models explaining the yield to maturity based on the weekly averages of all variables:

$$\begin{aligned} Yield_{i,t} &= \alpha_0 + \alpha_1 \times Islamic\ Dummy_{i,t} + \alpha_2 \times Repo\ Rate\ Residual_{i,t} + \alpha_3 \times Maturity_{i,t} \\ &+ \alpha_4 \times Maturity^2_{i,t} + \alpha_5 \times Coupon\ Rate_{i,t} + \alpha_6 \times Age_{i,t} + \alpha_7 \times 1^{st}\ PC\ of\ Liquidity_{i,t}, \end{aligned}$$

where *Repo Rate Residual* is estimated by first regressing the special repo rate on the first principal component (1^{st} *PC of Liquidity*), and then taking the residual term. *Repo Rate* is the historical repo rate reported by Bank Negara Malaysia (BNM) and is given in percentage points.

The yield to maturity is explained by *Islamic Dummy*, *Repo Rate Residual*, bond characteristics (maturity, square of maturity, coupon rate and age) and the first principal component (1^{st} *PC of Liquidity*) of all the liquidity proxies. *Yield* is the yield to maturity and is given in percentage points. For bonds having multiple trades in a week, we estimate the yield from individual trades by calculating a volume-weighted average for the week. *Islamic Dummy* is defined as 1 if the bond traded is Islamic sovereign bond, and 0 if it is conventional sovereign bond. *Maturity* and *Age* are both given in years, while *Coupon Rate* is given in percentage points. For each week t, we regress yield on the eight regressors shown above. We then report the time series average of the estimated coefficients. The t-statistics are given in parentheses and are calculated from Newey and West (1987). standard errors, which are corrected for heteroskedasticity and serial correlation. Significance at the 10%(*), 5%(**), or 1%(***) is indicated. Each model's R^2 and the number of observations are also reported. In order for week t to enter into the regression, we require that both Islamic and conventional bonds have reported special repo trades during that week. The final sample consists of 3,252 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. The bond transaction-level data are sourced from the Bond Info Hub web portal, which is a database set up by Bank Negara Malaysia (BNM).

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	2.897***	3.047***	3.013***	2.969***	2.689***	2.475***
	(77.19)	(55.36)	(47.84)	(38.36)	(22.2)	(22.77)
Islamic Dummy	0.052***	0.07***	0.131***	0.141***	0.179***	0.175***
	(11.56)	(7.39)	(5.23)	(3.69)	(3.77)	(2.95)
Repo Rate Residual				0.057***	0.115**	0.102**
				(3.22)	(2.09)	(2.1)
Maturity	0.166***	0.134***	0.162***	0.167***	0.188***	0.167***
	(17.75)	(10.98)	(10.12)	(7.93)	(7.48)	(10.15)
Maturity^2	-0.005***	-0.003***	-0.007***	-0.005**	-0.007***	-0.005***
	(-11.28)	(-6.42)	(-4.59)	(-2.35)	(-2.77)	(-3.37)
Coupon Rate					0.049	0.143***
					(1.62)	(5.7)
Age					0.019***	-0.008
					(3.09)	(-0.93)
1^{st} *PC of Liquidity*						-0.058***
						(-3.91)
R^2	0.93	0.899	0.923	0.936	0.956	0.961
N	37,670	10,488	3,252	2,783	2,769	2,769
# of Weeks	675	197	197	197	197	197

A. Appendix: Data Cleaning and Sample Construction Process

To make our price/yield estimation as accurate as possible, we further restrict our sample to fixed-rate "straight" instruments without optionality, and drop suspicious data points by implementing the following six steps. Table A-1 presents the number (share) of observations left after each step of filtering steps.

[Insert Table A-1 about here]

- *Removing errors*: We delete the observation if its instrument type, stock description, issuer and maturity date are all missing.
- *Removing missing yields*: The purpose of applying this filter is to make sure the price/yield information is available and accurate to the best of our knowledge.
- *Removing extreme values*: We omit outliers, which we define as price, yield and volume observations which below the 0.1th percentile or above the 99.9th percentile, considering all observations.
- *Removing duplicated reporting*: We remove duplicated reports of which the bond code, bond description, trade date, trade time, price, yield and amount are all identical. We believe these observations are real duplicates other than that these reports just randomly happened to be the same, because we could observe such cases repeatedly for some specific bonds
- *Price filtering*: We apply both price median filter and price reversal filter. The median filter eliminates any transaction where the price deviates by more than 10% from the daily median, or from a nine-day median centered at the trading day. The price reversal filter eliminates any transaction with an absolute price change deviating from the lead, lag and average lead/lag price change by at least 10%.
- *Six instruments*: The instruments in our database can be grouped into asset backed securities (ABS), corporate bonds, sovereign securities, commercial paper, Bank Negara Malaysia securities and medium-term notes. To exclude the impact of differential credit risks, we will

focus only on the Malaysian sovereign bonds and restrict our sample to 6 types of security: BNB, BNMN-DB, BNMN-IDB, BNMN-IDM, GII, and MGS.

B. Appendix: Islamic Bond (*Sukuk*) and Malaysian Bond Market

In contrast to conventional bonds, Islamic bonds have often been referred to as *Sukuk*, an Arabic term for financial certificates. The objective of Islamic and conventional bond issuance remains the same, i.e. to raise the necessary financing for projects. However, as an Islamic finance product, *Sukuk* must comply with certain underlying Shariah principles. That is, the funds raised by issuing *Sukuk* cannot be involved in non-Shariah compliant activities (e.g., gambling, alcohol, pork production, etc.) *Sukuk* are one of the most successful, visible, internationally-issued and accepted Islamic finance products. Malaysia issued the world's first *Sukuk* in 2000 and is currently the largest global issuer, with more than half of *Sukuk* issued worldwide being dominated in Malaysian ringgit (MYR).

The Malaysian bond market is predominantly traded by institutional investors. Both Islamic and conventional bonds are open to foreign investors, who serve as important players in the Malaysian bond market. The foreign holdings are at the same level with the holdings of domestic financial and social security institutions.

According to *AsianBondsOnline*, the Malaysian bond market is the third largest bond market in the Asia-Pacific region (ex-Japan). This is due to its increasing issuance volume, growing market size, and active trading activities. The issuance of Malaysian local currency (LCY) sovereign bonds increased steadily increased from USD4.75 billion in 2000 to USD156.46 billion in 2012. As of the end-March 2017, the total size of the Malaysian bond market was USD273 billion, peaking at USD329 billion in September 2014, which is close to 100% of the GDP of Malaysia. The yearly average of outstanding Malaysian LCY bonds in USD billions and a percentage of national GDP, respectively. Malaysia has progressively developed into an active Asian bond market since 2000. It witnessed its most dynamic year in 2011 with sovereign bond trading volumes reaching USD553.64 billion in total, and achieving an average turnover ratio of 0.83. The latter is a form of activity or liquidity measure, reflecting the frequency at which outstanding issues are traded in the market, i.e., the traded bond value divided by the outstanding bond value. In general, Malaysian sovereign bonds dominate the local currency bond market.

Nevertheless, the Malaysian sovereign bond market is active in both Islamic and conventional bonds. According to the Malaysian International Islamic Financial Centre (MIFC), *Sukuk* bonds represent a substantial portion (around 50%) of sovereign new issuance. In Malaysia, Islamic sovereign bonds are similar to conventional sovereign bonds in terms of the effective cash flows, issuance structure and legal status. Malaysian Government Securities (MGS), which are conventional bond issues, and its Islamic principles variant, Government Investment Issue (GII), are both long-term bonds issued by the government of Malaysia. According to local financial institutions, there are no substantial tax differences between them. However, GII, which are capped at 10 years, have relatively shorter maturities than MGS, which are capped at 20 years. In addition, GII (MYR1000 million) also have a higher threshold for the minimal issuance amount than MGS (MYR500 million).

Although GII is defined by Bank Negara Malaysia (BNM) as "long-term non-interest-bearing Government securities based on Islamic principles issued by the Government of Malaysia for funding developmental expenditure," the cash flow structure is indeed the same as that of MGS. One important concept in Islamic finance is the "sell and buy back" agreement, based on which "the Government will sell specified nominal value of its assets and subsequently will buy back the assets at its nominal value plus profit through a tender process." The "profit" in GII is, economically, no different than the "interest" in MGS when viewed in terms of repaying money to investors. As a consequence, MGS and GII are two specific types of sovereign bond instruments.

A more detailed description of the institutional background with graphs and tables can be found in Internet Appendix B

Table A-1 Data Cleaning and Sample Construction Process

This table illustrates the data cleaning process and the number (Panel A) and the share (Panel B) of observations remaining after cleaning step for each year of data and the whole dataset. The initial number of observations is given as *before cleaning*, which equals to the total number of transactions in Malaysian bond market during the period of January 2005 through December 2017. *After removing errors*: Delete if instrument type, stock description, issuer and maturity date are all missing. *After removing missing yields*: The price information filter is applied to make sure the price/yield information is available and accurate to the best of our knowledge. In general, we remove the observations whose yield is not reported by Bank Negara Malaysia (BNM). *After removing extreme values*: We omit outliers, which we define as price, yield and volume observations which are below the 0.1th percentile or above the 99.9th percentile, considering all observations. *After removing duplicated-reporting*: We remove duplicated reports of which the bond code, bond description, trade date, trade time, price, yield and amount are all identical. *After price-filtering*: We apply both price median filter and price reversal filter. The median filter eliminates any transaction where the price deviates by more than 10% from the daily median, or from a nine-day median cantered at the trading day. The reversal filter eliminates any transaction with an absolute price change deviating from the lead, lag and average lead/lag price change by at least 10%. *Six instruments*: The instruments in our database can be grouped into asset backed securities (ABS), corporate bonds, sovereign securities, commercial paper, Bank Negara Malaysia securities and medium-term notes. To exclude the impact of differential credit risks, we will focus only on the Malaysian sovereign bonds and restrict our sample to 6 types of security: BNB, BNMN-DB, BNMN-IDB, BNMN-IDM, GII, and MGS.

Panel A: Number of observations

year	before cleaning	errors	missing yields	after removing extreme values	duplicated-reporting	after price-filtering	six instruments
2005	39100	39100	29001	28818	28806	28806	22764
2006	41781	41781	30663	30557	30551	30551	26017
2007	40343	40343	26140	26013	26008	26008	23844
2008	37429	37429	34475	34095	34083	34083	27810
2009	34645	34645	33437	32646	32643	32643	25421
2010	43325	43325	42075	41970	41959	41959	33420
2011	51833	51833	50044	49887	49866	49866	40332
2012	56279	56279	54120	53938	53929	53929	40529
2013	55317	55317	53666	53495	53487	53487	39579
2014	52216	52216	50144	49989	48970	48970	35608
2015	56345	56345	54092	53876	52932	52932	39880
2016	67869	67869	57855	57627	57620	57617	43252
2017	52228	52228	48002	47888	46481	46481	34177
TOTAL	628710	628710	563714	560799	557335	557332	432633

Panel B: Share of observations

year	before cleaning	errors	missing yields	after removing extreme values	duplicated-reporting	after price-filtering	six instruments
2005	100.00%	100.00%	74.17%	73.70%	73.67%	73.67%	58.22%
2006	100.00%	100.00%	73.39%	73.14%	73.12%	73.12%	62.27%
2007	100.00%	100.00%	64.79%	64.48%	64.47%	64.47%	59.10%
2008	100.00%	100.00%	92.11%	91.09%	91.06%	91.06%	74.30%
2009	100.00%	100.00%	96.51%	94.23%	94.22%	94.22%	73.38%
2010	100.00%	100.00%	97.11%	96.87%	96.85%	96.85%	77.14%
2011	100.00%	100.00%	96.55%	96.25%	96.21%	96.21%	77.81%
2012	100.00%	100.00%	96.16%	95.84%	95.82%	95.82%	72.01%
2013	100.00%	100.00%	97.02%	96.71%	96.69%	96.69%	71.55%
2014	100.00%	100.00%	96.03%	95.74%	93.78%	93.78%	68.19%
2015	100.00%	100.00%	96.00%	95.62%	93.94%	93.94%	70.78%
2016	100.00%	100.00%	85.25%	84.91%	84.90%	84.89%	63.73%
2017	100.00%	100.00%	91.91%	91.69%	89.00%	89.00%	65.44%
TOTAL	100.00%	100.00%	89.66%	89.20%	88.65%	88.65%	68.81%

Internet Appendix

for

The curious case of Malaysian sovereign bonds

This Internet Appendix reports the supplementary results and institutional background as described below:

- Internet Appendix A: Supplementary Results of Nelson-Siegel Three-Factor Model
- Internet Appendix B: Islamic Bonds (*Sukuk*) and Malaysian Bond Market
- Internet Appendix C: List of Bond Instruments

A. Internet Appendix: Supplementary Results of Nelson-Siegel Three-Factor Model

In this internet appendix, we report some supplementary results of the Nelson-Siegel Three-Factor Model. In Figure IA-1, we plot the time-trend of the three estimated factors, based on which we compute the time series mean (median, 25th and 75th of β_{1t}, β_{2t} and β_{3t} from Table 5. In Figure IA-2, we show the fitted yield surfaces (i.e., the collection of the weekly yield curves) for both subsets of bonds. To clearly differentiate the yield surfaces, in Figure IA-3, we project the yield surface onto the "*Yield*-Time" panel (i.e., by shrinking the "*Maturity*" axis), which turns out as an area plot in Figure IA-3. Figure IA-4 takes the difference between the two area plots of the Islamic (*Sukuk*) and conventional sovereign bonds in Figure IA-3. We can see from Figure IA-4 that during the first half of our sample period, both bond subsets show a balanced pattern in terms of the yield spread. However, the Islamic sovereign bonds show consistently higher yields than their conventional counterparts during the second half of the sample period.

[Insert Figures IA-1 to IA-4 about here]

B. Internet Appendix: Islamic Bond (*Sukuk*) and the Malaysian Bond Market

In contrast to conventional bonds, Islamic bonds have often been referred to as *Sukuk*, an Arabic term for financial certificates. The objective of Islamic and conventional bond issuance remains the same, i.e., to raise the necessary financing for projects. However, as an Islamic finance product, *Sukuk* must comply with certain underlying Shariah principles. That is, the funds raised by issuing *Sukuk* cannot be involved in non-Shariah compliant activities (e.g., gambling, alcohol, pork production, etc.) *Sukuk* are one of the most successful, visible, internationally-issued and accepted Islamic finance products. Malaysia issued the world's first *Sukuk* in 2000 and is currently the largest global issuer, with more than half of *Sukuk* issued worldwide being dominated in Malaysian ringgit (MYR). As shown in Figure IA-5, during the time period from 2001 through 2016, 61% of *Sukuk* issued was dominated in MYR.

[Insert Figure IA-5 about here]

The Malaysian bond market is predominantly traded by institutional investors. Both Islamic and conventional bonds are open to foreign investors, who serve as important players in the Malaysian bond market. Figure IA-6 shows a significant increase in foreign holdings relative to the total amount outstanding in the Malaysian sovereign bond market. The foreign holdings are at the same level with the holdings of domestic financial and social security institutions.

[Insert Figure IA-6 about here]

According to *AsianBondsOnline*, the Malaysian bond market is the third largest bond market in the Asia-Pacific region (ex-Japan). This is due to its increasing issuance volume, growing market size, and active trading activities. As can be seen from Figure IA-7, the issuance of Malaysian local currency (LCY) sovereign bonds increased steadily increased from USD4.75 billion in 2000 to USD156.46 billion in 2012. As of the end-March 2017, the total size of the Malaysian bond market was USD273 billion, peaking at USD329 billion in September 2014, which is close to 100% of the GDP of Malaysia. Figure IA-8 presents the yearly average of outstanding Malaysian LCY bonds in USD billions and a percentage of national GDP, respectively. As seen from Figure IA-9, Malaysia has progressively developed into an active Asian bond market since 2000. It witnessed its most dynamic year in 2011 with sovereign bond trading volumes reaching USD553.64 billion in total, and achieving an average turnover ratio of 0.83. The latter is a form of activity or liquidity measure, reflecting the frequency at which outstanding issues are traded in the market, i.e., the traded bond value divided by the outstanding bond value. In general, Malaysian sovereign bonds dominate the local currency bond market.

[Insert Figures IA-7 to IA-9 about here]

Nevertheless, the Malaysian sovereign bond market is active in both Islamic and conventional bonds. According to the Malaysian International Islamic Financial Centre (MIFC), *Sukuk* bonds represent a substantial portion (around 50%) of sovereign new issuance. In Malaysia, Islamic sovereign bonds are similar to conventional sovereign bonds in terms of the effective cash flows, issuance structure and legal status. Table IA-1 provides a comparison between two specific types of Islamic and conventional sovereign bonds. Malaysian Government Securities (MGS), which are conventional bond issues, and its Islamic principles variant, Government Investment Issue (GII), are both long-term bonds issued by the government of Malaysia. According to local financial institutions, there are no substantial tax differences between them. However, GII, which are capped at 10 years, have relatively shorter maturities than MGS, which are capped at 20 years. In addition, GII (MYR1000 million) also have a higher threshold for the minimal issuance amount than MGS (MYR500 million).

[Insert Table IA-1 about here]

Although GII is defined by Bank Negara Malaysia (BNM) as "long-term non-interest-bearing Government securities based on Islamic principles issued by the Government of Malaysia for funding developmental expenditure," the cash flow structure is indeed the same as that of MGS. One important concept in Islamic finance is the "sell and buy back" agreement, based on which "the Government will sell specified nominal value of its assets and subsequently will buy back the assets at its nominal value plus profit through a tender process." The "profit" in GII is, economically, no different than the "interest" in MGS when viewed in terms of repaying money to investors. As a consequence, MGS and GII are two specific types of sovereign bond instruments.

C. Internet Appendix: List of Bond Instruments

This table presents a list of instruments of all debt securities in Malaysia's local currency (LCY) market. Debt securities in Malaysia's local currency (LCY) market are classified by type of issuer—government, quasi-government and corporate. Lists of debt securities available in this market are provided below.

Instrument	Name	Definition	Conventional/ Islamic	Government/ Corporate
BNB	*Bank Negara Bills*	*Bank Negara Bills issued by Bank Negara Malaysia*	*Conventional*	*Government*
BNMN-CB	*Bank Negara Monetary Notes - Coupon Based*	*Bank Negara Monetary Notes (BNMN)—discounted or coupon-bearing government securities with maturities of 91-, 182-, 364-days and one to three years. BNMNs are issued by BNM to manage liquidity in both conventional and Islamic markets, and have replaced BNM Bills and BNM Negotiable Notes beginning December 2006. BNMNs are offered through competitive auction through principal dealers.*	*Conventional*	*Government*
BNMN-DB	*Bank Negara Monetary Notes - Discount Based*			
BNMNF	Floating Rate Bank Negara Monetary Notes	BNMNF are instruments used for implementing monetary policy and in managing liquidity in the financial market. Floating rate BNMN issuance is conducted through competitive Dutch auction (uniform price) via the Principal Dealer network and the market participant will bid the tender based on spread.	Conventional	Government
BNNN	Bank Negara Negotiable Bills	Bank Negara Negotiable Bills - issued by Bank Negara Malaysia	Conventional	Government
KHA	Khazanah Bonds	Khazanah Bonds issued by Khazanah Nasional Berhad	Conventional	Government
MGS	*Malaysian Government Securities*	*Malaysian Government Securities issued by the Government of Malaysia*	*Conventional*	*Government*
MGSC	Malaysian Government Securities Callable	Since December 2006, Bank Negara Malaysia has introduced callable MGS which provides the Government with the option to redeem the issue at par by giving advance notice of five business days to bondholders. Typically, the issue will be called in whole on specific coupon date(s). However, these characteristics may vary in the future. Issuance of callable MGS allows the Government to better manage its cashflow as well as meet the diverse needs of investors. MGSC are issued via competitive auction by Bank Negara Malaysia on behalf of the Government. Successful bidders are determined according to the lowest yields offered and the coupon rate is fixed at the weighted average yield of successful bids.	Conventional	Government
MTB	Malaysian Treasury Bills	Short-term securities issued by the Government of Malaysia to raise short-term funds for Government's working capital. Bills are sold at discount through competitive auction, facilitated by Bank Negara Malaysia, with original maturities of 3-month, 6-month, and 1-year. The redemption will be made at par. Issued on a weekly basis and the auction will be held one day before the issue date. The successful bidders will be determined according to the most competitive yield offered. Normal auction day is Thursday and the result of successful bidders will be announced one day after. Tradable on yield basis (discounted rate) based of bands of remaining tenure (e.g., Band 4=68 to 91 days to maturity). The standard trading amount is RM5 million, and it is actively traded in the secondary market.	Conventional	Government

BNMN-IDB *BNMN-IDM*	*Bank Negara Monetary Notes - Islamic Discount Based*	*BNMN-i are Islamic securities issued by Bank Negara Malaysia replacing the existing Bank Negara Negotiable Notes (BNNN) for purposes of managing liquidity in the Islamic financial market. The instruments will be issued using Islamic principles which are deemed acceptable to Shariah requirement. The maturity of these issuances has also been lengthened from one year to three years. New issuances of BNMN-i may be issued either on a discounted or a coupon-bearing basis depending on investors' demand. Discount-based BNMN-i will be traded using the same market convention as the existing BNNN and Malaysian Islamic Treasury Bills (MITB) while the profit-based BNMN-i will adopt the market convention of Government Investment Issues (GII).*	*Islamic*	*Government*
BNMN-IPB BNMN-IPI	Bank Negara Monetary Notes - Islamic Profit Based	the profit-based BNMN-i will adopt the market convention of Government Investment Issues (GII).	Islamic	Government
GII	*Government Investment Issues*	*long-term non-interest-bearing Government securities based on Islamic principles issued by the Government of Malaysia for funding developmental expenditure. Similar with MGS, GII is issued through competitive auction by Bank Negara Malaysia on behalf of the Government. The GII issuance programme is pre-announced in the auction calendar with issuance size ranging from RM1 billion to RM3.5 billion and original maturities of 3-year, 7- year, 5-year and 10-year. GII is based on Bai' Al-Inah principles, part of the sell and buy back concept in Islamic finance. Under this principle, the Government will sell specified nominal value of its assets and subsequently will buy back the assets at its nominal value plus profit through a tender process. Profit rate is based on the weighted average yield of the successful bids of the auction. The nominal value of buying back the assets will be settled at a specified future date or maturity, while the profit rate will be distributed half yearly. The obligation of the Government to settle the purchase price is securitised in the form of GII and is issued to the investors. At maturity, the Government will redeem the GII and pay the nominal value of the securities to the GII holders. GII is one of the financial instruments that are actively traded in the Islamic Interbank Money Market.*	*Islamic*	*Government*
MITB	Malaysian Islamic Treasury Bills	short-term securities issued by the Government of Malaysia based on Islamic principles. MITB are usually issued on a weekly basis with original maturities of 1-year. MITB auctions are held one day before the issue date. The successful bidders will be determined according to the most competitive yield offered. Both conventional and Islamic institutions can buy and trade MITB . structured based on Bai' Al-Inah principle, part of sell and buy back concept. Bank Negara Malaysia on behalf of the Government will sell the identified Government's assets on competitive tender basis, to form the underlying transaction of the deal. Allotment is based on highest price tendered (or lowest yield). Price is determined after profit element is imputed (discounting factor). The successful bidders will then pay cash to the Government. The bidders will subsequently sell back the assets to the Government at par based on credit term. The Government will issue MITB to bidders to represent the debt created. tradable on yield basis (discounted rate) based on bands of remaining tenure (e.g., Band 4= 68 to 91 days to maturity). The standard trading amount is RM5 million, and it is actively traded based on Bai ad-Dayn (debt trading) principle in the secondary market.	Islamic	Government

SBNMI	*Sukuk* Bank Negara Malaysia Ijarah	SBNMI are issued based on the Al-Ijarah or sale-and-lease-back concept, a structure that is widely used in the Middle East. A special-purpose vehicle (SPV) has been established to issue the *Sukuk* Ijarah.	Islamic	Government
SPK	*Sukuk* Perumahan Kerajaan	a Shariah compliance long-term profit-based Government securities issued based on Commodity Murabahah structure. SPK is issued by the Government of Malaysia under the Housing Loan Fund Act 1971 to refinance funding for housing loans to Government civil servants and to extend new Government housing loans. The funds were previously raised through loans but is now replaced with *Sukuk* issuances, consistent with the Government's continuous support in developing the Malaysian *Sukuk* market.	Islamic	Government
ABS	Asset-Backed Securities	Asset-Backed Securities - bonds issued pursuant to a securitisation transaction	Conventional	Corporate
ABSMTN	Asset-Backed Securities - medium-term notes	Asset-Backed Securities - medium-term notes issued pursuant to a securitisation transaction	Conventional	Corporate
BONDS	Corporate bonds	Corporate Bonds issued by corporations	Conventional	Corporate
CAGB	Cagamas Bonds	Cagamas Bonds issued by Cagamas Berhad	Conventional	Corporate
CAGN	Cagamas Notes	Cagamas Notes issued by Cagamas Berhad	Conventional	Corporate
CP	Commercial paper	Commercial papers (CP) —short-term revolving promissory notes with maturities from 1 month to 1 year. Issued by corporations	Conventional	Corporate
CP-CPN	Commercial paper	Commercial paper - coupon	Conventional	Corporate
MTN	Medium-term Notes	Medium-term notes (MTN) —have tenors from 1 to 5 years and may be issued both on conventional or Islamic principles, and by direct placement or tender.	Conventional	Corporate
ABS-IMTN	Asset-Backed Securities - Islamic medium-term notes	Asset-Backed Securities - Islamic medium-term notes issued pursuant to a securitisation transaction	Islamic	Corporate
CAGABAIS	Cagamas Bithaman Ajil Islamic Securities	Cagamas Bithaman Ajil Islamic Securities issued by Cagamas Berhad	Islamic	Corporate
IABS	Islamic Asset-Backed Securities	Islamic Asset-Backed Securities - Sukuk issued pursuant to a securitisation transaction	Islamic	Corporate
IBONDS	Islamic Corporate Bonds	Sukuk issued by corporations	Islamic	Corporate
ICP	Islamic Commercial Paper	Islamic Commercial Papers issued by corporations	Islamic	Corporate
ICP-CPN	Islamic Commercial Paper	Islamic Commercial Paper - coupon	Islamic	Corporate
IMTN	Islamic Medium-term Notes	Medium-term notes (MTN) —have tenors from 1 to 5 years and may be issued both on conventional or Islamic principles, and by direct placement or tender.	Islamic	Corporate

SAC	Sanadat ABBA Cagama	Sanadat ABBA Cagamas issued by Cagamas Berhad	Islamic	Corporate
SMC	Sanadat Mudharabah Cagamas	Sanadat Mudharabah Cagamas issued by Cagamas Berhad	Islamic	Corporate

Source: Bank Negara, Bond Info Hub and FAST websites

Internet Appendix Figures and Tables

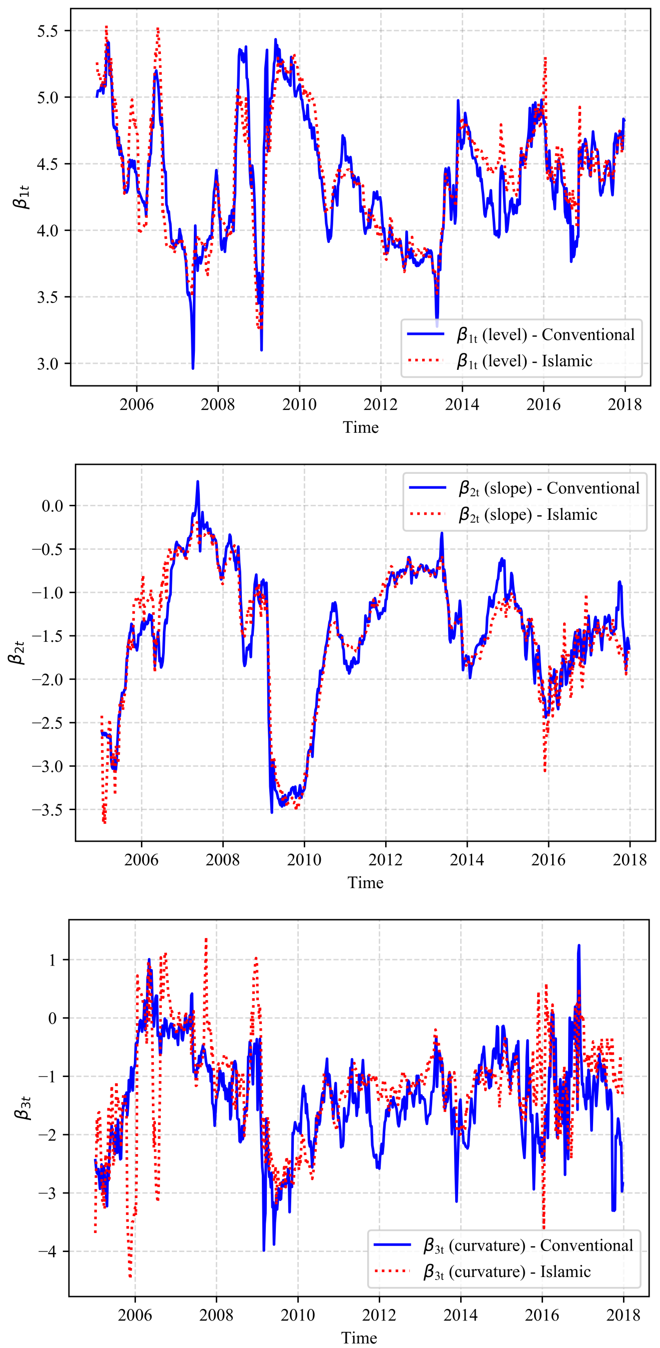


Figure IA-1 Time-trend of the Estimated Nelson-Siegel Factors

This figure shows the time-trend of the three estimated factors (i.e., level–$\widehat{\beta}_1$, slope–$\widehat{\beta}_2$, and curvature–$\widehat{\beta}_3$) from the Nelson-Siegel model. For each week, we regress the yields on the two factor loadings cross-sectionally. The factor loading is a function of the maturity. We then plot the time series of the three estimated factors. The dataset consists of 432,633 transactions and 37,686 bond-week observations for Malaysian sovereign bonds traded over the period January 2005 to December 2017. We report the time-trend of the estimated factors for both Islamic and conventional sovereign bonds.

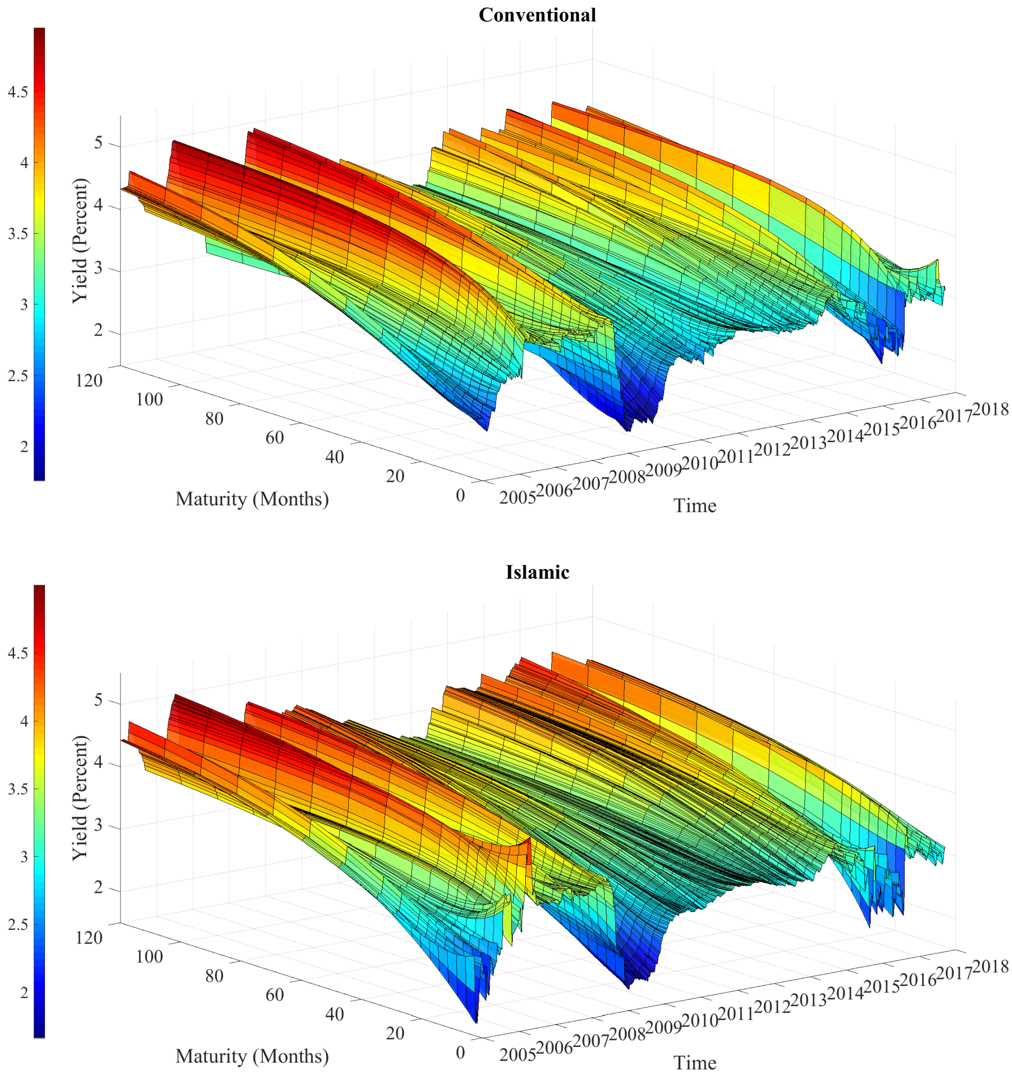


Figure IA-2 Fitted Nelson-Siegel Fitted Yield Surfaces
This graph shows the fitted yield surfaces using the Nelson-Siegel model over the sample period. For each week, we obtain the fitted yield curves by evaluating the Nelson-Siegel model at the value of the three estimated factors for that week (i.e., $\widehat{\beta}_1$, $\widehat{\beta}_2$, and $\widehat{\beta}_3$). After computing the fitted yield curves for all the weeks during the sample period, we plot the surface by shading the areas between the fitted yield curves. The dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks) after aggregating Malaysian sovereign bonds traded over the period January 2005 to December 2017. We report the fitted yield surfaces for both Islamic and conventional sovereign bonds.

Figure IA-3 Time-trend of the Fitted Yield *Levels*
This figure shows a time-trend of the yield levels for Islamic and conventional bonds across all the maturities ranging from 3 months to 10 years, respectively. We pick 5 representative maturities: 3 months, 1 year, 2 years, 5 years, and 10 years. We first plot the time series of the yield levels for the 5 maturities, and then shade the areas between the time series plots of the yield levels. The dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks) after aggregating Malaysian sovereign bonds traded over the period January 2005 to December 2017. We report the time-trend for both Islamic and conventional sovereign bonds.

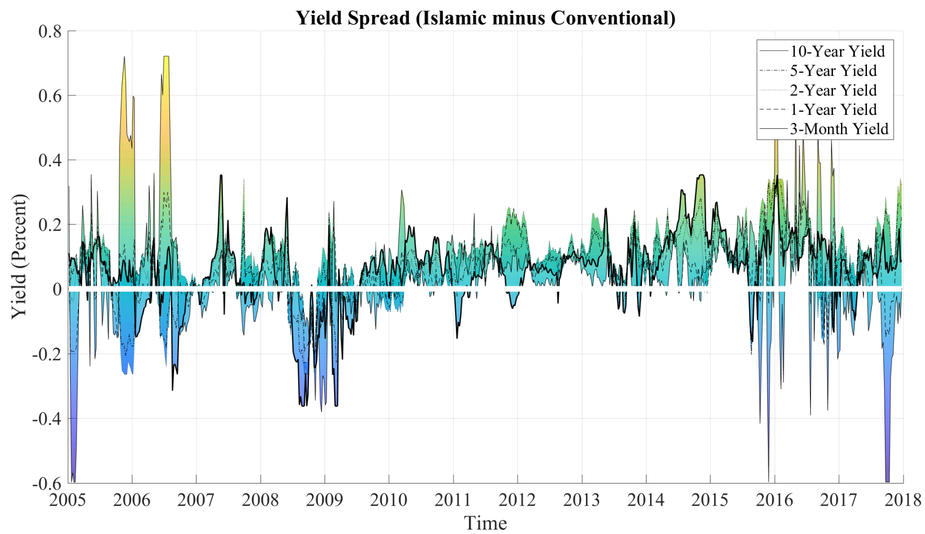


Figure IA-4 Time-trend of the Fitted Yield *Spreads*

This figure shows a time-trend of the yield spreads between Islamic and conventional bonds across all the maturities ranging from 3 months to 10 years. The yield spread is calculated by subtracting the yield level of *Sukuk* from that of conventional bonds. We pick 5 representative maturities: 3 months, 1 year, 3 years, 5 years and 10 years. We first plot the time series of the yield spreads for the 5 maturities, and then shade the areas between the time series plots of the yield spreads. The dataset consists of 432,633 transactions and 37,686 bond-week observations (675 weeks) after aggregating for Malaysian sovereign bonds traded over the period January 2005 to December 2017. We show the time-trend of the yield spreads, which is computed by subtracting the yield of *Sukuk* from that of conventional bonds.

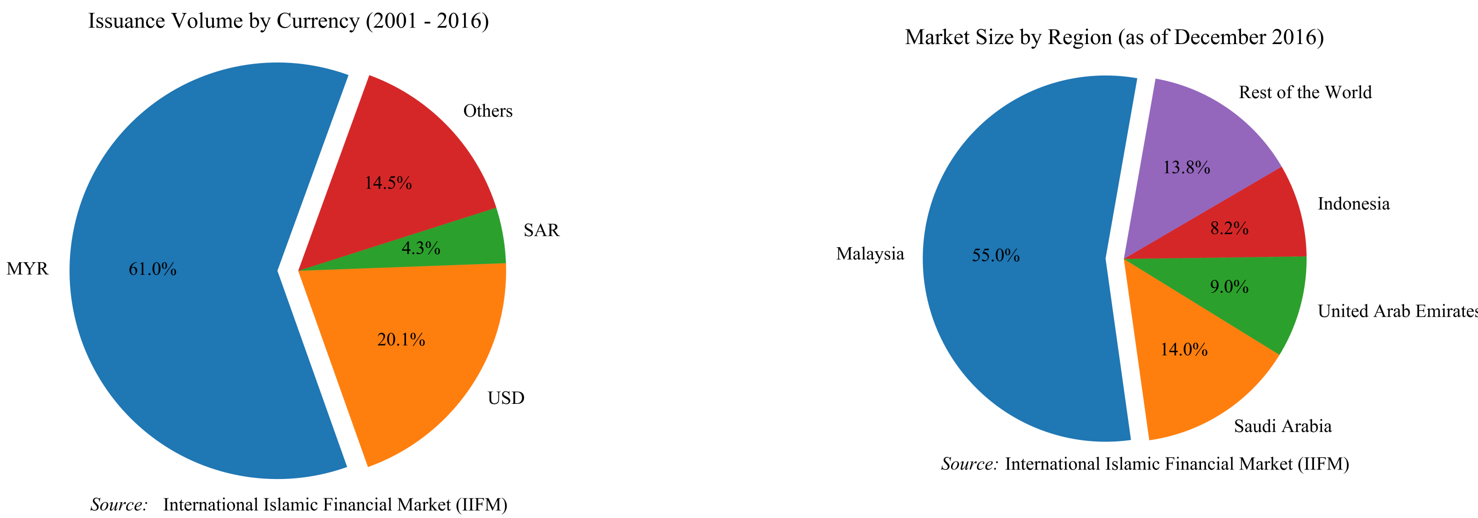
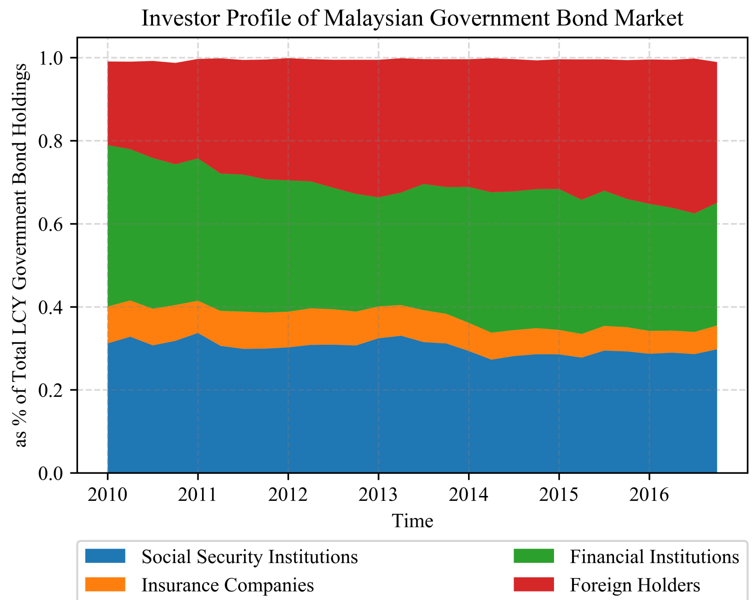
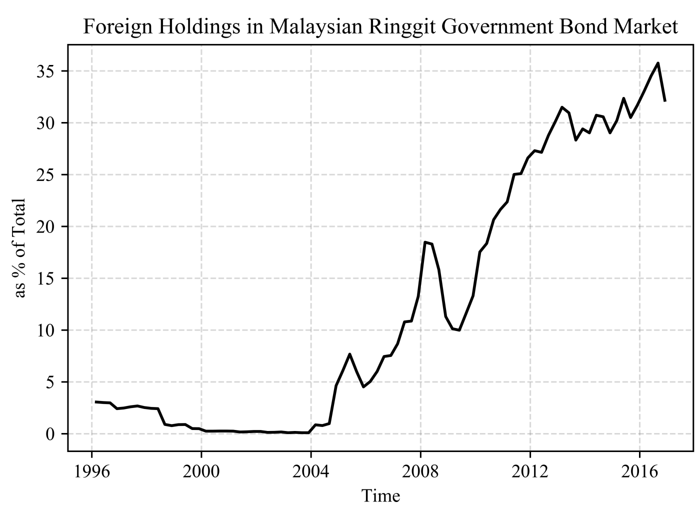


Figure IA-5 ***Sukuk* Issuance by Currency and Market Size by Region**

These two pie charts show the historical *Sukuk* issuance volume by currency and *Sukuk* outstanding by region, respectively. The period covers three years from 2001 through 2016.

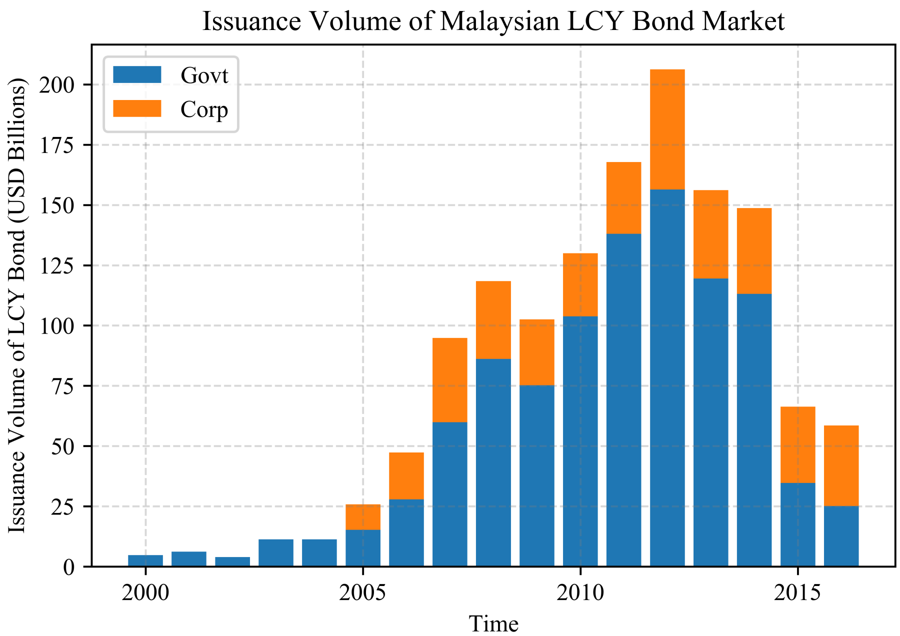


Source: AsianBondsOnline and Bank Negara Malaysia (BNM)



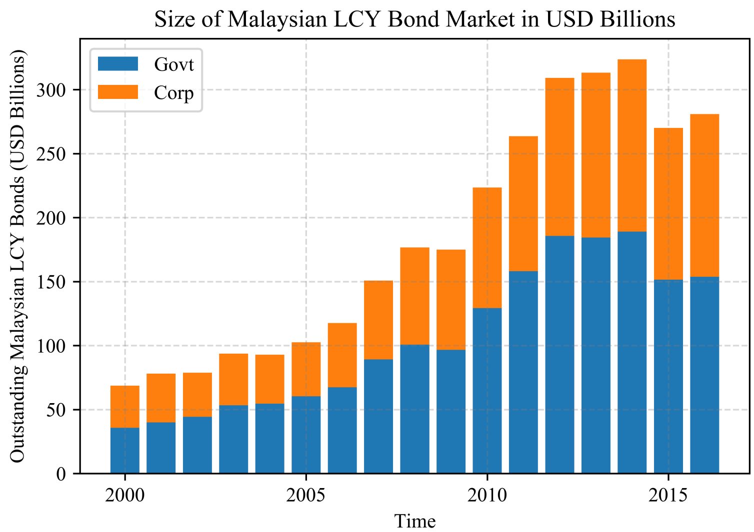
Source: AsianBondsOnline and Bank Negara Malaysia (BNM)

Figure IA-6 Investor Profile and Foreign Holding
The investor profile area plot shows the percentage of sovereign bond holdings by different institutional investors. The foreign holding plot shows the percentage in Malaysian sovereign bonds held by foreign investors relative to the total amount of bonds outstanding in Malaysian sovereign bond market.

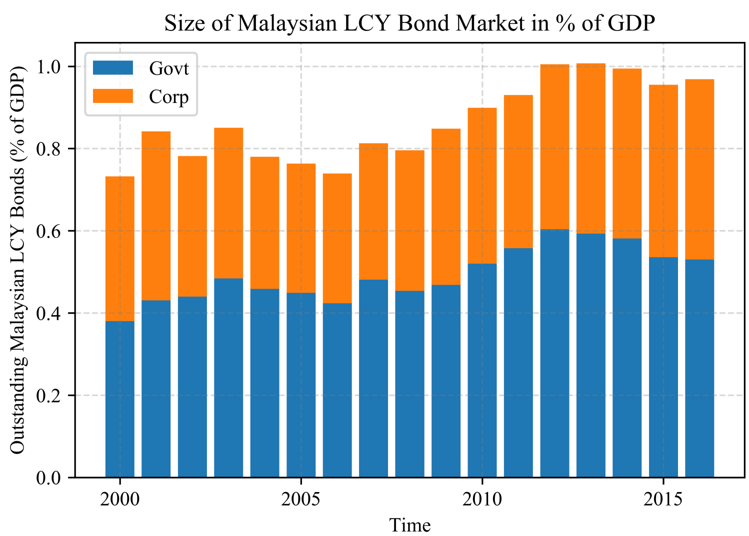


Source: AsianBondsOnline, Bank Negara Malaysia (BNM) and Bloomberg, L.P.

Figure IA-7 Issuance Volume in Malaysian Bond Market
This figure shows the total volume of Malaysian local currency (LCY) bond issuance, including both sovereign and corporate issuance, on a yearly basis. Sovereign bond issuance includes bonds issued by central governments, central banks, local governments, and quasi-government institutions. Corporate bond issuance includes bonds issued by both public and private companies, and financial institutions.

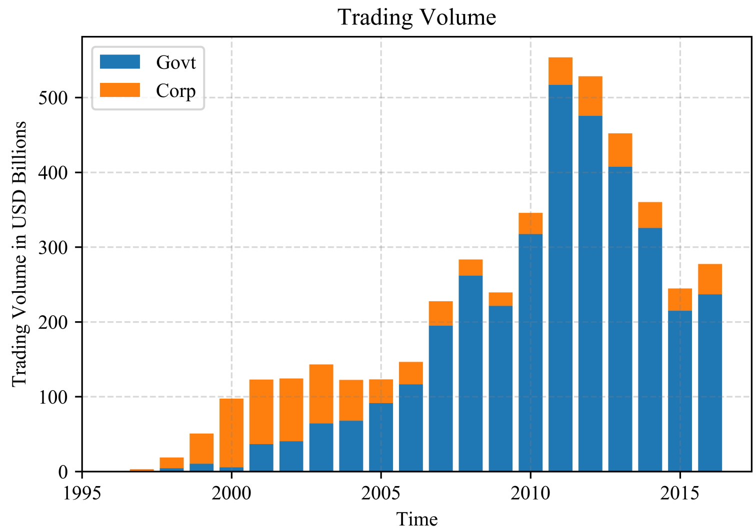


Source: AsianBondsOnline, Bank Negara Malaysia (BNM) and Bloomberg, L.P.

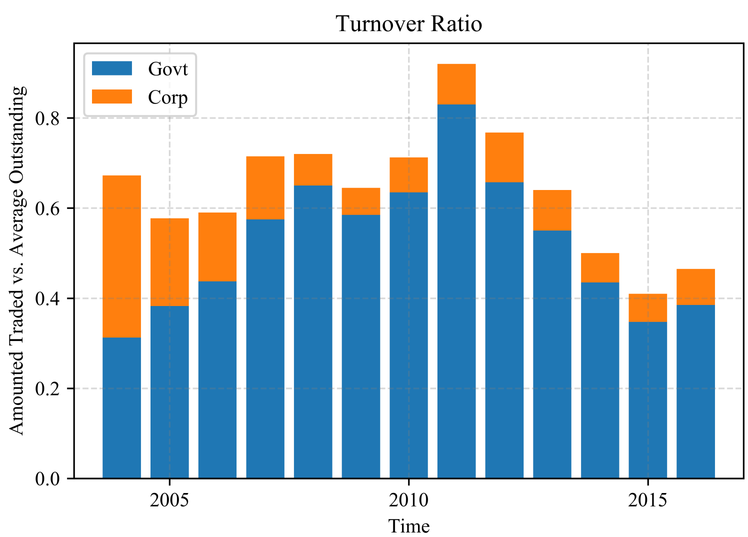


Source: AsianBondsOnline, Bank Negara Malaysia (BNM) and Bloomberg, L.P.

Figure IA-8 Size of Malaysian Bond Market
These two figures show the size of Malaysian local currency bond market in U.S. Dollar billions and in percent of national GDP, respectively. Sovereign bonds include obligations of the central governments, local governments, and the central bank. Corporate bonds comprise both public and private companies, including financial institutions. Financial institutions comprise both private and public-sector banks, and other financial institutions. Bonds are defined as long-term bonds and notes, Treasury bills, commercial paper, and other short-term notes.



Source: AsianBondsOnline, Bank Negara Malaysia (BNM) and Bloomberg, L.P.



Source: AsianBondsOnline, Bank Negara Malaysia (BNM) and Bloomberg, L.P.

Figure IA-9 Trading Volume and Turnover of Malaysian Bond Market
These two figures show the trading volumes in USD billions and turnover ratio in Malaysian bond market, respectively. Trading volume is the USD value of local currency sovereign and corporate bonds traded in the secondary markets. The turnover ratio indicates the frequency at which outstanding issues have been traded in the market. The turnover ratio is calculated as

$$turnover = \frac{value\ of\ bonds\ traded}{average\ amount\ of\ bonds\ outstanding}.$$

Table IA-1 Bank Negara Malaysia Information Notes

Bank Negara Malaysia Website gives the official information note about Islamic government bond and answers to some frequently asked questions. These documents list out the main features of Government Investment Issue (GII), which is a major form of Islamic government debt instruments. They cover a variety of aspects that people are interested in, such as Issuance, investor base, liquidity, return payment, redemption, tax treatment, regulatory treatment, legal status, and etc. A comprehensive understanding of these aspects is also quite critical for supporting our analysis and conclusion in this paper. The key information from these documents is summarized in the table below.

Features	Description
Issuer	The Issuer of GII is Government of Malaysia, which is the same as its conventional counterpart – Malaysian Government Securities (MGS).
Mode of Issue	GII is issued though a variable-rate multiple-price auction format (English auction format), with Bank Negara Malaysia as issuance agent to the Government. The auction process of GII is quite similar to that of MGS.
Governing Law	The governing law for GII is the Government Funding Act 1983, and other applicable laws of Malaysia.
Investor Base	The subscription in primary market and trading in secondary market for GII are open to both Islamic and conventional participants.
Trading Lot and Liquidity	The trading lot in secondary market for GII is RM 10 million, which is about the same as MGS. Trading of GII in the secondary market is pretty active, as several Islamic and conventional Principal Dealers are consistently providing market making service and liquidity.
Mandatory Rating	Government debt securities are exempted from mandatory rating for domestic issuance.
Return payment	Both GII and MGS pay profit/interest to debtholders semi-annually, following Actual/Actual day count basis.
Redemption	Both GII and MGS are redeemed at par on maturity date.
Tax Treatment	Malaysia has no capital gains tax and stamp duty for issuance and transfer of government debt securities. Income tax for resident individuals, unit trust companies and listed closed-end fund companies, as well as withholding tax for non-resident investors, are exempted for interest/profit earnings from ringgit-denominated government debt securities.
Regulatory Treatment	With respect to regulation, GII and MGS are treated quite similarly. For example, both of them have 0% risk weight under the Risk-Weighted Capital Adequacy Framework and the Capital Adequacy Framework for Islamic Banks. Both of them are eligible collateral for Standing Facility. And also, they are excluded from Single Customer Credit Limit.
Legal Status	Both of GII and MGS are direct obligation of the Government. They represent the same certificate of indebtedness or liability of the Government.
Default Protection	There's no difference in terms of investors' protection against default. Legal treatment for non-payment/late payment of the return portion and the principal amount is the same for both Islamic and conventional government debt securities.

Source: GII Information Note 2013, Bank Negara Malaysia, http://iimm.bnm.gov.my/index.php?ch=4;
GII FAQ 2013, Bank Negara Malaysia, http://iimm.bnm.gov.my/index.php?ch=4;
Islamic Interbank Money Market FAQs, BNM, http://iimm.bnm.gov.my/index.php?ch=1&pg=42.