Why interest free Islamic banking is not free from interest?

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Abstract

This paper develops a theoretical model for a conventional and an Islamic bank and shows how debt in conventional banks and Murabaha instrument in Islamic banks converge under competition. This competitive pricing mechanism induces Islamic bank to structure the Murabaha financial product with risk profile similar to the conventional bank's debt. Thus, the competition crowds out original Islamic financial structures and creates Shariah compliant replicas. The competitive pricing on the asset side in Islamic bank also causes the liability side Mudarabah rate with depositors to converge with the conventional deposit rate. Theoretical arguments in this paper are then supported by an empirical analysis using the linkages of benchmark interbank offer/lending rates between conventional banks and Islamic banks. For conventional banks, we take London interbank offer rate (LIBOR) and for Islamic banks we take Islamic interbank benchmark (offer) rate (IIBR). Our theoretical and empirical findings suggest that the Islamic financial instruments that are currently dominant in the industry differ from their conventional counterparts only in terms of their legal lexicon but in essence have little financial or structural difference.

Key words: Theoretical model; Conventional bank; Islamic bank; Interest free banking; Shariah compliance; LIBOR; IIBR;

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1. Introduction

Islamic Finance industry has experienced significant expansion in the last decade. The Middle Eastern petro dollars, thriving Asian economics and a growing religious consciousness amongst the world's Muslim population together, has contributed to this phenomenal growth of the industry. The Islamic finance industry's legitimacy and growth hinges upon the religious aspirations of its customers.

The industry's expansion, however, has not been without controversy. Shariah compliance of the industry has been a point of contention. While there seems to be a general consensus on the legitimacy of joint venture modes, like Musharkah and Mudarabah, the debt like structures of Murabaha and Ijarah, have been deemed controversial. Some consider them to be against the spirit of Islamic finance and point to their financial and economic impact which does not seem to be quite different from the conventional debt. They argue that the Islamic financial instruments, that are currently dominant in the industry (like Murabaha on the asset side which constitutes 70%-80% financing of Islamic banks) differ from their conventional counterparts only in terms of their legal lexicon but in essence have little financial or structural difference (Khan, 2010; Hasan and Dridi, 2010; Azmat, Skully and Brown, 2014_a, 2014_b, 2015). Hence, it is argued that these instruments are not truly Islamic. Others argue that the prevalent Islamic instruments undergo a rigorous process of Shariah approval and are compliant with 'juristically sound' Islamic principles. These instruments are Shariah compliant, irrespective of their wider financial implications (Ayub, 2009). The former blame the latter for relying too much on Islamic law and missing out on the spirit of the transactions while the latter blame the former on neglecting Islamic law and focusing too much on economic rationale.

This paper argues that Islamic banks operate in an environment dominated by conventional banks, in which the latter act as price setters while the former are price takers. In order to remain competitive and attractive to firms and depositors driven by the profit maximization mindset, Islamic banks price their financial products similar to conventional ones. In order to illustrate the pricing in a competitive marketplace, this paper uses debt in conventional banks and Murabaha instrument in Islamic banks as a case. The paper develops a theoretical model for a conventional and an Islamic bank and shows how conventional debt and Murabaha rates converge under competition. This competitive pricing mechanism induces Islamic bank to structure the Murabaha financial product with risk profile similar to the conventional bank's debt. The more the Islamic bank structures the Murabaha instrument closer to the conventional loan, the more the product becomes non-Shariah compliant. Thus, the competition crowds out original Islamic financial structures and creates Shariah compliant replicas. The competitive pricing on the asset side in Islamic bank also causes the liability side Mudarabah rate with depositors to converge with the conventional deposit rate.

Our model also shows that intervention by a centralized regulator is essential in a competitive environment to induce Islamic banks to formulate Shariah compliant financial products. The regulator fixes a structural threshold below which any financial product like Murabaha becomes non-Shariah compliant. The actual structure of the financial product developed by an Islamic bank is unobserved by the regulator. It only becomes known in the event of an audit conducted by the regulator. There lies asymmetric information between the regulator and the Islamic bank regarding the actual structure of the financial product (see also, Azmat, Skully and Brown, 2014_a). A periodic audit cannot be conducted by the regulator since it is costly. As a result, a random audit policy is adopted by the regulator to incentivize the Islamic bank in structuring Shariah compliant financial

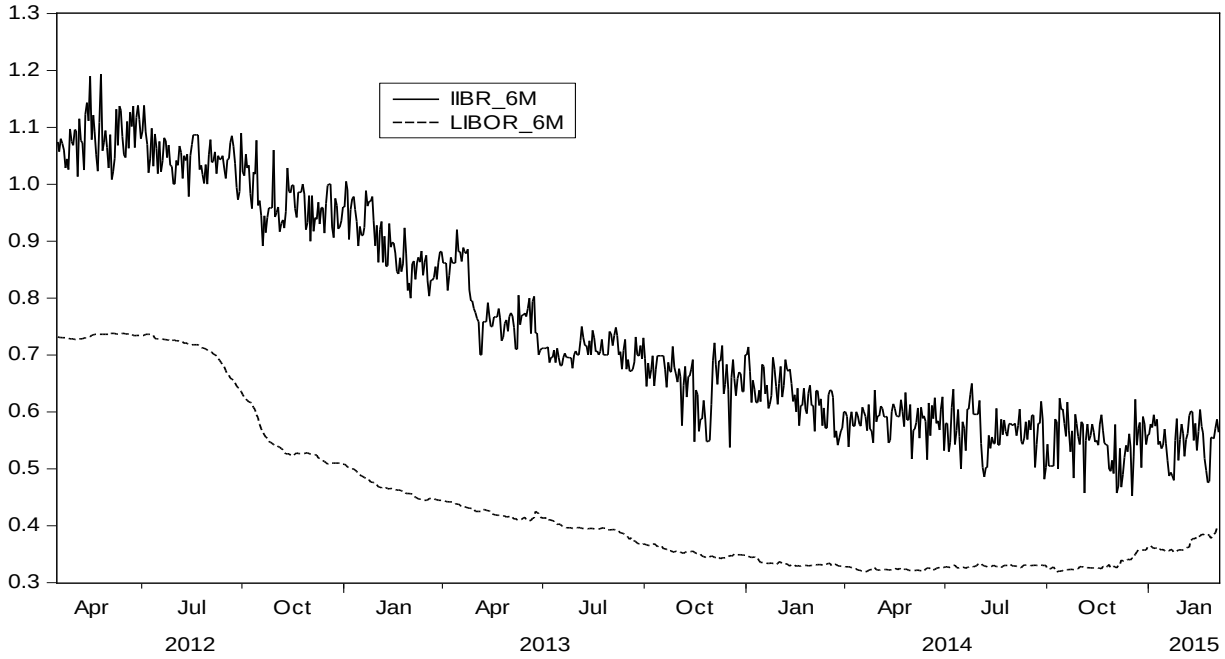
product. The Islamic bank does not know with certainty whether an audit will be conducted or not but it knows the probability with which it will be conducted. If an audit is conducted and it is found that the specified regulatory threshold is violated, then a penalty is imposed on the Islamic bank. The penalty acts as a deterrent for the Islamic bank from structuring and pricing its financial product similar to the conventional bank as a result of competition.

Furthermore, the proposed model illustrates that the depositors of Islamic bank can also induce the bank to structure and price its financial products like Murabaha on the asset side, in a Shariah compliant manner. This is done by demanding an appropriate return on Mudarabah deposits on the liability side. This encourages the Islamic bank to formulate Shariah compliant financial products on the asset side. Our theoretical model also argues that it is not the structure of Murabaha instrument that affects its price, but the other way round. The price of Murabaha is determined in a competitive setting which eventually affects the structure of this financial product.

As an empirical testing, we use the most widely-used benchmark offer/lending rates from both markets: London interbank offer rate (LIBOR) for conventional banks and Islamic interbank Benchmark rate (IIBR) for Islamic banks. These rates are used as the benchmark for determining their market-specific deposit, lending and derivative products. In Islamic banking, IIBR rates are utilised to price various Islamic financial instruments including Murabaha, Wakala, Mudarabah, retail financing instruments like property finance and personal loans, sukuk (bonds) and other Shariah compliant products. A visual inspection of the stability of the IIBR spreads over the LIBOR rates is a clear indication that Islamic banks simply add their spreads over LIBOR rates to determine their “Islamic” version of LIBOR rates (see Figure 1). The stability of IIBR spread confirms the fact that it is difficult for Islamic banks to entirely delink it from the conventional financial system and make the Shariah-compliant products free from interest (Chong and Liu, 2009).

Figure 1: IIBR and LIBOR rates

This figure shows the daily 6-month Islamic interbank benchmark rate (IIBR) and London interbank offered rate (LIBOR) both in US dollar. The rates are shown in percentage points. The sample covers the daily data from April 16, 2012, through March 5, 2015. The figure is based on the data collected from Thomson Reuters DataStream.



The theoretical arguments and empirical findings from IIBR-LIBOR relationships have important implications for the policy makers, regulators, Shariah conscious firms and Islamic bank depositors. For policy makers and regulators, it suggests that Islamic finance industry needs to be protected and given sufficient incentives for the promotion of Shariah compliant financial structures. For Shariah conscious firms and depositors, we suggest that there should be willingness amongst firms and depositors to accept lending and deposit rates which are different from the ones offered by the conventional banking system.

The rest of the paper is structured as follows. Section 2 provides an introduction to Islamic financial products to differentiate them from conventional ones. Section 3 develops the theoretical model. Section 4 describes the empirical setting and Section 5 presents some empirical findings. Section 6 concludes the paper.

2. Introduction to Islamic Finance

This section briefly discusses Islamic finance characteristics that differentiate it from conventional finance. The focus then shifts to Murabaha financing where a typical Murabaha contract is distinguished from a conventional loan. The section then analyses the competitive environment is which Islamic finance industry operates and its impact on the Murabaha structure.

2.1 Islamic Versus Conventional Finance

Islamic finance differs from its conventional counterparts due to several prohibitions stemming from Islamic law relating to riba (interest), gharar (uncertainty) and maysir (gambling) (Ayub, 2009). 'Riba' (interest) literally means an increase or excess (Usmani, 2002). Its modern day definition, however, includes any excess to the principal amount of loan (see Ayub, 2007). Islamic banks use Shariah compliant alternatives to conventional finance that are free from riba (interest), gharar (uncertainty) and maysir (gambling) such as Qard Hasana (interest free loan), Islamic joint venture (Musharkah/Mudarabah) and trade or lease based mode (Murabaha/Ijarah/Salam/Istisna) (Usmani, 2002; Ayub, 2009)

2.2 Murabaha – Structure, Risk and Pricing

A Murabaha contract refers to an agreement whereby the Islamic bank sells to a customer, at acquisition, cost plus an agreed profit margin (or mark-up), a specified kind of asset that is already in its possession (such as a manufactured good). The total cost is usually paid by the customer in instalments.

Murabaha structure typically involves the bank buying the underlying assets and selling it at a premium in return for a deferred payment. The asset has to come under the ownership of the bank

before it can be sold to the customer. This ownership requires that for a particular time period, the bank bears the risk of the underlying asset getting destroyed. The absence of this risk makes the structure non-Shariah compliant and tantamount to Riba. Islamic banks, therefore, ensure that they take possession of the asset even if it is for a very small time period. It is this ownership risk born by the Islamic bank that entitles it to the excess premium.

Islamic banks bear an additional cost not prevalent in the conventional loan structure due to the asset ownership. This potential cost is a direct outcome of the asset's destruction probability. If the asset is destroyed before the client (firm) takes its ownership, Islamic bank will bear its entire loss. The firm would remain exonerated as the asset ownership rests with the bank. A conventional bank is free from such risk as the conventional bank's concern is with the loaned amount and the underlying risk of asset being destroyed at no time comes under the bank's ownership. In a traditional loan contract, the firm, therefore, bears the entire asset risk.

Moreover, Islamic banks have to bear a supplementary cost associated with the ownership transfer and possession of the underlying asset. Islamic banks might have to hire trained personnel to ensure that the asset comes under their ownership before the offer of sale is made to the client. The asset possession also entails a storage cost for the bank. The asset type, ownership transfer cost and storage can significantly increase a Murabaha structure's total cost compared to a conventional loan. Since, this extra cost is very negligible, the paper ignores this element of cost while developing the model.

2.3 Mudarabah – Structure, Risk and Pricing

Mudarabah is a contract by which an investor/depositor places an investment fund with an Islamic bank (IB). The bank could have restricted or full discretionary power in making investment

decisions. The bank acts as an entrepreneur while the depositor acts as a capital provider. Both parties agree on a ratio of profit-loss sharing, which must be disclosed and agreed upon at the time of opening the investment account. Profits generated by the bank are shared with the depositor in accordance with the terms of the agreement while losses are borne solely by the depositor, unless they are due to IB's misconduct, negligence or breach of the contract terms.

3. Model

We start with a model for a conventional bank to determine the optimal deposit and lending rates. Then, a theoretical model of an Islamic bank is developed using Mudarabah and Murabaha contracts on the liability and asset sides respectively. Using the Islamic banking model, optimal Mudarabah profit sharing ratio and Murabaha mark-up rate are determined. Then the model shows how conventional bank's lending rate and Islamic bank's Murabaha rate converge in a competitive environment. Later, the role of regulator is incorporated in the model to ensure Shariah compliance of the financial product developed by Islamic bank. Finally, the role played by 'religiously conscious' depositors to induce Shariah compliance is illustrated.

3.1 Conventional Bank

It is assumed that the conventional bank charges a rate, R_{Lc}, to borrowers on conventional debt and pays a rate, R_{Dc}, to conventional depositors. P is the probability that bank funded project will succeed in which case the bank will get the return, R_{Lc}, and the principal amount of the loan, $L(R_{Lc})$. L is a function of R_{Lc} with $L'(R_{Lc}) < 0$. $1 - P$ is the probability that bank funded project will fail in which case the bank will receive zero return and will also lose out the loan's principal amount. Similarly, the depositors also receive the return, R_{Dc}, and the face value of deposits, D, only if the bank's project succeed. If it does not succeed, the depositors receive neither the return

nor the face value of their deposits. The reservation utility of depositors for investing their money in the conventional bank is given by $\bar{U}$.

Formally, conventional bank's problem is given by the following set up:

$$\underset{R_{Lc}, R_{Dc}}{Max}\ \pi = P[(1+R_{Lc})L(R_{Lc}) - L(R_{Lc})] + (1-P)[0 - L(R_{Lc})] - P[(1+R_{Dc})D - D] - (1-P)[0-D] \quad (1)$$

Subject to depositor's participation constraint -

$$P[(1+R_{Dc})D - D] + (1-P)[0-D] \geq \bar{U} \quad (2)$$

And the budget constraint -

$$D = L(R_{Lc}) \quad (3)$$

Solving the above system, we have the following Proposition 1;

Proposition 1: *The optimal deposit and lending rates for a conventional bank are given by Equations (4) and (5) respectively.*

$$R_{Dc} = \frac{\bar{U}}{PD} + \frac{(1-P)}{P} \quad (4)$$

$$R_{Lc} = \frac{(1-P)}{P} - \frac{L(R_{Lc})}{L'(R_{Lc})} \quad (5)$$

3.2 Islamic Bank

It is assumed that the Islamic bank has Murabaha and Mudarabah contracts on the asset and liability sides respectively. This is a reasonable assumption to make since most Islamic banks' contracts with borrowers are of Murabaha type while most contracts with depositors are Mudarabah

arrangements. Islamic bank charges a Murabaha rate, R_{Li}, to borrowers and pays a rate, βR_{Li}, to depositors where β is the Mudarabah profit sharing ratio.

Islamic bank buys a real asset and keeps it under its ownership for a certain period of time, T, before eventually transferring it to the borrower through a Murabaha contract. This exposes Islamic bank to the risk of the asset being destroyed during the time it is in the ownership of the bank. Under the bank's ownership, the time at which the asset can get destroyed, t, is a continuous random variable with a density function given by $f(t)$. Hence, the probability that the asset will be destroyed during the period of bank's ownership is given by Equation (6).

$$P_d = \int_0^T f(t)dt \tag{6}$$

Compared to conventional bank which only faces the risk of the success or failure of bank funded project (credit risk), Islamic bank faces an additional risk of the asset being destroyed while under its ownership. As a result, Islamic bank receives return, R_{Li}, and the principal value of the Murabaha loan, $L(R_{Li})$, from the borrower, only if the asset is protected under its ownership and the bank funded project succeeds. If either the asset is destroyed under the bank's ownership or the bank funded project fails, in both cases the bank receives zero return and losses the principal value of the Murabaha loan. L is a function of R_{Li} with $L'(R_{Li}) < 0$. Similarly, depositors also receive the return, βR_{Li}, and the face value of their deposits, D, from the bank, only if the asset is saved under the bank's ownership and the bank funded project succeed. If any of these two conditions are not satisfied, depositors receive zero return from the bank, and also forego the face value of their deposits. The reservation utility of depositors for investing their saving in Islamic bank is assumed for the time being to be given by $\overline{U}$ – similar to the conventional bank. This assumption will be relaxed in the later section.

Formally, the Islamic bank's problem is given by the following setup;

$$\underset{\beta, R_{Li}}{\text{Max}}\pi = (1-P_d)[P\{(1+R_{Li})L(R_{Li}) - L(R_{Li})\} + (1-P)\{0 - L(R_{Li})\}] + P_d[0 - L(R_{Li})] - (1 -$$

$$P_d)[P\{(1+\beta R_{Li})D - D\} + (1-P)\{0-D\}] - P_d[0-D] \quad (7)$$

Subject to the depositor's participation constraint -

$$(1-P_d)[P\{(1+\beta R_{Li})D - D\} + (1-P)\{0-D\}] + P_d[0-D] \geq \bar{U} \quad (8)$$

And the budget constraint -

$$D = L(R_{Li}) \quad (9)$$

Solving the above system, we have the following Proposition 2;

Proposition 2: *The optimal Mudarabah profit sharing ratio and the optimal Murabaha mark-up rate for an Islamic bank are given by Equations (10) and (11) respectively.*

$$\beta = \frac{\bar{U}+P_d D}{(1-P_d)PR_{Li}D} + \frac{(1-P)}{PR_{Li}} \quad (10)$$

$$R_{Li} = \frac{P_d}{(1-P_d)P} + \frac{(1-P)}{P} - \frac{L(R_{Li})}{L'(R_{Li})} = \frac{\int_0^T f(t)dt}{\left(1-\int_0^T f(t)dt\right)P} + \frac{(1-P)}{P} - \frac{L(R_{Li})}{L'(R_{Li})} \quad (11)$$

Using Equations (5) and (11) we have the following Corollary 1.

Corollary 1: *In the absence of competition, Islamic bank's Murabaha rate charged to borrowers is greater than the conventional bank's lending rate.*

$$R_{Li} > R_{Lc} \quad (12)$$

Using Equations (4) and (10) we have the following Corollary 2.

Corollary 2: *In a non-competitive setting, Islamic bank's Mudarabah rate offered to depositors is greater than the conventional bank's deposit rate.*

$$\beta R_{Li} > R_{Dc} \tag{13}$$

3.3 Convergence of Conventional and Islamic Banking rates under Competition

In a competitive setting, to remain attractive to profit maximizing firms (borrowers), Islamic bank has to offer a Murabaha rate which is similar if not identical to conventional lending rate. The only variable in the Murabaha rate equation that is within the control of Islamic bank is the probability of the asset being destroyed while under bank's ownership. One way to reduce this probability is to reduce the time period, T, for which the bank keeps the asset under its ownership. The Islamic bank cannot reduce the time period to zero, since this would make the Murabaha instrument non-Shariah compliant from the legal perspective. Hence, the bank structures the Murabaha instrument in the following manner:

$$\lim_{T\to 0} P_d = \lim_{T\to 0} \int_0^T f(t)dt \ \therefore \ P_d \to 0 \tag{14}$$

From Equation (14), we have the following Propositions 3 and 4.

Proposition 3: *Competitive forces induce the Islamic bank to charge a Murabaha rate similar to the conventional bank's lending rate.*

$$R_{Li} \cong R_{Lc} \tag{15}$$

Proposition 4: *In a competitive environment, Islamic bank offers a Mudarabah rate similar to the conventional bank's deposit rate.*

$$\beta R_{Li} \cong R_{Dc} \tag{16}$$

3.4 Regulator's Role

If Islamic bank structures a Murabaha instrument as illustrated in Equation (14), it gives an illusion of the instrument being non-Shariah compliant. Although, the instrument is not impermissible in purely legal terms until the bank actually reduces T and P_d to absolute zero levels, the essence of the transaction gives rise to the perception of non-Shariah compliance. It is because the Murabaha instrument is now 'priced' similar to the conventional bank loan. The perception of Shariah compliance is very important in Islamic Finance since the industry's legitimacy and ultimately its existence hinges upon the religious aspirations of its customers.[1] Hence, in a competitive environment, intervention by a regulator is essential to ensure that Islamic and conventional products are priced differently and the illusion of similarity between them is brushed aside. The regulator can stipulate a time period, T^*, for which the asset must be kept in the bank's ownership for the transaction to be called Shariah compliant. If actual T is lower than T^*, the Murabaha transaction is deemed non-Shariah compliant by the regulator. There lies asymmetric information between the bank and the regulator with regards to the time period, T, for which the asset is actually kept under bank's ownership. The bank has information about this time period but the regulator only knows about it in the case of an audit conducted by it. Since the audit is costly, instead of conducting periodic audit, the regulator commits to a random audit policy. The Islamic bank does not know with certainty whether an audit will be conducted or not but it knows the probability, φ, with which it will be conducted. If an audit is conducted and it is found that the bank has kept the

[1] The AAOFIF 2008 proclamation highlighted the significance of perception in Islamic Finance industry. The standard setting body declared that 85% of all Islamic bonds were non-Shariah compliant which resulted in a massive decline in the Islamic bond market.

asset for a time period lower than the one specified by the regulator, a penalty,$\mathbb{P}$, is imposed on the bank. The penalty acts as a deterrent to the bank from violating the regulatory threshold.

Formally, the regulatory floor is given by the following expression.

$$\overline{P_d} = \int_0^{T^*} f(t)dt \tag{17}$$

Equation (17) leads to the following Proposition 5.

Proposition 5: *With regulatory intervention, the optimal Murabaha mark-up rate for an Islamic bank is given by*

$$R_{Li} = \frac{\overline{P_d}}{(1-\overline{P_d})P} + \frac{(1-P)}{P} - \frac{L(R_{Li})}{L'(R_{Li})} = \frac{\int_0^{T^*} f(t)dt}{\left(1-\int_0^{T^*} f(t)dt\right)P} + \frac{(1-P)}{P} - \frac{L(R_{Li})}{L'(R_{Li})} \tag{18}$$

We can calculate the penalty, $\mathbb{P}$, that should be imposed by the regulator to incentivize the bank to conform to the regulatory threshold expressed in Equation (17). This brings us to Proposition 6 below.

Proposition 6: *The penalty, $\mathbb{P}$, that must be levied on the Islamic bank to ensure that it does not violate the regulatory floor laid down by the regulator is given by*

$$\mathbb{P} = \frac{(\overline{P_d} - P_d)PL(R_{Li})(1+R_{Li})}{\varphi} \tag{19}$$

$$\forall\ P_d < \overline{P_d}$$

Where, $\overline{P_d}$, is the destruction probability of the asset corresponding to time period, T^*, specified by the regulator and, P_d, is the destruction probability corresponding to actual time period, T, chosen by the bank to keep the asset under its ownership.

3.5 Depositor's Role

Religiously conscious depositors of Islamic bank can also induce the bank to conform to a Shariah compliance threshold similar to the one in Equation (19). This is done by demanding an appropriate profit sharing ratio on Mudarabah deposits. This appropriate profit sharing ratio is expressed in the following proposition.

Proposition 7: *The optimal Mudarabah profit sharing ratio on the liability side, to induce the Islamic bank to follow the Shariah compliance threshold while pricing the Murabaha instrument on the asset side, is given by*

$$\beta = \frac{\bar{U}+\overline{P_d}D}{(1-\overline{P_d})PR_{Li}D} + \frac{(1-P)}{PR_{Li}} \tag{20}$$

Since the depositors price $\overline{P_d}$, the bank is also forced to price the Murabaha instrument in a Shariah compliant manner by incorporating $\overline{P_d}$.

4. Empirical Setting

In order to provide some empirical support of our theoretical argument, we look at the widely-used benchmark interbank offer rates from Islamic banks and conventional banks. For Islamic banks, we take Islamic interbank benchmark rate (IIBR), and for conventional bank, we take LIBOR rates. Both IIBR and LIBOR are available in different maturities and are determined by their corresponding best panel banks. IIBR (in US dollar[2]) was first launched on 14th November, 2011 by seventeen Islamic banks[3] from six Middle Eastern countries in conjunction with the Thomson

[2]The reason to provide the IIBR in US dollar is to have uniformity across all contributors, which have substantial reserves in US dollars and five of the six countries peg their currencies to the US dollar. Moreover, the purpose of setting the benchmark in US dollar is to allow other Shariah based financial institutions around the world to use for pricing their Shariah compliant products.

[3]The official Contributor Panel for the IIBR as of 22 November 2011 is comprised of 17 members as follows: Abu Dhabi Islamic Bank, Ahli United Bank, Al Baraka Bank, Al Hilal Bank, Dubai Islamic Bank, Noor Islamic Bank,

Reuters. IIBR was corrected since April 16, 2012 as it was initially set in bid-rate similar to that of London interbank bid rate (LIBID). Since that amendment, IIBR has never exceeded LIBOR for a given maturity and IIBR has been always set above the LIBOR creating a "piety premium". It is to be noted that IIBR is used by most if not all Islamic banks in the Gulf region in pricing various Islamic financial instruments including Murabaha, Wakala, Mudarabah, retail financing instruments like property finance and personal loans, sukuk (bond) and other Shariah compliant products. Thus, the diverse use substantiates the choice of IIBR and its relationship with its conventional counterpart, LIBOR. The relationship between the two is expected to indicate how difficult it is for Islamic banks to offer a true interest-free product. We investigate both the long-term equilibrium relationship and short-term dynamic relationship between LIBOR and IIBR. For the long-term equilibrium relationship, we apply Johansen's cointegration test and, for the short-term dynamic relationship, we use asymmetric generalized dynamic conditional correlation (AG-DCC) model of Cappiello, Engle and Sheppar (2006).

To explain the AG-DCC model of Cappiello et al (2006), we start with Engle's (2002) DCC model. Let $y_t = \left[y_{1,t} y_{2,t}\right]'$ be a $k \times 1$ vector containing changes in the IIBR and LIBOR series for different tenors/maturities. The conditional distribution of these rate changes is assumed to be normal with mean zero and covariance H_t:

$$y_t = \varepsilon_t \sim N(0, H_t) \; \forall \; t = 1, \ldots, T \tag{21}$$

$$\varepsilon_t = D_t \eta_t \tag{22}$$

All DCC models use the fact that H_t can be decomposed in the following manner:

$$H_t = D_t R_t D_t \tag{23}$$

Sharjah Islamic Bank, Al Salam Bank, Bahrain Islamic Bank, Ithmaar Bank, Kuwait Finance House, National Bank of Kuwait, Barwa Bank, Masraf Al Rayan, Qatar Islamic Bank, Alinma Bank, National Commercial Bank (Al Ahli).

D_t is a $k \times k$ diagonal matrix of time-varying standard deviations from univariate GARCH models (with or without any asymmetry effects) with $\sqrt{h_{\mathrm{i},t}}$ on the *i* th diagonal and R_t is the time-varying correlation matrix. In the first stage, we fit a univariate GARCH model for each tenor of the IIBR or LIBOR series, and obtain $h_{\mathrm{i},t}$. In the second stage, standardized residuals, η_t (residuals standardized by standard deviations from univariate GARCH models) are used to estimate the coefficients governing the dynamics of correlation, again with or without allowing for asymmetry in the correlation parameters. Engle's (2002) DCC is given by:

$$Q_t = (1 - \theta_1 - \theta_2)\bar{R} + \theta_1 \eta_{t-1}\eta'_{t-1} + \theta_2 Q_{t-1} \tag{24}$$

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{25}$$

where, $\bar{R} = E[\varepsilon_t \acute{\varepsilon}_t]$ and θ_1 and θ_2 are the scalars such that $\theta_1 + \theta_2 < 1$. Scalar parameters θ_1 and θ_2 represent the effects of previous standardized shock and conditional correlation persistence, respectively. $Q_t^* = \begin{pmatrix} \sqrt{q_{11}} & 0 \\ 0 & \sqrt{q_{22}} \end{pmatrix}$ is the diagonal component of the square root of the diagonal elements of $Q_t = \begin{pmatrix} q_{11} & q_{12} \\ q_{21} & q_{22} \end{pmatrix}$. As long as Q_t is positive definite, Q_t^* is a matrix which guarantees $R_t = Q_t^{*-1} Q_t Q_t^{*-1}$. R_t is a correlation matrix with ones on the diagonal and every other element ≤ 1 in absolute value. The Engle's DCC model above in Equations (24) and (25) does not allow for asymmetry. To incorporate asymmetry in the correlation dynamics, Cappiello et al (2006) modify Engle's DCC model by translating the model into a quadratic form as in (26):

$$Q_t = \left(\bar{R} - \theta_1' \bar{R} \theta_1 - \theta_2' \bar{R} \theta_2 - \theta_3' \bar{N} \theta_3\right) + \theta_1' \eta_{t-1}\eta'_{t-1}\theta_1 + \theta_3' n_{t-1} n'_{t-1} \theta_3 + \theta_2' Q_{t-1} \theta_2 \tag{26}$$

where, θ_1, θ_2 and θ_3 are $k \times k$ parameter matrices, $n_t = I[\varepsilon_t < 0] \mathrm{o} \varepsilon_t$ ($I[\cdot]$ is a $k \times 1$ indicator function which takes on value 1 if the argument is true and 0 otherwise; "o" indicates the Hadamard product and $\bar{N} = E[n_t n_t']$). Cappiello et al (2006) refer to the model in Equation (26) as AG-DCC model.

5. Empirical Results

Prior to reporting empirical findings of the DCC model, it is customary to look at the order of integration of both IIBR and LIBOR series to ascertain whether there is a long-term equilibrium relationship between the two. The degree of integration between IIBR and LIBOR has a significant influence on the statistical properties of the spread (IIBR – LIBOR). A visual inspection from Figure 1 (Introduction Section) suggests that the spread is stable and IIBR is always set above the LIBOR for given maturity. So, we check for cointegration using Johansen cointegration test and find that both rates are highly cointegrated.[4] This finding suggests that the Islamic banks' lending at IIBR (cost plus funding) will attract piety premium and the lending banks will make losses if the spread decreases and reaches below the LIBOR.

Since Johansen cointegration tests does not reflect on the short-term dynamic relationship, we use AG-DCC model of Cappiello et al (2006) to investigate the short-term dynamic relationship between IIBR and LIBOR rates.[5] Our empirical setting and modelling focus on both the contemporaneous and lagged relationship because of the timing difference between Makkah (followed for IIBR rate setting by panel banks) and London (followed by LIBOR rate setting by panel banks). Consideration of timing difference is important as the Information Technology (IT) allows the news to be transmitted across the markets almost instantaneously. Since London market closes 3-hours later than Makkah, we expect information from last trading day in London would be reflected on the new IIBR rate.

[4] Results are not reported to conserve the space but can be obtained from authors on request.

[5] There are several benefits of using GARCH based estimates instead of an error correction method. GARCH based estimates report different characteristics of the data including variance, co-variance and the impact of the asymmetry. For short-term dynamics correlation, DCC is extensively used in finance literature. Hence, we use AG-DCC model to capture the short-term dynamic correlation between LIBOR and IIBR.

While LIBOR are available for various currencies, we only focus on dollar-LIBOR as the IIBR is also set at US dollar. Moreover, IIBR panel banks come from those Middle-East countries whose currencies are pegged to US dollar. So, using dollar-LIBOR is more justifiable and relevant than other currency denomination of LIBOR.

Table 1, which shows the AG-DCC parameters for overnight, 1 week, 1 month, 3 month, 6 month and 1 year tenors of LIBOR and IIBR rates. Panel A of Table 1 shows the results of the correlation dynamics on contemporaneous sense without considering the timing difference between the Middle-Eastern market and London market, while Panel B does consider the timing difference and hence used the lagged LIBOR rates of the corresponding maturities/tenors. Three AG-DCC parameters θ_1, θ_2 and θ_3 are reported in this table. As stated earlier, θ_1 indicates the effects of previous standardized shocks, θ_2 indicates the correlation persistence and θ_3 indicates the asymmetric effect (impact of negative shock/bad news) in the correlation dynamics. The significance of either $\theta_1$or θ_2 indicates the existence of dynamic correlations between LIBOR and IIBR.

As observed in Panel A, there exists significant correlations between LIBOR and IIBR on contemporaneous sense. The analysis also suggests asymmetric effect for 1 month tenor.

Panel B reports almost similar results with the exception of 1 week maturity, for which neither of the correlation parameters is statistically significant. The effect of asymmetry is only observed for overnight maturity.

This finding reflects two important phenomena: (1) while IIBR rates are claimed to be independently determined reflecting their own market characteristics, the IIBR premium/spread, IIBR *minus* LIBOR, is expected to be highly stable reinforcing the lending banks to consistently set the IIBR above the LIBOR and (2) Shariah-conscious borrowers are willing to pay the piety premium. Our finding is consistent with the theoretical argument in Azmat, Skully and Brown

(2015), who use Islamic Joint Venture (IJV) in explaining the nature of the relationship between Islamic and conventional banking and argue that the two banking system cannot be entirely separated. Our empirical finding is closely related to the findings of Chong and Liu (2009), who report, for Malaysia, that Shariah-compliant products are not free from interest.

Table 1: IIBR and LIBOR Relationship

This table shows the dynamic relationship between IIBR and LIBOR for different maturities. Panel A shows the coefficient, standard error in parentheses and the level of significance of the three AG-DCC parameters, θ_1, θ_2 and θ_3 on contemporaneous sense, while Panel B shows these values based on lagged LIBOR rates as the market for LIBOR closes later than the market for IIBR. θ_1 denotes the effects of previous standardized shocks, while θ_2 stands for the correlation persistence. The significance of either of these parameters indicates the existence of dynamic correlations between LIBOR and IIBR. θ_3 indicates the asymmetric effect in the correlation dynamics. ***, ** and * indicate the level of significance at 1%, 5% and 10%, respectively.

Panel A: Time-varying AG-DCC Parameters for IIBR-LIBOR (Contemporaneous correlation)

AG-DCC Parameters	Overnight	1 week	1 month	3 month	6 month	1year
θ_1	-0.008***	-0.0188*	-0.025	-0.031***	-0.032***	-0.014***
	(0.000)	(0.011)	(0.017)	(0.009)	(0.000)	(0.002)
θ_2	0.929***	0.975***	0.089	0.768**	0.756***	0.572
	(0.102)	(0.024)	(0.398)	(0.303)	(0.000)	(0.814)
θ_3	-0.001	-0.001	-0.111*	0.001	0.012	-0.016
	(0.021)	(0.007)	(0.067)	(0.041)	(0.027)	(0.036)

Panel B: Time-varying AG-DCC Parameters for IIBR-LIBOR (Lagged LIBOR)

AG-DCC Parameters	Overnight	1 week	1 month	3 month	6 month	1year
θ_1	-0.002***	-0.005	0.011	0.004	-0.023***	0.009
	(0.000)	(0.036)	(0.016)	(0.026)	(0.000)	(0.019)
θ_2	0.774***	-0.247	0.939***	0.961***	0.777***	0.886***
	(0.064)	(0.976)	(0.076)	(0.199)	(0.009)	(0.119)
θ_3	-0.059***	0.124	-0.005	0.007	-0.027	0.009
	(0.000)	(0.087)	(0.017)	(0.057)	(0.029)	(0.037)

6. Conclusion

This paper attempted to reconcile the difference between those who feel that the financial impact of Islamic financial structures is no different from convention instruments and, hence, they should be considered non-Shariah compliant and those who advocate their Shariah legitimacy by pointing out the juristically sound underlying financing modes. The paper showed that financial impact of

Islamic and conventional instruments has its origin in the way they are priced and structured. This similarity in the pricing mechanism and structures is an outcome of not the underlying Islamic financial modes but the competitive environment where Islamic banks compete for their clients with conventional banks. Even pure Islamic structures if implemented in the current competitive environment would have financial impact similar to the conventional instruments. As a case, we have empirically investigated the relationship between IIBR with its conventional counterpart, LIBOR. We find that even though IIBR setting process goes through several stages, scrutiny and approval of different committees and Shariah board, it is still highly correlated with LIBOR. Most interestingly, the relationship is stable over the entire period of IIBR history. While Shariah compliant borrowers are ready to pay higher premium, arbitragers have enough room to gain from such stable relationship.

Appendix

A.1. Proof of Proposition 1

Assuming depositor's participation constraint in Equation (2) is binding, and rearranging this equation gives the optimal deposit rate for the conventional bank provided by Equation (4).

Simplifying Equation (1) gives the below expression,

$$\pi = P[R_{Lc}L(R_{Lc})] - P[R_{Dc}D] - (1-P)[L(R_{Lc})] + (1-P)[D] \quad (27)$$

Substitute Equation (3) and Equation (4) in Equation (27) gives the following expression,

$$\pi = P[R_{Lc}L(R_{Lc})] - \overline{U} - (1-P)L(R_{Lc}) \quad (28)$$

Differentiating Equation (28) with respect to the conventional bank's lending rate results in,

$$\frac{d\pi}{dR_{Lc}} = PR_{Lc}L'(R_{Lc}) + PL(R_{Lc}) - (1-P)L'(R_{Lc}) = 0 \quad (29)$$

Solving Equation (29) for the optimal lending rate leads to Equation (5).

A.2. Proof of Proposition 2

Assuming depositor's participation constraint in Equation (8) is binding, and rearranging the said equation gives the optimal Mudarabah profit sharing ratio for the Islamic bank provided by Equation (10).

Simplifying Equation (7), and substituting Equations (9) and (10) in it, gives the following expression,

$$\pi = (1-P_d)PR_{Li}L(R_{Li}) - \overline{U} - P_dL(R_{Li}) - (1-P_d)(1-P)L(R_{Li}) \quad (30)$$

Differentiating Equation (30) with respect to the Islamic bank's Murabaha mark-up rate gives,

$$\frac{d\pi}{dR_{Li}} = (1-P_d)PR_{Li}L'(R_{Li}) + (1-P_d)PL(R_{Li}) - P_dL'(R_{Li}) - (1-P_d)(1-P)L'(R_{Li}) = 0 \quad (31)$$

Solving Equation (31) for the optimal Murabaha mark-up rate leads to Equation (11).

A.3. Proof of Proposition 3

Using Equation (14), it can be shown that the Islamic bank's Murabaha rate charged to borrowers converges with the conventional bank's lending rate.

$$\lim_{P_d \to 0} R_{Li} = \lim_{P_d \to 0} \left(\frac{P_d}{(1-P_d)P} + \frac{(1-P)}{P} - \frac{L(R_{Li})}{L'(R_{Li})} \right) \therefore R_{Li} \to R_{Lc} \quad (32)$$

A.4. Proof of Proposition 4

Using Equation (14), it can also be seen that Islamic bank's Mudarabah rate offered to depositors converges with the conventional bank's deposit rate.

$$\lim_{P_d \to 0} \beta R_{Li} = \lim_{P_d \to 0} \left(\frac{\bar{U} + P_d D}{(1-P_d)PD} + \frac{(1-P)}{P} \right) \therefore \beta R_{Li} \to R_{Dc} \quad (33)$$

A.5. Proof of Proposition 5

Substituting Equation (17) in Equation (11), results in Equation (18).

A.6. Proof of Proposition 6

The penalty imposed by the regulator should be such that the Islamic bank is made indifferent between reducing the actual destruction probability, P_d, below the regulatory threshold, $\overline{P_d}$, and the alternative of keeping the probability at the regulatory specified floor. The said penalty will be the one which results in the same level of profit earned by the bank in both cases.

Simplifying Equation (7), and substituting Equations (9) and (10) in it, results in Equation (30). Further simplifying Equation (30), gives the expression below.

$$\pi = PR_{Li}L(R_{Li}) - \bar{U} - L(R_{Li}) + PL(R_{Li}) - P_d PL(R_{Li})(1 + R_{Li}) \quad (34)$$

At the regulatory threshold, Equation (34) becomes

$$\pi = PR_{Li}L(R_{Li}) - \bar{U} - L(R_{Li}) + PL(R_{Li}) - \overline{P_d}PL(R_{Li})(1 + R_{Li}) \quad (35)$$

If the Islamic bank reduces the actual destruction probability, P_d, below the regulatory threshold, $\overline{P_d}$, the regulator imposes a penalty, $\mathbb{P}$, which results in Equation (34) becoming the following.

$$\pi = PR_{Li}L(R_{Li}) - \bar{U} - L(R_{Li}) + PL(R_{Li}) - P_dPL(R_{Li})(1 + R_{Li}) - \varphi\mathbb{P} \quad (36)$$

Subtracting Equation (35) from Equation (36) and equating the result to zero, gives the following expression.

$$PR_{Li}L(R_{Li}) - \bar{U} - L(R_{Li}) + PL(R_{Li}) - P_dPL(R_{Li})(1 + R_{Li}) - \varphi\mathbb{P} - PR_{Li}L(R_{Li}) + \bar{U} + L(R_{Li}) - PL(R_{Li}) + \overline{P_d}PL(R_{Li})(1 + R_{Li}) = 0 \quad (37)$$

Simplifying Equation (37), results in

$$(\overline{P_d} - P_d)PL(R_{Li})(1 + R_{Li}) = \varphi\mathbb{P} \quad (38)$$

Solving Equation (38) for penalty, $\mathbb{P}$, provides the expression for Equation (19).

A.7. Proof of Proposition 7

Substituting Equation (17) in Equation (10), results in Equation (20).

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