

# Predicting Distress in Islamic Banks: The Effectiveness of Capital Measures in CAMELS Framework

Zahid ur Rehman Khokher\* and Syed Musa bin Syed Jaafar Alhabshi

*Institute of Islamic Banking and Finance, International Islamic University Malaysia*

**Abstract:** This study aims to identify key capital adequacy measures and other parameters that effectively predict distress in Islamic banks taking a panel of 65 banks from 13 countries between 2008-2017 using logistic regression model. The paper also intends to see whether simpler ratios perform better than more complex, risk weighted measures in predicting distress in these banks. A total of nine alternative capital and leverage indicators are used in the model that mainly rely on financial and accounting data, which are supplemented by the addition of market leverage for listed banks. In order to capture variability in cross country analysis and impact of economic conditions and shocks, the study also adds several macroeconomic indicators in the model. The results suggest that most of the standard CAMELS indicators are relevant for studying distress in Islamic banks. Further, it is shown that three other capital ratios – Tier 1, tangible common ratio and market leverage - are equally effective in studying Islamic bank failures. The findings, however, reflect that Basel III leverage ratio and other accounting-based ratios do not offer effective early warning signals of Islamic bank stress. Overall, equity based risk-weighted capital ratios offer a more robust framework of regulation and supervision in Islamic banks.

**Keywords:** Early Warning System, Leverage Ratio, Bank Failure, Basel III, CAMELS, Risk-Based Capital, Regulation, Islamic Banks, Emerging Markets.

## 1. INTRODUCTION

Despite increasing growth and importance of capital market and insurance sectors in last half century, banking sector remains dominant part of financial systems throughout the developing world in Asia, Africa, Middle East, Latin America and others. Banks, as financial intermediaries, play their role by extending credit to actors in the economy through maturity transformation (Turner, 2010) and producing financial claims while ensuring liquidity demands by the depositors are met on demand ((DeAngelo & Stulz, 2014). They also play significant role in providing other ancillary services useful to society such as facilitating transfers, supporting local and international trade and providing other fee based services. Consequently, they play key role in the smooth running of the financial and economic systems where they operate, thus contributing to economic growth and well-being of the individuals and firms at large.

Due to this significant role of banks in the economy, banking authorities around the world ensure strong regulation and supervision of banking sector for several reasons: i) to protect individual depositors; ii) to maintain a reliable payment system; iii) to ensure a well-articulated money supply as a part of monetary stability; iv) to see that customers get required services at reasonable prices; v) to protect the customer rights

and interests when dealing with banks (Pappas, Izzeldin, & Fuertes, 2016; Spong, 2000). Nevertheless, repeated banking crises since early twentieth century are a testimony that banking regulation and supervision is not sufficient to keep them from failing. Especially, during the global financial crisis of 2007-08, the colossal failure of many large, systemically important banks and other financial institutions demonstrated the damage such failures can bring to not only local financial systems and economies but also at the regional and global level. Many governments chose to offer loans as well as explicit and implicit guarantees for banks' creditors (depositors and subordinated debt holders) which helped the banks' management and shareholders to evade the responsibility, while the risks were effectively transferred to the respective governments and ultimately the tax payers – a phenomenon commonly expressed as 'privatizing the gains and socializing the losses'<sup>1</sup> (Acharya, Gujral, Kulkarni, & Hyun Song Shin, 2011; Berger, DeYoung, Flannery, Lee, & Öztekin, 2008; KAZU, 2009). These failures had enormous implications on the macroeconomic stability, growth and employment in these countries. The experiences of bank failures and distress in the last decade and the profound repercussions such failures could have for the society,

<sup>1</sup>The range of these 'bail-outs' has been estimated quite differently. As an indication, Bloomberg's estimation on the cumulative "spending" by the US Federal Reserve (this includes asset purchases plus lending) was \$7.77 trillion. Another study finds that the total spending was actually over \$29 trillion. A Detailed Look at the Fed's Bailout by Funding Facility and Recipient, by James Felkerson, University of Missouri-Kansas City, Dec 2011. [http://www.levyinstitute.org/pubs/wp\\_698.pdf](http://www.levyinstitute.org/pubs/wp_698.pdf)

\*Address correspondence to this author at the Institute of Islamic Banking and Finance, International Islamic University Malaysia; Tel: +6013-3514060; Fax: 603-61964053; E-mail: zaahid@gmail.com

nevertheless, has renewed interest in the study of bank failures and the tools that can predict such catastrophic events.

Historically, banking regulators have used capital adequacy (CAR) ratio as the primary instrument in their toolkit to monitor the performance of their banks and as an early warning signal to take corrective supervisory action if a bank falls below the stipulated requirements (Mayes & Stremmel, 2012). However, the size and scale of global financial crisis showed that CAR does not offer sufficient information to predict an impending distress in a banking institution due to, among others, financial innovation and off-balance sheet vehicles which allowed the banks to indulge in 'capital arbitrage' and increase the leverage 'without any limits' (Admati, 2016). Capital regulation based on risk-weighted assets encouraged innovation designed to circumvent regulatory requirements and shifted banks' focus away from their core economic functions (Blundell-wignall & Atkinson, 2010). The global standard setter for banks, the Basel Committee on Banking Supervision (BCBS) responded to this issue with two key measures: i) introducing a non-risk weighted leverage ratio as a 'backstop' to CAR, with the impact of off-balance sheet assets fully considered, and ii) stipulating two new standardised ratios for liquidity management, called Liquidity Coverage Ratio and Net Stable Funding Ratio. Accordingly, in addition to focusing on the predictive power of CAR for bank distress, the literature produced after the global financial crisis has also given consideration to the imposition of leverage ratio and its implications for banking supervision. Similarly, some literature also suggested several alternative ratios such as gross revenue ratio, tangible common equity ratio, base risk weight ratio etc. and claimed that these ratios offer better, or at least equivalent, predictive power on bank distress as the classical CAR (see section 2 for details).

The size of Islamic banking sector is now over USD 1,700 billion and it has shown tremendous, mostly double-digit growth in last two decades in important regions of the world including Asia, Middle East, Africa and Europe (International Monetary Fund, 2018). This sector has achieved market share of more than 15% of overall banking sector in over 12 jurisdictions (Islamic Financial Services board, 2018) with at least four countries having market share of over 50%. At the individual institutional level, many Islamic banks have grown in size and complexity and have expanded beyond their border, at the regional and international level. Similarly, some of these large Islamic banks

could have the status of domestic systemically important banks in the Basel III regime when applied by respective banking regulators (IFSB, 2015). Some possible examples of these banks are: Kuwait Finance House, Albaraka Bank, Dubai Islamic Bank, Islami Bank Bangladesh, Alrajhi Bank and Qatar Islamic Bank etc. Owing to differences in business model, operations and balance sheet structures, the underlying risk of Islamic banking products and services are different from conventional banks which can have financial stability implications for these markets (Beck, Demirgüç-kunt, & Merrouche, 2013; Hasan & Dridi, 2011; IMF, 2017).

The growing significance of Islamic banks thus calls for attention on the appropriate toolkit to be used for their monitoring and supervision. Owing to several peculiarities in the balance sheet structure and associated Shari'ah rules, the global standard setting body for prudential regulation of Islamic finance, the Islamic Financial Services Board (IFSB) has issued over five standards and guidelines on various aspects of capital adequacy regulation with calculation methodology of CAR in Islamic banks, covering aspects such as appropriate Shari'ah compliant instruments to be considered as components of capital and changes to be made in credit, market and operational risk to calculate risk weights. Similarly, its latest capital adequacy standard IFSB-15 (IFSB, 2013) has explained the possible impact of smoothing practices and risk absorbency in profit sharing investment accounts (PSIA) on CAR and changes to be made in its calculation methodology. Similarly, it has provided preliminary guidance on the application of Basel Committee's leverage ratio on Islamic banks, which is being revised now.

However, there are only a few studies available in Islamic banking literature that have empirically tested the possible metrics that can serve as early warning indicator of distress in these banks. One reason of this phenomenon could be the relative stability as well as infancy of Islamic banking sector. Similarly, there have not been many outright liquidations of Islamic banks in past decade or so. Nevertheless, it will not be correct to state that Islamic banks have been totally immune to any financial distress as previous studies such as (Abou-El-Sood, 2015; Hasan & Dridi, 2011; Pappas *et al.*, 2016) have recorded. For example, some Islamic banks in various jurisdictions have faced challenges in meeting regulatory CAR, whereas some have been dissolved or their control has been taken by supervisors. Similarly, some have been merged or

acquired by other banks due to financial difficulties. Many banks in Gull Cooperation Council (GCC) countries, including Islamic banks, were also granted state support, including deposit placement by the respective governments.

Accordingly, this study attempts to expand the literature on Islamic banks in a number of ways: First, contrary to studies on bank distress that mostly focus on economically advanced markets, this study takes comprehensive dataset of 65 banks from 13 countries between 2008-2017 representing emerging markets in the GCC, North Africa, Asia and Europe; Second, in addition to CAR, several other alternative ratios proposed in literature on conventional banks have been tested for their efficacy in predicting distress in Islamic banks; Third, over half of dataset includes publicly listed Islamic banks that permits the testing of market leverage as one of the potential ratios, which is not tested in other studies on Islamic banks; Fourth, a new ratio called "Islamic banking leverage" is proposed and examined that takes into account the risk absorbency feature of PSIA; and Fifth, it offers insights on the application of Basel III proposals on Islamic banks by testing their relevance and effectiveness for this sector. This guidance will help Islamic finance standard setters, bank regulators and Islamic banks in choosing the most appropriate tool of leverage regulation and early warning signal.

The remaining paper is structured as follows: Section 2 consists of literature review which briefly tracks the history of bank regulation and the importance of early warning signals. Section 3 gives an overview of empirical models used for predicting bank distress, proposes a criterion for identifying distress in Islamic banks and explicates unique aspects of potential distress determinants from Islamic banking perspective. Section 4 offers empirical analysis and suggests policy implications for Islamic bank regulation and broader application on banks operating in emerging markets. Section 5 concludes the paper with some closing remarks and suggests ways to extend the study.

## 2. LITERATURE REVIEW

### 2.1. The History of Bank Regulation before Basel II and Role of Capital Regulation

While the history of formal banks goes as far as four centuries, explicit application of capital rules for commercial banks only started in 1980s. Before the

implementation of these formal rules, supervisors of banking sector used to gauge the appropriateness of capital levels as a rule of thumb (Estrella, Park, & Peristiani, 2000). United States implemented capital rules in 1981, followed by introduction of Basel I in 1988 for 'internationally active banks'. This framework was further strengthened by the introduction of Base II in 2004 that required large, international banks to maintain capital against their credit, market and operational risk. Since then, it has become principal mechanism for banking sector regulatory and supervisory authorities for measuring the bank strength. The CAR is essentially a risk-adjusted ratio, which is expressed in percentage as bank's total capital to its risk weighted credit exposures (Berger *et al.*, 2008; Spong, 2000). The main objective of the CAR is to offer a 'cushion' to the 'unexpected losses' and protect the bank's fund providers (depositors, lenders and investors). Thus, as a principle, a larger bank will need higher amount of capital than a small sized bank, whereas a high-risk bank will need higher capital than a bank with less risk, other things equal.<sup>2</sup> The maintenance of minimum CAR by the banks thus helps to keep confidence of stakeholders in the strength and resilience of the banking system, which is a major policy objective of any banking-sector regulator or supervisor in the world.

Since different types of banking assets such as cash, financing, investments and other assets have different risk profiles, CAR primarily adjusts for assets that are less risky by allowing banks to "discount" lower-risk assets. For example, government debt instruments (treasury bills, domestic government bonds) are allowed a 0% "risk weighting" - that is, they are subtracted (or excluded) from total assets for calculating the CAR (Admati, DeMarzo, Hellwig, & Pfleiderer, 2012; Hildebrand, 2008; Spong, 2000).

However, despite the implementation of CAR regime in most of the countries in 1990s and first decade of the new century, it could not provide a strong mechanism for absorbing the losses for several reasons. For example, in addition to considering common equity as a part of capital, Basel II permitted the banks to use hybrid debt capital instruments (such as long-term preferred shares, perpetual debt instruments, convertible debt instruments etc.) and subordinated term debt as a part of capital, despite

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<sup>2</sup>For 'expected' losses, a provisioning regime is followed by banking institutions.

acknowledging the fact that “subordinated term debt instruments have significant deficiencies as constituents of capital in view of their fixed maturity and inability to absorb losses except in a liquidation”.<sup>3</sup> The use of borrowed funds in the form of debt based instruments – such as subordinated term debt and hybrid capital – allowed the banks to further leverage their balance sheets in the calculation of regulatory capital calculations where most of their balance sheets were already heavily leveraged due to the use of customer and interbank deposits on the liability side. Under pressure from shareholders to increase returns, banks relied heavily on these debt-based instruments and operated with minimal equity, leaving them vulnerable if things went wrong. As an example, during 2000-2008 period, the world’s largest 21 banks raised a total capital of USD 1.76 trillion, in which USD 1.64 trillion (93%) of capital was raised in the form of debt (Acharya *et al.*, 2011).

The use of high leverage in large conventional banks had enormous implications for the global financial system during the 2007-2008 global financial crisis. When these banks were hit hard with the losses and their equity was evaporated, instead of passing on the losses to the holders of these capital instruments, the governments in the crisis countries chose to ‘bail-out’ these banks by bearing the risks themselves (effectively transferring it to the tax payers) for the fear of contagion due to the failure of too-big-to-fail financial institutions. (Acharya, Mehran, & Thakor, 2015; Admati, 2016). Similarly, the risk weighting of the assets permitted the banks to design innovation aimed at evading the CAR and shifting the focus of banks away from undertaking key business function. Such products, as well as use of off-balance sheet vehicles, re-securitisation, money market funds etc. allowed the banks to indulge in ‘capital arbitrage’ and increase the leverage ‘without any limits’. Thus, an unintended consequence of Basel II was its contribution to, or even reinforcement of adverse systemic shocks that materialized during the global financial crisis of 2007-08 (Admati, 2016). Capital regulation based on risk-weighted assets encouraged innovation designed to circumvent regulatory requirements and shifted banks’ focus away from their core economic functions (Blundell-wignall & Atkinson, 2010). These financial

innovations also helped amplifying the banks’ asset-liability mismatch and risk to funding liquidity (D’Hulster, 2009; Wissén, 2010).

Another different, but closely associated, criticism on capital regulation was that risk-based measures, especially the use of internal models by the banks, are costly to implement and challenging to supervise. Therefore, a number of studies around the global financial crisis suggested the use of ‘simpler’ ratios that could be effective in predicting the vulnerability in banking institutions such as leverage ratio (Estrella *et al.*, 2000; Haldane, 2012)..

## 2.2. Capital Reforms Introduced by Basel III

(Hildebrand, 2008) mentions that from historical perspective, before the introduction of risk weight sensitivity in assets by the Basel I Accord in 1998, most countries used to apply simple leverage ratios. Some countries such as Canada, United States and Switzerland have been applying an unweighted leverage ratio since many decades before the financial crisis (Bordeleau, Crawford, & Graham, 2009; D’Hulster, 2009; Gambacorta & Karmakar, 2016; Kamada & Nasu, 2010).

Hence, in order to respond to the lessons learned during the global financial crisis and replicating the experience of aforementioned countries, a number of studies by the BCBS as well as other bodies recommended the introduction of leverage ratio to resolve the problem of excessive leverage in the financial system (BCBS, 2010a; Bordeleau *et al.*, 2009; Hildebrand, 2008; Kellermann & Schlag, 2013). Consequently, when the BCBS introduced the reform package of global financial regulation in December 2010, commonly known as Basel III, it introduced the leverage ratio as a “backstop” measure to support the risk-based capital regulations that stipulate CAR. This new leverage ratio was aimed to constrain the build-up of leverage in the banking sector and to help avoid destabilizing deleveraging processes which can damage the broader financial system and the economy (BCBS, 2010b). This ratio, as defined by the Basel Committee is an un-weighted measure and calculated as Tier 1 capital to on-and off-balance sheet exposure i.e. an economic leverage, with a minimum value of 3%.

The interest in the introduction of leverage ratio led to the introduction of vast literature which made an effort to investigate various aspects of the proposed

<sup>3</sup>Para 49(xii) of Basel II, 2006 version. Basel Committee on Banking Supervision. <https://www.bis.org/publ/bcbs128.htm>

ratio, its relative robustness as a capital measure and interaction with other ratios.<sup>4</sup> For example, these studies look at the objective of regulating the financial sector and see how far leverage ratio fits into this objective? (Admati, DeMarzo, Hellwig, & Pfleiderer, 2010; Atkinson & Blundell-Wignall, 2010; Blum, 2008; Blundell-Wignall & Caroline Roulet, 2013; Brei & Gambacorta, 2014; Demirguc-Kunt, Detragiache, & Merrouche, 2010; Estrella *et al.*, 2000; Haldane, 2012; Kellermann & Schlag, 2013; Merrouche, Detragiache, & Merrouche, 2010; Ojo, 2015).

On the other hand, (Atkinson & Blundell-Wignall, 2010; Demirguc-Kunt *et al.*, 2010; Estrella *et al.*, 2000; Haldane, 2012; Kellermann & Schlag, 2013) investigate the interaction between the leverage ratio and CAR and give their findings on the simultaneous implementation of both ratios vis-à-vis the application of either of the two ratios.

More importantly, several studies on conventional banks questioned the use of leverage ratio as a secondary measure and noticed that leverage ratio (as well as some other measures) is a better measure, or at least of similar value, as CAR in gauging banks' strength and predicting their distress in the future. Similarly, it is easy and less costly to implement. Therefore, these studies suggest that this ratio should be given equal importance in the bank regulation, instead of using it only as a "backstop" measure as suggested by the BCBS (Blundell-wignall & Atkinson, 2010; Buehler, J., & Samandari, 2010; Haldane, 2012).

Contrary to the above studies where arguments are presented in favour of implementing leverage ratio as an additional requirement to capital ratios, some researchers have found contradicting results that show that it is not effective in all the cases. These include: (Pratomo & Ismail, 2007) for Malaysian banks, (Kellermann & Schlag, 2013) for Swiss banks and by (DeAngelo & Stulz, 2014) for US banks.

### 2.3. The Need for Early Warning Systems on Bank Distress

Due to the significance of banking sector to the financial systems, the literature on bank distress and its prediction models has been produced in large

numbers. However, availability of reliable data remains a challenge in many developing markets and therefore, most research has been dedicated to either US, EU or other advanced markets. (Mayes & Stremmel, 2012) tracks about 40 such studies, over 35 of which have been conducted for advanced markets.

Central banks and bank supervisors use a range of on- and off-site surveillance tools to track the performance and stability of banking institutions. (Chernykh & Cole, 2015; Poghosyan & Čihák, 2011). Banks are required to maintain capital at "minimum acceptable level" as well as adequate level of capital ratio (Estrella *et al.*, 2000). Similarly, both Basel II and Basel III have made a distinction in capital for going concern and gone concern capital, commonly known as Tier 1 and Tier 2 capital. This distinction is important since net worth of the bank reduces sharply when it is in distress and close to becoming a gone concern. Therefore, regulators have a reason to select a capital ratio that is closely correlated with the bank distress i.e. the ratio should exhibit a relationship with high failure probability of the bank. Accordingly, bank supervisors have devised various early warning systems and linked them with various levels of capital as well as other indicators of bank performance. In practical terms, however, all distress events are unique. Nevertheless, the main job of prediction models is to search for some patterns which can be associated with bank distress with reasonable accuracy. The challenge is that over time, banks understand how their vulnerability is being monitored by regulators, which leads them to "massage the respective ratios" while still keeping the business as usual (Estrella *et al.*, 2000). The continuous change in response poses challenges on the prediction quality of these models which require the need for continuous improvement and adjustments.

### 2.4. Models for Predicting Bank Distress

One of the earliest bank distress models was developed by the US in late 1970s by the Federal Deposit Insurance Corporation (FDIC) called CAMELS model. This model monitored several key aspects of bank performance such as financial, operational and managerial quality. Thus, it included dimensions of: capital adequacy (C), asset quality (A), management quality (M), earning power (E), liquidity (L) and sensitivity to market risk (S), the last of which was introduced in 1996 after Basel II. Interestingly, despite being one of the earliest models, CAMELS is still widely used both in practice by the bank supervisors and in academia for accessing the bank distress. Some

<sup>4</sup>While most studies quoted here were conducted after the introduction of Leverage Ratio as a part of Basel III package in 2009-2010 that is applicable at the global level, some papers mentioned here were undertaken prior to this period as some regulatory authorities such as those in US, Canada and Switzerland have a Leverage Ratio based capital regime since 1990s.

papers added macroeconomic variables such as GDP growth, credit growth, inflation, interest rates and exchange rates. Similarly, some researches have chosen to use market information, such as risk (return volatility), share prices and bond spreads ((Mayes & Stremmel, 2012).

Most studies have used “survival models” to measure the hazard of distress or failure in banks. Survival models are of two types, where first type of model is called Pobit or logit models which predict the exit, failure, survival or loss of one entity i.e. do or die model. Both approaches use statistical estimation techniques such as maximum likelihood that offer better estimation than linear estimation methodologies. However, they have different assumptions about the distribution of data: The logit model considers a logistic distribution whereas probit model presumes a standardised normal distribution. The second type of model is called hazard or duration models which predicts the duration of entity’s existence starting from entry to exit i.e. when and how long will the entity survive. These models are also termed as survival time analysis. The more dominant of this model is Cox proportional hazard model (Mayes & Stremmel, 2012; Pappas *et al.*, 2016).

More recently, with the availability of more data and advanced processing power, some new non-statistical techniques have been developed for predicting bank distress. These include: artificial neural networks which make use of non-linear data. Similarly, data development analysis uses liner programming technique and non-parametric approach to benchmark banks with certain qualities. Moreover, some non-parametric techniques such as Kaplan-Mier estimator of survival function have been used in literature (Pappas *et al.*, 2016). Another quite popular method in literature to study the soundness of firms is z-score as it is inversely proportional to the probability of a firm’s insolvency (Čihák & Hesse, 2010).

## **2.5. Empirical Literature on Capital Ratios in Conventional and Islamic Banks**

One of the earlier studies, conducted before the global financial crisis, was undertaken by (Estrella *et al.*, 2000). Using a data set of 62,000 observations for failed and surviving banks in US over a five-year period (1988-1992), they have tested three ratios for their analysis using both proportional hazard model and logit regression: risk weighted CAR, leverage ratio and gross revenue ratio. The study finds that for the long

term, risk weighted CAR is the most effective predictor of bank failure. However, for a short horizon of less than two years, other two measures provide equally useful information.

The comparison between the implications of various capital ratios got further attention in the academic literature after the financial crisis when international bodies such as G-20 and the Basel Committee announced the introduction of Leverage Ratio as a part of global regulatory reforms.

One of first such studies was undertaken by (Blum, 2008) who focused on the reporting aspects of regulatory capital ratios. Using a theoretical model, they observed that if supervisors have a limited ability to identify or to sanction dishonest banks in their reporting of risk-based capital (CAR), a risk-independent leverage ratio restriction may be necessary to induce truthful risk reporting as risky banks have an incentive to underestimate their risks. They also observe that leverage ratio can work as a safeguard against potential shortcomings of risk-sensitive requirements, notably regulatory arbitrage and problem of validation.

The information value of the capital ratios to the equity holders is studied by (Demirguc-Kunt *et al.*, 2010), who observed that during the global financial crisis, stock returns were relatively more sensitive to leverage ratio than the CAR. They study the impact of various levels of capital – such as Basel’s total CAR, Tier 1 capital ratio, Tier 2 capital ratio, common equity ratio and leverage ratio – on the stock returns. For analysis of panel data, the study tests an empirical model on 381 conventional banks in 12 economies during the period Q1 of 2005 to Q1 of 2009. All banks are from advanced economies. In their model, taking banks’ stock returns as dependent variable, where independent variables include bank capital, bank-specific variables (such as P/E ratio, loan loss provisions, liquid assets, total deposits, net loans etc.) and some dummy variables.

Another significant study on this subject was performed by (Haldane, 2012) of Bank of England who made a comparison of the performance of two measures of capital in predicting bank failure using logit regression and proportional hazard model using US bank data, namely Tier 1 regulatory capital ratios and simple leverage ratio. The study finds that Leverage Ratio is better predictor of bank distress for large banks, whereas for small regional banks, Tier 1 shows more robust results.

(Blundell-wignall & Atkinson, 2010) compare the write-downs and credit losses from banks in OECD countries (excluding US) during the financial crisis (accumulated from January 2007 until mid-2009) in reference to two measures: a) Tier 1 capital ratios; and b) leverage ratio (Common equity/total assets). Their comparison found that higher Tier 1 ratio was closely associated with bigger losses of these banks on a cumulated basis during the crisis. On the contrary, they found that simple leverage ratio has an inverse relationship with the losses experienced by the banks during the financial crisis of 2007-08. Thus, they argue, that leverage ratio is a better measure of gauging the potential credit risk a bank could experience in distressed market conditions.

Similarly, (Blundell-Wignall & Caroline Roulet, 2013) study models on the distance-to-default and conduct a multivariate regression analysis of a panel of 94 banks over a period 2004-2011. They compare Basel Tier 1 ratio with the leverage ratio in order to identify which measure is better predictor of time to default. They control the data for each bank's market beta which included housing prices, size, leverage, trading assets, wholesale funding and cross border revenue. Overall, the study found that leverage ratio is much better predictor of default risk than the Tier 1 capital ratio.

For Islamic banks, the studies on this subject have been quite limited. (Čihák & Hesse, 2010) compared the relative strength of Islamic and conventional banks used z-score as a measure of bank soundness. Z-score. They empirically test the data from 77 Islamic bank and 397 conventional banks from 18 jurisdictions for 1993-2004 period. Along with using basic financial ratios, to control for asset size, composition of assets, cost efficiency, market concentration as well as macroeconomic cycles, they add several variables in the model such as: asset size, loan to assets ratio, cost to income ratio, Herfindahl index, GDP growth, inflation rate and currency depreciation. Their results showed that small Islamic banks have stronger performance than their peers, whereas for large Islamic banks, their conventional peers are financially stronger. Similarly, smaller Islamic banks are more stronger financially from the large Islamic banks due possibly to the credit risk management weaknesses in the large banks.

(Pappas *et al.*, 2016) studied the hazard of failure in Islamic and conventional commercial banks using non-parametric Kaplan-Mier estimator as well as Cox proportional hazard model. The study took sample of 421 banks in the Middle East, Africa and Asia between 1995 to 2010 with 106 Islamic banks and 315

conventional banks. Using a range of accounting ratios and macroeconomic variables, the paper observed that higher leverage increases the failure risk of conventional banks whereas the effect is instead favourable for Islamic banks. At macroeconomic level, a relevant finding for policymakers is that failure risk is more strongly driven by macroeconomic factors such as inflation for Islamic banks. Their analysis also suggests that Islamic banks have lower failure risk and are less interconnected which reduces the likelihood of domestic co-failure.

In last three years, however, quite a number of papers have been published using different prediction models of Islamic banks, sometimes in comparison with conventional banks. The summary of these studies is provided in the Table below.

The publication of above literature on the resilience of Islamic banking and prediction models for distress is quite valuable for understanding the dynamics of this fast-growing industry. A common factor that can be noticed in these papers is the use of various alternative ratios complementing the CAMEL framework, though last element sensitivity against market risk (S) has not been studied by most studies. Since outright failures of Islamic banks failures are quite limited, most studies don't have any distressed bank in their sample data. Similarly, only a few studies have taken a global data of Islamic banks and instead selected a sample at their national level only. It can be also observed that no study has used market-based indicators such as market leverage in the model. The use of macroeconomic variables is also limited to a few papers. Most importantly, no study has covered the impact of alternative capital ratios proposed by Basel III or other significant studies on this subject and their possible implications on the regulation and supervision of Islamic banks.

### 3. MODEL FORMULATION AND DATA

#### 3.1. Research Objective and Methodology

Key objective of this paper is to study the effectiveness of capital ratios and other parameters in predicting distress in Islamic banks. In order to study the robustness of various capital and leverage ratios as other stability indicators, this paper will use logit survival model and test the predictive power of various ratios for the failure of Islamic banks. A number of studies cited in this dissertation have used this technique such as (Aliyu & Yusof, 2017; Estrella *et al.*,

**Table 1: Overview of Literature on Failure/Distress in Islamic Banks**

Authors	Model	Period	# of Banks	Failed/ Distressed Banks	Region	Variables Used	Macroeconomic Variables	Key Results
(Pappas <i>et al.</i> , 2016)	Logit & Hazard Model	1995-2010	106 Islamic 315 Conventional	8 Islamic 89 Conventional	18 Muslim Countries	24	GDP growth, Inflation, FX depreciation, bank concentration, Islamic banking share, sovereign rating	Higher leverage and higher liquidity decrease failure risk in sample banks.
(Budiman, Herwany, & Kristanti, 2017)	Z-score	2011-2015	11 Islamic banks	Nil	Indonesia	6	NIL	No distress in any bank.
(Sapuan, Bakar, & Ramlan, 2017)	Neural Network	2005-2014	16 Islamic banks	Nil	Malaysia	3	NIL	Credit risk is the main predictor of distress.
(Halteh, Kumar, & Gepp, 2018)	Stochastic Model, Altman Z-Score	2014	101 Islamic banks	Nil	Islamic Countries	18	NIL	Working Capital/Total Assets and Return on Revenue are the most significant predictors of distress.
(Kumar & Sayani, 2015)	Z-score	2008-2014	11 Listed Islamic Banks	Nil	5 GCC Countries	7	NIL	All sample banks were resilient. Earning ability remains a challenge.
(Aliyu & Yusof, 2017)	Logit & Hazard Model	1987-2014	170 Islamic Banks	28 Banks	24 mainly Muslim Countries	12	Inflation, GDP per capita.	Capital, managerial efficiency and liquidity are the major determinants.
(Abdul Rahman & Masngut, 2014)	Neural Network	2006-2010	17 Islamic banks	Nil	Malaysia	6	NIL	All sample banks were resilient
(Khan, 2016)	Altman Z-Score, O-Score, Logit	2009-2015	40 Listed Financial Firms	20 Firms	Pakistan	10	NIL	Logit model is most effective. Retained earnings, profitability and liquidity (current liabilities) are key determinants of distress.
(Anwar & Ali, 2018)	Artificial Neural Networks	Jan 2013-Feb 2015	1 bank (Bank Syariah Mandiri)	Nil	Indonesia	14	Exchange rate, inflation rate, interest rate	11 out of 14 variables are significant.
(Laila & Widihadnanto, 2017)	Altman Z-Score	2011-2014	4 Islamic, 10 Conventional Banks	Nil	Indonesia	6	NIL	The model equally robust for both conventional and Islamic banks.
(Wanke, Azad, & Barros, 2016)	Dynamic Slacks Based Model	2009-2013	27 Conventional Banks, 16 Islamic Banks	Nil	Malaysia	6	NI	Higher inefficiency levels and slacks in Islamic banks than the conventional ones.



2000; Haldane, 2012; Khan, 2016; Pappas *et al.*, 2016). The purpose is to use the identified significant indicators as early warning signal for taking timely corrective action so that possibility of complete failure of the bank can be avoided and interest of depositors, investment account holders and other stakeholders can be safeguarded.

Logistic (or logit) regression is used for analysing a data set in which one or more explanatory variables determine the outcome which is measured as a dichotomous variable i.e. where there are only two possible outcomes. Thus, it offers a best fit model to describe the relationship between the dichotomous variable of interest and as set of independent variables. In this way, it generates the coefficients of formula to predict a logistic transformation of the probability of presence of dichotomous variable of interest. Unlike the ordinary regression, where objective is to find parameters that minimise standard (sum of squared) errors, logit regression estimates find parameters that maximize the likelihood of observing the sample values.

A logit regression expression can be stated as:

$$\text{logit}(p) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_i X_i$$

where p is the probability of presence of the interest variable.

The logit transformation can be defined as logged odds:

Odds =  $p/(1-p)$  i.e. probability of the presence of interest variable / probability of the absence of interest variable.

Thus, logit expression can be mentioned as:

$$\text{logit}(p) = \ln(p/(1-p)) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_i X_i$$

The starting hypothesis will be that distress in Islamic banks can be correctly predicted using CAMELS indicators as predictors in a logit regression model.

$$D = \beta_0 + \beta_C X_C + \beta_A X_A + \beta_M X_M + \beta_E X_E + \beta_L X_L + \beta_S X_S + u$$

Where D denotes bank distress or failure, and explanatory variable X refers to respective CAMELS indicators as explained in the Table below.

It is worth mentioning that almost none of the literature referred in section 2.4 and 2.5 has covered the last component related to S. In this paper, this indicator has been included and defined as: total securities to total assets.

It is expected that decline in capital, earning and liquidity measures will result in potential financial distress in the bank, hence a negative sign is expected. Similarly, increase in NPF, management cost and sensitivity indicators will be an indication of potential difficulties, leading to a positive sign.

In order to test the logit model, defining the criteria for bank distress is important. As stated in the earlier section, absolute failure of Islamic banks is rare. In the advanced economies, failure of small to mid-sized banks is not a major event since small depositors are taken care of by the deposit insurance providers and failure of weaker bank is considered beneficial in the wider interest of competitiveness and market economy. In the emerging markets, on the other hand, regulatory

**Table 2: The Description of CAMELS Variables**

Explanatory Variable	Description	Formula
C (Capital)	<i>Basel risk-weighted Capital Adequacy ratio</i>	Total capital to total risk weighted assets(RWA)
A (Asset Quality)	<i>Non-Performing Financing (NPF)</i>	NPF to total financing
M (Management)	<i>Efficiency Measure</i>	<i>Cost to Income Ratio =</i> operating costs (administrative and fixed costs, such as salaries and property expenses, but not bad debts that have been written off) divided by operating income
E (Earning)	<i>Income</i>	Net Operating Income (before depreciation) to Assets
L (Liquidity)	<i>Liquid Assets</i>	Investment in securities, cash and placements with other banks to total assets
S (Sensitivity to Market Risk)	<i>Multiple factors, including profit rate risk, commodity risk, equity risk and foreign exchange risk</i>	Rate sensitive liabilities (Securities) to total assets

authorities make an effort to take necessary actions to keep the going concern status of the banks, to the extent possible. Sometimes, stronger banks are encouraged to take over the weaker banks or get merged. Similarly, sometimes governments and regulators intervene to rescue the failing banks by putting deposits, changing bank management or putting temporarily under supervisor's control. Therefore, it is in order to use the criteria of bank distress adopted by (Haldane, 2012; Pappas *et al.*, 2016) for considering a bank in distress: An Islamic banks is considered in distress if any of the following criteria is met:

- i. negative net worth;
- ii. has gone into bankruptcy, dissolution or liquidation;
- iii. has been put under supervisor's control or has required government's financial support; and
- iv. acquisition by another bank or merger into another bank.

In addition, two more criteria are added related to capital adequacy ratio of sample Islamic banks:

- v. risk-weighted capital adequacy is below minimum requirement of 10%; and
- vi. tier 1 capital is less than 8%.

These two ratios are added in consideration of the fact that regulators in many sample countries, especially in GCC, require their banks to follow relatively higher capital adequacy ratios than those suggested by the BCBS. A low CAR is also a reflection of bank's impending problems related to management, asset quality, liquidity, profitability or other key dimensions of its operations.

### 3.2. Additional Supervisory Parameters and Macroeconomic Variables

In section 2.1 and 2.2, the paper referred to the evolution of supervisory parameters for bank regulation and the importance given to two primary ratios in Basel III framework, namely risk weighted CAR and non-risk weighted leverage ratio. In addition to these two primary measures, some other literature have suggested a number of other indicators which, in their analysis, are better measures of gauging bank strength and predicting bank distress more effectively. These ratios include:

- Gross Revenue Ratio: (Estrella *et al.*, 2000) suggested the use of this ratio much earlier than the financial crisis. Taking a data of bank failures in US for five years (1988-1992), the paper found this ratio equally robust in predicting bank distress as risk weighted CAR, though the former is simpler, easy to calculate from financial reports and cheaper to supervise. Moreover, since this ratio is less correlated with other regulatory ratios on capital, it offers less room for regulatory arbitrage by the banks. This ratio is, however, risk sensitive only to the extent that riskier projects will have higher expected revenues. The shortcoming of this ratio is that banks involved in fee-based activities will have higher gross revenues. The ratio is also more closely linked to business cycles than the CAR.
- Tangible common equity ratio (TCE): (Buehler *et al.*, 2010) found this ratio more effective in predicting bank distress than other capital ratios, including leverage ratio. Since TCE deducts goodwill, preferred shares, and other intangibles from shareholders' equity, this ratio offers a stringent measure than Tier 1 capital because the latter includes the intangibles. Similarly, this ratio ensures that equity capital is available to absorb losses even that bank is not a going concern since bank have an option to either not make dividend payments entirely or to defer them until a later date.
- Tier 1 ratio: (Haldane, 2012; Merrouche *et al.*, 2010) has tested this ratio, along with CAR and found it equally affective in measuring bank strength.
- Base Risk Weight: (Kellermann & Schlag, 2013) studied the relative effectiveness of CAR and leverage ratio for Swiss banks and found that application of these two ratios simultaneously, as proposed by BCBS, could motivate the banks to take higher risk as leverage ratio becomes a "binding capital requirement". Therefore, they suggest the introduction of this new ratio that is calculated as risk weighted assets to total on- and off-balance sheet assets. The paper highlights that proposed ratio helps resolve this unintended consequence of applying both ratios at a time, is simple to calculate and maintains the risk sensitivity element.

In addition to these six alternative capital ratios, the study will also consider three other leverage ratios:

**Table 3: The Definitions of Alternative Capital and Leverage Ratios**

	Capital/Leverage Ratio	Definition
1	Basel Tier 1 ratio	Tier 1 capital to total RWA
2	Tangible common equity ratio	Shareholders equity, less goodwill, and other intangibles to RWA
3	Book leverage ratio	1- (book value of equity / book value of assets)
4	Basel leverage ratio	Tier 1 Capital to Exposure (on balance sheet + off balance sheet)
5	Market leverage ratio	1- (market value of equity (=number of shares * end of year stock price) / market value of bank (=market value of equity + book value of liabilities)
6	Islamic banking leverage ratio	1- [(book value of equity + book value of PSIA) / book value of assets]
7	Gross revenue ratio	Tier 1 Capital to (total financing, non-financing income and fee based income before the deduction of any expenses).
8	Base risk weight ratio	RWA to Total Exposure (on balance sheet + off balance sheet)

book leverage, market leverage and a newly proposed ratio called 'Islamic banking leverage'. Book leverage is based on accounting data and serves similar purpose as Basel leverage ratio, though it does not include off-balance sheet items. Market leverage, on the other hand, relies on stock market information and therefore can be only investigated for publicly listed banks. Due to its very nature, it is considered forward looking (Barclay, Morellec, and Smith, 2006) and has more managerial importance (Welch, 2004). The paper also adopts definition of 'Islamic banking leverage' from (Khokher & Alhabshi, 2018) which considers the contractual feature of PSIA offered by Islamic banks according to which these account holders are expected to share the losses incurred on the assets funded by them. If this expectation is true, PSIA should be considered part of the equity and definition of leverage to be modified accordingly.

Based on the aforementioned alternative definitions of capital and leverage, the previous model will be tested by changing CAR with following ratios with the hypothesis that there no differences in the ability of logit model to predict Islamic bank distress using alternative capital adequacy ratios. A variety of capital ratio will help suggest whether simpler ratios perform better than more complex, risk weighted measures in predicting distress in Islamic banks as suggested by (Haldane, 2012).

Finally, three macroeconomic variables: GDP growth, current account and credit (credit-to-GDP ratio) will be added to model as suggested by (Haldane, 2012) with the hypothesis that there is no difference in the ability of logit model to predict Islamic bank distress with additional macroeconomic variables.

### 3.3. Description of Data

This study takes a panel of 65 Islamic banks from 13 countries between 2008-2017, representing all the key regions where Islamic banking is being offered, that includes: Bahrain, Egypt, Jordan, Kuwait, Palestine, Qatar, Saudi Arabia and UAE in the Middle East and North Africa region; Bangladesh and Pakistan from South Asia; Indonesia and Malaysia from Southeast Asia and Turkey from Europe. The sample includes 34 Islamic banks that are publicly listed whereas remaining are unlisted. A large ratio of publicly traded Islamic banks will help to study the impact of market-based leverage indicator. This study focuses on Islamic commercial banks that are either full-fledged banks or independent subsidiaries of conventional banks. Thus, Islamic investment banks and Islamic windows of conventional banks are excluded due to the nature of data required for analysis purposes.

Data for the calculation of market leverage, book leverage, market value of equity, market value of assets, Basel CAR, asset quality, earnings, tangible

**Table 4: The Definitions of Alternative Capital and Leverage Ratio**

1	GDP	Gross Domestic Product Growth
2	Current account	Sum of the balance of trade (goods and services export less imports), net income from abroad and net current transfers
3	Credit	Total credit to the private non-financial sector

common equity, Basel Tier 1 ratio and gross revenue ratio for listed Islamic banks were mostly extracted from Thomson Reuters' DataStream and other missing information were gathered from Fitch Connect and annual reports of the Islamic banks directly. However, the calculation of the above-mentioned indicators for non-listed banks were mainly based on data from Thomson Reuters' Eikon and complemented with data from Fitch Connect and individual financial reports. To calculate Islamic banking leverage, data for total unrestricted PSIA were mainly taken from annual reports and published financial statements of Islamic banks. Off balance sheet items were mainly taken from Fitch Connect and annual reports. Moreover, data for economic indicators such as GDP growth and current account were taken from the World Bank's World Development Indicators and Fitch Connect. On the other hand, total credit to the private non-financial sector data were taken from the Bank for International Settlements.

#### 4. EMPIRICAL ANALYSIS

This paper uses trans-national panel data from some of the selected countries. Based on the table, the highest number of Islamic banks is from Malaysia (15 banks), followed by Bahrain (7), Indonesia (6) and UAE (6). Out of 65 banks, 8 banks are considered distressed banks based on the criteria defined in the previous section.

Descriptive statistics of the variables used in the analysis shows that mean capital adequacy is much

higher (19.64%) than the regulatory capital requirement of 8% or 10%, though with high dispersion. Mean earning is modest whereas liquidity is generally ample. Mean Tier 1 capital and tangible common equity ratios are close to overall CAR, showing the reliance of Islamic banks on more equity than debt. It is in contrast to large conventional banks, where most of the capital is raised through debt based, Tier 2, instruments as reported by (Acharya *et al.*, 2011).

While multicollinearity is one of the main issues in panel data analysis, Variance Inflation Factors (VIF) and pairwise correlation is undertaken to check the presence of multicollinearity. According to (O'Brien, 2007), the VIF value should not exceed 10, however, in this case the maximum VIF is 1.48 for GDP growth. Similarly, the pairwise correlation reported in Table below also shows that there is no presence of multicollinearity as the value of pairwise correlation does not exceed 0.80 (Kennedy, 2008). Hence, the analysis are free from multicollinearity issue.

Based on the first hypothesis, the study estimated a logit model by incorporating bank distress (dependent variable) and CAMELS indicators (independent variables) to examine whether these indicators could correctly predict the failure/ distress of Islamic banks. To evaluate the goodness-of-fit of logistic models, pseudo  $R^2$  is used in line with other studies on logit regression. In addition, to understand the overall fitness of the model, the study referred to likelihood ratio (LR)  $\chi^2$  test. Based on the overall results, the model fitness is good as  $\chi^2$  is found to be significant at 1%

**Table 5: List of Countries and Bank Description**

Country	Number of Banks	Listed Bank	Non-listed Bank	Distressed Banks
Bahrain	7	5	2	0
Bangladesh	4	4	0	2
Egypt	3	2	1	0
Indonesia	7	1	6	1
Jordan	2	1	1	0
Kuwait	4	4	0	0
Malaysia	15	1	14	3
Pakistan	4	2	2	1
Palestine	1	1	0	0
Qatar	4	3	1	0
Saudi	4	4	0	0
Turkey	4	1	3	1
UAE	6	5	1	0
Total	65	34	31	8

**Table 7: Variance Inflation Factors**

Variable	VIF	SQRT VIF	Tolerance	R-Squared
C	1.0500	1.0300	0.9495	0.0505
A	1.0500	1.0200	0.9538	0.0462
M	1.0900	1.0400	0.9214	0.0786
E	1.0800	1.0400	0.9262	0.0738
L	1.3400	1.1600	0.7452	0.2548
S	1.4500	1.2100	0.6885	0.3115
GDP	1.1400	1.0700	0.8738	0.1262
CA	1.4800	1.2100	0.6778	0.3222
CREDIT	1.2900	1.1400	0.7745	0.2255
Mean VIF	1.2200			

**Table 8: Pairwise Correlation among main Independent Variables**

	C	A	M	E	L	S	GDP	CA	CREDIT
C	1								
A	-0.0043	1							
M	0.0557	0.0699	1						
E	-0.0031	-0.1418	-0.1101	1					
L	-0.0189	0.1324	-0.0377	-0.0462	1				
S	-0.0154	0.0878	-0.0165	-0.0589	0.2638	1			
GDP	-0.0148	0.0152	-0.0352	0.0638	0.0198	-0.0005	1		
CA	0.1806	-0.1248	-0.0014	-0.0992	-0.1178	-0.0021	0.2568	1	
CREDIT	-0.0197	0.0961	-0.1418	-0.1027	0.1365	-0.0156	-0.2431	-0.3936	1

level and the Pseudo R<sup>2</sup> is 31%. For this model the total number of observations is 622.

The results exhibit that out of six potential determinants as per CAMELS framework, four indicators Basel CAR (C), management efficiency (M), liquidity (L) and sensitivity to risk (S) are significant. All the significant indicators have expected signs. The high coefficient of C shows its strong predictive power on the log-odds of Islamic bank distress.

After estimating the logit regression, the study also estimated conventional goodness of fit test to check the robustness of the results. In line with this, the study estimated Hosmer-Lemeshow Chi<sup>2</sup> and Pearson Chi<sup>2</sup>, and their results are reported in the table below. As highlighted by (Abduh, 2014), Hosmer-Lemeshow test serves similar purpose as F-test in ANOVA, and measures overall goodness of fit for the overall model. Both these tests suggested that the findings of the logit models are robust since the study found both the Hosmer-Lemeshow Chi<sup>2</sup> and Pearson Chi<sup>2</sup> are statistically significant at 5% and 1% levels respectively.

**Table 9: Predicting Islamic Bank Distress Using CAMELS Indicators**

	Dependent Variable: D
C	-33.2446*** (7.9484)
A	-4.2079 (6.5835)
M	0.8095 <sup>^</sup> (0.4310)
E	-0.5644 (7.5515)
L	-3.5407 <sup>^</sup> (1.8246)
S	0.0241*** (0.0084)
Cons	1.5707 (1.1356)
N	622
chi <sup>2</sup>	61.8800***
Pseudo R <sup>2</sup>	0.3144

<sup>^</sup> p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01.

Equation: D = β<sub>0</sub> + β<sub>C</sub>X<sub>C</sub> + β<sub>A</sub>X<sub>A</sub> + β<sub>M</sub>X<sub>M</sub> + β<sub>E</sub>X<sub>E</sub> + β<sub>L</sub>X<sub>L</sub> + β<sub>S</sub>X<sub>S</sub> + u.

**Table 10: Goodness of Fit Test**

Number of observations	622
Number of groups	10
Hosmer-Lemeshow chi <sup>2</sup>	18.17**
Pearson chi <sup>2</sup>	948.96***

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

The study further tests the sample predictive power for the estimated model by using the linear prediction technique is used with a cut-off point at 50% similar with the previous study of (Mayes & Stremmel, 2012). All predictions with a value over 50% are considered as correctly predicting failures. Based on the results reported below, we can classify 97% of distress in Islamic banks correctly based on logit technique used in the study. Since the estimated model did not detected any bank failure, hence the study has sufficient confidence that there are no type II errors.

**Table 11: Prediction Accuracy (Logit Model)**

Bank Distress	
Correctly Detected	Falsely Detected
97.27%	-

In the next part, the paper focuses on the significance of alternative capital ratios hypothesising that there are no differences in the ability of alternative capital and leverage indicators to predict Islamic bank distress. These variables are: Basel tier 1 ratio (TIER1CAPITAL), tangible common equity ratio (TANGIBLE), book leverage ratio (Lb), Basel leverage ratio (Bl), market leverage ratio (Lm), Islamic banking leverage ratio (Li), gross revenue ratio (GROSSREV) and Base risk weight ratio (RISKWEIGHT). Each of these variables are separately included in the regression along with CAMELS (except C) and reported in the Table below. It can be observed that the overall fitness of the models is pretty good as the Chi<sup>2</sup> is significant for all the models at 1% level. The Pseudo R<sup>2</sup> is highest when market leverage is used as capital indicator followed by Tier 1 capital and tangible common equity ratios. In all three cases, Pseudo R<sup>2</sup> is higher than the base model with Basel CAR taken as capital ratio. These three capital indicators also significant and negatively signed as expected. The significance of market leverage shows that market based indicators are relevant for studying the robustness in Islamic banks and predicting their distress, which has not been considered in past studies on Islamic banks.

For other indicators, liquidity and sensitivity to risk are significant in all the models tested which shows the importance of these two determinants in bank distress. More importantly, the coefficient of liquidity is quite high, especially for market leverage specification, which shows that along with capital ratio, problems in liquidity are the major factor that be linked to bank distress. This is plausible since Islamic banks continued to be plagued by the low supply of high quality Shari'ah complaint liquid assets, with lack of secondary markets and lender of last resort facilities by the central banks. (IFSB, 2016; Said, 2011).

Another significant finding of this result is that Basel leverage ratio is not significant, which is in contrast to several studies undertaken for larges sized conventional banks, some of which are quoted in the literature review section. Nevertheless, the results are consistent with the findings of (Haldane, 2012) who found that leverage ratio is not significant for small sized, inter-state banks in US whereas it is significant for large, internationally active US banks. As Islamic banks are generally small and operate at local or regional level, this result is consistent. Similar, is the case of book leverage and Islamic banking leverage indicators. From these results, we can draw the conclusion that simpler, accounting based ratios are not relevant for predicting bank distress in Islamic banks. One possible explanation could be that the leverage in Islamic banks is generally lower than conventional banks, whereas the limit prescribed by the Basel leverage ratio was mainly based on lower common equity in the capital of large conventional banks. Similarly, since Islamic banks have low Tier 2 based debt capital, in practical sense, CAR, Tier 1 ratio and tangible common equity are not drastically different with each other.

After using these alternative capital adequacy ratios in the logit models, the study then checks their robustness by conducting several robustness checks as performed in the previous tables. It was found that Hosmer-Lemeshow chi<sup>2</sup> and Pearson Chi<sup>2</sup> are both significant for Tier 1 capital, tangible common equity and book leverage. A somewhat surprising result is experienced for market leverage, which is not significant in either of the tests.

While checking for prediction accuracy, the results seem promising. None of the models was falsely detected; similarly, above 96% of the models are correctly specified based on the relevant test reported in the table below.

Table 12: Predict Islamic Bank Distress Using Alternative Capital Adequacy Ratios

		Dependent Variable: D						
TIER1CAPITAL	-30.2574*** (5.6503)							
TANGIBLE		-25.8733*** (6.5192)						
Lb			6.3404 (4.5512)					
BI				-0.0109 (0.1445)				
Lm					-10.6318*** (4.1064)			
Li						1.9658 (1.5659)		
GROSSREV							-0.1188 (0.0966)	
RISKWEIGHT								-0.0037 (0.0144)
A	-13.0613 (8.0876)	-17.6544** (8.2632)	-7.7559 (6.5924)	-7.9447 (6.5635)	-5.4559 (12.7195)	-5.5272 (6.6997)	-10.0665 (7.3848)	-8.1014 (6.6016)
M	0.9935** (0.4808)	0.7058 (0.5338)	0.2845 (0.3978)	0.0461 (0.3224)	0.0249 (0.7910)	0.1676 (0.3168)	0.1362 (0.4234)	0.0475 (0.3203)
E	1.1566 (7.4979)	-2.2492 (7.4185)	-4.2434 (8.8719)	-6.2312 (9.4367)	-0.6629 (23.4064)	-0.3114 (9.0485)	-17.0774 (11.2207)	-6.2841 (9.4418)
L	-4.0025** (1.8617)	-4.0127** (1.9075)	-5.6682*** (1.8638)	-5.3909*** (1.8606)	-12.1619*** (4.3494)	-4.9860*** (1.8975)	-4.8332** (2.0323)	-5.3764*** (1.8560)
S	0.0320*** (0.0077)	0.0317*** (0.0085)	0.0326*** (0.0072)	0.0353*** (0.0071)	0.0675*** (0.0176)	0.0352*** (0.0079)	0.0428*** (0.0082)	0.0353*** (0.0071)
CONS	0.2292 (0.6676)	0.4725 (0.7952)	-8.1796* (4.2594)	-2.3964*** (0.5276)	-0.4174 (1.0661)	-4.3631*** (1.5311)	-2.3058*** (0.6394)	-2.3862*** (0.5285)
N	624	607	625	625	344	608	592	625
Chi <sup>2</sup>	69.7400***	62.07***	36.20***	33.52***	63.86***	35.95***	38.84***	33.64***
Pseudo R <sup>2</sup>	0.3540	0.3281	0.1837	0.1701	0.5770	0.1837	0.2221	0.1707

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01.

Table 13: Goodness of Fit Test (Various Capital Adequacy Measures)

Capital Adequacy	TIER1CAPITAL	TANGIBLE	Lb	BI	Lm	Li	RGROSSREV	RISKWEIGHT
Number of observations	624	607	625	625	344	608	592	625
Number of groups	10	10	10	10	10	10	10	10
Hosmer-Lemeshow chi <sup>2</sup>	23.20***	20.41***	17.03***	9.31	0.94	10.62	6.80	13.60*
Pearson chi <sup>2</sup>	1495.10**	1199.46***	886.36***	655.00	107.43	635.08	687.05***	652.29

**Table 14: Prediction Accuracy (Various Capital Adequacy Measures)**

Capital Adequacy	Bank Distress	
	Correctly Detected	Falsely Detected
TIER1CAPITAL	97.12%	-
TANGIBLE	96.87%	-
Lb	96.32%	-
Bl	96.32%	-
Lm	97.97%	-
Li	96.22%	-
RGROSSREV	97.47%	-
RISKWEIGHT	96.32%	-

As a final test, three macroeconomic variables, GDP growth (GDP), current account (CA) and credit (credit-to-GDP ratio) (CREDIT) are also included in the base model to examine the Islamic bank distress. Overall fitness of the model is relatively good as well as the pseudo  $R^2$  is also reasonable. However, after adding these macroeconomic variables, the study only found that current account and GDP growth are statistically significant and have negative effect on Islamic bank distress, all other base variables except capital adequacy ratio lose their significance.

The goodness of fit test reported in the table below does not seem to be promising as both of the tests showed insignificant result. However, the prediction accuracy still remains high, above 97% reported in the table.

**Table 15: Goodness of Fit Test**

Number of observations	279
Number of groups	10
Hosmer-Lemeshow chi2	2.86
Pearson chi <sup>2</sup>	62.25

**Table 16: Prediction Accuracy (Logit Model)**

Bank Distress	
Correctly Detected	Falsely Detected
97.13%	-

## 5. CONCLUSION AND POLICY IMPLICATIONS

This study uses the data of 65 Islamic banks from 13 key Islamic finance markets, with listed and non-

listed banks roughly divided equally. The paper tests six key CAMELS determinants of bank distress in logit regression model, along with eight alternative capital ratios and three macroeconomic variables.

The results of this study are significant from many perspectives and extend the literature on bank distress in emerging markets and Islamic finance in several ways: First, the result delineate that most of the standard CAMELS indicators are relevant for studying distress in Islamic banks. More specifically, risk weighted capital adequacy ratio is significant in analysing resilience in Islamic banks. Second, management quality, liquidity and sensitivity of assets have a clearly identifiable influence. The strong evidence of liquidity on distress in Islamic banks was clearly visible. Similarly, for the first time in any such study on Islamic banks, the findings of this paper show that sixth component of CAMELS, sensitivity to risk is a significant factor and should be considered. Third, based on extensive literature review, eight other alternative ratios are tested, which showed that apart from standard CAR, three other capital ratios are also effective in studying Islamic bank failures. Fourth, market-based leverage, which is tested for the first time in Islamic banking distress literature according to our knowledge, is significant. Fifth, this paper also offers insights on the ongoing debate on the implementation of Basel III leverage ratio on Islamic banks. The results showed that this ratio does not give useful early warning signals for problems in Islamic banks, as probably their leverage is quite low. Finally, it is shown that among the macroeconomic variables, GDP and credit growth exhibit a significant influence, though goodness of fit of this model is not high. Thus, it can be suggested that the base CAMELS models is quite



significant and offer reliable signals without the addition of macroeconomic variables.

With the increasing size, significance and international expansion of Islamic banks, the stability of individual banks and the financial systems in which they operate is gaining global attention. The “systemically important” market share of this sector in over a dozen important jurisdictions, as stated by the IMF and IFSB in their latest reports ((IFSB, 2016; IMF, 2017; International Monetary Fund, 2018) and the inclusion of this sector in the global financial sector surveillance programme signifies that the development and refinement of early warning parameters for predicting distress in these banks will play a key role not only for bank regulators but also for deposit insurance providers who perform the role of the resolution authority. These findings are also important for governments, policy makers and capital market regulators as liquidity is found to be significant predictor of Islamic bank failure. With the severe shortcomings in liquidity management infrastructure and liquidity support tools available to central banks for Shari’ah compliant banks require a collective effort by key industry stakeholders, including Shari’ah scholars for offering innovative solutions. In this regard, the role of International Islamic Liquidity Management Corporation (IILM) based on Kuala Lumpur needs to be expanded to a wider level from its existing 10 jurisdictions. Similarly, new liquidity requirements proposed by Basel III, called Liquidity Coverage Ratio and Net Stable Funding Ratio can only be effectively implemented by Islamic banks if the aforementioned bottlenecks are resolved. This is also a lesson from the global financial crisis that it is not merely the capital, but liquidity which results in the distress and ultimate bankruptcy of the banks.

The study can be further expanded in several ways. As the objective of this study was to test market leverage, the focus was given to those jurisdictions where consistent market-based data was available. The selection of non-listed banks was also chosen from the same markets. However, there is a room for further extending the data from more jurisdictions. More macroeconomic indicators such as inflation, exchange rate can also be tested in this model. More market-based data such as earning volatility, stock prices can offer additional insights on the distress prediction of listed Islamic banks. Finally, apart from using logit regression, other estimation techniques such as hazard models and neural networks can offer valuable insights.

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