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Abstract

Research shows the importance of social networks in the generation of valuable firm resources through informational flows. We extend this conceptualization to Shariah governance and the global Shariah elite as embodied by the Shariah supervisory board. Utilizing a unique dataset of 140 Islamic financial institutions over 2011-2015, across 16 nations, we find that interlocking behavior amongst Shariah supervisory boards is time-invariant and network proximity has an inverted U-shaped curvilinear impact on the performance of Islamic financial institutions. Our findings extend the academic literature on SSB interlocking behavior by disentangling the impact of network proximity on the Shariah governance-firm performance nexus.

Keywords: social networks; Shariah supervisory board; Islamic banking and finance; Shariah governance; global Shariah elite; corporate governance

1. Introduction

The Islamic financial system has experienced substantial growth over the past several decades and has demonstrated robust performance over periods of exogenous shocks (Aliyu, Hassan, Mohd Yusof, & Naiimi, 2017; Hassan & Aliyu, 2018; Ibrahim & Rizvi, 2018; Narayan & Phan, 2019). Much of the existing literature (Farag, Mallin, & Ow-Yong, 2018; Mollah, Hassan, Al Farooque, & Mobarek, 2017; Mollah & Zaman, 2015) attributes this robust performance to Shariah governance as embodied by a collective of Shariah scholars known as the Shariah supervisory board (SSB). However, whilst studies into SSBs are growing, what is still relatively unclear is the contribution of the SSB and their individual religious scholars to this governance and Islamic financial institution (IFI) performance nexus (Mallin, Farag, & Ow-Yong, 2014; Narayan & Phan, 2019; Nawaz, 2019). Moreover, a *priori* conceptualizations of the role of SSBs are limited, and as such, much of extant empirical studies draw heavily from the conventional literature.

In this light, given that there is increasing evidence within the conventional socio-economic sciences (Mingo, Morales, & Dau, 2018; Riccaboni, Wang, & Zhu, 2020; Tao, Li, Wu, Zhang, & Zhu, 2019; Zhang, Lu, & Zheng, 2020) of the importance and the influence of social interactions on economic behavior, one avenue of exploration is the social network links of SSBs as the key contributor to IFI outperformance (Gözübüyük, Kock, & Ünal, 2018). The concept of social networks within this context relates to the cross-firm relationships and links manifested by the presence of similar Shariah scholars on the religious boards of different IFIs. The Shariah-scholars, by virtue of being on multiple SSBs, then propagate connections between various IFIs thus creating a network of firms manifesting an impact on firm performance via informational transfers (Bassens, Derudder, & Witlox, 2012; Pollard & Samers, 2013). However, we can be more sophisticated in our conception and examination of social networks within an SSB and IFI setting, and extend the definition of a social network to not only include direct links between IFIs but also investigate proximity to highly connected

IFIs (Gözübüyük et al., 2018). The development of sociometric measures have allowed for greater delineation and disentanglement of social network structures along these lines. This rethink about the fundamental role of the SSBs has refocused the studies about the characterizations of the SSB with interlocking behavior and network ties being a core area for further development and discourse.

As a first in the extant empirical literature, Gözübüyük et al. (2018) show that direct links amongst SSBs within a social network structure result in poorer IFI performance providing some support for the busy board hypothesis within the Shariah governance framework (Zona, Gomez-Mejia, & Withers, 2018). The findings from Gözübüyük et al. (2018) further highlight the density of the SSB network structure with the dominance of a small group of Shariah scholars within IFIs – the global Shariah elite. However, the reality of the situation is much more complicated. Social network structures can vary and positioning within the structure can also impact the ability of SSBs to convey resources to the hiring firm. In other words, within a dense SSB network where the expertise and knowledge are concentrated within a small group of Shariah scholars, there is importance in disentangling the impact of these informational flows through proximity to this small, but important group, on IFI performance (Borgatti, 2005; Brandes, Borgatti, & Freeman, 2016). Our study differs from the extant academic literature in that we pursue and extend this line of enquiry through the adoption of economics of sociology paradigm suggesting that the sociological characteristics of firms drive some element of economic rent procurement. We develop the conceptual foundations within the extant literature by utilising a multi-theoretic resource dependence and elite network theorisation of SSB interlocking behaviour. Moreover, we also differentiate our study from Gözübüyük et al. (2018) by extending the conception social networks beyond that of just direct links between SSBs and progress the academic enquiry into network proximity and firm performance.

As such, our central hypothesis not only seeks to examine the interlocking behavior of SSBs over time but also posits that the social connections of SSBs, through scholars within the global Shariah elite, facilitate important channels of informational flow between institutions, which in turn have an impact on IFI performance. More specifically, we focus on the proximity of SSBs within the interlocking structures between IFIs as sources of informational flows thus facilitating some improvement in firm performance (Valente, Coronges, Lakon, & Costenbader, 2008). As our core incremental contribution, we go beyond the extant academic literature (Gözübüyük et al., 2018) and examine the proximity of SSBs within these dense networks. We further test for curvilinear threshold impacts of network proximity on IFI performance thus providing a more granular and detailed analysis. To the best of our knowledge, our study is the first of its kind that adopts this more sophisticated conception of proximity to the global Shariah elite thus providing a richer view of the social network positioning of SSBs further disentangling the source of resource provision. Moreover, IFIs exist within a unique institutional environment for our analysis of informational flows wherein there are regulatory divergences along geo-political dimensions but are still governed within an overarching theological framework creating a paradoxical regulatory and governance landscape (Apaydin, 2018; El-Hawary, Grais, & Iqbal, 2007). In this regard, we follow Ararat, Claessens, and Yurtoglu (2020) and Claessens and Yurtoglu (2013) in moving away from using a singular agency lens in our conception thus better understanding the dynamics corporate governance mechanisms taking place within and amongst different firms, focusing on multi-country, and longitudinal studies.

We achieve this by utilizing a proprietary dataset comprising of a sample of 140 IFIs over the period of 2011-2015, across 16 different countries. From our sociometric measures, we discover, that the number and density of the interlocking behavior of SSBs have increased two-fold over the five-year period and that there is no discernible difference in the network structures for both Shariah-based and Shariah-compliant IFIs and Islamic banks and other IFIs.

Our sociometric analysis confirm prior findings (Bassens, Derudder, & Witlox, 2011; Bassens et al., 2012; Pollard & Samers, 2007, 2013) indicating geographical connections of the largest Islamic financial hubs via a network of interlocking firm-based board memberships by the global Shariah elite

Additionally, utilizing a fixed effects OLS panel estimation method, we discover that network proximity as measured by Closeness has a significant negative curvilinear impact on IFI performance suggesting a diminishment of the benefits of informational transfers beyond a threshold point. Our results indicate that the positive impacts of SSB network proximity invert at approximately 0.11 Closeness or an average node distance of nine. Our findings run contrary and extend the extant academic literature on IFI interlocking behavior (Gözübüyük et al., 2018; Safiullah & Shamsuddin, 2018, 2019) in indicating that network proximity as measured by Closeness centrality has a significant inverted U-shaped curvilinear impact on IFI performance. Our results are robust to numerous tests of sensitivity and endogeneity of estimations.

From a managerial perspective, our findings provide some important policy implications for the leaders of IFIs. Firstly, along with the extant literature, we indicate no benefits from hiring highly connected SSBs. Moreover, our findings allow us to go beyond the existing knowledge and indicate to the managers of IFIs that it is the network proximity of SSBs that yield economic benefits. We argue that this shift in focus from highly connected SSBs to SSB proximity will result in cost-savings that can be channeled towards governance mechanisms to manage the average distance of SSB connections given the existence of its negative curvilinear relationship on firm performance. Additionally, we highlight that the patterns of network structures are relatively time invariant and awareness of these facets can help facilitate decision-making and the building of appropriate governance resources along these lines of network proximity management. In other words, any investment in SSB proximity management can yield long-term benefits. This has broader implications as Islamic finance grows into more traditional financial hubs a more developed understanding of the nuances of Shariah governance has to be developed. Our study allows for greater appreciation of the continued pressures and upheavals of the global political and economic systems as it traverses the period of the Arab spring. As such, our study helps us to gain further theoretically relevant insight into the elements that have to be incorporated into our understanding of the role of the SSBs and Shariah governance.

The paper is organized as follows. The following section provides an overview of the core academic literature on board and SSB interlocks, highlighting the conceptualization of the global Shariah elite and provides a breakdown of the operation of the SSB in the Shariah corporate governance framework. Section 3 offers a description of the data and methodology used within this study whilst section 4 provides a succinct explanation of the findings and subsequent robustness tests. The final section establishes some concluding remarks from the study and puts forward research limitations and further avenues for study.

2. Theoretical Framework

2.1. The role of the Shariah supervisory board – A resource dependence perspective

The academic literature into the interlocking nature of corporate boards is predominately grounded within the socio-economic sciences. It ranges from firm-based studies of organizational behavior to industry-wide examinations on international directorates. The suggestion is that firms adapt their preferences and socio-economic decision-making to the actions of their peers through decision externalities (Chatterjee, Chollet, & Trendel, 2017; Fligstein & McAdam, 2019; Fracassi, 2017; Kim & Cannella, 2008; Renneboog & Zhao, 2011; Zhang et al., 2020).

Within the economic and financial sciences, agency theory as popularized by Ross (1973), Mitnick (1975) and Jensen and Meckling (1976), and Pfeffer and Salancik’s (2003) resource dependence theory dominate the academic landscape in relation to interlocking and social network effects on firm performance. Empirically, there is support for resource dependence theory (RDT) as an explanation of a positive board interlock-firm performance nexus and this pattern persists with examinations of Shariah governance and SSB interlocking behavior (Cheng, Felix, & Zhao, 2019; Fligstein & McAdam, 2019; Fracassi, 2017; Riccaboni et al., 2020; Tao et al., 2019). Fundamentally, under RDT we can think of the board, and in this case the SSB, as a portfolio of resources that a firm is able to construct. From an institutionalist perspective, the firm would then assemble an SSB with a certain set of qualities that it believes would maximize its objectives. In this regard, given the academic support for interlocking directorates as a source of resource that maximizes firm performance, IFIs would then seek Shariah-scholars who accrue some economic benefit from their social-network positioning and status. The resource benefits from this network position and status arise from knowledge acquisition of Shariah scholars through sitting on multiple boards and as they partake in a greater number of religious decision-making process. This can be further delineated as follows.

Early conceptualizations (Mollah & Zaman, 2015) of the SSBs placed them as a supra-entity within the governance structure, above that of even the conventional board of directors. However, there is little evidence of this over-watch role, but rather SSBs reside more as an entity of expertise provision, akin to that of legal lawyers, thus furthering the theoretical conception along a resource dependence lens within the economics sciences (Nawaz & Virk, 2019). Fundamentally, the SSBs facilitate the concept of religious governance through their interface with the conventional boards and such play a substantial role within the overall corporate governance structure of IFIs (Islamic Financial Services Board, 2009; Safieddine, 2009). This interaction with the conventional board involves religious approval of the economic underpinnings of financial transactions and activities undertaken by the IFIs. The approval process involves a screening criterion that decomposes financial activities, instruments and transactions into ‘line-of-business’ and assessing financial ratios (see Ho (2015) for a breakdown of screening practices). Summarily, ‘line-of-business’ assessments review the income generated from prohibited activities such as the sale of alcohol whilst a financial ratios examination characterizes the earnings, interest income and proportional debt of an IFI a long some quantitative dimension.

As such, given this expertise provision through the application of a religious screening criterion, informational flows borne out of the interlocking behavior of SSBs can directly or indirectly have an impact on the performance of IFIs. From a direct perspective, SSBs can impact the operations of an IFI through the application of theological judgment (Kok & Filomeni, 2020) whilst indirectly there is the building of social and religious capital from being associated with a reputable scholar. In this light, additional SSB memberships will ameliorate religious scholar knowledge as they partake in varying religious audits and approvals, and these marginal memberships also further cement position within the religious elite and thus reputation (Gözübüyük et al., 2018). As such, there are tangible economic benefits from hiring or being connected to these scholars, however, there are concerns about the limits to knowledge transfer and informational overload. Within the Islamic financial system, these can be borne out of variances in the screening criterion utilized by Islamic financial systems in that there not only are nuances between Islamic religious schools of thought but also between-firm and between-market variances of Shariah-screening criterion (Ashraf & Khawaja, 2016; Ho, 2015). This further raises the importance of our central hypotheses in discerning the nature of informational flows through SSB interlocking behavior and its impact of firm performance.

2.2. Shariah scholar networks – An elite network lens

In parallel to economics and finance, sociology has also contributed greatly to the study of board network behavior in terms of antecedents and outcomes by looking beyond merely interlocking behavior further disentangling the impact of these inter-organizational and inter-personal links (Mills, 1956; Mizruchi, 1983, 1984; Useem, 1980). Fundamentally, this stream of research highlighted that the nature of the interlocking behavior – indirect, direct connections, and network proximity – could further explain the impacts of these social networks (Arranz, Arroyabe, & Fernandez de Arroyabe, 2018; Borgatti, 2005; Borgatti & Foster, 2003; Brandes et al., 2016; Brass, Galaskiewicz, Greve, & Tsai, 2004; Freeman, 1979). In addition, sociological lenses such as social cohesion and elite networks (Haelmann, Schoenherr, & Vig, 2018; Mills, 1956; Useem, 1980) provide evidence that these networks reflected both inter-firm and intra-class ties (Benton, Hafeez, & Mun, 2019; Haelmann et al., 2018; Mizruchi, 1996; Widmer, 2011).

Empirically there is increasing evidence for this conception of elite networks amongst the Shariah scholars of respective IFIs. Specifically, studies such as Pollard and Samers (2013), Bassens et al. (2011, 2012) and Gözübüyük et al. (2018) highlight interlocks amongst SSBs as an important mechanism for informational transfers between IFIs and extend Latour's (2017) actor network theory via an examination of geographical political-economy. These studies illustrated a relatively dense social network of Shariah scholars who manifested geographical connections between institutions and Islamic financial hubs. Moreover, this dense social network was propagated via a small group of Shariah scholars revealing a structure akin to Useem's (1980) conceptualization of elite networks – the global Shariah elite.

The formation of the global Shariah elite can be attributed to structural characteristics in terms of a lack of human capital and as such the dependence on a small group of Islamic scholars (Farook & Farooq, 2013; Najeeb & Ibrahim, 2014). However, this elite group can also be borne ideologically, in terms of a shared religious belief and a willingness to defend those beliefs to ensure a propagation of religious capital (Kok, 2020; Omneya, Chantziaras, Ibrahim, & Omoteso, 2020). Moreover, in securing the quality of the theological underpinnings of this group they are essentially serving their main principal – God (Safieddine, 2009). In addition to both structural and theological arguments for the global Shariah elite, it should be noted as well that whilst SSBs do not have the strategic purview as initially conceptualized, IFIs would not be able to exist without their expertise, thus furthering the importance of our central hypothesis of discerning the interlocking behavior of SSBs and the impact of informational flows from proximal connections (Gözübüyük et al., 2018).

Whilst there are some ontological differences within the theoretical lenses adopted by both the sociological, and financial and economic sciences, the underlying conclusions are very much compatible indicating the possibility of multidisciplinary approaches to the study of board interlocks and network behavior. In the following section we introduce the concept of Islamic banking and finance and Shariah governance and examine the extant literature on the interlocking behavior of SSBs, and present our hypotheses.

3. Literature review and hypotheses development

The growth of Islamic banking and finance has been nothing short of an economic phenomenon over the past two decades. IFIs continue to grow, not only, within traditional Islamic financial markets such as that of the middle-east and far-east Asia, but also within conventional financial markets such as that of the UK and Europe (Calder, 2019). Much of this growth and outperformance against conventional finance has been attributed to the unique nature of parameterizing technical, financial operations with Islamic religious ideology (Calder, 2019). Under Shariah, Islamic finance has to abide by several tenets such as i) the prohibition of interest or money for money (*riba*), ii) the reduction of uncertainty (*gharar*) and gambling (*maysir*), iii) the requirement that all transactions and financial instruments are permitted (*halal*), and iv) the need for financial transactions to exist in the real economy, e.g. profit-loss sharing activities (El-Gamal, 2008). These religious principles give rise to a unique governance situation with the job of assessing if IFIs and financial instruments abide by these principles resting with a collective of Shariah scholars known as the Shariah-supervisory board (SSB).

Given their importance, the extant academic research on SSBs and, more specifically, their network structure is relatively underdeveloped. Early studies such as El-Gamal (2011), provide a descriptive conceptualization of SSBs and highlight concerns about the composition and quantity of interlocks between SSBs of different IFIs. These concerns are related to firms' potential to seek out specific Shariah scholars for their perceived leniency during the Shariah approval process, known more colloquially as 'fatwa shopping' (Azmat, Skully, & Brown, 2014, 2015; Ullah, Harwood, & Jamali, 2018). Conceptually, there is some discourse within the literature about the exacerbation of the issues of 'fatwa shopping' borne out the dependence on a small pool of human capital and expertise thus also manifesting greater SSB connections (Farook & Farooq, 2013; Narayan & Phan, 2019). More recently, given the changes in corporate reporting standards (AAOIFI, 2017; Islamic Financial Services Board, 2018), we are beginning to observe a growth in the academic research on SSBs. Much of this research examines the Shariah governance and firm performance nexus using SSB characteristics, predominately the size of the SSB (Mollah et al., 2017; Mollah & Zaman, 2015). This new tranche of research also sheds new light into the traditional concerns about a lack of development of human capital and there is some evidence of the growing number of Shariah scholars especially with new initiatives from central regulatory bodies such as the IFBS and accredited qualification (Farook & Farooq, 2013; Kok, Akwei, Giorgioni, & Farquhar, 2022).

However, beyond this, research examining and exploring the composition and nature of interlocks of SSBs is limited. In terms of a conceptualization of SSB interlocks, Pollard and Samers (2007, 2013) provide a brief examination of the contribution of Shariah scholars across geographical borders but do not highlight the contributions across these boundaries directly. In parallel to Pollard and Samers (2013), Bassens et al. (2011, 2012) provide a clear review of the network of individual Shariah scholars across the core Islamic financial hubs. However, the undertaken spatial analysis within both Pollard and Samers (2013) and Bassens et al. (2011, 2012) focuses predominately on geographical transfers and is static in nature thus ignoring institutional, operational and temporal evolution of informational transfers through SSB composition and number of interlocks.

Conceptualization of the SSBs utilizing this social network lens highlighted the stresses placed upon a relatively small pool of human capital conferred by early sociological examinations of the interlocking behavior and network ties of SSBs (Bassens et al., 2011, 2012). More recently, seminal studies by Gözübüyük et al. (2018) set forth the first longitudinal empirical examination of the impact of SSB social network on the Shariah governance-IFI performance nexus. Utilizing a sample of 103 IFIs, across 13 countries over the period of 2009 and 2010, they illustrated that SSB interlocks have a negative impact on IFI performance arguing that individual Shariah scholars extract economic rent from these network ties as opposed to passing this on to the hiring firm thus furthering the argument of the global Shariah elite. Whilst Gözübüyük et al. (2018) do provide some first insight into the impact of SSB interlocking behavior on firm performance, they adopt a narrow definition of interlocking behavior in direct links within a dense network. We extend this narrow definition and examine the impact of SSB network proximity on IFI performance. More specifically, within a dense network structure, proximity to the highly connected global Shariah elite could result in informational acquisition, thus impacting IFI performance. Moreover, what is interesting is given the increasing number of Shariah scholars, we still observe the establishment of links amongst this small group of the global Shariah elite which highlights the importance of our study in further delineating the impact of social network dynamics of SSBs on firm performance.

Firstly, we can delineate proximity as the path dependency of informational flows between Shariah scholars. Given that *a priori* hypothecation of path dependency of SSBs are limited we have to draw from the traditional board studies and their use of the Betweenness centrality metric. Betweenness indicates that an SSB acts as an information broker, and exists as a gateway that many SSBs must pass to reach other (Brandes et al., 2016; Freeman, 1979). As such, an SSB with high Betweenness centrality exists within the “shortest’ path to other IFIs and has early access to novel and diverse information, with more control over information diffusion. Put simply, an SSB with a high Betweenness measure acts as a bridging entity, potentially, linking the global Shariah elite to the less-connected SSBs within the network. Thus, high Betweenness SSBs benefit from having first access to unique information from both highly connected scholars and the network periphery that in turn will positively impact firm performance. These links can extend to cover informational flows between different types of IFIs, for example between Islamic banking and non-banking IFIs or IFIs that adopt varying interpretations of Shariah borne out of the different Islamic banking paradigms – i) Shariah-based and ii) Shariah-compliant. Shariah-based banking paradigms adopt a stricter interpretation of Shariah. Given this access to novel information in their role as bridging activities we put forth our first hypothesis:

> **H1**: SSB network proximity as measured by Betweenness centrality has a linear and positive impact on IFI performance

However, SSBs with high betweenness will have to manage the increased informational load and engage in activities to filter redundant and novel information, potentially, pulling resources away from the fulfilment of core Shariah governance objectives. The high amount of informational flows can also cause knowledge drift (Burt, 2004; Gilsing, Nooteboom, Vanhaverbeke, Duysters, & van den Oord, 2008) as Shariah scholars process redundant information. With Betweenness centrality, there is potential 'information load' suggesting that information coming through various paths is similar and highly superfluous thus rendering the broker role redundant. For example, given that what is Shariah-compliant will be Shariah-based but not *vice-versa*, there are potentially redundancies in information flowing between Shariah-based and Shariah-compliant IFIs (Berg, El-Komi, & Kim, 2016; Dharani, Hassan, & Paltrinieri, 2019; Ullah et al., 2018). The countervailing effects of increased Betweenness give us our second hypothesis:

H2: SSB proximal connections as measured by Betweenness centrality have an inverted U-shaped curvilinear impact on IFI performance

Secondly, it is possible to disentangle proximity to the global Shariah elite in terms of distance to others within the dense network or what is more commonly called within the conventional literature as Closeness centrality. Closeness centrality reflects access to abundant information in the network which could be gathered from other SSBs directly or indirectly via knowledge flows (Brandes et al., 2016; Opsahl, Agneessens, & Skvoretz, 2010). Once again, given the existence of a dense network of religious scholars of the global Shariah elite, it is likely that the lower the Closeness of an SSB, i.e. less distance within the network, the easier it can access resources from established scholars and will be able to monitor the patterns of religious rulings and innovations of product structures between IFIs (Freeman, 1979). The informational benefits from having closer and quicker to highly connected scholars to gives us our third linear hypothesis:

H3: SSB network proximity as measured by Closeness centrality has a linear and positive impact on IFI performance

However, the assertion of informational overload can also be applied to Closeness centrality (Podolny & Baron, 1997) in that at the highest levels of Closeness SSBs will have access to excessive information may cause difficulties in focusing on relevant knowledge, which can be counterproductive (Cyert & March, 2011). Given these counteracting effects of Closeness centrality, we put forward our fourth hypothesis:

H4: The network proximity of an SSB as measured by Closeness centrality has an inverted U-shaped curvilinear impact of IFI performance

Finally, for completeness of study, we test for the impact of direct links as established within Gözübüyük et al. (2018), measured using Degree centrality. Summarily, Degree centrality is measured by the number of direct connections an SSB has within the network (Borgatti, 2005; Borgatti & Foster, 2003; Freeman, 1979), and mainly reflects the intensity of local knowledge and resources which are accessible from a focal SSB (Dong, McCarthy, & Schoenmakers, 2017; Dong & Yang, 2016; Freeman, 1979). In other words, given that Shariah financial expertise is developed by partaking in religious screening processes, the more SSB memberships that a Shariah scholar possesses, the greater the knowledge-base and information acquisition. As such, highly connected scholars and SSB with many direct links propagate the opportunity for information transfer in the form of theological knowledge gained thus having a subsequent impact on IFI performance (Crespí-Cladera & Pascual-Fuster, 2015; Larcker, So, & Wang, 2013). This gives us our fifth hypothesis for the linear impacts of direct connections:

> **H5**: Direct SSB network connections as measured by Degree centrality have a positive impact of IFI performance

However, there is increasing redundancy in the information as SSBs become more central whereby these direct connections result in focal SSBs receiving high volumes of information but have to spend time filtering what is known and what is novel. Additionally, the notion of the global Shariah elite further fosters this countervailing argument to the initial positive effects of direct connections as SSBs strive to maintain their position within this elite network as opposed to fulfilling their core focus of Shariah governance, i.e. the busy-board (Zona et al., 2018). Therefore, given these competing arguments, we put forth that an increase in direct network ties beyond a certain level may lead to declining efficiency and IFI performance, leading to our final hypothesis:

H6: Direct network connections between SSBs as measured by Degree centrality have an inverted U-shaped curvilinear impact on IFI performance

The following section highlights our utilized methodology in addressing our established research hypotheses.

4. Methods

4.1. Sample and data collection

We utilize a proprietary dataset, hand collected from the published financial statements of IFIs over the 5-year period of 2011-2015. Using the list of IFIs within the FT Banker database, we filter firms based upon availability of annual financial statements excluding any IFI without at least 3 years' worth of data. We reduce the sample further by screening for outliers utilizing a median absolute deviation methodology (Rousseeuw & Croux, 1993). This results in a final sample of 140 IFIs across 16 nations. The sample distribution is given in Table 1:

Table 1 Sample breakdown of Islamic financial institutions

Country	Count	Panel A: Institutional Type		Panel B: Mode of Operation	
		Banking	Non-banking	Shariah-based	Shariah-compliant
Bahrain	19	6	13	17	2
Bangladesh	11	9	2	4	7
Brunei	1	1	0	1	0
Indonesia	32	27	5	9	23
Kuwait	5	3	2	3	2
Malaysia	32	19	13	20	12
Maldives	1	1	0	1	0
Nigeria	1	1	0	1	0
Oman	4	4	0	2	2
Pakistan	13	11	2	4	9
Palestine	1	1	0	1	0
Qatar	2	2	0	2	0
Saudi Arabia	10	8	2	6	4
Sri Lanka	2	1	1	2	0
UAE	3	2	1	2	1
UK	3	0	3	3	0
Total	**140**	**97**	**43**	**76**	**64**

*Note: this table breaks down the sample by institutional type and mode of operation. Institutional type breakdown is given in Panel A whilst mode of operation is given in Panel B. Non-banking IFIs include Islamic insurance companies, investment houses and finance companies. Shariah-based IFIs adopt a stricter application of Shariah that includes structuring firm operations in line with religious doctrine. Shariah-compliant firms, adopt the use of Shariah-windows/-screens that accommodate broadly the core tenets of Shariah.

4.2. Shariah supervisory board characteristics and network creation

Within the literature (Al Mannai & Ahmed, 2019) it is believed that the composition of SSBs would include professionals, such as lawyers and bankers, with Shariah scholars. However, this is not reflected in the data, and the majority, if not all, of the SSBs within our sample are composed of purely Shariah scholars albeit some may have conventional formal qualifications outside just the theological. What is consistent across the empirical literature (Mollah et al., 2017; Mollah & Zaman, 2015; Safiullah & Shamsuddin, 2018, 2019) and also within our data is a trend towards larger SSBs. Whether this is borne out of the criticisms of the dependence on the global Shariah elite or a testament to the growing efforts to develop the human capital within the Islamic financial system is unclear. Additionally, in line with the literature (Safiullah & Shamsuddin, 2019), SSBs are also consistently highly qualified with the majority, if not all, of the members possessing a PhD or theological equivalent. In relation to cross-border operation, there is little evidence indicating operational barriers to employment and, in fact, central efforts to harmonize the regulatory framework for the Islamic financial system have greatly diminished these hurdles (Ashraf & Khawaja, 2016).

However, whilst there is little evidence operationally of any barriers to cross-border employment for SSB members, there is, possibly, some effect from the nuances between the traditional schools of Islamic thought (Khuri, 2006). These theological nuances can be a limiting factor to employment, based on theological expertise, however, we do see evidence of intra-religious appointments, for example, Shariah scholars that work for both Middle-Eastern and Malaysian IFIs. Both these nations adopt different theological Sunni paradigms – mainly Hanbali in the Middle-East whilst it is Shafi'i in Malaysia – however, the presence of interlocking SSBs across both Islamic financial systems illustrates that theological expertise can be attained facilitating cross-border connections (Khuri, 2006; Najeeb & Ibrahim, 2014). In fact, the majority of the granular connections within our sample are cross-borders, for example, of the 418 links in 2015, 256 are cross-borders whilst 162 are within-borders, and this pattern persists over the 5-year sample period. There is evidence of within-region links, especially amongst Middle-Eastern IFIs in support of Bassens et al. (2011, 2012) and Pollard and Samers (2013), but our data indicates cross-region connections between the Middle-East, South East Asia and Europe. We go on to further decompose the nature of the SSB social networks within our sample.

We generate an annual 140 x 140 social network matrix over the period of 2011- 2015. These network matrices are created along institutional dimensions matching SSBs with at least one similar scholar. We utilize UCINET to generate our normalized sociometric measures of network positioning – Betweenness, Closeness, and Degree. Reviewing the sociometric results in Table 2, we see that graph density does not change substantially over the five years. There is a substantial increase in the number of (unique) connections within the networks, with node edges nearly doubling from 2011 to 2015. We also notice the growth in the "connected-ness" of the densest components, with a doubling of the number of SSBs from 2011 to 2015 – 43 to 88 IFIs respectively. This is further illustrated by the drop in the number of connected components in 2015 to 5. This increasing trend for connectedness is also reflected with the measures of Betweenness and Degree centrality whilst there is a drop-in Closeness annually. This is indicative of increased interlocking and closing distance between the SSBs within the sample.

Table 2 Annual breakdown of sociometric measures

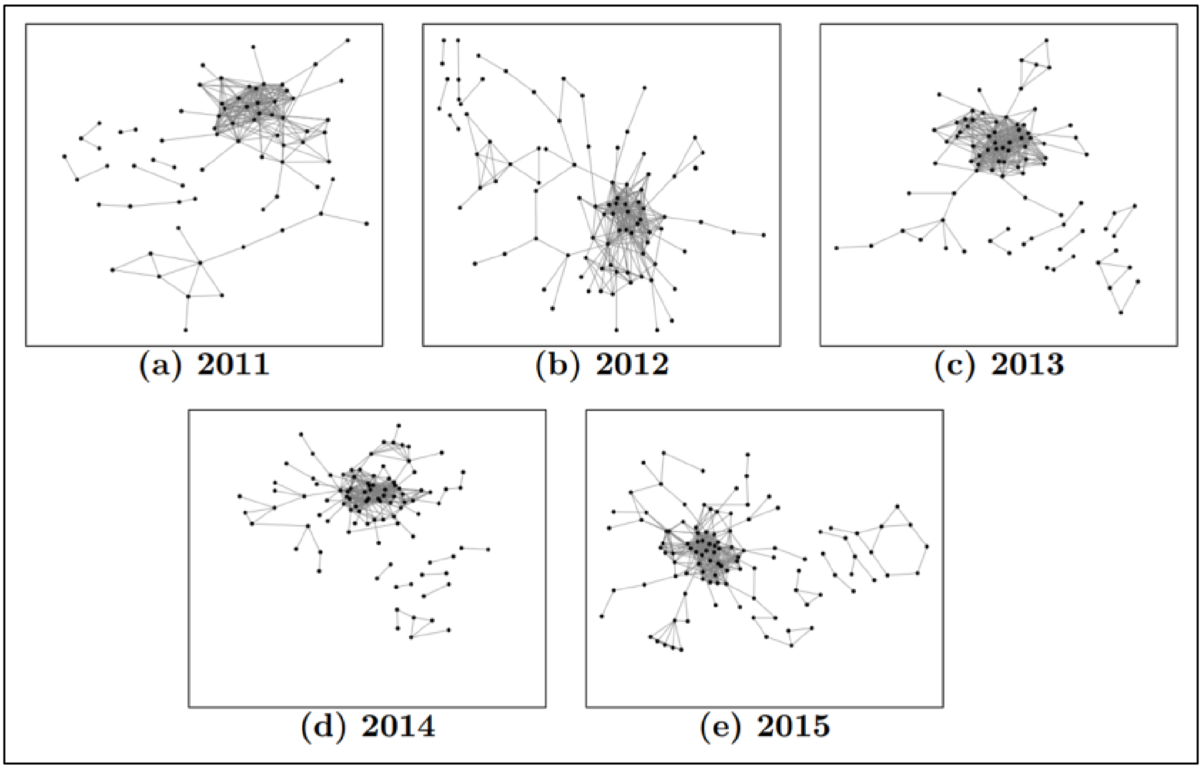
Metric	2011	2012	2013	2014	2015
Vertices (IFIs)	72	91	87	99	109
Unique Edges and Total Edges	251	307	372	366	418
Connected Components	8	7	7	8	5
Maximum Vertices in a Connected Component	43	71	65	81	88
Maximum Edges in a Connected Component	225	285	355	354	397
Graph Density	0.098	0.075	0.099	0.075	0.071
Measures of centrality					
Betweenness centrality	0.086	0.342	0.325	0.625	0.696
Closeness centrality	16.508	10.055	0.117	0.115	0.121
Degree Centrality	0.029	0.036	0.044	0.022	0.049

*Note: this table highlights the annual evolution of key sociometric measures, including our calculated centrality metrics, over the sample period 2011-2015. Vertices highlight the number of IFIs captured within the calculation of the sociometric measures. The unique and total edges indicate the number of undirected connections between

SSBs at a firm level. The number of connected components illustrates the number of subgraphs where at least two vertices are connected to each other but connected to no other vertices. The maximum number of vertices in a connected component represents the largest number of IFIs within a connected component. The maximum number of edges in a connected component highlights the largest number of unique undirected connections within a connected component. Graph density is a ratio of actual connections against total possible connections. Betweenness centrality is a normalised quantification of the average number of times a node acts as a bridge to other nodes. Closeness centrality is a measure of the natural distance between all nodes. Degree centrality is a normalised measure of the number of direct connections a node possesses. The metrics for Betweenness, Closeness, and Degree, are an aggregation of the sample. A larger metric for Betweenness, and Degree, indicates greater centrality. A lower metric for Closeness indicates greater centrality.

Additionally, we utilize NodeXL to generate visualizations of the evolution of the connections between the SSBs over the sample period, given in Figure 1. We observe that the network structures remain relatively consistent across the five panels – (a) to (e) – with a single dense component accompanied by smaller connected components.

Figure 1 Social network structure by year: 2011-2015



*Note: this figure indicates SSB network links at firm-level. Panels (a) – (e) highlight the temporal evolution of the network structure from 2011-2015 respectively.

Breaking down the dense components in each year by nation, the density of the social network structures is dominated by SSBs from Bahrain, Saudi Arabia, the UAE, Kuwait, Oman, Qatar, and the UK with a few Malaysian SSBs represented. The periphery of the network structures is predominately made up of SSBs from Bangladesh, Malaysia and Indonesia. Additionally, Indonesian and Malaysian SSBs also make up the smaller connected components within the diagrams, indicating that they possess separate in-country networks (Bassens et al., 2012; Djelic, 2004; Pollard & Samers, 2013). This pattern is consistent and holds for all five years.

We extend the network analysis to include two nominal characteristics – i) Shariah-based and Shariah-compliant modes of operation and ii) Islamic banks and other IFIs. For brevity, we have not reported these social network diagrams. In terms of mode of operation, we notice no discernible difference in the formation of the social networks between Shariah-based and Shariah-compliant IFIs and network density is comprised of a relatively balanced mix of both institutional modes. In terms of Shariah banks and other IFIs, once again we observe no discernible difference when it comes to density of social network; however, the IBs do facilitate connections between the peripheries with the density of the social network. We expect this given the role of IBs as financial intermediators. Once again, the structure of the social network for both nominal characterizations of SSBs is consistent over the five-year period. In the following section, we breakdown the variables utilized within our core estimated models.

4.3. Dependent and control variables

We utilize return on assets (ROA) as our measure of firm performance, calculated by dividing net income by total assets, as it is widely used within the empirical Islamic financial literature (Gözübüyük et al., 2018; Mollah et al., 2017). Additionally, our use of ROA is further motivated by the nature of financing within the Islamic financial system, with the majority of financial contract being structured debt (Islamic Financial Services Board, 2020), thus appearing on the asset-side of IFI balance sheets and as such is their core source of revenue generation. Moreover, these financial assets will be assessed by the SSB in relation to their permissibility and as such any economic benefit or detriment of informational flows between

SSB networks will be better captured via ROA as a measure of firm performance (Kok & Filomeni, 2020; Kok, Giorgioni, & Farquhar, 2022).

For completeness, we include, *a priori*, variables controlling for corporate governance, firm-based, and macroeconomic characteristics on firm performance. We control for the size of the SSB and SSB qualification as this is shown to have some impact on IFI performance (Mollah et al., 2017; Mollah & Zaman, 2015; Safiullah & Shamsuddin, 2019). We establish further corporate governance controls for conventional board effects on firm performance including i) number of board members, ii) tenure of board members, iii) number of board meetings, iv) board interlocks and v) board qualification (Adams, Hermalin, & Weisbach, 2010; Ashraf, Rizwan, & Azmat, 2020; Pugliese, Minichilli, & Zattoni, 2014). Additionally, we control for firm-based characteristics using i) total assets as a measure of firm size, ii) ownership structure, and iii) the ratio of Shariah assets to total assets (Mateev & Bachvarov, 2020). We use total assets as our measure of firm size given that our firms are rank ordered on this dimension. Along with our ownership variable, we are mindful that characteristics such as CEO-chair duality and an internally appointed CEO also capture important elements of firm control; however, our sample demonstrates near-zero variance for both variables (Pugliese et al., 2014). Following Kok and Filomeni (2020), and Chen and Yu (2021) we establish controls for macroeconomic variations by including measures of i) economic wealth as measured by change in GDP, ii) price change as measured by the consumer price index (CPI), iii) market liquidity and iv) market demand as indicated by urban population growth. As part of the macroeconomic variations we also control for market structure and institutional quality within less industrialized nations by including measures regulation and risk (Albaity, Mallek, & Noman, 2019). For our measure of risk, we use both non-performing loans to gross loans and for regulation, we construct an equally weighted index using World Bank governance measures including political stability, efficiency of governance, quality of regulation, degree of corruption and strength of the rule of law (Cuervo-Cazurra & Genc, 2008). Our regulation measure exists on a scale of ±2.5 with values below 0, indicating poorer regulation and vice versa. In totality, our models consist of three independent and sixteen control variables.

4.4. Estimation procedure

In order to undertake our analysis, we utilize a fixed-effects ordinary least squares (OLS) panel regression, including both cross-sectional and period fixed effects, thus allowing us to control for unobserved heterogeneity. Additionally, all estimations are conducted with White's robust errors on the diagonal in order to address heteroskedasticity. We run separate models for each of our measures of centrality and introduce squared variants of our centrality measures to capture the curvilinear effects of network proximity on firm performance. Table 3 presents the full definition of all variables utilized within regression equations (1) and (2).

We establish the following empirical model to test our three linear measures of centrality – **H1, H3,** and **H5:**

$$FP_{i,t} = \alpha_{i,t} + \beta_1 CENT_{i,t} + \vec{\beta}_2 \overrightarrow{GOV}_{i,t} + \vec{\beta}_3 \overrightarrow{FIRM}_{i,t} + \vec{\beta}_4 \overrightarrow{ECON}_{i,t} + \gamma_t + \lambda_i + \varepsilon_{i,t}$$

Eq. (1)

We run the following model to test for the curvilinear effects of our measures of centrality – **H2, H4,** and **H6**:

$$FP_{i,t} = \alpha_{i,t} + \beta_1 CENT_{i,t} + \beta_2 CENT_{i,t}^2 + \vec{\beta}_3 \overrightarrow{GOV}_{i,t} + \vec{\beta}_4 \overrightarrow{FIRM}_{i,t} + \vec{\beta}_5 \overrightarrow{ECON}_{i,t} + \gamma_t + \lambda_i + \varepsilon_{i,t}$$

Eq. (2)

Where,

$FP_{i,t}$ = measure of firm performance for institution i at time t (dependent variable)

$CENT_{i,t}$ = given measure of centrality for institution i at time t

$CENT^2_{i,t}$ = given squared measure of centrality for institution i at time t

$\overrightarrow{GOV}_{i,t}$ = matrix of corporate governance control variables for institution i at time t

$\overrightarrow{FIRM}_{i,t}$ = matrix of firm characteristics control variables for institution i at time t

$\overrightarrow{ECON}_{i,t}$ = matrix of macroeconomic, country control variables for institution i at time t

γ_t= period fixed effects

λ_i= cross-sectional fix effects

$\varepsilon_{i,t}$= residuals

Table 3 Description of variables

Name	Identifier	Description	Academic foundations
		Measure of firm performance	
Return on assets	ROA	return on assets calculated as $\frac{net\ income_{i,t}}{total\ assets_{i,t}} \times 100$ (source: institutional annual reports)	– Gözübüyük, Kock, and Ünal (2018) – Mollah, Hassan, Al Farooque, and Mobarek (2017)
		Measures of centrality	
Betweenness centrality	NBET	normalized measure of Betweenness centrality calculated as $B'_{i,t} = \frac{B_{i,t}}{(N_t-1)(N_t-2)/2}$ where $B_{i,t} = \sum_{j \neq i \neq k} \frac{g_{i,j,k,t}}{g_{j,k,t}}$; $g_{j,k,t}$ is the shortest path linking firms j, k and t and g_{ikjt} is the number of paths that contain firm I in year t; Nt is the network size in year t. Larger Betweenness centrality values indicate a shorter path to other nodes	– Dharani, Hassan, and Paltrinieri (2019) – Ullah, Harwood, and Jamali (2018) – Berg, El-Komi, and Kim (2016) – Gilsing, Nooteboom, Vanhaverbeke, Duysters, and van den Oord (2008) – Burt (2004)
Closeness centrality	FCLO	measure of Closeness centrality calculated as $C_{i,t} = \frac{1}{\sum_y d(i,j)}$, where d(i.j) is the average distance between nodes. Smaller Closeness values indicate nearer distance to all other nodes.	– Brandes, Borgatti, and Freeman (2016) – Cyert and March (2011) – Opsahl, Agneessens, and Skvoretz (2010) – Podolny and Baron (1997)
Degree Centrality	NDEG	normalized measure of Degree centrality calculated as $D'_{i,t} = \frac{D_{i,t}}{n-1}$ where, $D_{i,t}$ is the number of direct links. Larger Degree centrality values indicate a greater number of direct connections to other nodes	– Zona, Gomez-Mejia, and Withers (2018) – Crespí-Cladera and Pascual-Fuster (2015) – Larcker, So, and Wang (2013)Borgatti (2005) – Borgatti and Foster (2003) – Freeman (1979)
		Governance control variables	
Shariah supervisory board size	SSBS	number of Shariah scholars on the Shariah supervisory board (source: institutional annual reports)	– Safiullah and Shamsuddin (2019) – Safiullah and Shamsuddin (2018) – Mollah et al. (2017) – Mollah and Zaman (2015) – Safiullah and Shamsuddin (2018)

Shariah supervisory board qualification	SSBQ	average level of Shariah scholar formal academic qualifications as measured by the follow: 4: doctoral-level; 3: postgraduate-level; 2: undergraduate-level; 1: everything beneath undergraduate-level; 0: no formal academic qualifications (source: institutional annual reports)	− Safiullah and Shamsuddin (2019) − Ashraf and Khawaja (2016)
Conventional board size	BODS	number of corporate board members (source: institutional annual reports)	− Ashraf, Rizwan, and Azmat (2020) − Pugliese, Minichilli, and Zattoni (2014) − Adams, Hermalin, and Weisbach (2010) − Vafeas (2003)
Independent conventional board members	BODI	number of independent corporate board members (source: institutional annual reports)	
Conventional board tenure	BODT	average age of BOD members in years (source: institutional annual reports)	
Conventional board meetings	BODM	number of corporate board meetings per year (source: institutional annual reports)	
Conventional board qualification	BODQ	average level of conventional board member formal academic qualifications as measured by the follow: 4: doctoral-level; 3: postgraduate-level; 2: undergraduate-level; 1: everything beneath undergraduate-level; 0: no formal academic qualifications (source: institutional annual reports)	
		Firm characteristics control variables	
Total value of assets	TOAS	log of value of total assets (source: institutional annual reports)	− Kok, Giorgioni, and Farquhar (2022) − Mateev and Bachvarov (2020) − Kok and Filomeni (2020) − Farag, Mallin, and Ow-Yong (2018) − Mallin, Farag, and Ow-Yong (2014)
Ratio of Shariah assets to total assets	STOA	ratio of Shariah assets to total assets (source: FT Banker)	
Ownership structure	OWN	percentage of block holders. Block holders defined as entities holding 5% or more in equity stock (source: institutional annual reports)	
		Macroeconomic and market control variables	
GDP growth rate	GDP	annualized, year on year change in sovereign GPD growth rate (source: Bloomberg)	− Chen and Yu (2021) − Kok and Filomeni (2020) − Albaity, Mallek, and Noman (2019) − Gözübüyük et al. (2018) − Martin, Gozubuyuk, and Becerra (2015) − Cuervo-Cazurra and Genc (2008)
Consumer price index	INF	annualized, year on year change in sovereign consumer price index as a measure of inflation (source: Bloomberg)	
Market liquidity	LIQ	annualized, year on year change in sovereign broad money supply as a % (source: Bloomberg)	
Market risk	RISK	annualized measure of non-performing loans to gross loans made by the banking sector as a percentage (source: World Bank	
Regulation	REG	equally weighted index measuring regulatory development. Index includes World Bank measures of the perception of political stability, government efficiency, regulatory quality, degree of corruption and strength of rule of law within the sovereign nation. Scale is from -2.5 (poor regulatory development) to +2.5 (good regulatory development) (source: World Bank)	
Population growth	POP	log of sovereign urban population growth (source: World Bank)	

*Note: this table provides a full definition of all dependent, independent and control variables used within our core models

5. Findings and Discussions

5.1. Descriptive statistics

The descriptive statistics are presented in Table 4. Average ROA is 1.49% with a standard deviation of 1.80%. In terms of measures of centrality, normalized measures of Betweenness, and Degree centrality stand at 0.44, and 0.03 with standard deviations of 1.13 and 0.05 respectively. Closeness is measured as a ratio with a mean of 0.12 across the network matrix and a standard deviation of 0.03. Examining the control variables, the average size of the SSB is just under 4 scholars with a deviation of 2, indicating that the SSBs are approximately half the size of the conventional boards with an average of 8. We see that SSBs, on average, have a higher level of qualification than the conventional boards at 3.08 against 2.03 respectively. Average board tenure is 3.39 years, average number of board meetings is 8.05 per year, and average number of board interlocks is 3.67 with standard deviations of 2.43, 5.91 and 2.07 respectively. In terms of firm controls, the average change in the value total assets is 0.098% with a deviation of 0.718%, while the change in the ratio of Shariah- to total-assets is 0.003 with a deviation of 0.105. The average ownership structure is 67% block holder with a standard deviation of 32%. Regarding macroeconomic controls, we observe that average GDP growth, inflation, liquidity and population growth is 4.868%, 4.163%, 10.323% and 16.455% respectively. Looking at the measure of industry risk for the sovereign financial sector is 4.34% with a deviation of 4.24%. Finally, the average level regulatory development is -0.15 with a deviation of 0.54, which places this these measures on the marginally poorer end of the scale of ±2.5.

Table 4 Summary statistics

Variable	Obs.	Unit	Mean	Min.	Max.	Q1	Q3	S.D.	Kurt.	Skew.	Norm.
ROA	584	%	1.49	-8.99	6.04	2.01	1.53	1.80	9.08	-1.54	No
NBET	695	Normalized	0.44	0.00	11.43	0.26	0.63	1.13	32.61	4.66	No
FCLO	695	Normalized	0.12	0.08	0.19	0.11	0.13	0.03	1.86	-0.10	No
NDEG	695	Normalized	0.03	0.00	0.22	0.02	0.05	0.05	5.39	1.82	No
SSBS	628	No. of members	3.99	1.00	15.00	3.59	4.73	2.02	5.51	1.23	No
SSBQ	608	Index	3.08	0.00	4.00	2.76	3.33	1.08	4.45	-1.46	No
BODS	633	No. of members	8.03	2.00	23.00	6.83	8.89	3.60	5.03	1.07	No
BODT	622	No. of years	3.39	0.00	14.67	2.75	4.06	2.43	5.45	1.36	No
BODM	571	No. of meetings	8.05	0.00	51.00	9.39	7.08	5.91	18.12	3.24	No
BODI	586	No. of members	3.67	0.00	10.00	2.41	4.58	2.07	3.68	0.86	No
BODQ	596	Index	2.03	0.00	3.67	2.12	1.82	0.80	2.83	-0.50	No
TOAS	645	Ln	7.53	0.80	12.12	6.00	9.58	2.02	3.16	-0.41	No
STOA	625	Ratio	0.64	0.00	1.00	0.36	0.81	0.44	1.30	-0.46	No
OWN	627	%	67	0.00	100	65.21	61.95	32.08	2.24	-0.63	No
GDP	695	%Δ	4.87	-2.35	13.38	5.26	4.83	1.82	6.35	-0.05	No
INF	695	%Δ	4.16	-0.42	12.85	5.52	2.92	2.65	3.44	0.80	No
LIQ	690	%Δ	10.32	-4.42	49.98	12.56	8.87	5.48	9.74	0.92	No
RISK	569	Ratio	4.34	0.40	20.92	5.79	2.62	4.24	4.26	1.58	No
REG	690	Index	-0.15	-1.18	1.37	-0.38	0.31	0.54	-1.06	0.17	No
URBP	690	%Δ	16.45	11.85	18.74	16.60	16.25	1.37	3.23	-1.06	No

*Note: this table highlights the descriptive statistics for our dependent, independent and control variables used within our core models.

5.2. Correlation matrix

The correlation matrix is presented in Table 5. Pair-wise correlation above ±9% are significant at a 10% level. Whilst the majority of correlations are within acceptable bounds there are notable values between the measures of centrality as highlighted within the extant literature (Rothenberg et al., 1995; Valente et al., 2008). Given these pair-wise correlations, we choose to run each centrality measure as a separate model to mitigate the issues of multicollinearity within our estimations.

Table 5 Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ROA	1																			
NBET	-0.09	1																		
NDEG	-0.24***	0.40***	1																	
FCLO	-0.17***	0.36***	0.59***	1																
SSBS	0.00	0.11**	0.07	0.25***	1															
SSBQ	-0.07	0.00	0.00	-0.05	-0.12**	1														
BODS	-0.03	0.10*	0.17***	0.29***	0.63***	-0.35***	1													
BODT	0.07	0.05	-0.06	-0.12**	-0.05	0.03	0.04	1												
BODM	0.14***	-0.11**	-0.20***	-0.16***	0.04	0.01	-0.03	-0.02	1											
BODI	-0.17***	0.18***	0.27***	0.25***	0.25***	0.22***	0.27***	0.13**	-0.13	1										
BODQ	0.16***	-0.11**	-0.28***	-0.25***	-0.22***	0.27***	-0.41***	-0.03	0.22***	-0.09	1									
TOAS	0.05	0.16***	0.21***	0.10*	0.21***	0.27***	0.24***	0.25***	0.06	0.47***	0.01	1								
STOA	-0.27***	0.03	0.13**	0.23***	0.22***	-0.09	0.14**	-0.01	-0.23***	0.00	-0.34***	-0.28***	1							
OWN	-0.14**	-0.02	-0.07	-0.12**	-0.36***	0.32***	-0.61***	-0.12**	-0.11**	0.01	0.26***	-0.21***	0.11**	1						
GDP	0.18***	-0.06	-0.28***	-0.07	0.19***	-0.13**	0.07	0.00	0.17**	-0.08	0.15**	-0.06	-0.12**	-0.14**	1					
INF	0.12**	-0.22***	-0.25***	-0.14**	-0.15***	-0.34***	0.03	-0.25***	0.14**	-0.46***	0.17**	-0.28***	-0.22***	-0.23***	0.22***	1				
LIQ	0.16***	-0.21***	-0.25***	-0.03	-0.09*	-0.36***	0.08	-0.13**	0.10*	-0.30***	0.04	-0.18***	-0.20***	-0.29***	0.40***	0.52***	1			
RISK	-0.10*	-0.07	-0.02	-0.02	-0.03	-0.42***	0.31***	-0.23***	-0.14**	-0.20***	-0.37***	-0.24***	0.00	-0.26***	-0.14**	0.39***	0.34***	1		
REG	-0.21***	0.20***	0.30***	0.18***	0.16***	0.41***	-0.15***	0.17***	-0.04	0.40***	0.01	0.13**	0.26***	0.41***	-0.13**	-0.68***	-0.65***	-0.59***	1	
URBP	0.02	-0.03	-0.04	-0.03	-0.09*	-0.13**	0.14**	-0.15**	0.01	-0.14**	-0.08	0.09	-0.12**	-0.19***	-0.01	0.33***	0.07	0.10**	-0.29***	1

*Note: this table indicates the correlation matrix of the core variables in our dataset. ***, ** and * represent significance at 0.01, 0.05 and 0.1 respectively

5.3. Regression outputs

Table 6 presents the outputs from the OLS panel estimations of the measures of centrality with both period and cross-sectional fixed-effects. Models (2), (4), and (6) highlight our core models testing the curvilinear relationship between our measures of centrality and ROA as indicated by Eq. (2). We also test for linear relationships between our centrality metrics and ROA as indicated by Eq. (1) in Models (1), (3), and (5). As a minor test of robustness, the lack of significance of linear centrality within these models further support our curvilinear hypothecation and results.

Table 6 Ordinary least squares (OLS) estimations

Dep. Var. = ROA	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
NBET	-0.0010	0.0006				
	(0.0006)	(0.0012)				
$NBET^2$		**-0.0002*** **				
		(0.0001)				
FCLO			0.0346	**0.5254** **		
			(0.0341)	**(0.2604)**		
$FCLO^2$				**-2.2561***		
				(1.1969)		
NDEG					-0.0619	-0.1176
					(0.0692)	(0.1166)
$NDEG^2$						0.2784
						(0.5332)
SSBS	0.0008	0.0009	0.0007	0.0005	0.0007	0.0007
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
SSBQ	-0.0018	-0.0017	-0.0017	-0.0015	-0.0018	-0.0019
	(0.0011)	(0.0011)	(0.0011)	(0.0012)	(0.0012)	(0.0012)
BODS	0.0002	0.0001	0.0001	0.0002	0.0002	0.0003
	(0.0008)	(0.0009)	(0.0009)	(0.0008)	(0.0008)	(0.0009)
BODT	-0.0003	-0.0003	-0.0004	-0.0003	-0.0002	-0.0002
	(0.0009)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
BODM	**0.0003** **	**0.0003** **	**0.0003** **	**0.0004** **	**0.0003** **	**0.0003** **
	(0.0002)	**(0.0002)**	**(0.0001)**	**(0.0001)**	**(0.0002)**	**(0.0002)**
BODI	-0.0005	-0.0005	-0.0006	-0.0007	-0.0007	-0.0007
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0009)
BODQ	0.0026	0.0028	0.0022	0.0020	0.0020	0.0020
	(0.0028)	(0.0028)	(0.0029)	(0.0029)	(0.0029)	(0.0029)
TOAS	0.0042	0.0042	0.0037	0.0038	0.0038	0.0038
	(0.0031)	(0.0031)	(0.0031)	(0.0030)	(0.0031)	(0.0031)
STOA	0.0066	0.0068	0.0066	0.0079	0.0070	0.0072
	(0.0054)	(0.0054)	(0.0055)	(0.0056)	(0.0056)	(0.0056)
OWN	0.0075	0.0074	0.0066	0.0055	0.0060	0.0060
	(0.0082)	(0.0082)	(0.0080)	(0.0080)	(0.0082)	(0.0082)
GDP	-0.0012	-0.0013	-0.0012	-0.0011	-0.0011	-0.0011
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
INF	-0.0020	-0.0020	-0.0020	-0.0019	-0.0019	-0.0019
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0014)	(0.0014)

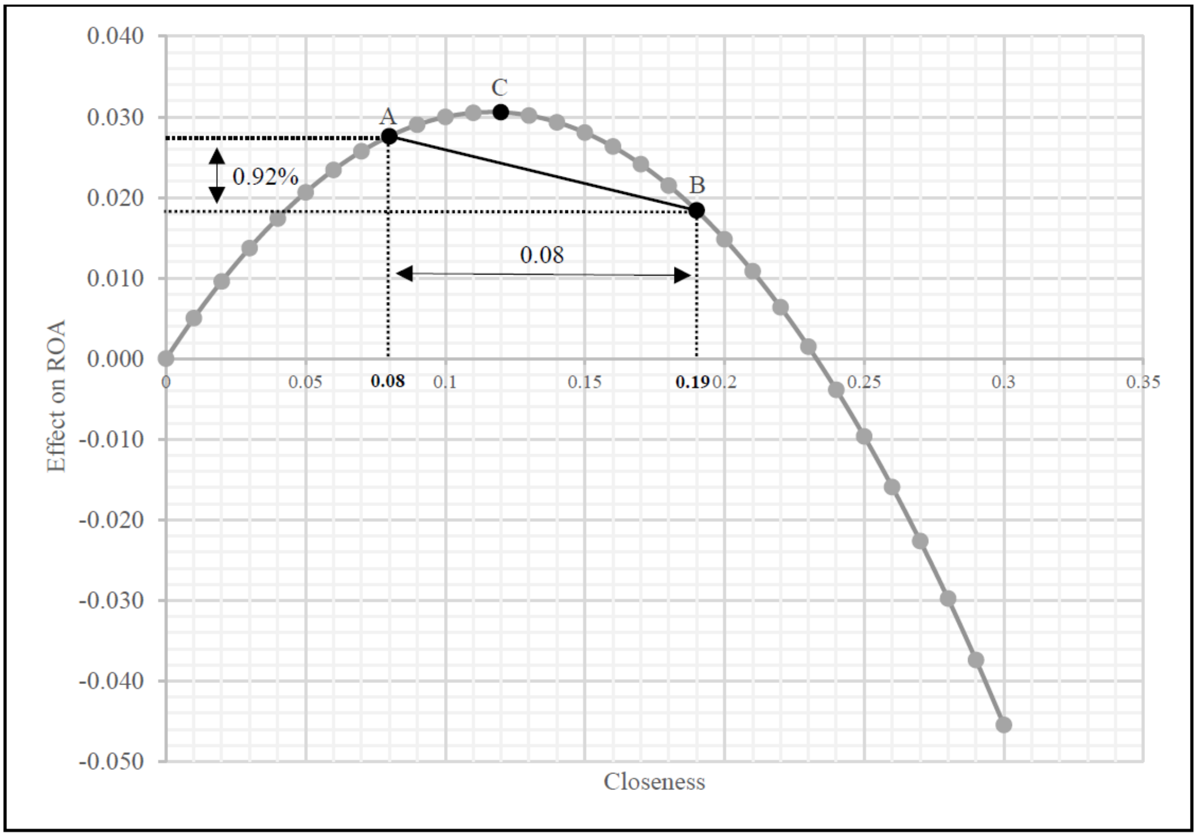
LIQ	-0.0003	-0.0003	-0.0004	-0.0005	-0.0004	-0.0004
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
RISK	**-0.0031*** **	**-0.0031*** **	**-0.0031*** **	**-0.0028*** **	**-0.0029*** **	**-0.0029*** **
	(0.0009)	**(0.0009)**	**(0.0009)**	**(0.0010)**	**(0.0009)**	**(0.0009)**
REG	-0.0070	-0.0080	-0.0034	0.0036	0.0015	0.0017
	(0.0256)	(0.0256)	(0.0262)	(0.0264)	(0.0259)	(0.0261)
URBP	**-0.4428*** **	**-0.4444*** **	**-0.4490*** **	**-0.4235*** **	**-0.4212*** **	**-0.4188*** **
	(0.1178)	**(0.1180)**	**(0.1192)**	**(0.1185)**	**(0.1189)**	**(0.1194)**
Obs.	326	326	326	326	326	326
No. of cross-sections	95	95	95	95	95	95
Cross-section FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	56.96%	57.05%	56.73%	57.10%	56.89%	56.74%
F-stat.	**4.7398*** **	**4.7211*** **	**4.7055*** **	**4.7286*** **	**4.7298*** **	**4.6750*** **

*Note: this table indicates the core fixed effects OLS panel regression outputs. The dependent variable is ROA. All models are run as fixed effect OLS panel regressions with both period and cross-sectional effects. White's robust standard errors in parentheses. The main predictors are Betweenness centrality (Models 1 & 2), Closeness centrality (Models 3 & 4), and Degree centrality (Models 5 & 6). Models (1), (3), and (5) represent our core linear estimations as presented in Eq. (1). Models (2), (4), and (6) represent our core curvilinear estimations as represented by Eq. (2). Curvilinear effects are captured with the inclusion of a squared transformation of our respective measures of centrality. All models include a full specification of control variables including: size of the SSB; average SSB qualification on a scale of 0 to 4 (the higher the number the higher the qualification); conventional board size; number of independent conventional board members; average conventional board tenure; average number of conventional board meetings; average conventional board qualification on a scale of 0 to 4 (the higher the number the higher the qualification); log of total assets; ration of Shariah to total assets; percentage block holders (5% or more ownership); GDP growth rate; CPI; market liquidity; market risk; sovereign measure of regulatory development on a scale of -2.5 to +2.5 (higher is better); log of urban population growth. ***, ** and * represent significance at 0.01, 0.05 and 0.1 respectively.

From Table 6, all models are statistically significant at a 1% level with adjusted R^2 values within the region of 56%. Examining the individual measures of centrality, our results indicate the presence of a curvilinear relationship between Closeness (Model 4) and firm performance as measured by ROA suggesting an acceptance **H4**. From our results, we find no support of curvilinear impacts for Betweenness and Degree centrality on IFI performance. Whilst, we do observe from Model (2) that the quadratic term for Betweenness is significant at 10% level, the non-significance of the linear term does not allow us to make any meaningful assessment of this result. Non-significance aside, some interpretation of the coefficients for Model (1) and (2) do highlight an inverted U-shaped curvilinear impact of Betweenness on IFI firm performance. This suggests that beyond a threshold point, the benefits from increasing informational flows from being a bridging node inverts, potentially as a result of informational overload or redundancies. Moreover, unlike the results for Closeness in Model (4), the significance of the quadratic term in Model (2) does not hold consistently within the proceeding robustness tests that are undertaken. Additionally, whilst not significant, we observe a negative coefficient for the linear Degree term (Model 5 and 6), which is in line with the empirical literature (Gözübüyük et al., 2018) in suggesting that there are no benefits accrued from hiring highly connected scholars. However, although not significant, we observe the existence of a U-shaped relationship between Degree centrality and IFI performance. Potentially, this is indicative of a threshold point for the negative impacts of direct connectedness wherein the information benefits of additional connections outstrip the detriments of a busy board. We proceed to discuss our significant results for Closeness centrality – Model (4).

Examining the direction of coefficients for both FCLO and $FCLO^2$, i.e. +ve linear term but -ve quadratic term, this illustrates an inverted U-shape to the curvilinear effects suggesting an inversion of the positive effects of additional interlocking behavior beyond a threshold point. Utilizing the coefficients of both linear and quadratic terms from Model (6) we are also able to discern the vertex or turning point of the curvilinear relationship between Closeness and ROA. Our results indicate a turning point of 0.116 Closeness, i.e. -0.5254 / (2 * -2.2561), which is approximately an average distance of nine nodes (1 / 0.116) – Point C, Figure 2. This indicates that there are positive effects of increasing closeness up to an average distance of nine nodes upon which the effects invert and that any increase in Closeness beyond nine nodes yields negative economic benefits to the hiring IFI. What is also notable, is the magnitude of the reversion with an increase in Closeness beyond nine nodes resulting in a drop in the slope of the ROA by double its value. From our, data we can also determine that the absolute change in ROA from the Closest to the least Close IFI within our sample is approximately 0.92%, i.e. $(-2.3501 * (0.19^2 – 0.08^2)) + (0.5506 * (0.19 – 0.08))$ – this is the absolute difference in ROA from Point A to Point B in Figure 2. Additionally, differencing the coefficients of both the linear and quadratic terms of Closeness in Model (4), our results highlights an average marginal change in ROA of approximately 52%.

Figure 2 Inverted U-shaped curvilinear relationship between Closeness and ROA



*Note: this figure provides a visualization of the curvilinear relationship indicated by our empirical estimations. Point C indicates the turning point of the polynomial – 0.117 Closeness or approximately an average distance of nine nodes. Points A and B represent the marginal change in ROA from the Closest to the least Close IFI within the sample – change of 0.92% in ROA. The change in Closeness from Point A to B is 0.08.

Combined with our annual decomposition of the centrality metrics in Table 2, our results confirm the extent conventional socio-economic literature on the benefits of efficiency of proximity to other SSBs, more specifically to the densest elements of the network. Fundamentally, our results indicate that there is an economic edge to being within close proximity to the global Shariah elite and taking advantage of the informational flows from highly experience scholars (Brandes et al., 2016; Opsahl et al., 2010). Additionally, our indication of an inverted U-shaped curvilinear relationship between Closeness and IFI performance also further confirm the extant academic literature of diminishing benefits of proximity within the social network beyond a threshold point (Cyert & March, 2011).

However, from a Shariah governance, and global Shariah elite perspective, the results are *a priori* equivocal in that we are unsure why as SSBs get closer to each other, this results in an inversion of the positive effects of reducing proximity. From the literature, one potential source of information overload or redundancy could arise from the diversity in banking paradigms within the Islamic financial system – i) Shariah-based and ii) Shariah-compliant (Kok, Akwei, et al., 2022; Oseni, 2013). Given this nuance, this may be information distortion from reducing proximity arising from the differences between Shariah-based and -compliant IFIs. We test this, through the inclusion of an interaction term between Closeness and mode of operation dummy. Our results indicate no differences between the curvilinear effects of Closeness on firm performance between Shariah-based and compliant IFIs. This is potentially indicative of cross-group informational distortions given the curvilinear relationship is not unique to individual Islamic banking paradigms – either Shariah-based or -compliant.

Another possible argument for the curvilinear relationship between Closeness and firm performance arises in the amount of innovation within the Islamic banking sector (Abedifar, Ebrahim, Molyneux, & Tarazi, 2015; Alamad, 2017) thus potentially propagating informational distortions of higher Closeness SSBs from non-banking IFIs. Using a similar interaction term between Closeness but substituting the dummy variable for institutional type we test this as well. Similarly, our results indicate no differences between banking and non-banking IFIs regarding the curvilinear relationship of Closeness and IFI performance. Once again, we argue that there are potential cross-group informational overloads when it comes to banking and non-banking IFIs.

We also offer an explanation in relation to the rapid growth of the Islamic financial sector. In this regard, since 2010 there has been substantial consolidation within the sector, which has been accompanied by new market entrants from the conventional financial system (Hassan & Aliyu, 2018; Narayan & Phan, 2019). There have also been large drives towards expanding the base of Shariah scholars beyond the smaller group of global Shariah elite (Najeeb & Ibrahim, 2014). Coupling both these elements and discerning that the religious approval process is open to interpretation by individual scholars, it is possible that the desire for new IFIs to be competitive through the offering of new religious financial structures and "younger" SSBs can manifest the perceived informational overload and redundancies from additional interlocking behavior and network proximity of SSBs. In the same vein that distance allows for information to be filtered and assessed between SSBs, by narrowing that distance there is increased strain on new Shariah scholars within the religious certification process.

Beyond the dependent variables, we also observe some persistent effects amongst our controls where the number of conventional board meetings is a significant, positive predictor of IFI performance, whilst both market risk, as measured by the ratio of non-performing loans to gross loans, and the log of urban population having a significant and negative impact on firm performance. The effects for both the number of board meetings and risk are in the expected direction in that, *a priori*, there is substantial literature supporting the positive effects of additional meetings as a governance mechanism (Vafeas, 1999) and the reduction in firm performance given an increase the perceived risk of a particular sector (Fama, 1986). However, what is *a priori* nebulous is the negative impact of urban population given its role as a proxy for demand. We offer an economic explanation for this surrounding a market's demographics and supply and demand equilibrium dynamics. Given that an increasing population can indicate increasing demand, it is likely that this demand will be matched by that of increased supply as well, in that business will compete for a growing number of customers. As such, the increase in competition can place downward pressure on earnings of firms (Hopenhayn, Neira, & Singhania, 2018).

5.4. Robustness Tests

5.4.1. Alternative estimation methods – Two stage least squares (2SLS) and generalized methods of moments (GMM)

The robustness and the consistency of the regression outputs and their ceteris paribus interpretations depend upon the exogeneity of the regressors within the estimated equations. As part of our robustness tests, we compare our OLS estimates to both a 2SLS and a two-step dynamic GMM estimation. Both 2SLS and GMM models are run with ROA as the dependent variable of firm performance.

For the 2SLS estimation, we utilize both past centrality (Gözübüyük et al., 2018; Martin, Gozubuyuk, & Becerra, 2015) and number of secure internet servers (Licoppe & Smoreda, 2005; Vriens & van Ingen, 2017) as instruments for our core measures of centrality. In relation to past centrality, we use the one-period lagged version of our respective centrality measure within our models. Given that social networks are relatively stable over time there is exogeneity of past centrality given that previous year's information may not be relevant to current decision-making (Martin et al., 2015). The number of secure internet servers fulfils the exogeneity conditions for instrumental variables given that SSB interlocking behavior is a spatial phenomenon and this instrument increases the chance of forming connections via improvements in information technology (Angrist & Pischke, 2009; Bascle, 2008). Our 2SLS results are given in Table 7.

Table 7 Two stage least squares (2SLS) estimations

Dep. Var. = ROA	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
NBET	0.0028	-0.0047				
	(0.0080)	(0.0056)				
$NBET^2$		0.0003				
		(0.0006)				
FCLO			0.4559	**4.3798***		
			(0.4734)	**(2.3868)**		
$FCLO^2$				**-19.9580***		
				(10.9317)		
NDEG					0.0423	-0.8516
					(0.1526)	(0.5663)
$NDEG^2$						3.2947
						(2.3758)
SSBS	0.0003	0.0008	-0.0011	-0.0002	0.0006	0.0011
	(0.0015)	(0.0014)	(0.0024)	(0.0015)	-0.0013	(0.0017)
SSBQ	-0.0012	-0.0014	-0.0005	-0.0014	-0.0013	-0.0024
	(0.0015)	(0.0016)	(0.0022)	(0.0015)	(0.0014)	(0.0019)
BODS	0.0004	0.0011	-0.0004	0.0007	0.0004	0.0010
	(0.0015)	(0.0015)	(0.0019)	(0.0013)	(0.0013)	(0.0014)
BODT	-0.0002	-0.0003	-0.0014	-0.0002	-0.0003	0.0001
	(0.0011)	(0.0011)	(0.0013)	(0.0012)	(0.0011)	(0.0011)
BODM	**0.0003***	**0.0004****	0.0003	**0.0006*****	**0.0003****	**0.0003****
	(0.0002)	**(0.0001)**	(0.0002)	**(0.0002)**	**(0.0002)**	**(0.0002)**
BODI	-0.0009	-0.0007	-0.0011	-0.0010	-0.0007	-0.0006
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0010)	(0.0016)
BODQ	0.0003	0.0031	0.0022	0.0023	0.0021	0.0038
	(0.0048)	(0.0036)	(0.0039)	(0.0036)	(0.0033)	(0.0040)
TOAS	0.0033	-0.0041	0.0030	0.0039	0.0051	0.0037
	(0.0058)	(0.0028)	(0.0044)	(0.0039)	(0.0033)	(0.0037)
STOA	0.0121	0.0058	0.0052	**0.0117***	**0.0101***	**0.0165****
	(0.0083)	(0.0075)	(0.0100)	**(0.0061)**	**(0.0058)**	**(0.0082)**
OWN	0.0100	0.0085	0.0050	0.0010	0.0117	0.0082
	(0.0083)	(0.0093)	(0.0140)	(0.0115)	(0.0086)	(0.0093)
GDP	-0.0011	0.0000	-0.0027	-0.0009	-0.0011	-0.0015
	(0.0015)	(0.0016)	(0.0027)	(0.0014)	(0.0015)	(0.0016)
INF	-0.0020	-0.0017	-0.0016	-0.0008	-0.0020	-0.0010
	(0.0018)	(0.0016)	(0.0018)	(0.0020)	(0.0017)	(0.0018)
LIQ	-0.0007	-0.0003	-0.0007	**-0.0010***	-0.0006	-0.0008
	(0.0005)	(0.0005)	(0.0005)	**(0.0005)**	(0.0005)	(0.0005)
RISK	-0.0044	**-0.0056****	**-0.0049****	**-0.0049****	**-0.0052****	**-0.0058****
	(0.0030)	**(0.0022)**	**(0.0023)**	**(0.0023)**	**(0.0021)**	**(0.0023)**
REG	0.0014	-0.0115	0.0380	0.0365	-0.0093	0.0256
	(0.0357)	(0.0325)	(0.0522)	(0.0402)	(0.0369)	(0.0360)
URBP	**-0.5053*****	**-0.4646*****	**-0.5318*****	**-0.4438*****	**-0.5379*****	**-0.4692*****
	(0.1872)	**(0.1560)**	**(0.1727)**	**(0.1599)**	**(0.1811)**	**(0.1597)**
Obs.	293	293	293	293	293	293
No. of cross-sections	95	95	95	95	95	95
Cross-section FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	48.66%	53.83%	36.42%	46.09%	53.65%	46.97%
F-stat.	**3.9603*****	**3.9741*****	**4.0095*****	**4.0231*****	**3.9551*****	**3.9592*****
J-stat	1.706	3.343	0.106	1.591	1.840	1.811
KP Wald-stat	0.609	0.702	1.865	3.387	7.095	0.891
Hausman-stat	2.673	2.886	2.625	1.936	0.255	2.140

*Note: this table indicates the 2SLS panel regression outputs. The dependent variable is ROA. All models are run as fixed effect 2SLS panel regressions with both period and cross-sectional effects. White's robust standard errors in parentheses. The main predictors are Betweenness centrality (Models 1 & 2), Closeness centrality (Models 3

& 4), and Degree centrality (Models 5 & 6). Models (1), (3), and (5) represent our core linear estimations as presented in Eq. (1). Models (2), (4), and (6) represent our core curvilinear estimations as represented by Eq. (2). Curvilinear effects are captured with the inclusion of a squared transformation of our respective measures of centrality. Both the one-period lagged measure of respective centrality and the number of secure internet servers are utilized as instruments. All models include a full specification of control variables including: size of the SSB; average SSB qualification on a scale of 0 to 4 (the higher the number the higher the qualification); conventional board size; number of independent conventional board members; average conventional board tenure; average number of conventional board meetings; average conventional board qualification on a scale of 0 to 4 (the higher the number the higher the qualification); log of total assets; ration of Shariah to total assets; percentage block holders (5% or more ownership); GDP growth rate; CPI; market liquidity; market risk; sovereign measure of regulatory development on a scale of -2.5 to +2.5 (higher is better); log of urban population growth. Sargan-Hansen J-stat values for valid instruments, Kleibergen-Paap test for weak identification of instruments, and Durbin-Wu-Hausman test statistics for regressor endogeneity presented at the bottom of the table. ***, ** and * represent significance at 0.01, 0.05 and 0.1 respectively

All 2SLS estimated models are run with both cross-sectional and period fixed-effects and White's robust standard errors. All models in Table 7 are statistically significant at a 1% level with adjusted R^2 values within the region of 50%. Our 2SLS outputs are consistent with our OLS estimations in indicating the presence of a curvilinear relationship between Closeness centrality and IFI performance – Model (4) – and an acceptance of **H4**. Additionally, there is also consistency in terms of the direction of coefficients indicating an inverted U-shaped curvilinear relationship. More importantly, the vertex as suggested by the 2SLS outputs is also consistent with OLS estimations, indicating a turning point of 0.110 Closeness, i.e. -4.3798/ (2 * -19.9580), or approximately an average distance of nine nodes. We further test for instrument exogeneity using the Durbin-Wu-Hausman test, instrument validity using the Kleibergen-Paap (KP-Wald) test for weak instruments, and the Sargan-Hansen test for overidentification of instruments. None of the test statistics for the respective tests, indicated above, are significant for models (1) – (6) indicating both the exogeneity and validity of our instruments within our 2SLS estimations. The test outputs are presented at the both of Table 7.

Next, we also estimate the models utilizing a two-step dynamic GMM[1] estimation with White's robust standard errors (see Arellano and Bover (1995); Blundell and Bond (1998)).

[1] Briefly, by utilizing a GMM regression, we can treat all explanatory variables as endogenous by utilizing their AR(1) transformations as instruments. This eliminates unobserved heterogeneity and addresses omitted variable bias. Consistency between our GMM and OLS outputs enables us to make a claim towards the estimation robustness of our results.

Additionally, both period and cross-sectional fixed-effects are included to further control for sample heterogeneity. Given our unbalance panel data, we use Fisher type tests for unit root testing of individual variables, utilizing a Schwarz information criterion (SIC) of lag length selection (Woolridge, 2018). The results of the SIC suggest the use of a single lag for our GMM estimations. The results of our GMM estimations are given in Table 8.

Table 8 Generalized Method of Moments (GMM) estimations

Dep. Var. = ROA	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
ROA(-1)	0.1172	0.1174	0.1143	0.1234	0.1160	0.1135
	(0.1201)	(0.1199)	(0.1199)	(0.1173)	(0.1218)	(0.1193)
NBET	**-0.0008****	0.0007				
	(0.0004)	(0.0013)				
$NBET^2$		-0.0002				
		(0.0001)				
FCLO			**0.0693****	**0.8777***		
			(0.0267)	**(0.4475)**		
$FCLO^2$				**-3.7687***		
				(2.0223)		
NDEG					-0.0237	-0.1074
					(0.0489)	(0.0951)
$NDEG^2$						0.4001
						(0.4224)
SSBS	0.0015	**0.0016***	0.0015	0.0012	0.0013	0.0013
	(0.0010)	**(0.0010)**	(0.0009)	(0.0009)	(0.0009)	(0.0010)
SSBQ	-0.0018	-0.0017	-0.0018	-0.0016	-0.0017	-0.0018
	(0.0011)	(0.0012)	(0.0011)	(0.0012)	(0.0012)	(0.0012)
BODS	0.0000	-0.0003	0.0002	0.0003	0.0001	0.0001
	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
BODT	-0.0001	0.0001	-0.0001	-0.0002	0.0001	0.0002
	(0.0007)	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0008)
BODM	0.0002	0.0002	0.0002	**0.0003***	0.0002	0.0002
	(0.0002)	(0.0002)	(0.0002)	**(0.0001)**	(0.0002)	(0.0002)
BODI	0.0001	0.0004	0.0000	-0.0001	-0.0001	0.0000
	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
BODQ	-0.0006	-0.0004	-0.0012	-0.0016	-0.0014	-0.0010
	(0.0015)	(0.0014)	(0.0015)	(0.0016)	(0.0015)	(0.0016)
TOAS	**0.0098*****	**0.0095*****	**0.0091*****	**0.0090*****	**0.0090*****	**0.0089*****
	(0.0023)	**(0.0022)**	**(0.0019)**	**(0.0020)**	**(0.0021)**	**(0.0021)**
STOA	**0.0107*****	**0.0104*****	**0.0106*****	**0.0120*****	**0.0108*****	**0.0116*****
	-0.0031	**(0.0031)**	**(0.0028)**	**(0.0030)**	**(0.0029)**	**(0.0029)**
OWN	0.0151	0.0143	0.0141	0.0122	0.0136	0.0134
	(0.0098)	(0.0099)	(0.0095)	(0.0091)	(0.0095)	(0.0095)
GDP	-0.0006	-0.0008	-0.0008	-0.0004	-0.0006	-0.0007
	(0.0009)	(0.0008)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
INF	-0.0015	-0.0012	-0.0013	-0.0015	-0.0015	-0.0017
	(0.0010)	(0.0012)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
LIQ	**-0.0007****	-0.0006	**-0.0007***	**-0.0008****	**-0.0007***	**-0.0007***
	(0.0004)	(0.0004)	**(0.0004)**	**(0.0004)**	**(0.0004)**	**(0.0004)**
RISK	**-0.0026****	**-0.0025****	**-0.0024***	-0.0020	-0.0023	-0.0021
	(0.0012)	**(0.0012)**	**(0.0013)**	(0.0013)	(0.0013)	(0.0013)
REG	**0.0416*****	**0.0398*****	**0.0455*****	**0.0506*****	**0.0384*****	**0.0360*****

	(0.0104)	**(0.0105)**	**(0.0100)**	**(0.0119)**	**(0.0099)**	**(0.0094)**
URBP	**-0.1913*** (0.0487)**	**-0.1844*** (0.0516)**	**-0.1859*** (0.0471)**	**-0.1728*** (0.0486)**	**-0.1818*** (0.0450)**	**-0.1763*** (0.0460)**
Obs.	173	173	173	173	173	173
No. of cross-sections	81	81	81	81	81	81
Cross-section FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
AR(1)	**-1.8162***	**-1.8761***	**-1.7008***	**-1.6665***	**-1.8396***	**-1.8695***
AR(2)	-1.4053	-1.3018	-1.3102	-1.0235	-1.3601	-1.1602
J-stat.	4.9289	4.7841	5.1781	6.4258	4.7248	4.6936

*Note: this table indicates the GMM panel regression outputs. The dependent variable is ROA. All models are run as fixed effect GMM panel regressions with both period and cross-sectional effects. White's robust standard errors in parentheses. The main predictors are Betweenness centrality (Models 1 & 2), Closeness centrality (Models 3 & 4), and Degree centrality (Models 5 & 6). Models (1), (3), and (5) represent our core linear estimations as presented in Eq. (1). Models (2), (4), and (6) represent our core curvilinear estimations as represented by Eq. (2). Curvilinear effects are captured with the inclusion of a squared transformation of our respective measures of centrality. AR(1) transformations are utilized as instruments and Schwarz Information Criterion (SIC indicates single lag). All models include a full specification of control variables including: size of the SSB; average SSB qualification on a scale of 0 to 4 (the higher the number the higher the qualification); conventional board size; number of independent conventional board members; average conventional board tenure; average number of conventional board meetings; average conventional board qualification on a scale of 0 to 4 (the higher the number the higher the qualification); log of total assets; ration of Shariah to total assets; percentage block holders (5% or more ownership); GDP growth rate; CPI; market liquidity; market risk; sovereign measure of regulatory development on a scale of -2.5 to +2.5 (higher is better); log of urban population growth. Arellano and Bond AR(1) and AR(2) serial correlation test stats, and Sargan-Hansen J-stats for exogeneity of instruments presented at the bottom of table. ***, ** and * represent significance at 0.01, 0.05 and 0.1 respectively

Once again, our GMM estimation outputs are consistent with our OLS estimations in suggesting a curvilinear relationship between Closeness and firm performance and an acceptance of **H4** - Model (4). The coefficients for both the linear and quadratic term also indicate consistency with OLS outputs and indicate and U-shaped curvilinear relationship. Similar to both OLS and 2SLS estimations, both the linear and quadratic coefficients in Model (4) also indicate a vertex of 0.116 Closeness, i.e. -0.8777 / (2 * -3.7687), or an approximate turning point of an average firm distance of nine nodes. The non-significance of the Sargan-Hansen J-stat for all models in our GMM estimations also indicates no evidence of instrument overidentification suggesting instrument validity. Additionally, we run the Arellano and Bond serial correlation test for both AR(1) and AR(2) orders (Alvarez & Arellano, 2003). The significant AR(1) and non-significant AR(2) test-statistics indicate a non-rejection of the null hypothesis and that our models possess no serial correlation. Given that our results from both

2SLS and GMM are consistent with our fixed effect panel regression in Table 6, we can highlight that our OLS estimates are robust to alternative estimation methodologies.

5.4.2. Alternative dependent variable – Return on Equity (ROE)

We also estimate our core models using an alternative measure of firm performance. This has the benefit of indicating the stability of sensitivity of estimation outputs thus furthering the robustness of results and increases the usefulness of our findings in highlighting that the impact of our measure of centrality extends beyond just a single measure of firm performance. In line with much of the extant literature we use return on equity (ROE) as out alternative measure of firm performance (Mollah & Zaman, 2015; Pugliese et al., 2014) All models are run as fixed-effect OLS panel regressions – both period and cross-sectional effects – with White's robust standard errors on the diagonal. The results are given in Table 9.

Table 9 Alternative measure of firm performance – Return on Equity (ROE)

Dep. Var. = ROE	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
NBET	-0.0054	0.0046				
	(0.0041)	(0.0081)				
$NBET^2$		**0.0014***				
		(0.0008)				
FCLO			0.3809	**3.5988***		
			(0.3085)	**(1.9627)**		
$FCLO^2$				**-14.7857***		
				(8.6418)		
NDEG					0.0141	-0.5082
					(0.3187)	(0.6970)
$NDEG^2$						2.5841
						(2.7545)
SSBS	0.0096	0.0100	0.0079	0.0068	0.0093	0.0097
	(0.0102)	(0.0102)	(0.0095)	(0.0091)	(0.0101)	(0.0102)
SSBQ	0.0005	0.0012	0.0009	0.0021	0.0006	0.0003
	(0.0094)	(0.0093)	(0.0092)	(0.0092)	(0.0094)	(0.0095)
BODS	0.0021	0.0006	0.0016	0.0020	0.0021	0.0024
	(0.0055)	(0.0055)	(0.0057)	(0.0056)	(0.0057)	(0.0057)
BODT	0.0039	0.0041	0.0029	0.0031	0.0040	0.0043
	(0.0051)	(0.0052)	(0.0051)	(0.0050)	(0.0052)	(0.0052)
BODM	-0.0005	-0.0005	-0.0005	-0.0003	-0.0005	-0.0005
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
BODI	-0.0028	-0.0018	-0.0036	-0.0041	-0.0032	-0.0027
	(0.0049)	(0.0051)	(0.0053)	(0.0052)	(0.0053)	(0.0054)
BODQ	**0.0292****	**0.0306****	**0.0281****	**0.0263***	**0.0271****	**0.0277****
	(0.0127)	**(0.0125)**	**(0.0129)**	**(0.0134)**	**(0.0130)**	**(0.0129)**

TOAS	**0.0651*** (0.0142)**	**0.0646*** (0.0145)**	**0.0607*** (0.0141)**	**0.0611*** (0.0140)**	**0.0625*** (0.0141)**	**0.0622*** (0.0143)**
STOA	0.0441 (0.0380)	0.0456 (0.0378)	0.0425 (0.0370)	0.0503 (0.0350)	0.0451 (0.0375)	0.0474 (0.0377)
OWN	0.0184 (0.0465)	0.0173 (0.0465)	0.0110 (0.0460)	0.0047 (0.0458)	0.0162 (0.0460)	0.0161 (0.0464)
GDP	-0.0041 (0.0040)	-0.0055 -0.0040	-0.0041 (0.0043)	-0.0032 (0.0047)	-0.0038 (0.0044)	-0.0038 (0.0044)
INF	0.0000 (0.0062)	0.0003 (0.0063)	0.0003 (0.0061)	0.0005 (0.0061)	-0.0001 (0.0063)	0.0000 (0.0063)
LIQ	0.0016 (0.0016)	0.0020 (0.0016)	0.0013 (0.0017)	0.0003 (0.0016)	0.0015 (0.0017)	0.0014 (0.0017)
RISK	**-0.0182** (0.0072)**	**-0.0184** (0.0073)**	**-0.0185** (0.0072)**	**-0.0168** (0.0073)**	**-0.0177** (0.0075)**	**-0.0174** (0.0075)**
REG	-0.1468 (0.1734)	-0.1605 (0.1751)	-0.1029 (0.1815)	-0.0498 (0.1965)	-0.1342 (0.1967)	-0.1316 (0.1969)
URBPOP	**-1.5812*** (0.4907)**	**-1.5760*** (0.4935)**	**-1.6625*** (0.5002)**	**-1.4955*** (0.5194)**	**-1.5959*** (0.5320)**	**-1.5687*** (0.5308)**
Obs.	315	315	315	315	315	315
No. of cross-sections	96	96	96	96	96	96
Cross-section FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	66.61%	66.70%	66.70%	67.03%	66.37%	66.30%
F-stat.	**6.4002*** **	**6.3765*** **	**6.4206*** **	**6.4555*** **	**6.3430*** **	**6.2502*** **

*Note: this table indicates the fixed effects OLS panel regression outputs with an alternative measure of firm performance. The dependent variable is ROE. All models are run as fixed effect OLS panel regressions with both period and cross-sectional effects. White's robust standard errors in parentheses. The main predictors are Betweenness centrality (Models 1 & 2), Closeness centrality (Models 3 & 4), and Degree centrality (Models 5 & 6). Models (1), (3), and (5) represent our core linear estimations as presented in Eq. (1). Models (2), (4), and (6) represent our core curvilinear estimations as represented by Eq. (2). Curvilinear effects are captured with the inclusion of a squared transformation of our respective measures of centrality. All models include a full specification of control variables including: size of the SSB; average SSB qualification on a scale of 0 to 4 (the higher the number the higher the qualification); conventional board size; number of independent conventional board members; average conventional board tenure; average number of conventional board meetings; average conventional board qualification on a scale of 0 to 4 (the higher the number the higher the qualification); log of total assets; ration of Shariah to total assets; percentage block holders (5% or more ownership); GDP growth rate; CPI; market liquidity; market risk; sovereign measure of regulatory development on a scale of -2.5 to +2.5 (higher is better); log of urban population growth. ***, ** and * represent significance at 0.01, 0.05 and 0.1 respectively

All models are statistically significant at a 1% level with adjusted R^2 values within the region of 67%. Similar to our OLS estimations for ROA, our results for ROE also indicate an acceptance of **H4** and that there is an inverted U-shaped curvilinear relationship between Closeness and IFI performance – Model (4). The vertex from our ROE estimations also largely consistent in indicating a turning point of 0.12 Closeness, i.e. -3.5988 / (2 * -14.7857), or approximately an average node distance of eight nodes. Given our results from Table 9, we can indicate that our OLS estimations are robust to alternative dependent variables.

5.4.3. Testing for sample heterogeneity

As a final test of robustness, we assess the heterogeneity of our sample utilizing two methods. Firstly, we censor the sample, by excluding the largest and the smallest IFIs, and rerun our core regression models from Eq. (1). The results from these estimations are given in Table 10. For brevity and tractability, we have chosen to not include the estimation outputs for the control variables but it should be noted that all models in Table 10 include the full specification of controls.

Table 10 OLS regressions on censored dataset – removing the largest and smallest IFIs

Dep. Var. = ROA	**Panel A: Top 10% of sample removed**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
NBET	-0.0002	0.0007				
	(0.0008)	(0.0023)				
$NBET^2$		-0.0002				
		(0.0006)				
FCLO			0.0416	**0.8013*** **		
			(0.0387)	**(0.2597)**		
$FCLO^2$				**-3.4763*** **		
				(1.1906)		
NDEG					-0.1230	-0.0847
					(0.0803)	(0.1449)
$NDEG^2$						-0.2193
						(0.8720)
Obs.	294	294	294	294	294	294
No. of cross-sections	85	85	85	85	85	85
Cross-section FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	56.69%	56.49%	56.85%	57.75%	57.59%	57.39%
F-stat.	**4.6520*** **	**4.5892*** **	**4.6768*** **	**4.7775*** **	**4.7893*** **	**4.7222*** **
Dep. Var. = ROA	**Panel B: Bottom 10% of sample removed**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
NBET	-0.0008	0.0009				
	(0.0006)	(0.0011)				
$NBET^2$		**-0.0002*** *				
		(0.0001)				
FCLO			0.0312	**0.4968***		
			(0.0341)	**(0.2550)**		
$FCLO^2$				**-2.1389***		
				(1.1777)		
NDEG					-0.0722	-0.1143
					(0.0697)	(0.1155)
$NDEG^2$						0.2108
						(0.5183)
Obs.	304	304	304	304	304	304
No. of cross-sections	87	87	87	87	87	87

Cross-section FE	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	51.78%	51.99%	51.60%	51.96%	51.93%	51.73%
F-stat.	**4.0409*** **	**4.0380*** **	**4.0185*** **	**4.0348*** **	**4.0600*** **	**4.0065*** **

*Note: this table indicates the core fixed effects OLS panel regression outputs run on a censored sample. The dependent variable is ROA. Panel A gives the outputs with the top 10% of the sample removed – the largest firms. Panel B givens the regression outputs with the bottom 10% of the sample removed – the smallest firm. All models are run as fixed effect OLS panel regressions with both period and cross-sectional effects. White's robust standard errors in parentheses. The main predictors are Betweenness centrality (Models 1 & 2), Closeness centrality (Models 3 & 4), and Degree centrality (Models 5 & 6). Models (1), (3), and (5) represent our core linear estimations as presented in Eq. (1). Models (2), (4), and (6) represent our core curvilinear estimations as represented by Eq. (2). Curvilinear effects are captured with the inclusion of a squared transformation of our respective measures of centrality. All models include a full specification of control variables including: size of the SSB; average SSB qualification on a scale of 0 to 4 (the higher the number the higher the qualification); conventional board size; number of independent conventional board members; average conventional board tenure; average number of conventional board meetings; average conventional board qualification on a scale of 0 to 4 (the higher the number the higher the qualification); log of total assets; ration of Shariah to total assets; percentage block holders (5% or more ownership); GDP growth rate; CPI; market liquidity; market risk; sovereign measure of regulatory development on a scale of -2.5 to +2.5 (higher is better); log of urban population growth. ***, ** and * represent significance at 0.01, 0.05 and 0.1 respectively

Once again, all models in Table 10 are run as fixed effect OLS panel regressions against ROA as a dependent variable – controlling for period and cross-sectional effects – with White's robust standard errors on the diagonal. Panel A in Table 10 indicates the outputs with the top 10% of the sample removed, i.e. the largest IFIs, whilst Panel B displays the outputs with the bottom 10% of the sample removed, i.e. the smallest IFIs. We observe consistency between the outputs in Table 6 and Panels A and B of Table 10 with the acceptance of **H4** and the presence of an inverted U-shaped curvilinear relationship between Closeness and IFI performance.

Secondly, we engage a test of the robustness of the data and the models through the use of quantile symmetry and slope equality tests. Given that our data is organize in rank order we can engage both quantile symmetry and slope equality tests for sample heterogeneity along a size dimension. We further decompose our sample in three quantiles, allowing us to further discern if there are significant differences between IFIs of varying sizes. We utilize the Wald test for both quantile symmetry and slope equality. Summarily, non-rejection of the null hypothesis for both tests indicate that smaller models are appropriate representations of the unrestricted models (Koenker & Bassett, 1982). The test statistics (X^2= 46.8198, 3 quantiles, 36 d.f. – Wald test for slope equality; X^2= 14.2644, 3 quantiles, 19 d.f. – Wald test for symmetric quantiles) for our curvilinear Closeness model (Model 4) are not significant at a 5% level thus indicating a non-rejection of the null hypotheses for the respective Wald tests indicating that there is sample homogeneity.

6. Conclusions

Our study seeks to examine the interlocking behavior of SSBs and further decomposes the impact of social network positioning of SSBs on the performance of IFIs. Extant research has shown the dominance of a small group of Shariah scholars within the SSB networks forming what can be conceptualized as the global Shariah elite who establish both in- and out-boundary national networks of competence and informational flows. Our empirical results provide support for this resource dependence conceptualization of SSB interlocking behavior and the wider socio-economic literature of elite networks. More specifically, we contribute to the extant academic literature in the following manner. Firstly, our analysis provides new insight into the socio-economic impact of SSB social network positioning in indicating that network proximity as measured by Closeness centrality possesses a significant curvilinear effect on IFI performance. This suggests that beyond a threshold point, the benefits of indirect interlocking behavior invert into financial detriments for hiring IFIs. Our results run contrary to existing studies such as Gözübüyük et al. (2018) and indicates that it not direct but rather network proximity that manifests economic value to the hiring firm. To the best of our knowledge this use of granular data to establish direct and indirect links, and network proximity to assess SSB interlocking behavior on IFI performance is the first of its kind within the extant academic literature.

Secondly, our examination of the interlocking behavior of SSBs confirms the existing sociological studies where these interlocks link geographical hubs of Islamic finance (Bassens, Engelen, Derudder, & Witlox, 2013; Djelic, 2004; Gözübüyük et al., 2018; Pollard & Samers, 2013). We observe a dense geographical network comprised of middle-eastern, Malaysian and British SSBs, whilst the periphery is predominately populated with SSBs from Pakistan and Bangladesh, with Malaysian and Indonesian SSBs establishing their separate in-boundary networks. Moreover, we also discover that there are no discernible differences in the structure of these social networks amongst Shariah-based and Shariah-compliant IFIs, but we observe that IBs link the periphery with the dense core of the social networks. Finally, our use of a multi-theoretic economic of sociology lens merging resource dependency and elite networks theory furthers the broader Shariah governance literature in further disentangling the role of the SSB and provides further evidence that any conceptualization of SSBs has to move beyond the traditional agency framework (Hassan & Aliyu, 2018; Narayan & Phan, 2019).

From a practical perspective, our study possesses important implications for managers as it further decomposes the social network structures of SSBs and their impact on firm performance. We illustrate from our findings that managers have to be aware of the benefits of the informational flows from establishing closer links with other IFIs. More specifically, our results indicate that it is network proximity as opposed to direct connections that positively impact IFI performance. From a policy-based perspective, we highlight to hiring IFIs that there are no benefits from acquiring highly connected Shariah scholars. Our results further indicate that as social networks become denser, there are increasing complexities to informational flows that negate the initial economic benefits borne from network proximity. As such, given that it is highly likely that the move away from highly connected Shariah scholars will result in cost-savings, our findings allow us to indicate to managers of IFIs that these savings should be put towards managing the proximity of the SSB so as to avoid issues of informational overload and Shariah governance process redundancies. Our study also highlights that the patterns of network structures are relatively time invariant and awareness of these facets can help facilitate decision-making and the building of appropriate governance resources. This has broader implications as Islamic finance grows into more traditional financial hubs a more developed understanding of the nuances of Shariah governance has to be developed. Moreover, given the failings of conventional governance mechanisms within financial institutions over the financial crises, Shariah governance is a generative area of study as an alternative framework.

Whilst our results are important, our study faces several limitations. Firstly, while we have established a parsimonious model with an endogeneity-robust estimation method, we have not considered alternative conceptualizations of the SSB – stakeholder model - which may provide further explanatory power. Secondly, we attempt to control for national regulatory differences by utilizing several governance indicators; there could be further consideration for central Islamic financial regulatory bodies such as the IFSB and AAOIFI.

To conclude, adopting a multi-theoretic economics of sociology approach, we set out to examine the interlocking behavior of SSBs and to further decompose the impact of SSB network position on IFI performance. Our results shed new light on the benefits of SSB network proximity on IFI performance. However, there are threshold limits to these positive impacts. Our findings also provide support for the existing socio-economic literature in that SSB social networks develop along geographical dimensions. We contend that further research could include a stakeholder conceptualization of SSB networks.

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