The Impact of Introducing a (Nearly) Redundant Security: Evidence from Malaysian Corporate Bonds

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Abstract

We examine Islamic and conventional bonds in Malaysia with a model that considers clientele effects on redundant securities. Religious investors are restricted to Islamic bonds while other investors could purchase either type, suggesting that firms will only choose to offer Islamic bonds as they have the greatest demand. Contrary to this prediction, we find theoretically that differential liquidity shocks across clienteles may induce a firm to issue conventional bonds even though a large group of investors cannot purchase them. We test our model with corporate bond data from Malaysia during 1997-2017 and find evidence that liquidity shocks affect both the issuance and purchase decisions in Malaysia. As a result, issuance in the conventional bond market continues throughout the sample period despite the increasing popularity of nonconventional debt and the growth of Islamic financial institutions.

JEL Classifications: G12, G15, G20

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What happens to the market for an existing financial instrument when a new, but similar security is introduced? Several researchers have considered theoretically how the introduction of new securities, such as options or mortgage-backed securities, affects welfare, pricing and volatility (Ross, 1976; Allen and Gale, 1988; Detemple, 1990; Detemple and Selden, 1991; Gorton and Pennacchi, 1993; Back, 1993; Elul, 1995; Duffie and Rahi, 1995; Bhamra and Uppal, 2009). Boyle and Wang (2001) emphasize that there are two approaches to the valuation of a new security in an incomplete market: (1) Assume the prices of the existing securities are fixed, set up a replicating portfolio that mimics the cash flows of the new security, and use the existing prices to value the new security; or (2) evaluate the demand and supply of the new security in a general equilibrium framework to determine the market clearing price. Because prices are not fixed in the second approach and a general equilibrium analysis considers the impact on substitutes, the new security may have implications for the price of the existing one (Detemple and Selden, 1991). This is particularly likely when the new security is not in zero net supply, but studies have shown that even the introduction of derivatives seems to have an impact on the price of the underlying securities (Conrad, 1989; Dannhauser, 2017; Cao, Jin, Pearson, and Tang, 2021).

Issuers of redundant securities that are in positive net supply may be motivated to offer them as a method of expanding the set of potential investors (Allen and Gale, 1988). For example, a firm might issue a green bond with all the features of its existing conventional bond if it believes the new security will attract capital from environmentally conscious investors who otherwise would shun its bonds (Gollier and Pouget, 2022). Because it may increase the amount of risk-sharing in the economy, issuing securities to previously untapped investor segments may increase welfare and lower the cost of capital for the firm. By the same logic, countries excluding potential investors from their markets, such as in periods of capital market restrictions in Mexico, Indonesia, and Finland, could improve their citizens' investment outcomes through liberalization (Chari and Henry, 2004; Domowitz, Glen, and Madhavan, 1997; Bailey, Chung, and Kang, 1999). Similarly, the segmentation of municipal bond markets in the U.S. may also limit risk-sharing opportunities and investment outcomes (Babina, Jotikasthira, Lundblad, and Ramadorai, 2021).

We consider the case of a redundant security that expands the set of investment opportunities for a restricted clientele. In particular, we analyze the Malaysian corporate bond market, which changed dramatically after the introduction of Shariah-compliant Islamic corporate bonds in the 1990s. Godlewski, Turk-Ariss, and Weill (2013) state that these Islamic financial instruments "are structured to replicate the cash flows of conventional bonds." Thus, the only sense in which they are not redundant securities is that they fit the requirements of a religious clientele. Because Islam does not approve of interest, many Muslims in Malaysia do not invest in conventional corporate bonds, but they are willing to buy Islamic corporate bonds that have a different method of creating effectively the same cash flows.

While the prospect of lowering debt costs by issuing Islamic bonds may be appealing to many firms, the cost of complying with Islamic principles may be so high as to outweigh the benefits. We describe these costs in the next section and consider how they vary across firms and over time. At the same time, if the relative cost of issuing an Islamic bond is low and demand from the religious clientele is very high, firms may find that they can recoup the costs by offering the Islamic bond at a lower yield spread (i.e., higher price) than the conventional one. In that case, nonreligious investors might shun the redundant bond in favor of the old type and the firm would issue both types of bonds in two segmented markets. In contrast, if the religious clientele is large enough and has sufficiently high demand, firms may decide to only issue Islamic bonds.

Given that corporate bonds are illiquid, investors may also take secondary market conditions into account when deciding whether to buy one or both types of bonds in the primary market. As with most securities, liquidity shocks may motivate some investors to trade them in the secondary market. There are even conditions under which non-religious investors might actually find that the new bond is more desirable than the conventional one because it is traded by a larger group of investors and therefore may be more resilient in the face of liquidity shocks.

In sum, possible equilibria include segmented markets where each type of investor only buys one type of security, full integration of the markets where the non-religious investors own Islamic as well as conventional bonds both in the primary market and secondary market and where firms

issue both types of bonds, or corner solutions where one or both types of bonds are not offered in the primary market by some or all firms. Another possibility is that the non-conventional bonds are not bought by non-religious investors in the primary market but they do trade them later on. We consider these outcomes using a model that incorporates secondary market trading into the issuance decision of the firm.

Using data on Islamic bonds from 1997-2017, we examine the issuance of Islamic and conventional bonds, as well as their pricing, liquidity and ownership. We find that nearly half of the traded bonds in our sample period are Islamic and these bonds are bought by both religious and non-religious investors in the primary market. Conventional bonds ceased to be the most popular security of choice by 2005, but neither do they disappear from the Malaysian market. Only a small number of firms issue both types of bonds in the same calendar year, but these "mixed" issuers continue to rely on both types throughout the sample. Using Islamic banks as a proxy for religious investors, we find that they account for a relatively small fraction of Islamic bond traders, whereas commercial banks and investment banks are the most active traders for both securities. Their purchases of Islamic bonds occur in both the primary and secondary markets.

Consistent with the prediction of our model, we find that the Islamic bonds have a lower yield than their conventional counterparts, holding all other factors equal. If the costs of issuing Islamic bonds are higher, as our data suggest, the firm must receive a higher price for the bonds to find it worthwhile to issue them. Even if there are no cost differentials for the two types of bonds, if the Islamic bonds offer greater protection against liquidity shocks they will sell at a higher price than the conventional ones, which must sell at a discount for non-religious buyers to buy the entire offering. Using data from the Taper Tantrum of 2013 we find evidence that religious investors experience differential liquidity shocks than other investors, supporting our prediction of secondary market effects on primary market participation.

The remainder of this paper is organized as follows. Section I provides a brief summary of the differences between the types of bonds in Malaysia. Section II presents a model of the decision to issue Islamic or conventional bonds in the face of clientele effects and liquidity concerns, and

Section III lays out testable hypotheses related to the model. Section IV describes the data used in the empirical analysis, and Section V presents the empirical results. Section VI concludes.

I. Islamic Finance in Malaysia

Previous research emphasizes that investors' demand for redundant securities often arises because of trading frictions and/or regulations.[1] We focus on the potential of the new security to overcome investment restrictions facing a religious clientele, and the potential for greater risk-sharing as a result. Rahi and Zigrand (2009) also present a theory of redundant securities that highlights restricted access to capital markets by certain clienteles, but in their setting the clienteles remain segregated and only arbitrageurs, who have the power to introduce new securities, can trade both the old and new securities. Similarly, empirical research on clienteles in pre-liberalized emerging market countries (Chari and Henry, 2004; Domowitz, Glen, and Madhavan, 1997) analyzes the effects of binding legal constraints on foreign investors. In contrast, Malaysia imposes no legal restrictions that would prevent religious individuals from purchasing conventional bonds. Instead, the prohibition is personal, reflecting the religiosity of the population. And, there are no restrictions keeping non-religious investors from buying Islamic bonds, if they so desired.

In a setting similar to those of Chen (1995) and Rahi and Zigrand (2009), Duffie and Rahi (1995) remark that most successful financial innovations are the result of exchanges and investment banks looking to sell new products, which they would not pursue if demand were negligible. In contrast, the Islamic bond market in Malaysia developed through the large and persistent efforts of the federal government to make Malaysia into an international Islamic financing center (Asian Development Bank, 2016).[2] Given its origins, the introduction of Islamic bonds in Malaysia may have occurred in the face of initially weak demand rather than as a natural response by profit-

[1] Banerjee and Graveline (2013) and Figlewski and Webb (1993) emphasize the advantages of redundant derivatives vis-a-vis short-selling. Litzenberger and Rolfo (1984) provide evidence that taxes drive differential yields on redundant U.S. Treasury securities, in line with Miller (1986). Back (1993); Massa (2002); Roll, Schwartz, and Subrahmanyam (2010) and Gorton and Pennacchi (1993) highlight the effects of asymmetric information on the demand for new securities.

[2] For example, the central bank's five year plan in 2000 stated that 'Islamic banking ...will be more significant, larger and sizeable.'

maximizing financial institutions. Thus, these securities could eventually have disappeared if government policies had been unsuccessful in growing the market. Alternatively, they may have grown in popularity as Malaysia has promoted these securities, including providing tax breaks for Islamic bond issuance and developing Islamic institutions.[3]

While the government is the major factor driving the growth of the market, there are no rules requiring all government entities to avoid conventional bonds. For example, Nasir, Hassan, and Tijani (2020) point out that the seven government-linked investment companies (GLICs), which collectively own upwards of a third of the publicly traded stocks in Malaysia, are not subject to the Shariah Governance Framework of 2010 that regulates Islamic banks and insurance companies. Five of the seven GLICs are pure investment vehicles and have a fiduciary obligation to their investors and therefore may not be committed to only purchasing Islamic securities. One expects Lembaga Tabung Haji (LTH), however, which exists to help Malaysians save for religious pilgrimages, to embrace Shariah principles wholeheartedly. Likewise. Permodalan Nasional Berhad (PNB), which was set up to increase Bumiputra (native Malaysian) ownership of companies, may also tilt strongly towards Islamic securities, but Kumpulan Wang Persaraan Diperbadankan (KWAP), Lembaga Tabung Angkatan Tentera (LTAT) and Employees Provident Fund (EPF) have weaker mandates. Nonetheless, Nasir, Hassan, and Tijani (2020) show that the EPF has adopted more Shariah governance structures than KWAP and LTAT. The two other GLICs, Khazanah and Ministry of Finance, Inc., are closely aligned with federal government policies, as they are directly owned by the Ministry of Finance.

Given the government's energetic support of Islamic finance and the benefit of a larger pool of potential investors, why don't all Malaysian companies choose to issue Islamic bonds? One possible reason is that Islamic bonds may be less liquid and conventional bond investors prefer the more liquid securities. Indeed, the liquidity of these non-conventional bonds is likely to be lower, all else constant, due to the prohibitions on speculation in Islam. To avoid earning profits through trading, religious investors in Malaysia are even more likely to "buy and hold" their bonds

[3]For example, the Securities Commission set up a dedicated Islamic Capital Market Department in 1995 and created the Shariah Advisory Council in 1996 to provide guidance on financial topics related to Shariah law.

than the typical fixed income investor. Nonetheless, if the religious population finds these securities appealing and government efforts to grow the market are successful, the pool of investors in Islamic bonds may become large enough to overcome differences in liquidity.

Investors will take their future liquidity needs into account when deciding whether to purchase a security in the primary market (Friewald, Hennessy, and Jankowitsch, 2015; Ellul and Pagano, 2006). Oehmke and Zawadowski (2015, 2017) argue that the less expensive of the two trading venues is likely to become the dominant one, suggesting that issuance of the less liquid security could decline. In contrast, Sambalaibat (2022) argues that an illiquid market with high search costs can benefit from the existence of a related one, which can improve the liquidity of both. Gorton and Pennacchi (1993), in their analysis of MBS, show that two markets can co-exist, depending on the extent of informed trading and clientele effects. Chava, Ganduri, and Ornthanalai (2019) point out that the impact on trading may depend on characteristics of the firm, such as its financial health. A large literature on corporate bond liquidity implies that a reduction in liquidity in the conventional bond market would lead to higher yields.[4]

Despite their ability to improve risk-sharing, Islamic debt securities will never be a source of financing for every Malaysian issuer because of the religion's restrictions on the type of business to be financed. Islamic principles oppose not only interest payments and debt, but businesses that rely on them, such as commercial banks. Further, Islam looks unfavorably upon activities that involve degrees of speculation, including casinos, stock trading and insurance. Food and alcohol are also subject to restrictions, with the latter impacting Islamic debt issuance by hotel operators and resorts. The Securities Commission (SC) and its Shariah Advisory Council oversee the issuance of Islamic securities and have shown no inclination to fudge the definition of a Shariah-compliant investment. In fact, the Council began publishing a list in the late 1990s of firms it deemed to be compliant with Shariah law, and excluding firms with substantial business operations in non-permissible industries. Beginning in April 2004, the Council was explicit in stating that a compliant firm could not have gambling, commercial banking or sales of pork account for

[4]See, for example, Driessen (2005); Longstaff, Mithal, and Neis (2005); DeJong and Driessen (2012) and Han and Zhou (2016).

more than 5% of its activities. Some activities, such as tobacco sales, are viewed somewhat less negatively, as the Council set the limit on these to 10%. Other non-permissible activities, such as trading stocks and operating a hotel, were limited to 25%. The Council also provided detailed guidelines on the disposal of investments that no longer met Shariah law, which, if not involving a loss, meant selling them within six months. These rules on compliance were kept in place until 2013, when the government attempted to shift the market towards a more Middle Eastern, and therefore less liberal, interpretation of Islamic principles. The new guidelines moved some activities to the 5% category, eliminated the 10% category and lowered the limit on stock trading, hotel operations and rental income to 20%. In a surprise move, it added two new financial ratio benchmarks that limited cash held in conventional banks and debt to no more than 33% of assets, while at the same time not limiting cash held in Islamic bank accounts and instruments and not limiting debt in the capital structure if it were Islamic. Largely as a result of the financial ratio rules, 158 firms, out of 801, were removed from the November Shariah-compliant list. As a result, LTH and other Islamic-focused funds were forced to sell some large stock positions.[5] These rules remained in place until the end of our sample period.

The choice to issue Islamic debt securities is also affected by the higher fixed costs of non-conventional bonds, which arise because the process of issuing them is complicated (Halim, How, Verhoeven, and Hassan, 2019). Issuance needs to be done with a Shariah advisor and certified as Shariah compliant. It often involves setting up a special purpose vehicle (SPV) to avoid the payment of interest. The security is set up so that the investor receives some of the firm's profits (specified as a percentage of the face value of the security), which means the firm must ring-fence a set of assets that has reliable operating profits. Prior to 2007, Islamic bond issuance also involved a stamp tax on corporate asset sales, but subsequently the government created an exemption in order to increase the appeal of Islamic bonds.

Prior to the start of our sample in 1997, religious investors in Malaysia would have invested in Shariah-compliant Malaysian financial instruments with the help of Bank Islam Malaysia, which

[5]The Edge, December 2,2013, "Islamic funds in a spot? Revised Syariah list excludes 148 firms, includes big cap stocks"

was the only Islamic bank from 1983-1993. To increase competition and grow Islamic financing, Bank Negara Malaysia (BNM) allowed conventional banks to operate "Islamic banking windows" (IBWs) from 1993 onwards. As part of the restructuring of the distressed, state-owned Bumiputra Bank, in 1999 the government combined the Islamic portion of one of the country's leading banks, Commerce-Asset Holding Bhd, with Bumiputra's to form the second Islamic bank, Bank Muamalat Malaysia Bhd. The number of stand-alone Islamic banks remained at two until BNM granted several additional charters in 2005. Thus, from 1993-2005, a large portion of religious investor activity was carried out through IBWs. A complaint about Islamic windows was that it was difficult to prevent mixing Shariah-compliant activities with non-compliant ones, and the windows all but disappeared once the government allowed bank holding companies to set up Islamic subsidiaries.[6] Ariff (2017) describes the Islamic subsidiaries of conventional banks as equivalent to stand-alone Islamic banks in their product offerings and in their clienteles, with the only major difference being that the subsidiaries were more efficient and ended up with more customers. While Islamic bank deposits grew tremendously in popularity from 1983 until the advent of the Islamic window in 1993, by December 1997 the fraction of banking system deposits represented by Islamic bank deposits was still less than 3%. Deregulation allowing Islamic bank subsidiaries and foreign Islamic banks helped propel the share to about 12% by year-end 2005 and largely grew unimpeded to approximately 25% by the end of the sample period.

II. Model

In this section, we present a model of demand for Islamic and conventional bonds that guides the empirical analysis in Section V. The model allows us to consider the circumstances that lead to segmented markets, where each type of firm issues only one type of bond, or to integrated markets where issuers rely on both sources of funding. The model also addresses the issues of the benefits of access to finance, as the amount of investor demand and the cost of issuance determine whether

[6] BNM data on Islamic finance reports that 25 commercial banks offered Islamic deposits in 1998, with the number falling off in subsequent years. While some of the decline reflects the consolidation of the banking system after the 1997-1999 'Asian Flu' crisis, the failure to rebound is consistent with a shift towards the use of subsidiaries.

a project will be financed and its profits. Finally, the model addresses the effects of secondary market liquidity on the decision to issue a bond in the primary market.

Consider a firm that at time 0 seeks to raise a cash amount F to finance a project that pays out a one-time gross return R_2 at time 2. With probability $1-q$, the project generates a return $R_2 = R > 1$, whereas with probability q the project fails ($R_2 = 0$). To raise F, the firm may issue conventional (C) zero-coupon bonds or non-conventional (NC) zero-coupon bonds that target a particular clientele. In our applications, we use the terms "NC bond" and "Islamic bond" interchangeably, and similarly for "C bond" and "non-Islamic bond." The timeline for debt financing is as follows: At time 0, bonds are issued in the primary market. At time 1, investors may trade bonds in the secondary market. At time 2, the debt matures. While bondholders are paid par value when $R_2 = R$, they receive nothing when $R_2 = 0$.

At time 0, the firm decides on the number of bonds of type j to issue, where $j = c$ for C bonds and $j = nc$ for NC bonds. At the same time, it decides on the prices at which it will offer the bonds, $P_{0,j}$, taking into account the known demand functions of potential investors. The cost of issuing a type-j bond includes a fixed origination cost K_j which may be higher for NC bonds than C bonds ($K_{nc} > K_c$), reflecting the fact that compliance with Islamic principles requires the firm to hire a Shariah advisor and possibly to set up a separate subsidiary. NC bond issuance may also incur a variable cost k_{nc}.

Investors fall into one of two categories: Religious (R) and non-religious (NR). R investors are prohibited from holding C bonds, while NR investors face no restrictions on their investment choices. For investor type $\tau \in \{\text{R}, \text{NR}\}$, there are N_τ investors. The variables $h_{i,t,c}$ and $h_{i,t,nc}$ quantify the number of C and NC bonds held by investor i after markets close at date t. Short-selling is prohibited. The average number of type-j bonds held by type-τ investors at time t is $h_{\tau,t,j} = \frac{1}{N_\tau} \sum_{\{i:\tau(i)=\tau\}} h_{\tau,t,j}$.

By issuing $H_j = N_r h_{r,0,j} + N_{nr} h_{nr,0,j}$ units of type-j bonds, the firm raises a cash amount of $F_j = H_j P_{0,j}$. If the total amount raised in the corporate bond market, $F_c + F_{nc}$, falls short of the target F, the firm may raise the shortfall $F - F_c - F_{nc}$ through equity issuance which incurs a fixed

issuance cost K_e. Normalizing interest rates to zero, the firm's time-2 net benefit from investment in the project is computed as the gross return on investment minus the sum of the payments to bond holders and equity owners and origination and maintenance costs:

$$\begin{aligned} W_{f,2} &= FR_2 - H_c \mathbb{1}_{\{R_2=R\}} - H_{nc}\left(\mathbb{1}_{\{R_2=R\}} + k_{nc}\right) - \max(0, F - F_c - F_{nc})R_2 \\ &\quad - K_c \mathbb{1}_{\{H_c>0\}} - K_{nc}\mathbb{1}_{\{H_{nc}>0\}} - K_e \mathbb{1}_{\{F_c+F_{nc}<F\}}. \end{aligned} \tag{1}$$

Bond investors take positions in the primary market, and may adjust these positions in the secondary market in response to new information. This new information arises in form of a cost of carry $y_{\tau,1}$ that is realized just prior to time 1, as illustrated in Figure 1. The cost of carry measures investors' capital commitment costs, that is, the net benefits of outside opportunities that investors forego by holding the firm's bonds to maturity. It can vary between different types of investors, due to differing access to alternative investment opportunities or differing liquidity requirements. For instance, NR investors might discover new non-Shariah-compliant investment opportunities just before time 1, raising their cost of carry. However, this would not affect R investors due to their restricted investment options. Or, R investors might face unexpected cash needs related to activities to maintain Shariah compliance.

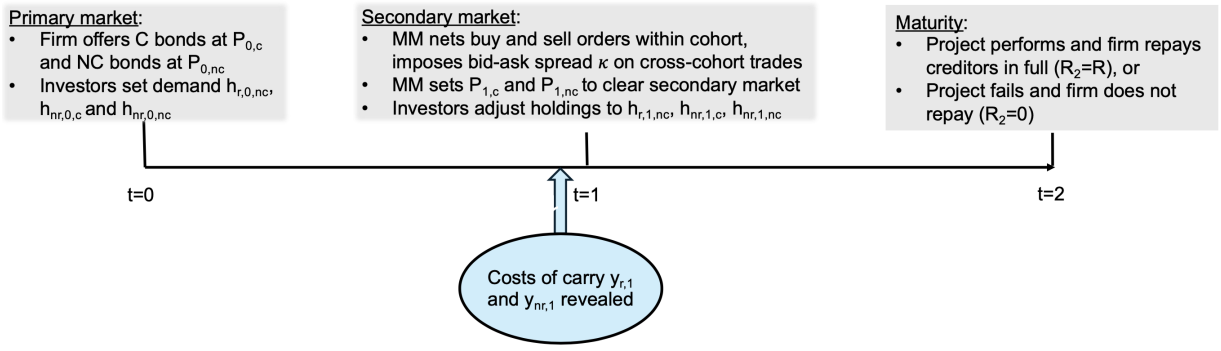

Figure 1: Timeline for bond issuance, trading and maturity

We consider a market structure where R investors' trades are facilitated by an "R bank" and NR investors' trades are facilitated by an "NR bank." These banks buy $h_{\tau,0,j}$ type-j bonds for each of their clients in the primary market, and $h_{\tau,1,j} - h_{\tau,0,j}$ bonds in the secondary market. Secondary

market trading is facilitated by a broker who charges a proportional fee κ to sell bonds on behalf to of a type of investors and sets prices $P_{1,c}$ and $P_{1,nc}$ to clear the secondary market. Type-τ investor's wealth at time 2 is computed as

$$\begin{aligned} W_{\tau,2} &= \sum_{j\in\{c,nc\}} \left(\mathbb{1}_{\{R_2=R\}} - P_{0,j} - y_{\tau,1}\right) h_{\tau,0,j} \\ &\quad + \sum_{j\in\{c,nc\}} \left(\mathbb{1}_{\{R_2=R\}} - P_{1,j} + \kappa \mathbb{1}_{\{h_{\tau,1,j}<h_{\tau,0,j}\}} - y_{\tau,1}\right) (h_{\tau,1,j} - h_{\tau,0,j}), \end{aligned} \tag{2}$$

with the restriction $h_{r,t,c} = 0$ for R investors.

Using $\mathbb{E}_t(W_2)$ and $\mathbb{V}_t(W_2)$ to denote the mean and variance of W_2 conditional on time-t information, agents' time-1 utility from time-2 wealth is

$$U_{1,A}(W_2) = \mathbb{E}_1(W_2) - \frac{1}{2} A \mathbb{V}_1(W_2), \tag{3}$$

for some agent-specific risk aversion parameter A. We take the firm to be risk-neutral, and set A to A_r for R investors and to A_{nr} for NR investors.

II.1. Equilibrium

We solve for a Nash equilibrium defined as follows:

Definition. *An equilibrium is such that*

1. *The issuer prices the bonds to maximize expected utility or, since the issuer is risk-neutral, expected future wealth $E_0(W_{f,2})$.*

2. *Given $P_{0,c}$ and $P_{0,nc}$, the type-τ bank chooses the amount $h_{\tau,0,j}$ of type-j bonds that each type-τ investor will buy in the primary market by maximizing expected utility $\mathbb{E}_0(U_{1,A_\tau}(W_{\tau,2}))$.*

3. *Given time-1 information, the broker quotes prices $P_{1,c}$ and $P_{1,nc}$ that clear the secondary market.*

4. *Given time-1 information and* $(P_{1,c}, P_{1,nc})$*, the type-*τ *bank adjusts the positions of its clients to optimize their utility* $U_{1,A_\tau}(W_{\tau,2})$.

5. *Each agent makes decisions consistent with the equilibrium strategies of all other agents.*

II.2. Equilibrium Outcomes

Solutions to the model are derived in Appendices A–C. We consider three possible outcomes in turn: (1) the firm only issues conventional bonds, which are purchased in full by NR investors; (2) only Islamic bonds are issued and these may or may not be purchased by both types of investors; and (3) the firm chooses to issue both C and NC bonds, which may be sold separately to the two groups (segmented markets) or which may result in some NC bonds being purchased by NR investors. Case (1) where only C bonds are issued describes the market in Malaysia prior to the existence of Islamic bonds. After the introduction of Islamic bonds, given the large fraction of R investors in Malaysia, cases (2) and (3) became a more likely outcome.

II.2.a. Only conventional bonds are issued

To find the equilibrium price and quantity of the C bonds in the primary market, we first consider how much NR investors are willing to pay for the bond in the secondary market. At time 1, the bond price depends on the size of the shock, which determines the amount and direction of desired trading. In Appendix Equation (A.3), we categorize the size of the liquidity shock, $y_{nr,1}$, into four regions. If it is very small the NR investors would like to buy more of the C bonds. That is, if $y_{nr,1} < 1 - q - P_{1,c} - A_{nr}q(1-q)h_{nr,0,c}$ then the quantity demanded at time 1 will be greater than the amount bought at time 0. This reflects the fact that, at the time of the secondary market purchases and sales, the cost of carry is known and therefore no longer poses a risk that requires a compensating premium. A second possible outcome at time 1 is that the shock is not small, but neither is it very large. In this case, the NR investors would not sell any of their primary market holdings but neither would they want to buy more. A third case involves a larger shock that engenders selling to the broker. In the extreme, a very large shock makes the NR investors wish to

sell all of their bonds. This fourth case arises when the shock is large enough to cover both the fair value of the investment (the risk neutral return) and the trading costs: $y_{nr,1} > 1 - q - P_{1,c} + \kappa$.

The broker responds to each of the four categories of liquidity shocks by setting the secondary market price such that the market clears without him holding any bonds. For each possible value of the cost of carry there is a unique price, as given in (A.4), that clears the market, leaving the holdings of the NR investors as a group unchanged between time 0 and time 1. This does not mean that no one trades, but that all trading is done between one NR investor and another, with the broker simply providing the price that will clear the market.

The model assumes full information, which means the NR investors incorporate the potential price effects of these four possible types of shocks into their purchase decisions (A.5) at time 0. The firm takes their demand curve into account before deciding how many bonds to issue.[7]

When deciding between issuing bonds, relying partially on equity, or foregoing the investment opportunity, the firm considers the issuance costs of debt and equity. As shown in Equations (A.8)–(A.13), the firm prefers debt financing when bond issuance costs are low, especially relative to equity issuance costs. If issuance costs are high for both financing options, the firm may forgo the investment. Otherwise, it opts for a mix of equity and debt. When bonds are issued, their price tends to be higher if there are more investors or if the expected cost of carry is lower. Appendix A provides the solution in detail.[8]

[7]This result is similar to that on IPO underpricing in Ellul and Pagano (2006), where aftermarket illiquidity and the potential for misvaluation of the firm's value leads to a discount at the time of the IPO. Future trading conditions also affect primary market issuance in Friewald, Hennessy, and Jankowitsch (2015). In both models, secondary market trades can cause losses because of the existence of an informed trader. There are no informed traders in our setting. Rather, the compensation for future liquidity shocks arises from the risk of decreased wealth when a large number of sales causes downward price pressure.

[8]The derivation in the appendix assumes that only C bonds are issued. It does not aim to explain how such a "C-bonds only" equilibrium may arise when both types of bonds are available. Intuitively, the latter could occur because there are no R investors or so few that it is not worth covering the fixed costs of issuing NC bonds. Similarly, a very high fixed cost of issuing NC bonds would lead to the same outcome, even if there were many R investors. Another possible explanation for this equilibrium is that R investors are more risk averse than the NR investors, demanding a high discount for NC bonds.

II.2.b. Only Islamic bonds are issued

The details of this equilibrium are presented in Appendix B. Here, the primary market demand curve depends on the mix of NR and R investors and their expected future trading. If the two groups have the same degree of risk aversion, which we typically assume, their NC demand curves will have the same shape. This causes the aggregate amount purchased at issuance by each group to be approximately in proportion to their representation in the population. How much their holdings at time 0 deviate from their "fair share" depends on their future trading, which depends on their respective costs of carry. While we assume in our base case numerical solutions that the expected shock is the same for both types of investors, the actual value of the respective shocks determines the time 1 bond price. If either group has a small shock they would each like to add bonds to their portfolios, but given that the number of bonds is fixed prior to the realization of the shock, they cannot both buy more bonds. Thus, whether one group buys more bonds or not depends on the relative sizes of the cost of carry outcomes. These trades involve the broker's bid-ask spread, κ, which may dampen investor demand in the primary market.

If the R investors' shock is much higher than the NR investors' and there are not many NR investors, there will be considerable downward pressure on the bond price at time 1. This reflects the fact that many people want to sell their holdings and there are few buyers. In this case, the broker will set the price very low and the NR investors will be induced to buy quite a bit from the R investors. In the extreme case, the R investors will sell all of their holdings down to zero, whereas case 2 leaves them with a positive amount of Islamic debt. If the two shocks are similar, the portfolios in period 1 will be unchanged from period 0 in the aggregate. A fourth case has the NR investors suffering a bad shock compared to the R investors', engendering purchases by the R investors. In the extreme fifth case, the NR investors will sell all of their NC bonds to the R investors and, if they are the majority of investors, it will be at a very low price. Because the amount of selling in the secondary market depends on the relative sizes of the liquidity shocks and the number of investors of each type, it is not possible to determine the demand schedule for the bond in the primary market from the secondary market price schedule.

Nonetheless, as in the case of the conventional-only bond issuance, the fact that the cost of carry shock may be severe causes investors to discount the bond more than if there were no liquidity shocks. In this equilibrium, where there is one type of bond and two types of investors, the discounting is not as extreme as when there are only conventional bonds and only NR investors. This results because there is another set of investors with uncorrelated liquidity shocks that offer some protection from mass selling pressures. Because they are available to buy the bonds when your personal cost of carry is unusually high. they have a dampening effect on the risk premium you require for holding risky assets. This effect raises the price of the bond in the primary market.

Another difference compared to the conventional market only case is that investors now have a choice of buying the bonds later in the secondary market rather than in the primary market. The incentive to wait to purchase the bonds is increased by the fact that a large liquidity shock suffered by the 'other guys' means you can buy the bonds at a steep discount.[9] Knowing that you may be able to buy the bond at a lower price in the secondary market if the other investors are forced to sell their bonds means you are less inclined to buy them in the primary market, putting downward pressure on the primary market price. While this may offset the improved price from having a second set of investors who are potential buyers, it is unlikely to completely offset the benefit. With risk aversion, the potential loss from selling in period 1 matters more to an investor's utility than the potential gain from buying bonds at a bargain price, leaving the net effect on the primary market price still higher than in Section II.2.a. This illustrates the benefit of greater risk-sharing to the firm: not only does the demand curve shift out by dint of having more investors overall, but the price the firm obtains for an NC bond is higher than if the investor set were simply increased with more NR investors.

[9]The discount is steep relative to the price that would occur in the case in Section II.2.a with the same size shock. It might not be at a discount to the primary market price here because the risk premium for liquidity shocks disappears in time 1 (when both shock values are known). In a model with more periods and thus with continued risk of forced selling the price might be lower than the primary market price as well.

II.2.c. Both Islamic and conventional bonds are issued

Given the greater risk-sharing of having both types of investors participate in the firm's bond offering, the equilibrium in Section II.2.b appears to offer the highest welfare for the economy, raising the question of why a firm would offer both types of bonds. Since everyone can buy NC bonds, offering C bonds to NR investors when they would be as happy with NC bonds seems like a poor decision for the firm, especially if both types of bonds have positive fixed costs. The details of the solution to this case are found in Appendix C.

As in the previous sections, the demand for either type of bond in the primary market depends on its expected future pricing in period 1, which is a function of trading conditions. For the C bond, the demand curve is relatively straightforward as only NR investors affect its price in period 1. We note that the price of the C bond at that time depends not only on the liquidity shock of the NR investors, but on the number of bonds the NR investors hold in total in their portfolios, not on the amount of C bonds in the portfolio. Given that the two bonds have identical value to NR investors at time 1 (when the expected value to them only reflects the probability of default and the risk premium associated with it), the marginal benefit of buying one more C bond in the secondary market is the same as the marginal value of buying another NC bond.

As in Section II.2.b, the secondary market price of the NC bond is a function of the relative costs of carry, and once again there are five ranges of relative shocks that describe the NC bond price. If the NR shock is very low relative to the R investors' shock, the NR investors will desire to buy more NC bonds. However, now the cutoff for the top of this range does not just depend on risk aversion and the fraction of NR investors, but how many C bonds they have already bought. The more C bonds the NR investors buy in the primary market, the more likely they are to sell all of the NC bonds when theirs is the higher of the two groups' liquidity shocks. Likewise, when theirs is the smaller of the shocks, having bought C bonds in the primary market means the NR investors are more likely than in Section II.2.b to buy all of the R investors' NC bonds. Given that the two bonds have identical value to NR investors at time 1, the NR investors will prefer to buy the cheaper of the two bonds. If their shock is large, the C bonds will be very cheap and they will

not want to buy the NC bonds. If their shock is small, in relative terms, they will view the NC bonds as the cheaper of the two and will be more inclined to buy them compared to the case where only Islamic bonds are issued.

NR investors are better off if the firm offers both types of bonds because the liquidity shocks differ between the two groups. If the NR group shock is worse than the R group's and the NR group only owns C bonds, the price of the C bond will fall more from liquidity-induced selling compared to the NC bond. Thus, NR bond investors will want to own some NC bonds in the primary market so that they can hedge liquidity shocks. If the NR group has the larger shock, the NR investors will sell their NC bonds. If theirs is the less severe shock, the NR investors will meet their liquidity needs with sales in the C bond market. Because they benefit from a diversified bond portfolio, NR investors are willing to pay a bit more to own both NC and C bonds. This drives up the price of the NC bond, but only if the firm offers both types of bonds. If neither type of bond has a fixed cost, the firm will be better off issuing both types. In this case, it would not receive as high a price on the C bonds as the NC bonds, but the overall pricing will be more favorable to the firm than if it just issued NC bonds.

Even in the absence of liquidity shocks, the firm would want to issue both types of bonds (assuming no fixed costs). This is because the only difference between the investors is willingness to buy C bonds. If only NC bonds are offered, the demand curve is simply the sum of the two demand group's demand curves. If there are large numbers of both types of investors, the firm may find that it raises capital most cheaply by offering both types of bonds. By having a second market for what is essentially the same security as the Islamic bond, the firm is able to move up the demand curve in the Islamic market and obtain a higher price among those investors. That is, the firm's optimal issuance decision involves third-degree price discrimination. The NR investors pay a lower price for the same credit-risky instrument, which allows the firm to charge a higher price to its R clientele.

III. Hypothesis Development

While the benefit to the firm of having a broader set of investors by issuing NC bonds is substantial, the previous discussion indicates that it may not be so high as to squeeze out all C bond issuance. Whether firms choose to only issue NC bonds when the proportion of R investors is high depends on the values of the other model parameters. Next, we present results on the two types of bonds while making reasonable assumptions about the values of these parameters. In particular, we assume: the probability of default is 1%, which is similar to the long-term average reported by the two Malaysian rating agencies; the return on the project, if it succeeds, is set to 20%; the cost of carry is assumed to average .005 for both populations; and the risk aversion parameter, A_τ, is set to one for both R and NR investors. The bid-ask spread, represented by κ, is set to 1%. The firm must raise \$100 in order to undertake the project, which is supplied by 100 investors. While equity issuance is possible, we set the cost of equity issuance K_e to be sufficiently high that the firm always chooses to raise all of the necessary financing through the bond market. Lastly, we show outcomes where both sets of investors suffer a liquidity shock with an expected value of .01.

We first consider the possible outcomes when the cost of issuing a bond is zero ($K_c = K_{nc} = 0$). Under these parameters, the greater the population of R investors, the more the firm will raise its required funds in the form of NC bonds. Figure 2 shows that the firm will issue almost equal amounts of each type of bond when the ratio of R to NR investors is one. The fact that the dotted and solid lines cross slightly to the right of the line marked '1', and that the solid line lies above the dotted line everywhere to the left of the intersection, indicates that NC bonds provide the larger part of the financing. This is as expected, given that all investors can buy both types of bonds and only NR investors can buy C bonds. With this intuition, it is not surprising either that the number of NC bonds exceeds the number of C bonds.[10] While it is not surprising that a firm will issue more Islamic bonds than conventional ones, all else equal, it is somewhat surprising that they do not issue more of them. Yet, the fraction of NC bonds is scarcely above half when the two groups

[10] We assumed for the sake of simplicity that the face value of a bond is \$1, which means that its price will be less than one dollar given the default risk. Therefore, to raise \$100 of funding a firm must issue more than 100 bonds.

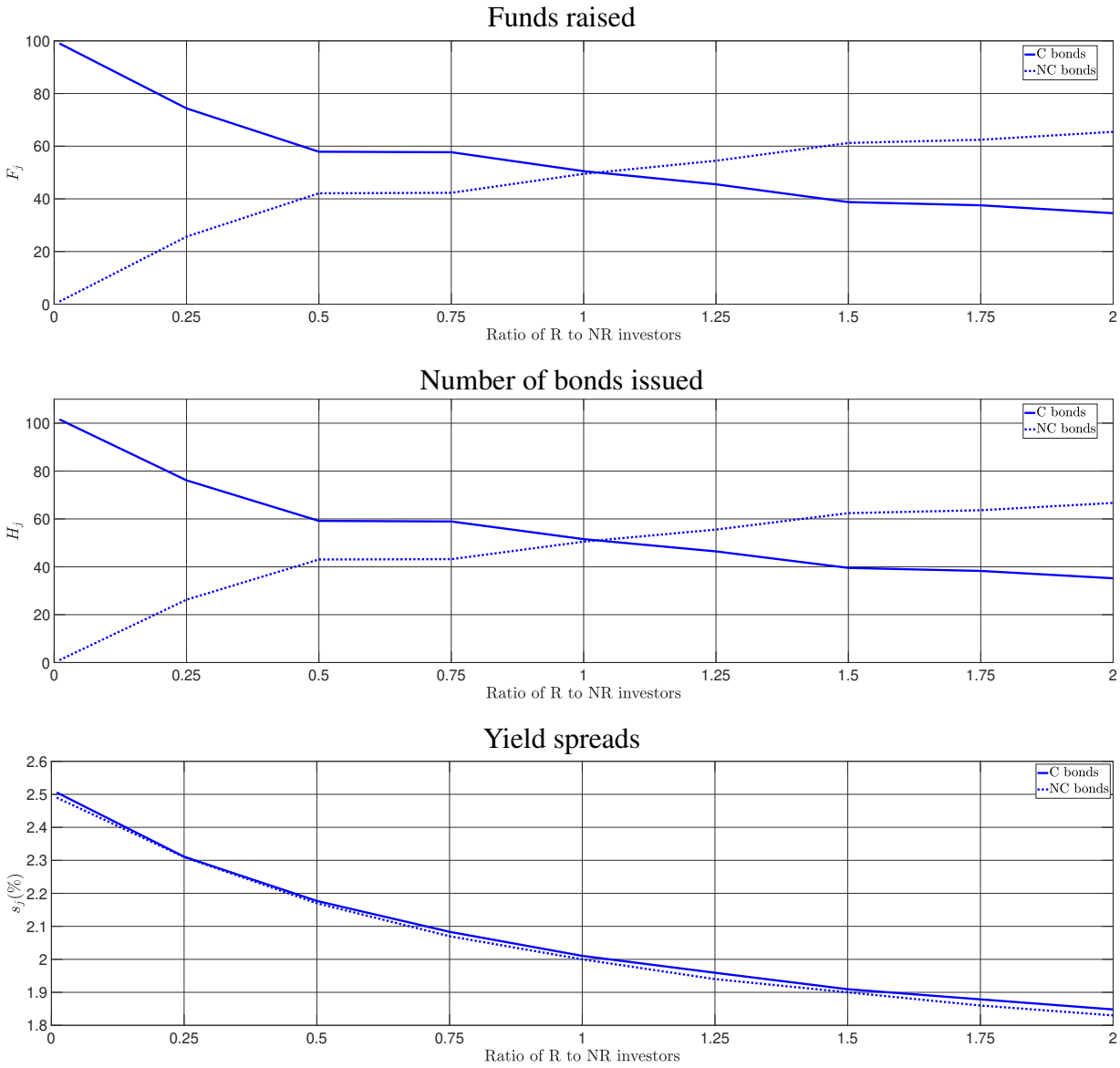

Figure 2: Primary bond market outcomes—Number of R investors

The figure shows the dollar amount, notional and price of funds raised in conventional and non-conventional bond markets. The remaining model parameters are as follows: $A_r = A_{nr} = 1$, $N_{nr} = 100$, $y_\tau \in \{0, 0.01\}$ with $\mathbb{E}(y_\tau) = 0.005$, and $\kappa = 0.01$.

are equal in size. And, the fraction of C bonds does not approach zero very quickly as the ratio of NR to R rises.

This result arises from the third-degree price discrimination. The fact that both investor types have identical downward-sloping demand curves means the firm would have to accept a low price for all of its bonds if it issued only NC bonds, whereas by offering some C bonds, the firm is able to reduce the amount needed to sell in the NC market and move up the aggregate demand curve

there. However, since the bonds are redundant, NR investors will be indifferent between the two bonds if they are offered at identical prices, which means that the company cannot sell as many C bonds as it would like to raise the price in the NC market. Therefore, to ensure that its optimal number of C bonds are bought in its entirety by the NR investors, the firm must lower the price. The lowest panel of Figure 2 shows that the price of the NC bond will be higher and its yield lower. It does not require much of a price break to entice the NR investors to buy the C bonds, given these preferences, so that the yield differentials are sometimes barely perceptible.

Whether the firm pursues this strategy depends on the relative size of the clienteles and the expected size of a liquidity shock. If there is high potential for Islamic bonds to provide protection against liquidity shocks the NR investors may be very keen to own them. In this case, the firm would have to offer the C bonds at a very low price, which may be too low for price discrimination to lead to higher overall proceeds. For certain parameter values of risk aversion and liquidity shocks, if R investors represent the vast majority of the population, conventional bond issuance may be squeezed out so much that the C bond market ceases to exist. For the set of parameters associated with Figure 2 this only happens when the R population approaches 100%.

Hypothesis 1. *Given issuance costs, clientele characteristics and liquidity factors, issuers may prefer to issue both types of bonds at the same time.*

Non-religious investors view the two bonds as perfect substitutes, especially when the bonds are issued by the same firm. If a "Mixed issuer" issues both bonds at the same time at the same price, the religious investors will shun the conventional bond, leaving the entire issue to be absorbed by the non-religious investors. If there are no other considerations, the non-religious investors might buy the entire offering but they might instead buy some Islamic bonds. To ensure that the conventional bonds are bought in full, the firm will offer them at a slightly lower price than the Islamic bonds.

Hypothesis 2. *"Mixed issuers" set prices lower for C bonds than NC bonds.*

In the equilibrium where the firm issues both types of bonds, the lower price of the C bonds

will make them more attractive to NR investors. If no offsetting factors make NR investors desire the NC bonds, the entire offering of Islamic bonds will be sold to the R investors. Looking at the far right side of the graph showing proceeds (Panel A of Figure 2), the ratio of R investors to NR investors is 2 and two thirds of the funds raised is through NC bonds. This implies that NR investors provide one third of the funding in the form of C bonds and the remaining two thirds comes from R investors, who are two-thirds of the population. Thus, although issuance is not segmented, the two markets are segmented across investors, with each group buying just one type of bond. Despite the fact that everyone can buy the Islamic bonds, not everyone does. This owes to the fact that the bonds are redundant in the eyes of the NR investors, who view the price as the only difference.

III.1. Cost of issuance

Next, we consider the issuance choice of the firm when the two bonds differ in their costs. A major consideration for the firm in choosing the mix of bonds to issue is the cost of creating them. We argue that, all else equal, Islamic bonds are more expensive to create. For certain businesses, such as stand-alone commercial banks, the cost of becoming Shariah-compliant is infinite. In equilibrium, the firm will only find it optimal to issue the more costly security if it can recoup the costs through a higher price.

Hypothesis 3. *High relative fixed costs of issuing NC bonds tilts the firm's funding choice away from NC bonds.*

If the issuance cost of an Islamic bond is very high, the firm would only issue C bonds and ignore the set of investors who cannot buy them. The interesting case arises when the NC bond is more costly to create but there are many R investors who would buy them. In this case, the firm still needs to recoup the cost of issuance of the more expensive Islamic bonds, but it might find that the demand for the bonds is so great that it can easily sell them at a price that covers the added costs. We assume that the prices of the bonds in the primary market are high enough to cover the fixed costs. Otherwise, the bonds would not be offered.

III.2. Expected cost of carry

If the firm finds it optimal to issue both types of bonds, with the C bonds being offered more cheaply than the NC bonds, NR investors will avoid buying the Islamic bonds. We next consider the circumstances that would lead NR investors to buy the more expensive NC bonds. The model shows that this outcome can occur if the yield differential between Islamic and conventional bonds is small, and NR investors see a substantial benefit to NC bonds related to future trading conditions. We model future trading conditions by introducing a cost of carry shock that differs between the two sets of investors. While the cost of carry can have the same expected value for each group, the assumption that the two shocks are uncorrelated leads to a potential hedging benefit for the NR investors. If either type of investors experiences a liquidity shock that induces selling at a loss, an investor will benefit from having many other investors who might buy. The potential set of investors is always greater in the NC market because it is open to both NR and R investors, while the C bond market has a limited set of buyers. From the perspective of NR investors, the higher the fraction of R investors, the more appealing the NC bonds are at issuance and they may be high enough to offset the higher bond price that arises from higher issuance costs.

If there are no costs of carry, and therefore no secondary market trading in the model, the NR investors will not be willing to pay the higher cost of the NC bond, and the two markets will each have a homogenous set of investors. If the cost of carry is very high on average, even if it is expected to be the same for both groups, the benefits of holding two types of bonds increases for the NR investors. Therefore, they will be willing to bear a higher cost of NC bonds and the firm's optimal offering mix will tilt towards NC bonds. In Figure 3, we show the effects of the expected costs of carry on the firm's issuance decision. The higher the effects of secondary market liquidity, the more NC bonds are issued by the firm. While we do not expect the average cost of carry to differ between the two groups, we do assume they are not identical and are a source of differential secondary market prices. The more correlated the liquidity shocks, the smaller the impact of secondary market trading on the issuance decision.

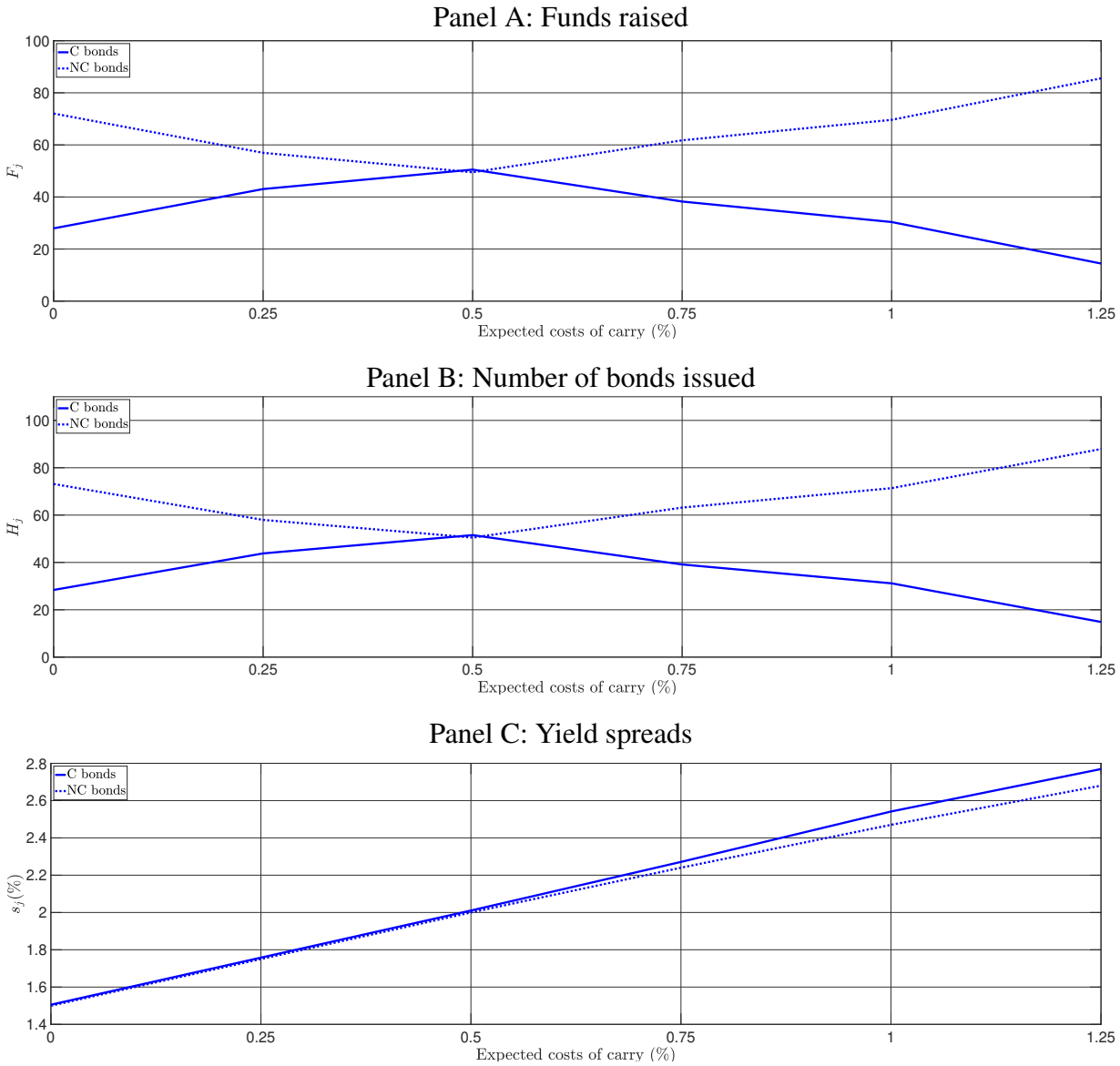

Figure 3: Primary bond market outcomes—Expected costs of carry

The figure shows the dollar amount, notional and price of funds raised in conventional and non-conventional bond markets. The remaining model parameters are as follows: $A_r = A_{nr} = 1$, $N_r = N_{nr} = 100$, and $\kappa = 0.01$.

Hypothesis 4. *NR investors may buy both types of bonds from a mixed issuer if the benefits from greater secondary market liquidity offset the lower yield of the NC bond in the primary market.*

III.3. Investor risk aversion

The firm's choice to issue both types of bonds in equilibrium reflects that fact that both bonds' demand curves are downward-sloping. Thus far, we have only considered the case where each

investor exhibits the same degree of risk aversion, resulting in demand curves for the two types of bonds that are identical. Here we consider the firm's issuance choice when one set of investors is more risk averse than the other. Figure 4 plots the ratio of R investors' risk aversion to the risk aversion of NR investors on the horizontal axis. The more risk averse the R group, the fewer Islamic bonds are issued. This reflects the greater discount to fair value that R investors would place on the cash flows. Assuming higher fixed costs of issuance for NC bonds, the mix would tilt even further away from NC bonds. The results on risk aversion are not symmetric because the lower demand from R investors is somewhat diluted by the potential demand from NR investors for NC bonds. In contrast, if the demand for C bonds drops from risk aversion, no other group would step in to buy the bonds. We do not believe the Islamic and non-religious investors differ on average in Malaysia, although it is possible that the former group includes more retail investors (who are more risk averse) and the latter more institutional ones.

III.4. Trading costs

Lastly, we consider the impact of the bid-ask spread on issuance. If the firm issues both types of bonds, the NR investors will only pay the higher price associated with Islamic bonds if the secondary market liquidity benefits are high. The magnitude of these benefits depends on the downward price pressure when a liquidity shock hits. The higher the bid-ask spread, the less likely an investor will find it worthwhile to trade in the secondary market. In the most extreme case where the bid-ask spread is so high that no one trades, liquidity shocks fully eat into the profitability of a bond investment. Thus, higher trading costs reduce the appeal of NC bonds to NR investors and understanding their demand, the firm will use more C bonds (Figure 5).

III.5. Model Summary

The ability to issue NC bonds to a new group of investors (the R group) allows the firm greater flexibility in its debt financing. We have shown that if the costs of issuance are not too great for NC bonds and the R group is large enough, Islamic bonds will be issued in equilibrium. Whether

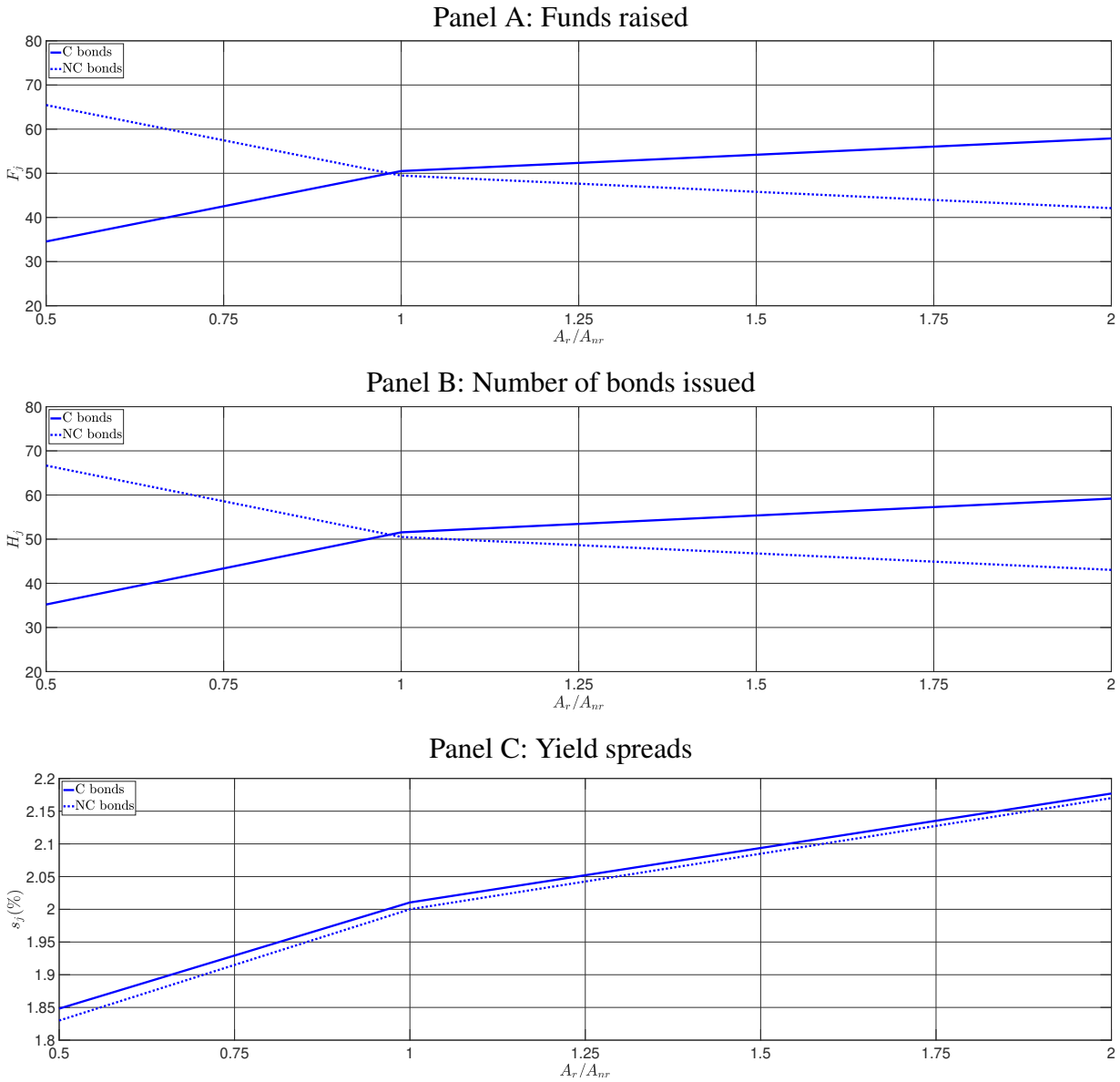

Figure 4: Primary bond market outcomes—Investor risk aversion

The figure shows the dollar amount, notional and price of funds raised in conventional and non-conventional bond markets. The remaining model parameters are as follows: $A_{nr} = 1$, $N_r = N_{nr} = 100$, $y_\tau \in \{0, 0.01\}$ with $\mathbb{E}(y_\tau) = 0.005$, and $\kappa = 0.01$.

they are issued together with conventional bonds by the same firm at the same time depends on the issuance costs, the effects of secondary market liquidity and the number of religious investors. Regardless of the mix of bonds, the fact that the firm now has access to a wider set of investors means that it retains a higher portion of the investment payoff then if it were restricted to raising funds only through conventional bonds or a combination of C bonds and external equity. Thus, the

firm would be more likely to take on a given investment project and expand its assets.

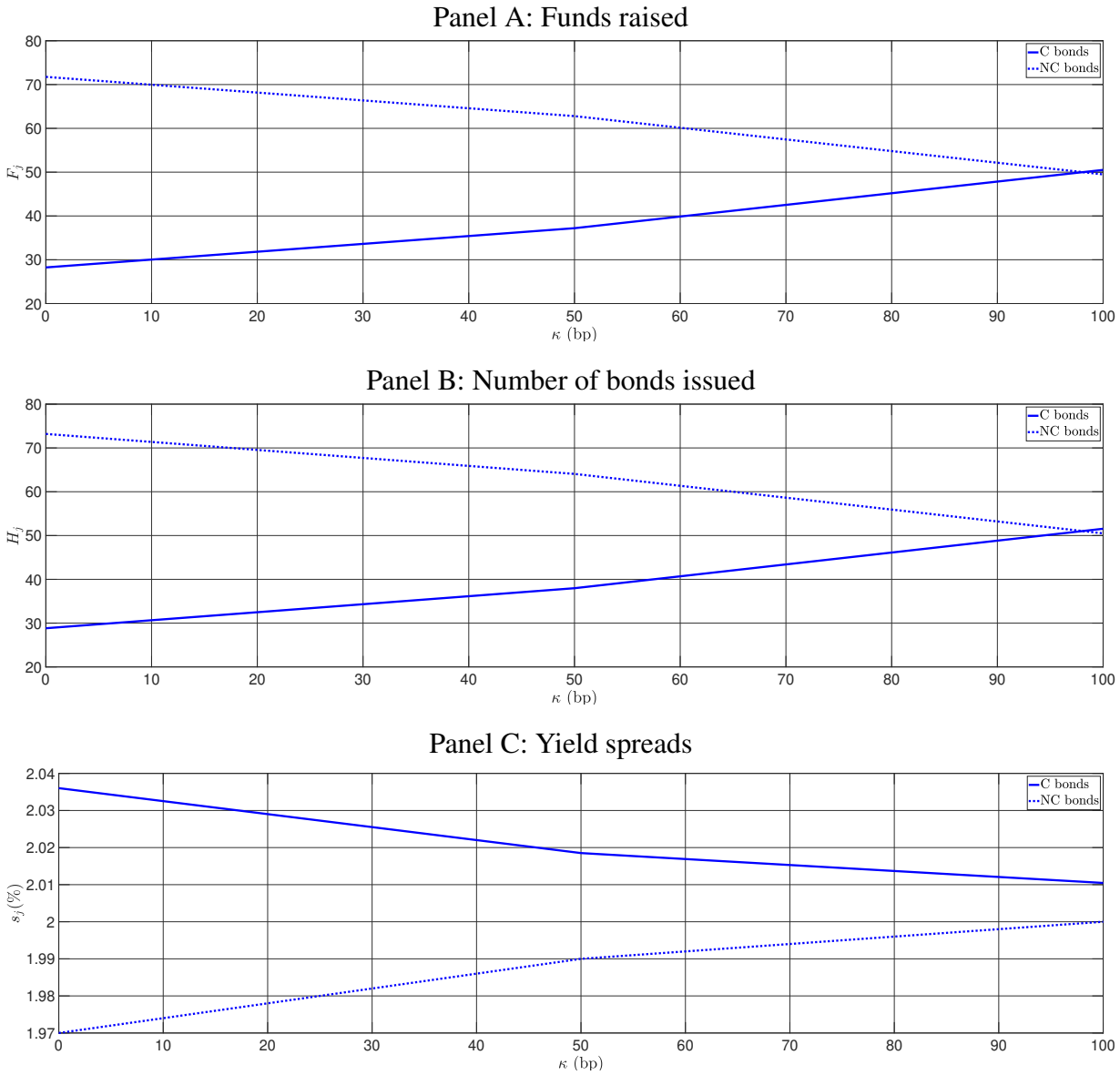

Figure 5: Primary bond market outcomes—Trading costs

The figure shows the dollar amount, notional and price of funds raised in conventional and non-conventional bond markets. The remaining model parameters are as follows: $A_r = A_{nr} = 1$, $N_r = N_{nr} = 100$, and $y_\tau \in \{0, 0.01\}$ with $\mathbb{E}(y_\tau) = 0.005$.

III.6. Empirical Approach

In the remainder of the section we discuss our approach to testing the predictions of the model with data on Malaysian corporate bonds. Our data include information on the types of investors,

allowing us to separate religious investors from non-religious ones. While we cannot observe the cost of issuance for either type of bond, substantial independent evidence points to variation in costs across time and industry that we exploit in our empirical analysis. Transaction data allows us to examine pricing and liquidity differences in the two markets.

To test Hypothesis 1, which simply posits that there do exist conditions under which some issuers will wish to issue both conventional and Islamic bonds at the same time ('simultaneous mixed issuance'), we examine issuance patterns over time and across industries. If markets are segmented, issuers will only issue one type of bond at any point in time and will never issue both types of bonds in the same year. We find support for the hypothesis if we find a persistent presence of simultaneous mixed issuance.

To test Hypothesis 2, which posits that mixed issuers will issue conventional bonds at cheaper prices (higher yields) than Islamic bonds, we examine primary market data on the yield spreads of Islamic and conventional bonds. To ensure that the spreads reflect differences in yields that occur because of price discrimination, we restrict the sample to bonds of mixed issuers that are issued during the same calendar month (simultaneous issues of mixed issuers). To control for differences in yields due to the slope of the credit yield curve, the spread differentials are calculated for a set of the issuer's bonds that all have a similar maturity. If the bonds differ in rating due to bank guarantees or subordination, these features are also controlled for when finding pairs of Islamic and conventional bonds. In this test, we ignore price data from the secondary market (i.e., trades that occur more than a month after the issuance date) because they may be affected by price pressures related to cost of carry shocks.

To test Hypothesis 3, that high fixed costs of issuing non-conventional bonds diminish the likelihood of non-conventional issuance, we create an indicator variable for firms that are likely to have high costs of issuing nonconventional bonds. These include firms in industries related to finance, hospitality, alcohol and tobacco. Within these categories, we make exceptions for firms that are Islamic banks and those that are related to the Malaysian federal government, which has been a

champion of Islamic finance throughout our sample period.[11] We also set the high cost indictor variable to one for foreign firms, which we assume are less familiar with the Shariah compliance rules in Malaysia. If the hypothesis is true, the high costs indicator should be significantly related to the likelihood of issuing an Islamic bond.

Time variation in the costs of issuing Islamic bonds can also be exploited. Namely, we can also examine issuance before and after the November 2013 revision of the compliance rules. This event increased the cost of issuing Islamic bonds for firms that were close to the 33% cutoff in terms of leverage. We examine firms that were removed from the list to determine if high debt levels were a significant factor in removing the firm. If so, we conclude that one of the additional costs of issuing Islamic debt after 2013 is a degree of inflexibility related to the firm's capital structure choices.

To test Hypothesis 4, we investigate the ownership patterns of the two types of bonds in the primary market. Although our dataset is a trading one, we proxy for primary market activity by examining trades in the month of issuance. If the potential liquidity benefits of Islamic bonds are high enough, the NR investors will buy them in the primary market. Alternatively, if the benefits of liquidity are too low the NR investors will only buy the bonds in the secondary market and in those cases when the prices are lower than average.

A priori we expect the Islamic market to be less liquid, at least early in the sample period, because there are few bonds issued. Also, the Islamic banks do less financing than conventional banks and are more likely to invest their deposits in bonds (government and corporate). Given that most deposits stay with the bank, Islamic banks would have little incentive to trade, even if trading were viewed more favorably in the Islam religion. Actual trading conditions might be worse for Islamic bonds on average and still provide a hedge against liquidity shocks for NR investors if they are not too much worse and the two groups' shocks are uncorrelated. Thus, another test related to Hypothesis 4 is to examine differences in liquidity in the two markets. If the liquidity of Islamic bonds is very poor, the benefits to NR investors of buying both types of bonds are likely to be too

[11] We also except those that are related to the Malaysian state governments.

small.

The benefits to NR investors of owning NC bonds are greatest when liquidity shocks to the two groups of investors are uncorrelated. We investigate this element of the model by examining trading in unusual periods. Chari, Dilts Stedman, and Lundblad (2020) find that the unwinding of unconventional monetary policy had significant spillover effects on emerging market assets, with particularly strong effects during the Taper Tantrum period of May 2013 to December 2013. We investigate trading by Islamic banks and by non-religious investors during this episode to determine the extent to which the two group's trading patterns differ.

IV. Data

Our main source of data is transaction-level trades of bonds reported in the Bursa Malaysia's Electronic Trading Platform (ETP), which includes data from October 1997 onwards. Our data end in August 2017. One may be concerned that we miss several important years in the introduction of the new security because Shell MDS issued the first Islamic corporate bond in Malaysia in 1990. However, we are confident that our data capture the early development of the Islamic market for several reasons. First, we note that the Shell MDS debt was a private placement and was not readily available to trade by ordinary investors, or even many institutional investors. Jalil (2005) shows that other private Islamic corporate debt offerings occurred during 1990-2001, but the East Asian crisis of the late 1990s severely hindered their issuance. Herzi (2010) remarks that trading of securities at any price other than par would have limited the success of private debt instruments until institutions were erected to expand the scope of permissible financial activities. Both Herzi and Jalil note that these include the creation of an Islamic Capital Market unit within the Securities Commission in 1995 and the creation of the Shariah Advisory Council in 1996.

Similar to TRACE in the United States, financial institutions in Malaysia are required to report all Ringgit corporate bond transactions. Hence, the ETP database has comprehensive coverage of transaction prices and quantities, which are reported with a date and time stamp. Our sample includes 375,841 transactions involving 12,888 fixed-income securities. Our final sample contains

6,395 Islamic bonds and 6,486 conventional bonds that were issued between 1992 and 2017. The database also indicates whether the trade was a buy or a sell and information on who traded it. It reports issuer name, bond issue date, coupon, maturity date, the type of instrument, whether it is Islamic or conventional, the offering amount, and ratings from each of Malaysia's two rating agencies, Malaysian Rating Corporation Bhd. (MARC) and RAM Holdings Bhd. (RAM). The sample consists mainly of bonds, medium-term notes (MTNs), and commercial paper, but also includes asset-backed securities (ABS), loan notes and loan stocks. Commercial paper constitutes the most commonly issued security, reflecting its very short tenor.

While traders are not identified by name, the ETP dataset includes an identification (ID) number for each investor and categorizes them by organization type. The categories are: asset managers, finance companies, commercial banks, investment banks, Islamic banks, government, domestic business, foreign and others. With an exception in 2008, the ID does not change over time, allowing us to determine if an investor who purchases conventional bonds one year buys Islamic bonds the next or vice versa. We are also able to determine if a trade is the first ever for a particular investor (IDs are unique to a firm or government).

The ETP contains both yield and price data, both of which need to be filtered for data entry errors. To that end, extreme price movements are excluded from the sample when analyzing yield spreads and liquidity. Details on the steps taken to clean prices and yields are discussed in the Appendix.

Yield spreads on corporate bonds are calculated as the difference between the corporate yield to maturity and that of a similar maturity government bond, where the sovereign bond rate is imputed from an estimated yield curve. The benchmark yield curve is based on Bloomberg's curve-fitting model for Malaysian government yields, which are only available from 1999 onwards.

Bonds may be issued by a firm or by its subsidiaries. There are 683 issuing entities in the sample and these are owned by 429 firms. Ownership of the subsidiaries can change over time. Thus, there are never as many as 429 firms with traded bonds at a single point. The issuing entity is the firm in 222 instances. The details on ownership are described in the Appendix, as is the

process of identifying the industry of the firm. Financial data are available for 266 firms, but these data may not be available for all relevant years. Panel A of Table 1 shows descriptive statistics for the firms in years when data are available. Panel B reports statistics related to the bonds at the time they are offered. Panel A shows that the firms that only issue Islamic bonds are smaller firms with greater revenue growth. The mixed issuers are the largest firms in the sample and grow slightly less quickly than the other firms. Consistent with their larger size, Panel B shows that the mixed issuers' bonds have a larger face value. Islamic bonds have a longer maturity than conventional bonds, despite having lower ratings. Note that the ratings are those issued by one or both of the Malaysian rating agencies and are more lenient than Moody;s or S&P. This explains why nearly 40% of the sample holds the highest rating whereas in the US only a small fraction of firms are rated AAA. The table shows that most of the bonds have a AA or AAA rating. Most of the other bonds (not shown) are rated A or BBB. Yield spreads are only available for a portion of the sample. The extreme negative values reflect the fact that the government of Malaysia has only moderate creditworthiness during much of the sample period and firms with stable cash flows are viewed more positively in extreme downturns, such as the Asian Flu period of 1997-1999.

V. Empirical Results

V.1. H1—Issuers' choice between Islamic and conventional bonds

First, we consider the size and growth of the Islamic bond market in Malaysia (Figure 6). Islamic corporate bonds have clearly gained in popularity, with issuance on a par with conventional bonds by 2005. The market grew further in the next five years, so that by 2010 it was not uncommon for Islamic bond issuance in Malaysia to outpace issuance of conventional corporate bonds in any given quarter. In untabulated results, we regress the difference between Islamic and conventional

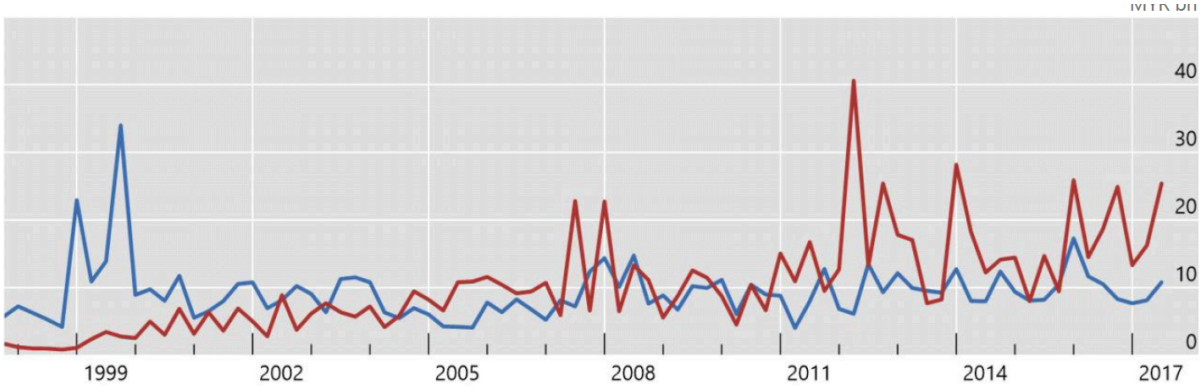

Figure 6: Issuance of Islamic bonds over time

The figure shows the Ringgit value of Islamic bonds issued each quarter (in red) and the comparable value for conventional bonds (in blue).

bond issuance on a quarterly time trend and find a significant positive coefficient. While the popularity of Islamic bonds suggests conventional bonds are squeezed out by the end of the sample, we note that the Ringgit value of traditional bonds increases over the sample period.

In line with Hypothesis 1, Panel A of Figure 7 shows that at any point in time some issuers prefer one over the other type of bonds or issue both bonds. Panel B documents that the optimal mix of securities being issued differs across industries. Thus, while many companies opt to issue only one type of bond, with more of them choosing Islamic as time goes one, conventional bonds are not completely squeezed out.

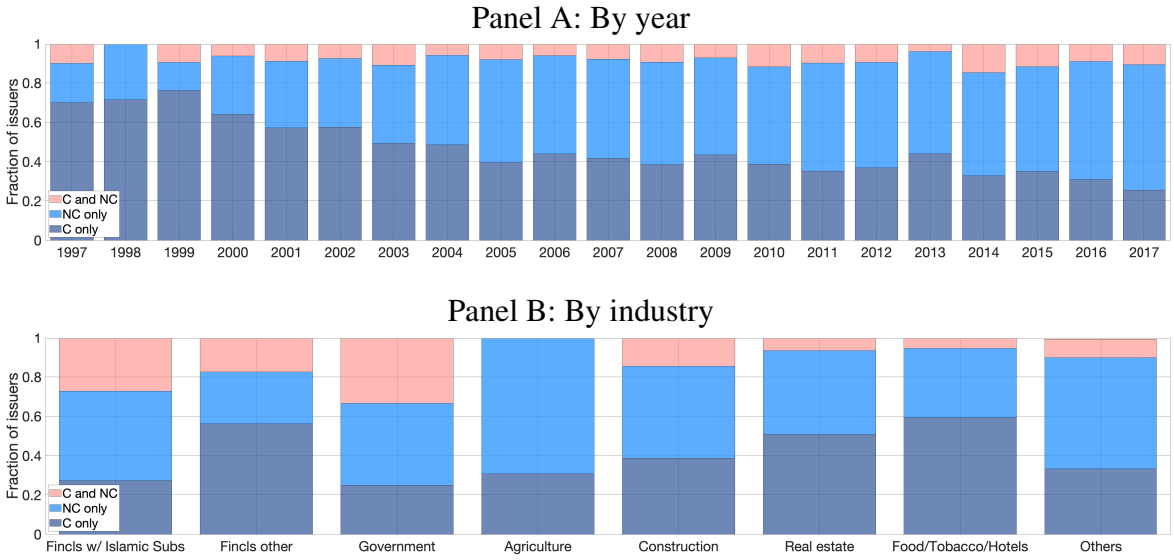

Figure 7: Issuer preferences over time and across sectors

The figure shows the fraction of C-only issuers, NC-only issuers and mixed issuers. Panel A depicts the distribution over time, whereas Panel B shows the distribution by industry.

Table 1: Summary Statistics

A. Firm year statistics					
Full sample	N	Mean	SD	Min	Max
Log Assets	1607	7.21	2.40	1.07	12.99
ROA	1607	0.03	0.07	-0.58	0.27
Sales growth	1607	0.16	0.49	-0.77	6.02
Debt/assets	1607	0.32	0.18	0.00	0.94
Issue NC bonds only					
Log Assets	429	5.97	1.72	1.45	11.69
ROA	429	0.03	0.08	-0.58	0.27
Sales growth	429	0.20	0.50	-0.77	3.01
Debt/assets	429	0.33	0.18	0.00	0.94
Issue C bonds only					
Log Assets	529	6.97	2.57	1.07	12.99
ROA	529	0.03	0.07	-0.58	0.27
Sales growth	529	0.15	0.59	-0.77	6.02
Debt/assets	529	0.30	0.17	0.00	0.94
Mixed issuers sample					
Log Assets	649	8.24	2.20	3.16	12.99
ROA	649	0.03	0.06	-0.40	0.27
Sales growth	649	0.14	0.37	-0.74	3.01
Debt/assets	649	0.32	0.19	0.00	0.94
B. Bond statistics					
Full sample	N	Mean	SD	Min	Max
Face value	12878	125.94	306.01	0.25	15918.56
Maturity	12881	3.44	5.90	0.02	100.07
AAA rated	12881	0.39	0.49	0.00	1.00
AA rated	12881	0.33	0.47	0.00	1.00
A or BBB rated	12881	0.27	0.45	0.00	1.00
Yield spread	3842	1.32	2.59	-4.22	142.59
Conventional bonds					
Face value	6486	120.36	346.97	0.25	15918.56
Maturity	6486	1.95	4.56	0.04	100.07
AAA rated	6486	0.42	0.49	0.00	1.00
AA rated	6486	0.26	0.44	0.00	1.00
Yield spread	1344	1.51	4.05	-4.22	142.59
Nonconventional bonds					
Face value	6392	131.60	257.79	0.80	5500.00
Maturity	6395	4.96	6.66	0.02	100.07
AAA rated	6395	0.37	0.48	0.00	1.00
AA rated	6395	0.39	0.49	0.00	1.00
Yield spread	2498	1.21	1.22	-0.70	15.52

The table reports summary statistics for firms with financial data. Variables are defined in the Appendix.

V.2. H2—Primary market prices of conventional bonds issued by mixed issuers

We identify four firms that issue both types of bonds in the same month and use their bonds' spreads to evaluate the relative pricing of conventional bonds. We consider any trade in the first month of issuance to be representative of a primary market price, including in some cases prices from the when-issued market. For this test, we exclude short-term bonds (with less than one year to maturity) because they are not expected to be liquid. While we pool the four issuers' bonds together in these regressions, we control for variation in credit quality with ratings indicators and issuer fixed effects. To further ensure that credit risk does not bias the coefficients, we run separate regressions for each maturity bucket. The size of the offering amount is also used as a control.

The results are shown in Table 2. Each of the six maturity regressions exhibits lower yield spreads, and thus higher prices, for Islamic bonds. The difference in the spreads is significant in half of the six cases. As noted earlier, the firm need not sell the conventional bonds at a large discount to the Islamic ones, as it need only to make them slightly more appealing to NR investors who would otherwise value them equally. The small, sometimes insignificant, difference in yields shown here is consistent with that aspect of the model.

Table 2: Primary Market Yield Spreads

	1–2 yrs	2–3 yrs	3–5 yrs	5–7 yrs	7–12 yrs	$>$ 12 yrs
Islamic	-0.062**	-0.025**	-0.239**	-0.020	-0.001	-0.036
	(0.017)	(0.008)	(0.014)	(0.018)	(0.017)	(0.035)
log issue amount	0.032**	0.014**	-0.016	-0.008	0.010	-0.060**
	(0.007)	(0.004)	(0.010)	(0.010)	(0.009)	(0.020)
Issuer FE	✓	✓	✓	✓	✓	✓
Rating FE	✓	✓	✓	✓	✓	✓
Month FE	✓	✓	✓	✓	✓	✓
R-sqr	0.96	0.98	0.91	0.99	0.93	0.96
RMSE	0.09	0.06	0.14	0.09	0.14	0.20
Obs	318	519	717	217	563	408

The table reports regressions to explain primary market yield spreads for different maturity ranges. Standard errors are in parentheses. ** indicates significance at the 5% level, and * indicates significance at the 10% level. Issuer fixed effects (FE), rating fixed effects (FE), and month fixed effects (FE) are included in all regressions.

V.3. H3—The impact of issuance costs

Table 4 shows the results of a regression that explains Islamic bond issuance. The dependent variable is a continuous one that measures the fraction of total issuance of NC bonds by the firm in any year that it issues a bond. While the average cost of issuing an Islamic bond likely fell over the sample period, for some issuers the cost is extremely high, if not infinite, as their businesses do not fit in with Islamic principles. We create a measure of the firm's exposure to non-permissible industries that ranges from zero to one. This variable's value is calculated by averaging industry indicators of its subsidiaries. To create this variable we consider the 28 possible industries of the firm's issuing entities (its subsidiaries as well as the parent itself). The greater the fraction of issuers that are in commercial banking, alcohol, tobacco or insurance and are not Islamic banks, the higher the exposure. Because the government champions Islamic issuance, we set the high cost variable to zero for quasi-government issuers, such as Khazanah. Finally, we set the high cost variable to one for foreign issuers on the assumption that they are less familiar with the issuance process and Shariah law in Malaysia. Reflecting Islamic principles that view financing of tangible goods, such as roads and airports, more favorably than financial engineering or trading, we create a separate indicator for industries that do not produce these products (intangible indicator).

The first column of Table 3 shows support for Hypothesis 3 in that the coefficient on the high cost variable is negative and statistically significant. In the next column we add the intangible indicator variable, which also suggests that higher costs tilt issuance away from Islamic bonds, although the variable is not statistically significant. The specification in column (3) of the table adds controls for bond ratings. The rating data provided by ETP are not senior-implied ratings of the firm, so our rating indicators are instead based on the average of bond ratings across the firm's issuing entities. Some of the bonds enjoy higher rating from bank guarantees or are secured, so the rating indicator variables may not fully capture the operating risk of the company. Nevertheless, their inclusion helps to explain the variation in issuance. Column (4) of Table 3 includes financial variables, which are not available for quasi-government firms or for most of the privately held firms in the sample. Thus, the sample size drops by about one-third. The size of the firm,

Table 3: Islamic Bond Issuance

	(1)	(2)	(3)	(4)	(5)
High issue cost	-2.024**	-1.909**	-1.880**	-1.989**	-2.269**
	(0.168)	(0.177)	(0.183)	(0.248)	(0.264)
Intangible		-0.229*	-0.274*	-0.644**	-0.624**
		(0.117)	(0.120)	(0.166)	(0.173)
AAA			0.297	0.344	0.064
			(0.216)	(0.304)	(0.320)
AA			1.332**	0.943**	0.632*
			(0.207)	(0.283)	(0.299)
A–BBB			0.748**	0.691*	0.551
			(0.209)	(0.275)	(0.286)
Log assets				0.084*	0.097*
				(0.037)	(0.040)
ROA				1.635	2.014
				(1.260)	(1.311)
Sales growth				0.018	0.053
				(0.181)	(0.195)
Year FEs					✓
constant	0.584**	0.691**	-0.061	-0.476	0.790
	(0.059)	(0.081)	(0.188)	(0.312)	(0.650)
R-sqr	0.08	0.09	0.12	0.12	0.16
Obs	1555	1555	1551	961	958

The table reports logistic regression estimates of Islamic bond issuance. The dependent variable is the amount of Islamic bond issuance in a calendar year scaled by that year's total bond issuance, conditional on issuing a positive total issuance amount. The 'High issue cost' variable takes a value between zero and one where one occurs when all of the firm's subsidiaries are in high cost industries and zero occurs when none are. 'Intangible' also ranges from zero to one and is equal to one when all of the firm's subsidiaries are in industries that produce tangible goods. Other variable definitions are included in the Appendix. Standard errors are in parentheses. ** indicates significance at the 5% level, and * indicates significance at the 10% level. Year fixed effects (FE) are included in Model (5).

measured by log (assets), has a significant positive coefficient, reflecting the greater ability of large companies to absorb the fixed issuance costs and to carve out a set of assets that are suitable for an NC bond. The last column of the table adds in time fixed effects to capture the possibility that the government's policy changes have led to a lower relative cost of issuing Islamic bonds over time. In all six regressions, the coefficient on the high cost variable is statistically significant and negative, supportive of H3.

Next, we consider the relationship between issuance costs and Shariah compliance. While firms are not required to be publicly traded in order to issue an Islamic bond, the Council opines

on all listed companies, so that noncompliance of a listed firm would prevent it from issuing one. Only by restructuring would a noncompliant listed firm access the Islamic market, such as in the case of financial firms that issue through their Islamic bank subsidiaries. To show the effect of cost on compliance status, we analyze the publicly traded firms in our sample that could have been on the list in May 2013 or November 2013. We also separately consider the set of firms in the sample that was removed from the list in November 2013, when the Council instituted a more conservative set of rules.

Table 4 shows that our high cost variable is a strong predictor of noncompliance. The variable is significantly negative in both time periods, as shown in each of the four leftmost columns. In models (1) and (3), the variable is included by itself. Models (2) and (4) of the table also include the firm's leverage. As expected, the leverage variable is not significant in May 2013 (in column (2)) but it has a negative impact in November when the Council disallowed firms solely on the basis of their financial ratios. This result can be seen as well in column (5) where the dependent variable is one for firms that were removed from the list in November and zero for those that were compliant in November. While removals could have occurred for earning too much interest on a traditional debt instrument, the regression indicates that a major reason for becoming noncompliant was excessive debt in the capital structure.

V.4. H4—Liquidity offset

Given the issuance costs of Islamic bonds and the expected low yields, NR investors may choose not to participate in their offerings. We test this hypothesis with primary market purchases of Islamic bonds sold by mixed issuers. The dependent variable in these regressions is the fraction of a bond's buyers that are not religious. We define purchases as trades that occur in the same calendar month as the issuance date, including sell trades, given that the sellers acquired the bonds within the time frame (and likely through the offering process). Islamic banks represent NR clients throughout the sample, but they may not be the only religious investors in the early part of the sample when IBWs had a large share of Islamic deposits. Prior to the establishment of Islamic bank

Table 4: Shariah Advisory Council Decisions in 2013

	Shariah-Compliant				Removed from List
	May		November		
	(1)	(2)	(3)	(4)	(5)
High issue cost	-8.227**	-8.029**	-6.407**	-7.733**	
	(2.549)	(2.518)	(2.381)	(2.611)	
Leverage		1.075		-3.807**	6.707**
		(1.323)		(1.129)	(1.610)
constant	1.690**	1.401**	0.872**	2.032**	-4.119**
	(0.242)	(0.417)	(0.193)	(0.414)	(0.688)
R-sqr	0.19	0.19	0.09	0.17	0.22
Obs	140	140	140	140	140

The table reports regressions related to inclusion on the Shariah Advisory Council list of compliant stocks. In columns (1) and (2), the dependent variable is one for firms that are on the list in May 2013 and zero if they are publicly listed but not on the list. In columns (3) and (4) the dependent variable is one for firms that are compliant in Nov. 2013 and zero otherwise. The dependent variable in specification (5) is one if a firm was removed from the Nov. 2013 list and zero if it was included. Standard errors are in parentheses. ** indicates significance at the 5% level, and * indicates significance at the 10% level.

subsidiaries of domestic banks, which was allowed in 2002, R investors might have purchased Islamic bonds through the commercial banks' IBWs. Thus, we measure the buying activity of NR investors two ways: (1) as a fraction of all trades, where the numerator includes all commercial bank trades; and (2) as a fraction of total trades, excluding commercial banks from both the numerator and denominator. While Islamic bank subsidiaries were allowed as early as 2002, we observe bond trades by these subsidiaries for the first time in 2005.[12] Given that the number of Islamic banks increased sharply between 2008 and 2009, we expect the fraction of bonds bought by NR investors to decrease as the new institutions demanded a larger share.

We present the results of this analysis in Table 5. Models (1) and (2) differ only in the definition of the dependent variable, where model (2) excludes the commercial banks from the calculations. The constant variable's coefficient is close to 1 in both instances, indicating that a very large fraction of the purchases is done by NR investors. The percentage of NR buyers decreases later in the sample, when there are more Islamic banks. The coefficient on the 2009 and later variable

[12] While the identity of the traders in ETP is not known, the id number 40 is the only Islamic bank in 1997, which is during the period when Bank Islam Malaysia was the only Islamic bank in the country. The second bank, Bank Muamalat, was chartered in 1999, which is when we also observe trades by id 91. Ids 40 and 91 are the only Islamic bank traders until 2005 when four more Islamic bank ids appear as both sellers and buyers.

Table 5: NR investors' Purchases of Islamic Bonds in the Primary Market

	(1)	(2)	(3)	(4)
2009 and later	-0.014	-0.077**	-0.016	-0.016
	(0.010)	(0.029)	(0.010)	(0.011)
log issue amount			0.012*	0.013*
			(0.005)	(0.005)
Rating below AA				0.045**
				(0.011)
Maturity				-0.002**
				(0.001)
constant	0.966**	0.887**	0.739**	0.733**
	(0.007)	(0.022)	(0.095)	(0.097)
R-sqr	0.00	0.01	0.01	0.02
RMSE	0.12	0.33	0.12	0.12
Obs	540	464	540	540

The table reports regression estimates of the fraction of non-religious (NR) buyers of Islamic bonds issued by mixed issuers. The dependent variable in models (1) and (3)-(5) is the number of NR buyers divided by the total number of buyers of the bond. The sample in columns (1) and (3)-(4) includes all Islamic bonds of mixed issuers that are offered in the same calendar month as a conventional bond. In column (2) the dependent variable is defined as the number of NR investors that are not commercial banks divided by the total number of buyers excluding commercial banks. The sample size in (2) declines because some Islamic bonds are only purchased by commercial banks and Islamic banks. Variable definitions are included in the Appendix. Standard errors are in parentheses. ** indicates significance at the 5% level, and * indicates significance at the 10% level.

is significantly negative in models (2) and (3) and negative in all four regressions, despite the declining cost of issuing Islamic bonds. That is, if the cost deterred NR investors from purchasing NC bonds early on, their share of the purchases would have increased after 2008, all else constant. The fact that it decreased indicates that the demand from Islamic banks had a larger impact after 2008. We argue that the higher cost of Islamic bonds can be offset by their secondary market benefits, which is supported by the positive coefficient on the log of the bond's face value. The coefficient is consistent with the idea that larger offerings involve more traders and thus more potential buyers (Fisher, 1959; Hotchkiss and Jostova, 2017; Helwege and Wang, 2021). In model (4) we include credit quality and maturity as controls. The constant term is over .7 in all of the regressions, showing the very high willingness of NR investors to buy Islamic bonds in the primary market.

Next, we consider the correlation between NR liquidity shocks and R liquidity shocks during the Taper Tantrum episode. We observe above average trading activity in the months of May, June

and July in 2013 whereas August and later in the year do not exhibit any evidence of a liquidity shock found in Chari, Dilts Stedman, and Lundblad (2020). For the sake of completeness, we present some evidence on both time periods in Table 6. Models (1), (2) and (3) differ in the measure of trading activity used for the dependent variable, but all three regressions are similar in showing that Islamic bonds trade less frequently than conventional bonds and that trading during the Spring of 2013 is unusually high. In Models (4) and (6), the Taper Tantrum variable is replaced with an indicator for months May-December 2013, but the variable has the wrong sign in both models. In models (5) and (6) the Islamic bond indicator is interacted with the Taper Tantrum variable (Taper year in (6)). Once the interaction variable is included, the Taper Tantrum loses significance, implying that the excess trading during the period owes mainly to the trading of Islamic bonds. In Model (6) the interaction variable is also significant, indicating a greater amount of trading of Islamic bonds than normal in this period.

Given that Model (5) of Table 6 shows that Islamic bonds are traded more than usual during the Taper Tantrum while other bonds are not, we next consider who trades Islamic bonds during this episode and whether their trades involve buying or selling. Table 7 shows regression estimates of the number of trades by Islamic banks (Model (1)) and by non-religious traders (Model (2)), as well as regressions explaining the net purchases of Islamic bonds by the two groups (Models (3) and (4)). Table 7 shows that religious investors, represented by Islamic banks, traded more heavily during the Taper Tantrum. BNM data on financing by type of bank shows that Islamic banks do less lending and hold more government bonds than traditional Malaysian banks. The spillover effects of the Taper Tantrum on their government bond portfolio may have induced more trading of their other assets, including Islamic corporate bonds. The NR investors also trade Islamic bonds more heavily during this episode (Model (2)), but the two groups are not typically on the same side of the trades. Model (3) shows that Islamic banks are net sellers of Islamic bonds during the Taper Tantrum, while Model (4) shows a positive coefficient for the NR investors. While the NR buyers do not have significantly greater purchases during the episode, there is no indication that NR traders sell as much as R investors during this period. The amount of trading during the

Taper Tantrum period in Malaysia and the differences in trading patterns across the two groups is evidence that there is a significant benefit to NR investors of holding NC bonds as a hedge against liquidity shocks.

VI. Conclusion

We examine the case of redundant bonds in Malaysia using data that starts in the early days of the Islamic bond market and continues for two decades. On the one hand, conventional bond issuance should remain the base case for all but a handful of niche firms if the issuance costs of Islamic bonds (such as certification of Shariah compliance) are too high. On the other hand, if these costs are low enough, one might expect firms to choose Islamic bonds over conventional ones and take advantage of the fact that all investors can buy the new non-conventional type bonds. Our theory points to two factors that prevent either conventional or Islamic bond issuance from squeezing out the other:

(1) Non-religious investors may benefit from the existence of two types of bonds due to their advantages as a buffer against liquidity shocks; and

(2) Firms may be able to raise more money, holding constant the total number of bonds issued, if they issue both types.

Indeed, we show empirically, that even among the firms that engage in 'approved' business activities and could easily issue only Islamic bonds, conventional bond issuance does not completely disappear. In fact, we observe mixed issuers in every year in the sample. While these issuers are small in number, the value of the bonds issued is fairly large. Between the mixed issuers and the firms that do not issue Islamic bonds at all, the value of conventional bond issuance remained high throughout. At the same time, consistent with the model, issuance costs do play a role in tilting the firm's funding choice of conventional vs. Islamic bonds.

When mixed issuers choose to issue both types of bonds at the same time ('simultaneous mixed issuance'), we find that the conventional bonds are cheaper (have a higher yield). This result is

Table 6: Level of Trading Activity during the Taper Tantrum

	No. trades (1)	No. trading days (2)	Volume of trades (3)	No. trades (4)	No. trades (5)	No. trades (6)
Islamic	-0.298**	-0.298**	-2.265**	-0.300**	-0.309**	-0.319**
	(0.017)	(0.017)	(0.372)	(0.017)	(0.017)	(0.018)
Taper tantrum	0.208**	0.208**	2.248**		-0.006	
	(0.041)	(0.041)	(0.510)		(0.075)	
Islamic x Taper tantrum					0.295**	
					(0.085)	
Taper year				-0.026		-0.354**
				(0.019)		(0.051)
Islamic x Taper year						0.219**
						(0.046)
AAA rated	0.118**	0.118**	3.800**	0.104**	0.118**	0.118**
	(0.016)	(0.016)	(0.306)	(0.016)	(0.016)	(0.016)
AA rated	0.456**	0.456**	1.927**	0.433**	0.456**	0.457**
	(0.014)	(0.014)	(0.230)	(0.014)	(0.014)	(0.014)
A or BBB rated	0.344**	0.344**	2.493**	0.346**	0.343**	0.344**
	(0.015)	(0.015)	(0.432)	(0.014)	(0.015)	(0.015)
Bond age	-0.001**	-0.001**	-0.004**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log(face value)	0.453**	0.453**	4.788**	0.450**	0.453**	0.453**
	(0.007)	(0.007)	(0.147)	(0.007)	(0.007)	(0.007)
Maturity 4-7 yrs	-0.181**	-0.181**	-0.862	-0.150**	-0.181**	-0.181**
	(0.018)	(0.018)	(0.478)	(0.017)	(0.018)	(0.018)
Maturity 7+ yrs	2.628**	2.628**	1.060	2.646**	2.628**	2.628**
	(0.228)	(0.228)	(2.979)	(0.228)	(0.228)	(0.228)
constant	-7.275**	-7.275**	-80.163**	-7.177**	-7.266**	-7.234**
	(0.111)	(0.111)	(2.544)	(0.108)	(0.111)	(0.111)
R-sqr	0.12	0.12	0.03	0.12	0.12	0.12
RMSE	2.34	2.34	48.37	2.34	2.34	2.34
Obs	147,651	147,651	147,651	147,651	147,651	147,651

The table reports regression estimates of the impact of the Taper Tantrum on trading of Malaysian corporate bonds. The dependent variable in columns (1), and (4)-(6) is the number of trades in a calendar month, while (2) counts the number of days with trading in a month and the dependent variable in (3) is the Ringgit value of trades in a month. Taper tantrum is an indicator variable for the months of May, June and July 2013 and Taper year is an indicator variable for the last eight months of 2013. Islamic is an indicator variable set to one for bonds that are Shariah-compliant and zero otherwise. Variable definitions are included in the Appendix. Standard errors are in parentheses. ** indicates significance at the 5% level, and * indicates significance at the 10% level.

consistent with our model, which shows that the optimal issuance choice of the firm may involve two different prices for what is essentially the same asset from the investor's perspective.

Table 7: Trades by Islamic Banks and Other Traders during the Taper Tantrum

	IB no. (1)	NR no. (2)	IB net buys (3)	NR net buys (4)
Taper tantrum	0.102**	0.371**	-1.848**	0.954
	(0.026)	(0.071)	(0.583)	(1.197)
AAA rated	0.097**	0.509**	-0.259	-3.037*
	(0.007)	(0.027)	(0.165)	(1.200)
AA rated	0.091**	0.719**	0.141	-0.037
	(0.005)	(0.021)	(0.095)	(1.055)
A to BBB rated	0.088**	0.589**	0.141	-0.505
	(0.006)	(0.025)	(0.187)	(0.934)
bond age	-0.000**	-0.001**	0.000	0.001*
	(0.000)	(0.000)	(0.000)	(0.001)
log (face value)	0.092**	0.675**	-0.016	-1.433
	(0.003)	(0.012)	(0.097)	(0.801)
4 to 7 yrs	-0.050**	-0.227**	-0.244	4.431**
	(0.008)	(0.028)	(0.161)	(1.611)
7+ yrs	-0.326**	-1.113**	-0.170	-32.643
	(0.033)	(0.244)	(0.441)	(41.469)
constant	-1.561**	-11.496**	0.327	24.360
	(0.054)	(0.205)	(1.694)	(13.721)
R-sqr	0.04	0.11	0.00	0.00
RMSE	0.76	2.89	18.08	170.40
Obs	110,232	110,232	110,232	110,232

The table reports regression estimates of the abnormal trading of Islamic bonds during the Taper Tantrum by Islamic Banks and other traders. The dependent variable in columns (1) and (2) is the number of trades of Islamic bonds in a calendar month by Islamic banks (1) and by other traders (2). The dependent variable in (3) and (4) is the Ringgit value of net purchases of Islamic bonds by Islamic banks (3) and other traders (4) in a month. Taper tantrum is an indicator variable for the months of May, June and July 2013. Variable definitions are included in the Appendix. Standard errors are in parentheses. ** indicates significance at the 5% level, and * indicates significance at the 10% level.

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APPENDIX

A. Only Conventional Bonds Are Issued

This appendix considers the case where only C bonds are issued. In this case, R investors do not participate in the bond market and there is no role for an R bank. To simplify notation, we set $y = \mathbb{E}_0(y_{nr,1})$. In the secondary market, according to Equations (2) and (3), the representative NR investor maximizes the utility

$$\begin{aligned} U_{1,A_\tau}(W_{nr,2}) &= (1-q-P_{0,c}-y_{nr,1})\,h_{nr,0,c} \\ &\quad + \left(1-q-P_{1,c}+\kappa \mathbb{1}_{\{h_{nr,1,c}<h_{nr,0,c}\}}-y_{nr,1}\right)(h_{nr,1,c}-h_{nr,0,c}) - \frac{1}{2}A_{nr}q(1-q)h_{nr,1,c}^2, \end{aligned} \tag{A.1}$$

subject to the constraint $h_{nr,1,c} \geq 0$. Equation (A.1) relies on the assumption that $\mathbb{1}_{\{R_2=R\}}$ is independent of the choice of $h_{nr,1,c}$. Taking the derivative of $U_{1,A_{nr}}(W_{nr,2})$ with respect to $h_{nr,1,c}$, and setting it to zero, yields the FOC

$$1-q = P_{1,c} - \kappa \mathbb{1}_{\{h_{nr,1,c}<h_{nr,0,c}\}} + y_{nr,1} + A_{nr}q(1-q)h_{rn,1,c}. \tag{A.2}$$

Equation (A.2) describes the scenario where net benefits from buying one additional unit of C bonds are exactly offset by the additional costs.

Solving for $h_{nr,1,c}$ yields

$$h_{nr,1,c} = \begin{cases} \frac{1-q-P_{1,c}-y_{nr,1}}{A_{nr}q(1-q)}, & \text{if case 1: } y_{nr,1} < 1-q-P_{1,c}-A_{nr}q(1-q)h_{nr,0,c} \\ h_{nr,0,c}, & \text{if case 2: } y_{nr,1} \in 1-q-P_{1,c}+[0,\kappa]-A_{nr}q(1-q)h_{nr,0,c} \\ \frac{1-q-P_{1,c}+\kappa-y_{nr,1}}{A_{nr}q(1-q)}, & \text{if case 3: } y_{nr,1} \in 1-q-P_{1,c}+\kappa-(A_{nr}q(1-q)h_{nr,0,c},0] \\ 0, & \text{if case 4: } y_{nr,1} > 1-q-P_{1,c}+\kappa. \end{cases} \tag{A.3}$$

Cases 1–4 are labeled in order of an increasing realized cost of carry, with case 1 indicating the

lowest cost of carry outcomes and case 4 the highest. As a result, the number of bonds desired by the investors is decreasing from case 1 to case 4. The broker anticipates the demand function (A.3). The price schedule

$$P_{1,c} = 1-q-y_{nr,1}-A_{nr}q(1-q)h_{nr,0,c} \tag{A.4}$$

gives the lowest price that ensures that case 2 applies ($h_{nr,1,c} = h_{nr,0,c}$) and the secondary market clears.

Given $P_{0,c}$, the NR bank chooses $h_{nr,0,c}$ to maximize expected utility, taking into account the secondary-market prices schedule (A.4) and demand function $h_{nr,1,c} = h_{nr,0,c}$:

$$\mathbb{E}_0(U_{1,A_{nr}}(W_{nr,2})) = (1-q-P_{0,c}-y)\,h_{nr,0,c} - \frac{1}{2}A_{nr}q(1-q)h^2_{nr,0,c}.$$

The FOC for $h_{nr,0,c}$ is

$$h_{nr,0,c} = \max\left(0, \frac{1-q-P_{0,c}-y}{A_{nr}q(1-q)}\right). \tag{A.5}$$

The associated issuer utility is

$$\mathbb{E}_0(U_{1,0}(W_{f,2})) = (\min(F,F_c)R-H_c)(1-q) - K_c\,\mathbb{1}_{\{H_c>0\}} - K_e\,\mathbb{1}_{\{F_c<F\}}, \tag{A.6}$$

with an outside option of zero. If the firm invests in the project but sets prices such that $F_c = 0$ by setting $P_{0,c} = 0$ or $P_{0,c} \geq 1-q-y$, then $\mathbb{E}_0(U_{1,0}(W_{f,2})) = -H_c(1-q) - K_c\,\mathbb{1}_{\{H_c>0\}} - K_e \leq 0$. In that sense, the firm will either invest in the project and set $P_{0,c} \in (0, 1-q-y)$, or it will forego the project.

Case 1—No investment In this case, $\mathbb{E}_0(U_{1,0}(W_{f,2})) = 0$.

Case 2—Investment, partially funded through bond issuance Suppose the firm invests in the project and sets prices such that $F_c \in (0, F)$. Then Equation (A.6) becomes

$$\mathbb{E}_0(U_{1,0}(W_{f,2})) \quad = \quad H_c(P_{0,c})(P_{0,c}R-1)(1-q)-K_c-K_e.$$

The FOC for $P_{0,c}$ is $H_cR = -H_c'(P_{0,c}R-1)$, which can be solved for

$$P_{0,c}^{(2)} \quad = \quad 1-q-y-\frac{(1-q-y)R-1}{2R}.$$

At this price, $h_{nr,0,c} = h_{nr,0,c}^{(2)}$ with

$$h_{nr,0,c}^{(2)} \quad = \quad \frac{(1-q-y)R-1}{2RA_{nr}q(1-q)} = \frac{1-q-y-\frac{1}{R}}{2A_{nr}q(1-q)},$$

and

$$\mathbb{E}_0(U_{1,0}(W_{f,2})) \quad = \quad N_{nr}\frac{1-q-y-\frac{1}{R}}{2A_{nr}q}\left[\left(\frac{1-q-y}{2}+\frac{1}{2R}\right)R-1\right]-K_c-K_e.$$

The condition $F_c = H_cP_{0,c} \in (0, F)$ is equivalent to

$$(1-q-y)R \quad \in \quad \left(1, \sqrt{1+4R^2A_{nr}q(1-q)\frac{F}{N_{nr}}}\right). \tag{A.7}$$

Case 3—Investment, fully funded through bond issuance Suppose the firm invests in the project and chooses a $P_{0,c}$ so that $F_c = F$. In this case, $\mathbb{E}_0(U_{1,0}(W_{f,2})) = (FR-H_c)(1-q)-K_c$, meaning the issuer will choose the largest such $P_{0,c}$ (smallest H_c). In particular, $P_{0,c} = P_{0,c}^{(3)}$ with

$$P_{0,c}^{(3)} \quad = \quad P_{0,c}^{(2)} - \frac{1}{2R}\left(1-\sqrt{[(1-q-y)R]^2-4R^2A_{nr}q(1-q)\frac{F}{N_{nr}}}\right).$$

At this price, $h_{nr,0,c} = h^{(3)}_{nr,0,c}$ with

$$h^{(3)}_{nr,0,c} = h^{(2)}_{nr,0,c} + \frac{1 - \sqrt{[(1-q-y)R]^2 - 4R^2 A_{nr} q(1-q)\frac{F}{N_{nr}}}}{2RA_{nr}q(1-q)}.$$

and

$$\mathbb{E}_0(U_{1,0}(W_{f,2})) = (FR - N_{nr}h_{nr,0,c})(1-q) - K_c.$$

Note that $P^{(3)}_{0,c} < P^{(2)}_{0,c}$ is equivalent to $(1-q-y)R < \sqrt{1 + 4R^2 A_{nr} q(1-q)\frac{F}{N_{nr}}}$. Thus, when case 2 is an option (i.e., (A.7) applies), the issuer weighs case 2 with higher bond prices and lower numbers of bonds issued against case 3 with lower bond prices and higher number of bonds are issued. All scenarios other than cases 1, 2 or 3 result in lower utility than what the issuer can achieve across these cases.[13]

In what follows, we state the conditions for a particular case to be the optimal issuer choice.

No investment is optimal The issuer prefers case 1 over cases 2 and 3 if and only if fixed costs are sufficiently large, to the extent that

$$K_c > FR(1-q) - N_{nr}\frac{1-q-y-\sqrt{(1-q-y)^2 - 4A_{nr}q(1-q)\frac{F}{N_{nr}}}}{2A_{nr}q} \tag{A.8}$$

$$K_c + K_e > \frac{N_{nr}R}{4A_{nr}q}\left(1-q-y-\frac{1}{R}\right)^2 \tag{A.9}$$

All else the same, investment is more likely when there are more investors (high N_{nr}), the return on investment is higher (high R), among others.

[13] Suppose there is a scenario for the firm to invest in the project and choose a $P_{0,c}$ so that $F_c = H_c P_{0,c} > F$. Since F_c is a continuous function of $P_{0,c}$ that approaches zero as $P_{0,c}$ approaches $1-q-y$, there would also exist a greater value for $P_{0,c}$, and smaller value for H_c, at which $F_c = F$ and expected issuer utility is higher.

Partially debt-funded investment is optimal The issuer prefers case 2 over cases 1 and 3 if and only if neither debt nor equity issuance costs are too high:

$$\begin{aligned} K_c + K_e \;<\; & \frac{N_{nr}R}{4A_{nr}q}\left(1-q-y-\frac{1}{R}\right)^2 \\ & -\max\left\{0, FR(1-q) - N_{nr}\frac{1-q-y-\sqrt{(1-q-y)^2-4A_{nr}q(1-q)\frac{F}{N_{nr}}}}{2A_{nr}q} - K_c\right\}. \end{aligned} \tag{A.10}$$

Fully debt-funded investment is optimal The issuer prefers case 3 over cases 1 and 2 if and only if fixed debt issuance costs are small enough and equity issuance costs are high enough:

$$K_c \;<\; FR(1-q) - N_{nr}\frac{1-q-y-\sqrt{(1-q-y)^2-4A_{nr}q(1-q)\frac{F}{N_{nr}}}}{2A_{nr}q} \tag{A.11}$$

$$\begin{aligned} K_e \;>\; & \frac{N_{nr}R}{4A_{nr}q}\left(1-q-y-\frac{1}{R}\right)^2 - FR(1-q) \\ & + N_{nr}\frac{1-q-y-\sqrt{(1-q-y)^2-4A_{nr}q(1-q)\frac{F}{N_{nr}}}}{2A_{nr}q}. \end{aligned} \tag{A.12}$$

Figure A.1 displays the firm's funding decision as a function of fixed issuance costs. When debt issuance costs are sufficiently low—both in absolute terms and relative to equity issuance costs—the firm finances the project through debt issuance. When debt and equity issuance costs are comparable but still not too high, the firm raises funds both in the equity and the debt market.

B. Only Non-Conventional Bonds Are Issued

This appendix considers the case where only NC bonds are issued, that is, $H_c = 0$. In this case, both R investors and NR investors may participate in the bond market.

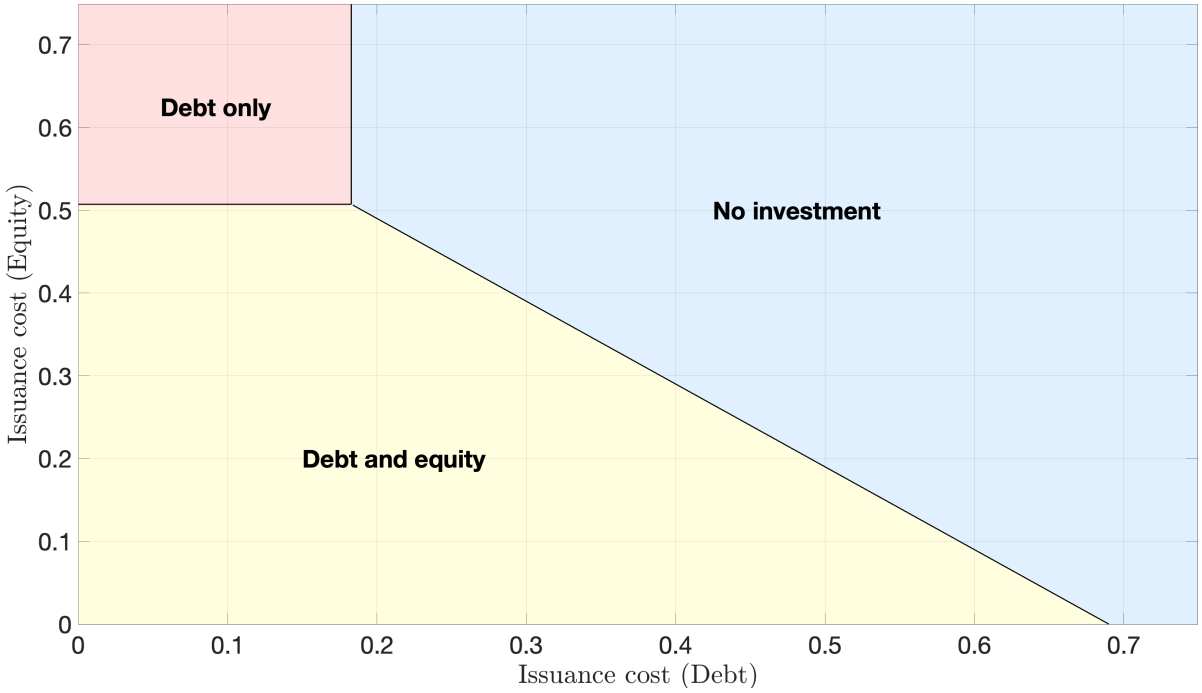

Figure A.1: Funding decisions as a function of issuance costs

The figure shows the firm's funding decision as a function of fixed issuance costs. The model parameters are set to $F = 1$, $A_{nr} = 1$, $N_{nr} = 100$, and $y_\tau \in \{0, 0.01\}$ with $\mathbb{E}(y_\tau) = 50$ bps.

B.1. Investor demand in the secondary market

According to (2) and (3), at time 1 the representative type-τ investor maximizes the utility

$$\begin{aligned} U_{1,A_\tau}(W_{\tau,2}) &= (1-q-P_{0,nc}-y_{\tau,1})\,h_{\tau,0,nc} \\ &\quad + \left(1-q-P_{1,nc}+\kappa \mathbb{1}_{\{h_{\tau,1,nc}<h_{\tau,0,nc}\}}-y_{\tau,1}\right)(h_{\tau,1,nc}-h_{\tau,0,nc}) - \frac{1}{2}A_\tau q(1-q)h_{\tau,1,nc}^2. \end{aligned}$$

As before, this relies on the assumption that $\mathbb{1}_{\{R_2=R\}}$ is independent of the choice of $h_{\tau,1,nc}$. Taking the derivative of $U_{1,A_\tau}(W_{\tau,2})$ with respect to $h_{\tau,1,nc}$, and setting it to zero, yields the FOC for type-τ investors:

$$1-q = P_{1,nc} - \kappa \mathbb{1}_{\{h_{i,1,nc}<h_{i,0,nc}\}} + y_{\tau(i),1} + A_\tau q(1-q)h_{i,1,nc}.$$

Solving for $h_{\tau,1,nc}$ yields

$$h_{\tau,1,nc} = \begin{cases} \frac{1-q-P_{1,nc}-y_{\tau,1}}{A_\tau q(1-q)}, & \text{if case 1: } y_{\tau,1} < 1-q-P_{1,nc}-A_\tau q(1-q)h_{\tau,0,nc} \\ h_{\tau,0,nc}, & \text{if case 2: } y_{\tau,1} \in 1-q-P_{1,nc}+[0,\kappa]-A_\tau q(1-q)h_{\tau,0,nc} \\ \frac{1-q-P_{1,nc}+\kappa-y_{\tau,1}}{A_\tau q(1-q)}, & \text{if case 3: } y_{\tau,1} \in 1-q-P_{1,nc}+\kappa-(A_\tau q(1-q)h_{\tau,0,nc},0] \\ 0, & \text{if case 4: } y_{\tau,1} > 1-q-P_{1,nc}+\kappa. \end{cases} \tag{B.1}$$

B.2. Secondary market pricing

With $\overline{y} = \frac{N_r A_{nr}}{N_r A_{nr}+N_{nr}A_r} y_{r,1} + \frac{N_{nr}A_r}{N_r A_{nr}+N_{nr}A_r} y_{nr,1}$ and

$$\begin{aligned} \underline{g} &= \min\{y_{r,1}+A_r q(1-q)h_{r,0,nc}, y_{nr,1}+A_{nr}q(1-q)h_{nr,0,nc}\} \\ \overline{g} &= \max\{y_{r,1}+A_r q(1-q)h_{r,0,nc}, y_{nr,1}+A_{nr}q(1-q)h_{nr,0,nc}\}, \end{aligned}$$

the price schedule is given as

$$P_{1,nc} = \begin{cases} 1-q-y_{r,1}-A_r q(1-q)\frac{H_{nc}}{N_r}, & \text{if } y_{nr,1} > y_{r,1}+\kappa+A_r q(1-q)\frac{H_{nc}}{N_r} \\ 1-q-\overline{y}-\frac{A_r A_{nr} q(1-q)H_{nc}}{N_r A_{nr}+N_{nr}A_r}+\frac{N_{nr}A_r}{N_r A_{nr}+N_{nr}A_r}\kappa, & \text{if } y_{nr,1} \in y_{r,1}+\kappa+A_r q(1-q)\frac{H_{nc}}{N_r} \\ \qquad -\left(\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr} q(1-q)h_{nr,0,nc},0\right] & \\ 1-q-\left(\underline{g},\overline{g}+\kappa\right], & \text{if } y_{nr,1} \in y_{r,1}+\kappa+A_r q(1-q)\frac{H_{nc}}{N_r} \\ \qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr} q(1-q)h_{nr,0,nc}+(-2\kappa,0] & \\ 1-q-\overline{y}-\frac{A_r A_{nr} q(1-q)H_{nc}}{N_r A_{nr}+N_{nr}A_r}+\frac{N_r A_{nr}}{N_r A_{nr}+N_{nr}A_r}\kappa & \text{if } y_{nr,1} \in y_{r,1}-\kappa+A_r q(1-q)\frac{H_{nc}}{N_r} \\ \qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr} q(1-q)h_{nr,0,nc} & \\ \qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_{nr}A_r}(A_r q(1-q)h_{r,0,nc},0] & \\ 1-q-y_{nr,1}-A_{nr}q(1-q)\frac{H_{nc}}{N_{nr}}, & \text{if } y_{nr,1} < y_{r,1}-\kappa+A_r q(1-q)\frac{H_{nc}}{N_r} \\ \qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr} q(1-q)h_{nr,0,nc} & \\ \qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_{nr}A_r} A_r q(1-q)h_{r,0,nc} & \end{cases}$$

With $\Delta y_r = y_{r,1} - y_{nr,1}$, the amount of NC bonds bought by the representative NR investor in

the secondary market, denoted as $\Delta h_{nr,nc} = h_{nr,1,nc} - h_{nr,0,nc}$, is

$$\Delta h_{nr,nc} = \begin{cases} \frac{H_{nc} - N_{nr} h_{nr,0,nc}}{N_{nr}}, & \text{if } \Delta y_r > \theta_{\text{high}} \\ \frac{(1-q) - P_{1,nc} - y_{nr,1} - A_{nr} q(1-q) h_{nr,0,nc}}{A_{nr} q(1-q)}, & \text{if } \Delta y_r \in (\theta_{\text{med}_h}, \theta_{\text{high}}] \\ 0, & \text{if } \Delta y_r \in [\theta_{\text{med}_l}, \theta_{\text{med}_h}] \\ \frac{(1-q) - (P_{1,nc} - \kappa) - y_{nr,1} - A_{nr} q(1-q) h_{nr,0,nc}}{A_{nr} q(1-q)}, & \text{if } \Delta y_r \in [\theta_{\text{low}}, \theta_{\text{med}_l}) \\ -h_{nr,0,nc}, & \text{if } \Delta y_r < \theta_{\text{low}} \end{cases}$$

where

$$\begin{aligned} \theta_{\text{high}} &= \kappa + A_{nr} q(1-q) \frac{H_{nc}}{N_{nr}} \\ \theta_{\text{med}_h} &= \theta_{\text{high}} - \frac{N_r A_{nr} + N_{nr} A_r}{N_{nr} A_r} A_r q(1-q) h_{r,0,nc} \\ \theta_{\text{med}_l} &= \theta_{\text{med}_h} - 2\kappa \\ \theta_{\text{low}} &= \theta_{\text{med}_l} - \frac{N_r A_{nr} + N_{nr} A_r}{N_r A_{nr}} A_{nr} q(1-q) h_{nr,0,nc} \\ &= -\kappa - A_r q(1-q) \frac{H_{nc}}{N_r} \end{aligned}$$

Moreover, $\Delta h_{r,nc} = -\Delta h_{nr,nc}$ since $\Delta h_{nr,c} = 0 = h_n r, c$ and the aggregate amount of F is fixed.

C. Conventional and Non-Conventional Bonds Are Issued

This appendix considers the case where both C and NC bonds are issued. Both types of investors may participate in the bond market.

C.1. Secondary market price schedule and demand function

Define

$$\begin{aligned}
\overline{y} &= \frac{N_r A_{nr}}{N_r A_{nr}+N_{nr}A_r} y_{r,1} + \frac{N_{nr}A_r}{N_r A_{nr}+N_{nr}A_r} y_{nr,1} \\
\underline{g} &= \min\{y_{r,1}+A_r q(1-q)(h_{r,0,nc}, y_{nr,1}+A_{nr}q(1-q)[h_{nr,0,c}+h_{nr,0,nc}]\} \\
\overline{g} &= \max\{y_{r,1}+A_r q(1-q)h_{r,0,nc}, y_{nr,1}+A_{nr}q(1-q)[h_{nr,0,c}+h_{nr,0,nc}]\} \\
X &= A_r q(1-q)\frac{H_{nc}}{N_r} - A_{nr}q(1-q)\frac{H_c}{N_{nr}}.
\end{aligned}$$

Then

$$P_{1,nc} = \begin{cases}
1-q-y_{r,1}-A_r q(1-q)\frac{H_{nc}}{N_r}, & \text{if } y_{nr,1} > y_{r,1}+\kappa+X \\
1-q-\overline{y}-\frac{A_r A_{nr}q(1-q)[H_c+H_{nc}]}{N_r A_{nr}+N_{nr}A_r}+\frac{N_{nr}A_r}{N_r A_{nr}+N_{nr}A_r}\kappa, & \text{if } y_{nr,1} \in y_{r,1}+\kappa+X \\
\qquad -\left(\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr}q(1-q)h_{nr,0,nc}, 0\right] & \\
1-q-\left(\underline{g}, \overline{g}+\kappa\right], & \text{if } y_{nr,1} \in y_{r,1}+\kappa+X \\
\qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr}q(1-q)h_{nr,0,nc} + (-2\kappa, 0] & \\
1-q-\overline{y}-\frac{A_r A_{nr}q(1-q)[H_c+H_{nc}]}{N_r A_{nr}+N_{nr}A_r}+\frac{N_r A_{nr}}{N_r A_{nr}+N_{nr}A_r}\kappa & \text{if } y_{nr,1} \in y_{r,1}-\kappa+X \\
\qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr}q(1-q)h_{nr,0,nc} & \\
\qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_{nr}A_r}(A_r q(1-q)h_{r,0,nc}, 0] & \\
1-q-y_{nr,1}-A_{nr}q(1-q)\frac{H_c+H_{nc}}{N_{nr}}, & \text{if } y_{nr,1} < y_{r,1}-\kappa+X \\
\qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_r A_{nr}} A_{nr}q(1-q)h_{nr,0,nc} & \\
\qquad -\frac{N_r A_{nr}+N_{nr}A_r}{N_{nr}A_r} A_r q(1-q)h_{r,0,nc} &
\end{cases}$$

and

$$P_{1,c} = 1-q-y_{nr,1}-A_{nr}q(1-q)[h_{nr,0,c}+h_{nr,1,nc}]+[0,\kappa]. \tag{C.1}$$

The associated demand is $h_{r,1,nc} = \frac{H_{nc} - N_{nr} h_{nr,1,nc}}{N_r}$, $h_{nr,1,c} = h_{nr,0,c}$, and

$$h_{nr,1,nc} = \begin{cases} 0, & \text{if } y_{nr,1} > y_{r,1} + \kappa + X \\ \frac{(1-q) - P_{1,nc} - A_{nr} q(1-q) h_{nr,0,c} - y_{nr,1} + \kappa}{A_{nr} q(1-q)} < h_{nr,0,nc}, & \text{if } y_{nr,1} \in y_{r,1} + \kappa + X \\ & \quad - \left(\frac{N_r A_{nr} + N_{nr} A_r}{N_r A_{nr}} A_{nr} q(1-q) h_{nr,0,nc}, 0 \right] \\ h_{nr0nc}, & \text{if } y_{nr,1} \in y_{r,1} + \kappa + X \\ & \quad - \frac{N_r A_{nr} + N_{nr} A_r}{N_r A_{nr}} A_{nr} q(1-q) h_{nr,0,nc} + (-2\kappa, 0] \\ \frac{(1-q) - P_{1,nc} - A_{nr} q(1-q) h_{nr,0,c} - y_{nr,1}}{A_{nr} q(1-q)} \geq h_{nr,0,nc}, & \text{if } y_{nr,1} \in y_{r,1} - \kappa + X \\ & \quad - \frac{N_r A_{nr} + N_{nr} A_r}{N_r A_{nr}} A_{nr} q(1-q) h_{nr,0,nc} \\ & \quad - \frac{N_r A_{nr} + N_{nr} A_r}{N_{nr} A_r} (A_r q(1-q) h_{r,0,nc}, 0] \\ \frac{H_{nc}}{N_{nr}}, & \text{if } y_{nr,1} < y_{r,1} - \kappa + X \\ & \quad - \frac{N_r A_{nr} + N_{nr} A_r}{N_r A_{nr}} A_{nr} q(1-q) h_{nr,0,nc} \\ & \quad - \frac{N_r A_{nr} + N_{nr} A_r}{N_{nr} A_r} A_r q(1-q) h_{r,0,nc} \end{cases}$$

Equivalently, with $\Delta y_r = y_{r,1} - y_{nr,1}$, the amount of NC bonds bought by NR investors in the secondary market, denoted as $\Delta h_{nr,nc} = h_{nr,1,nc} - h_{nr,0,nc}$, is

$$\Delta h_{nr,nc} = \begin{cases} \frac{H_{nc} - N_{nr} h_{nr,0,nc}}{N_{nr}}, & \text{if } \Delta y_r > \theta_{\text{high}} \\ \frac{(1-q) - P_{1,nc} - y_{nr,1} - A_{nr} q(1-q)[h_{nr,0,c} + h_{nr,0,nc}]}{A_{nr} q(1-q)}, & \text{if } \Delta y_r \in (\theta_{\text{med}_h}, \theta_{\text{high}}] \\ 0, & \text{if } \Delta y_r \in [\theta_{\text{med}_l}, \theta_{\text{med}_h}] \\ \frac{(1-q) - (P_{1,nc} - \kappa) - y_{nr,1} - A_{nr} q(1-q)[h_{nr,0,c} + h_{nr,0,nc}]}{A_{nr} q(1-q)}, & \text{if } \Delta y_r \in [\theta_{\text{low}}, \theta_{\text{med}_l}) \\ -h_{nr,0,nc}, & \text{if } \Delta y_r < \theta_{\text{low}} \end{cases}$$

where

$$\begin{aligned}
\theta_{\text{high}} &= \kappa + A_{nr} q(1-q) \frac{H_c + H_{nc}}{N_{nr}} \\
\theta_{\text{med}_h} &= \theta_{\text{high}} - \frac{N_r A_{nr} + N_{nr} A_r}{N_{nr} A_r} A_r q(1-q) h_{r,0,nc} \\
\theta_{\text{med}_l} &= \theta_2, \theta_{\text{med}_h} - 2\kappa \\
\theta_{\text{low}} &= \theta_3 - \frac{N_r A_{nr} + N_{nr} A_r}{N_r A_{nr}} A_{nr} q(1-q) h_{nr,0,nc} \\
&= -\kappa - A_r q(1-q) \frac{H_{nc}}{N_r} + A_{nr} q(1-q) \frac{H_c}{N_{nr}}
\end{aligned}$$

Moreover, $\Delta h_{r,nc} = -\Delta h_{nr,nc}$ and $\Delta h_{nr,c} = 0$.

C.2. Primary market demand function

Given $P_{0,c}$, $P_{0,nc}$, $h_{r,0,nc}$ and $h_{nr,0,nc}$, the optimal investment by NR investors in C bonds maximizes, in expectation, the utility

$$\begin{aligned}
U_{1,A_{nr}}(W_{i,2}) &= (1 - q - P_{0,c} - y_{\tau,1}) h_{\tau,0,c} + \left(\mathbb{1}_{\{R_2 = R\}} - P_{1,c} + \kappa \mathbb{1}_{\{h_{\tau,1,c} < h_{\tau,0,c}\}} - y_{\tau,1} \right) (h_{\tau,1,c} - h_{\tau,0,c}) \\
&\quad + \left(\mathbb{1}_{\{R_2 = R\}} - P_{0,nc} - y_{\tau,1} \right) h_{\tau,0,nc} + \left(\mathbb{1}_{\{R_2 = R\}} - P_{1,nc} + \kappa \mathbb{1}_{\{h_{\tau,1,nc} < h_{\tau,0,nc}\}} - y_{\tau,1} \right) (h_{\tau,1,nc} - h_{\tau,0,nc}) \\
&\quad - k_s \mathbb{1}_{\{h_{\tau,0,c} < 0 \text{ or } h_{\tau,1,nc} < 0\}} - \frac{1}{2} k_{\tau,c} (h_{\tau,0,c}^2 + h_{\tau,1,c}^2)
\end{aligned}$$

The FOC is

$$h_{nr,0,c} = \max \left(0, \frac{1 - q - P_{0,c} - \mathbb{E}_0(y_{\tau,1}) - A_{nr} q(1-q) \, \mathbb{E}_0(h_{nr,1,nc})}{A_{nr} q(1-q)} \right).$$

D. Variable Definitions

- **C-only issuer**: An issuer that only has conventional bonds in the sample.
- **High issue cost**: An indicator variable for firms that are likely to incur high costs of issuing Islamic bonds. The indicator variable is set to one for issuers that have subsidiaries in any of the financial industries (banking, capital markets, consumer finance, insurance and leasing), but not counting Islamic bank subsidiaries. The variable is also set to one for foreign issuers. It is set to zero for quasi-government issuers unless they are foreign.
- **Industry**: Issuers are categorized as having exposure to 28 industries. See the Data Appendix for details. Issuer industry variables are averages of their subsidiaries' industry indicator variables.
- **Intangible**: Indicator variable for issuers that are not producers of tangible goods. Producers of tangible goods are issuers that have at least half of their subsidiaries (including themselves) in the following industries: agriculture, automobile manufacturing, building materials, chemicals, construction, energy, food and tobacco, machinery, metals and mining, other manufacturing, paper, telecommunications, textiles, and transportation.
- **Islamic**: An indicator variable for a bond that has been certified as Islamic by the Securities Commission of Malaysia, as reported in the ETP database.
- **Issuer**: The ultimate owner of the entity (operating firm, SPV, or government-backed corporation/fund) that issued the bond. Ownership is defined as having over 50% of the equity.
- **Leverage**: Total debt to assets.
- **Log assets**: Log of book value of assets as reported by CapIQ or, when not available in CapIQ, Oriana.
- **Log issuance amount**: The log of the Ringgiit par value of debt at time it was issued.
- **Maturity**: The number of years until the bond matures.
- **Mixed issuer**: An issuer that issues both conventional and Islamic bonds at least once during the sample period.

- **NC-only issuer**: An issuer that only has Islamic bonds in the sample.
- **Primary market buyers**: The primary market is defined as including any trade reported in the ETP database that takes place in the calendar month of the issue date. These include when-issued trades, which typically occur no more than three days before the issuance date.
- **Rating indicators**: The RAM long-term bond credit rating is used to create indicators for broad categories (AAA; AA; A; BBB; and below investment grade). A-BBB is an indicator for being either A or BBB. When RAM ratings are not available, MARC ratings are used. If only short-term ratings are available, then P1 is assigned as AAA and P2 as A. P3 or lower is considered below investment grade.
- **Religious and non-religious investors**: Traders are defined as religious if their organization type is 'Islamic bank'. Non-religious investors are traders with all other organization types except 'N/A' or 'Unknown'.
- **ROA**: Return on assets is defined as net income divided by total assets.
- **Sales growth**: The percentage change in sales/revenue of the issuer over the previous fiscal year. If the fiscal year changes, the growth figure is adjusted downward for issuers with delays in reporting and upwards for ones with shortened years.
- **Simultaneous issues of mixed issuers**: Bonds of both conventional and Islamic types are issued in the same calendar month by the same issuer.
- **Subsidiary**: The name of the entity that issued the bond. If there is no firm, fund or government entity that has over 50% of the equity then the subsidiary is the same as the issuer.
- **Yield spread**: The difference between the imputed government yield with the same maturity and the bond's yield to maturity. The yield units are percentage points.

E. Data Appendix

In this section we discuss details related to the cleaning of the dataset as well as the sources of data for the creation of additional variables. These steps fall into the following categories: yields and prices; ratings; industry; ownership and Shariah compliance. A very small fraction of the original dataset was excluded from the analysis for the following reasons: (1) one bond only traded once and the trade date was after the bond was redeemed (using the redemption date reported by Factiva); (2) one issuer's bonds were excluded from the sample because the issuer was described as the first issuer of a municipal bond in Malaysia (reported in Factiva). Many bonds were issued by entities that have a connection to state governments but these are not described as municipal bonds and they are kept in the sample.

E.1. Transaction prices and yields

The ETP reports the yield at which a transaction took place, as well as its price. These are often entered into the sample as zero rather than as missing. We treat a zero price or yield as missing. The price can be calculated from the size of the trade and the nominal value of the trade (the face value of a bond times the number of bonds) and this calculated price is used to clean the sample. The calculated yield is not used to clean the dataset because the coupon is frequently reported as zero when it has a positive value, which can be seen by the fact that the bond's traded price is nearly always close to par. We do not use reported yields that differ by 20% or more from the median price on a given day if there are at least five trades on that day. We also treat prices as missing if they differ from the previous day by more than 20% if the following day the price (yield) rebounds to its previous value and remains there for at least a week. In tests related to liquidity, bonds that have less than one year remaining until maturity are also excluded from the analysis. Trading-based analysis also ignores cross-trades. Cross-trades are transactions where trader A sells a bond to trader B, and then buys the same quantity of that bond from trader B at the same price within ten minutes.

E.2. Ratings

The ETP dataset includes a rating from either the Rating Agency Malaysia (RAM) or the Malaysian Rating Agency Corporation (MARC) or both. However, in many cases it is not the rating at the time of the trade date. We identify this problem from the fact that the rating of a firm that eventually defaulted is 'D" for every trade, even on the issuance date. Whether the rating agency is RAM, MARC, Moody's or S& P, there is a tendency to leave ratings unchanged. To the extent that we could find RAM and MARC annual default and transition studies for our sample period, they confirm that the vast majority of ratings are stable from year to year. Thus, the majority of the ratings are correct even if they are ratings from a later time period. To make the ratings more accurate we followed these steps: First, we downloaded the entire history of MARC ratings from the MARC website and searched for any rating action that MARC called an upgrade or a downgrade. MARC was formed in late 1995 and had a lower market share than RAM for several years, so these data are not comprehensive. Second, we search the RAM website for headlines of ratings announcements with the words downgrade or upgrade. The RAM website includes articles from 2005 and later. Third, we search news articles in Factiva for announcements related to RAM and MARC downgrades and upgrades and for ratings assignments when the ETP has no rating data. There are a very small number of bonds issued by Malaysian firms that have no ratings from RAM or MARC but do have one from Moody's (an A rating). We assign these to the AAA category given that Moody's is less lenient. Neither RAM nor MARC assign ratings to government entities, such as Khazanah. Likewise, there are no ratings for foreign issuers. Given that all of the entities with Malaysian government guarantees are AAA-rated by dint of their government support, we classify all government-related bonds as AAA. Likewise, given the much higher average creditworthiness of the foreign issuers in the sample, they also are considered AAA-rated. After revising the rating data, there are slightly more than 200 observations with no rating information. We note that the ratings are specific to a bond, not the firm (they are not senior implied ratings). Thus, a firm could have two bonds with different ratings trading on the same day. Many of the bonds have higher ratings than the firm's stand-alone rating because they have bank guarantees and some of those

ratings change over time because the banks' ratings changed.

E.3. Industry

We identified the industry of the issuer from several sources. For issuers with data in CapIQ, we considered that database's category. In the case of an SPV, CapIQ did not report the ultimate beneficiary of the proceeds and only listed the industry as SPV (financial). We supplemented these data and found industry for firms not in CapIQ with a search in Factiva. For issuers with no information in Factiva, we searched the internet. SPV issuers' industry are entered as the industry of the SPV parent firm if the SPV is merely a funding conduit for the firm. There are a small number of SPVs that are not funding conduits and their industries may differ from their parents'. From information in CapIQ and Factiva, we identified 114 of the 683 issuers as SPVs. We classify the 683 issuers into one of 28 industry categories, where the choice to create an industry is based on having a sufficient number of firms in the category. The categories, in order of most populated to least, with numbers in parentheses are: real estate (83), construction (82), transportation (67), banking (58), utilities (53), energy (29), capital markets (28), agriculture (20), food and tobacco (24), telecommunications (23), hotels (22), government (18), retail (17), consumer finance (15), information technology (15), automobile manufacturing (13), healthcare (13), leasing (12), metals and mining (12), building materials (11), paper (11), chemicals (9), machinery (9), other manufacturing (9), conglomerates (8), media (8), insurance (7), and textiles (7).

E.4. Ownership

Particularly in the case of SPVs, many Malaysian issuers are part of a business group where the boundaries of the company are imprecise. For example, our data includes bonds issued by Ambank (M) Bhd., Ambank Islamic Bhd., AmInvestment Bank Bhd., and AMMB Holdings Bhd. If we count these as separate, independent issuers we may be overstating the degree of control exercised by each entity, as well as overstating the degrees of freedom in our analysis. Thus, rather than analyzing issuer-specific characteristics and securities issuance patterns, we carry out our analysis

at the parent level. Parents are defined as firms or funds with over 50% of the shares of the issuer. If no such organization exists, because ownership is dispersed or because the blockholder is an individual or family that does not own the issuer via a company, then the issuer is considered to be the parent. We determine the ownership of listed firms from their annual reports. If the ownership changes from one month to the next we identify the data of change from the report or Factiva. Many of the firms in the sample are not publicly traded. Their ownership information is from Factiva. It is not uncommon for an article in Factiva to mention the ultimate ownership in an article about the bond's rating (which is often identical to what is on RAM's website). Other articles might mention the percentage of shares owned when there are multiple shareholders or if a well-known entrepreneur has sold or bought a stake. If we are unable to find any information about the parent in Factiva, we assume that the issuer is the parent. If the company is a joint venture (JV) with equal ownership between the JV investors, the issuer is considered to be the parent, but if one investor in the JV has over 50% of the shares, it is the parent. Parent ownership changes often in this sample but the exact date is not always known. Thus, ownership data is recorded for the month and year rather than the day.

The Malaysian government is a parent in numerous cases but not always with the same controlling entity. Of the five GLICs mentioned in Section I, the ETP is the parent of six issuers, LTH only one, and PNB controls 14 issuers in our sample, while LTAT and KWAP do not have controlling interests in any of our issuers. In addition to these GLICs, Khazanah and the Ministry of Finance are the parents of 27 and 12 issuers, respectively. Some of the issuers they control are the government-linked companies (GLCs) that "graduated" from the GLC Transformation Program in 2015, such as Sime Darby and UEM's PLUS. We identify 16 issuers as owned by the Government of Malaysia directly, including Danaharta, the entity set up to deal with toxic bank assets in the Asian Flu crisis of the late 1990s. In addition to the federal government, some of the issuers are owned by state government, particularly Sarawak, Johor and Selangor.

We identified foreign governments as the owners of several issuers. For example, the Korea Development Bank, the Export-Import Bank of Korea and the Industrial Bank of Korea issued

more than a dozen bonds with trades in our ETP. Supranational issuers include the World Bank and Asian Development Bank. We categorize all parents as foreign if they are not described in Factiva as Malaysian companies. More than half of the 21 foreign parents are from other countries in Asia.

E.5. Shariah compliance

For parts of the analysis, we restrict the sample to firms that could be included on the Shariah Advisory Council's list of Shariah-compliant securities. The lists start in 1997 and, beginning in 2001, are updated twice a year. Most of the firms on the list have publicly traded common stock at the time of the list, although it is possible that some only have traded warrants or some other equity-linked security that trades on the Bursa Malaysia. Private firms in our sample could be considered compliant with Shariah law when they ask to issue a bond but those firms are not included on the list. The lists are available at https://www.sc.com.my/development/icm/shariah-compliant-securities/list-of-shariah-compliant-securities. For earlier years, additions and removals from the list are available from articles in Factiva.

Because only listed firms can be included on the list, comparisons between firms that are on the list and those that are not are restricted to listed firms. We identify listed firms through the following process. First, we check the current status of the firm in CapIQ and if it is public, collect data on its initial public offering (IPO) date. If the firm is not on listed as publicly trade in the latest version of CapIQ, we check the Bursa Malaysia website to see if it was ever listed during the sample period (https://www.bursamalaysia.com/bm/market_information/announcements/). Firms that change their names return no data if the search does not use the most recent name, but the previous name is listed with previous annual reports if the new name is used. We check for firm name changes in Factiva. The later Shariah lists note the code assigned to the firm by the Bursa, so name changes are also identified by comparing names across Shariah lists for the same code.