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INNOVATIVE CAPACITY IN MUSLIM-MAJORITY COUNTRIES: DOES ISLAMIC FINANCE PLAY A ROLE?

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ABSTRACT

The paper examines the influences of Islamic finance and overall financial development on innovative capacity of Muslim-majority nations. It employs a panel dataset comprising 15 Muslim-majority countries over the period 2016-2022. Innovative capacity is measured by the number of patent applications, decomposed into applications made by residents and non-residents. Employing the Feasible GLS technique and taking into account the presence of heteroskedastic and serially correlated errors, we find that the development of Islamic finance is vital for innovations. More specifically, we find robust evidence suggesting that Islamic finance positively affects innovations by non-residents while it has no influence on innovations by residents. Furthermore, overall financial development also significantly influences innovations by non-residents but not innovation by residents. Moreover, there is evidence that trade openness and foreign direct investment positively influence innovations and natural resource rents exert negative impact on innovations. The study concludes that financial system policies that encourage the awareness, accessibility, and depth of Islamic finance operations are needed to boost innovative capacity. Awareness campaign and policies aimed at developing technical education in these countries should be pursued to boost the innovative capacities of residents, which is considerably lower when compared to innovative activities from abroad.

Keywords: Innovation, Islamic finance, Financial development, Muslim-majority countries.
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I. INTRODUCTION

The importance of innovative capacity of individuals and enterprises in the growth and development of an economy cannot be overemphasized. New ideas and invention must continue to surface to meet the ever-evolving demands for products locally and internationally. According to the Schumpeterian innovation paradigm, every organization must engage in "new combinations" of factors of production in order to survive in a continually changing business environment (Schumpeter, 1934). This premise has been reinforced over time by new theories that identify innovation as a primary driver of national economic growth (Howitt & Aghion, 1998; Romer, 1990). Schumpeter's (1934) innovation theory also emphasizes the importance of the financial system in implementing innovative endeavors, as they are both costly and risky with uncertain outcomes (Nawrocki & Jonek-Kowalska, 2022).

The financial system aims to provide financial resources to firms that seek to develop or absorb knowledge. Later research, notably in the field of financial intermediation, has emphasized this importance. The theory of financial intermediation identifies the financial system as a stimulus for entrepreneurship because it performs "qualitative transformation of assets," hence reducing risks associated with asymmetric information, controlling costs, and so on (Gurley & Shaw, 1955). The financial system plays a crucial role in identifying and financing high-potential firms and implementing innovative procedures. Financial system development is also a key factor in long-term economic growth, according to other studies that expand on endogenous growth models. This strand of the literature supports the premise that information asymmetry, transaction cost, and idiosyncratic risks are reduced through the financial system (Haruna et al., 2024).

Beyond the theoretical stances, one of the relevance of finance, in general, relates to access to capital. Innovation requires significant investment in research and development (R&D), infrastructure, and skilled labour (Fryges et al., 2015). Adequate financing, especially from financial institutions, enables firms to invest in new technologies. Finance is also relevant to innovation because it provides risk capital through venture capital and private equity, which encourages startups and businesses to develop breakthrough innovations (Wellalage & Locke, 2020). The financial system helps to boost innovation through several services, including banking, venture capital, and the capital market. For instance, bank loans have widely been employed to help businesses fund R&D and scale up innovative products and services. Access to bank financing helps firms, especially startups, and SMEs, to invest in technological advancements and promote more innovation (Brown et al., 2009). Moreover, venture capital can also play a pivotal role in promoting innovation by providing essential funding, strategic guidance, and resources to startups and emerging companies. This support enables entrepreneurs to develop groundbreaking technologies and business models that might otherwise struggle to secure financing through traditional means (Samila & Sorenson, 2011; Bernstein et al., 2016). Therefore, given the role of innovations in growth, expanding financial access to startups and businesses can boost innovation-led economic growth. With the importance of finance in general to innovation, Islamic finance is expected to play a more significant role in boosting innovation by providing alternative financing mechanisms that align with ethical and risk-sharing principles.

Theoretically, as a case is being made for the importance of the financial system to the advancement of innovations, there should equally be a strong case for the role of Islamic finance in promoting innovations. The rules and norms of Islamic law (*Shari'aa*) is the main guide for the policies and operations of Islamic finance, making it a reflection of Islamic injunctions (Pollard & Samers, 2007). One of the main principles in Islamic finance is the prohibition of *Riba*, that is, giving or taking interest, which is considered oppressive in Islamic law. The prohibition of *Riba* is therefore, based on the notion that profit is not eligible to be taken by exchanging money for money, but by trading in goods and services (Mbawuni & Nimako, 2017). However, Islam allows for a return on capital as long as it contributes to the productive process. Therefore, interest-taking is replaced with profit and loss sharing (Haruna et al., 2024).

The profit and loss sharing concept is considered more humane to interest on loans, in turn, makes Islamic finance a viable alternative to help boost productivity in businesses, especially for enterprises that engage in inventing new products for the market, because profits for such businesses usually take longer to be made (Pericoli, 2020). This is also argued from the point that interests place undue pressure on enterprises which negatively affects their long-term performance and has ultimately led to the failure of many small enterprises (Rabbani et al., 2021). Furthermore, Islamic finance emphasizes financial inclusion and equitable distribution of wealth (Andiansyah et al., 2022). By promoting inclusivity, Islamic finance ensures that the benefits of innovation are widely shared across society. This can lead to the development of innovations that address the needs of diverse populations, fostering inclusive and sustainable development (Muhammed et al., 2024). Moreover, Islamic finance discourages short-termism and speculative activities, promoting investments with long-term value creation. This long-term perspective is beneficial for innovation, which often requires sustained investment over time. Islamic financial institutions can provide relatively patient capital that supports long-term R&D projects, allowing innovators to develop breakthrough technologies without the pressure for immediate returns. All these provide some arguments for the need to examine if truly, the development of Islamic finance has helped boost innovative capacity. However, despite the need for this investigation, only a few studies have made such an attempt, leaving some voids in empirical literature regarding the Islamic finance-innovation nexus.

Some of the attempts that investigate the impact of Islamic finance on innovation include the works of Haruna et al. (2024) and Alhammadi (2024). However, the study by Alhammadi (2024) focuses on a conceptual explanation of the relationship between Islamic finance and innovations. Thus, it lacks empirical evidence from which evidence-based policy implications could be derived. The empirical investigation in the work of Haruna et al. (2024) is only an enterprise-level analysis, which only focuses on Cameroonian SMEs. The study provides some evidence for the role of Islamic finance in promoting three types of innovation, process, product, and marketing innovation. Despite its significant contributions, the study's implication is limited to Cameroonian SMEs, as SMEs in different countries display inherently unique characteristics. Furthermore, given that the study covers local SMEs, the three types of innovation are most likely those by residents. However, the level of innovation in a country is not

limited to those made by residents. Non-resident innovations are as important as those made by residents due to their ability to attract technological transfer from foreign countries. Haruna et al. (2024) is not only a geographically restricted study that poses no cross-country implication, but it does not also consider the total innovation made in a country, which includes innovation by non-residents. This leaves a huge gap regarding the role of Islamic finance in boosting innovations across countries. These voids motivate this study. The main objective of this study is therefore, to examine the role of Islamic finance development, as well as overall financial development on innovative capacity in Muslim-majority countries in which the Islamic finance system is well adopted and practiced.

The rest of the paper is organized as follows: Section 2 reviews the literature, Section 3 explains the data and methods, Section 4 presents and discusses the results, and Section 5 summarizes the study and makes policy recommendations.

II. LITERATURE REVIEW

2.1 Theoretical Literature

2.1.1. Finance and Innovation

In economics literature, the theoretical link between finance and innovation is usually based on the Schumpetarian theory of innovation. The theory stresses the importance of financial markets in enabling entrepreneurs to realize their creative ideas. It contends that innovation is the fundamental driver of economic development and that entrepreneurs, aided by financial resources, are the key agents of innovation (Schumpeter, 1934). The theory emphasizes the role of financial intermediaries, such as banks, in providing the capital required for entrepreneurs to invest in innovative technology and business models. Many potentially transformative ideas would not be implemented if they have no access to funding, and this has some implications for economic growth (Schumpeter & Backhaus, 2003). Furthermore, the financial constraints theory provides a theoretical foundation for the finance-innovation nexus from an enterprise-level viewpoint. This theory explores how limited access to finance can impede enterprises' ability to invest in innovation. Firms, particularly smaller and newer ones, frequently suffer considerable financial constraints, which might hinder their ability to develop and commercialize novel technology (Baskin & Miranti, 1997). Financial markets can help to foster innovation by removing these barriers. For example, venture capital is an important source of investment for start-ups with tremendous growth potential but high risk, which traditional banks may not be willing to support (Cleary et al., 2007).

2.1.2. Islamic Finance and Innovation

Drawing inspiration from the Schumpeterian school of innovation to establish a resilient and ethical approach to financial innovation, the Islamic school of innovation framework integrates principles from traditional innovation theories with Islamic economic philosophy (Dusuki & Abdullah, 2007). It emphasizes that financial innovation within Islamic finance should align with Shariah principles, promoting ethical and socially responsible financial products (Chapra, 2008). This

approach not only fosters economic development but also ensures that innovations contribute positively to society (Mansour et al., 2015). While the framework incorporates Joseph Schumpeter's innovation theory, which emphasize the role of entrepreneurs in economic transformation, innovation in the Islamic context is encouraged only if it preserves social justice, reduces inequality, and avoids exploitation (Mansour et al., 2015). The key features of this framework include an emphasis on ethical and socially responsible innovation, product development and financial engineering, and institutional and regulatory support. Unlike conventional financial innovation, which often prioritizes profit maximization, the Islamic School of Innovation promotes ethical investments that contribute positively to society (Dusuki & Abdullah, 2007). Islamic finance prohibits interest (riba), excessive uncertainty (gharar), and unethical investments, guiding financial innovation within moral and ethical boundaries (Chapra, 2008). Furthermore, the framework encourages Shariah-compliant financial engineering, leading to the creation of innovative Islamic financial products, such as Sukuk (Islamic bonds), Takaful (Islamic insurance), and Islamic fintech solutions (Iqbal & Mirakhor, 2013). It supports risk-sharing models (mudarabah and musharakah) rather than debt-based financing, ensuring sustainable financial innovation (Ahmed, 2008). The growth of Islamic financial innovation depends on strong institutional governance and regulatory frameworks (Hasan, 2010). International bodies such as AAOIFI (Accounting and Auditing Organization for Islamic Financial Institutions) and IFSB (Islamic Financial Services Board) play a crucial role in guiding innovative financial products within the Islamic finance ecosystem (Dusuki & Abdullah, 2007).

2.2. Empirical Literature

2.2.1. Financial System and Innovation

In addition to the theoretical stances on how finance and Islamic finance relate to innovation, several empirical papers have investigated the impact of the financial system on innovation, mostly on enterprise innovation. These studies employ various measures of innovation, including the output-based measure, the global innovative index, the Community Innovation Surveys from the OECD's Oslo Manual, and the input-based measure. The former two measures are mostly applied when the analysis concerns cross-country investigation while the latter two are applied to enterprise-level analysis. As for the input-based measure, the focus is on an enterprise's total investment in research and development (R&D). In this case, total enterprise expenditure on R&D is used to capture the level of innovation. The Community Innovation Surveys from the Oslo Manual recommends a survey-based approach to assess an enterprise's usage of four types of innovation: product, process, marketing, and organizational. The output-based measure focuses on the number of patents generated, therefore, the larger the patent applications, the more the innovative capacity of a country. The global innovative index employs numerous indicators across knowledge creation, infrastructure, education, and political environment to compute a ranking of several economies based on innovation performance. Regardless of the metric used, empirical investigations consistently show that the financial sector improves innovative capacity.

Empirical findings consistently demonstrate that financial development positively influences innovation. Micucci & Rossi (2017) find that firms in Italy relying on bond and equity financing exhibit higher R&D investment levels, indicating that relationship lending only partially substitutes direct access to financial markets. Similarly, Nanda & Nicholas (2014) highlight the negative impact of banking distress on firm-level innovation during the Great Depression, particularly in capital-intensive industries. Fryges et al. (2015) show that a higher loan share facilitates greater R&D expenditure among young firms, while Xiong et al. (2023) establish that Digital Inclusive Finance (DIF) significantly enhances enterprise R&D innovation, particularly for private firms.

Further research has analyzed the impact of financial access on patent applications. Liu et al. (2022) find that commercial financing increases enterprise technical innovation and patent quality. Liu et al. (2019) confirm that bank loans drive technological innovation in Chinese listed firms. Adegboye & Iweriebor (2018) demonstrate that ease of access to bank finance positively influences innovation among Nigerian SMEs, particularly in product, process, and organizational innovations. Ruiz-Palomo et al. (2022) further emphasize that removing financial constraints enables SMEs to innovate more effectively, especially in technology and management innovation, with a larger impact on women-led businesses.

Despite the overwhelming evidence supporting the role of finance in fostering innovation, limited studies have examined the role of Islamic finance in this domain. Haruna et al. (2024) provide firm-level evidence that Islamic finance promotes SME innovation in Cameroon, particularly in technological innovation. Alhammadi (2024) conceptually discusses the potential of Islamic finance in supporting economic sustainability and innovation in Gulf Cooperation Council (GCC) countries. However, a cross-country empirical investigation into the impact of Islamic finance on innovation remains scarce, creating a gap in the literature that this study aims to address.

2.2.2. Islamic Finance and the Economy

Islamic finance has been widely recognized as a potential driver of economic growth. Studies by Naz & Gulzar (2022) and Wahyuningsih & Nurzaman (2020) examine the linkage between Islamic finance and macroeconomic performance. Andiansyah et al. (2022) find that Islamic financial instruments, including Sukuk, Shari'ah-compliant stocks, and Zakat, positively contribute to economic growth through their profit-and-loss-sharing mechanism, which eliminates interest-based financing. Islamic finance operates under the principles of risk-sharing and ethical financial transactions, which support financial inclusion and sustainable development (Askari et al., 2014; Nafar & Amini, 2017). Alhammadi (2022) explores the restructuring of Islamic banking post-COVID-19, highlighting its role in economic recovery. Al Madani et al. (2020) demonstrate that Sukuk investments align with Maqasid Al-Shari'ah by promoting sustainability and human well-being. Othman et al. (2021) find that Zakat distribution supports Sustainable Development Goals (SDGs) by improving economic welfare in Malaysia.

Furthermore, Aassouli et al. (2018) assess the role of Islamic financial institutions in liquidity management and sustainable development, confirming that financial

innovation in Islamic banking enhances financial stability. Budalamah et al. (2019) propose that Waqf can be leveraged to finance municipal projects aligned with SDG targets. Yesuf & Aassouli (2020) argue that incorporating Environmental, Social, and Governance (ESG) considerations into Islamic finance promotes sustainable investments. Using a sample of 15 Muslim-majority countries, Muhammed et al. (2024) find a positive association between Islamic financial development and sustainable growth.

2.2.3. Other Determinants of Innovation

Beyond financial development, several other factors influence innovation at both enterprise and national levels. At the firm level, Pertuz et al. (2018) identify organizational structure, work climate, and human resource management as key determinants of innovation among medium-sized firms. Restrepo-Morales et al. (2019) emphasize the role of R&D activities and strategic alliances in enhancing SME innovation in Colombia. Babuchowska & Marks-Bielska (2021) find that compliance with regulations and quality improvement drive innovation in Polish dairy farms. Kireyeva et al. (2021) find that a company's age, kind, sector, R&D, and technology all favorably impact its innovation potential. Kireyeva et al. (2021) also find that market competition and geography have a negative impact on innovation.

For country-level analyses, determinants of innovation include, income level and human capital (Qureshi et al., 2021; Furman et al., 2002; Agwu & Emeti, 2014; Zanello et al., 2016; Zhu et al., 2020), infrastructural development (Hsu et al., 2014; Agwu & Emeti, 2014; Pan et al., 2021; Qureshi et al., 2021), trade openness (Khan et al., 2023; Furman et al., 2002; Zhu et al., 2020), institutional quality (Farsi & Toghraee, 2015), and increased investment (Sudolska & Łapińska, 2020; Qureshi et al., 2021; Farsi & Toghraee, 2015).

Therefore, taking into consideration other determinants of innovation, this study arrives at the explanatory variables alongside Islamic finance and financial development that are included in its empirical model as specified in the next section. This enables the study to effectively investigate this phenomenon by bridging the gaps in the literature and controlling for important variables.

III. METHODOLOGY

3.1. Data

This study uses a panel dataset comprising 15 Muslim-majority countries, i.e. the United Arab Emirates, Sudan, Saudi Arabia, Qatar, Pakistan, Oman, Nigeria, Maldives, Malaysia, Kuwait, Jordan, Indonesia, Bangladesh, Brunei, and Bahrain. The time period is between 2016 and 2022. The study focuses on these countries, where, like other developing countries, there is strong need for innovation to transform the economies and boost their quest for sustainable development. Also, these countries are leading in terms of the depth of Islamic finance, and the evaluation of the effect and sustainability of such finance source is still yet to be fully revealed. Furthermore, the selection of these countries among other Muslim-majority countries, as well as the selection of the start and end periods, is

based on data availability, as consistent data on Islamic finance development are not available for other countries. The analysis uses annual information from the World Bank's World Development Indicators (WDI) database as well as from a combined Islamic Finance Development report of the Islamic Corporation for the Development of the Private Sector (ICD), the Islamic Development Bank (ISDB) Group, and Refinitiv Reports. Table 1 lists the variable descriptions.

3.2. Model

The following regression model is specified to achieve the aims of this study. The first model examines how Islamic finance, among other factors, influences innovative capacity while the second model specifies the influence of overall financial development on innovation. Both Islamic finance and overall financial development are included separately to avoid the high correlation between which may lead to severe multicollinearity problem.

Following the literature on the relationship between finance and innovation (Haruna et al., 2024; Zhu et al., 2020), the empirical model of this study is specified as follows:

$$logINO_{it} = \gamma_0 + \gamma_1 logGDPP_{it} + \gamma_2 logFDI_{it} + \gamma_3 logTO_{it} + \gamma_4 logNR_{it} + \gamma_5 logIFD_{it} + e_{it} \quad (1)$$

where logINO is the natural log of innovation – the dependent variable, which is used in three variants – total innovation, innovation by residents, and innovation by non-residents. As described in Table 1, total innovation is captured by the total patents application in each country while residents and non-residents innovation are captured, respectively, by patents applications by the residents of the country and non-residents who engage in foreign investments from other countries. The explanatory variables include natural log of GDP per capita (logGDPP), natural log of foreign direct investment (logFDI), natural log of trade openness (logTO), natural log of natural resource rents (logNR), and natural log of Islamic financial development (logIFD). *e* represents the disturbance term.

Innovation is represented in this study by patent applications, following Liu et al. (2019). A patent application is a pending request at a patent office for the issuance of a patent for an invention specified in the patent specification, as well as a set of one or more claims stated in a formal document that includes all relevant official documents and correspondence. Total innovation refers to total patent application; innovation by residents refers to patent applications by residents of a country, while innovation by non-residents refers to patent application by non-residents of a country. Both innovation by residents and non-residents are considered to foster more specific and informed policy recommendations. Patent applications are deemed more suitable to capture innovation because, on one hand, there is relatively more consistent cross-country data than other measures, and on the other hand, it reflects the actualized creation of an idea which will most likely represents innovation. Alternative measures such as research and development expenditure is a direct input into the innovation process but this may not always

result into an innovation. Number of scientific publications is also an alternative but is flawed based on similar argument, in that, the published ideas may not transform into actual creation.

Following Muhammed et al. (2024), Islamic financial development in this study is quantified using the Islamic finance development score. The Islamic finance development score is a simple average of each country's score in the various Islamic finance development sub-indicators that helps to measure the overall success of the Islamic finance industry in relation to its basic faith-based goals. It is a worldwide composite indicator that includes indicators from specific countries and industries. The Islamic Finance Development score is a single indicator that provides a comprehensive picture of the Islamic finance industry, including all sectors. It is computed from several crucial sub-indicators that support the industry.

The Indicator's components include the quantitative development of Islamic finance, corporate governance of Islamic finance institutions, corporate social responsibility, knowledge of Islamic finance, and awareness of its availability (Muhammed et al., 2024).

Overall financial development is captured in this study by the financial development index developed by the International Monetary Funds (IMF). This is in line with the study by Destek et al. (2020). The financial development index is employed to effectively capture each countries financial system's performance in terms of depth, access, and efficiency. The index ranges between 0 and 1, with 0 signifying the worst performance of the financial system and 1 signifying the best performance of the financial system.

3.3. Data Analysis

Summary statistics are used to perform a descriptive analysis on the variables. The statistics primarily indicate the mean, standard deviation, lowest, and maximum values for each variable. Pairwise correlation is also utilized to determine the relationship between variables and ensure that the relationships among explanatory variables are not too strong, which could lead to multicollinearity issues. Scatter plots of relationships are also used to further describe the relationships among some variables. The feasible generalized least squares (FGLS) method is employed in the empirical analysis to establish how innovation is influenced by Islamic finance and overall financial development. FGLS enables estimation that is robust to heteroskedasticity and cross-sectional dependence as well as autocorrelation within units (Biørn, 2010).

The Feasible Generalized Least Squares (FGLS) method is an econometric technique used to estimate the parameters of a regression model when the assumptions of ordinary least squares (OLS) are violated, particularly the assumption of homoscedasticity (constant variance of errors) or no autocorrelation in the errors. FGLS is particularly useful when the error terms exhibit heteroscedasticity or serial correlation. The GLS is a generalized form of OLS that accounts for heteroscedasticity or autocorrelation by transforming the model in a way that the transformed error terms are homoscedastic and uncorrelated (Greene, 2012). However, GLS requires knowledge of the exact structure of the variance-

covariance matrix of the errors, which is often unknown in practice (Maddala & Lahiri, 2009). The FGLS is an extension of GLS where the variance-covariance matrix of the errors is unknown and must be estimated from the data (Greene, 2012). The method involves a two-step process - the Initial OLS estimation and transformation and re-estimation. The first step is the estimation of the model parameters using OLS, and then using the residuals from this estimation to estimate the structure of the error variance-covariance matrix. The second step is the transformation of the original model using the estimated variance-covariance matrix and re-estimating the parameters using GLS on the transformed model (Greene, 2012).

The main advantages of this method are that, it can produce more efficient (lower variance) estimates than OLS when the assumptions of OLS are violated, and it helps in correcting the bias in standard errors that occurs due to heteroscedasticity or autocorrelation, leading to more reliable hypothesis tests (Greene, 2012).

The Feasible Generalized Least Squares (FGLS) method is commonly used to address heteroscedasticity and autocorrelation in panel and time-series data. However, several alternative estimation techniques can be employed depending on the nature of the data and the econometric challenges faced. Among the viable alternative to FGLS in the context of static panel regression is the panel-corrected standard errors (PCSE) estimator. PCSE is an alternative to FGLS that also corrects for heteroscedasticity and cross-sectional dependence in panel data (Beck & Kats, 1995). However, unlike the dataset of this study, it is preferred when T > N, as FGLS tends to underestimate standard errors in small panels. The Maximum Likelihood Estimation (MLE) is another alternative estimation technique. MLE is an efficient estimator under normality assumptions and is widely used when parameters need to be estimated in nonlinear models. however, MLE is particularly beneficial when dealing with limited dependent variables, i.e., discrete choice or categorical variables (Greene, 2012). This makes MLE unusable for this study.

IV. RESULTS AND ANALYSIS

4.1. Descriptive Analysis

From the descriptive statistics in Table 2, the average total innovation (patent applications) recorded for these countries for 2016-2022 is about 2,032, with the lowest being 89 patent applications and the highest being 11,481 patent applications. These total patent applications comprise patent applications by residents of each country (used to capture innovation by residents) and patent applications by non-residents (captures innovation by non-residents). On one hand, average patent application by residents is about 386, with the least being only 2 applications and the most being 3,093 applications. On the other hand, average patent application by non-residents is substantially higher for each of the countries. Its average stands at about 1,646, with the lowest application being only 1 application and the most being 8,538 applications.

Average GDP per capita stands at US$17,181.9 at 2015 constant prices. A country has as low as US$1,307.7 GDP per capita during the period under study, while a country has as high as US$64,233.3. Average net foreign direct investment inflows to these countries are 2.435 percent of GDP, while a country experiences a

net outflow of 1.686 percent of GDP and a country has as much as 17.13 percent of GDP. Trade openness is high with an average of 82.69 percent of GDP recorded. A trade worth of 2.699 percent of GDP is the lowest recorded and a trade worth of 172.8 percent of GDP is the highest. Natural resource rents have an average of 11.71 percent of GDP, with as low as 0.003 percent of GDP accruing to a country and natural resource rent of as high as 45.15 percent GDP accruing to a country. Islamic finance development index averages 51.51, with the lowest being 23 and the highest being 132. Overall financial development index has an average of 0.362, with the lowest being 0.095 and the highest being 0.732.

As a further description of the variables, the correlations among them are presented in Table 3. The correlation matrix reveals a high positive relationship between innovations by residents and non-residents, as expected. In addition, innovation by residents and Islamic finance development are positively correlated and significant. Also, overall financial development is significantly and positively related to innovation by residents. Moreover, a significant negative correlation is established between innovation by residents and each of GDP per capita and trade openness, which is quite surprising. It is expected that innovation by residents should move in the same direction with both variables to indicate that more innovation occur with higher income and more openness to international trade. However, the negative relationship might be suggestive of a situation in which higher attempt to create new ideas only occur when income is low and there is need to create something to earn a living. It may also be true that higher exposure to international trade gives rise to lots foreign alternative goods which may discourage the need to create new ideas. Similarly, innovation by non-residents is only seen to be significant and positive in its correlation with each of Islamic finance development and overall financial development. Furthermore, there is significant and positive correlation between GDP per capita and each of trade openness, natural resource rents, and overall financial development; and between FDI and trade openness, but there is significant and negative correlation between FDI and each of natural resource rents and overall financial development. A significant positive correlation is also established between trade openness and each of natural resource rents, Islamic finance development and overall financial development, and between natural resource rents and Islamic finance development. A high correlation also exists between Islamic finance development and overall financial development.

Table 1.
Definitions of Variables

Variable Name	Description	Supporting literature	Data Source
Innovation by residents	Patents application made by residents of a country in a given year.	Liu et al. (2019)	World Development Indicators (WDI)
Innovation by non-residents	Patents application made by non-residents in a country in a given year.	Liu et al. (2019)	World Development Indicators (WDI)
Total Innovation	Patents application made by both residents and non-residents in a country in a given year.	Liu et al. (2019)	World Development Indicators (WDI)
Islamic Finance Development	An index of a country's score for the development of Islamic finance. It was computed with scores from sub-indicators, which are quantitative development, governance, knowledge, corporate social responsibility, and awareness.	Muhammed et al. (2024)	Islamic Corporation for the Development of the Private Sector (ICD)-Islamic Development Bank (ISDB) Group-Refinitiv Islamic Finance Development Reports.
Overall financial development	Index of financial development. A ranking of countries based on the success of their financial institutions in terms of depth, access, and efficiency. It is an index that ranges between 0 and 1.	Destek et al. (2020)	
GDP per capita	GDP per capita in US dollars at constant 2015 prices.	Qureshi et al. (2021)	World Development Indicators (WDI)
Trade Openness	Percentage share of total international trade in GDP.	Khan et al. (2023)	World Development Indicators (WDI)
Natural resource abundance	Percentage share of total natural resources rents GDP.	Omidi et al. (2019)	World Development Indicators (WDI)
Foreign Direct Investment	Net inflows of foreign direct investment, (balance of payment – BoP) as a percentage share GDP.	Sudolska & Łapińska (2020)	World Development Indicators (WDI)

Source: Author's Compilation

Table 2.
Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Total innovation	2,032.3	2706.7	89	11,481
Innovation (residents)	386.2	534.8	2	3,093
Innovation (non-residents)	1646.1	2246.2	1	8,538
GDP per capita	17,181.9	17,046.8	1,307.7	64,233.3
FDI	2.435	3.119	-1.686	17.13
Trade openness	82.69	47.95	2.699	172.8
Natural resource rent	11.71	10.84	0.003	45.15
Islamic finance development index	51.51	23.49	23	132
Overall financial development index	0.362	0.147	0.095	0.732

Source: Author's Computations using Stata 14

Table 3.
Correlation Matrix

Variable	1	2	3	4	5	6	7	8	9
1. Innovation (residents)	1.0								
2. Innovation (non-residents)	0.83***	1.0							
3. Total innovation	0.88***	0.99***	1.0						
4. GDP per capita	-0.27***	-0.13	-0.16*	1.0					
5. FDI	-0.05	0.02	0.01	-0.08	1.0				
6. Trade openness	-0.21**	0.05	0.01	0.55***	0.49***	1.0			
7. Natural resource rent	-0.09	-0.13	-0.13	0.63***	-0.24**	0.24**	1.0		
8. Islamic finance development index	0.37***	0.56***	0.54***	0.07	-0.05	0.41***	0.04	1.0	
9. Overall financial development index	0.21**	0.46***	0.42***	0.54***	-0.18*	0.55***	0.40***	0.74***	1.0

Source: Author's Computations using Stata 14

Note: *** p<0.01, ** p<0.05, * p<0.1

Overall, the correlations among the explanatory variables (all excluding innovation indicators) are not high (i.e. at least 0.8) that could lead to multicollinearity problems and thus they can be entered into a single model together as explanatory variables.

For a clearer picture of the relationships that exist between the dependent variable, innovation indicators, and each of the main explanatory variables, Islamic finance development and overall financial development, Figures 1 and 2 present the scatter plots with fitted regression lines. All variables are in their natural logarithm. The plots depict a positive relationship between total innovation and each of Islamic finance development (panel A) and overall financial development (panel D). By contrast, the relationship between innovation by residents and Islamic finance development (panel B) is flat, indicating that it may not be significant, and its relationship with overall financial development even looks negative (panel E). Similar to total innovation, innovation by non-residents shows a relatively steeper regression line with Islamic finance (panel C) and overall financial development (panel F), an indication of a strong relationship. A more valid evaluation of these relationships is provided in the panel regression analysis, which helps to establish the role of Islamic finance and overall financial development in innovation.

4.2. Empirical Analysis

Moving to the main results of this study, the Feasible GLS results are presented in Tables 4 and 5 to examine how Islamic finance and financial development affect innovation in Muslim-majority countries. The results take into account the possibility of heteroskedasticity and serial correlation problems. In Table 4, the results reveal that Islamic finance development has a positive impact on total innovation, and the significance of its coefficient is at 10%. Its coefficient of 0.292 indicates that total innovation is increased by 0.292 percent due to a one percent rise in Islamic finance development. This implies that, to some extent, Islamic finance development is vital to improving total innovation levels in these countries. This

buttresses the positively sloped regression line in panel A of Figure 1, which shows that there is a positive relationship between Islamic finance development and total innovation. These findings corroborate the findings of Haruna et al. (2024) and Alhammadi (2024).

Moreover, trade openness has a positive coefficient as well. With its coefficient being 0.348, a rise of one percent in trade openness helps to increase total innovation by 0.348 percent. This buttresses the fact that increase in international trade exposes the gaps in trade in terms of product, which in turn, motivates the need for innovation to creating ideas and inventions to fill these gaps. The finding supports those of Khan et al. (2023) and Furman et al. (2002). Natural resource rents on the other hand, has a negative coefficient of -0.0697, indicating that its rise by a one percent will cause total innovation to fall by about 0.07 percent. This finding partly reflects the notion of resource curse which posits that countries with more resources tend to be slower in growth and productivity. GDP per capita and FDI are statistically insignificant to provide evidence for their impact on total innovation. This simply means that evidence only supports the positive impacts of Islamic finance development and trade openness, and the negative impact of natural resource rents. We also present a Wald Chi-squared statistic for the model which has 38.69 as its value and 0.000 as its p-value, signifying that the overall model is in good fit due to the significance of the statistic.

The results also reveal that Islamic finance development has a positive coefficient in the second equation set for innovation by residents. However, it is insignificant. This implies that no statistical evidence could be provided for the impact of Islamic finance development on innovation by residents. This simply buttresses the initial relationship established in panel B of Figure 1, that the relationship between the two variables is weak. Similarly, the negative coefficient of FDI and positive coefficients of trade openness and natural resource rents are not statistically supported due to them being insignificant. However, GDP per capita has a negative coefficient that is statistically significant. The coefficient value is -0.537, indicating that about 0.537 percent of innovation by residents is reduced due to a one percent rise in GDP per capita. This is surprising but as mentioned earlier in the initial relationships, the outcome may reflect the laxity to innovate and create new ideas when income is higher in these countries. Note that the Wald Chi-squared statistic for the model is 15.51 as it is significant, signifying that the overall model is in good fit.

Further results reveal that in the third equation, Islamic finance development has a positive impact on innovation by non-residents, which is statistically significant at 1%. Its coefficient of 1.062 indicates that innovation by non-residents is increased by 1.062 percent due to a one percent rise in Islamic finance development. This implies that, Islamic finance development is very important to improving innovation by non-residents in these countries. Haruna et al. (2024) and Alhammadi (2024) also document similar findings regarding the influence of Islamic finance on innovation. In a similar vein, Muhammed et al. (2024) and Yesuf & Aassouli (2020) emphasizes its importance on sustainable development. This also supports the positively sloped regression line in panel C of Figure 1, which shows that there is a predetermined positive relationship between Islamic finance development and innovation by non-residents.

The positive impact of Islamic finance on innovation carries several significant implications for economic development, financial markets, technological progress, and policy formulation. Particularly, the findings can be explained from several angles. The positive impact may stem from the fact that, Islamic finance operates on profit-and-loss sharing (PLS) principles through instruments like Mudarabah (equity financing) and Musharakah (joint ventures), which encourage risk-taking and long-term investment. This provides alternative funding sources for startups and SMEs engaged in high-risk, high-reward innovation activities, especially in markets where traditional venture capital is limited. It may also be due to the emphasis placed on Shariah compliance, which prohibits investments in industries harmful to society. Investments tend to be directed toward ethical sectors, such as renewable energy, healthcare, education, and socially responsible technology. Furthermore, Islamic finance promotes financial inclusion by offering non-interest-based financing, particularly for those underserved by conventional banks (e.g., SMEs, microenterprises, and unbanked populations). Instruments like Qard Hasan (benevolent loans) and Zakat-based microfinance could support small-scale innovators who lack collateral for conventional loans.

Trade openness has a positive coefficient (0.630), suggesting that a rise of one percent in trade openness helps to increase innovation by non-residents by 0.630 percent. As stated earlier, the finding supports the findings of Khan et al. (2023) and Furman et al. (2002). Natural resource rents on the other hand, has a negative coefficient of -0.106, indicating that its rise by a one percent will cause innovation by non-residents to fall by about 0.106 percent. This also supports the resource-curse hypothesis. GDP per capita and FDI are statistically insignificant to provide evidence for their impact on innovation by non-residents. This simply means that evidence only supports the positive impacts of Islamic finance development and trade openness, and the negative impact of natural resource rents. The Wald Chi-squared statistic for the model is 86.44 with a p-value of 0.000, signifying that the overall model is in good fit.

The fact that Islamic finance boosts innovation by non-residents more than innovation by residents suggests that Islamic finance hub among these countries (such as UAE, Malaysia, Saudi Arabia) attract foreign investors due to well-developed Islamic capital markets, Sukuk issuances, and Shariah-compliant venture capital. Non-residents, including foreign firms and investors, may find Islamic financial instruments attractive for financing R&D and innovation, particularly if their home countries lack such financial options. In other words, Non-residents can leverage Islamic financial structures (e.g., Mudarabah, Musharakah, and Sukuk) to finance innovation, while local entrepreneurs may still rely on conventional banking systems or face regulatory barriers in accessing Islamic finance. Furthermore, in some countries, Islamic finance regulations favor large-scale or foreign investments rather than local innovators and SMEs. Stringent collateral and creditworthiness requirements in Islamic finance may limit access for local entrepreneurs, while foreign investors with strong financial backing may qualify more easily. Moreover, Non-residents (e.g., multinational firms, expatriate entrepreneurs, and foreign investors) often engage in higher-risk, high-reward innovation projects, particularly in sectors like fintech, renewable energy, and biotech. Local residents may be risk-averse, preferring traditional business models

over disruptive innovations due to cultural, financial, and institutional constraints. Therefore, Foreign innovators may receive better financial and policy support, whereas domestic innovators may face risk aversion and institutional rigidity that discourage innovation.

As for the impacts of overall financial development, the results in Table 5 reveals that overall financial development has a positive impact on total innovation, which is significant at 5%. Its coefficient of 0.609 indicates that total innovation is increased by 0.609 percent due to a one percent rise in overall financial development. This implies that overall financial development is vital to improving total innovation levels in these countries. This strongly supports the positively sloped regression line in panel D of Figure 2, which shows that there is a positive relationship between overall financial development and total innovation. The finding supports the findings that the development of the financial system is vital for innovation growth as found in the studies by Wellalage & Locke (2020), Adegboye & Iweriebor (2018), Liu et al. (2022), and Xiong et al. (2023).

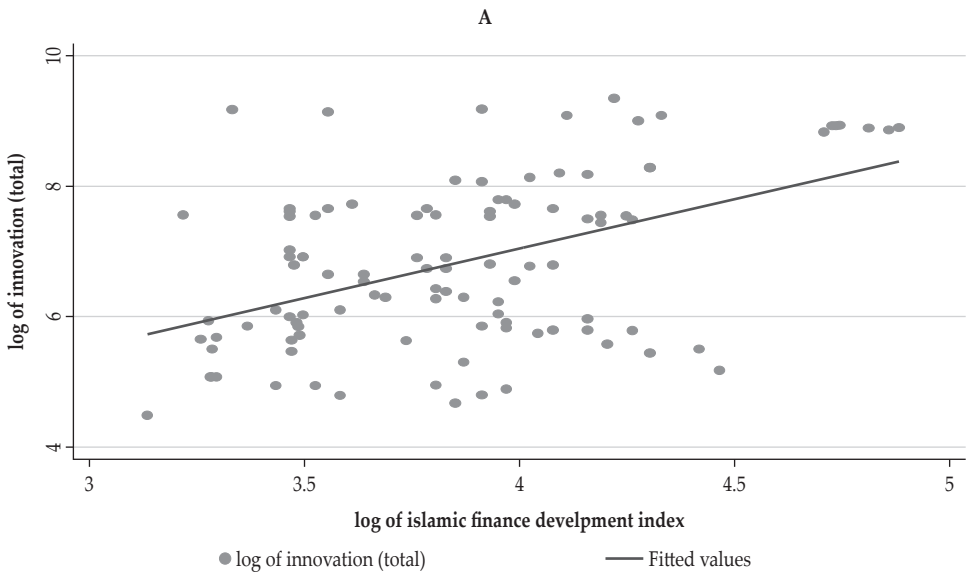
Furthermore, FDI has a positive coefficient as well. With its coefficient being 0.112, a rise of one percent in FDI helps to increase total innovation by 0.112 percent. Trade openness also has a positive coefficient. With its coefficient being 0.271, a rise of one percent in trade openness helps to increase total innovation by 0.271 percent. This supports the findings of Khan et al. (2023) and Furman et al. (2002). Natural resource rents on the other hand, has a negative coefficient of -0.0904, indicating that its rise by a one percent will cause total innovation to fall by about 0.09 percent. This reveals that increase in natural resource rents decreases innovation, which corroborates the resource-curse hypothesis. GDP per capita is not significant to provide evidence for its impact on total innovation. This simply means that evidence only supports the positive impacts of overall financial development, FDI and trade openness, and the negative impact of natural resource rents. The Wald Chi-squared statistic of 39.49 with p-value of 0.000 indicates that the overall model is in good fit.

The results further reveal that overall financial development has a positive coefficient in the second equation. However, it is insignificant. This implies that no statistical evidence could be provided for the impact of overall financial development on innovation by residents. This simply buttresses the initial relationship established in panel E of Figure 2, that the relationship between the two variables is weak. As for other variables, trade openness has a positive coefficient of 0.276, which is slightly significant at 10%, indicating that there will be 0.276 percent rise in innovation by residents due to a one percent rise in trade openness. Similar to overall financial development, the negative coefficient of FDI and positive coefficients of natural resource rents are not statistically supported due to them being insignificant. However, GDP per capita has a negative coefficient that is statistically significant. The coefficient value is -0.553, indicating that about -0.553 percent of innovation by residents is reduced due to a one percent rise in GDP per capita. The regression has the Wald Chi-squared statistic of 11.83 and it is significant. Thus, the overall model is in good fit.

In addition, the results reveal that in the third equation, overall financial development has a positive impact on innovation by non-residents, which is statistically significant at 1%. Its coefficient of 1.884 indicates that innovation by

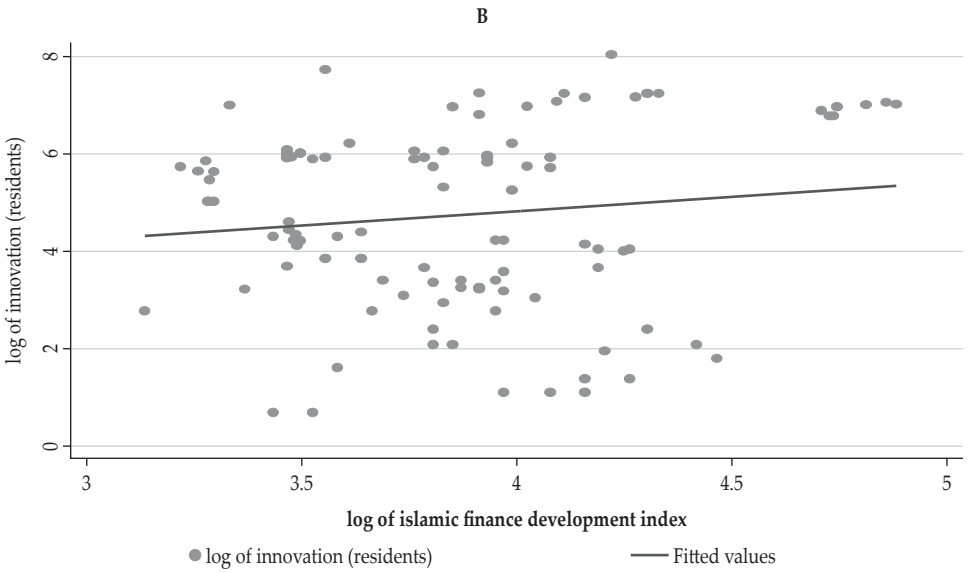
non-residents is increased by 1.884 percent due to a one percent rise in overall financial development. This implies that, financial development is very important to improving innovation by non-residents in these countries. This also supports the positively sloped regression line in panel F of Figure 2, which shows that there is a positive relationship between financial development and innovation by non-residents. The asymmetric impact of Islamic finance and financial development on innovation by non-residents versus residents can be attributed to capital attraction policies, regulatory constraints, financial access issues, risk aversion, and talent migration.

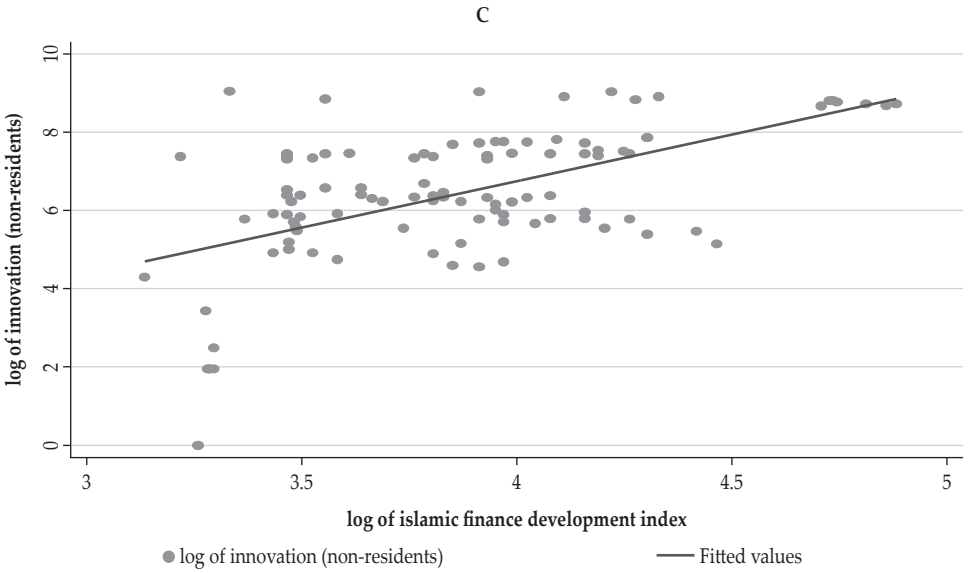
Moreover, trade openness has a positive coefficient as well. With its coefficient of 0.593, a rise of one percent in trade openness helps to increase innovation by non-residents by 0.593 percent. Natural resource rents on the other hand, has a negative coefficient of -0.155, indicating that its rise by a one percent will cause innovation by non-residents to fall by about 0.155 percent. Also, GDP per capita has a negative coefficient of -0.354, indicating that its rise by a one percent will cause innovation by non-residents to fall by about 0.354 percent. FDI does not have a coefficient that is statistically significant to provide evidence for its impact on innovation by non-residents. The Wald Chi-squared statistic for the model is 72.25 and it is significant, signifying that the overall model is in good fit.



Source: Author's Plot using Stata 14

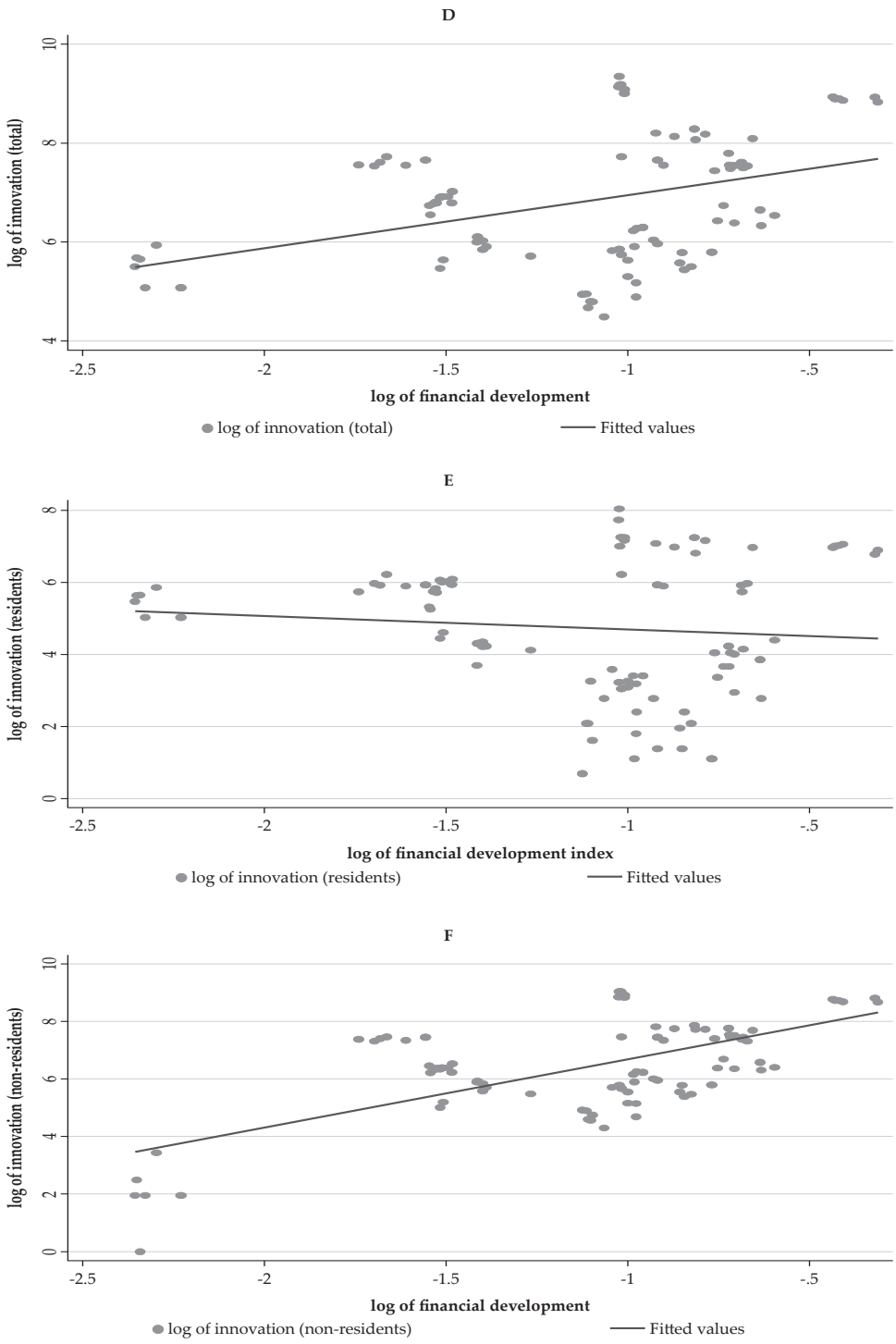
Figure 1.
Scatter Plot of Relationships (Innovation and Islamic Finance Development)





Source: Author's Plot using Stata 14

Figure 1.
Scatter Plot of Relationships (Innovation and Islamic Finance Development)
(Continued)



Source: Author's Plot using Stata 14

Figure 2.
Scatter Plot of Relationships (Innovation and Overall Financial Development)

Table 4.
Islamic Finance Development and Innovation

Dependent Variable =	(1) Total Innovation	(2) Innovation (by residents)	(3) Innovation (by non-residents)
log(GDP per capita)	0.0361	-0.537***	0.0285
	(0.0950)	(0.157)	(0.123)
log(Foreign direct investment)	0.0479	-0.114	-0.0521
	(0.0616)	(0.123)	(0.0840)
log(Trade openness)	0.348***	0.252	0.630***
	(0.134)	(0.166)	(0.241)
log(Natural resource rent)	-0.0697**	0.0406	-0.106**
	(0.0329)	(0.0793)	(0.0467)
log(Islamic finance development)	0.292*	0.407	1.062***
	(0.163)	(0.317)	(0.214)
Constant	3.999***	7.276***	-0.180
	(0.830)	(1.461)	(0.944)
Heteroskedastic panels	*controlled*	*controlled*	*controlled*
Serially correlated errors	*controlled*	*controlled*	*controlled*
Wald Chi-squared	38.69***	15.51***	86.44***
p-value (Wald Chi-squared)	0.000	0.008	0.000

Source: Author's Computations using Stata 14

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5.
Overall Financial Development and Innovation

Dependent Variable =	(1) Total Innovation	(2) Innovation (by residents)	(3) Innovation (by non-residents)
log(GDP per capita)	-0.0385	-0.553***	-0.354**
	(0.108)	(0.188)	(0.150)
log(Foreign direct investment)	0.112*	-0.0982	0.123
	(0.0603)	(0.117)	(0.0826)
log(Trade openness)	0.271**	0.276*	0.593**
	(0.111)	(0.157)	(0.254)
log(Natural resource rent)	-0.0904**	0.0694	-0.155***
	(0.0353)	(0.0800)	(0.0560)
log(Financial development)	0.609**	0.124	1.884***
	(0.255)	(0.408)	(0.319)
Constant	6.801***	8.972***	9.517***
	(1.041)	(1.863)	(1.143)
Heteroskedastic panels	*controlled*	*controlled*	*controlled*
Serially correlated errors	*controlled*	*controlled*	*controlled*
Wald Chi-squared	39.49***	11.83**	72.25***
p-value (Wald Chi-squared)	0.000	0.037	0.000

Source: Author's Computations using Stata 14

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 6.
Robustness Check Result for Islamic Finance Development and Innovation

Dependent Variable =	(1) Total Innovation	(2) Innovation (by residents)	(3) Innovation (by non-residents)
Innovation (lagged)	0.664***	-0.0131	0.865***
	(0.144)	(0.136)	(0.134)
log(GDP per capita)	-0.152	-0.0783*	-0.119
	(0.140)	(0.0400)	(0.0893)
log(Foreign direct investment)	71.89**	60.62	30.70
	(35.47)	(36.93)	(34.79)
log(Trade openness)	24.74	4.546	16.35
	(26.59)	(12.77)	(15.72)
log(Natural resource rent)	24.24**	-13.74	15.07
	(12.15)	(16.72)	(15.11)
log(Islamic finance development)	33.03**	14.03*	16.37***
	(13.81)	(8.402)	(5.847)
Constant	-928.6	650.1	-197.4
	(913.0)	(1,187)	(809.5)
Wald Chi-squared	414.07***	68.30***	432.18***

Source: Author's Computations using Stata 14

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 7.
Robustness Check Result for Overall Financial Development and Innovation

Dependent Variable =	(1) Total Innovation	(2) Innovation (by residents)	(3) Innovation (by non-residents)
Innovation (lagged)	0.693***	-0.0260	0.887***
	(0.169)	(0.167)	(0.166)
log(GDP per capita)	-0.160	-0.0835**	-0.121
	(0.122)	(0.0372)	(0.0964)
log(Foreign direct investment)	85.47*	69.19*	40.07
	(47.21)	(41.34)	(29.66)
log(Trade openness)	17.77**	-0.00575	12.73
	(8.817)	(5.250)	(8.618)
log(Natural resource rent)	35.19*	-9.673	22.50**
	(19.27)	(9.639)	(10.15)
log(Financial development)	5.405	2.648	2.405
	(5.730)	(3.460)	(3.737)
Constant	-668.6	823.4	-17.78
	(1,186)	(1,369)	(862.4)
Wald Chi-squared	222.14***	18.66***	309.56***

Source: Author's Computations using Stata 14

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

4.3. Robustness Analysis

To verify the robustness of the above results, we add lagged dependent variable and apply the GMM estimation method. The GMM results presented in Table 6 reveal that the impact of Islamic finance is consistently positive on innovation, signifying that this impact is robust to an alternative model specification and estimation. The results further show that Islamic finance is significant for resident innovation as well, albeit with very weak evidence. As for the impact of overall financial development, the GMM result in Table 7 reveal that the coefficients of overall financial development are still positive for all forms of innovation but not significant, signifying that the evidence provided for the positive impact of financial development on innovation in the GMM results is weak.

V. CONCLUSION

The paper investigates the impact of Islamic finance development and overall financial development on innovation in 15 Muslim-majority countries across Sub-Saharan Africa, Middle East and North Africa, and South Asia with the most developed Islamic finance platforms according to the Islamic corporation for Development-Islamic Development Bank-Refinitiv joint report. The findings of this study reveal that Islamic finance development plays a crucial role in promoting innovation in these countries. The reason may stem from the fact that Islamic finance uses tools like Mudarabah (equity financing) and Musharakah (joint ventures), which promote risk-taking and long-term investment, and function on the basis of profit-and-loss sharing (PLS). For entrepreneurs and SMEs involved in high-risk, high-reward innovative endeavors, this offers alternate funding options, particularly in regions with a dearth of traditional venture capital. It could also be owing to the emphasis on Shariah compliance, which forbids investments in industries that are detrimental to society. Renewable energy, healthcare, education, and socially responsible technology are among the ethical areas that receive investments. Furthermore, Islamic finance promotes financial inclusion by providing non-interest-based financing, particularly to people who are underserved by traditional banks (SMEs, microenterprises, and unbanked populations). Instruments such as Qard Hasan (benevolent loans) and Zakat-based microfinance could help small-scale entrepreneurs who lack collateral for traditional loans.

More specific findings reveal that Islamic finance is vital in boosting innovation by non-residents but not innovation by residents. Overall financial development in these countries also promotes innovation by non-residents and not innovation by residents. The non-response of innovation by residents to the developments of Islamic finance and overall financial sector may be explained by the fact that well-developed Islamic capital markets, Sukuk issuances, and Shariah-compliant venture capital in some of these countries attract foreign investors, making the non-residents innovation to be larger in quantitative terms than innovation by residents. Furthermore, non-residents (e.g., multinational corporations, expatriate entrepreneurs, and foreign investors) frequently invest in higher-risk, high-reward innovation initiatives, particularly in fintech, renewable energy, and biotech while local citizens may be risk-averse, preferring old business models over disruptive

innovations due to cultural, financial, and institutional restraints. As a result, foreign innovators may receive greater financial and regulatory assistance, but indigenous innovators may suffer risk aversion and institutional conservatism, which inhibit innovation.

Therefore, to bridge the gap between Islamic finance, financial development, and innovation, practitioners must tailor financial products for local innovators, regulators should create inclusive financial policies, and researchers need to explore alternative models that better explain the linkage between finance and innovation. Specifically, for practitioners such as financial institutions, investors, and businesses, Islamic finance offerings must be expanded to local innovators. Islamic financial institutions should develop more tailored financial products (e.g., Mudarabah-based startup financing, Musharakah for SMEs) to encourage resident entrepreneurs in Muslim-majority countries. Firms should actively engage in cross-border collaborations to leverage trade openness for technology transfer, joint R&D, and knowledge spillovers to boost domestic innovation. Financial institutions can also address the likely risk aversion among local innovators by introducing Islamic credit guarantees and risk-mitigation funds to encourage local entrepreneurs to engage in high-risk, high-reward innovation projects.

For regulators, financial inclusion measures must be strengthened for local innovators. Policymakers should ease regulatory constraints to ensure SMEs and startups can access Islamic venture capital, Sukuk financing, and Qard Hasan microfinance. To boost innovation, especially by residents, governments should introduce tax incentives, R&D grants, and subsidized financing for firms investing in Shariah-compliant innovation-driven projects. Regulatory bodies should balance foreign investment attraction and local innovation promotion by ensuring that financial resources do not disproportionately favor non-residents over local innovators. The role of Islamic FinTech should also be enhanced. Authorities should create a supportive regulatory framework for Islamic FinTech (e.g., blockchain-based smart contracts, digital Sukuk) to enhance financial accessibility for startups. For future research, the findings of this study means that other areas of related research should be pursued. Research should focus on how Islamic finance influences different innovation sectors (e.g., fintech, health-tech, agritech, and green technology) to provide more targeted policy recommendations. Future studies should also adopt comprehensive innovation indices beyond patents and R&D expenditures, incorporating social and environmental innovation metrics. A comparative study on whether Islamic finance is more effective than conventional finance in driving innovation should also be pursued as it would provide valuable policy insights.

The implications of this study and the highlighted policy recommendation portray its contributions to the literature. Notwithstanding, the study has some limitations. First, the study is restricted by number of observations, mainly from only 15 Muslim-majority countries and the limitation of periods to seven years. This is mainly due to data availability. On the one hand, the dataset for Islamic finance development used in this study is limited to few Muslim-majority countries. On the other hand, the index of Islamic finance is only available from 2016, limiting the start of the sample period. In the presence of more elaborate dataset, this issue can be re-investigated to provide more informative analysis. Secondly, overall Islamic

finance is employed in this study, however, specific Islamic finance products and service are not captured. Such analysis can foster more specific policy focus and more elaborate analysis.

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