Bank Concentration and Economic Volatility in the OIC Countries: The Role of Financial Development

Edib Smolo
Effat University, Jeddah, Kingdom of Saudi Arabia
esmolo@effatuniversity.edu.ba

CroEconSur
Vol. 24
No. 2
December 2022
pp. 79-121

Received: May 23, 2022
Accepted: November 2, 2022
Research Article

doi:10.15179/ces.24.2.3

Abstract

This study examines the effect of bank concentration and financial development on economic volatility in member countries of the Organization of Islamic Cooperation (OIC). Using the GMM estimator, we cover the 2000–2017 period. Based on both linear and non-linear estimations, we find no significant impact of bank concentration on economic volatility. By contrast, financial development reduces economic volatility. Moreover, the relationship between concentration and volatility is influenced by financial development. Considering this, policymakers should put more emphasis on developing the financial sector than controlling bank concentrations. We find that our findings remain robust in the

face of different specifications and proxies used to measure bank concentration and financial development.

Keywords: economic volatility, bank concentration, financial development, OIC, GMM

JEL classification: C33, E44, G21, G28

1 Introduction

Even though an effective and operational financial system is needed for every economy to grow, the structure of that system may take different forms. This is at least what the literature is telling us. In other words, financial system operations may or may not contribute to the overall growth and stability depending on how the financial system is organized. The financial development structure may reflect a monopolistic or a competitive market, affecting growth and stability in different ways. A competitive market structure is argued to lead to better market practices and eventually improved efficiency, whereas a concentrated market structure may lead to excessive rents, higher interest rates, lack of credit availability, and moral hazard. This became to be known as the *competition–stability view*.

The *competition–fragility view* suggests that this is not always true. Competition, especially excessive competition, can cause economic instability, and financial markets dominated by bank concentration are beneficial. This means that banks are better able to monitor financial stability thanks to the concentrated market structure. It is also possible for them to earn higher profits, which in turn will increase their capital buffers.

Recent studies offer no clear conclusions. Several researchers have reported that financial development and bank concentration may promote overall growth, stability, and even instability (Deidda & Fattouh, 2005; Cecchetti & Kharroubi, 2012; Lee & Hsieh, 2013b; Law & Singh, 2014; Arcand, Berkes, & Panizza,

2015; Prochniak & Wasiak, 2016). However, Beck, Demirgüç-Kunt, and Levine (2006) and Schaeck, Čihák, and Wolfe (2009) show no support for the claim that bank concentration alone leads to instability. Meanwhile, financial development may lead to economic stability (Beck, Degryse, & Kneer, 2014), but it may come at the cost of financial volatility (Ibrahim, 2007).

In addition, the depth, size, and structure of a country's financial system significantly affect the relationships between financial development, bank concentration, economic growth, and volatility. Similarly, despite extensive literature on the topic, the Organization of Islamic Cooperation (OIC) member countries are left out.[1] Again, given that the evidence for the above relationships is inconclusive, it is not clear whether financial development and bank concentration add to economic volatility in OIC countries.

The current study addresses all these issues and gaps in the existing literature. In particular, this study relies on several bank concentration and financial development measures to address their impact on economic volatility using a sample from OIC countries. Besides a few studies that partially cover some OIC countries (Abojeib, 2017; Smolo, 2019, 2020; Smolo, Ibrahim, & Dewandaru, 2021), this group of countries has been vastly ignored, although it is attractive for the following reasons. First, developed countries are the primary focus of existing studies, and very few studies focus on developing ones. Second, the OIC countries are countries with majority Muslim populations. According to Islamic teachings, financial activities based on interest (*riba*) are strictly prohibited for Muslims.

For this reason, many Muslims stay away from banking and financial activities. This leads to a substantial unbankable population in these countries. Third, the emergence of Islamic financial services led to structural changes within OIC financial sectors. Accordingly, Iran, Sudan, Brunei, Saudi Arabia, Kuwait, Malaysia, Qatar, UAE, Bangladesh, Djibouti, Jordan, Palestine, and Bahrain are systemically important Islamic finance jurisdictions (IFSB, 2019, pp. 10–11).

1 The OIC was founded in 1969 and it is the second-largest inter-governmental organization after the United Nations. It consists of 57 member states and has a population of more than 1.6 billion.

Thus, it is interesting to see whether financial structure affects economic volatility in countries where Islamic banking is present. Fourth, banks are considered an integral and crucial part of a flourishing financial market (Lee & Hsieh, 2013a, 2013b; Moyo, Nandwa, Oduor, & Simpasa, 2014). Since OIC countries are primarily bank-based, they offer unique datasets to investigate the topic. Fifth, while most studies focus on the finance–growth nexus, far too little attention has been paid to bank concentration–volatility and finance–volatility relationships. This is especially true for OIC member countries. Finally, given the heterogeneous nature, bank–market structure, and overall underdevelopment of the sample countries, the findings could provide significant insights. In short, considering the above shortcomings of the existing literature, this study contributes to the literature by addressing these issues using the latest data available and sample countries not previously covered.

Thus, there are two main objectives of this study. The first one investigates how bank concentration affects economic volatility in OIC countries, and it leads us to *hypothesis 1 (H1): bank concentration contributes to economic volatility*. The second one investigates whether the concentration–volatility relationship depends on OIC countries' level of financial development. This brings us to *hypothesis 2 (H2): financial development decreases economic volatility*. By focusing primarily on OIC countries, we want to see whether our findings differ from other studies. Thus, our findings will be a valuable contribution to the existing body of literature.

This study relies on the generalized method of moments (GMM) estimator to meet these objectives and answer the above questions. Data for this study were collected using several databases available on the World Bank website. Consequently, this study provides an exciting opportunity to advance our knowledge of bank concentration–economic volatility relationships considering the level of financial development. Based on the results, we cannot either confirm or reject our *H1* as majority or concentration measures coefficients are insignificant. *H1*, however, is confirmed in the case of the finance–concentration interaction model. On the

other hand, ample results confirm *H2*, whereby financial development measures (individually and with concentration ratios) decrease economic volatility.

The remainder of the paper is organized as follows. Section 2 provides a brief literature review on the topic. Section 3 explains the data selection process, model development, and method used in this study. Section 4 discusses the empirical results of various estimation models. Finally, Section 5 concludes the study.

2 Literature Review

Two contradictory views emerged regarding the bank concentration and economic volatility relationship. A more competitive banking sector (less concentration) contributes to a more stable financial system and economy (*competition–stability view*). In other words, a lack of competition leads to concentration that hurts economic growth and could result in volatility (Cetorelli & Strahan, 2006; Guzman, 2000).

Nevertheless, several authors claim that bank concentration and monopolistic power benefit economic growth and overall stability (*competition–fragility view*). They claim that excessive competition is detrimental to the economy and financial stability (Di Patti & Dell'Ariccia, 2004; Deidda & Fattouh, 2005). Still, although bank competition may benefit economic growth, it can also increase risks and financial instability (Davis, 2007). Accordingly, there is a trade-off between market efficiency and the risk of instability due to increased bank competition and reduced bank concentration, respectively. This view, Davis (2007) argues, has often been unstated.

There is ample empirical evidence for the above claims. For instance, using a sample of 171 Chinese banks, Lee and Hsieh (2013a) find that banks' profitability increases while banks' risk decreases when there is an increase in bank concentration. However, the same study shows that while competition increases profitability, it also brings more risk. Similarly, no evidence of the positive impact

of increased concentration on greater banking sector fragility is evidenced by Beck et al. (2006). Their results show only that the stability is higher in countries with fewer restrictions for entry and activities and with a better institutional framework that is conducive to competition. They cover a sample of 69 countries and the 1980–1997 period, investigating the relationship between various banking systems, regulatory features, and country characteristics on one side, and the likelihood of a financial crisis on the other. Relatively same results are reported in another study by Schaeck et al. (2009). They also find that competition decreases the probability of a crisis. At the same time, concentration alone does not increase but instead reduces the crisis probability. However, based on the results presented, concentration measures represent inappropriate proxies for competition.

On the contrary, having bank concentration may not be the best option, as there are counter-arguments to this view. In short, large banks may lead to a *too-big-to-fail* phenomenon and eventually to excessive risk-taking, both by banks and their customers, due to the increased interest rates on loans. Furthermore, the financial structure affects economic growth and volatility (Yeh, Huang, & Lin, 2013). In addition, market-based economies experience faster economic growth. However, in the long run, they suffer more from economic volatility (Ibrahim, 2007).

While financial development promotes economic growth, too much of it can harm it and result in instability (Law & Singh, 2014). This means that financial development benefits for economic growth are not limitless (Arcand et al., 2015; Cecchetti & Kharroubi, 2012; Deidda & Fattouh, 2005; Ibrahim & Alagidede, 2017; Ma & Song, 2018; Prochniak & Wasiak, 2016).

The literature is somewhat limited when it comes to OIC member countries. For instance, using GMM, Abojeib (2017) finds a limited positive impact of market power on stability in dual banking (Islamic and conventional) systems. Employing the same methodology and covering 41 OIC member countries, Smolo (2019) investigates whether economic growth and income volatility depend on bank concentration and financial development levels. As several bank concentration

and financial development measures are used, the results show a mixed impact on income volatility. Furthermore, financial development plays a role in bank concentration–income volatility relationships. Similar results are reported in a recent paper by Smolo et al. (2021). Their results indicate no significant effect of bank concentration on economic volatility, although financial development decreases volatility.

Although Smolo (2019) and Smolo et al. (2021) use the same method and focus on the OIC countries, their results are far from being conclusive as different concentration measures used in their studies provided inconclusive results. Our results are more consistent and robust to other concentration and financial development measures.[2]

To sum up, the effect of financial development and bank concentration on economic volatility depends on the size, structure, and level of a country's financial system. It also depends on the proxies used for bank concentration and financial development measures (Smolo, 2019). Furthermore, apart from Abojeib (2017), Smolo (2019), and Smolo et al. (2021), there is a general lack of research on the topic focusing on OIC member countries. Therefore, this study provides new evidence on the topic using several bank concentration and financial development measures and focusing on OIC member countries.

3 Data and Methodology

3.1 Data

Our sample selection, data collection procedures, and filtering criteria are discussed briefly in this section. To investigate bank concentration impact on economic volatility and for reasons discussed earlier, we opt for OIC countries. Due to data availability, we cover the period between 2000 and 2017 and 49 out

2 Apart from that, our data are more complete as we include 49 out of 57 OIC countries and cover a longer period than Smolo (2019) that covered only 41 countries. Data used by Smolo (2019) are available at Mendeley Data repository, see: Smolo, Edib (2019), "Bank Concentration, Financial Development, Economic Growth and Income Volatility", *Mendeley Data, V1*, doi: https://doi.org/10.17632/rmjj8m3pgg.1

of 57 OIC countries.[3] Following the literature review, we focus on several bank concentration measures and control variables.

Specifically, the study uses bank concentration measures such as CR3 and CR5, which measure the ratio of 3 and 5 largest commercial banks' assets to commercial banking assets. It also uses the Herfindahl-Hirschman index (HHI), which measures bank size relative to the industry, an index that measures market power, i.e. the Lerner index (LI), and a measure of competition, i.e. the Boone indicator (BI). To gauge financial development, the study uses standard measures, namely the ratio of private credit to GDP (PR), the ratio of liquid liabilities to GDP (LL), and the ratio of broad money to GDP (M3).

As for country control variables, the study uses gross capital formation as a ratio to GDP (GCF), trade openness (TO) that is the sum of exports and imports of goods and services measured as a share of GDP, government size (GS), which is the government's final consumption expenditure to GDP ratio, inflation adjusted by the GDP deflator (I), and the global financial crisis 2008–2009 dummy (C). The bank control variables are the ratio of bank non-interest income to total income (BNI), bank cost-to-income ratio (BCI), and bank net interest margin ratio (BNIM). All these data are sourced from various World Bank databases.

3.2 Model Development

Our baseline model is based on a model used by Smolo (2019) and Smolo et al. (2021). It can be defined as follows:

$$\sigma_{i,t}=\alpha\sigma_{i,t-1}+\beta CON_{i,t}+\delta B_{i,t}+\theta C_{i,t}+\nu_i+\varepsilon_{i.t} \quad (1)$$

where $\sigma_{i,t}$ is the standard deviation of the annual growth rate of real per capita GDP as a proxy for the volatility of country i at time t; $\sigma_{i,t-1}$ is the lagged volatility

3 Afghanistan, Albania, Algeria, Azerbaijan, Bahrain, Bangladesh, Benin, Burkina-Faso, Cameroon, Chad, Cote d'Ivoire, Egypt, Gabon, Gambia, Guinea, Guyana, Indonesia, Iraq, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libya, Malaysia, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Oman, Pakistan, Qatar, Saudi Arabia, Senegal, Sierra Leone, Sudan, Suriname, Syrian Arab Republic, Tajikistan, Togo, Tunisia, Turkey, Uganda, United Arab Emirates, Uzbekistan, Yemen and Palestine (West Bank and Gaza).

variable; $CON_{i,t}$ is one of the concentration measures; $B_{i,t}$ and $C_{i,t}$ are vectors of the bank- and country-specific control variables, respectively; ν_i controls for time-invariant factors; and $\varepsilon_{i,t}$ is a residual.

We incorporate several bank concentration measures (market structure and market power).[4] Hence, the sign and magnitude of β in the estimations' results using the model in Equation 1 would indicate the nature of concentration–volatility relationships. This is because the marginal effect of bank concentration on economic volatility is equal to the partial derivative of σ with respect to *CON*, or mathematically:

$$\frac{\partial \sigma}{\partial \, \mathrm{CON}} = \beta \tag{2}$$

Consequently, β needs to be greater than zero for bank concentration to increase volatility.

To see if this impact of bank concentration depends on the level of financial development, we introduce an interaction term to Equation 1 as presented in Equation 3. All constitutive terms are included in our interaction model specifications following Brambor, Clark, and Golder (2006).

$$\sigma_{i,t} = \alpha\sigma_{i,t-1} + \beta_1 CON_{i,t} + \beta_2 FIN_{i,t} + \beta_3 (CON_{i,t} \times FIN_{i,t}) + \delta B_{i,t} + \theta C_{i,t} + \nu_i + \varepsilon_{i,t} \tag{3}$$

where $FIN_{i,t}$ represents one of our financial development measures and $CON_{i,t} \times FIN_{i,t}$ represents the interaction variable. Other terms are as defined earlier.

Table 1 and Table 2 summarize descriptive statistics and correlation matrices of the dependent, independent, and control variables. Libya's highest economic volatility is recorded for 2013, while the lowest was in Lebanon in 2009. The average economic volatility of our sample countries is 2.81, and its standard deviations are found to be much higher, making it very volatile on average. By looking from the market structure perspective of bank concentration (CR5, CR3, and HHI), Table 1 shows high levels of bank concentration on average, especially

4 Another non-structural measure of competition used in the literature is the *H-statistic* developed by Panzar and Rosse (1987). However, it is not used as the data were not sufficient.

in the case of bank concentration ratios. However, the market power measures indicate relatively lower levels of bank concentrations within the sample countries. On the other hand, private credit as a measure of financial development is on average lower and has lower variations than the other two measures of financial development, i.e., liquid liabilities and broad money.

Table 1: *Summary of Descriptive Statistics*

Symbol	Obs.	Mean	Std. Dev.	Min.	Max.
σ	848	2.814	3.152	.103	18.56
CR3	831	73.28	19.29	29.128	100
BI	802	2.949	.117	2.155	3.208
HHI	737	.135	.093	.036	.507
CR5	726	84.846	14.962	36.891	100
LI	600	.318	.138	-.057	.632
PR	824	27.188	24.037	2.228	107.911
LL	824	46.132	39.645	8.355	232.91
M3	830	49.631	41.119	9.68	239.318
GCF	820	24.263	7.906	9.342	50.778
TO	825	77.023	34.628	25.853	199.356
BNI	848	41.248	14.262	12.052	77.726
GS	821	14.063	5.015	4.545	28.058
BNIM	848	5.14	2.772	1.016	14.456
I	848	34.239	9.962	7.595	74.293
BCI	848	53.315	14.311	24.359	90.437

Notes: σ – Economic volatility; CR3 – 3-bank concentration ratio; BI – Boone indicator; HHI – Herfindahl-Hirschman index; CR5 – 5-bank concentration ratio; LI – Lerner index; PR – Private credit; LL – Liquid liabilities; M3 – Broad money; GCF – Gross capital formation; TO – Trade openness; BNI – Bank non-interest income; GS – Government size; BNIM – Bank net interest margin; I – Inflation; BCI – Bank cost-to-income ratio.

Source: Author's compilation.

Table 2: *Correlation Matrices*

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) σ	1.000															
(2) CR5	0.123	1.000														
(3) CR3	0.111	0.908	1.000													
(4) HHI	0.148	0.282	0.269	1.000												
(5) BI	-0.079	0.174	0.157	-0.216	1.000											
(6) LI	0.198	0.173	0.065	0.039	0.099	1.000										
(7) PR	-0.084	-0.197	-0.172	-0.274	0.155	0.064	1.000									
(8) LL	-0.107	-0.226	-0.165	-0.220	0.113	-0.078	0.793	1.000								
(9) M3	-0.109	-0.243	-0.179	-0.233	0.110	-0.082	0.797	0.991	1.000							
(10) TO	0.083	0.158	0.183	-0.066	0.178	0.328	0.626	0.389	0.391	1.000						
(11) GCF	-0.144	-0.110	-0.067	0.081	0.068	0.226	0.110	0.095	0.131	0.191	1.000					
(12) GS	0.045	0.308	0.219	0.026	0.207	0.329	0.275	0.212	0.197	0.277	0.118	1.000				
(13) I	0.199	-0.041	-0.008	-0.033	-0.165	-0.100	-0.206	-0.184	-0.169	-0.063	-0.022	-0.246	1.000			
(14) BCI	-0.018	0.070	0.099	0.189	-0.226	-0.499	-0.429	-0.255	-0.272	-0.361	-0.286	-0.121	0.049	1.000		
(15) BNI	0.056	0.159	0.156	0.095	-0.057	-0.106	-0.322	-0.326	-0.355	-0.136	-0.118	-0.134	0.006	0.253	1.000	
(16) BNIM	0.209	-0.033	0.008	0.194	-0.336	-0.013	-0.563	-0.495	-0.496	-0.330	-0.079	-0.229	0.163	0.395	0.007	1.000

Source: Author's calculations.

3.3 Method

The literature under review indicates a prevalence of cross-sectional studies and datasets regarding methods used in similar studies. They rely on various techniques from the ordinary least square (OLS), the mean group (MG) and pooled mean group (PMG), and instrumental variables (IV) to the generalized method of moments (GMM). Each method has its limitations. For instance, estimates produced using the OLS method are biased as there is a correlation between explanatory variables and the disturbance term (Barajas, Chami, & Yousefi, 2013). On the other hand, the MG and PMG estimators of Pesaran and Smith (1995) do not impose the above restriction and allow heterogeneous parameters. As long as N and T are large enough, we can consistently estimate the mean of long-run coefficients across countries using the unweighted average of the individual country parameter estimates.

Another method available for researchers is the generalized method of moments (GMM) estimators developed by Hansen (1982) and operationalized by Arellano and Bond (1991). This Arellano-Bond or difference GMM estimator was further improved by Arellano and Bover (1995) and Blundell and Bond (1998) and became known as the system GMM. The later estimator is considered superior to the former as it is more consistent (Arellano & Bover, 1995; Hsiao, 2007).

After all, following the existing literature and given our dataset, it seems that GMM estimators are the best fit for this study. Thus, this study applies the system GMM as its primary estimation method.

4 Empirical Results

4.1 Linear Model

We start our discussion by presenting the results of the baseline model. They are shown in Table 3. However, before addressing the results, a few remarks on the arrangement of the table are in order. It consists of two panels. While panel A

takes a 3-bank concentration ratio (CR3) as the main independent variable, in panel B, it is the Boone indicator (BI). As proxies for the financial development, each panel takes independently private credit (PR) and liquid liabilities (LL) to GDP ratio. Thus, models (1), (2), and (3) from panel A and models (7), (8), and (9) from panel B use PR as the financial development proxy. In contrast, models (4), (5), (6), and (10), (11), (12) use LL in panel A and panel B, respectively. At the same time, in models (1), (4), (7), and (10), we include only country-specific control variables. In subsequent models – (2), (5), (8), and (11) – we have bank-specific variables as well. Finally, we add a crisis dummy in the remaining models to see whether it affects economic volatility in our sample countries.

Several post-estimation specification tests follow each model in the study, and they are reported below tables. In particular, we reject the null of no first-order serial correlation (AR1) but fail to reject the null of no second-order serial correlation in the first-differenced errors (AR2). This is the case in all estimations that we run. These two conditions are required for the GMM estimates to be consistent. Furthermore, the Hansen tests confirm the absence of correlation between the instruments and the error term. As a result, we can conclude that the models fit GMM estimations and confirm the instruments' validity.

Now, we turn to the results from Table 3. Under all specifications, there is a high level of persistence. We find that the estimated coefficients of the economic volatility variable that is lagged for one period remain highly significant and above 0.66. This is not the case, however, with our main independent variables. Out of twelve estimations, the results show that CR3 and BI are not significantly associated with economic volatility in the OIC countries save for model (4). Even in this case, its positive effect can be ignored economically as it is very marginal. These findings are partially consistent with the results of Beck et al. (2006), Schaeck et al. (2009), Yeh et al. (2013), Smolo (2019), and Smolo et al. (2021).

As for our financial development proxies, PR and LL, the results indicate that they significantly lower economic volatility in the sample countries. Only in models (8)

and (9) the impact of PR, although negative, is insignificant. However, we follow the majority view, i.e., financial development significantly decreases economic volatility. These results are in line with results reported by Beck et al. (2014) and Ali, Ibrahim, and Shah (2022) and partially with findings by Smolo (2019). However, they are contrary to those reported by Ibrahim (2007), Schaeck et al. (2009), Yeh et al. (2013), and Law and Singh (2014). As for the country-specific control variables, the results reveal that the trade openness and the gross capital formation are significantly attributed with a positive and negative contribution to economic volatility, respectively.

In contrast, the government size and inflation are insignificant in most regressions. Similar findings are reported by Yeh et al. (2013) and Ali et al. (2022). However, when it comes to the bank-specific control variables, only BNI significantly decreases economic volatility. In contrast, the other two, BCI and BNIM, are insignificant in all models. Finally, the global financial crisis dummy plays no significant role in economic volatility within OIC countries. Smolo (2019), Smolo et al. (2021), and Ali et al. (2022) report similar results. The financial sector's underdevelopment in the sample countries could be a possible reason for the global financial crisis's insignificance. In other words, they were not exposed to toxic products that primarily led to the crisis. At the same time, most of these markets are not well integrated into the world financial system and hence may not be that affected by the crisis contagion. As a result, and due to the insignificant results of the financial crisis dummy in other models, we are not going to report it in the other specifications.

Table 3: *Concentration–Volatility Relationship – Baseline Results*

Variables	Panel A – 3-bank concentration ratio (CR3)						Panel B – The Boone indicator (BI)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Economic volatility$_{t-1}$ (σ_{t-1})	0.674***	0.715***	0.715***	0.672***	0.714***	0.713***	0.733***	0.726***	0.722***	0.661***	0.735***	0.731***
	(0.046)	(0.014)	(0.014)	(0.042)	(0.012)	(0.013)	(0.015)	(0.047)	(0.046)	(0.019)	(0.044)	(0.044)
3-bank concentration ratio	0.003	0.002	0.002	0.005*	0.003	0.003						
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)						
Boone indicator (log)							-0.372	-0.856	-0.891	-0.528	-0.642	-0.655
							(1.167)	(1.361)	(1.355)	(1.259)	(1.345)	(1.339)
Private credit (log)	-0.283*	-0.247***	-0.244***				-0.231***	-0.304	-0.316			
	(0.152)	(0.086)	(0.087)				(0.041)	(0.205)	(0.204)			
Liquid liabilities (log)				-0.328**	-0.365***	-0.361***				-0.319***	-0.377**	-0.397**
				(0.142)	(0.084)	(0.086)				(0.072)	(0.179)	(0.179)
Gross capital formation (log)	-0.100	-0.342***	-0.336***	-0.116	-0.342***	-0.336***	-0.322***	-0.174	-0.178	-0.439**	-0.243	-0.252
	(0.203)	(0.114)	(0.116)	(0.182)	(0.108)	(0.110)	(0.121)	(0.216)	(0.216)	(0.179)	(0.179)	(0.178)
Trade openness (log)	0.589**	0.535***	0.532***	0.542**	0.506***	0.505***	0.549***	0.497*	0.500*	0.646***	0.384*	0.394*
	(0.295)	(0.100)	(0.104)	(0.259)	(0.106)	(0.109)	(0.101)	(0.275)	(0.279)	(0.155)	(0.209)	(0.222)
Government size (log)	-0.208	-0.207**	-0.209**	-0.162	-0.194*	-0.199*	-0.196	-0.176	-0.164	-0.243	-0.151	-0.146
	(0.184)	(0.103)	(0.103)	(0.178)	(0.108)	(0.108)	(0.124)	(0.206)	(0.216)	(0.176)	(0.184)	(0.195)
Inflation (log)	0.437**	0.155	0.159	0.438**	0.178	0.181	0.182	0.286	0.303	0.134	0.313	0.326
	(0.200)	(0.151)	(0.149)	(0.195)	(0.151)	(0.148)	(0.148)	(0.218)	(0.219)	(0.145)	(0.210)	(0.212)
Bank non-interest income (log)		-0.194	-0.191		-0.296***	-0.294***		-0.559*	-0.575*		-0.518**	-0.540**
		(0.130)	(0.133)		(0.100)	(0.103)		(0.306)	(0.304)		(0.240)	(0.240)
Bank cost-to-income ratio (log)		-0.201	-0.196		-0.241	-0.236		-0.008	-0.003		-0.044	-0.044
		(0.182)	(0.184)		(0.170)	(0.173)		(0.263)	(0.263)		(0.243)	(0.244)
Bank net interest margin (log)		0.052	0.053		-0.036	-0.033		-0.144	-0.168		-0.125	-0.150
		(0.125)	(0.124)		(0.111)	(0.110)		(0.269)	(0.264)		(0.191)	(0.184)
Crisis (dummy)			-0.004			-0.021			0.143			0.100
			(0.093)			(0.090)			(0.203)			(0.196)

Constant	-1.758	1.411	1.351	-1.442	2.584**	2.523**	0.185	2.606	2.659	1.195	3.268	3.396
	(1.179)	(1.125)	(1.163)	(1.145)	(1.024)	(1.074)	(1.185)	(2.276)	(2.300)	(1.324)	(2.290)	(2.316)
Observations	742	742	742	742	742	742	708	708	708	708	708	708
No. of instruments	10	27	28	10	27	28	23	14	15	23	15	16
No. of groups	47	47	47	47	47	47	47	47	47	47	47	47
AR1 *p*-value	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
AR2 *p*-value	0.220	0.220	0.220	0.220	0.218	0.219	0.226	0.212	0.203	0.207	0.211	0.204
Hansen *p*-value	0.455	0.230	0.232	0.460	0.226	0.227	0.141	0.182	0.166	0.139	0.244	0.225

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's calculations.

Table 4: *Concentration–Volatility Relationship – Non-Linear Model*

Variables	Panel A – 3-bank concentration ratio				Panel B – The Boone indicator			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic volatility$_{t-1}$ (σ_{t-1})	0.673***	0.713***	0.697***	0.712***	0.734***	0.710***	0.662***	0.724***
	(0.043)	(0.014)	(0.014)	(0.013)	(0.015)	(0.051)	(0.020)	(0.048)
3-bank concentration ratio	-0.002	-0.019	-0.019	-0.024				
	(0.022)	(0.015)	(0.016)	(0.016)				
CR3 squared	0.000	0.000	0.000	0.000*				
	(0.000)	(0.000)	(0.000)	(0.000)				
Boone indicator (log)					6.296	1.441	0.734	-1.141
					(10.096)	(12.224)	(12.761)	(12.244)
BI squared					-3.524	-1.578	-0.752	0.068
					(5.496)	(6.678)	(6.924)	(6.649)
Private credit (log)	-0.245**	-0.258***			-0.230***	-0.254***		
	(0.123)	(0.083)			(0.042)	(0.093)		
Liquid liabilities (log)			-0.292***	-0.390***			-0.322***	-0.278**
			(0.064)	(0.079)			(0.074)	(0.137)
Gross capital formation (log)	-0.167	-0.317***	-0.294***	-0.316***	-0.304**	-0.373*	-0.430**	-0.338
	(0.139)	(0.117)	(0.104)	(0.112)	(0.125)	(0.223)	(0.182)	(0.212)
Trade openness (log)	0.417*	0.487***	0.462***	0.453***	0.551***	0.592***	0.651***	0.523**
	(0.228)	(0.103)	(0.123)	(0.112)	(0.101)	(0.214)	(0.158)	(0.215)
Government size (log)	-0.124	-0.152	-0.124	-0.120	-0.218*	-0.201	-0.254	-0.189
	(0.179)	(0.102)	(0.111)	(0.113)	(0.127)	(0.208)	(0.182)	(0.214)
Inflation (log)	0.435**	0.173	0.233	0.198	0.177	0.001	0.131	-0.001
	(0.191)	(0.151)	(0.144)	(0.151)	(0.146)	(0.163)	(0.144)	(0.162)
Bank non-interest income (log)		-0.209		-0.323***		-0.239		-0.228
		(0.128)		(0.096)		(0.207)		(0.183)
Bank cost-to-income ratio (log)		-0.211		-0.259		-0.189		-0.168
		(0.183)		(0.172)		(0.236)		(0.222)

Bank net interest margin (log)		0.018		-0.082		0.057		0.076
		(0.124)		(0.110)		(0.136)		(0.133)
Constant	-0.983	2.157*	0.623	3.635***	-2.896	2.329	0.712	3.413
	(0.986)	(1.259)	(0.802)	(1.145)	(4.837)	(5.752)	(5.819)	(5.692)
Observations	742	742	742	742	708	708	708	708
No. of instruments	14	28	25	28	24	23	24	24
No. of groups	47	47	47	47	47	47	47	47
AR1 *p*-value	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001
AR2 *p*-value	0.224	0.226	0.230	0.225	0.226	0.217	0.207	0.219
Hansen *p*-value	0.486	0.220	0.211	0.215	0.145	0.107	0.142	0.121
Inflection point	33.437	62.386	59.025	61.153	0.893	0.456	0.488	8.379

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In this table, CR3 squared is the square term of the 3-bank concentration ratio. BI squared is the square term of the Boone indicator.

Source: Author's calculations.

4.2 Non-Linear Bank Market Structure and Economic Volatility Relationships

We shift our focus to the possible non-linear relationship between bank concentration and economic volatility. Hence, whether the relationship between bank concentration and volatility is non-linear or not is tested by integrating the square term in our original model. In particular, we introduce the square term of the 3-bank concentration ratio (CR3 squared) and the square term of the Boone indicator (BI squared). These findings are reported in Table 4. Again, the post-estimation tests confirm that the GMM method is adequate and that the instruments used are valid.

In short, our findings from Table 3 are confirmed. In particular, the lagged dependent variable's coefficients remain as highly significant as before. Our focus variables, the bank concentration measures, are still found to have an insignificant impact on economic volatility. However, the non-linearity of the bank concentration–economic volatility relationship cannot be confirmed as the square terms (CR3 squared and BI squared) are insignificant, except under model (4). Nevertheless, based on overall results, we can conclude that bank concentration does not impact economic volatility in linear or non-linear ways. These findings are partially in line with the results reported by Smolo (2019) and Smolo et al. (2021) but in contrast to the results reported by Ibrahim and Alagidede (2017) and Ma and Song (2018). Furthermore, our financial development indicators align with the main results, confirming their significant effect on reducing economic volatility within OIC member countries. Finally, the results confirm the results reported in the baseline model above by looking at the other control variables.

4.3 Finance, Bank Market Structure, and Economic Volatility Relationships

Now, we want to see whether the concentration–volatility relationships within OIC countries depend on the level of financial development. Namely, we investigate the impact of bank concentration and financial development on economic volatility and their combined effect on volatility. Individually, bank concentration and financial development may have a positive or negative impact. However, when their impacts are combined, the overall effect on economic volatility may be increased or decreased by each other.

Our interaction model estimations are presented in Table 5. In this interaction model, there are four interaction terms. In particular, we interact the 3-bank concentration ratio with private credit (CR3*PR) and liquid liabilities (CR3*LL) in panel A. Similarly, we interact the Boone indicator with private credit (BI*PR) and liquid liabilities (BI*LL) in panel B. Odd number models present baseline relationships using only country-specific control variables. In contrast, even number models present this relationship with all control variables.

In short, the table offers mixed results. In contrast to the previous results reported in Table 3 and Table 4, all models in panel A of Table 5 reveal a significantly positive effect of CR3 on economic volatility. In this panel, however, both financial development proxies (PR and LL) have an insignificant impact on economic volatility. Nevertheless, our interaction terms (CR3*PR and CR3*LL) have a marginally significant impact on reducing volatility. Furthermore, the joint significance tests ($\beta_1+\beta_3$) indicate that CR3 and financial development proxies are different from zero, confirming the hypothesis that CR3 has a different impact on economic volatility when interacting with financial development proxies. In other words, at low levels of financial development, bank concentration reduces economic volatility. Similar findings are reported by Beck et al. (2014), Smolo (2019), and Smolo et al. (2021). Thus, it can be said that an increase in financial development slightly decreases the positive impact of the market structure concentration (CR3) on volatility. To put it differently, while CR3

increases economic volatility, financial development reduces it indirectly through its negative impact on CR3. In short, having in mind the panel A models, we can decrease economic volatility by either increasing the financial development and/or decreasing the market structure concentration, *ceteris paribus*. Still, the estimated results for other control variables in panel A align with previously reported ones.

Now, we are turning to panel B estimation results. It seems that once we introduce the interaction terms in this panel, bank concentration indicator (BI), financial development proxies (PR and LL), and interaction terms (BI*PR BI*LL) become insignificant. This means that bank concentration, financial development, or interaction terms do not affect economic volatility. This finding is further substantiated by the insignificance of their joint significance tests ($\beta_1+\beta_3$). Nevertheless, model specifications in panel B do not significantly change the estimated coefficients of our control variables as they confirm our main results reported earlier.

In brief, our results suggest that the market structure (CR3) has a marginally positive impact on economic volatility. However, this positive impact is slightly decreased by increasing financial development. In essence, the study finds partial evidence that the effect of bank concentration on economic volatility depends on the level of financial development. These findings could be explained by OIC countries' overall (under)development. As reported in Table 1, the sample countries are faced, on average, with a very high degree of market structure concentration (CR3) and relatively shallow levels of financial development. Consequently, the effect of CR is somewhat predominant compared to financial development. Thus, greater attention should be given to improving the overall financial development within OIC countries to tackle volatility caused by bank concentration.

Table 5: *Finance and Concentration–Economic Volatility Relationship*

Variables	Panel A – 3-bank concentration ratio				Panel B – The Boone indicator			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic volatility$_{t-1}$ (σ_{t-1})	0.700***	0.708***	0.712***	0.709***	0.730***	0.743***	0.729***	0.724***
	(0.064)	(0.014)	(0.014)	(0.013)	(0.014)	(0.046)	(0.067)	(0.043)
3-bank concentration ratio	0.029*	0.024***	0.030**	0.032***				
	(0.016)	(0.008)	(0.012)	(0.012)				
Boone indicator (log)					-4.597	-4.432	5.583	5.336
					(3.853)	(4.820)	(5.482)	(5.095)
Private credit (log)	0.338	0.303			-2.122	-1.762		
	(0.351)	(0.219)			(1.409)	(1.853)		
CR3*PR	-0.008	-0.007***						
	(0.005)	(0.003)						
BI*PR					1.732	1.456		
					(1.288)	(1.682)		
Liquid liabilities (log)			0.244	0.192			2.108	1.908
			(0.202)	(0.199)			(2.027)	(1.882)
CR3*LL			-0.008**	-0.008***				
			(0.003)	(0.003)				
BI*LL							-2.164	-2.119
							(1.876)	(1.762)
Gross capital formation (log)	-0.132	-0.323***	-0.265***	-0.304***	-0.360***	-0.276	-0.222	-0.238
	(0.208)	(0.114)	(0.094)	(0.103)	(0.120)	(0.188)	(0.224)	(0.185)
Trade openness (log)	0.583**	0.517***	0.500***	0.506***	0.561***	0.353*	0.373	0.397*
	(0.281)	(0.094)	(0.106)	(0.103)	(0.103)	(0.206)	(0.245)	(0.216)
Government size (log)	-0.219	-0.195*	-0.190*	-0.192*	-0.191	-0.146	-0.130	-0.150
	(0.195)	(0.111)	(0.106)	(0.112)	(0.121)	(0.197)	(0.227)	(0.189)
Inflation (log)	0.418*	0.158	0.204	0.187	0.180	0.317	0.331	0.323
	(0.216)	(0.148)	(0.145)	(0.152)	(0.151)	(0.212)	(0.248)	(0.208)

Bank non-interest income (log)		-0.199		-0.321***		-0.420*		-0.498**
		(0.125)		(0.106)		(0.238)		(0.237)
Bank cost-to-income ratio (log)		-0.206		-0.246		-0.054		-0.051
		(0.183)		(0.167)		(0.246)		(0.247)
Bank net interest margin (log)		0.068		-0.044		-0.006		-0.127
		(0.120)		(0.109)		(0.201)		(0.192)
Constant	-3.560*	-0.282	-2.007	0.547	4.874	6.288	-6.335	-3.291
	(1.901)	(1.214)	(1.258)	(1.245)	(4.128)	(5.822)	(6.468)	(5.631)
$\beta_1+\beta_3$	0.020*	0.017***	0.022**	0.024***	-2.865	-2.976	3.419	3.218
	(0.011)	(0.006)	(0.009)	(0.009)	(2.619)	(3.207)	(3.690)	(3.423)
Observations	742	742	742	742	708	708	708	708
No. of instruments	25	28	25	28	24	16	13	16
No. of groups	47	47	47	47	47	47	47	47
AR1 *p*-value	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001
AR2 *p*-value	0.240	0.227	0.228	0.216	0.219	0.210	0.230	0.212
Hansen *p*-value	0.226	0.231	0.243	0.238	0.125	0.237	0.252	0.245

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In this table, CR3*PR is the 3-bank concentration ratio–Private credit (log) interaction term. BI*PR is the Boone indicator–Private credit (log) interaction term. CR3*LL is the 3-bank concentration ratio and Liquid liabilities (log) interaction term. CR3*LL is the Boone indicator–Liquid liabilities (log) interaction term.

Source: Author's calculations.

4.4 Robustness Tests

Here, we will briefly discuss the main findings of the robustness tests following the format that we had in the previous subsections (robustness tables are reported in Appendix 1). For robustness test purposes, we will report results using three additional measures of the bank concentration. Two of them are market structure measures – the 5-bank concentration ratio (CR5) and the Herfindahl-Hirschman index (HHI) – and the third one is a market power measure – the Lerner index (LI). Also, this study will apply another financial development measure commonly used in the literature. This measure is the broad money (M3), and we want to see whether our results will be consistent even when we change this variable.

The results for our baseline model are reported in Table A1 (see Appendix 1). Panels A and B report results using CR5 and HHI (market structure measures), respectively, and panel C reports results using LI or the market power measure. The results from panels A and B are in coherence with our main results reported in Table 3. This applies to our principal and country-specific control variables, while bank control variables are mainly insignificant. In other words, bank concentration is not significantly attributed to changes in economic volatility in OIC countries.

Panel C, on the contrary, indicates that the impact of bank concentration as proxied by the market power measure (LI) on economic volatility is positive and significant. Although contrary to our main results and the other market power measure used earlier, i.e., the Boone indicator, these results align with Yeh et al. (2013) and Smolo (2019). One possible explanation for these results could be the market structure/power measure used, i.e., how bank concentration ratios and LI are calculated. Given the results, it might be that LI is a more relevant measure of the bank market power than concentration ratios. In other words, the unorthodox way of measuring market power is the new industrial measure and not the traditional one (Feinberg, 1980; Beck, 2008; Carbó, Humphrey, Maudos, & Molyneux, 2009; Soedarmono, 2010; Leon, 2015). Nevertheless, this is the

only difference from our main results, as other coefficients follow previously reported results.

When it comes to the non-linear models, our results are robust to new model specifications as the overall impact is insignificant, linear or non-linear (see Table A2 in Appendix 1). Model (4) is the only model that reports significant coefficients of CR5 and its square term (CR5 squared). Accordingly, this model indicates that bank concentration decreases economic volatility up to a point when bank concentration reaches 72.97 percent, and its effect becomes positive. This points out a U-shaped relationship between bank concentration and economic volatility. However, we may conclude that this relationship is insignificant for two main reasons. First, most of the specifications show insignificance. Second, we need to be careful when taking results provided by the CR5 measure as we lack a significant number of observations on this variable. To make this finding more meaningful and reliable, we need to collect a better dataset or restrict our investigation to the period for which these data are available.

The robustness test results for our second objective are provided in Table A3. While our main results in Table 5 show that bank concentration reduces economic volatility at low levels of financial development, the same is not the case when CR5 and HHI are used instead of CR3. Most of the concentration, financial development, and interaction terms coefficients are insignificant. This is also confirmed by the insignificance of the joint significance tests. In contrast, panel C shows that bank power (LI) plays a significant role in economic volatility, and this effect is dependent on the financial development levels of OIC countries. As briefly pointed out above, this discrepancy in results could be due to the market structure/power measure used and how they are calculated. According to Leon (2015), concentration measures may provide different efficiencies, and they represent aggregate or national level calculations, while the Lerner index is bank-specific and varies over time.

Furthermore, LI does not measure competition but bank pricing power. It is instrumental when analyzing the effects of market power on banks' risk-taking behavior and performance (Leon, 2015). At the same time, it has been documented in the literature that different concentration measures may lead to different results, especially in a cross-country analysis (Carbó et al., 2009). Our control variables, however, are consistent throughout other specifications.

Finally, we use broad money (M3) as an alternative measure of financial development to check our main results reported in Table 3, Table 4, and Table 5. These robustness test results are reported in Table A4. Panels A, B, and C address linear, non-linear, and interaction models, respectively, considering our main bank concentration variables CR3 and BI.

In general, all specifications indicate a high significance of the lagged dependent variable coefficients, and they are close to earlier reported values. In addition, bank concentration is not attributed to significant economic volatility, linear or non-linear, as per the main results. Similarly, all specifications under panel C, where our second objective is tested, are in line with our main results. In other words, some evidence is found for the hypothesis that the effect of bank concentration depends on the level of financial development of OIC countries. Our control variables are in line with our previous results.

5 Concluding Remarks

This study investigated whether bank concentration affects economic volatility (*H1*) in sample countries and whether this relationship depends on financial development (*H2*). Due to the paucity of literature on these countries, this study provides new insights. By using GMM estimation methods, concentration measures, and control variables, we provide several conclusions.

There is no significant relationship between bank concentration and economic volatility – both linearly and nonlinearly – as most concentration measures

coefficients are insignificant. In contrast, financial development measures (individually or in conjunction with concentration ratios) contribute to economic stability as they lower volatility significantly. No matter what proxies and estimation specifications are used, these results are generally consistent.

Slight inconsistency in our results could be attributed to different proxies used for the analysis as they may lead to varying results in cross-country analysis (Carbó et al., 2009; Leon, 2015). Hence, while a minor result indicates a positive impact of the market structure concentration (CR3) on volatility, it can be offset by increasing financial development. In other words, we can decrease economic volatility in the sample countries by either increasing the financial development and/or decreasing the market structure concentration, *ceteris paribus*.

In general, the findings offer some critical insights into the topic from a heterogeneous sample of countries with different levels of bank concentration and financial development. In short, policymakers should not worry that much about bank concentration (at least temporarily). To avoid its possible negative impact on economic stability, they should instead focus on fostering financial development that decreases economic volatility either directly or through its impact on concentration. Thus, greater attention should be given to improving the overall financial development within OIC countries to tackle volatility caused by bank concentration. Still, careful attention should be given to proxies used for the analysis, as the use of different proxies may lead to different and sometimes conflicting results.

Literature

Abojeib, M. M. (2017). *Competition–stability relationship in dual banking systems: Islamic vs. conventional banks* (Doctoral dissertation). Retrieved from: https://ikr.inceif.org/handle/INCEIF/2421

Ali, M., Ibrahim, M. H., & Shah, M. E. (2022). Impact of non-intermediation activities of banks on economic growth and volatility: An evidence from OIC. *The Singapore Economic Review*, *67*(1), 333–348. doi: https://doi.org/10/ghr5zk

Arcand, J. L., Berkes, E., & Panizza, U. (2015). Too much finance? *Journal of Economic Growth*, *20*(2), 105–148. doi: https://doi.org/10.1007/s10887-015-9115-2

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277–297. doi: https://doi.org/10.2307/2297968

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. doi: https://doi.org/10.1016/0304-4076(94)01642-D

Barajas, A., Chami, R., & Yousefi, S. R. (2013). The finance and growth nexus re-examined: Do all countries benefit equally? *IMF Working Paper No. 13/130*. doi: https://doi.org/10.5089/9781484372104.001

Beck, T. (2008). Bank competition and financial stability: Friends or foes? *World Bank Policy Research Working Paper No. 4656*. doi: https://doi.org/10.1596/1813-9450-4656

Beck, T., Degryse, H., & Kneer, C. (2014). Is more finance better? Disentangling intermediation and size effects of financial systems. *Journal of Financial Stability*, *10*, 50–64. doi: https://doi.org/10.1016/j.jfs.2013.03.005

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2006). Bank concentration, competition, and crises: First results. *Journal of Banking & Finance*, *30*(5), 1581–1603. doi: https://doi.org/10.1016/j.jbankfin.2005.05.010

Bikker, J., & Haaf, K. (2002). Competition, concentration and their relationship: An empirical analysis of the banking industry. *Journal of Banking & Finance*, *26*(11), 2191–2214. doi: https://doi.org/10.1016/S0378-4266(02)00205-4

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. doi: https://doi.org/10.1016/S0304-4076(98)00009-8

Boone, J. (2004). A new way to measure competition. *CentER Discussion Paper No. 2004-31*. doi: https://doi.org/10.2139/ssrn.557821

Boone, J. (2008). A new way to measure competition. *The Economic Journal*, *118*(531), 1245–1261. doi: https://doi.org/10.1111/j.1468-0297.2008.02168.x

Brambor, T., Clark, W. R., & Golder, M. (2006). Understanding interaction models: Improving empirical analyses. *Political Analysis, 14*(1), 63–82. doi: https://doi.org/10.1093/pan/mpi014

Carbó, S., Humphrey, D., Maudos, J., & Molyneux, P. (2009). Cross-country comparisons of competition and pricing power in European banking. *Journal of International Money and Finance*, *28*(1), 115–134. doi: https://doi.org/10.1016/j.jimonfin.2008.06.005

Cecchetti, S. G., & Kharroubi, E. (2012). Reassessing the impact of finance on growth. *BIS Working Paper No. 381*.

Cetorelli, N., & Strahan, P. E. (2006). Finance as a barrier to entry: Bank competition and industry structure in local U.S. markets. *The Journal of Finance*, *61*(1), 437–461. doi: https://doi.org/10.1111/j.1540-6261.2006.00841.x

Davies, S. (1979). Choosing between concentration indices: The iso-concentration curve. *Economica*, *46*(181), 67–75. doi: https://doi.org/10.2307/2553097

Davis, K. (2007). Banking concentration, financial stability and public policy. In C. Kent & J. Lawson (Eds.), *The structure and resilience of the financial system* (pp. 255–284). Sydney: Reserve Bank of Australia. Retrieved from: https://www.rba.gov.au/publications/confs/2007/pdf/davis.pdf

Deidda, L., & Fattouh, B. (2005). Concentration in the banking industry and economic growth. *Macroeconomic Dynamics*, *9*(2), 198–219. doi: https://doi.org/10.1017/S1365100505040174

Di Patti, E. B., & Dell'Ariccia, G. (2004). Bank competition and firm creation. *Journal of Money, Credit and Banking*, *36*(2), 225–251. doi: https://doi.org/10.1353/mcb.2004.0011

Feinberg, R. M. (1980). The Lerner index, concentration, and the measurement of market power. *Southern Economic Journal*, *46*(4), 1180–1186. doi: https://doi.org/10.2307/1057252

Guzman, M. G. (2000). The economic impact of bank structure: A review of recent literature. *Economic and Financial Review*, *Q2*, 11–25.

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, *50*(4), 1029–1054. doi: https://doi.org/10.2307/1912775

Hsiao, C. (2007). Panel data analysis—Advantages and challenges. *TEST*, *16*(1), 1–22. doi: https://doi.org/10.1007/s11749-007-0046-x

Ibrahim, M., & Alagidede, P. (2017). Financial sector development, economic volatility and shocks in sub-Saharan Africa. *Physica A: Statistical Mechanics and Its Applications*, *484*, 66–81. doi: https://doi.org/10/gfhzbj

Ibrahim, M. H. (2007). The role of the financial sector in economic development: The Malaysian case. *International Review of Economics*, *54*(4), 463–483. doi: https://doi.org/10.1007/s12232-007-0023-4

IFSB. (2019). *Islamic financial services industry stability report 2019*. Kuala Lumpur: Islamic Financial Services Board (IFSB).

Law, S. H., & Singh, N. (2014). Does too much finance harm economic growth? *Journal of Banking & Finance*, *41*, 36–44. doi: https://doi.org/10.1016/j.jbankfin.2013.12.020

Lee, C.-C., & Hsieh, M.-F. (2013a). The impact of bank capital on profitability and risk in Asian banking. *Journal of International Money and Finance*, *32*(Supplement C), 251–281. doi: https://doi.org/10.1016/j.jimonfin.2012.04.013

Lee, C.-C., & Hsieh, M.-F. (2013b). Beyond bank competition and profitability: Can moral hazard tell us more? *Journal of Financial Services Research*, *44*(1), 87–109. doi: https://doi.org/10.1007/s10693-012-0151-1

Leon, F. (2015). Measuring competition in banking: A critical review of methods. *Halshs-01015794v2*. Retrieved from: https://halshs.archives-ouvertes.fr/halshs-01015794v2

Lerner, A. P. (1934). The concept of monopoly and the measurement of monopoly power. *The Review of Economic Studies*, *1*(3), 157–175. doi: https://doi.org/10.2307/2967480

Ma, Y., & Song, K. (2018). Financial development and macroeconomic volatility. *Bulletin of Economic Research*, *70*(3), 205–225. doi: https://doi.org/10.1111/boer.12123

Moyo, J., Nandwa, B., Oduor, J., & Simpasa, A. (2014, January 30). *Financial sector reforms, competition and banking system stability in sub-Saharan Africa*. Paper presented at the Conference on Macroeconomic Challenges Facing Low-Income Countries: New Perspectives, Washington, DC.

Panzar, J. C., & Rosse, J. N. (1987). Testing for "monopoly" equilibrium. *The Journal of Industrial Economics*, *35*(4), 443–456. doi: https://doi.org/10/bcx9h3

Pesaran, M. H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, *68*(1), 79–113. doi: https://doi.org/10.1016/0304-4076(94)01644-F

Prochniak, M., & Wasiak, K. (2016). The impact of the financial system on economic growth in the context of the global crisis: Empirical evidence for the EU and OECD countries. *Empirica*, *44*(2), 295–337. doi: https://doi.org/10.1007/s10663-016-9323-9

Schaeck, K., Čihák, M., & Wolfe, S. (2009). Are competitive banking systems more stable? *Journal of Money, Credit and Banking*, *41*(4), 711–734. doi: https://doi.org/10.1111/j.1538-4616.2009.00228.x

Smolo, E. (2019). *The effect of bank concentration and financial development on economic growth and income volatility: Evidence from the OIC countries* (Doctoral dissertation). Retrieved from: https://ikr.inceif.org/handle/INCEIF/3176

Smolo, E. (2020). Bank concentration and economic growth nexus: Evidence from OIC countries. *Applied Finance Letters*, *9*, 81–111. doi: https://doi.org/10/ghsgg7

Smolo, E., Ibrahim, M. H., & Dewandaru, G. (2021). Impact of bank concentration and financial development on growth volatility: The case of selected OIC countries. *Emerging Markets Finance and Trade*, *57*(7), 2094–2106. doi: https://doi.org/10/gjm367

Soedarmono, W. (2010). Bank competition, institution and economic development: Evidence from Asia during 1999-2007. *Economics Bulletin*, *30*(3), 2119–2133.

Yeh, C.-C., Huang, H.-C., & Lin, P.-C. (2013). Financial structure on growth and volatility. *Economic Modelling*, *35*(Supplement C), 391–400. doi: https://doi.org/10.1016/j.econmod.2013.07.034

Appendix 1

Table A1: *Robustness Tests: Baseline Models*

Variables	Panel A				Panel B				Panel C			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Economic volatility$_{t-1}$ (σ_{t-1})	0.357***	0.300*	0.370***	0.370***	0.644***	0.412***	0.555***	0.424***	0.520***	0.520***	0.803***	0.805***
	(0.051)	(0.158)	(0.050)	(0.124)	(0.087)	(0.079)	(0.025)	(0.079)	(0.098)	(0.049)	(0.023)	(0.024)
5-bank concentration ratio	0.005	-0.001	0.005	0.005								
	(0.007)	(0.009)	(0.005)	(0.007)								
Herfindahl-Hirschman index					-0.185	0.336	0.277	0.484				
					(0.616)	(0.658)	(0.481)	(0.610)				
Lerner index									1.486**	1.178**	0.639*	0.761
									(0.594)	(0.556)	(0.386)	(0.477)
Private credit (log)	-0.383***	-0.565			-0.295*	-0.288**			-0.269**	-0.132		
	(0.137)	(0.411)			(0.168)	(0.121)			(0.135)	(0.097)		
Liquid liabilities (log)			-0.291*	-0.601*			-0.342***	-0.318*			-0.180***	-0.145*
			(0.169)	(0.307)			(0.072)	(0.166)			(0.049)	(0.085)
Gross capital formation (log)	-0.369	-0.584	-0.401	-0.576	-0.581**	-0.714***	-0.477***	-0.724***	-0.780***	-0.743***	-0.514***	-0.516***
	(0.337)	(0.527)	(0.307)	(0.444)	(0.266)	(0.240)	(0.176)	(0.241)	(0.263)	(0.192)	(0.125)	(0.128)
Trade openness (log)	0.699**	0.798*	0.562*	0.673**	0.359	0.588**	0.534***	0.565***	0.516*	0.422***	0.270***	0.257***
	(0.287)	(0.435)	(0.304)	(0.292)	(0.232)	(0.230)	(0.113)	(0.208)	(0.280)	(0.111)	(0.078)	(0.082)
Government size (log)	0.051	0.118	0.123	0.195	0.159	0.262	0.074	0.236	-0.073	0.144	-0.070	-0.077
	(0.267)	(0.448)	(0.268)	(0.322)	(0.217)	(0.174)	(0.139)	(0.161)	(0.299)	(0.203)	(0.138)	(0.143)
Inflation (log)	0.358**	0.771**	0.367**	0.334	0.528**	0.478**	0.456**	0.498**	0.746**	0.732***	0.154	0.181
	(0.177)	(0.369)	(0.176)	(0.234)	(0.244)	(0.212)	(0.182)	(0.212)	(0.294)	(0.280)	(0.233)	(0.238)
Bank non-interest income (log)		-0.012		-0.208		0.187		0.136		0.362*		0.020
		(0.450)		(0.273)		(0.171)		(0.179)		(0.188)		(0.124)

Bank cost-to-income ratio (log)		-0.427		-0.655		-0.446*		-0.403		-0.065		0.087
		(0.686)		(0.436)		(0.268)		(0.269)		(0.375)		(0.261)
Bank net interest margin (log)		0.000		0.085		0.254*		0.239		0.151		0.033
		(0.337)		(0.218)		(0.141)		(0.161)		(0.184)		(0.131)
Constant	-1.122	0.486	-0.831	3.727	-0.194	0.159	-0.459	0.554	-0.620	-2.533	0.967	0.322
	(1.229)	(3.892)	(1.356)	(3.285)	(1.241)	(1.814)	(0.989)	(2.068)	(1.387)	(1.835)	(0.938)	(1.638)
Observations	661	661	661	661	672	672	672	672	548	548	548	548
No. of instruments	17	24	18	24	9	23	23	23	10	20	17	19
No. of groups	45	45	45	45	45	45	45	45	38	38	38	38
AR1 *p*-value	0.004	0.075	0.004	0.070	0.002	0.003	0.001	0.003	0.010	0.007	0.004	0.004
AR2 *p*-value	0.095	0.068	0.095	0.069	0.397	0.263	0.349	0.267	0.151	0.151	0.149	0.152
Hansen *p*-value	0.462	0.362	0.226	0.500	0.436	0.166	0.279	0.156	0.906	0.844	0.177	0.146

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's calculations.

Table A2: *Robustness Tests: Non-Linear Models*

Variables	Panel A				Panel B				Panel C			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Economic volatility$_{t-1}$ (σ_{t-1})	0.624***	0.565***	0.389*	0.327***	0.717***	0.556***	0.675***	0.552***	0.796***	0.435***	0.766***	0.764***
	(0.153)	(0.073)	(0.218)	(0.043)	(0.020)	(0.047)	(0.050)	(0.059)	(0.021)	(0.080)	(0.020)	(0.020)
5-bank concentration ratio	-0.014	-0.044	-0.050	-0.079*								
	(0.055)	(0.042)	(0.059)	(0.043)								
CR5 squared	0.000	0.000	0.000	0.001**								
	(0.000)	(0.000)	(0.000)	(0.000)								
Herfindahl-Hirschman index					0.174	1.662	0.001	1.003				
					(1.345)	(2.242)	(1.541)	(1.617)				
HHI squared					-0.899	-3.226	0.171	-1.113				
					(2.695)	(4.156)	(3.063)	(3.097)				
Lerner index									0.655	-0.657	0.385	0.212
									(0.855)	(1.209)	(0.874)	(0.919)
LI squared									0.278	2.665	0.766	0.919
									(1.224)	(1.716)	(1.242)	(1.235)
Private credit (log)	-0.144	-0.300*			-0.187***	-0.235**			-0.087**	-0.151*		
	(0.178)	(0.178)			(0.053)	(0.092)			(0.034)	(0.087)		
Liquid liabilities (log)			-0.413*	-0.314			-0.249***	-0.176			-0.192***	-0.128*
			(0.247)	(0.228)			(0.062)	(0.145)			(0.042)	(0.076)
Gross capital formation (log)	-0.248	-0.185	-0.538	-0.578**	-0.443***	-0.632***	-0.347***	-0.538***	-0.504***	-0.796***	-0.544***	-0.557***
	(0.431)	(0.311)	(0.420)	(0.239)	(0.157)	(0.219)	(0.129)	(0.167)	(0.102)	(0.185)	(0.099)	(0.109)
Trade openness (log)	0.218	0.434*	0.595	0.635**	0.319***	0.569***	0.345***	0.338***	0.253***	0.504***	0.335***	0.332***
	(0.334)	(0.234)	(0.415)	(0.249)	(0.097)	(0.120)	(0.071)	(0.122)	(0.050)	(0.126)	(0.054)	(0.058)
Government size (log)	0.034	0.109	0.240	0.234	0.092	0.069	0.082	0.163	-0.076	0.126	-0.058	-0.034
	(0.325)	(0.237)	(0.318)	(0.234)	(0.103)	(0.183)	(0.129)	(0.144)	(0.108)	(0.220)	(0.118)	(0.125)
Inflation (log)	0.184	0.223	0.256	0.399***	0.228	0.481**	0.415**	0.301*	0.221	0.939***	0.251	0.272
	(0.229)	(0.265)	(0.240)	(0.122)	(0.159)	(0.228)	(0.183)	(0.182)	(0.179)	(0.303)	(0.176)	(0.170)

Bank non-interest income (log)		-0.126		-0.025		0.299**		0.170		0.366**		0.079
		(0.275)		(0.233)		(0.140)		(0.129)		(0.172)		(0.106)
Bank cost-to-income ratio (log)		-0.186		-0.327		-0.535**		-0.473**		-0.419		-0.105
		(0.405)		(0.347)		(0.266)		(0.212)		(0.375)		(0.202)
Bank net interest margin (log)		0.058		0.126		0.347**		0.287*		0.381**		0.151
		(0.170)		(0.186)		(0.147)		(0.155)		(0.168)		(0.108)
Constant	0.574	2.163	2.062	3.537	0.105	-0.251	-0.492	1.095	0.380	-1.798	0.554	0.187
	(2.436)	(2.706)	(2.528)	(2.963)	(0.808)	(1.424)	(0.836)	(1.522)	(0.687)	(1.721)	(0.714)	(1.459)
Observations	661	661	661	661	672	672	672	672	548	548	548	548
No. of instruments	11	27	10	27	25	19	23	26	24	25	24	27
No. of groups	45	45	45	45	45	45	45	45	38	38	38	38
AR1 *p*-value	0.038	0.009	0.019	0.008	0.001	0.002	0.003	0.006	0.003	0.030	0.003	0.003
AR2 *p*-value	0.120	0.108	0.122	0.074	0.408	0.344	0.402	0.321	0.152	0.129	0.152	0.150
Hansen *p*-value	0.236	0.623	0.312	0.511	0.260	0.157	0.309	0.423	0.503	0.457	0.496	0.511
Inflection point	53.331	75.937	66.741	72.973	0.097	0.258	-0.003	0.450	-1.177	0.123	-0.251	-0.115

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In this table, CR5 squared is the square term of the 5-bank concentration ratio. HHI squared is the square term of the Herfindahl-Hirschman index. LI squared is the square term of the Lerner index.

Source: Author's calculations.

Table A3: *Robustness Tests: Financial Development Interaction Models*

Variables	Panel A				Panel B				Panel C			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Economic volatility$_{t-1}$ (σ_{t-1})	0.758***	0.760***	0.754***	0.756***	0.735***	0.520***	0.554***	0.558***	0.552***	0.799***	0.795***	0.795***
	(0.015)	(0.014)	(0.015)	(0.014)	(0.048)	(0.124)	(0.025)	(0.030)	(0.040)	(0.021)	(0.021)	(0.021)
5-bank concentration ratio	-0.006	-0.004	-0.005	-0.001								
	(0.012)	(0.012)	(0.012)	(0.012)								
Herfindahl-Hirschman index					-0.200	0.997	1.903	1.277				
					(2.111)	(1.828)	(2.282)	(2.281)				
Lerner index									1.061	1.774**	3.479***	3.483***
									(0.989)	(0.735)	(1.186)	(1.092)
Private credit (log)	-0.335	-0.284			-0.225**	-0.179			-0.253***	0.088		
	(0.298)	(0.307)			(0.111)	(0.142)			(0.084)	(0.073)		
CR5*PR	0.003	0.002										
	(0.003)	(0.003)										
HHI*PR					0.044	-0.309						
					(0.763)	(0.739)						
LI*PR									0.101	-0.350**		
									(0.242)	(0.173)		
Liquid liabilities (log)			-0.308	-0.245			-0.286**	-0.146			0.054	0.109
			(0.261)	(0.247)			(0.112)	(0.153)			(0.095)	(0.105)
CR5*LL			0.002	0.001								
			(0.003)	(0.003)								
HHI*LL							-0.479	-0.254				
							(0.636)	(0.628)				
LI*LL											-0.749***	-0.780***
											(0.273)	(0.273)
Gross capital formation (log)	0.067	0.069	0.063	0.056	-0.411*	-0.673**	-0.457**	-0.579***	-0.755***	-0.510***	-0.482***	-0.501***
	(0.141)	(0.135)	(0.140)	(0.135)	(0.216)	(0.273)	(0.181)	(0.171)	(0.154)	(0.112)	(0.107)	(0.118)

Trade openness (log)	0.158	0.140	0.168	0.158*	0.339*	0.528**	0.529***	0.474***	0.477***	0.258***	0.280***	0.275***
	(0.122)	(0.104)	(0.108)	(0.088)	(0.176)	(0.263)	(0.113)	(0.110)	(0.074)	(0.052)	(0.047)	(0.053)
Government size (log)	0.016	0.019	0.021	0.018	0.103	0.151	0.073	0.122	0.048	-0.041	-0.036	-0.013
	(0.099)	(0.109)	(0.106)	(0.116)	(0.147)	(0.230)	(0.139)	(0.143)	(0.154)	(0.113)	(0.106)	(0.113)
Inflation (log)	0.098	0.098	0.113	0.111	0.395	0.572**	0.462**	0.481**	0.597**	0.210	0.192	0.207
	(0.148)	(0.145)	(0.145)	(0.141)	(0.258)	(0.264)	(0.182)	(0.196)	(0.258)	(0.179)	(0.185)	(0.178)
Bank non-interest income (log)		-0.100		-0.179		0.232		0.227*		0.128		0.057
		(0.155)		(0.152)		(0.224)		(0.119)		(0.086)		(0.102)
Bank cost-to-income ratio (log)		-0.105		-0.139		-0.531		-0.316		-0.066		-0.118
		(0.203)		(0.192)		(0.347)		(0.223)		(0.193)		(0.206)
Bank net interest margin (log)		0.065		0.014		0.456**		0.330**		0.188*		0.120
		(0.096)		(0.091)		(0.214)		(0.141)		(0.112)		(0.106)
Constant	-0.049	0.502	-0.036	0.985	-0.537	-0.292	-0.715	-0.872	-0.534	-0.675	-0.257	-0.368
	(1.077)	(1.391)	(1.287)	(1.339)	(1.220)	(1.584)	(1.092)	(1.357)	(1.258)	(1.066)	(0.768)	(1.347)
$\beta_1+\beta_3$	-0.003	-0.001	-0.003	0.000	-0.156	0.688	1.425	1.023	1.162	1.424**	2.730***	2.703***
	(0.009)	(0.009)	(0.009)	(0.009)	(1.369)	(1.172)	(1.665)	(1.670)	(0.767)	(0.586)	(0.924)	(0.841)
Observations	661	661	661	661	672	672	672	672	548	548	548	548
No. of instruments	25	28	25	28	40	27	24	27	23	27	24	27
No. of groups	45	45	45	45	45	45	45	45	38	38	38	38
AR1 *p*-value	0.006	0.006	0.006	0.007	0.002	0.001	0.001	0.001	0.006	0.003	0.003	0.003
AR2 *p*-value	0.125	0.123	0.123	0.121	0.423	0.331	0.349	0.337	0.148	0.150	0.150	0.149
Hansen *p*-value	0.407	0.420	0.410	0.428	0.384	0.262	0.292	0.243	0.402	0.506	0.501	0.514

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In this table, CR5*PR is the 5-bank concentration ratio–Private credit (log) interaction term. HHI*PR is the Herfindahl-Hirschman index–Private credit (log) interaction term. LI*PR is the Lerner index–Private credit (log) interaction term. CR5*LL is the 5-bank concentration ratio–Liquid liabilities (log) interaction term. HHI*LL is the Herfindahl-Hirschman index–Liquid liabilities (log) interaction term. LI*LL is the Lerner index–Liquid liabilities (log) interaction term.

Source: Author's calculations.

Table A4: *Robustness Tests: Baseline and Interaction Models (M3)*

Variables	Panel A				Panel B				Panel C			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Economic volatility$_{t-1}$ (σ_{t-1})	0.650***	0.727***	0.736***	0.738***	0.744***	0.750***	0.737***	0.633***	0.715***	0.713***	0.738***	0.527***
	(0.112)	(0.018)	(0.014)	(0.013)	(0.016)	(0.017)	(0.014)	(0.018)	(0.014)	(0.013)	(0.069)	(0.018)
3-bank concentration ratio	0.003	0.003			-0.014	-0.006			0.029**	0.031***		
	(0.004)	(0.002)			(0.016)	(0.016)			(0.011)	(0.011)		
CR3 squared					0.000	0.000						
					(0.000)	(0.000)						
Boone indicator (log)			-0.177	-0.169			8.740	-1.085			7.013	-2.430
			(1.155)	(1.169)			(9.206)	(12.196)			(6.035)	(5.056)
BI squared							-4.679	0.252				
							(4.992)	(6.610)				
Broad money (log)	-0.278*	-0.297***	-0.250***	-0.281***	-0.192***	-0.262***	-0.257***	-0.285***	0.237	0.202	2.623	-1.019
	(0.151)	(0.104)	(0.051)	(0.081)	(0.064)	(0.096)	(0.052)	(0.104)	(0.199)	(0.185)	(2.213)	(1.934)
CR3*M3									-0.007**	-0.008***		
									(0.003)	(0.003)		
BI*M3											-2.660	0.643
											(2.043)	(1.797)
Gross capital formation (log)	-0.360	-0.265**	-0.318***	-0.347***	-0.157*	-0.340**	-0.294**	-0.539***	-0.262***	-0.295***	-0.291	-0.466***
	(0.279)	(0.129)	(0.117)	(0.125)	(0.091)	(0.162)	(0.117)	(0.184)	(0.096)	(0.105)	(0.216)	(0.171)
Trade openness (log)	0.568*	0.459***	0.544***	0.541***	0.332***	0.464***	0.550***	0.758***	0.499***	0.502***	0.528**	0.697***
	(0.320)	(0.120)	(0.110)	(0.103)	(0.103)	(0.122)	(0.111)	(0.158)	(0.105)	(0.099)	(0.234)	(0.173)
Government size (log)	-0.298	-0.171	-0.194	-0.192	-0.110	-0.301**	-0.218	-0.316	-0.194*	-0.193*	-0.168	-0.177
	(0.274)	(0.117)	(0.130)	(0.134)	(0.107)	(0.145)	(0.136)	(0.203)	(0.108)	(0.115)	(0.227)	(0.197)
Inflation (log)	0.048	0.164	0.212	0.173	0.198	-0.023	0.205	0.088	0.214	0.195	0.156	0.541***
	(0.315)	(0.152)	(0.148)	(0.150)	(0.132)	(0.157)	(0.146)	(0.148)	(0.144)	(0.151)	(0.299)	(0.177)
Bank non-interest income (log)		-0.294***		-0.213**		-0.340**		-0.110		-0.304***		-0.108
		(0.112)		(0.101)		(0.139)		(0.137)		(0.109)		(0.139)

Bank cost-to-income ratio (log)		-0.203		-0.213		-0.195		-0.289		-0.268		-0.117
		(0.186)		(0.171)		(0.176)		(0.223)		(0.169)		(0.233)
Bank net interest margin (log)		-0.000		0.047		0.055		0.220*		-0.002		0.048
		(0.115)		(0.108)		(0.110)		(0.132)		(0.112)		(0.155)
Constant	0.831	2.048*	0.092	1.966	0.205	3.429***	-4.063	2.881	-2.073	0.375	-7.549	2.690
	(1.616)	(1.205)	(1.246)	(1.583)	(0.735)	(1.247)	(4.369)	(5.809)	(1.279)	(1.254)	(7.104)	(5.540)
$\beta_1+\beta_3$									0.022**	0.023***	4.353	-1.787
									(0.009)	(0.009)	(4.034)	(3.334)
Observations	749	749	715	715	749	749	715	715	749	749	715	715
No. of instruments	24	25	23	26	25	28	24	27	25	28	20	26
No. of groups	48	48	48	48	48	48	48	48	48	48	48	48
AR1 *p*-value	0.004	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001
AR2 *p*-value	0.226	0.229	0.214	0.206	0.250	0.233	0.214	0.177	0.233	0.221	0.224	0.152
Hansen *p*-value	0.233	0.182	0.145	0.144	0.166	0.293	0.148	0.136	0.254	0.243	0.133	0.242
Inflection point					46.539		2.150					

Notes: (i) Standard errors in parentheses; (ii) * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In this table, CR3 squared is the square term of the 3-bank concentration ratio. BI squared is the square term of the Boone indicator. CR3*M3 is the 3-bank concentration ratio–Broad money (log) interaction term. BI*M3 is the Boone indicator–Broad money (log) interaction term.

Source: Author's calculations.

Appendix 2

Concentration ratio (CR_k)

This measure represents the cumulative market share of the k largest banks in a country to the assets of the whole banking industry, and it can be presented mathematically as:

$$CR_k = \sum_{i=1}^{k} S_i$$

where CR_k is the concentration ratio of the k largest banks and S_i is the market share of bank i. In general, researchers opt for either CR5 or CR3 concentration ratios depending on data availability. CR5 and CR3 are commonly defined as a measure of the degree of competitiveness of the banking sector, proxied by the total assets of the five and three largest commercial banks, respectively, as a share of total commercial banking assets. Nevertheless, Bikker and Haaf (2002) state that choosing a number of banks, k, to be included in the concentration index is arbitrary.

Herfindahl-Hirschman index (HHI)

HHI index is calculated as the sum of the squares of the market shares of all firms (banks) in the market, and mathematically, it can be expressed as follows:

$$HHI = \sum_{i=1}^{N} S_i^2$$

where S_i represents the market share of every bank in the market and N is the number of banks. The HHI index would be equal to one if a market is dominated by a single firm/bank (in a monopolistic environment). In contrast, the HHI index would approach zero in a market where all firms/banks are of equal size (in a competitive environment). The HHI index can be affected by the number of banks in the market and/or the inequality in market shares among different

banks. According to Davies (1979), the larger number of banks in the market, the less sensitive the index is to changes in the number of banks.

The Lerner index (LI)

The Lerner index (LI), developed by Abraham P. Lerner (1934), is one of the most popular non-structural measures of market power. It measures a bank's/firm's market power by calculating the ratio between price and marginal cost. In other words, LI is defined as the spread between prices (P) and marginal costs (MC), divided by prices (P). Mathematically, it is expressed as follows:

$$LI = \frac{P - MC}{P}$$

Hence, the Lerner index ranges between zero (0) and one (1). When P = MC, the Lerner index is equal to zero in perfect competition, indicating that a firm/bank has no pricing power. As the Lerner index approaches one, it shows increasing markup of price over marginal costs and hence market power of a firm/bank. Finally, when LI = 1, it indicates the monopolistic power of a firm/bank.

Boone indicator (BI)

Boone (2004, 2008) developed a new measure of competition that relates the profit or market share of a firm/bank with its efficiency. In particular, the Boone indicator is based on the idea that as a market becomes more competitive, efficient firms/banks (i.e. firms with lower marginal costs) gain market share and earn higher profits as compared to less efficient firms/banks that are punished by lower profits and market shares. The BI can be specified as follows:

$$\ln S_i = \alpha + \beta \ln MC_i$$

where S_i is the market share and is defined as $S_i = p_i q_i / \Sigma_j p_j q_j$, MC is the marginal cost, and β is known as the Boone indicator.

The value of β is negative as the market shares of banks with lower marginal costs are expected to increase. A larger value of β, in absolute terms, indicates a more substantial effect and higher degree of competition in the market.