A Structural Model of "Alpha" for the Capital Adequacy Ratios of Islamic Banks

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Original citation & hyperlink:
Baldwin, K, AlHalboni, M & Helmi, H 2019, 'A Structural Model of "Alpha" for the Capital Adequacy Ratios of Islamic Banks' Journal of International Financial Markets, Institutions and Money, vol. 60, pp. 267-283.
https://dx.doi.org/10.1016/j.intfin.2018.12.015

DOI 10.1016/j.intfin.2018.12.015
ISSN 1042-4431

Publisher: Elsevier

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Abstract

The denominator of the capital adequacy ratio (CAR) for Islamic banks includes an adjustment factor, *alpha*, arising from the subsidisation of investment account holders’ returns using bank equity. The methodology established by the risk management standard-setting body for Islamic banks, the IFSB, estimates an alpha for each country using panel-data and normally distributed asset returns for its credit institutions. Consequently, the IFSB methodology precludes bank-specific alphas linked to the actual risk profile of underlying assets. There is also no discernible mapping between alpha and a bank’s own propensity to subsidise cash returns. This paper instead develops a new theoretical model for bank-specific alpha that is estimated for 43 Islamic banks in 11 countries. Our alpha values broadly correspond with those of the IFSB. However, a form of regulatory arbitrage is shown to exist which favors banks with relatively high alphas. This finding also has policy implications for bank efficiency and systemic risk.

JEL Classification: G21, G28

Keywords: Islamic Banking; Capital Adequacy Ratio; Regulation; Displaced Commercial Risk; Alpha; Islamic Financial Services Board.

1. Introduction

The capital adequacy ratio (CAR) for Islamic banks takes into consideration a unique type of deposit account not offered by conventional banks. These accounts are profit-sharing investment accounts, which are effectively a hybrid of debt and equity. So far, the literature on how to adjust the conventional CAR formula for Islamic banks has been scarce (see Sundararajan, 2007 and 2008 for the IFSB model, and Toumi et al., 2018 for an enhancement of the IFSB model). Our paper aims to fill this gap. We develop a new theoretical model for a parameter captured within the existing CAR model first introduced by the IFSB (2011, 2013) called *alpha*, which is essential to an Islamic bank's CAR (Daher et al. 2015). Estimation of our model for 43 banks in 11 countries reveals valuable new insights concerning the level of capitalisation of Islamic banks. We show that imposition of a single country alpha in some countries leads to the over-capitalisation of some banks, and the under-capitalisation of others. Additionally, for other countries, we find Islamic banks are either all over-, or all under-, capitalised, leading to bank efficiency and competition issues, or enhanced systemic risk.

If bank regulation is to be effective, deposit-taking institutions must be able to withstand unexpected losses. Bank capital plays a crucial role in achieving this objective. Bank capital contributes to financial market stability by safeguarding individual institutions against individual failure and reducing the risk of spill-over between banks, i.e. systemic risk (Berger et al., 1995; Bitar et al., 2018). In a comprehensive study using a sample of 1200 banks in 45 countries, Anginer and Demirgüç-Kunt (2014) show that maintaining regulatory capital is effective in reducing systemic risk. This result bodes well for the continued emphasis on the capital adequacy ratio as a key regulatory policy tool. Indeed, Furlong and Keeley (1989) and Rochet (1992) conclude that a higher capital adequacy ratio may also reduce the incentive of banks to take on excessive risk, thereby ameliorating moral hazard effects[1]. Not surprisingly, however, an over-capitalised banking system limits the bank financing and investment activities, which negatively impacts bank profitability and efficiency, as well as reducing economic growth (Barrell et al., 2009; Allen et al., 2012; Abou-El-Sood, 2016; Bitar et al., 2018).

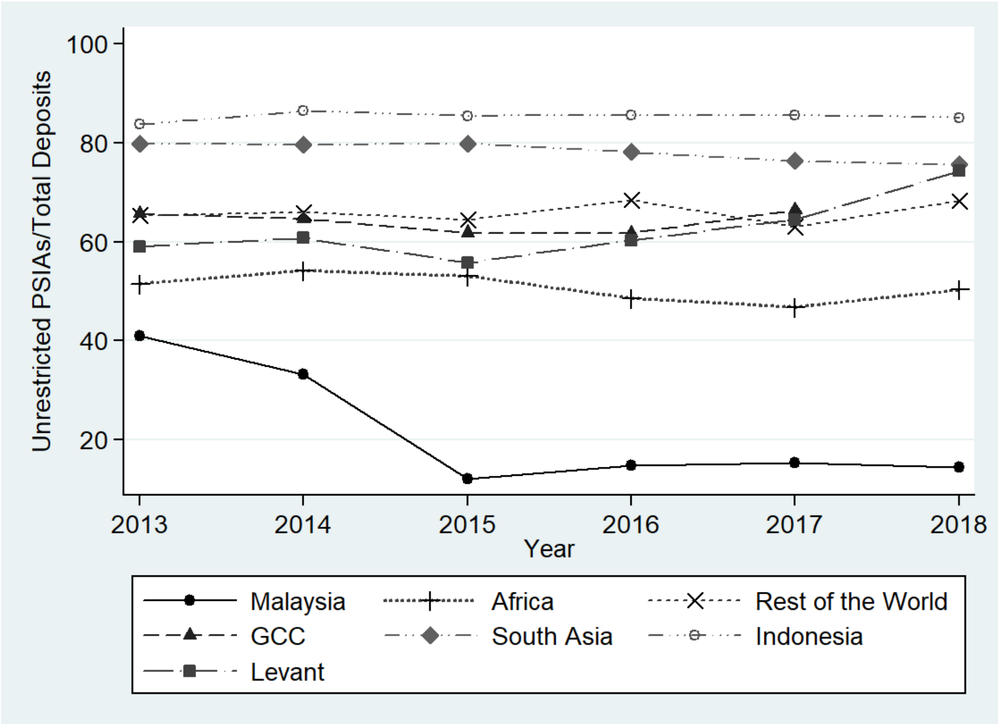
The approach taken by regulators of Islamic banks is to adopt the Bank for International Settlements' (BIS) standards as far as possible (BCBS, 2010). However, where these standards

[1] Consistent with this result, exacerbation of the moral hazard problem due to undercapitalization is shown in Calem and Rob (1999). In a dynamic model in which banks build up capital through retained earnings, this paper shows that when capital is low relative to the regulatory minimum, banks choose a very risky loan portfolio to maximize the option value of deposit insurance.

cannot be applied, the Islamic Financial Services Board (IFSB) has issued its own standards for Islamic banks[2]. A good example of the relevance of standards that account for the specificities of Islamic banks concerns *Profit Sharing Investment Accounts* (PSIAs). PSIAs are liability-side accounts, typically available at retail level, but also at the wholesale level. They are commonly perceived as the nearest Shari'a-compliant alternative to conventional deposit accounts, although strictly speaking, they are variable return products that put investor capital at risk. PSIA fund providers, also known as *Investment Account Holders* (IAHs), invest in underlying assets that are managed (and usually originated) by the bank. The bank receives a share of profit generated from IAH assets as remuneration for its funds' management role. However, losses, if any, are ordinarily borne entirely by IAHs.

Profit sharing investment accounts are a significant retail funding source for Islamic banks. Figure 1 shows unrestricted PSIAs as a percentage of total deposits between 2013 and 2018.

Figure 1: PSIAs as a % of Total Deposits



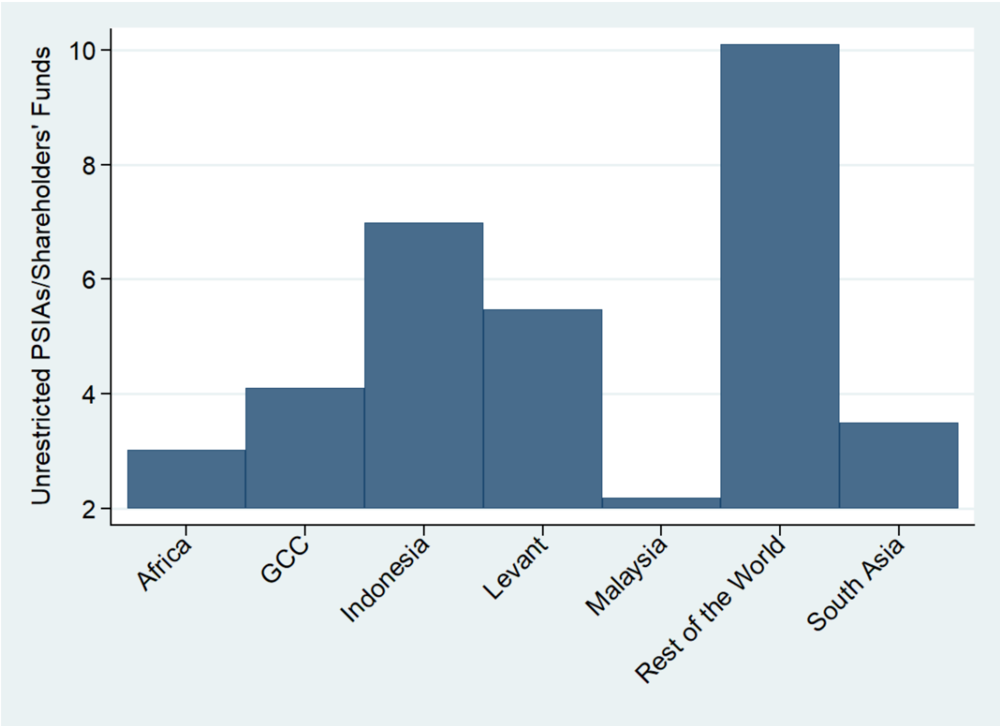
Note: Africa includes Nigeria and Sudan. GCC includes Bahrain, Kuwait, Oman, and Qatar. South Asia includes Bangladesh and Pakistan. The Levant includes Jordan, Lebanon, Syria, and Palestine. Rest of the world includes Iran, Turkey, and Yemen. Source: Islamic Financial Services Board (IFSB) and Orbis bank focus.

With the exception of Malaysia, Figure 1 shows that PSIAs constituted more than 50% of total deposits for most of the period between 2013 and 2018. For the Levant (Syria, Jordon, Palestine

[2] The IFSB is a global risk management standard-setting body for Islamic financial services providers.

and Lebanon), South Asia (Pakistan and Bangladesh), and Indonesia, PSIAs are more than 75% of total deposits as at 2018. For other regions, namely Africa (Nigeria and Sudan), the GCC (defined in Figure 1 as Bahrain, Qatar, Oman, and Kuwait; data not available for 2018), and the Rest of the World (defined in Figure 1 as Iran, Turkey, and Yemen), PSIAs as a percentage of total deposits fluctuated between 2013 and 2018 but were nevertheless consistently the most important retail funding source for Islamic banks. The case of Malaysia is exceptional. Malaysia saw a pronounced decline in the use of PSIAs pursuant to the introduction of its Islamic Financial Services Act of 2013. This legislation changed the funding landscape for Islamic banks by prohibiting the smoothing of returns paid to investment account holders (see Ernst and Young, 2016; IFSB, 2017). Islamic banks in Malaysia had previously smoothed returns paid to IAHs in order to align returns paid on PSIAs to benchmark rates. As a result of this change, the proportion of PSIAs decreased significantly from 41% in 2013 to 14% by 2018. The significance of PSIAs to Islamic banks excluding Malaysia is also shown below. Figure 2 shows the average proportion of PSIAs to shareholders' funds for Islamic banks in 17 countries between 2013 and 2018.

Figure 2: PSIAs as a % of Shareholders' Funds



Note: Africa includes Nigeria and Sudan. GCC includes Bahrain, Kuwait, Oman, and Qatar. South Asia includes Bangladesh and Pakistan. Levant includes Jordan, Lebanon, Syria, and Palestine. Rest of the world includes Iran, Turkey, and Yemen. Source: Islamic Financial Services Board (IFSB) and Orbis bank focus.

This paper concerns the risk sensitivity of the IFSB's version of the CAR formula for Islamic banks. Because of the unique features of PSIAs, the capital adequacy ratio (CAR) formula of the BIS has been adapted for Islamic banks by the IFSB (IFSB, 2013). The IFSB adaptation of the BIS formula adjusts the denominator of the CAR, namely total risk-weighted assets, by recognising a risk which arises as a result of the way Islamic banks manage cash returns to IAHs in practice. This risk is termed *Displaced Commercial Risk* (DCR). DCR arises because Islamic banks face regulatory and/or commercial pressure to pay cash returns to IAHs aligned to a conventional deposit rate benchmark (Sundararajan, 2007; Chong and Liu, 2009; Zainol and Kassim, 2010; Aysan et al., 2017). However, the actual returns generated by IAH assets (net of the bank's profit share and provision for IAH assets, hereafter "contractual" returns) may be less than the benchmark rate, causing Islamic banks to subsidise cash returns paid to IAHs (AAOIFI, 1999). The ongoing practice of smoothing cash returns to IAHs using subsidies (as well as reserves) is confirmed by recent literature examining this practice across different jurisdictions (see Hamza, 2016; Suandi, 2017; Lassoued et al., 2018; Zainuldin and Lui, 2018; Toumi et al., 2018). As a result of DCR, the rate of return risk manifesting in IAH assets, which should vest with IAHs, is displaced to bank shareholders, giving rise to a potentially deleterious impact on bank capital if shareholders subsidise the returns paid to IAHs using their own capital. For instance, at times during the 1980s, the International Islamic Bank for Investment and Development allocated its entire profit to IAHs, leaving its shareholders with zero income (Warde, 2000). Subsequently, the denominator of the CAR formula for Islamic banks includes a portion, alpha, of the risk-weighted assets of IAHs. Banks are currently not permitted to determine their own alphas but must apply an alpha which is prescribed to them by their regulator.

Until recently, only one methodology, that of the IFSB, was available to determine alpha. The IFSB's method of calculating alpha uses a country-specific panel data analysis of historical returns to bank equity (IFSB, 2011, 2013). The IFSB's method calculates alpha from the unexpected loss experience of different banks, some operating with DCR, and some without DCR[3]. However, there are several critical shortcomings with this approach. The first is preclusion of bank-specific alphas[4] since the panel-data approach aggregates the effects of DCR across multiple banks in a given jurisdiction. Secondly, decisions concerning IAH cash returns are a matter of bank policy, being fundamental to the retail appeal and commercial

[3] It may be possible for some banks to avoid DCR by managing specific reserves which can be released when required in order to achieve target IAH cash returns.
[4] The need for bank-specific alphas has also been highlighted by Toumi et al. (2011). Indeed, even before the introduction of alpha to the capital adequacy ratio by the IFSB in 2007, Errico and Farahbaksh (1998) had earlier recognised the importance of regulatory supervision of Islamic banks aligned to the specific operating structures of PSIAs in different countries.

success of Islamic banks in dual-banking systems[5]. However, for the IFSB methodology (and its enhancement using value-at-risk, instead of standard deviation, see Toumi et al., 2018) there is no available mapping from return subsidisation policy[6] to resulting quantitative impact on capital adequacy. This because reserves-based investment account return-smoothing practices mask the true extent to which banks are exposed to DCR (Boulila et al., 2010 confirmed the income smoothing practices of Islamic banks using a sample of 66 Islamic banks in 19 countries, a result also confirmed by Farook et al., 2012). Lastly, an accurate estimation of unexpected losses is data intensive (since unexpected losses are outlying events by definition), and therefore restricted by data limitations given the relatively short-lived operating history of Islamic banks to date[7].

In contrast to the IFSB's methodology, this paper develops a structural model to derive alpha. We model a decision logic for outcomes in which bank equity is used to subsidise returns paid to profit sharing investment account holders. Our model also relies on allocations between financial instruments within the pool of commingled assets which generate contractual returns to IAHs. Both of these features are absent from the IFSB and Toumi et al. models for alpha. We isolate the impact of DCR on unexpected losses by modelling the return distributions of different asset classes in which a bank, and its IAHs, are co-invested. This approach is significantly more versatile and admits an accurate determination of bank-specific alphas, something which is beyond the reach of an empirical panel-data approach applied to banks in aggregate, such as the IFSB's. The application of accurate bank-specific alphas which take asset composition and associated return profiles into consideration would allow regulators to apply capital charges that better reflect the actual risk sharing between an Islamic bank and its IAHs (Archer et al., 2010 and Toumi et al., 2011).

We then estimate our model for 43 Islamic banks operating in 11 countries. Our findings establish the existence of a form of regulatory arbitrage in which some banks hold too little capital to absorb unexpected losses due to DCR, while simultaneously, others hold too much capital. We also find that some countries exhibit a systematic capital bias, in which Islamic banks in a single country predominantly hold either too much capital or too little capital.

[5] Dual-banking systems exist where Islamic banks and conventional banks operate alongside each other.
[6] A return subsidisation policy is effectively a sub-policy of a bank's cash returns management policy. Other sub-policies concern the use of cash returns' smoothing reserves, including the PER (profit equalisation reserve) and the IRR (investment risk reserve).
[7] An attempt to circumvent this shortcoming by the IFSB relies on assuming normally distributed equity returns for which unexpected loss is a multiple of the standard deviation of returns, see Section 3.

These findings have regulatory policy implications for competition, systemic risk, and bank capital efficiency[8]. For countries in which regulatory arbitrage exists (e.g. Bahrain), banks holding too little capital (against DCR) are able to extend credit beyond a level which is prudent, while banks which are intrinsically less risky effectively receive punitive capital charges. This creates an un-level playing field[9] in the market for bank credit. Where banks predominantly hold too little capital (e.g. Jordan), not only are banks individually at greater risk of insolvency, but the system as a whole is insufficiently capitalised, thereby increasing systemic risk. Lastly, for countries in which banks predominantly hold too much capital (e.g. Qatar), the financial system as a whole has unutilized credit capacity, and therefore underserves the real economy.

The rest of the paper is set out as follows. Section 2 further elaborates on DCR and explains the IFSB's CAR formula. Section 3 describes the IFSB's methodology to determine alpha whilst highlighting its shortcomings. Section 4 derives alpha using a structural model for Islamic banks, which is then numerically illustrated in Section 5. Sections 6 and 7 respectively describe the data used to estimate our model and present the results of the estimation. Section 8 concludes the paper.

2. Background

Before deriving alpha, we briefly discuss two features of Islamic banks which impact displaced commercial risk: the first is their capital structure, and reserves used to manage returns paid to IAHs in the avoidance of subsidies (2a.); the second is the calculation formula for their capital adequacy ratios (2b).

[8] Chiuri et al. (2002) examined the negative impact that enforcement of a minimum capital adequacy ratio has on the supply of credit in emerging economies. They concluded that enforcement should be used with caution where the banking system is the main channel for credit, and in less developed financial systems.

[9] We acknowledge that regulatory tools that limit risk-taking by banks, such as a statutory risk reserve, liquidity requirements, and deposit insurance, are not tailored to the risk-profiles of individual banks, but instead applied equally to all banks in the same jurisdiction. Whilst this may contribute to an un-level playing field, granting preferential regulatory treatment to a sub-set of banks would require regulators to accurately assess a bank's risk management competence in avoiding or ameliorating losses in the first instance. Such detailed assessment is not only highly subjective but unlikely to ever materialize, not least due to the resource constraints of regulators, and the need for highly reliable bank information concerning internal risk management processes. An important distinction, however, between alpha and such regulatory tools, is that alpha is an integral component of a bank's risk-profile. It reflects subsidy decisions motivated by the bank's individual aversion to the withdrawal risk of investment account holders' funds. We propose that banks be afforded an opportunity to calculate their individual value for alpha, and, as is currently industry practice, use this value as input to a generic CAR formula that is itself applied equally to all Islamic banks. We are grateful to an anonymous referee for raising our awareness of this point.

2a. Capital Structure and Reserves

Islamic banks do not guarantee returns paid to either wholesale or retail providers of funds, i.e. there are no riskless returns. Instead, returns paid to fund providers are linked to the rates of return of underlying assets financed by investment of their capital. These assets include, inter alia, credit financing receivables originated by the purchase and sale of real assets (e.g., *Murabaha* contracts settled on a deferred payment basis), and from the leasing of assets (i.e., *Ijara* contracts structured as operating or finance leases) (Chong and Liu, 2009; Abedifar et al., 2016; Caporale and Helmi, 2018).

Other than shareholders' equity, the principal sources of capital for Islamic banks are Profit Sharing Investment Accounts (PSIAs)[10]. These are limited term equity interests governed by a *Mudaraba* contract[11]. A Mudaraba contract is a partnership between work and capital in which the providers of funds (IAHs) and the managing agent (the bank, which is the *Mudarib*) share profit generated from the investment of PSIA capital (Kammer et al., 2015; El Alaoui et al., 2018). The mudarib's profit share is a fee for applying effort and skill to manage the assets of IAHs. The profit sharing ratio is agreed in advance. Losses arising on the investment of PSIA funds, if any, are borne by IAHs, as long as there has been no breach of fiduciary duty by the bank acting as mudarib (e.g., through acts of malfeasance, negligence or breach of contract) (Toumi, et al., 2011).

There are two types of PSIAs. In *restricted* PSIAs, the bank manages IAH funds with a specific investment mandate, and cannot exercise investment discretion (assets funded by restricted PSIAs are held off-balance-sheet by the bank). In the *unrestricted* form of PSIA, the bank has full discretion to manage IAH funds. The capital of unrestricted PSIAs is invested alongside bank shareholders in a commingled pool of assets originated and managed by the bank (assets funded by unrestricted PSIAs are held on the bank's balance sheet). Unrestricted PSIAs form the vast majority of investment accounts, and, by similarity to conventional funding, are a hybrid of equity and time deposits instruments. They cannot be considered Tier 1 equity[12] since they do not carry voting rights (Ariss and Sarieddine, 2007)[13]. However, Investment account

[10] It is not uncommon for the volume of PSIAs to be several times that of an Islamic bank's on-balance sheet assets. Indeed, Archer and Karim (2009) state that PSIAs "by far constitute the largest source of funds for Islamic banks".

[11] PSIA funds may also be provided on a *wakala* basis in which the bank acts as agent in managing them in return for a fixed fee.

[12] Neither are they Tier 2 equity. See Grais and Kulathunga (2007).

[13] Ariss and Sarieddine (2007) discuss alternatives to, and variations of, PSIAs, including a) treating Islamic banks as mutual funds from a regulatory perspective, where the only redemption obligation is to return initial capital to account holders net of gains / losses, b) retaining the current PSIA structure but allocating assets to investors based on their risk appetites (referred

holders are able to 'vicariously monitor' the management of an Islamic bank through monitoring by its shareholders (Archer et al., 1998).

Whilst the contractual return to IAHs is the gross return on underlying assets net of the bank's profit share and provisions, in practice, Islamic banks may choose to pay cash returns which differ from contractual returns (i.e. returns derived only from the underlying assets) through the application of reserves. For a sample of 15 Islamic banks in 8 countries, Sundararajan (2007) concluded that the returns on investment accounts were uncorrelated with the returns on bank net assets, in contrast to a positive relationship that would exist if returns on (commingled) assets were shared between IAHs and shareholders without adjustment using reserves. A significant positive correlation between PSIA returns and conventional deposit rates has also been reported for Islamic banks in Malaysia, for example, Chong and Liu (2009), and Zainol and Kassim (2010). The latter study also finds that conventional deposit rates are negatively related to PSIA account volumes, indicating PSIA investors have a profit motive rather than investing for religious reasons.

The disconnect between cash returns paid to IAHs and contractual returns available from underlying assets results from a need, actual or perceived, for the performance of unrestricted PSIAs to track conventional deposit rates. If contractual returns available to unrestricted PSIAs are deemed insufficient by bank management, an Islamic bank may attempt to enhance (or smooth) cash returns paid to IAHs using a reserve called the *Profit Equalisation Reserve* (PER)[14]. The PER is created by appropriations from the gross returns of IAH assets, before the deduction of the bank's profit share, from previous periods. The PER is within the equity of IAHs. An Islamic bank may also subsidise (positive) contractual returns by reducing its current-period profit share, or by making direct allocations from shareholders' equity (Sundararajan, 2008). Notably, however, if contractual returns to unrestricted PSIAs are negative (i.e. if losses arise), then due to Shari'a impermissibility, the bank cannot make up IAH losses using its own capital. In this case, the bank (if it so desired) would make up losses by drawing upon an *Investment Risk Reserve* (IRR). The IRR is created by allocations made from the contractual returns of IAHs after all other deductions (being for PER, provisions, and the bank's profit share) from previous periods. The IRR, if sufficient, can be used to smooth

to as 'segmentation' in El-Hawary et al. (2007), and creating different subordination levels for the rights of investment account holders. Archer and Karim (2009) go one step further and propose establishing separate funds' management entities, which Islamic banks would manage as mudharib.

[14] Boulila et al. (2010) tested 66 Islamic banks from 12 countries to conclude that profit smoothing was not the result of applying loan loss provisions.

returns to IAHs and/or to make total contractual losses. Most relevant (to the development of a structural model for alpha) from the foregoing statements of practice, is that a) subsidisation of cash returns paid to IAHs by shareholders equity occurs if the joint application of the PER and the IRR is insufficient, and b). Islamic banks are not permitted to make whole any losses which arise on PSIAs by using shareholders' equity (Grais and Kulathunga, 2007; Mejia et al., 2014).

2b. Capital Adequacy Ratio

It is clear from the above, that the relation between contractual returns from IAH assets, and cash returns paid to IAHs is affected by the application of smoothing and loss reserves (within the equity of IAHs), as well as return subsidies from shareholders. Because shareholders' capital, or current period earnings, may be used to subsidise contractual returns to IAHs in underperforming periods, the CAR formula for Islamic banks (IFSB, 2013) is

$$CAR = \frac{Eligible\ Capital}{\sum Risk\ Weighted\ Assets} \quad (1)$$

where the IFSB defines the denominator (see BCBS, 2010 and IFSB, 2013) as

A. Total risk-weighted assets (credit + market + operational)

Less:

B. Risk-weighted assets funded by restricted PSIAs (credit + market)
C. $(1-\alpha)$*Risk-weighted assets funded by unrestricted PSIAs (credit + Market)
D. α*Risk-weighted assets funded by PER and IRR of unrestricted PSIAs (credit+ market)

The formula is explained as follows:

1. The bank assumes all operational risk, with no deduction from total right-weighted assets made in respect of operational risk arising from accounts managed on behalf of either restricted or unrestricted PSIAs.
2. The bank assumes credit risk and market risk arising from all assets under its management minus deductions B, C and D:

   B. No DCR arises in respect of restricted PSIAs. This is because, for restricted PSIAs, the bank follows a stipulated investment mandate, in effect acting only as an executing agent (much like a conventional securities broker). Also, restricted PSIAs are not retail products, and so their returns are not expected to track conventional deposit rates. Consequently, restricted PSIAs do not require supporting capital of the bank.

C. DCR arises, in general, from unrestricted PSIAs. Therefore, a portion of the credit and market risk arising from assets funded by unrestricted PSIAs, $\alpha \in [0,1]$, is included in the total risk-weighted assets which bank capital is required to support.

D. The portion, α, of risk-weighted assets funded by unrestricted PSIAs in C must be adjusted for PER and IRR. This is because PER and IRR are within the equity of IAHs and established to absorb losses. Therefore, bank capital is not required to support assets funded by these reserves. Due to adjustments C and D, the amount of unrestricted PSIA risk-weighted assets included within the total risk weighted assets of the bank is $\alpha *$ (unrestricted PSIAs – PER – IRR).

From the IFSB's CAR formula, we observe that for $\alpha = 1.0$, unrestricted PSIAs are treated like conventional deposits for the purpose of the CAR calculation, and that for $\alpha = 0.0$, unrestricted PSIAs are treated as pure investment products, absorbing losses if they arise with no guarantee of redemption value or return on capital. The former scenario depicts a full displacement of IAH risk to shareholders, and the latter depicts zero displacement of risk.

Before reviewing the IFSB's methodology for alpha in the next section, we note from Al-Hares et al. (2013) that due to their high capitalisation, Islamic banks in the GCC (Gulf Cooperation Council) had already met the capital requirements of Basel III by 2011 (the deadline being 2019). Against this backdrop, Islamic banks have been receptive to the (more stringent) IFSB definition (Eq. (1)), which includes additional regulatory capital held in respect of displaced commercial risk.

3. IFSB methodology for Alpha

We now turn to the IFSB's methodology for determining alpha, which is set forth in its Guidance Note No. 4 issued in March 2011 (GN-4) (IFSB, 2011). In this section, we outline the determination of Alpha in accordance with Archer et al. (2010) from which GN-4 was developed.

The main assertion of Archer et al. (2010) is to state

$$\alpha = \frac{UL_2 - UL_0}{UL_1 - UL_0} \quad (2)$$

"UL" denotes the unexpected loss to shareholders' equity capital. The subscripts are: "0", being no DCR, i.e. pure investment-like unrestricted PSIAs; "1", being maximum DCR, i.e. pure deposit-like unrestricted PSIAs; "2", for which unrestricted PSIAs are a hybrid of pure investment-like and pure deposit-like products (the general case).

Before discussing the approach to estimating UL_0, UL_1, and UL_2, we note that for the case of maximum DCR, i.e. unrestricted PSIAs are deposit-like instruments for which $UL_2 = UL_1$, alpha equals an IFSB upper limit of 1.0. In this case, the CAR formula indicates that *all* of the credit and market risk of unrestricted PSIAs would vest with shareholders. However, this is incongruous with the Shari'a, which does not permit the bank as fund manager (*mudharib*), in other words, the shareholders to make whole any losses which could arise on assets funded by investment account holders (collectively the *raab-al-mal*), as discussed earlier.

The estimation method described (but not applied to actual data) in Archer et al. (2010) suggests calculating UL_0, UL_1, and UL_2 based on a historic time series of equity returns for banks with differing policies concerning PSIA account management. In the case of zero DCR (for which investment accounts are pure investment-like), the model in Archer et al. (2010) sets PER = IRR = 0 (since smoothing and loss reserves would be unnecessary if PSIAs are investment-like), and stipulates no subsidisation of returns to IAHs from shareholders' equity. The volatility of shareholders' returns (estimated empirically) would then be used to calculate UL_0 as

$$UL_0 = Z\sigma_0\sqrt{T} \quad (3)$$

where Z depends on the confidence interval chosen, and σ_0 is estimated from actual time series data. In a similar fashion, UL_1 is calculated using the same specification in Eq. (3), but with σ_1(the volatility of bank equity returns) being for banks with a full displacement of risk to shareholders, i.e. maximum DCR.

$$UL_1 = Z\sigma_1\sqrt{T} \quad (4)$$

Lastly, UL_2 is estimated from the volatility, σ_2, of equity returns of banks for which the management of unrestricted PSIAs creates a partial displacement of risk.

$$UL_2 = Z\sigma_2\sqrt{T} \quad (5)$$

Whilst Archer et al. (2010) states this methodology provides a "first cut" estimation of alpha, an obvious shortcoming is the assumption of normality underpinning Eqs. (3) – (5), given the prominence on the balance sheets of Islamic banks of financing receivables such as *Murabaha* and *Ijara*, each of which has highly asymmetric return distributions. If a single return distribution is to be invoked to model the impact of DCR on bank equity returns, it would be more reasonable to assume a loan loss distribution.

Before we develop a structural model in the next section, we emphasise fundamental differences in our approach to calculating alpha and our position concerning its regulatory application. For the empirical approach in Archer et al. (2010) the impact of DCR on bank equity due to the underlying risks which give rise to subsidisation cannot be separated from return smoothing practices. Following from this observation, in our opinion:

a) Islamic banks should hold sufficient capital to absorb unexpected losses from *intrinsic* DCR, which, in our definition, is DCR arising only from the potential for subsidisation given the risk profiles of underlying asset returns and conventional deposit rates;

b) Capital to absorb losses arising from intrinsic DCR should be based on structural models specific to individual banks and the composition of their asset portfolios. Such models should invoke the underlying economics of the way in which DCR arises in the first instance to derive bank-specific alphas (see formulation in the next section). This would also serve to reduce the opportunity for cross-subsidisation of capital charges between banks - if regulators set one alpha for an entire jurisdiction, as they currently do, then banks with higher DCR benefit from lower capital charges and increased competitiveness compared to banks with lower DCR; and

c) Islamic banks may hold less capital than in b) if the potential impact of intrinsic DCR is ameliorated by reserves-based returns management practices and/or the use of hedging instruments[15]. However, regulators would have to be provided evidence in support to approve this level of capital for banks making such claims.

The approach described in a) to c) is particularly relevant to Islamic banks because the management of smoothing reserves, and the setting of IAH return targets, may not follow an objective rules-based approach applied consistently over time for all banks in a given

[15] Basel precedents such as the treatment of credit risk mitigants exist to support this view (BCBS, 2006).

jurisdiction. In turn, this weakens the quality of data used for empirical estimation of alpha in accordance with the IFSB methodology.

4. A Structural Model for Alpha

Consider a bank with initial shareholders' assets A, which we normalize to unity, and initial unrestricted PSIA assets βA, where $\beta \geq 0$. Shareholders and IAHs are invested in the same pool of commingled assets (hereafter "shared assets") over a single period having an ex-ante uncertain rate of return $\tilde{R}$. The investment period is T years, and the ex-ante uncertain benchmark conventional deposit rate prevailing after time T is $\tilde{r}(\geq 0)$. If $\tilde{R} > 0$, the contractual share of gross returns for IAHs is $\theta \in (0,1)$, whereas the bank earns a mudarib share, $(1-\theta)$, of gross returns, as remuneration for its funds' management role.

The change in bank equity over the investment period[16], $\Gamma(\tilde{R}, \tilde{r})$, is

$$\Gamma(\tilde{R}, \tilde{r}) = \tilde{R} + \beta(1-\theta)\max(\tilde{R}, 0) - \mu\beta\max(\tilde{r} - \theta\max(\tilde{R}, 0), 0) \tag{6}$$

The first term in Eq. (6) is the return to bank equity from shareholders' assets. The second term is the bank's mudarib share, which is zero if assets are loss-making. The third term is the subsidy, with $\mu \in [0,1]\ \forall \tilde{R}, \tilde{r}$, being the bank's propensity to subsidise IAH cash returns[17]

$$\text{Subsidy} = \begin{cases} \mu\beta\tilde{r} & \text{if } \tilde{R} \leq 0 \\ \mu\beta(\tilde{r} - \theta\tilde{R}) & \text{if } 0 < \tilde{R} < \dfrac{\tilde{r}}{\theta} \\ 0 & \text{if } \tilde{R} \geq \dfrac{\tilde{r}}{\theta} \end{cases} \tag{7}$$

μ is a key policy variable reflecting the bank's aversion to shortfalls in cash returns paid to investment account holders relative to the conventional deposit rate prevailing at the end of the period[18].

The model in Eq. (6) and Eq. (7) provides a structure to the subsidy. This contrasts with the model of Archer et al. (2010), which invokes a parameter without further subdivision, "D_K",

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[16] We ignore leveraged finance costs in Eq. (6) for simplicity and without loss of generality.

[17] Generally, the propensity to subsidise cash returns will depend on $\tilde{R}$ and $\tilde{r}$.

[18] A financial economic model of the propensity to subsidise IAH returns based on aversion to withdrawal risk is the subject of further research.

being “any transfer of profits by the IIFS [Islamic bank] from its shareholders to its IAH expressed as a percentage of shareholders’ capital”.

Next, suppose that the pool of shared assets consists of N assets for which

$$\tilde{R} = \sum_{1}^{N} w_i \tilde{r}_i \qquad (8)$$

where w_i is the initial portfolio weight (by value) of the i$^{\text{th}}$ asset whose rate of return is $\tilde{r}_i$.

Assumption 1:

Portfolio weights are constant over the investment period.

Assumption 1 finds its basis in the relatively short maturities of investment accounts compared to the commingled pool of assets funded by IAHs and shareholders’ funds. Investment accounts are mostly in tenors of up to 12 months, whereas commingled assets have maturities extending to several (sometimes many) years (e.g. consumer financing for home appliances, Shari’a compliant mortgages for home buyers *etc*.)

From Assumption 1, Eq. (6) and Eq. (8)

$$\text{Pr.}\left(\Gamma(\tilde{R}, \tilde{r}) > \mathrm{Y}\right) = \text{Pr.}\left(\Gamma\left(\sum_{1}^{N} w_i \tilde{r}_i \,, \tilde{\mathrm{r}}\right) > \mathrm{Y}\right) \qquad (9)$$

We also make the following assumption:

Assumption 2:

Losses on shared assets are perfectly positively correlated with each other, but perfectly negatively correlated with the conventional deposit rate.

Recall that in calculating the regulatory capital adequacy ratio for any bank, capital charges are added using simple summation, with no adjustment for diversification of risk. Simple summation implicitly assumes a perfect positive correlation between asset losses (not necessarily a perfect correlation of returns spanning their entire range, however). Assumption 2 is therefore consistent with this approach. The second part of Assumption 2, namely asset losses perfectly negatively correlated with the conventional deposit rate, ensures prudence in the calculation of capital charges for displaced commercial risk, i.e. a capital charges large enough to absorb unexpected losses arising from simultaneously low asset returns and high deposit rates.

Further, Assumption 2 reduces Eq. (9) from a multivariate problem (with n+1 risk drivers) to a univariate problem, for which

$$\mathrm{Pr.}\left(\Gamma(\tilde{R},\tilde{r}) > \mathrm{Y}\right) = \mathrm{Pr.}\left(\Gamma\left(\sum_{1}^{N} w_i\, \mathrm{F_i}^{-1}(\tilde{\mathrm{u}}), \mathrm{F_r}^{-1}(1-\tilde{\mathrm{u}})\right) > \mathrm{Y}\right) \tag{10}$$

where $\tilde{u}\sim U(0,1)$ (a uniform distribution), $\mathrm{F_i}(.)$ is the cumulative distribution of the return of the i^th asset, and $\mathrm{F_r}(.)$ is the cumulative distribution of the return of the conventional deposit rate.

We now invoke a useful property of uniform distributions which simplifies the remaining derivation of alpha. If $\mathrm{Pr.}\,(\mathrm{J}(\tilde{\mathrm{u}}) > \mathrm{Y}) = C$, where C is a constant in the interval [0,1], and $\mathrm{J}(\tilde{\mathrm{u}})$ is monotone increasing in ũ, then $\mathrm{Pr.}\left(\tilde{\mathrm{u}} > J^{-1}(Y)\right) = \mathrm{C}$, and $1 - J^{-1}(Y) = C$, from which $Y = J(1-C)$. Using this property in (10), we derive the VaR loss, Y, at confidence C

$$\mathrm{Y} = \Gamma\left(\sum_{1}^{N} w_i\, F_i^{-1}(1-\mathrm{C}), \mathrm{F_r}^{-1}(\mathrm{C})\right) \tag{11}$$

or in other words, using Eq. (6),

$$\begin{aligned}\mathrm{Y} = \sum_{1}^{N} w_i\, \mathrm{F_i}^{-1}(1-\mathrm{C}) + \beta(1-\theta)\left[\sum_{1}^{N} w_i\, \mathrm{F_i}^{-1}(1-\mathrm{C})\right]^{+} \\ - \mu\beta\left[F_r^{-1}(C) - \theta\left[\sum_{1}^{N} w_i\, \mathrm{F_i}^{-1}(1-\mathrm{C})\right]^{+}\right]^{+}\end{aligned} \tag{12}$$

Suppose some number of shared assets, m, where $0 \le m \le N$, have non-zero expected losses, and that the remaining $N-m$ assets have zero expected loss, then from Eq. (12), the unexpected loss of bank equity *without* DCR, UEL_0, is

$$UEL_0 = \sum_{1}^{\mathrm{N}} \mathrm{w_i F_i}^{-1}(1-\mathrm{C}) + \beta(1-\theta)\left[\sum_{1}^{N} w_i\, \mathrm{F_i}^{-1}(1-\mathrm{C})\right]^{+} - \sum_{1}^{\mathrm{m}} \mathrm{LGD_i p_i w_i} \tag{13}$$

The last term on the right-hand side of Eq. (13) is the expected loss arising only the bank's assets (expected losses arising on IAH assets are $\beta \sum_1^{\mathrm{m}} \mathrm{LGD_i p_i w_i}$). Further, the unexpected loss *with* DCR, UEL_2[19], is

$$UEL_2 = \sum_1^{\mathrm{N}} \mathrm{w_i F_i}^{-1}(1-\mathrm{C}) + \beta(1-\theta)\left[\sum_1^{N} w_i \, \mathrm{F_i}^{-1}(1-\mathrm{C})\right]^{+} - \mu\beta\left[F_r^{-1}(C) - \theta\left[\sum_1^{N} w_i \, \mathrm{F_i}^{-1}(1-\mathrm{C})\right]^{+}\right]^{+} - \sum_1^{\mathrm{m}} \mathrm{LGD_i p_i w_i} \qquad (14)$$

In Eq. (14) we deduct the same expected loss as in case of no DCR, Eq. (13), given the bank does not make good losses on IAH assets, and therefore does not set aside capital via corresponding provisions. Finally, alpha is given by the additional unexpected loss to bank equity arising from subsidisation, $UEL_2 - UEL_0$, as a fraction of the unexpected loss from each unit of IAH assets, so that

$$\widehat{\alpha} = -\frac{\mu\beta\left[F_r^{-1}(C) - \theta\left[\sum_1^{N} w_i \, \mathrm{F_i}^{-1}(1-\mathrm{C})\right]^{+}\right]^{+}}{\sum_1^{\mathrm{N}} \mathrm{w_i F_i}^{-1}(1-\mathrm{C}) - \sum_1^{\mathrm{m}} \mathrm{LGD_i p_i w_i}} \qquad (15)$$

Eq. (15) is the main theoretical result of the paper. Its significance is that it admits calculation of bank-specific alpha, in principle without recourse to empirical estimation. The expression for alpha depends on the following: the cumulative distributions of the returns on assets within the shared portfolio; the cumulative distribution of the conventional deposit rate; the confidence interval (usually prescribed by regulators); the profit sharing ratio of the bank; the volume of investment accounts relative to the bank's ownership of shared assets; expected losses; and asset allocations within the shared assets' portfolio.

Three remarks concerning Eq. (15) are now in order:

(1) In Eq. (15) we recognise that alpha may take values exceeding 1.0. Alpha is therefore no longer interpreted (as per the IFSB definition) as the proportion of IAH assets requiring capital support. Alpha is instead a *multiplier* allowing the bank and its regulator to express additional capital required to support DCR in units of risk-weighted assets of IAHs. The use of risk-weighted assets as a numeraire for alpha is something which of itself may be

[19] We choose subscripts "0" and "2" for consistency with the IFSB notation.

open to challenge, given the point highlighted in this paper, namely that from the perspective of Shari'a, it is impermissible for Islamic banks to make whole the losses of IAHs.

Continuing with this line of reasoning, we may instead express the denominator of the IFSB CAR formula equivalently as

$$RWA_B + \hat{\alpha}\beta RWA_P(1 - PER - IRR) \quad (16)$$

in order to not suggest alpha is bounded at 1.0 (see Eq. (1)), and where: RWA_B is the risk weighted assets of bank shareholders, including, however, the operational risk which arises on all assets managed by the bank; β is the ratio of unrestricted PSIAs to bank assets; RWA_P is the (credit and market) risk weighted assets of unrestricted PSIAs; PER and IRR are the percentage of IAH assets allocated to each reserve respectively.

(2) In regards to the application of Eq. (15), it should be noted that the sub-portfolio of receivables within the shared assets' portfolio should be aggregated and treated as a single asset if, for example, Vasicek (2002) is used to describe the loss ratio distribution. This is due to a default correlation assumption which must be respected in order to apply the Vasicek (2002) result[20].

(3) Eqn. (15) ensures that stricter non-performance criteria for receivables (funded jointly by IAHs and shareholders' funds) results in a higher capital charge for displaced commercial risk. For example, reducing the period of non-performance (e.g. from 6 months to 3 months) before which delinquency is deemed to have occurred leads to a higher value for the probability of default, p_i[21], and a higher expected loss[22]. In turn, this reduces the denominator of the expression in Eq. (15) so increases alpha.

In the next section, we illustrate Eq. (15) to calculate alpha for a stylised Islamic bank. In doing so, we all introduce model assumptions used thereafter to estimate alpha for banks in our sample.

[20] For example, treating each receivable independently, and then imposing perfect loss correlation between each asset in accordance with our derivation of alpha, would preclude applying a general, not necessarily perfect, default correlation per Vasicek (2002).

[21] In other words, for a portfolio of receivables with a given risk profile, the ex-ante probability of default is higher if we increase the number of future states of the world in which a default event will be deemed to have occurred.

[22] All other terms in the expression for alpha in Eq. (15) are VaR loss amounts, and are not affected by a change in the expected loss. This is because the VaR loss and the expected loss are merely different characterizations of the loss distribution attaching to a receivables portfolio.

5. Numerical Illustration

Suppose the shared portfolio consists of m receivables with a total allocation $w_L = \sum_1^m w_i$, and $N - m$ equities with allocation $w_E = \sum_{m+1}^N w_i$. We calculate alpha for two types of underlying asset classes, being receivables and equities, and different portfolio compositions ranging from 100% receivables to 0% receivables. This will provide a comparison of alphas which relate to a ‘pure commercial bank’ (commingled portfolio is 100% receivables), a ‘pure investment bank’ (commingled portfolio is 100% equities), and banks which are in between (investing in both receivables and equities). We also use a value for μ of 50%.

For the purpose of illustration, and for the estimation that follows in the next section, let the sub-portfolio of receivables, and the sub-portfolio of equities, each be treated in aggregate. For the special case of a commingled portfolio bifurcated between receivables and equities, (15) may be restated as

$$\widehat{\alpha} = -\frac{\mu\beta\left[F_r^{-1}(C) - \theta\left[w_L \mathrm{F_L}^{-1}(1-\mathrm{C}) + w_E \mathrm{F_E}^{-1}(1-\mathrm{C})\right]^+\right]^+}{w_L \mathrm{F_L}^{-1}(1-\mathrm{C}) + w_E \mathrm{F_E}^{-1}(1-\mathrm{C}) - w_L.LGD.p} \tag{17}$$

We now proceed to impose assumptions in order to calculate alpha.

Assumption 3: Loan loss ratio

The loss ratio of the receivables is described by Vasicek (2002) [21]:

$$Pr.\left(\tilde{L} < X\right) = N\left[\frac{\sqrt{1-\rho}N^{-1}(X) - N^{-1}(p)}{\sqrt{\rho}}\right] \tag{18}$$

where p is the unconditional probability of default of receivables in the portfolio (the same for all receivables), and ρ is the correlation of defaults between receivables[23].

Assumption 4: Equity returns process

The distribution of equity returns, $\tilde{R}_E$, is Gaussian:

$$d\tilde{R}_E = \mu_E dt + \sigma_E dz_E \tag{19}$$

where μ_E is the equity return drift, σ_E is the equity volatility, and dz_E is a weiner process for shocks to equity returns.

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[23] Which is also the correlation between the returns of balance sheet assets of obligors in the receivables portfolio.

Assumption 5: Benchmark deposit rate process

The benchmark deposit rate, $\tilde{r}_t$, is modelled using Vasicek (1977):

$$d\tilde{r}_t = a(b - \tilde{r}_t)dt + \sigma_r dz_r \tag{20}$$

where a is the speed of reversion, b is the long-term mean deposit rate, σ_r is the volatility of the deposit rate, and dz_r is a weiner process for shocks to the deposit rate[24].

In order to apply Assumptions 3-5 to the illustration, we first derive the resulting cumulative distributions. It is easily verified for Eq. (19) that the inverse cumulative distribution function for the equities sub-portfolio after 1 year is given by

$$F^{-1}{}_E(1 - C) = \mu_E + \sigma_E N^{-1}(1 - C) \tag{21}$$

The C-centile deposit rate, $F^{-1}{}_r(C)$, is derived by noting from the Vasicek model, that the benchmark deposit rate after time t is normally distributed with mean $r_0 e^{-at} + b(1 - e^{-at})$ and variance $\frac{\sigma_r}{2a}(1 - e^{-2at})$. Therefore, the C-centile deposit rate after 1 year is

$$F^{-1}{}_r(C) = r_0 e^{-a} + b(1 - e^{-a}) + N^{-1}(C)\sigma_r \sqrt{\frac{1 - e^{-2a}}{2a}} \tag{22}$$

where r_0 is the initial deposit rate.

Table 1: Summary of parameter values for the numerical illustration

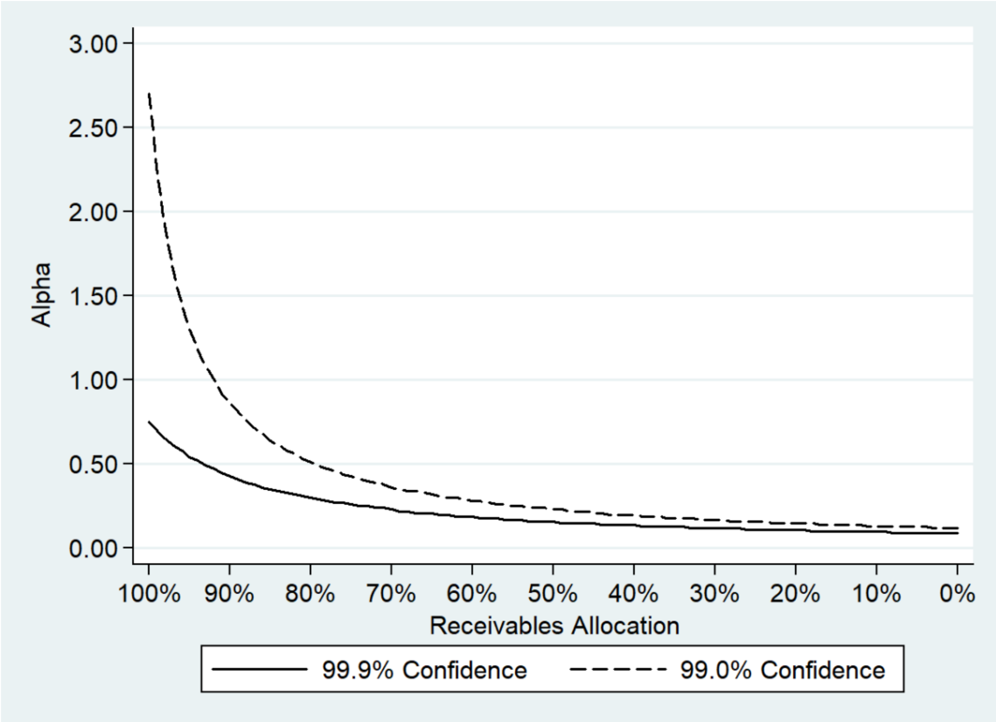
Parameter	Definition	Value
*Panel A: Receivables sub-portfolio**		
R_C	Promised return on receivables	5%
p	Unconditional default probability	2%
ρ	Default correlation	18%
LGD	Loss given default	40%
Panel B: Equities sub-portfolio		
μ_E	Equity return drift	15%
σ_E	Equity return volatility	20%
Panel C: Benchmark deposit rate		
r_0	Initial deposit rate	2%
a	Mean reversion speed	1%
b	Mean reversion level	3%
σ_r	Deposit rate volatility	5%

*Note: The equivalent risk-weight of the receivables sub-portfolio calculated from Eq. (13) with $\beta = 0$ and 8% minimum CAR is 100%, corresponding to a credit rating of BBB+ to BB-.

[24] The Vasicek model admits negative interest rates. However, since we seek the C-centile positive rate in order to calculate alpha, this is not a model limitation.

For the parameter values in Table 1, alpha versus portfolio allocation to the receivables sub-portfolio is shown in Figure 3 for confidence levels 99.9% and 99.0%.

Figure 3: Alpha v Portfolio Allocation



From Figure 3, we observe that alpha is higher at 99.0% confidence than at 99.9% confidence for all allocations to the receivables sub-portfolio. The reason for this is that even though at lower confidence, the VaR deposit rate is lower (which reduces alpha), the combined VaR loss of the shared portfolio at 99.0% is several times less severe, which reduces the absolute size of the denominator in Eq. (15), causing a notable increase in alpha.

We also observe, from Figure 3, that alpha decreases as the allocation to equities increases. This is because equity VaR is far more significant than the VaR of the receivables sub-portfolio (recall that on non-defaulted receivables, the bank continues to realise the promised return). Consequently, the relative impact of the subsidy paid to IAHs is far lower when more of the shared assets are allocated to equities[25].

In the next two sections, we define our data set and apply our model to calculate bank-specific alphas. We also calculate country alphas using the IFSB's methodology applied to the same

[25] By virtue of Assumption 2, it should be noted that a perfect correlation of losses arising on commingled equities and receivables necessarily captures a phenomenon of systemic risk in which financial distress negatively impacts multiple asset classes simultaneously. Further, Assumption 2 also ensures that widespread impairment of asset portfolios is accompanied by high deposit rates. This is consistent with an increase in the rates of return offered by banks to depositors and other providers of liquidity when markets are distressed.

data set. This serves two purposes. Firstly, using the IFSB methodology to estimate alphas equal to those applied by regulators implicitly validates our data set. Secondly, we are able to directly compare bank-specific alphas derived using our model to alphas imposed by each bank's regulator. In turn, this provides an indication of potential over-, or under-capitalisation of banks for displaced commercial risk.

6. Data

The main part of the data set contains an annual balance sheet and income statement data. The sample includes all Islamic retail banks listed in the Orbis database. The data was collected for financial year ends from Dec 31st, 2009 to Dec 31st, 2016. The sample data does not include Islamic windows[26]. The sample includes only banks that report all of the following information: (1) shareholders' capital, (2) PSIA funds, (3) equity-based financing assets, (4) debt-based financing assets, (5) provisions, (6) return on shareholders' capital after appropriations to IRR and PER, (8) return on IAHs' capital after appropriations to the IRR and PER, and (9) Mudarabah income. The resulting sample contained 43 banks in 11 countries, with the number of banks in each country shown in the following table:

Table 2: Sample country distribution

Country	Number of Banks
Bahrain	6
Jordan	4
Kuwait	1
Maldives	1
Oman	2
Pakistan	1
Palestine	2
Qatar	7
Sudan	13
Syria	3
Yemen	3
Total	43

Data for the parameters of our model are as follows:

a) *Benchmark deposit rate*

[26] Islamic windows involve conventional banks offering Islamic financial products. Such banks are regulated in accordance with rules ordinarily applied to conventional banks.

The benchmark deposit rate used in each country[27] is the 3-month rate, the rationale being that PSIA account volumes aggregated across banks in each country are highest for this tenor.

Historic deposit rates were sourced from the IMF website coinciding with the financial reporting period end dates of each bank.

Parameters of the Vasicek model are estimated for the actual deposit rate time series in each country by applying maximum likelihood estimation to the error term defined as the difference between the expected change in deposit rate from Eq. (20), and the actual change in deposit rate.

b) Profit sharing ratios

The Orbis dataset has some notable limitations – neither the funds allocated to IRR and PER, nor the IAHs' contractual share of the Mudarabah profit, are reported. Therefore, we are unable to measure return subsidies transferred by shareholders to IAHs directly. In order to incorporate return subsidies in our estimation of alpha (through the propensity to subsidise returns to IAHs), we first calculate a profit sharing ratio for each bank. This is the profit sharing ratio which ensures that over the sample period, IAHs earn an average contractual return equal to the average benchmark deposit rate.[28] The excess of the actual (cash) return paid to IAHs in a particular reporting period over the contractual return they would receive for the calculated profit sharing ratio, is the return subsidy[29].

c) Receivables assets

The promised return on receivables (R_C) is proxied by the ratio of gross income from receivables to the size of receivables assets. Data for the receivables' risk model parameters, namely loss given default, unconditional probability of default, and default correlation, is as follows:

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[27] Sudan is an exception to this, since it only has Islamic banks in operation. For Sudan, we use the musharaka average share percentage (sourced from the central bank in Sudan) as the benchmark return in respect of which displaced commercial risk arises.

[28] If it were not true that contractual returns generated by Islamic banks for their IAHs equals the benchmark rate on average, then in equilibrium, by providing PSIAs to IAHs, Islamic banks would persistently either deplete shareholder capital through payment of subsidies, or pay cash returns in excess of the benchmark rate unnecessarily. Avoidance of both scenarios is achieved through effective portfolio management of commingled assets.

[29] If only the cash flows generated by the underlying assets, i.e. contractual returns, were paid to IAHs, then the expected return of IAHs would be higher than conventional deposit rates due to the ex-ante uncertainty of asset returns. However, the result of using subsidies to smooth returns to IAHs is that the bank ultimately pays cash returns aligned to conventional deposit rates. The consequence of return smoothing is thus to de-link returns paid to IAHs from the risk profile of the underlying assets, and to remove the risk premium that would otherwise attach to IAH returns.

I. The unconditional probability of default (p) is proxied by the ratio of total provisions to total receivables.

II. Loss Given Default (LGD) data is published by only a very small number of bank regulators in our country sample, with values ranging from 45% to 60%. We assume a value for LGD within this range of 50%.

III. Default correlation (ρ) data is unavailable. This parameter is given an assumed value of 20% so that the default correlation of receivables is neither weakly, nor strongly, positive.

d) Equity assets

For the expected return to equity assets within the commingled portfolio of each bank, we use the returns to shareholders' equity over the sample period. The volatility of equity returns is proxied by the volatility of the equity market in each country (the only exception being Yemen, for which Syria is used prior to the start of its conflict period in 2011, at which time Yemen and Syria had similar country credit ratings[30]).

e) A propensity to subsidise returns

The propensity to subsidise returns paid to IAHs, μ, is calculated as the ratio of total actual subsidies paid to IAHs over the sample period, to potential subsidies that would need to be paid to IAHs in order to equate their actual returns to the corresponding benchmark deposit rate when contractual returns are insufficient, i.e.

$$\mu = \frac{\sum_i (R_i^a - [\theta R_i]^+)^+}{\sum_i (r_i - [\theta R_i]^+)^+} \tag{23}$$

the summations being overall sample periods. Then alpha is calculated as

$$\mu \left\langle \frac{\beta \left[F_r^{-1}(C) - \theta \left[w_L \mathrm{F_L}^{-1}(1-\mathrm{C}) + w_E \mathrm{F_E}^{-1}(1-\mathrm{C}) \right]^+ \right]^+}{w_L \mathrm{F_L}^{-1}(1-\mathrm{C}) + w_E \mathrm{F_E}^{-1}(1-\mathrm{C}) - w_L . LGD . p} \right\rangle \tag{24}$$

where averaging of the term in brackets (⟨ ⟩) is over the sample period.

7. Results

The following table summarises the results of applying our data set to estimate alpha in accordance with our structural model, as well as using the IFSB model.

[30] Per the IMF.

Table 3: Alpha using Structural model and IFSB model

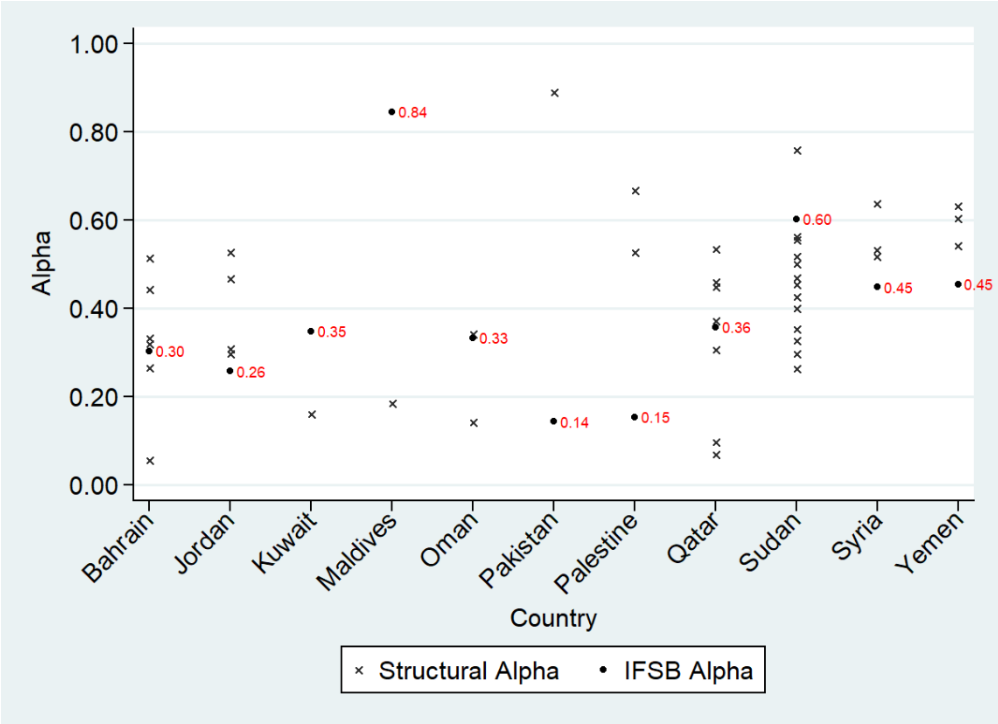
Country	Bank	Structural Alpha	IFSB Alpha
Bahrain	Bank A	0.054	
Bahrain	Bank B	0.264	
Bahrain	Bank C	0.318	
Bahrain	Bank D	0.332	0.302
Bahrain	Bank E	0.442	
Bahrain	Bank F	0.513	
Jordan	Bank G	0.297	
Jordan	Bank H	0.308	
Jordan	Bank I	0.466	0.256
Jordan	Bank J	0.526	
Kuwait	Bank K	0.159	0.347
Maldives	Bank L	0.183	0.844
Oman	Bank M	0.140	0.332
Oman	Bank N	0.341	
Pakistan	Bank O	0.890	0.142
Palestine	Bank P	0.527	0.152
Palestine	Bank Q	0.666	
Qatar	Bank R	0.068	
Qatar	Bank S	0.096	
Qatar	Bank T	0.305	
Qatar	Bank U	0.370	0.356
Qatar	Bank V	0.448	
Qatar	Bank W	0.459	
Qatar	Bank X	0.534	
Sudan	Bank y	0.262	
Sudan	Bank Z	0.297	
Sudan	Bank AA	0.326	
Sudan	Bank AB	0.352	
Sudan	Bank AC	0.398	
Sudan	Bank AD	0.426	
Sudan	Bank AE	0.454	0.602
Sudan	Bank AF	0.469	
Sudan	Bank AG	0.500	
Sudan	Bank AH	0.517	
Sudan	Bank AI	0.554	
Sudan	Bank AJ	0.562	
Sudan	Bank AK	0.758	
Syria	Bank AL	0.516	
Syria	Bank AM	0.532	0.447
Syria	Bank AN	0.636	
Yemen	Bank AO	0.542	
Yemen	Bank AP	0.603	0.454
Yemen	Bank AQ	0.631	

Note: Structure model is calculated using Eq. (15), and the IFSB model is calculated using Eq. (2).

We see from Table 3 that values for the IFSB alpha correspond to those applied by supervisory authorities in each country. For example, Bahrain 0.30, Qatar 0.35, and Sudan 0.55. This validates our data set as well as our application of the IFSB model.

Our bank-specific results for alpha are illustrated in Figure 4 below, which shows that for 4 of the 11 countries in our sample (Bahrain, Oman, Qatar, Sudan), the IFSB's alpha is contained within the range of structural alpha values calculated for Islamic banks in those countries. In 4 of the countries (Jordan, Palestine, Syria and Yemen), the IFSB's alpha was outside of the range of structural alphas, being below the lowest bank-specific alpha.

Figure 4: Structural Alpha vs IFSB Alpha



The following table summarises the minimum, maximum, and median values of the structural alpha for banks in each sample country:

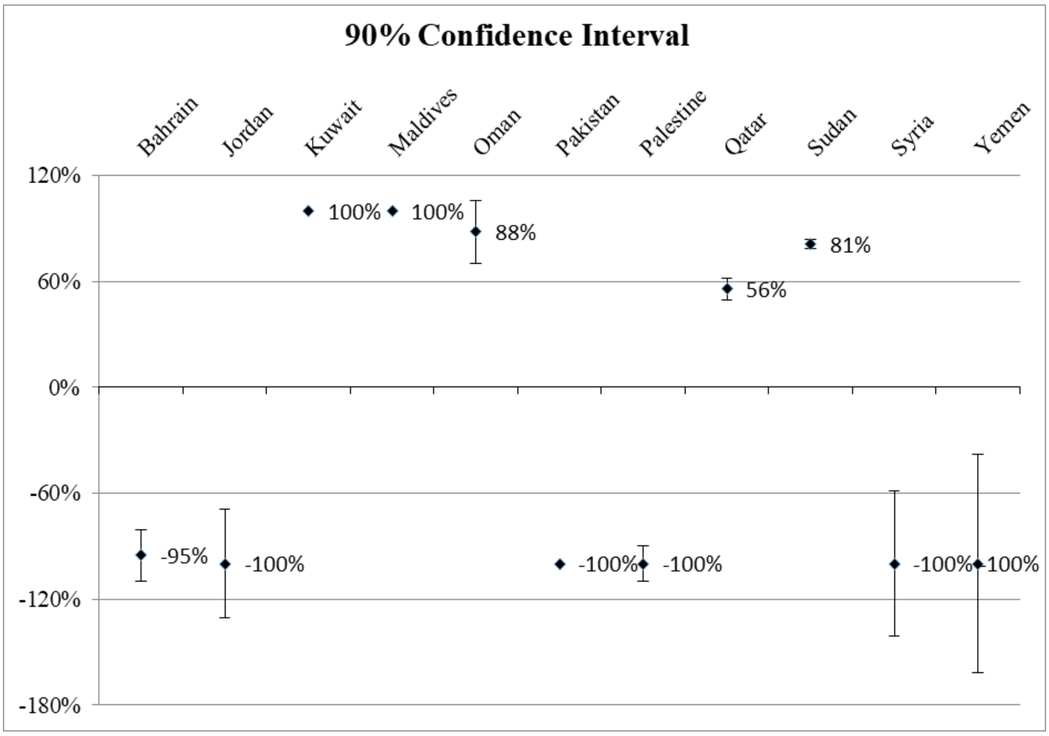
Table 4: Dispersion of Structural alphas around IFSB alpha

Country	Structural alpha			IFSB alpha
	Min	Median	Max	
Bahrain	0.054	0.325	0.513	0.302
Jordan	0.297	0.387	0.526	0.256
Kuwait	0.159	0.159	0.159	0.347
Maldives	0.183	0.183	0.183	0.844
Oman	0.140	0.241	0.341	0.332
Pakistan	0.890	0.890	0.890	0.142
Palestine	0.527	0.597	0.666	0.152
Qatar	0.068	0.370	0.534	0.356
Sudan	0.262	0.454	0.758	0.602
Syria	0.516	0.532	0.636	0.447
Yemen	0.542	0.603	0.631	0.454

These results shed light on the extent to which applying a single country alpha over- or under-estimates the amount of regulatory capital actually required to support displaced commercial risk. Across all of the countries in our sample, 20 banks operate in jurisdictions having an IFSB alpha above their own bank-specific alpha, whereas 23 banks face an IFSB alpha which is below their bank-specific alpha. Whilst this appears to represent a fairly even split, it is notable that 12 of the 13 banks tested in Sudan face an IFSB alpha which is above their own bank-specific alphas. In contrast, all banks tested in Jordan, Syria and Yemen face an IFSB alpha below the required alpha based on their own exposure to displaced commercial risk. In other words, several countries are polarized, and apply alphas which are either far too high, or far too low.

In order to quantify the relative monetary amount of over- or under-capitalisation of Islamic banks for the effects of displaced commercial risk in each country, we calculated the eligible capital required to achieve each bank's capital adequacy ratio using its structural alpha instead of its IFSB alpha. Where required eligible capital is less (more) than a bank's actual eligible capital, it is deemed to have a capital shortage (excess). Additionally, acknowledging the relatively small number of Islamic banks in each country, and our resulting small sample size, we applied the t-distribution to determine a range of over- or under-capitalisation at the 90% confidence interval. Figure 5 summarises these results:

Figure 5: Percentage shortage (excess) of capital



The ratio for each country shown in Figure 5 is positive (negative) if there is an overall capital excess (shortage)[31]. Figure 5 shows mixed results, with Qatar showing a fairly equal balance between banks holding too much or too little capital against displaced commercial risk. There is also no consistent pattern across countries, indicating that on a global basis, regulators are enforcing capital adequacy ratio requirements through their application of alpha that is either too prudent or too lenient, but rarely anywhere in between.

8. Conclusion

In this paper, we developed a structural model which enables the calculation of bank-specific alpha by taking into consideration the composition of assets and their associated return profiles, as well as the propensity of banks to subsidise investment account holder returns. The model directly captures the potential shortfall between contractual returns to investment account holders, and benchmark deposit rates, wherein contractual returns are generated from a commingled portfolio bifurcated between equity-like assets, and debt-like assets. The model

[31] For countries with an overall capital excess, the ratio is calculated as excess (aggregated for banks with excess capital) divided by the sum of excess plus shortage (aggregated for banks with capital shortage). For countries with an overall capital shortage, the ratio is calculated as minus shortage divided by the sum of excess plus shortage.

relies on estimating the propensity of banks to subsidise investment account holder returns using shareholders' equity. The estimation is applied to 43 Islamic banks in 11 countries.

Our model represents a fundamental advancement beyond the IFSB's model, the latter having so far been adopted wholesale by bank regulators to determine the amount of capital required to support displaced commercial risk. Our results show that the values of alpha applied by regulators broadly correspond to the values of alpha we calculate for banks in our sample. We find that of the 43 banks tested, 20 banks have bank-specific alpha values below, and 23 banks have bank-specific alphas above, their respective regulatory alphas. However, these results also establish the presence of a form of regulatory arbitrage given the current widespread adoption of the IFSB's methodology, with an effective (in-country) cross-subsidisation of alpha from high alpha banks to low alpha banks taking place. Further, we show that Islamic banks in some countries (e.g. Jordan) are undercapitalised (for the effects of DCR), whilst others (e.g. Qatar) are overcapitalized.

This finding has policy implications concerning capital efficiency and most importantly, financial stability. Whilst Islamic banks remain well-capitalised, the cross-subsidisation of regulatory alpha represents somewhat minor capital inefficiency. However, for as long as Islamic banks continue to perform an intermediary role using the capital of PSIAs, and as bank capital becomes scarcer over time, the concerns of some banks which hold too much capital against DCR will inevitably increase. Additionally, banks that hold too little capital against DCR increase systemic risk in the networks within which they operate[32]. In future, therefore, bank regulators may prefer to differentiate banks in accordance with their actual exposure to DCR, and apply alphas calculated either internally by banks themselves (as happens for the BIS's internal ratings-based approach (IRB) for the calculation of credit risk), or centrally by the regulator based on risk and financial statement disclosures.

[32] Brunnermeier et al. (2009) support our argument for bank-specific alpha. The authors refer to a "growing consensus" that capital requirements should reflect contribution to the risk of the financial system as a whole rather than merely a bank's absolute individual risk.

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Appendix

Table 5: Islamic bank asset classification

Equity Asset	Receivables Asset
Certificates of Investment Funds	Ijara
Held to Maturity Investments	Istisna
Investment in Sukuk	Mudaraba part of financing
Investments in Leases (Tajeer)	Musawama Financing
Investments in Subsidiaries, Associated Companies and Joint Ventures	Profit Financing Activities
Musharaka	Other Financing Activity
Mutual Funds Units	Qard Hasan
Other Islamic Investments	Salam Receivables
Other Islamic Portfolios and Funds	Total Murabaha
Total Investment Securities	
Total Trading Investments	
Unquoted Other Islamic Portfolios and Funds	
Wakala Investment	