

# Risk management with a duration gap approach

## Empirical evidence from a cross-country study of dual banking systems

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### Abstract

**Purpose** – In line with the IFSB and BCBS methodology, the purpose of this study is to undertake a comparative analysis of dual banking systems for asset-liability management (ALM) practices with the duration gap, in Islamic Commercial Banks (ICBs) and Conventional Commercial Banks (CCBs). Based on the research objective, two research questions are developed: How do the duration gaps of ICBs compare with those of similar sized CCBs? Are there any country-specific and regional differences among ICBs in terms of managing their duration gaps?

**Design/methodology/approach** – The research methodology comprises two-stages: stage one uses a duration gap model to calculate the duration gaps of ICBs and CCBs; stage two applies parametric tests. In terms of the duration gap model, the study determines the duration gap with a four-step process. The study selected a sample of 100 banks (50 ICBs and 50 CCBs) from 13 countries for the period 2009-2015.

**Findings** – The paper provides empirical insights into the duration gap and ALM of ICBs and CCBs. The ICBs have more variations in their mean duration gap compared to the CCBs, and they have a tendency for a higher (more) mean duration gap (28.37 years) in comparison to the CCBs (11.79 years). The study found ICBs as having 2.41 times more duration gap compared to the CCBs, and they are exposed to increasing rate of return (ROR) risk due to their larger duration gaps and severe liquidity mismatches. There are significant regional differences in terms of the duration gap and asset-liability management.

**Research limitations/implications** – Future studies also consider “Off-Balance Sheet” activities of the ICBs, with multi-term duration measures. A larger sample size of 100 ICBs with 10 years’ data after the GFC would be more beneficial to the industry. In addition, the impact of an increasing benchmark rate (e.g. 100, 200 and 300 bps) on the ICBs as per the IFSB 20 per cent threshold can also be established with the duration gap approach to identify the vulnerabilities of the ICBs.

**Practical implications** – The study makes profound contributions to the literature and suggests various policy recommendations for Islamic banks, regulators, and standard setters of the ICBs, for identifying and measuring the significance of the duration gaps; and management of the ROR risk under Pillar 2 of the BCBS and IFSB, for financial soundness and stability purposes.

**Originality/value** – To the best of the authors’ knowledge, this is a pioneer study in Islamic banking involving a sample of 100 banks (50 ICBs and 50 CCBs) from 13 countries. The results of the study provide



## 1. Introduction

One of the aspects, which has received significant prominence after the Global Financial Crisis (GFC) of 2007/2008 is the strengthening risk management of financial institutions including banks, reflecting improved risk management tools, techniques and regulatory standards. As a result, the global financial system has been undergoing unprecedented supervisory structural transformations and improvements in securing the financial stability of the financial intermediation function and rebuilding the trust of various stakeholders. To this end, the emergence of the Islamic financial services industry (IFSI)[1], anchored by key peculiar specificities and various inbuilt stabilisers (such as unbridled leverage, lack of synthetic and exotic products, stable funding base, etc.), has now become an integral part of global finance. This certainly indicates the viability of Islamic financial institutions (IFIs)[2], including Islamic Commercial Banks' (ICBs) operations. There is growing appreciation in the international financial community of the inbuilt strengths of the IFSI[3]. This recognition has been established because international institutions (e.g. the IMF and the World Bank) and international standard-setting organisations (e.g. BCBS, IOSCO and IAIS) have been working closely with the Kuala Lumpur-based IFSB[4].

Although the growth of the IFSI in the past decades has been extraordinary, the composition of the IFSI, however, remains highly bank-centric and deeply geographically focused in a few jurisdictions. The IFSI has proven to be relatively resilient compared to its conventional counterpart during the early waves of the financial tsunami, as IFIs were relatively less impacted by the GFC. However, it is also recognised that when the GFC turned into an economic crisis, certain IFIs (e.g. Arcapita Bank, IDG, Gulf Finance House, Kuwait Finance House, Dubai Islamic Bank) were exposed to spillover effects (a.k.a. second round effects). This is because ICBs operate in the same financial and economic environment of dual banking systems (Chattha and Bacha, 2010; Chattha and Alhabshi, 2017). With the exception of Sudan and Iran (which have fully *Shari'ah*-compliant banking systems), dual banking (where conventional financial institutions operate parallel to the IFIs) is the reality in almost every country where ICBs operate, which implies shared risks, returns and cash flows between ICBs and Conventional Commercial Banks (CCBs). Hence, there is a compelling need to address the source and impacts of these vulnerabilities and risks from an Islamic financial stability perspective, to keep ICBs resilient and less vulnerable.

The stylised balance sheet of an ICB indicates structural differences, which are different compared to its conventional counterpart, thus outlining different effects on risk management and risk implications (Section 2.2). From the business model of an ICB, its activities are exposed to a variety of financial risks such as credit risk/counterparty risk, liquidity risk, equity investment risk, market risk, rate of return (ROR) risk and operational risk (Chattha, 2013; IFSB, 2005). As stated earlier, the economic and financial environment in dual banking systems inevitably exposes ICBs to the same problems encountered by CCBs, especially benchmark rate risk (Bacha, 2004; Chattha and Bacha, 2010; Chattha and Alhabshi, 2017). Therefore, one of the risks is the potential squeeze of Net worth (NW) or economic value of equity (EVE) as benchmark[5] rate risk changes due to wider liquidity and duration gaps (Bierwag *et al.*, 2000; Bierwag and Kaufman, 1992; and Chattha and Bacha, 2010; Chattha and Alhabshi, 2017). This reflects the relevance of studying ICBs'

profitability and vulnerabilities under volatile (or changing)[6] benchmark rates risk conditions. Therefore, identifying, quantifying and regulating these vulnerabilities as per the IFSB is a very important consideration for the ICBs in a dual banking environment, and forms the subject of our study.

In particular, in the case of the ROR risk in the banking book of an ICB, it is an analogue of interest rate risk (IRR) in the banking book of CCBs as defined by the BCBS, and it is dealt with in Pillar 2 instead of Pillar 1 (IFSB, 2014) under the BCBS and the IFSB[7]. Therefore, “benchmark rate risk”, if not properly managed, has the potential to pose a substantial danger to an ICB’s earnings and capital base, and it can also affect the underlying value of an ICB’s assets, impact its funding costs and make it more vulnerable to contingent risks from off-balance sheet exposures. This is particularly relevant because benchmark rates in many countries are at historically low levels and there is the risk that IRR could increase significantly once rates “normalize”. Consequently, an effective risk management process – addressing the “economic value perspective through duration gap model (i.e. weighted average maturity in which the weights are stated in present value terms)” – is essential to the safety and financial soundness of an ICB. The IFSB, under Pillar 2, has outlined the importance of the assessment of ROR in the banking book through the duration gap approach.

A critical review of existing recent literature on ICBs mainly categorises the risk management studies into:

- general risk management practices (Khan and Ahmad, 2001; Romzie and Abdul Rahim, 2015);
- risk reporting and disclosure (Mohd. Ariffin *et al.*, 2009; Romzie, 2009); and
- risk management tools and practices (Alam and Masukujjaman, 2011; Chattha and Bacha, 2010; Fauziah *et al.*, 2011; Hassan, 2009; Khalid and Amjad, 2012; Ben Selma Mokni *et al.*, 2014; Sundararajan and Errico, 2002; Zainol, 2015).

However, no specific study has been conducted to explain the times-series and cross-section variation of the ICBs’ duration gaps for a longer period. In addition, the existing work also does not provide enough evidence on:

- whether ICBs have more gaps on a long-term basis compared to CCBs;
- the main reasons explaining the duration gaps practices for ROR risk;
- whether there are any cross-country specific and regional differences in terms of managing duration gaps and liquidity gaps of ICBs and CCBs; and
- the implications of higher duration gaps for ICBs and their supervisors under Basel or IFSB Pillar 2.

Taking into account the above background, our study attempts to bridge this gap from an Islamic finance perspective. The main objective of the study is to undertake a comparative analysis of dual banking systems for asset-liability management practices with the duration gap, in ICBs and CCBs. For our research objective, two research questions are developed, whereas hypotheses development is provided in Section 5:

*RQ1.* How do the duration gaps of ICBs compare with those of similar sized CCBs?

*RQ2.* Are there any country-specific and regional differences among ICBs in terms of managing their duration gaps?

With the above considerations, to the best of the authors' knowledge, this is a pioneer study in Islamic banking involving a sample of 100 banks (50 ICBs and 50 CCBs) from 13 countries for the period 2009-2015. The results of the study provide empirical evidence regarding the estimation of duration gap and variations across jurisdictions in terms of vulnerability of ICBs and CCBs. In our results, the study found that the ICBs have 2.41 times more duration gap compared to the CCBs, and they are exposed to increasing ROR risk due to their larger duration gaps and severe liquidity mismatches. The study also found significant regional differences in terms of duration gap and asset-liability management. In this respect, our study offers deeper insight into the issue and gives guidance to ICBs on managing their duration gaps while factoring in country-specific differences of ICBs' business models[8], and provides direction to the ICBs to reflect upon the importance of liquidity risk, ALM, the impact of benchmark rate risk (ROR risk) under Pillar 2 of the BCBS and IFSB, and financial stability. Moreover, our results highlight the involvement of, and implication for, supervisors and international standard-setting bodies (e.g. IFSB).

The rest of the paper is structured as follows: Section 2 explains Islamic finance with its key specificities, and theoretical considerations for ROR risk for ICBs; Section 3 covers the detailed literature review on the measurement of the ROR risk with a duration gap approach; Section 4 presents the description of the data and the methodology including the application of Duration Gap model, and Cumulative Short-term Liquidity Mismatch Gap (CLGAP); in Section 5, we discuss the empirical results of the study and the practical implications; and finally, Section 6 concludes the entire study, followed by appendix.

## **2. Islamic finance: structural differences and risk implications**

### *2.1 Islamic banking sector growth*

In terms of accurate statistics, according to the [IFSB \(2017\) Islamic Financial Services Industry Financial Stability Report](#), the IFSI's total worth across its three main sectors (banking, capital markets and Takaful [Islamic insurance]) is estimated at US\$1.89tn in 2016[9]. Islamic banking remains the most dominant form of asset-based intermediation system with approximately 80 per cent of Islamic financial assets held within the banking sector in different asset classes, products and services[10].

### *2.2 An Islamic commercial banks' stylised balance sheet: structural differences and implications*

As alluded to earlier, one of the key elements of an ICB's specificities is the structural differences in its balance sheet composition compared to a CCB, which consequently has different effects on risk management and risk implications ([Table I](#)). At first glance, the stylised or the schematic balance sheet of an ICB appears to be similar to a one-stop shopping mall concept, reflecting a universal banking model where all the traditional intermediation functions such as retail and core banking, and investment banking functions are being undertaken for a variety of customers ([Chattha, 2013](#)). Both sides of the ICBs' balance sheet have peculiar features, which fundamentally differentiate the ICBs from their conventional counterparts, the CCBs. These specificities indicate various risk implications for ICBs, and play an important role in the development of financial regulation by supervisors.

Referring to [Table I](#), it is obvious that the asset side of an ICB is involved in buying physical assets before selling, direct equity investment and investment in *Sukūk*[11]. Further, an ICB is also involved in leasing and trading in real estate properties, and fund management services, which are traditionally not offered by the CCBs, rather by their

Assets	Liabilities and capital
Cash and cash equivalents	Current account/Demand Deposits [Non- <i>Mudārabah</i> ( <i>Wadī'ah</i> or <i>Qarḍ</i> )]
Central bank placements	Savings account [ <i>Mudārabah</i> or Non- <i>Mudārabah</i> ( <i>Wadī'ah</i> or <i>Qarḍ</i> )]
Interbank placements	Commodity <i>Murābahah</i> account ( <i>Tawarruq/Murābahah</i> )
Financing/Sales receivables	Interbank deposits ( <i>Murābahah/Mudārabah</i> )
Asset-based Financing “based on <i>Murābahah</i> , <i>Bay' Muajjal</i> , <i>Salam</i> or <i>Istisnā'</i> contracts”	Unrestricted PSIA ( <i>Mudārabah</i> )
Equity financing or investments “based on <i>Mudārabah</i> and <i>Mushārahah</i> contracts”	Profit Equalisation Reserve (PER)
Lease financing assets based on “ <i>Ijarah</i> and <i>Ijarah Muntahia Bittamlik</i> (IMB) contracts”	Investment Risk Reserve (InRR)
Investment in securities	Other deposits
Investment in leased assets	<i>Salam/Istisnā'</i> payable for financing
Investment in real estate	Tier –2 <i>Sukūk</i> /Instrument
Equity investment in joint ventures	Other liabilities
Equity investment in capital ventures	Capital and Reserves
Inventories	
Other assets	
Fixed assets	
<i>Off-Balance sheet – Restricted Investment Account</i>	

Source: Authors

**Table I.**  
Stylised balance  
sheet of an ICB and  
risk implications

separate subsidiaries. Various types of contracts defining contractual rights and obligations of counterparties underlie each category of asset. Sales, lease and equity financing assets are based on different forms of financing contracts. Therefore, on the asset side, an ICB may assume the role of, among others, a trader (under *Murābahah*), a lessor (under *Ijarah*), an investor (under *Mudārabah* and/or *Mushārahah*) or a developer or manufacturer (under *Istisnā'*).

On the liability side, “demand deposits such as current accounts, which are guaranteed by owner’s equity and, in most cases, represent non-*Mudārabah* funds, are considered as liabilities” (IFSB Compilation Guide, IFSB, 2011, p. 30). In addition to a current account or a savings account, an ICB offers Profit Sharing Investment Accounts (PSIA), which is a specific feature of Islamic finance and one of the key distinctions in terms of its risk-reward mechanism[12]. Further, with respect to the PSIA on the funding side, the contracts most frequently used are forms of fund management contracts, which are mostly based on *Mudārabah*, whereby the ICB acts as the entrepreneur (“*mudarib*”), and the provider of funds as (“*rab-alma*”), the so-called unrestricted PSIA[13]. This arrangement is based on an agreed upon formula (i.e. profit sharing ratio, say, 70:30). Moreover, with respect to the PSIA, to manage displaced commercial risk (DCR)[14], an ICB sets aside reserves such as the Profit Equalisation Reserve (PER) and the Investment Risk Reserve (InRR). The former is set aside to smooth the returns paid to unrestricted PSIA, and the latter is set aside to buffer any potential loss exposure of unrestricted PSIA.

In light of the above, the following risk implications are derived from the balance sheet structure of an ICB:

- no re-pricing of sale contracts (e.g. *Murābahah*);
- asset-backed nature of structures;
- risk transformation[15];
- key risks and risk management controls;
- role of risk weights and PSIA in Capital Adequacy Ratio (CAR)[16]; and
- corporate and *Shari'ah* governance.

Besides, in essence, the above description of the stylised balance sheet raises key concerns for an ICB given that the presence of a majority of sales-based contracts (from short-term to long-term) are funded by the short-term PSIA funds. This highlights an acute inherent asset-liability maturity mismatch, which is studied in this research.

### *2.3 Risks in the Islamic banking industry – key gaps and considerations*

It is important to note that while the risks are an integral part of the banking industry, regardless of ICBs or CCBs, robust risk management differentiates and outlines the intensity of these risks and vulnerabilities to ensure financial stability and other unintended economic consequences. However, the need for risk management in ICBs requires more attention due to the unique structure of their assets and liabilities. For instance, according to the IFSB:

The different business models of the ICBs, new emerging products and risk mitigants employed by the ICBs have created new levels of complexities that may lead to financial instability and other unintended economic consequences (IFSB, 2014, p. 24).

This necessitates the undertaking of certain studies, which may explain the implications of these models with particular reference to ICBs as not many studies offer useful insight on this issue[17].

To address some of the key risks and distinctive risk features of Islamic financial transactions and contracts offered by the ICB, IFSB (2005) provides comprehensive regulation on risk management controls through guiding principles. These controls are for both the ICBs and their supervisors. These 15 principles, which complement Pillar II of the Basel II, are grouped together under six types according to risk. ICBs are also exposed to other specific risks such as “*Shari'ah* non-compliance risk, fiduciary risk, ROR risk and DCR”, in addition to the customary banking risks (e.g. credit, market and operational risks).

Following the GFC, the role of the regulators and supervisors to place prominence on the adequacy and capability of an ICB's management of risks during their normal supervisory review process has been intensified. Both the BCBS and the IFSB lay out clear guidelines on risk management from supervisory perspectives, in particular for ROR risk. IFSB (2014) has indicated that it is essential for ICBs to have benchmark rate risk measurement systems including a number of generally accepted techniques (such as *gap* analysis and *duration gap* analysis) for measuring the benchmark rates risk exposure of both *earnings* and *economic value*. The IFSB's most recent work on ROR risk is in IFSB (2015), also known as CPIFR (Core Principles for Islamic Finance Regulation), in which CPIFR 26 on *ROR risk* advocates that the supervisory authorities should require ICBs (through policies and regulations) to have an appropriate ROR risk strategy and ROR management framework that provides a comprehensive ICB-wide view of ROR risk[18].

In addition to the above reflections, the existing literature on risk management practices and tools from ICBs' perspective shows a lot of variations but seems to focus on general risk management practices without combining institutional and regulatory perspectives. There are a wide range of studies on risk management practices for ICBs in different countries, for

dealing with different types of risk (Al-Janabi, 2008; Alam and Masukujjaman, 2011; Al-Ajmi and Hameeda, 2012; Al-Tamimi and Al-Mazrooei, 2007; Ben Selma Mokni *et al.*, 2014; Fauziah *et al.*, 2011; How *et al.*, 2005; Hassan, 2009; Hussain and Naysary, 2014; Mohd. Ariffin *et al.*, 2009; Romzie and Abdul Rahim, 2015; Usman *et al.*, 2011). Of these studies, three of them (Ben Selma Mokni *et al.*, 2014; Romzie and Abdul Rahim, 2015; How *et al.*, 2005) are worth citing here in the context of this study.

First, Ben Selma Mokni *et al.* (2014) investigate in detail the way each risk is measured and managed by ICBs in the MENA region. While the study discusses and analyses:

[. . .] the current practices employed in the risk management of ICBs, and identifies the tools and methods used in managing credit risk, market risk, liquidity risk and operational risk by ICBs.

It leaves some important gaps in terms of how the ROR risk could be captured through the duration gap, and other quantitative techniques. Second, Romzie and Abdul Rahim (2015) examine the risk management practices of ICBs internationally by explaining the unique risks as recommended by the IFSB. While exploring the differences in risk management practices based on various parameters (such as the country, size, type and age of the bank), Romzie and Abdul Rahim find “a lack of effective risk management practices in relation to liquidity risk, DCR and equity investment risk by ICBs”, but they do not provide evidence on how the DCR and ROR risk are measured by ICBs across the jurisdictions. Finally, How *et al.* (2005, p. 76) provide evidence for Malaysia by showing that “banks engaging in Islamic financing have lower credit and liquidity risks, but significantly higher IRR than banks that do not offer such facilities.” Nevertheless, the study does not show the effect of higher IRR through the duration gap on the ALM. Furthermore, one of the reasons for such lower liquidity risks could be that these ICBs have access to the SLOLR mechanism in Malaysia (Chattha and Halim, 2014).

After a careful review of the above studies, we establish the following:

- the studies have merely focused on general risk management practices (with qualitative focus on perception and practices), and therefore, they did not look into a specific risk from an institutional perspective (a quantitative measurement of certain risks);
- they were country-specific rather than having a comparative focus; and
- there was no regulatory perspective (e.g. compliance with Pillar 2) in the light of ongoing developments pertaining to the GFC. In this study, we combine these perspectives.

### 3. Literature review

#### 3.1 What is duration gap? Duration gap for measuring rate of return risk

It is important to define the concept of duration gap to provide context for discussing the relevant past studies on the issue. Gup *et al.* (2007), citing Bierwag (1987), define duration as “the weighted average time (measured in years) to receive all cash flows from a financial instrument”, and the duration gap is the difference between the duration of a bank’s assets and liabilities. In simple terms, it is defined as the “weighted average maturity in which the weights are stated in present value terms” (Chattha and Bacha, 2010, p. 16). On the other hand, similar to the BCBS, the IFSB provides an identical definition of duration measure.

Based on the above definition, we can conjecture that when the duration gap is positive, any increase (decrease) in benchmark rates, will result in a decrease (increase) in the NW of a bank. On the other hand, when the duration gap is negative, any increase (decrease) in

benchmark rates, will result in an increase (decrease) in the NW of a bank. However, when the duration gap is zero, any increase or decrease in benchmark rates, will bring no change to the NW of a bank. This relationship emphasises the need for having in place appropriate strategies for managing the duration gap. In this context, there are two strategies when managing duration gaps – aggressive and defensive (Chattha and Bacha, 2010). The former would alter the duration gap in anticipation of changes in interest rates[19]. The latter strategy within this context would seek to keep the duration of assets ( $D_A$ ) equal to the duration of liabilities ( $D_L$ ), thereby maintaining a duration gap of zero.

### 3.2 Duration gap perspective and relevant empirical studies

The issues of duration and duration gaps (DGAP) have been studied comprehensively in the past decades, due to its significance for CCBs, but very little research is available, which studies the application of such a measure for ICBs. The academic literature on the duration gap can be classified into three main categories:

- (1) classical studies explaining the concept of duration gap;
- (2) empirical studies used to reflect the importance of duration gap to the banking system to measure the benchmark rate risk; and
- (3) contemporary studies showing the determinants of the duration gap as a proxy for measuring the impact of benchmark rate risk for banks.

Among the notable classical studies are Alden (1983), Bierwag (1987), Bierwag and Kaufman (1992), Bierwag *et al.* (2000), Fooladi and Roberts (2000) and Macaulay (1938). All of these studies have established that gaps, which are computed as functions of the  $D_A$  and  $D_L$ , are a more meaningful measure of IRR exposure for depository institutions, than are the simpler and more commonly used maturity gaps. To understand the classical work on the major highlights, development and use of DGAP theories and concepts, Bierwag and Fooladi (2006) provide a comprehensive historical perspective in the context of duration analysis. In fact, they note that the concept of duration is among a few major innovations devised by economists, however, they also argue that “the concept of duration still remains something of a mystery and a curiosity[20]”.

Macaulay (1938), the father of the duration concept, has provided in the literature extensive basis for the modern development of duration gap analysis. In his work, he described the “duration as the weighted average number of years until the cash flows (CF) of an asset or liability occur”. This demonstrates that the CF’s duration should be multiplied by the present values (PV) of each CF with the respective maturity, and finally, those results must be added and the sum then divided by the PV of the CF. In this context, the  $D_A$  or  $D_L$  will always be  $\leq$  to the term-to-maturity[21]. While Alden (1983) authored one of the classical works on gap management with respect to managing IRR in banks. His work is classified as one of the pioneers in terms of intellectual contribution to ALM and IRR management. For IRR management and ALM, he described three techniques: *maturity gap* approach[22], *simulation* approaches[23] and *duration gap* approach. In particular, he provided technical calculations on the duration model in his work and reflected that duration analysis can be used for many purposes by the banks, including hedging MVE.

Moreover, Dembiec *et al.* (1989) also contribute a distinguished work on the application of ALM and duration gap to the industry. In their study, after determining the assets and liabilities, they used modified duration measurement and incorporated estimates of the  $D_A$  and the  $D_L$ . David (1995) using the duration-based approach explains that a negative duration gap means that the  $D_A$  is greater than the  $D_L$ . Koch and MacDonald (2009) also



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hold a similar view that IRR is measured by comparing the weighted average  $D_A$  with the weighted average  $D_L$ . They identify four steps in the duration gap analysis:

- (1) developing an interest rate forecast;
- (2) estimating the market value of bank assets, liabilities and stockholders' equity;
- (3) estimating the weighted  $D_A$  and weighted  $D_L$ [24]; and
- (4) forecasting the changes in the market value of stockholders' equity across different interest rate environments.

BCBS (2004) provides a detailed framework, which formalised IRR management through the duration gap and other techniques for banks under the supervisory authority. The framework discusses, among others:

- modalities of maturity gap calculations;
- the standardised rates shock;
- *duration-based weights* and calculation of the precise duration of assets and liabilities; and
- and the impact of changing market rates on banks.

In addition, while acknowledging that banks have access to a wide array of financial tools for managing their IRR, such as standard ALM procedures, Lopez (2004) specifically suggested that to cope with the IRR banks commonly use two approaches, the traditional *earnings* approach and the more challenging *economic value* approach. The latter approach uses a duration gap analysis.

Entrop *et al.* (2009) specifically evaluate the robustness of the standardised framework proposed by the BCBS (2004) to quantify the IRR of banks. This work provides an empirical application of the BCBS framework on IRR for CCBs. In their empirical methodology and analysis, they use and calculate the duration gap and modified duration gap for assets and liabilities of the sample banks. On the other hand, Ballester *et al.* (2009) provide empirical evidence through the estimation of the empirical duration coefficients. In their study, estimated empirical durations were found with "both positive and negative signs", as it could be expected. They argue that a higher duration, regardless of its sign, implies a higher IRR for the bank (greater variation in the value of the firm for a given change in interest rates). Moreover, using supervisory data and the information on *volumes* and *maturities* of different lender and borrower types, Entrop *et al.* (2012) calculated *modified duration* gaps to proxy for on-balance interest rate risk. The results indicated that duration gaps show positive effects, and almost all banking samples show a positive relationship with regard to duration gaps. In the context of duration gaps, their results also demonstrate that savings and cooperative banks have substantially larger duration gaps.

With respect to ICBs, Khan and Ahmed (2001) conducted a study (through a survey of 17 IFIs) about the perception of risks in the Islamic banking industry. They highlighted that the ROR risk or benchmark risk is considered the most serious risk faced by ICBs, as ICBs still use the same benchmark. From the ICBs' perspective, their work was one of the pioneer studies, which suggested the use of the duration gap approach for ICBs to manage their asset-liability mismatch, although they did not provide empirical evidence on the use of such a duration gap approach. Besides Khan and Ahmed, Salman (2006) uses the duration gap approach to identify factors responsible for the collapse of an IFI in Turkey. Using the duration approach, he shows that the maturity mismatches of assets and liabilities were

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high at Ihlas Finans[25], compared to other IFIs. The study also points out the higher duration gap in IFIs.

In addition, using the duration gap approach [Chattha and Bacha \(2010\)](#) provide empirical insight into ICBs' vulnerability to rate of risk exposure, in their preliminary cross-country study of nine countries with a sample of 60 commercial banks (30 CCBs and 30 ICBs) for the year 2006. The study concluded that, among others, ICBs for the year 2006 are: "more prone to duration gaps compared with their conventional counterparts". Although the results of [Chattha and Bacha](#) provide a preliminary clue about the vulnerability of ICBs, there seems to be, however, a lot of gaps in the study, which are addressed in this study. From a regulatory perspective, [IFSB \(2014\)](#) has indicated that it is essential for ICBs to have benchmark rate risk measurement systems including a number of generally accepted techniques (such as *duration gap* analysis) for measuring the benchmark rates risk exposure of both *earnings* and *economic value*. In this respect, there is a dearth of studies, which provide a comparative perspective under the duration gap for ICBs and CCBs.

[Ariffin and Kassim \(2014\)](#) provide a qualitative perspective on risk management practices of major Islamic banks in Malaysia with the objective of having a deeper understanding of the practices and identifying ways for further improvements. Their findings, through a survey, show that Islamic banks are perceived to use less technically advanced risk measurement techniques of which the most commonly used are credit ratings, gap analysis, duration analysis, maturity matching and earnings at risk. Similarly, [Rahman et al. \(2015\)](#) examine the risk management practices of Islamic and conventional banks in Bangladesh and reveal that conventional banks rely mostly on advanced techniques of risk management. In particular, with respect to the use of various risk management techniques, 71 per cent of the Islamic banks have used duration analysis. Both studies by [Ariffin and Kassim \(2014\)](#) and [Rahman et al. \(2015\)](#) do not provide any empirical explanation on the estimation and implication of the duration gap measure by the Islamic banks. these studies even do not discuss how the duration gap technique works in practice and can assist the ICBs in managing the rate of return risk in the banking book under Pillar 2.

Moreover, taking into account the specific features of ICBs, [Chattha and Alhabshi \(2017\)](#) provide a theoretically and empirically review of the possible prudential implications of lowly and increasing benchmark rates risk using duration gap methodology with a sample of 50 ICBs from 13 countries, for the period 2009-2015, and provide a sturdy risk management and regulatory perspective for Islamic banks and supervisors. Their results indicate that 80 per cent of the ICBs have positive and higher duration gap and only 20 per cent (10 ICBs) tend to have a negative duration gap. However, the study only took ICBs, and therefore, did not compare the results with the conventional counterpart, the CCBs, as authors suggested future studies can consider such analysis. This paper addresses this gap with a larger sample size of 100 banks (50 ICBs paired with 50 conventional banks).

[Khaliq et al. \(2017\)](#) use the duration gap analysis to measure the Islamic bank's sensitivity of bank assets and liabilities towards the rate of return risk due to the conventional interest rate volatility. Their empirical data and analyses covered a five-year period using annually based data (2008-2012) for Malaysian Islamic banks only. Though the quantitative results reveal that the majority of the Islamic banks are exposed to the interest rate risk but the study does not provide how the duration gap is estimated including estimating the weighted duration of assets and liabilities and process of estimation. More recently, [Hassan and Aliyu \(2018\)](#) provide a contemporary survey of Islamic banking literature and review empirical studies on Islamic banking. They find that the growing trend of the empirical literature on Islamic banking research is conducted using a range of diverse

methodologies including duration analysis. On one hand, this confirms the usage of the duration gap methodology; on the other hand, no explanation is provided how this methodology is used by the ICBs in their risk management and what are the implications.

The previous studies reveal significant gaps, for instance:

- no specific studies on duration gap management for long-term data are found reflecting the peculiar features of ICBs;
- trends of the duration gaps over a period of several years, which is key to determine whether the gaps have been increasing over the period of time or vice versa;
- country-specific and regional differences among ICBs in terms of managing their duration gaps and ALM; and
- main causes influencing the duration gaps of ICBs.

Keeping these considerations in mind, in this study we offer deeper insight into the issue and give guidance to ICBs on managing their duration gaps.

#### 4. Data and methodology

##### 4.1 Overview of sample – key considerations

We selected a sample of 100 banks (50 ICBs and 50 CCBs) from 13 countries, namely, *Bahrain, Bangladesh, Indonesia, Jordan, Kuwait, Malaysia, Pakistan, Qatar, Saudi Arabia, Turkey, UAE and Yemen*, for the period 2009-2015. It is worth mentioning that the sample countries hosting these 50 ICBs are leading Islamic finance jurisdictions, where almost 90 per cent of the total Islamic banking assets reside, within the dual banking systems. The size of these 50 ICBs amounted to US\$558bn in 2015 including the top 5 systemically important ICBs in terms of asset size, holding more than 70 per cent shares of Global Islamic Banking Assets.

The main reasons and criteria for choosing this sample and period are:

- balanced panel;
- latest data[26] of full-fledged ICBs (instead of including Islamic windows[27] or Islamic units or branches of the CCBs) globally; and
- full-fledged ICBs operating in dual banking systems (thus excluding Sudan and Iran, which are not considered to have a dual banking system)[28].

The details of the list of banks is shown in [Appendix 2](#). It is pertinent to note that the accessibility to long-horizon data for the ICBs covering 2007-2015, with relevant information on the undiscounted contractual maturity breakdown of the assets and liabilities, was a critical concern and posed a serious challenge[29]. In some cases, the desired data on the undiscounted maturity breakdown of the assets and liabilities was not provided by the ICBs in their published annual reports (or financial statements). For this reason, the study had to exclude many ICBs from the sample. It is also important to mention that some ICBs had reported only the data on the maturity of financial liabilities instead of disclosing full comparative information on the maturity breakdown of both the assets and the liabilities. This made the estimation of the duration gap impossible for these ICBs.

Due to the fact that this sample of 100 banks came from 13 jurisdictions, which had different reporting currencies, converting all the local currency of the respective banks into US\$, with a credible and consistent exchange rate was an important consideration. For this, the study used yearly data from the IMF International Financial Statistics (IFS) to ensure consistency in the data and comparison. Moreover, to extract the right information and data,

the study also translated all the data in Arabic, Indonesian, Malay and Turkish into English, where applicable, as some of the selected banks had reported data in their local language.

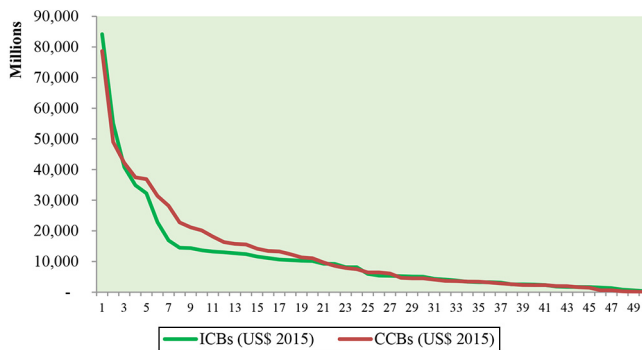
Finally, we faced a pairing challenge (Figure 1), as it was an extremely difficult and daunting task to pair each ICB with a similar sized CCB. A sample of 50 CCBs was selected after reviewing over 100 CCBs[30]. In deciding on an appropriate pair for an ICB, the most important consideration was the asset size, consistent with Chattha and Bacha (2010). To ensure the effective comparison of the ICBs with the CCBs, the study adopted three considerations:

- (1) the selected CCB must be within the sample ICBs jurisdiction;
- (2) the size of the ICB must be approximately equal to 80-90 per cent of the paired CCB (irrespective of the country, which means an ICB from Bahrain can be compared with a similar sized CCB from Malaysia); and
- (3) the total asset size of the ICBs must be equal to 90 per cent of the paired 50 CCBs' total asset size.

With these considerations, Figure 1 indicates the pairing in terms of the total asset size of the ICBs and the CCBs. With the exception of a few ICBs, it can be observed from the figure that the ICBs are almost equal to the CCBs in terms of asset size. The figure indicates that the ICBs have at least 90 per cent the same asset size as the CCBs, which facilitates the pairing and comparison.

*4.2 Data extraction for Islamic commercial banks and conventional commercial banks – process and description*

To calculate the duration gaps of ICBs, the data for the maturity breakdown of banks' assets and liabilities is manually and individually extracted from the banks' annual financial reports, required under the IFRS for the sample period. This ensured that the extracted data is reliable. A very stringent validation process was carried out to ensure that the extraction process was clean and accurate. Table II indicates the main parameters on which the data



**Figure 1.**  
100 banks asset size  
comparison

**Note:** The data from the ICBs and the CCBs are used to plot this figure. The actual data in terms of US\$ for each bank is available upon request

**Table II.**

Data used for the estimation of Duration Gap

Assets side		Liabilities side	
ICBs	CCBs	ICBs	CCBs
Financing, net Financing (or financing assets or sales receivables) using any debt-based contract such as <i>Murābahah</i> , CMT, <i>Ijārah</i> , <i>Istisnā</i> , <i>Salam</i> , etc	Loans/advances, net	Deposits All kinds of deposits backed by various <i>Shari'ah</i> -compliant contracts, for savings account, current account, fixed maturity	Deposits All kinds of deposits like savings account, current account or fixed with time maturity
Due from banks and financial institutions	Due from financial institutions	PSIA or unrestricted investment account  CMT-based deposits (also known as <i>Murābahah</i> payables or <i>Wakālah</i> payables) Due to banks and financial institutions	Due to financial institutions

**Note:** For comparison, in the case of PSIA, we considered it as a deposit instead of its legal status with respect to its contract

was extracted for both the ICBs and the CCBs. For the duration gap, on the assets side, to determine the amount of loan or financing[31], the study uses total loans/financing or advances (Chattha and Bacha, 2010; Ruprecht et al., 2013) as the case may be, from one-month to long-term financing (all maturity buckets). Unlike the CCBs, the data for the ICBs is complex due to the nature of the ICBs' balance sheet, as Islamic banks can participate or provide financing for their customers' projects or assets acquisition in numerous ways as per the principles of *Shari'ah*. Thus, financing, from the ICBs' perspective, is taken from five common debt-based contracts used by the ICBs across the countries[32]:

- (1) *Murābahah* (or similar contracts such as *Bai' Bithaman Ajil* or *Bai Muajjal*) (in these contracts, an ICB sells a specific asset, which is under the ownership of the bank, using a cost plus profit mechanism);
- (2) Commodity *Murābahah* or *Tawarruq*;
- (3) *Salam* (in this contract, the price is paid in advance to the customer, and the specified goods are supplied on a future date by the customer)[33];
- (4) *Istisnā'* (it is a kind of contract that is used in manufacturing of an asset according to the customer's specifications. The delivery of the asset is on a specified future date while the payment of the price is upfront); and
- (5) *Ijārah* (it is a rental or lease contract for a specified asset).

It should also be noted that financing extended by ICBs through equity-based contracts such as *Mushārahah* (joint venture – based on profit and loss sharing) and *Mudārahah* (based on profit sharing and loss bearing) is excluded from the analysis and estimation, as their pricing mechanism is *ex-post* and the study is addressing only *ex ante* pricing contracts, which are equivalent to their conventional counterparts in terms of risk and categorisation. On the liabilities side, similarly, in the case of deposits (including PSIA), the study includes deposits from customers (from one-month to long-term deposits maturity), deposits and placements of banks and other financial institutions and any funding/borrowing through

CMT. For the purpose of clarity and to ensure appropriate comparison, the study only includes “On-Balance Sheet” items listed as financing[34] (short-term to long-term) on the asset side and customer’s deposit[35] (short-term to long-term) on the liability side[36].

#### 4.3 Data analysis

The research methodology comprises two-stages: stage one uses duration gap model to calculate the duration gaps of the ICBs and the CCBs; stage two applies parametric tests.

4.3.1 Stage 1: Determination of duration gaps of the Islamic commercial banks and conventional commercial banks. The conceptual understanding of the duration gap has been elucidated in Section 3 thoroughly. Building on the same theory, the duration gap of a bank is demonstrated by comparing the weighted average duration of bank assets ( $D_A$ ) [Equation (1)] with the weighted average duration of bank liabilities ( $D_L$ ) [Equation (2)]. In terms of a model, the study determines the duration gap with a four-step process, consistent with Koch and MacDonald (2009), Chattha and Bacha (2010) and Chattha and Alhabshi (2017):

- (1) Determining the  $D_A$  and  $D_L$  for each asset and liability item of the balance sheet (in this study, financing and deposit).
- (2) Finding the weight (proportion) of each item within its category.
- (3) Calculating the weighted duration of  $D_A$  and  $D_L$  using (a) and (b).
- (4) Calculating the DGAP through deducting  $D_A$  from  $D_L$ [37].

Weighted average duration of bank assets ( $D_A$ ):

$$D_A = \sum_i^n w_i Da_i \quad (1)$$

where:

- $w_i$  = Market value of asset  $i$  divided by the market value of all bank assets;
- $Da_i$  = Macaulay’s duration of asset  $i$  [Equation (3)]; and
- $n$  = number of different bank assets.

Weighted average duration of bank liabilities ( $D_L$ ):

$$D_L = \sum_j^m z_j Dlj \quad (2)$$

where:

- $n_j$  = Market value of liability  $j$  divided by the market value of all bank liabilities;
- $Dlj$  = Macaulay’s duration of liability  $j$ ; and
- $jm$  = number of different bank liabilities.

The traditional Macaulay’s duration ( $D$ ) calculation:

$$D = \frac{\sum_{t=1}^k CF_t(t)/(1+y)^t}{\sum_{t=1}^k CF_t/(1+y)^t} = \frac{\sum_{t=1}^n CF_t(t)/(1+y)^t}{PV \text{ of the Security}} \quad (3)$$

where:

- $D$  = Duration;
- $CF_t$  = Cash Flow at  $t$  time;
- $Y$  = Yield to maturity or rate of discount;
- $T$  = Time at which cash flow is received;
- $PV$  = Present value of the security; and
- $n$  = Number of years to maturity.

4.3.2 *Key assumptions for the estimation of duration gap.* For the estimation of DGAP for ICBs and CCBs, it is also important to underline some important assumptions. The study assumes that “there is a flat term structure for all On-Balance-Sheet accounts at all times so that the profit rates are yields to maturity”. We also assumed that duration can be summarised as a single-factor model and “the profit rates are equal for each asset account and for each liability account” (Bierwag and Kaufman, 1992, p. 218). In addition, the following additional parameters are taken into consideration, which is consistent with BCBS (2004, 2006), Chattha and Bacha (2010), Chattha and Alhabshi (2017), Drechsler *et al.* (2018), Esposito *et al.* (2013) and IFSB (2014).

First, the study does not include the Off-Balance Sheet (OBS) items as the majority of the ICBs cannot avail the OBS for transaction purposes due to certain *Shari’ah* regulations, which are apparent in conventional banks. Second, the study does not include in its calculation any proportion or item of less than one-month maturity, where no duration is considered. However, up to 3 months is included with mid-point maturity. Third, to calculate average maturity for each asset and liability class, the average (or mid-point) is obtained between the class’s lower boundary and upper boundary. Fourth, in most cases, each bank has one maturity bucket where no upper boundary is available when financing/loans are classified without a specific upper limit. In this case, the study extends each end maturity bucket to 50 per cent, as the average maturity of the asset. Similarly, we apply the same rule for customers’ deposits on the liability side in the sample of 100 banks[38].

Finally, with respect to using a standard approach of a scale factor, it has been empirically tested in finance that the duration of the asset is always less than the maturity of the asset. We hold the estimated duration as 0.80 (80 per cent) of the average maturity for sample banks. This choice of a 0.80 factor is reflective of the non-availability of, and access to, information about the total sample size. This means that if the average maturity of an item is 5 years, then the duration would be 4.0 years ( $5 \times 0.8$ ). While the use of this factor is consistent with the literature of Bierwag and Kaufman (1992), Chattha and Bacha (2010) and Ruprecht *et al.* (2013), we provide further reasons after simulation of duration with equation (3)[39][40].

In addition to DGAP, the study also complements the findings with an estimation of the cumulative short-term liquidity mismatch gap (CLGAP) up to one-year. This is also known as a one-year repricing gap (Zainol, 2015) over various repricing maturity buckets, which are available in the respective banks’ balance sheet under liquidity risk. The CLGAP is estimated using the following equation (4) for 100 banks (50 ICBs and 50 CCBs):

$$CLGAP_{i,t} = (\text{Risk Sensitive Assets one-year}) - (\text{Risk Sensitive Liabilities one-year})$$

$$CLGAP_{i,t} = Total\ RSA_{i,t} - Total\ RSL_{i,t} \quad (4)$$

where:  $i$  (banks) = 1, . . . ,  $N$ ; and  $t$  (time in year) = 1, . . . ,  $T_i$

4.3.3 *Stage 2: Statistical tests.* In the end, after calculating the duration gaps, the study also undertakes statistical techniques, which consist of relevant parametric tests (e.g.  $F$ -tests,  $t$ -tests) to compare the sample means of the ICBs and the CCBs.

## 5. Empirical results, discussion and policy implications

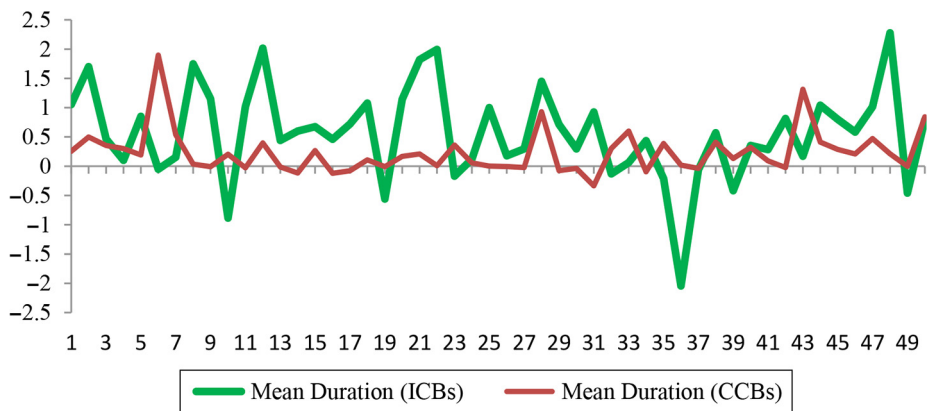
### 5.1 Stage 1: Determination of duration gaps of the Islamic commercial banks and the conventional commercial banks

DGAP is the main pillar of this study. Before explaining the results of the duration gap of the 100 banks, it is important to explicate the estimation process using the methodology and assumptions presented in the last chapter. In this context, to disclose the calculation process for the 100 banks, while [Table AI](#) (in [Appendix 1](#)) explains the DGAP for one of the ICBs, [Table AII](#) (in [Appendix 1](#)) covers one of the CCBs to illustrate  $D_A$  and  $D_L$  calculations. Therefore, in line with the research objectives, the results in this section explain the trend and magnitude of the duration gap of the ICBs and the CCBs (RQ1), followed by a discussion on country-specific and regional differences of duration gap (RQ2), and a discussion of the key reasons behind the larger duration gaps in the banking industry.

*5.1.1 Comparison trend of duration gap in Islamic commercial banks and conventional commercial banks.* Pairing the ICBs and the CCBs based on the asset size (\$), the consolidated results of the mean duration gap are exhibited in [Figure 2](#). Among the 50 paired samples used, the results reveal two important findings:

- (1) ICBs have more cross-sectional and time-series variations in their mean duration gap compared to their counterpart CCBs; and
- (2) ICBs have a tendency to have a higher (more) mean duration gap (28.37 years) in comparison to CCBs (11.79 years).

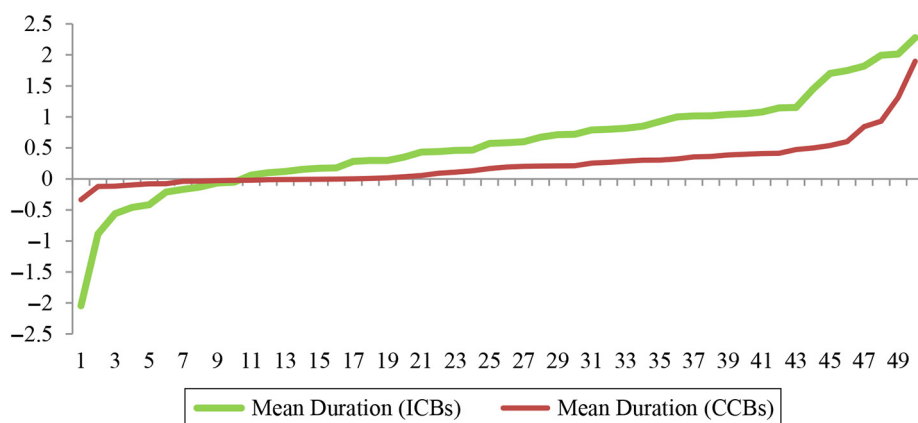
This shows that the ICBs have 2.41 times more mean duration gap compared to the CCBs. When the results are plotted ([Figure 3](#)) in ascending order (i.e. smaller to larger mean duration gap), the difference between the 50 ICBs and the 50 CCBs is enormous and alarming, reflecting serious implications for risk management and risk culture among the sample banks.



**Figure 2.**  
Variation of mean  
DGAP of banks  
(2009-2015)

**Note:** The Mean Duration Gap for each bank is measured in years. Figure 2 shows cross-sectional variations across the 100 banks (50 ICBs and 50 CCBs). The summary results of the 100 banks (50 ICBs and 50 CCBs) in Figure 2 are presented as per the four-step process indicated in Stage 1 in Section 4.3.1 and equations 1-3



**Figure 3.**

Variance of mean DGAP of Banks (2009-2015)

**Note:** The mean DGAP is measured in years for each bank

As is evident from [Figure 2](#), which plots the duration gaps for both ICBs and CCBs, the variance is much larger for the ICBs than the CCBs for the sample period 2009-2015 (see also [Tables AIII and AIV](#) in [Appendix 2](#)). With the exception of two banks, which have a mean duration gap of 1.90 and 1.31 years, respectively, the remaining 48 CCBs have mean duration gaps of less than 1.0 year. Within these 48 CCBs, almost seven CCBs have mean duration gaps close to 0, and 15 CCBs have mean duration gaps less than zero (negative) reflecting positively on ALM. This suggests that if these banks are expecting an increase in the benchmark rate they will not be affected negatively with respect to NW risk ([Chattha and Alhabshi, 2018](#)). For the ICBs on the other hand, at least 15 ICBs or 30 per cent of the study sample, have mean duration gaps greater than 1.0 year. Only two ICBs have mean duration gaps close to zero. Eight ICBs account for 50 per cent of the total duration gap of the study's sample observation. The highest duration gap estimated is at Sharjah Islamic Bank, 15.96 years (or a mean of 2.28) for 2009-2015, whereas the lowest duration gap is estimated to be -14.32 years at KFH Bahrain.

In total, seven ICBs have duration gaps in double-digit figures in terms of years. This significantly higher duration gap can be attributed to the inspiration and business model of these ICBs, which have more long-term financing with short-term deposits, demonstrating the inability to raise long-term deposits, consequently creating a severe mismatch in the assets and liabilities. Finance theory and academic literature suggest that when the duration gap is positive and higher, an increase in the benchmark rates, from the central bank, by any number of basis points would inflict severe consequences on the NW risk (or EVE) and the capital base of the banks. In this way, our duration gap results are consistent with [Khaliq et al. \(2017\)](#), [Chattha and Bacha \(2010\)](#) and [Chattha and Alhabshi \(2017\)](#).

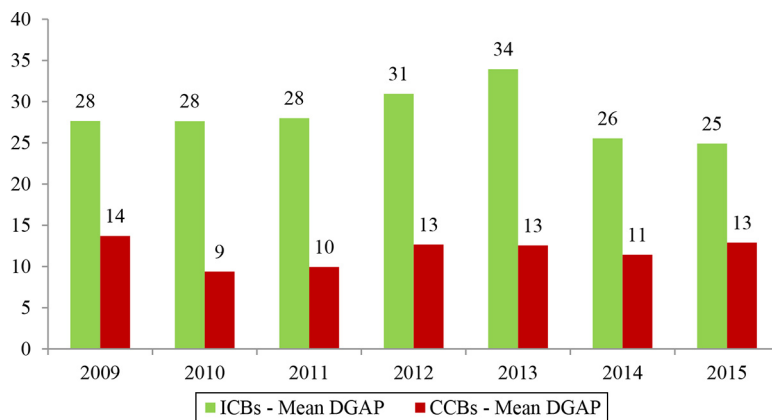
Despite higher duration gaps among the majority of the ICBs, there is little evidence signifying that nine ICBs also have mean duration gaps less than zero (negative). We can see from [Tables AIII](#) in [Appendix 2](#) that the highest negative mean duration gap is found at Kuwait Finance House, followed by Al Salam Bank from Bahrain, with -14.32 and -6.21 years, respectively. This negative duration gap is an indication that some ICBs have been managing the ALM more effectively. The secret to maintaining the negative duration gap in the above mentioned banks, simply put, is their competence – they have been efficacious in raising deposits from the customers on a long-term basis, and extending

financing into medium-term maturities. This mechanism appears to be the best natural hedge against the risks associated with asset liability mismatch. The highest negative duration gap is attributed to the fact that KFH Bahrain, Al Salam Bank and Bank Islami Pakistan, over the years, have an excess of long-term liabilities compared to financing structure. This also means that if any of their central banks raise the benchmark rates by any number of bps, these ICBs would not be negatively affected in their jurisdictions.

*5.1.2 Magnitude and countries' trend of the total duration gap.* Banking institutions, including ICBs and CCBs, are in the business of maturity transformation. Thus, it is not surprising to the academic world that some degree of maturity mismatch is inevitable and an essential part of financial intermediation. However, what is important is to determine the severity of the mismatch and whether the duration gap is increasing or decreasing over time, which in the case of this study is the sample period 2009-2015, for both the ICBs and the CCBs.

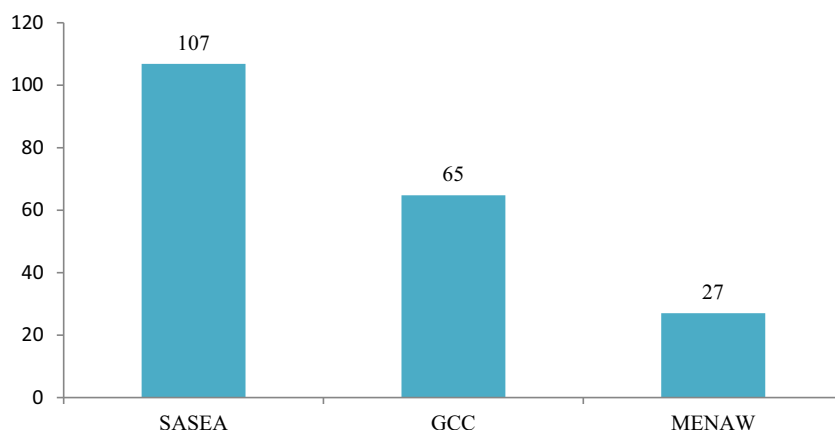
In aggregate, the study results show a general excess of short-term liabilities and long-term financing (Appendix 2). From the results, the study establishes that overall, the duration gap of all banks under observation increased during the seven years under review. For the ICBs, the duration gap remained in the range of 25-34 years, compared to the CCBs' range of 9-13 years. This indicates that the ICBs have a general tendency of maintaining a higher duration gap compared to their conventional counterparts, the CCBs. In particular, it is noted that the duration gap difference between the ICBs and the CCBs has been increasing throughout the seven years of research, except for 2014 and 2015, where it decreased marginally. Nonetheless, the difference between ICBs and CCBs remained a double-digit figure, posing a genuine and serious concern for the ICBs and their supervisors (Figure 4).

*5.1.3 Country and region specific duration gap of Islamic commercial banks.* Based on the results of RQ1, it appears that regional differences in terms of duration gap practices do exist for ICBs. Therefore, to explain the regional specific duration gap differences of the ICBs, the study divided the sample of 50 ICBs into three regions: Gulf Cooperation Council (GCC), South Asia and South East Asia (SASEA) and MENA and West (MENAW). The total number of ICBs from the GCC stood at 22: Bahrain (7), Kuwait (4), Qatar (4), Saudi Arabia (3) and UAE (4); the SASEA region had 20 ICBs: Bangladesh (3), Indonesia (2), Malaysia (11), and Pakistan (4); and the MENAW region had 8 ICBs: Jordan (2), South Africa



**Figure 4.**  
Trend and magnitude  
of DGAP of banks  
(2009-2015)

**Note:** The DGAP is measured in years for banks



**Figure 5.**  
Regional Distribution  
of the ICBs' DGAPs  
(Yrs.)

(1), Turkey (4) and Yemen (1)[41]. This grouping is done for the purpose of comparing the results of duration gaps of ICBs across countries, rather than to make any geographical classification of the sample countries.

Based on the above classification of regions, [Figure 5](#) highlights that the SASEA accounts for the largest duration gaps, with 107 years (54 per cent), followed by the GCC, with 65 years (32 per cent), and finally, the MENAW with only 27 years (14 per cent). This demonstrates the SASEA is the host of more duration gap and indicates the vulnerability of the ICBs operating in this region. Within SASEA, Malaysia is the dominant jurisdiction indicating significantly higher duration gaps. On the other hand, the GCC, which is almost the same size of SASEA, has almost 50 per cent lesser duration gaps compared to SASEA. Thus, regional distribution is skewed towards SASEA. For this reason, this study examined this region in detail and carried out empirical tests.

On the other hand, despite higher duration gaps for ICBs, it has been established by the study that all three regions tend to converge to the lowest duration gap in recent years. This could be attributed to the implementation of Basel III LCR and NSFR ratios for liquidity management, which started being implemented in 2014. On one hand, the recent trend indicates positive change in the risk profile of ICBs, but on the other hand, it also indicates that the difference in the duration gaps of these regions is significant and demands attention by the ICBs in their internal risk management culture, and by their respective supervisory authorities in their Pillar II supervisory review process.

In terms of countrywide findings, the results revealed two important observations for the simple observation:

- (1) there are nine countries, which have positive duration gaps; and
- (2) four countries have a negative duration gap.

It is interesting to note that ICBs in these four jurisdictions (Bahrain, Jordan, Pakistan and Yemen) tend to have close to zero or negative duration gaps ([Table AV](#)). A close examination of these four jurisdictions' ICB's balance sheets reflects that they are managing their duration of assets and duration of liabilities more effectively through long-term liabilities and reduced concentration of financing for longer-term maturities. This suggests and implies that these ICBs would not be affected should the benchmark rate be increased

by their respective supervisory authorities. However, the problem is far more serious in the majority of the other jurisdictions, which have positive duration gaps, suggesting the need for crucial reviews of their business models.

It is essential to mention that among the 13 jurisdictions, Malaysia (38 per cent), UAE (20 per cent), Indonesia (13 per cent) and Turkey (10 per cent) constitute almost 80 per cent of the total duration gap of the 50 ICBs. Not surprisingly, Malaysian ICBs have significantly higher mean duration gaps; which is interesting not only because of Malaysia's pioneering role in Islamic banking (Chattha and Bacha, 2010) but also because Malaysia has probably the most well-developed and competitive banking sector among the study's 13 sample countries. This highlights the rationale for closely examining the business model of these ICBs within Malaysia to identify what is causing these ICBs to have higher duration gaps, which can expose them to benchmark rate risk.

To add more significance to the existing literature and to investigate other on-balance sheet motivations of such a difference in the duration gap management practices among the ICBs across the 13 jurisdictions, we examined the business models of these ICBs thoroughly – by investigating their respective financial reports. This led to an appraisal of the key balance sheet indicators that could possibly explain the reasons. These indicators included: average financing to total assets ratio (FINA), average financing to total deposits ratio (FDR), average liquid assets to total assets ratio (LIQR) and average cumulative liquidity gap to total assets (LIQG). The balance sheets of the ICBs suggest that *Murabahah* financing is the most dominant form of financing extended by the ICBs to the customers to meet their different needs. The results of the FINA, FDR, LIQR and LIQG are discussed below and are presented in Figure A1 in Appendix 2.

In terms of FINA, ICBs also tend to have higher ratios compared to their counterparts, the CCBs (Figure A1). In particular, almost 15 or 30 per cent of ICBs have an average FINA above 70 per cent for the period under observation, compared to only 8 CCBs that stand at above 70 per cent. This demonstrates that the ICBs have not been successful in diversifying their portfolios. The study establishes that higher duration gaps in ICBs are explained by the higher FINA, as most ICBs channel their financing into long-term maturity buckets, as is evident in the duration gaps of the ICBs. The use of longer maturity buckets for financing presents a danger to ICBs with respect to the ALM. Similar to the FINA, the FDR also appeared higher for the sample ICBs compared to their conventional counterparts, the CCBs (Figure A1). In particular, to understand whether an ICB's aggressiveness in undertaking customer financing can explain their larger gaps, the study compared ICBs' FINA to the duration gaps and found some evidence of correlation, although not a strong one. This is understandable because for the FINA to influence the duration gap it must be complemented with longer maturity. For instance, if an ICB has 70 per cent FINA, but its financing to customer utilisation is within the short-term maturity buckets (say less than 5 years), then it will not have a direct impact on the duration gap. The second controlling situation is that if the duration of liabilities is longer, irrespective of the financing maturities, the duration gap is also going to be affected. In short, there is some evidence for a few banks that have higher FINA to have higher duration gaps [42]. This correlation between the FINA and the duration gap needs to be empirically tested to ascertain whether this factor or any other factor, significantly influences the duration gap with a larger sample size over a longer period of time.

With respect to the LIQR, the results indicated that the ICBs have a higher average LIQR compared to their counterparts, the CCBs (Figure A1), which can easily be attributed to excess liquidity and the unavailability of a number of instruments, on both the asset and liability side, in ICBs. More than 70 per cent of the ICBs have significantly higher LIQR

compared to the CCBs. The lowest average LIQR for one of the ICBs stands at 6.19 per cent and the highest average LIQR stands at 34 per cent. 22 ICBs have an average LIQR of more than 20 per cent, whereas 28 CCBs' average LIQR stands below 15 per cent. While this indicates a good trend for the ICBs, in terms of being liquid, it also highlights the deep liquidity problems faced by ICBs on the asset side. In the absence of HQLA and lack of opportunities, ICBs tend to hold more liquid assets (or cash) which, in turn, exposes these ICBs to risk-return trade-offs.

Moreover, the results of the 50 ICBs indicate that a majority of the ICBs have a negative LIQG (or CLGAP) compared to the CCBs. An important observation noted in Figure AIII is that both, the ICBs and the CCBs, have negative liquidity gaps, however, the magnitude of the ICBs' CLGAP is significantly higher when compared with the CLGAP of CCBs as a percentage of total assets. In this respect, it is important to note that a bank is considered to have positioned itself adequately in terms of assets and liabilities as long as short-term negative gap does not exceed 10 per cent of the total assets. While this threshold may be an industry norm, it would be judicious to note that different central banks can have different maturity mismatch limits.

## 5.2 Stage 2: Statistical tests

*5.2.1 Empirical tests for duration gap of Islamic commercial banks and similar sized conventional commercial banks.* Given the small population size, in comparing the sample means of ICBs and CCBs to test our hypothesis, student's *t*-test is used as the parametric test. The *t*-test will confirm that the hypothesis for RQ1 is statistically significant: *How do the duration gaps of ICBs compare with those of similar sized CCBs?* Hence, our first hypothesis is as follows:

- H1.* There is a significant difference in the duration gaps of ICBs compared with those of similar sized CCBs.

Running the parametric *t*-test for paired samples, the results for one tail and two-tail tests are presented in Table III. As can be noted from Table III, the sample statistics (2.659) fulfil the critical value of 5 per cent confidence level (2.010) to reject the null hypothesis, with the probability of the one-tail test (0.005) and two-tail test (0.01), which are significant.

	Mean duration (ICBs)	Mean duration (CCBs)
Mean	0.5674	0.2359
Variance	0.6251	0.1449
Observations	50	50
Pearson correlation	-0.0126	
Hypothesised mean difference	0	
Df	49	
<i>t</i> Stat	2.659	
P(T ≤ t) one-tail	0.005	
<i>t</i> critical one-tail	1.677	
P(T ≤ t) two-tail	0.011	
<i>t</i> critical two-tail	2.010	

**Notes:** The descriptive statistics of the test are available upon request; the following rules are applied for the hypothesis: (a) If the absolute *t* Stat value > 2 or the *t* Stat value is larger than the *t*-critical value, then the ratio is significant, and; (b) If the *p*-value is less than alpha (level of significance), then it is significant

**Table III.**  
*t*-test – paired two  
sample for means

Therefore, the study rejects the null hypothesis and confirms that there is a significant difference in the duration gaps of ICBs compared to CCBs.

*5.2.2 Empirical statistical tests between groups.* To claim that the group's mean duration gaps are statistically different from each other, we would need to run empirical statistical tests for RQ2: *Are there any country-specific and regional differences among ICBs in terms of managing their duration gaps?* Thus, our second hypothesis is as follows:

H2: There is a significant difference in the country-specific and regional differences among ICBs in terms of managing their duration gaps.

As our quantitative results highlighted Malaysian ICBs' duration gap concentration, therefore, to determine whether Malaysian ICBs are indeed statistically significantly different from the other ICBs from different countries and whether the findings of the study, that ICBs have higher duration gaps than CCBs, may have been skewed by this, we carried out a series of eight *F*-tests similar to [Chattha and Bacha \(2010\)](#). The results of these *F*-tests are presented in [Table IV](#). Except for one test (which compares GCC ICBs and SASEA ICBs), all the remaining tests are conducted with respect to the duration gap of Malaysian ICBs with other ICBs. The reason behind exclusively studying Malaysian ICBs is their significantly larger gaps, as pointed out in the previous subsection.

Overall, the results reveal that there is sufficient evidence available to reject the null hypothesis. We found a substantial country-specific difference in risk profile and Malaysian ICBs have significantly higher duration gaps. The first five of the eight tests examine whether the group of 11 Malaysian ICBs are statistically different from the other ICBs within the sample. In this respect, four out of five hypotheses, that the average duration gap of Malaysian ICBs equals that of the other ICBs, are strongly rejected and have a probability of less than 2 per cent of being true. This essentially confirms that Malaysian ICBs are indeed different from ICBs from our other sample countries. Interestingly, the last test of Malaysian ICBs vs. Pakistani CCBs is also rejected, confirming the existence of significant differences across the ICBs and CCBs. The rationale behind running this test was the fact that both the ICBs in Malaysia (11 ICBs) and the CCBs in Pakistan (10 CCBs) had the largest gaps within their respective categories. However, [Table IV](#) also specifies that there is insufficient evidence available to reject the fifth test (Malaysia ICBs vs MENAW ICBs),

Variable	<i>F</i> -Statistic	<i>F</i> -Critical	<i>p</i> -Value	
			P( <i>F</i> ≤ <i>f</i> ) one-tail	No. of observations
Malaysia ICBs vs Bahrain ICBs	6.01	3.21	0.0068	11 vs 7
Malaysia ICBs vs Other ICBs	3.78	2.66	0.0146	11 vs 39
Malaysia ICBs vs GCC ICBs	4.37	2.76	0.0100	11 vs 22
Malaysia ICBs vs SASEA ICBs	4.10	3.07	0.0204	11 vs 9
Malaysia ICBs vs MENAW ICBs	2.68*	3.13	0.0769	11 vs 8
GCC ICBs vs SASEA ICBs	1.71*	2.14	0.1231	22 vs 20
Malaysia ICBs vs Turkey CCBs	3.56*	3.63	0.0524	11 vs 8
Malaysia ICBs vs Pakistan CCBs	5.76	3.13	0.0072	11 vs 10

**Table IV.**  
Comparison of mean duration between groups (*F*-test)

**Notes:** \* No significant difference as the value of *F*-statistic is < *F*-critical, suggesting group variances are equal; before applying the statistical test for country-specific differences, the study computed the mean duration gaps of ICBs by country. [Tables AV](#) and [AVI](#) in [Appendix 2](#) show the results of the computation for each country and region for the period 2009-2015

suggesting that there is no significant difference between these two groups. Similarly, for the sixth (GCC ICBs vs. SASEA ICBs) and seventh tests (Malaysia ICBs vs Turkey CCBs), there is insufficient evidence available to reject these two tests. In fact, these two tests were undertaken to indicate whether there are any differences across the two regions, the GCC (22 ICBs) and SASEA (20 ICBs), which host almost 84 per cent of the sample ICBs.

### 5.3 Prudential policy implications

The study has significant prudential policy implications on the institutional level (bank level) and supervisory level. Although the scope and proportionality of these implications is dependent upon the ICBs' size, business model, complexity and cross-border operations, the relevance of these implications, however, is broadly applicable, irrespective of the jurisdiction where the ICBs operate.

First, the tendency to have a higher duration gap in ICBs does not explain the reasons for the same. This necessitates identifying the reasons why ICBs find themselves plagued by relatively higher duration gaps. Having examined the business models of the ICBs from 13 jurisdictions, we establish that due to the specificities of Islamic finance, ICBs would tend to have higher duration gaps, as they can not avail of certain risk management tools and techniques, due to certain *Shari'ah* limitations. These techniques include:

- lack of *Shari'ah*-compliant hedging instruments (e.g. swaps and options);
- lack of financing or assets' tradability (i.e. factoring of financing);
- lack of *Shari'ah*-compliant securitisation;
- lack of adjusting the price of assets due to sale contracts; and
- lack of floating rate assets and fixed rate liabilities.

These tools are easily available to the CCBs. Although the use of *Shari'ah*-compliant hedging instruments (such as profit rate swaps) is still not a common practice among ICBs, we are of the view that Shariah Supervisory Board of the respective ICBs should pay due consideration to the use of *Shari'ah*-compliant hedging instruments and resolve the matters from a financial stability perspective. In this respect, the International Islamic Financial Market (IIFM) has issued several documents including *Mubadalatul Arbaah* (Profit Rate Swap), which can be effectively explored and used by the ICBs.

Second, we also determined that the variation of duration gaps is also attributed:

- to the different reporting standards, in particular, the disclosure of the maturity of assets and liabilities into different maturity buckets. We did not find the consistency of maturity buckets across the ICBs as there was little evidence available for the ICBs to have implemented the AAOIFI accounting standards; and
- to the severe mismatch between their assets and liabilities, particularly on the liability side, due to the unavailability of financial instruments for different maturity buckets.

To this end, funding long-term deposits or borrowing, either through the *Shari'ah*-compliant inter-bank market or through the Islamic capital market is considered a major issue. The inability to raise long-term deposits or funding is due to many reasons, including, the inability of the ICBs to price the long-term deposits, lack of active Islamic capital market, and inadequate regulatory framework on issuing *Sukuk* as source of long-term funding. While long-term deposits can certainly bring the duration gap down to a low level, an

important consideration remains, however, that the ICBs will have to compensate the PSIA or depositors with competitive returns to entice long-term deposits.

Third, the ICBs should continuously monitor and control the gaps between maturing assets and liabilities in various time buckets. Control over maturity gaps should receive particular attention from the ICBs. A maturity ladder is a useful device to compare cash inflows and outflows for different time periods. There should be proper management of the duration gap of the assets and liabilities. In this respect, the ICBs should have in place the approved limits, set by their respective BOD, for maximum CLGAP and DGAP. These limits should be implemented by the ALCO. Furthermore, for ICBs, a review of the business model (both financing and funding options) is important to determine, which segment is causing higher duration gaps.

The next implication comes from examining the structure of the duration gaps of the ICBs, where banks with the largest duration gaps tend to have the largest  $D_A$  with low  $D_L$ . This suggests that the size of the duration gap is correlated with lengthy asset duration but not with short (not long) liability duration (Chattha and Bacha, 2010; Chattha and Alhabshi, 2017). As an example, the bank with the highest duration gap (Sharjah Islamic Bank) has the largest asset duration compared to duration of liabilities. For instance, for the year 2015, Sharjah Islamic Bank's total duration gap is 2.26 years ( $2.41 - 0.14$ ), in which the total  $D_A$  is found to be 2.41 years and  $D_L$  is found to be only 0.14 years. This indicates that almost 27 per cent of its total financing is in the "12 months to 60 months" maturity bucket, and 30 per cent of its total financing is from the "over 60 months" maturity bucket. On the other hand, 64 per cent of the total liabilities (or deposits) are in the less than 3 months maturity bucket, and 12 per cent is in the "3 months to 12 months" maturity bucket. The business model of this bank indicates a high concentration of short-term funding to finance long-term assets, thus explaining why the duration gap is higher. Similar observations have been made at Malaysian banks and banks in the GCC. It is quite surprising, particularly in Malaysia, that the ICBs tend to have higher duration gaps especially considering the fact that Malaysia has one of the finest Islamic finance architecture, including Islamic inter-bank, Islamic deposit insurance, Islamic commodity house, etc. This shows that an examination of the asset side is important to explain the larger gaps of ICBs across the jurisdictions.

Moreover, on the liability side, it is noticeable from the sample that ICBs have fewer instruments for long-term deposits, compared to the CCBs. This seems to restrict the ability of ICBs to increase the  $D_L$ , which can help manage the duration gap of the bank. In some jurisdictions, the utilisation of CMT-based deposits has helped some ICBs to increase their  $D_L$ . For instance, in Kuwait and Bahrain, the ICBs raise funding through CMT into longer-term maturities, which are being rolled over. This helps them in managing  $D_L$ . Additionally, there is also some evidence of the same at a few ICBs, which have issued *Sukūk* to raise long-term funding. While this has not been a common phenomenon due to the underlying *Shari'ah* and regulatory requirements, it can help to manage the duration gaps of ICBs in the future.

It is also important to highlight that as a result of the higher duration gap, the ICBs are vulnerable to a significant loss of EVE or NW risk under an increasing benchmark rate regime (Chattha and Alhabshi, 2017; Khaliq *et al.*, 2017). This in return, can cause problems of early settlement for financing, leading to higher non-performing financing (NPF), which can ultimately impact the capital base of the ICBs. On the other hand, the emergence of DCR is also inevitable, causing early withdrawals by the customers due to higher expectations of PSIA, and their switch to CCBs in a dual banking system. This would be a concern for their supervisors indicating the need for strengthening risk management tools (such as *stress*



*testing*), and applying innovative new techniques including PLS, to reduce the asset-liability mismatches.

Referring to LIQG (CLGAP) in [Figure A1](#) the existing business model of ICBs presents a danger of asset/liability mismatches, highlighting the need for innovation to effectively manage the duration gap with appropriate risk management tools. This innovation must take into consideration the close examination and review of the *Shari'ah*-compliant hedging tools approved and endorsed by the SSBs, and potential delinking efforts resulting in shifting from debt-based financing to equity sharing instruments such as *Musharakah* (joint venture – based on profit and loss sharing) and *Mudarabah* (based on profit sharing and loss bearing). This study reveals that asset-based financing is the core element in ICBs, dominated by *Murabahah*, *Ijarah*, *Istisna* and CMT instruments. These instruments, due to their *Shari'ah* rules and principles, serve to lengthen the duration and liquidity gaps of ICBs because exits from these transactions cannot be agreed upon in advance.

Next, taking into account the negative CLGAP of ICBs, it is quite obvious and reasonable to argue that until ICBs diversify their funding base, including the use of short-term funding markets offering liquidity at a variety of tenors in a *Shari'ah*-compliant way, they will continue to be exposed to a bank-run scenario. Without a stable and long-term funding base and HQLA, this makes ICBs less resilient to exogenous liquidity shocks. With a negative mismatch, ICBs may face funding risk, call risk, and event risk (i.e. the risk of rating downgrades). This indicates a need to:

- identify the profit rate sensitive products and activities in which the ICB is involved;
- establish a limit structure to monitor and control its profit rate risk;
- measure profit rate risk through establishing a maturity/re-pricing schedule that distributes profit rate RSA and RSL in pre-defined time maturity buckets (or time bands); and
- estimate the EVE under different stress shock scenarios (e.g. 200 bps) on a regular basis under Pillar II.

Finally, it is important for supervisory authorities to provide comprehensive guidance on the duration gap approach tailored for ICBs. The guidance should include surplus or shortfall of liquidity of ICBs or more specifically, the mismatch between inflows arising from financing activities on a contractual or behavioural basis and outflows arising from funding activities in various maturity buckets. The mismatches reported by the ICBs should be studied in detail, and supervisory actions should be taken against the ICBs that have a severe negative CLGAP. Moreover, supervisors should require single maturity buckets (e.g. up to 1 month, 1-3 months, 3-6 months, 6 months to 1 year, 1-3 years, 3-5 years, 5-10 years, etc.) in their jurisdiction for all banks including ICBs, and enforcement of the consistent usage of buckets should be part of the supervisory approach. Any change in the bucket by the ICBs, for any year, has to be made known to their supervisors, along with the rationale and reasons for the same. Supervisors are to improve the disclosure regime by implementing Basel Pillar III or the equivalent of the IFSB. Particularly, *on-site department* to make inspections and *off-site department* to monitor data and initiate dialogue on negative liquidity mismatches within ICBs, and this should be followed by remedial actions.

## 6. Conclusion

Previous research has shown inconclusive results in dual banking systems for time-series and cross-sectional characteristics, in terms of duration gaps for the ICBs and CCBs. A novelty of this research is that it provides empirical evidence regarding the estimation of the

duration gap for ICBs and CCBs from 13 countries. The analysis offered deeper insight into the issue and gave ICBs guidance on managing the duration gaps within their unique integrated regulatory system. By using the duration gap approach, the study established that among the 100 banks, the ICBs showed more cross-sectional and time-series variations in the duration gap. In particular, we found that ICBs had more variations in their mean duration gap compared to the CCBs, and they have a tendency for a higher (more) mean duration gap in comparison to the CCBs. This shows the ICBs as having 2.41 times more duration gap compared to the CCBs, and they are exposed to increasing ROR risk due to their larger duration gaps and severe liquidity mismatches. We established that the higher the duration gap, the higher would be the profit rate sensitivity of a financial instrument, and vice-versa.

Moreover, the study also found that the duration gap difference between the ICBs and the CCBs, throughout the seven years of research observation, remained significant at 16.50 years. It was also evident that the majority of the ICBs having a negative CLGAP compared to the CCBs, and the magnitude of the ICBs' CLGAP is significantly wider when compared with the CCBs. With respect to regional differences, in terms of duration gap, the results showed that the SASEA accounts for the largest duration gaps, followed by the GCC and the MENAW. This demonstrates that the SASEA is the host of more duration gaps, and indicates the vulnerability of the ICBs operating in this region. Out of the 13 jurisdictions, there are six jurisdictions (Indonesia, Malaysia, Qatar, Saudi Arabia, Turkey and UAE) where ICBs are more vulnerable in terms of duration gap and EVE risk.

Our study has significant policy implications on the institutional level and regulatory. Given that global benchmark rates are currently at a low, having fallen steadily over the past several years after the GFC, the study cautions that larger duration gaps will pose a serious challenge to ICBs as the benchmark rate cycle turns. One should bear in mind that as a result of higher duration gap, the ICBs are vulnerable to a significant loss of EVE or NW risk under an increasing benchmark rate regime. This should be empirically tested. For the ICBs to fully deflect this risk, while being part of a dual banking system, would require them to undertake significant improvements in their risk management tools (such as *stress testing*), and applying innovative new techniques.

We also argue that ICBs' business model of having more long-term financing with short-term deposits demonstrates their inability to raise long-term deposits, consequently creating a severe mismatch in the assets and liabilities. In our policy implications, a number of policy actions are recommended for the ICBs to address the duration gap. To reduce the duration gap, on the asset side, ICBs should engage in the diversification of their financing into medium-term maturities and into liquid assets (e.g. HQLA). The ICBs should also continuously monitor and control the gaps between maturing assets and liabilities in various time buckets. The use of *Shari'ah*-compliant hedging instruments (such as profit rate swaps) by the IIFM should be studied and implemented by the ICBs. A shift from debt-based financing to equity sharing instruments such as *Musharakah* and *Mudarabah* is desired for ICBs and supervisors should provide clear guidance on the operationalisation of this shift. Moreover, we also suggest that the ICBs should have in place the approved limits, set by their respective BOD, for maximum duration gap, and these limits should be implemented by the ALCO, and supervisors to enforce the implementation under Pillar 2. Other than supervisors, the role of international regulatory standard-setting bodies of Islamic finance (e.g. IFSB) to develop a regulatory framework tailored for ICBs is also essential. The implementation of IFSB relevant standards by the ICBs will improve the overall financial soundness and stability of the ICBs.

### 6.1 Limitations and future direction

Our study, similar to other studies, has some limitations due to the scope as we specifically focussed on a specific tool of risk management (which is the duration gap for benchmark rate risk under ALM). We make the following suggestions for further study. Future studies ought to be undertaken, perhaps, in the year 2019, to see the full effect of the IFSB LCR and NSFR standards on the liquidity management practices of the ICBs. A larger sample size of 100 ICBs with 10 years' data after the GFC would be more beneficial to the industry. Moreover, other than mismatch as a percentage of total assets, different measures of liquidity mismatch can be adopted, such as mismatch as a percentage of unrestricted PSIA. Cross-sectoral perspective with a duration gap can also be captured. The impact of an increasing benchmark rate (e.g. 100 bps, 200 bps and 300 bps) on the ICBs as per the IFSB 20 per cent threshold can also be established with the duration gap approach. Finally, the determinants of the duration gap for ICBs can be studied through Panel GMM estimation or *Random effect* or *Fixed effect* approach.

### Notes

1. It is common understanding in the literature that Islamic banking involves the provision of financial services by IFIs based on contracts that, apart from social and moral considerations, adhere to *Shari'ah* rules and principles with precepts such as profit-and-loss sharing, asset-backed and/or sales-based forms of financing/fund raising, etc. (Section 2)
2. The term "IFIs" is used broadly to refer to any institution offering Islamic financial products and/or services; whereas the term "ICBs" is used specifically to refer to Islamic Commercial Banks. The Islamic Financial Services Board (IFSB) uses the term "IIFS" for ICBs instead of IFIs as used by the AAOIFI.
3. For instance, in addition to Muslim dominant jurisdictions, non-Muslim jurisdictions (e.g. China, Singapore, Hong Kong, UK, Luxemburg, Japan, Korea, Mauritius, South Africa and Zambia) have not only indicated their interest in Islamic finance but also have shown some developments in the promotion of Islamic finance (Chattha, 2017a).
4. The IFSB was established in 2002 by central banks as a multilateral organisation to set prudential standards for the IFSI. It deals with issues common to the banking, securities and insurance sectors and complements the work of the BCBS, the IOSCO and the IAIS, respectively.
5. Interest rate risk (IRR) or "profit rate risk" or "benchmark risk" or "ROR" is used interchangeably in the study. Khan and Ahmed (2001) uses "benchmark risk" or "ROR" terminology instead of "IRR" so as to avoid unnecessary confusion since ICBs do not deal directly with interest rate. Subsequently, this term was used by the IFSB (2005, 2007), and other academicians and researchers (Cihak and Hesse, 2008; Chattha and Bacha, 2010). As a matter of practice and for certain reasons, ICBs use benchmark rate (e.g. the LIBOR) to price different financial instruments, therefore, changes in the market rates introduce some risk in the earnings and values of assets of ICBs.
6. The term changing benchmark rates does not imply that the benchmark rates used by the ICBs are floating rates, rather it indicates the direction of the rate, that is, an upward or downward increase in the benchmark rate. The term "changing benchmark rates" has been used by the BCBS (2004, p. 29). Moreover, for discussion on the *Shari'ah* perspective for benchmarking, Omar *et al.* (2010).
7. Basel II has three Pillars (BCBS, 2006). Pillar 1 is about minimum capital requirements, whereas Pillar 2 presents the supervisory review process of CCBs, while Pillar 3 covers the disclosure

requirements. Similarly, the IFSB has outlined its equivalent standards, such as IFSB (2013, 2014, 2007) corresponding to Pillar 1, Pillar 2 and Pillar 3, respectively.

8. Given that some ICBs have tweaked their *modus operandi*, changing their business models (e.g. a shift from PSIA to CMT-based funding) to address the issue of higher duration gaps, analysing the impacts of changing business models of ICBs on liquidity and duration gaps is important. This will establish: whether CMT in the ICBs in terms of liquidity and duration gaps has been effective or not; whether the duration gaps have increased (or decreased) during the last 10 years; and what the major causes for the increasing (decreasing) gaps among the ICBs are?
9. At present, according to some studies and estimates, Islamic financial products and services are being offered by more than 300 IFIs in more than 75 countries, and the IFSI's assets are projected to be worth over USD 3 trillion by 2020, a substantial increase from a mere USD150 billion (1990s).
10. The Islamic banking sector in some jurisdictions (e.g. Brunei, Kuwait, Malaysia, Qatar, Saudi Arabia, and the UAE) is gradually becoming substantial. These jurisdictions seem to have accomplished at least 15% market share for their ICBs compared to total banking assets.
11. For instance, under sales financing, the *Murābahah* contract requires having a specific asset, which is under complete ownership of the ICB, on which there is an agreement on cost and profit.
12. While unrestricted PSIA are reflected on-balance sheet as they are comingled with the funds of shareholders, restricted PSIA are normally considered as off-balance sheet assets and they are “managed by an ICB as an investment manager based on either a *Mudārabah* contract or an agency-based *Wakālah* contract” (IFSB Compilation Guide, 2011, p. 32).
13. The client alone bears the risk of loss unless this is due to misconduct and negligence on the part of the ICB. In effect, the ICB as *mudarib* has no funds in the *Mudārabah* exposed to losses.
14. DCR is the “consequence of the rate of return risk. It refers to the magnitude of risks that are transferred to shareholders to cushion the IAH from bearing some or all of the risks to which they are contractually exposed in *Mudārabah* funding contracts” (Islamic Financial Services Board (IFSB), 2005, p. 23).
15. For instance, in a *Murābahah* transaction, “the market risk transforms into the credit risk, that is, market risk is applicable before selling the *Shari'ah*-compliant commodities to the counterparty and after selling to counterparty market risk converts into credit risk when the payment is on deferred terms” (Chattha, 2013, p. 89).
16. The CAR also requires special attention to be paid to the PSIA, as suitable credit and market risk exposures arising from assets are proportionately borne by unrestricted PSIA as per the *Mudārabah* contract (IFSB, 2013). This is known as Alpha ( $\alpha$ ).
17. Due to various considerations, quite recently, some ICBs have tweaked their *modus operandi* – changing their business models to address the issue of higher duration gaps, but these developments have resulted in increased risks (Chattha, 2010; IFSB, 2015). The implications of this, and other different models within the ICBs, are relevant subjects of study within the context of dual banking systems.
18. Prior to issuing IFSB-17, Chattha *et al.* (2014) identified the need for assessment of ROR risk under the study entitled “*Evaluation by the IFSB of Core Principles Relevant to Islamic Finance Regulation*”.
19. For example, if interest rates were expected to increase, management would want to shift from a positive to a negative gap position; it could do this by reducing the  $D_A$  and/or increasing the  $D_L$ .
20. Bierwag and Fooladi (2006) further explain that it was not until the 1980s that there was widespread use of the duration concept in financial markets, in particular, how it could be used to minimise IRR. In late 1979 and early 1980, the volatility of IRR increased remarkably, and

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practitioners became very interested in the duration concept. As the 1980s proceeded, an enormous number of applications of duration were found and it became a concept having common use in the financial markets.

21. However, it is important to note that Fisher and Weil (1971) provided evidence of the impact of a non-flat term structure on duration ( $D_A$  or  $D_L$ ). By combining first-order derivative (or first-order approximation) and second- and higher-order (second-order approximation), both Macaulay and Fisher–Weil duration measures can be enhanced.
22. This approach matches the rate-sensitive assets (RSA) and rate-sensitive liabilities (RSL) to be matured within a specified range of maturity dates (i.e. 0-3 months, 3-6 months, 6-9 months, 1 year, etc.). In fact, according to Alden (1983) the gap model derives its name from the dollar gap (Gap \$) that is the difference between the dollar amounts of RSA and RSL.  $\text{Gap \$} = \text{RSA \$} - \text{RSL \$}$ . RSA are those that can experience contractual changes in interest rates during the gapping period. All financial assets that mature within the gapping period are rate-sensitive. RSL are similarly defined.
23. These are defined as computer designed modeling techniques with varying levels of sophistication, which provide results in a dynamic context. Regarding simulation models, it is debated that these models are often criticised as being “black boxes”, having unknown internal structures, and their inability to reflect the actual environment of the institution or bank being modelled.
24. In these steps, it is important to mention that on-balance sheet and off-balance sheet effects are included when calculating the duration gap. These estimates are used to calculate duration gap. However, this study will not incorporate the OBS items (as explained in Section 4).
25. Ihlas Finans House from Turkey closed in 2001 due to liquidity problems and financial distress.
26. The accessibility to long-horizon data posed a serious challenge. This was due to the fact that most of the ICBs started operations globally after 2007 and 2008. In addition, those ICBs which started operations before 2005 did not provide archive data on their website and other sources (such as stock exchange), which limited the scope of their inclusion into the sample.
27. We wanted to be very clear about the selection of the sample, and not to confuse the Islamic windows with ICBs for comparison purposes. This process ensured that the selection of the ICBs would be purely based on them being full-fledged ICBs in any jurisdiction.
28. Countries such as *Brunei, Egypt, Lebanon, Tunisia, Algeria, Syria* and *UK* with dual banking systems, where ICBs are allowed to operate, were not included in the sample of the selected 13 countries due to the unavailability of data and relevant information on the maturity breakdown of the assets and liabilities of the ICBs in these countries.
29. Taking into account the data challenges, we removed many ICBs from being part of the sample for the study, although initially the study included a sample of more than 100 ICBs.
30. In the process of pairing the ICBs with the CCBs, it was found that the asset size of most of the ICBs is smaller than that of the CCBs. To pair them with respect to the above conditions, we had to access more than 100 CCBs. It is also interesting to note that once a pair was formulated based on asset size, we found that the paired CCB does not always have long-horizon data, and at times, the relevant information on the maturity breakdown of the assets and liabilities was not available. This led to perusing more than 1,000 ( $100 \times 9$ ; 100 banks' annual reports across 9 years) annual reports of the CCBs. Finally, after considering the above challenges, and applying the conditions of pairing, the final 50 CCBs which are similar to the ICBs were selected from across 12 countries.
31. Term loans or advances apply to the CCBs, and financing (or Islamic financing) applies to the ICBs.

32. According to IFSB (2017), the data on “financing by type of the *Shariah*-compliant contracts” reveals that these five major financing contracts used by the ICBs as of 2017Q1 cover almost 85 per cent of total financing extended by the ICBs. [www.ifsb.org/press\\_full.php?id=400&submit=more](http://www.ifsb.org/press_full.php?id=400&submit=more)
33. From the *Shari'ah* perspective, both *Salam* and *Istisnā'* represent an exception to the sale rule (i.e. existence of assets at the time of sale).
34. Financing or loans/advances are the terms used by different banks. Financing covers short term financing, medium term financing and long term financing, for both ICBs and CCBs. However, the contracts used by both ICBs and CCBs are different.
35. Customer deposit, investor capital, participating capital, unrestricted equity of PSIA or deposits are the terms used on the liability side.
36. In addition, on the asset side, the study excludes any other assets such as fixed assets, deferred tax assets, investment in associates/real estate, etc. On the liability side, the study excludes other liabilities such as bills payable, deferred tax liabilities, etc.
37. Where the total amount of interest bearing assets and liabilities are not equal, then the DGAP is;
- $$D\text{ GAP} = D_A - \left(\frac{L}{A} \times DL\right)$$
38. This is because some banks have 15 years financing and others 20 years. There could be several maturity buckets providing different years of maturity in the banks which vary from one jurisdiction to another. Instead of assuming one constant estimated maturity [any year], the study considers the 50 per cent extension of the last bucket to calculate the duration gap. This is consistent with Chattha and Bacha (2010) and Chattha and Alhabshi (2017).
39. To be able to gauge the enormity of the problem, we elucidate with the help of the following example. For instance, if there are seven maturity buckets covering financing on the assets side of an ICB, and similarly assuming the same for deposits on the liability side, if we combine these buckets together we would need the duration of 14 buckets corresponding to the assets and liabilities. In this case, 14 items for one ICB require the estimation of duration for DGAP, given the information on each account's profit rate, repricing schedule, early withdrawal potential and default probability. The total different durations for 9 years will work out to be 12,600 durations ( $14 \times 9 = 126 \times 100$  banks) with different numbers. To estimate these 12,600 durations across a sample of 100 banks, we would need around 6,300 excel work sheets for each maturity and profit rate.
40. Therefore, keeping in mind the simple finance rule that duration will be lower than the actual maturity of the asset/liability item, and with the available information on each type/category of financing along with its maturity and profit rate, various simulations were undertaken to find out the appropriate and reasonable single measure of duration. For instance, given the available information, and by applying some assumptions on the asset side, using equation 3, we estimated the  $D_A$  of some banks, which indicated  $D_A$  varied from 0.70 to 0.85 of the estimated maturity, although the results were indifferent in terms of estimation of DGAP when using any point between this range. As such, the duration measure of 0.80 was deemed more appropriate and reasonable to be assumed as the duration estimation of various components of assets and liabilities.
41. Similarly, the total number of CCBs from the GCC stood at 13: Bahrain (2), Kuwait (4), Qatar (1), Saudi Arabia (1) and UAE (5); the SASEA region had 20 CCBs: Bangladesh (2), Indonesia (3), Malaysia (5) and Pakistan (10). Finally, the MENAW region had 17 CCBs: Jordan (4), South Africa (5) and Turkey (8). See Table AVI in Appendix 2.
42. For instance, Al Rajhi, being one of the largest ICBs in the study sample, has an average FINA of around 65 per cent, but its mean duration gap for the period under observation is around 1.15 years; whereas KFH Kuwait, being the second largest ICB in the sample, has a 58 per cent FINA, but its mean duration gap is negative. On the other hand, Abu Dhabi Islamic Bank, being the fifth largest, has a FINA of 72 per cent, but its mean duration gap of 1.70 years is higher than that of Al Rajhi (1.15) and KFH Kuwait (-0.064).

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### Further reading

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### Appendix 1. Explanation of the estimation of duration gap for Islamic commercial banks and Conventional commercial banks

This appendix explicates the estimation process using the methodology and assumptions presented in Section 4. [Table AI](#) explains the DGAP for one of the ICBs to disclose the calculation process for the 100 banks ([Table AII](#) covers one of the CCBs). Qatar International Islamic Bank (QIIB) serves as the sample ICB for the year 2015 (the most recent year), to illustrate  $D_A$  and  $D_L$  calculations.

The column titled “amount” shows the sum of the total financing and deposits spread into mainly five maturity repricing buckets: “upto 1 month”, “over 1 month to 3 months”, “over 3 months to 12 months”, “over 12 months to 60 months” and “over 60 months”, for the QIIB. The amounts denote the undiscounted values of the total financing for the given maturity buckets for the QIIB. These amounts are specified in local currency for duration gap calculation purposes, however, for the estimation of the impact of ROR risk they are converted to US\$, as explained in Section 4.

The column entitled “proportion” indicates the proportion of the respective asset class (or amount) compared to total asset value. For this reason, the sum is not essentially 1.00 (or 100 per cent), as the study is only concerned with the total financing, as explained earlier, and not with the entire assets class on the balance sheet, such as financial assets, fixed assets or other assets, intangible assets, etc. In addition, we can see that the ratio of QIIB’s total financing to total assets on its balance sheet is around 73 per cent, which is spread into five maturity repricing buckets as indicated above. Of this 73 per cent, the QIIB has 15 per cent of its financing assets maturing in the “upto one-month” bucket, which is the amount of assets (financing) maturing within the respective period, 5,971,140.00 QR, divided by the total yield rate asset, 40,540,045.00 QR. Applying the same calculation, it is 6 per cent, 22 per cent, 25 per cent and 5 per cent for assets maturing in “over 1 month to 3 months”, “over 3 to 12 months”, “over 12 to 60 months” and “over 60 months”, respectively.

The next column represents average maturity for each asset class. It is the average (reflected in months) between the lower boundary and upper boundary of the maturity bucket. The following column denotes the estimated maturity for each asset class in a year. The column “estimated duration” gives an estimation of each asset class’s duration, by assuming that the duration of an asset is lower than its maturity, and a single assumption of 0.80 is taken for all assets in all observed banks (Section 4.3.2). In the same column, the average of 2 months (or 0.17 years) for assets included in the “over 1 to 3 months” class is estimated; however, the duration gap for “upto one-month” is estimated as zero (0), as estimated maturity is considered zero, and for the maturity class “over 60 months”, an assumption of 7.5 years average maturity is taken, as outlined earlier under assumptions presented in Section 4.

The last column shows the weighted duration, which is obtained by multiplying the “proportion” by “estimated duration”. For assets maturing “over 1 to 3 months”, the weighted duration is 0.01 years, a product of asset weight, 0.06, times estimated duration, 0.13 years, (=  $0.80 \times 0.17$ ) for the QIIB. Assets maturing in less than 1 month do not have duration, and the rest of the weighted durations are 0.11, 0.59 and 0.33, for the respective asset classes. The maturity bucket of “over 12 months to 60 months” indicates the highest duration for financing. By totalling all the weighted duration of assets, the average duration for yield rate assets ( $D_A$ ) of QIIB is estimated as 1.04 year. Similarly, on the liability side,  $D_L$  is also calculated using this method. [Table AI](#) shows the calculation format for QIIB’s liabilities. As can be seen in the bottom-right corner of the table, duration for its liabilities ( $D_L$ ) is calculated to be 0.30 year.

Having calculated the  $D_A$  and  $D_L$ , DGAP can be calculated as a function of difference between  $D_A$  and  $D_L$ . The DGAP for the QIIB stands at 0.73 (1.04 – 0.30) years for the year 2015. Similarly, the DGAP for the remaining years is calculated for the QIIB, which stands at 0.34 (2009), 0.43 (2010), 1.17

Qatar International Islamic Bank (QIIB) 2015						
Assets	1	2	3	3 x 0.80 = 4	1 x 4 = 5	
Maturities Break Down	Amount QR (000)	Estimated avg. maturity (months)	Estimated maturity (Yrs.)	Estimated duration (Yrs.)	Duration of assets (Yrs.)	
Upto 1 month	5,971,140.00	—	—	—	—	
Over 1 month to 3 months	2,502,335.00	2.00	0.17	0.13	0.01	
Over 3 months to 12 months	8,930,186.00	7.50	0.63	0.50	0.11	
Over 12 months to 60 months	9,962,757.00	36.00	3.00	2.40	0.59	
Over 60 months	2,223,911.00	90.00	7.50	6.00	0.33	
Total yield rate assets	40,540,045.00		Total duration of the assets		1.04	
Liabilities						
Upto 1 month	16,988,158.00	—	—	—	—	
Over 1 month to 3 months	5,186,301.00	2.00	0.17	0.13	0.02	
Over 3 months to 12 months	6,717,943.00	7.50	0.63	0.50	0.10	
Over 12 months to 60 months	2,758,070.00	36.00	3.00	2.40	0.19	
Over 60 months	—	90.00	7.50	6.00	—	
Total yield rate liabilities	35,010,933.00		Total duration of the liabilities		0.30	
Duration gap of the QIIB =	Total Duration of the Assets	1.04	Yrs			
	Total Duration of the Liabilities	0.30	Yrs			
	QIIB DGAP	0.73	Yrs			

**Table AI.**  
Sample of duration of  
assets and liabilities  
calculation (financing  
vs deposit)

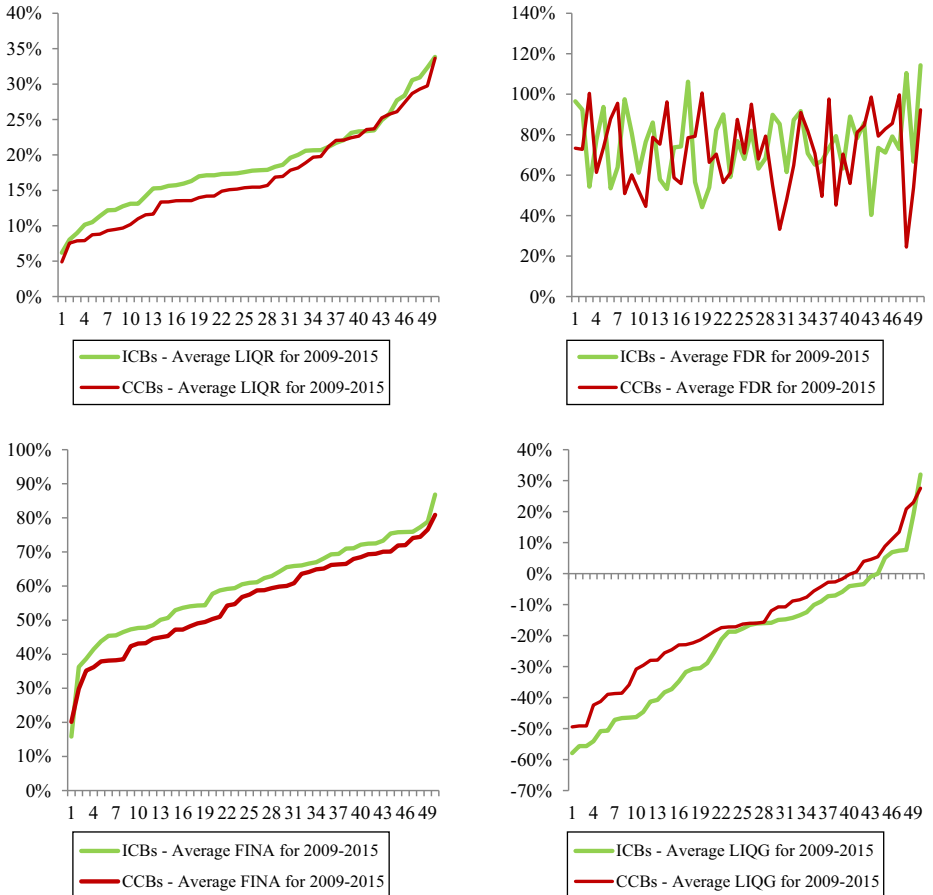
**Table AII.**  
Sample of duration of  
assets and liabilities  
calculation (loans vs  
deposit)

	1	2	3	3 x 0.80 = 4	1 x 4 = 5
	Amount RM (000)	Estimated avg. maturity (months)	Estimated maturity (Yrs.)	Estimated duration (Yrs.)	Duration of assets (Yrs.)
Alliance Bank 2015					
Assets					
Maturities break Down					
Upto 1 month	29,497,781.00	-	-	-	-
Over 1 month to 3 months	1,281,202.00	2.00	0.17	0.13	0.00
Over 3 months to 6 months	702,623.00	4.50	0.38	0.30	0.00
Over 6 months to 12 months	823,136.00	9.00	0.75	0.60	0.01
Over 12 months to 60 months	2,366,784.00	36.00	3.00	2.40	0.11
Over 60 months	2,202,385.00	90.00	7.50	6.00	0.25
.....					
Total Yield rate Assets	53,134,837.00				
Liabilities					
Upto 1 month	22,516,171.00	-	-	-	-
Over 1 month to 3 months	6,242,311.00	2.00	0.17	0.13	0.017
Over 3 months to 6 months	5,514,399.00	4.50	0.38	0.30	0.0339
Over 6 months to 12 months	5,206,645.00	9.00	0.75	0.60	0.06
Over 12 months to 60 months	575,012.00	36.00	3.00	2.40	0.03
Over 60 months	70,171.00	90.00	7.50	6.00	0.01
.....					
Total yield rate liabilities	48,761,668.00				
Duration gap of bank =	Total duration of the assets	0.37	Total duration of the liabilities		0.15
	Total duration of the liabilities	0.15	Yrs		Yrs
	Alliance Bank DGAP	0.22	Yrs		Yrs

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(2011), 1.24 (2012), 0.83 (2013) and 0.86 (2014). The total sum of duration gap for the period 2009-2015 for the QIIB is estimated to be 5.6 years, and the mean duration of 0.80 years, for the same period, respectively ([Appendix 2](#)).

With the above calculation process for the QIIB, [Table AII](#) presents the results of one of the CCBs, Alliance Bank, for the purpose of understanding. The remaining 98 banks follow the same process for the years 2009-2015, in terms of estimation of the DGAP. It is important to remark here that similar to [Table AI](#), eight similar tables were computed to calculate only the DGAP for the QIIB for the period 2009-2015. Using the same estimation for all the 100 banks (50 ICBs and 50 CCBs), the total number of tables generated for the study sample period exceeded 800. [Tables AIII-AVI](#) in [Appendix 2](#) present the consolidated results of the duration gap for each bank and country.



**Figure A1.**  
Key balance sheet indicators for duration gaps – results of the FINA, FDR, LIQR and LIQG

**Note:** The LIQR is measured as a per cent of Total Assets for the year 2009-2015; The FDR is measured as a per cent of Total Assets for the year 2009-2015; The LIQR is measured as a per cent of Total Assets for the year 2009-2015; The LIQG is measured as a per cent of Total Assets for the year 2009-2015

#	ICB bank name	2009	2010	2011	2012	2013	2014	2015	Grand total	Mean
1	ABC Islamic Bank	1.21	0.99	1.14	1.09	1.10	0.90	0.94	7.37	1.052
2	Abu Dhabi Islamic Bank	1.60	1.67	1.68	1.67	1.60	1.79	1.89	11.90	1.700
3	Affin Islamic Bank Berhad	0.60	0.55	0.38	0.38	0.37	0.41	0.57	3.25	0.465
4	Ahli United Bank	0.21	0.16	-0.08	0.11	0.10	0.10	0.11	0.71	0.101
5	Al Barakah Turkish Finance House	0.88	0.82	0.67	0.68	0.87	0.99	1.04	5.95	0.851
6	Al Barakah Bank Pakistan	0.16	0.00	-0.28	-0.37	-0.32	0.23	0.22	-0.36	-0.051
7	Al Barakah Bank Bahrain	-0.05	-0.02	-0.09	0.28	0.24	0.37	0.35	1.07	0.153
8	Al Barakah South Africa	1.55	1.66	1.85	1.92	1.84	1.27	2.15	12.24	1.749
9	Al Rajhi	0.81	1.22	1.28	1.25	1.13	1.12	1.24	8.06	1.152
10	Al Salam Bank	-1.21	-0.79	-1.17	-0.85	-0.98	-0.79	-0.41	-6.21	-0.887
11	Al Rajhi Malaysia Berhad	0.31	1.61	1.26	0.97	0.94	0.83	1.22	7.13	1.019
12	Amlslamic Bank Berhad	3.01	2.69	1.78	2.07	1.78	1.67	1.10	14.10	2.015
13	Asian Finance Bank Berhad	0.62	0.87	0.56	0.44	0.36	0.15	0.09	3.08	0.440
14	Bahrain Islamic Bank	0.44	0.75	0.21	0.94	0.69	1.29	-0.11	4.20	0.600
15	Bank Al Bilad	0.74	0.66	0.70	0.75	0.68	0.59	0.59	4.72	0.674
16	Bank Al Jazira	0.30	0.47	0.57	0.63	0.37	0.42	0.45	3.22	0.460
17	Bank Asya	0.69	0.89	0.90	0.76	0.01	0.90	0.90	5.04	0.720
18	Bank Islam Malaysia Berhad	1.08	1.47	0.78	0.15	2.76	0.70	0.59	7.54	1.077
19	Bank Islami Pakistan	-0.19	-0.41	-0.98	-1.33	-0.51	-0.73	0.22	-3.93	-0.561
20	Bank Muamalat Malaysia Berhad	1.25	0.91	0.95	1.18	2.25	0.81	0.67	8.02	1.146
21	Bank Syariah Mandiri	1.31	1.15	1.25	3.08	1.99	1.89	2.06	12.73	1.819
22	Bank Syariah Muamalat Indonesia	2.01	2.05	1.95	2.16	4.31	0.75	0.72	13.96	1.994
23	Barwa Bank	-1.81	-0.27	-0.24	0.73	0.55	-0.10	-0.04	-1.18	-0.169
24	Boubyan Islamic Bank	0.02	0.00	0.04	0.14	0.17	0.21	0.27	0.84	0.120
25	CIMB Islamic Bank Berhad	2.03	0.62	0.72	0.70	0.91	1.15	0.86	7.00	1.000
26	Dubai Islamic Bank	0.15	0.15	0.18	0.20	0.29	0.17	0.12	1.25	0.179
27	Dubai Islamic Bank Pakistan	0.48	0.42	0.30	0.22	0.22	0.20	0.23	2.08	0.297
28	Emirates Islamic Bank	1.19	0.91	1.41	1.56	2.19	1.46	1.43	10.14	1.448
29	Exim Bank Ltd	0.54	0.61	1.01	0.65	0.63	0.74	0.81	4.99	0.713
30	First Security Islamic Bank	0.65	0.78	0.73	0.71	-0.34	-0.20	-0.25	2.07	0.296
31	Hong Leong Islamic Bank Berhad	1.14	0.80	0.68	0.80	0.85	1.54	0.67	6.48	0.925
32	Islamic Bank Bangladesh Ltd	-0.09	-0.04	-0.09	-0.16	-0.18	-0.33	-0.02	-0.92	-0.131
33	Islamic International Arab Bank	0.07	0.09	0.06	0.23	0.19	0.02	-0.22	0.44	0.063

(continued)

**Table AIII.**  
Details of ICBs'  
duration gap (yrs.)

Table AIII.

#	ICB bank name	2009	2010	2011	2012	2013	2014	2015	Grand total	Mean
34	Ithmaar Bank	0.30	0.31	0.28	0.34	0.50	0.72	0.60	3.04	0.435
35	Jordan Islamic Bank	-0.29	-0.31	-0.27	-0.13	-0.17	-0.18	-0.11	-1.47	-0.210
36	KFH Bahrain	-2.24	-2.04	-1.75	-2.02	-1.59	-2.13	-2.55	-14.32	-2.045
37	KFH Kuwait	-0.17	-0.17	-0.10	0.00	-0.02	-0.01	0.02	-0.45	-0.064
38	KFH Malaysia Berhad	0.15	0.09	0.66	0.79	0.88	0.75	0.68	4.00	0.571
39	Khaleeji Commercial Bank	0.03	-1.64	0.62	0.39	0.29	-0.76	-1.85	-2.92	-0.417
40	Kuwait Turk Participation Bank	0.00	0.09	0.49	0.41	0.31	0.57	0.61	2.48	0.354
41	Kuwait International Bank	0.33	0.30	0.31	0.33	0.28	0.25	0.19	1.98	0.283
42	Masraf Al Rayan	0.81	0.58	0.38	0.32	0.59	1.66	1.37	5.71	0.816
43	Meezan Islamic Bank	-0.01	0.53	0.10	0.11	0.08	0.17	0.21	1.20	0.171
44	Public Islamic Bank Berhad	1.48	1.29	1.26	1.16	0.92	0.56	0.61	7.28	1.040
45	Qatar International Islamic Bank	0.33	0.43	1.17	1.24	0.83	0.87	0.73	5.60	0.800
46	RHB Islamic Bank	0.75	0.85	0.65	0.51	0.36	0.34	0.64	4.09	0.584
47	RHB Islamic Bank Berhad	1.79	1.32	1.31	0.99	0.66	0.33	0.71	7.10	1.015
48	Sharjah Islamic Bank	2.49	2.15	2.40	2.36	2.62	1.66	2.26	15.94	2.278
49	Tadhamon International Islamic Bank	-0.46	-0.39	-0.39	-0.35	-0.47	-0.58	-0.57	-3.22	-0.460
50	Turkiye Finans Participation Bank	0.66	0.79	0.77	0.74	0.81	0.84	0.92	5.53	0.790
	<i>Grand Total</i>	<i>27.66</i>	<i>27.62</i>	<i>27.98</i>	<i>30.95</i>	<i>33.93</i>	<i>25.55</i>	<i>24.91</i>	<i>198.60</i>	<i>28.371</i>

Note: Duration Gap as per the alphabetical order of the ICBs' names



#	CCB bank name	2009	2010	2011	2012	2013	2014	2015	Grand total	Mean
1	ABC Bank	0.643	0.301	0.684	-0.200	0.296	0.099	-0.036	1.788	0.2554
2	Aifin Bank	0.452	0.704	0.473	0.490	0.481	0.425	0.462	3.486	0.4981
3	Aktif Yatırım Bankası A.Ş	-0.113	0.216	0.608	0.349	0.554	0.392	0.475	2.481	0.3545
4	Al Khaleji Commercial Bank	0.247	0.012	0.255	0.424	0.674	0.326	0.166	2.105	0.3006
5	Alliance Bank	0.142	0.170	0.139	0.225	0.242	0.206	0.220	1.343	0.1918
6	AmBank	1.509	1.475	2.037	2.148	2.149	1.970	1.992	13.280	1.8972
7	Aradotubank A.Ş	0.658	0.690	0.565	0.513	0.411	0.510	0.420	3.767	0.5381
8	Arap Türk Bankası A.Ş	0.007	0.046	0.041	0.052	0.179	0.006	-0.076	0.255	0.0364
9	Bank Al Etihad	-0.032	-0.048	-0.084	-0.021	0.058	0.026	0.047	-0.055	-0.0078
10	Bank Al Falah	0.554	0.536	-0.123	-0.037	-0.026	0.412	0.108	1.424	0.2034
11	Bank AlHabbib	0.221	-0.033	-0.124	-0.063	-0.012	-0.176	-0.004	-0.191	-0.0273
12	Bank BJB	2.263	-0.113	0.106	0.316	-0.098	0.190	-0.052	2.781	0.3973
13	Bank BNI	0.394	-0.102	0.013	-0.142	-0.053	-0.143	-0.099	-0.084	-0.0120
14	Bank of Athens	-0.080	-0.197	-0.129	-0.129	-0.078	-0.106	0.560	-0.818	-0.1168
15	Bank of Jordan	0.543	0.478	0.523	-0.190	-0.098	0.055	0.115	1.870	0.2671
16	Bank of Punjab	-0.096	-0.146	-0.148	-0.117	-0.110	-0.124	-0.115	-0.856	-0.1223
17	Bank of Sharjah	-0.041	-0.051	-0.090	-0.085	-0.086	-0.092	-0.098	-0.545	-0.0778
18	Bank Panin	0.073	0.088	0.572	0.077	-0.119	0.016	0.054	0.760	0.1086
19	Bank Pozitif Kredi ve Kalkınma Bankası	0.109	-0.395	0.051	0.170	-0.114	0.088	0.029	-0.062	-0.0088
20	Burgan Bank	0.197	0.168	0.111	0.146	0.173	0.197	0.184	1.176	0.1680
21	Burgan Bank A.Ş	0.064	0.089	0.329	0.323	0.144	0.226	0.292	1.467	0.2096
22	Cairo Amman Bank	0.031	-0.003	0.016	0.023	0.004	0.002	-0.010	0.064	0.0091
23	Capital Bank of Jordan	0.259	0.175	0.285	0.423	0.437	0.302	0.653	2.533	0.3618
24	Capitecbank	-0.178	-0.223	0.089	0.164	0.163	0.156	0.224	0.394	0.0563
25	CBK Bank	-0.131	-0.198	-0.073	-0.009	-0.068	0.210	0.275	0.006	0.0008
26	Commercial Bank of Dubai	0.043	-0.004	-0.005	0.000	-0.134	-0.044	0.107	-0.036	-0.0052
27	Faysal Bank	0.073	0.099	-0.811	0.069	0.045	0.268	0.105	-0.152	-0.0218
28	Gulf Bank	0.828	0.985	0.797	1.034	0.952	0.914	1.011	6.520	0.9315
29	Habib Metro Bank	0.042	0.020	-0.131	-0.115	-0.100	-0.147	-0.099	-0.530	-0.0758
30	Habib Overseas Bank	-0.005	0.026	-0.336	0.001	0.034	-0.077	0.093	-0.264	-0.0377
31	HBL Bank	-0.661	-0.617	-0.912	-0.036	-0.005	-0.066	-0.048	-2.345	-0.3350
32	Hong Leong Bank	0.178	0.099	0.486	0.328	0.370	0.333	0.330	2.124	0.3034
33	ICBC Turkey Bank A.Ş	0.398	0.610	0.486	0.594	0.719	0.606	0.791	4.204	0.6005

(continued)

**Table AIV.**  
Details of CCBs'  
duration gap (yrs.)

Table AIV.

#	CCB bank name	2009	2010	2011	2012	2013	2014	2015	Grand total	Mean
34	IFIC Bank	0.285	0.123	0.057	0.077	-0.314	-0.226	-0.671	-0.670	-0.0957
35	Mashreq Bank	0.230	0.545	0.326	0.853	0.503	0.079	0.174	2.711	0.3872
36	MCB Bank	-0.059	-0.018	-0.012	-0.005	0.028	0.059	0.130	0.124	0.0177
37	Mercantile Bank	-0.007	-0.025	-0.033	-0.039	-0.053	-0.061	-0.039	-0.257	-0.0367
38	National Bank of Bahrain	0.518	0.475	0.482	0.461	0.319	0.280	0.336	2.871	0.4102
39	NBK Bank	0.245	0.254	-0.486	0.187	0.240	0.239	0.237	0.917	0.1310
40	NBP Bank	0.699	0.231	0.231	0.248	0.281	0.288	0.274	2.252	0.3217
41	NIB Bank	0.130	0.051	0.117	0.074	0.002	0.242	0.016	0.631	0.0902
42	One Bank Ltd	0.165	-0.123	-0.681	0.322	0.314	0.005	-0.157	-0.154	-0.0220
43	RAK Bank	1.239	1.307	1.385	1.360	1.296	1.091	1.517	9.195	1.3136
44	RHB Bank	0.476	0.538	0.533	0.417	0.382	0.266	0.279	2.890	0.4129
45	Saudi France Bank	0.175	0.219	0.323	0.240	0.287	0.270	0.486	2.001	0.2858
46	T-Bank	0.121	0.133	0.142	0.134	0.342	0.358	0.230	1.459	0.2084
47	Türkiye Kalkınma Bankası A.Ş	0.530	0.491	0.428	0.343	0.249	0.295	0.976	3.312	0.4731
48	Ubank	-0.083	0.050	0.287	0.374	0.382	0.294	0.183	1.486	0.2123
49	UBL Bank	-0.045	-0.123	0.202	0.045	-0.027	-0.031	-0.038	-0.017	-0.0024
50	UAB	0.493	0.389	0.937	0.841	1.346	1.014	0.888	5.909	0.8442
	<i>Grand Total</i>	<i>13.701</i>	<i>9.373</i>	<i>9.936</i>	<i>12.659</i>	<i>12.558</i>	<i>11.423</i>	<i>12.900</i>	<i>82.549</i>	<i>1.1792</i>

Note: Duration Gap as per the alphabetical order of the CCBs' names

**Table AV.**  
Details of ICBs'  
duration gap at  
country level

	ICBs Sum of DGAP (yrs.)							Grand total
	2009	2010	2011	2012	2013	2014	2015	
Bahrain	-1.534	-2.439	-0.763	0.171	0.247	-0.411	-3.026	-7.756
Bangladesh	1.095	1.347	1.645	1.209	0.115	0.197	0.541	6.150
Indonesia	3.327	3.202	3.201	5.244	6.304	2.637	2.782	26.696
Jordan	-0.218	-0.221	-0.218	0.104	0.028	-0.166	-0.339	-1.031
Kuwait	0.383	0.295	0.164	0.571	0.526	0.544	0.597	3.081
Malaysia	13.470	12.225	10.343	9.625	12.669	8.902	7.760	74.994
Pakistan	0.453	0.539	-0.854	-1.362	-0.538	-0.127	0.878	-1.013
Qatar	0.077	1.590	1.958	2.800	2.324	2.770	2.701	14.220
Saudi Arabia	1.852	2.350	2.556	2.639	2.181	2.133	2.284	15.996
South Africa	1.554	1.665	1.847	1.917	1.838	1.274	2.147	12.242
Turkey	2.227	2.584	2.827	2.595	2.006	3.301	3.463	19.003
UAE	5.434	4.878	5.672	5.780	6.699	5.075	5.698	39.237
Yemen	-0.462	-0.389	-0.395	-0.347	-0.469	-0.582	-0.574	-3.218
<i>Grand Total</i>	<i>27.657</i>	<i>27.625</i>	<i>27.983</i>	<i>30.947</i>	<i>33.931</i>	<i>25.545</i>	<i>24.913</i>	<i>198.600</i>

	CCBs sum of DGAP (yrs.)							Grand total
	2009	2010	2011	2012	2013	2014	2015	
Bahrain	1.161	0.776	1.166	0.261	0.615	0.379	0.301	4.659
Bangladesh	0.450	0.000	-0.624	0.400	0.000	-0.222	-0.828	-0.824
Indonesia	2.730	-0.126	0.690	0.251	-0.270	0.062	0.121	3.457
Jordan	0.800	0.602	0.740	0.235	0.400	0.385	1.250	4.411
Kuwait	1.139	1.208	0.349	1.358	1.297	1.560	1.708	8.619
Malaysia	2.757	2.986	3.668	3.607	3.623	3.199	3.283	23.123
Pakistan	0.858	0.000	-1.711	0.064	0.074	0.725	0.329	0.339
Qatar	0.247	0.012	0.255	0.424	0.674	0.326	0.166	2.105
Saudi Arabia	0.175	0.219	0.323	0.240	0.287	0.270	0.486	2.001
South Africa	-0.354	-0.370	-0.123	0.371	0.448	0.206	0.362	0.542
Turkey	1.773	1.880	2.649	2.477	2.484	2.482	3.136	16.882
UAE	1.964	2.187	2.553	2.969	2.924	2.048	2.588	17.234
<i>Grand Total</i>	<i>13.701</i>	<i>9.373</i>	<i>9.936</i>	<i>12.659</i>	<i>12.558</i>	<i>11.423</i>	<i>12.900</i>	<i>82.549</i>

**Table AVI.**  
Details of CCBs'  
duration gap at  
country level

### About the authors

Dr Jamshaid Anwar Chattha, CPIF, Dr Jamshaid is an ex-regulator, standard-setter and qualified chartered Islamic finance professional with 13+ years of direct Islamic financial sector experience in different countries that range from commercial banking to regulatory policy development and implementation. As Banking Supervision and Stress Testing Advisor to the IMF, he has provided policy advice to various central banks through nine IMF TA missions for Kuwait, Kyrgyz, Libya, Nigeria and Yemen and one for World Bank for Saudi Arabia. He is well travelled and has conducted 100+ technical workshops on Islamic finance for the IFSB, IMF, World Bank, IDB, Toronto Centre, AMF, Cambridge IFA and 20+ central banks in Middle East, South Asia, Central Asia and North and Central Africa and Europe. He regularly writes on risk management and regulatory issues pertaining to Islamic finance and his work has been published in international Scopus and ISI journals.

He has served the IFSB as Project Manager for various technical projects, as well as Assistant Secretary-General, Technical and Research, where he oversaw and provided immediate leadership and supervision to Technical and Research Division, responsible for standard development in Islamic banking, capital markets, and Takaful sectors; research; technical publications; annual flagship Stability Report; and PSIFs project. He has also served Central Bank of Kuwait as Chief Banking

Researcher, Chief Financial Analyst and Islamic Finance Expert in the Off-Site Supervision Department. He has hands-on experience in central bank pertaining to Basel II, 2.5, III, IFRS 9 implementation and its equivalent IFSB/AAOIFI framework. He also worked in Singapore and Pakistan.

Dr Jamshaid Anwar Chattha received his PhD in Islamic Banking and Finance from International Islamic University Malaysia (IIUM) with outstanding award. He graduated with a BSc (Mathematics and Economics). He holds an MBA–Finance (NUML), an MSc–Islamic Finance (IIUM) and a CIFP (INCEIF), all with distinctions and outstanding awards. He is also a fellow member of Chartered Institute of Islamic Finance Professionals (CIIF), Malaysia. He has Executive Education from Columbia Business School, New York, USA and Cambridge IFA, UK. Jamshaid Anwar Chattha is the corresponding author and can be contacted at: [jamshaid.anwar@gmail.com](mailto:jamshaid.anwar@gmail.com)

Dr Syed Musa Alhabshi is an Associate Professor in Institute of Islamic Banking and Finance, IIUM and Dean of Institute of Islamic Banking and Finance, IIUM and Dean of Graduate School of Business, University Tun Abdul Razak (2012-2013). He was also engaged as a Fellow Consultant with Amanie Business Solutions and International Institute of Islamic Finance Inc in providing advisory, research and training services to the Islamic financial services industry. Previously he was a technical consultant with Centennial Group International in developing Islamic Financial Services Board (IFSB) Prudential Standards.

He had served as a member of Accounting, Auditing and Governance Standards Board of Accounting Auditing Organization for Islamic Financial Institutions (AAOIFI). In Malaysia, he is currently a member of Malaysian Accounting Standards Board (MASB) Working Committee of Islamic Financial Reporting Standards. He has presented papers in both local and International Conferences, as well as published papers in academic journals and related academic literature.

Dr Syed Musa has a Diploma in Business Studies (1984) from Ngee Ann Polytechnic, a Bachelor in Business Administration (1989) from the International Islamic University of Malaysia and a Doctorate in Business Administration (1994) majoring in Accounting and Finance from University of Strathclyde, UK.

His areas of interest and expertise include Financial Markets, Investment Analysis, Macro-Economics, Economics of Social Issues and Quantitative Methods. He has wide experience in teaching, training, consultancy and research in the above areas. His works have been published in local and international journals.

His current research interest is in money systems that include the gold dinar. He is the author of the books *The Islamic Gold Dinar*, *The Theft of Nations* (both published by Pelanduk Publications) and *Real Money – Money and Payment Systems from an Islamic Perspective* published by IIUM Press.

Prof. Dato' Dr Ahamed Kameel Mydin Meera is currently the Managing Director of the Z Consulting Group. He was a Professor in the Faculty of Economics and Management Sciences, International Islamic University Malaysia and the Dean of the Institute of Islamic Banking and Finance, International Islamic University Malaysia. He holds a PhD degree in Finance from the University of North Texas, Denton, Texas, USA. His undergraduate and Masters Degrees were in the area of Economics from the International Islamic University Malaysia.