



Bank Concentration and Financial Risk in Jordan

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ABSTRACT

The main aim of this paper is to investigate the relationship between bank concentration and bank risk in the Jordanian banking industry from 2005 to 2016. While controlling for bank fundamentals and business cycle, we used two measurements to measure bank risk (Z-score and Non-performing loan ratio) and three measurements of bank concentration (Herfindahl-Hirschmann Index, Concentration Ratio and the Lerner Index). We applied the two-step Generalized Method of Moments (GMM) to analysis this relationship between concentration and risk. The empirical evidence shows bank concentration has a positive relationship with risk measured using non-performing loan ratio, and a negative relationship using Z-score. This suggests greater market power leads to greater risks, which in turn supports the concentration-fragility theory.

INTRODUCTION

A well-functioning financial system is the key to ensure the smooth flows of funds in an economy, which in turn contributes to the long-term growth and development in the country.¹ Past banking crises, such as the European banking crisis in 1992, the Venezuelan banking crisis in 1994, the Asian financial crisis in 1997 and the Ecuador banking crisis in 1998 are among many that show the serious damage and contagion resulting from a banking crisis to an economy and those of neighbouring countries.

In addition, the banking crises throughout the world, especially the 2008 financial crisis, showed the importance of bank concentration to the industry. Up until the present, the relationship

¹ According to Jordinvest (2012), the report of the banking system in Jordan; "The Jordanian banking sector is one of the key pillars supporting the Jordanian economy and has a positive and active role in developing the national economy". The banks function as an intermediary connecting between the lender and the borrower, which makes the borrower create or expand the business, which leads to contributes to economic development.

between bank concentration and stability has not been clear. Past studies employed two main theories that explain the relationship between bank concentration and risk, i.e., (1) bank concentration and stability and (2) bank concentration and fragility. The first, concentration-stability, is based on the concept that banks with a larger market share have greater opportunity to improve their profit rates and therefore decrease their financial fragility through higher “capital buffers” (Boyd, De Nicoló, and Smith, 2004). Additionally, large banks prefer to participate in “credit rationing” which is a method that makes credit less easily accessible or subject to high interest rates. Finally, larger banks that increase their “charter value” encourage their bank managers to make less risky decisions.

The second view, concentration-fragility, is the opposite of the first, and describes the point at which banks with large capitalization become “too big to fail” and leads the banks to take more risks. Moreover, larger banks will ask for higher interest rates, which, when imposed by banks with large market capitalization may cause a higher default rate from their borrowers (Boyd and De Nicolò, 2005). In addition, the higher degree of risk present might cause a drop in the banks’ management productivity, resulting in a higher degree of operational risk (Uhde and Heimeshoff, 2009).

Over the past 11 years, the Jordanian banking sector has shown considerable fluctuations in bank concentration levels. Based on the 2017 report issued by the Central Bank of Jordan, out of a total of twenty-five banks operating in Jordan, the assets of the five largest banks decreased from approximately 59.6% of total assets of the licensed banks at the end of 2006 to approximately 53.9% at the end of 2015. However, in 2016 the concentration ratio increased to 54.3%. These figures reveal a significant degree of fluctuation in the bank concentration ratio in Jordan. The aim of this research is to determine which of the two views is applicable to the Jordanian banking industry so as to help banks avoid financial shocks or crises.

Thus, this study aims to investigate the relationship between bank concentration and risk for the Jordanian banking industry over the period from 2005 to 2016. Data obtained from the financial statements of seventeen commercial and Islamic banks operating in Jordan between 2005 and 2016 were collected. The study employed two proxies for bank risk: Z-score and non-performing loan ratio, and three proxies for bank concentration: Herfindahl-Hirschmann Index (HHI), Concentration ratio (CCR) and the Lerner Index. It also applied a two-step Generalized Method of Moments (GMM) for testing the data. To the best of our knowledge, this research will be the first to examine the relationship between bank concentration and bank risk and will specifically focus on data obtained from Jordan.² This focus on a single country’s data should furnish greater understanding of the relationship between bank concentration and risk.³ Additionally, most studies have investigated the relationship between bank concentration and bank stability by referring to data taken from a single country in an advanced market rather than one from an emergency market.⁴ Moreover this research is different from that of other research in that it applies several measurements of bank concentration in the one study, i.e., concentration ratio of the largest 3, 5 and 7 banks (assets and loan), two measurement of HHI (total assets and total loans) and Lerner index.

The results obtained in this study show that bank concentration (HHI and concentration ratio) are significantly positive when non-performing loans is employed, and significantly negative when using Z-scores. However, the Lerner Index results are significantly negative for both Non-performing loans and Z-scores. Our analysis implies that the more concentrated a banking industry

² While there has been limited research conducted in Jordan using these factors, the main objectives of previous studies were to examine whether the Jordanian banking environment is competitive or concentrated, e.g., Demircuc-Kunt and Martinez Peria 2010.

³ Furthermore, studies such as Ben Ali et al. 2018, focus on more than one country, and include Jordan with other countries.

⁴ For studies of advanced markets see Chu, 2015 and Kasman and Kasman, 2015. For studies of emergency markets see Nguyen et al., 2018.

is, the riskier it becomes. The conclusion of our analysis provides support to the application of concentration-fragility to the Jordanian banking sector.

The following sections of this paper are organized as follows: Section 2 discusses relevant past studies; Section 3 explains methodologies adopted for this study; Section 4 discusses findings and their applications; and Section 5 presents our conclusion.

1. LITERATURE REVIEW

Based on previous studies, it is difficult to conclude the exact impact of banking market concentration on financial risk. The literature provides two contradictory views of the relationship between concentration and financial risk: concentration-stability and concentration-fragility.

1.1 Concentration-fragility

Concentration-fragility is one of the two views regarding the relationship between concentration and bank stability. This view argues that the higher the concentration, the more risk a bank takes. According to Boyd and De Nicolo (2005), banks often demand higher interest rates from their borrowers when there is little competition in the market. This places additional burdens on the borrower to cover the associated increases to the loan. Therefore, the chance of loan defaults would become greater, resulting in a higher chance for banks to fail.

Several studies have found evidence supporting the concentration-fragility view. Uhde and Heimeshoff (2009) conducted on 2,600 banks located in 25 European countries from 1997 to 2005 found clear evidence that banking market concentration negatively affects a bank's financial stability. Further confirmation was provided by Fiordelisi and Mare (2014), who used data collected from 2529 European banks between 1998 and 2009 to show that market power and financial stability are negatively associated.

Schaeck, Cihak, and Wolfe's (2009) study encompassing 38 nations and 28 systemic banking crises from the year of 1980 to 2003 found that the presence of concentration lowers the chance of a systematic crisis from happening, thereby supporting the concentration-fragility view. Liu, Molyneux, and Nguyen (2012) collected data from 4 different South East Asian countries. Their results showed concentration does increase a bank's risk-taking levels and so their study confirms the concentration-fragility theory. Fu et al. (2014) collected data from 14 Asian Pacific nations for the period from 2003 to 2009. The study concluded that when a high concentration level is present, a higher level of financial fragility is also present. A recent research by Li (2019) examined banks in 22 transition countries during the period from 1998 to 2016 and found support for the concentration-fragility view by applying NPL and Z-score for bank risk and Lerner index for bank competition.

1.2 Concentration stability

Some researchers have argued that the larger banks in a more concentrated market would have a better stability rate. When bankruptcy does occur, it causes higher opportunity costs which result in higher franchise values. Keeley (1990) states that larger banks which increase their charter value encourage bank managers to make less risky decisions. Moreover, Keeley concludes that an increase in competition will result in a reduction of a bank's value which will put it at risk and result in a lessening of its financial stability. Boyd et al. (2004) mention that the larger banks could improve their profit rates which would lead to a decrease in financial fragility through increased "capital buffers". This view suggests that if concentration is positively associated with banks, it will cause an increase in the probable rate of return on the banks' possessions as well as the standard deviation of their revenues.

In support of concentration-stability, Chang, Guerra, Lima, and Tabak (2008) used the banks' NPLs in order to study the association between credit risk and bank concentration in Brazilian banks. The results showed that having a more concentrated financial system helps to enhance financial stability by further reducing the lower default rates of its borrowers. In addition, Chu (2015) studied the relationship between these two factors in Canadian banks by examining data from 1867 to 1935. The results agreed with those of Chang, Guerra, Lima, and Tabak (2008), confirming the positive relationship between concentration and stability. A recent study by Albaity, Mallek, and Noman (2019) applied GMM to examine bank competition in MENA countries from 2006 until 2015 by using two measurements of bank stability and competition. They reviewed data from 276 banks and also found support for the concentration-stability view. Degl'Innocenti, Fiordelisi et al. (2019) examined seven developed investment banking industries from 1997-2014; they found that high market power leads to more bank stability. Marchionne and Zazzaro (2018) examined the Italian banking industry from 2006 to 2010; their results confirm concentration-stability.

Moreover, Azmi, Ali, Arshad, and Rizvi (2019) testing data from fourteen dual banks from 2005 till 2016 found the relationship between HHI and Z-score to be statistically positive. After reviewing bank data in 27 EU countries for both the long-term and short-term, Davis and Karim (2019) found a positive relationship between the Lerner index and Z-score. Hence, these findings weaken the concentration-fragility hypothesis and confirm the concentration-stability view. Phan, Anwar, Alexander, and Phan (2019), using bank data from China, Malaysia, Vietnam and Hong Kong from 2004 until 2014, found strong support for the concentration-stability view. Furthermore, Beck et al. (2006) collected data from 69 nations between 1980 and 1997 in order to study the relationship between concentration and financial stability. The result was that market power decreases the likelihood that a nation will be subjected to a universal banking crisis, thus confirming the concentration-stability view.

1.3 U-shaped relationship

Several researchers have found the existence of a U-shaped relationship between bank concentration and bank risk. Ben Ali et al. (2018) studied the association between banking concentration and stability on data collected from 173 industrialized and developing nations for the period from 1980 to 2011. The results prove that both the concentration-stability and concentration-fragility views are possible. Căpraru and Andrieș (2015) examined data from 923 commercial banks in 27 European nations from the period between 2001 and 2009. Their results show a variation in the relationship between concentration and financial stability with some countries showing a positive relationship between the two factors and others showing a negative one. González, Razia, Búa, and Sestayo (2017) examined 356 banks operating in MENA countries during the period from 2005 to 2012. They also found empirical support for concentration-stability and concentration-fragility views. Noah, Jacolin, and Brei (2018) found a U-shaped relationship between bank concentration and bank credit risk in Sub-Saharan Africa for the period from 2000 to 2015.

In addition, following examination of banks located in Canada, U.K and the U.S.A., Kanas, Al-Tamimi, Albaity and Mallek (2019) found that the relationship between the Lerner Index and Non-performing loan is statistically negative. However, they also found the relationship between market concentration for the biggest 5 banks and NPL is positively significant. This finding also supports the two views. Kasman and Kasman (2015) examined data from Turkish banks for the period from 2002 until 2012 by using the NPL and Z-score to measure the level of stability, and using HHI and concentration ratio (five largest banks) to measure market power. Their results indicate that the level of concentration and a bank's credit risk taking (NPL) are positively linked; however, the concentration ratio and the Z-score are negatively linked. In the case of Vietnam, Nguyen, Le, and Tran (2018) found a U-shaped relationship between market power and bank risk.

2. METHODOLOGY

This research uses a two-step GMM system to study the relationship between bank concentration and financial risk for 17 banks in Jordan during the period from 2005 to 2016. The sample includes the annual reports of Islamic and commercial banks in Jordan. We used a dynamic panel to analyze the connections between concentrations and financial risk. In addition, the dynamic panel data contained one or more lagged for the dependent variable. Our GMM regression model is specified as follows:

$$Risk_{it} = \alpha + \beta Risk_{it-1} + \beta_1 Con_{it} + \lambda Bank\ Specifics_{it} + \delta Business\ Cycle_t + \varepsilon_{it} \quad (1)$$

Where $Risk_{it}$ is Z-score and Non-performing loan ratio for i banks and t time, $Risk_{it-1}$ is the lag of the risk. Con is concentration. For instance, considering Non-Performing Loan ratio as the dependent variable in the above equation, a negative value of the coefficients would decrease the NPL and lead to support of the concentration-stability view. However, a positive value for β_1 would furnish empirical support for the concentration-fragility view. Therefore, as concentration, measured by the Herfindahl-Hirschmann Index (HHI), Concentration ratio (CCR) and Lerner Index, increases, bank Non-performing loan would also increase. In addition, if the coefficients show different signs, the results would support a U-shaped relationship. $Bank\ Specifics$ and $Business\ Cycle$ are control variables which include Earnings, Liquidity, Bank Size, Growth of GDP and Inflation. Finally, ε_{it} is a composite error term.

The data were collected from several databases. For those banks listed on the Amman stock exchange, we collected the data from Bloomberg and Bankscope; however, for the banks not listed on the Amman stock exchange, the data were obtained manually from annual reports of those banks. For macroeconomic factors, we collect the data from World Bank and the global economic databases. Table 1 shows the descriptive data for the variables. We have 204 observations from 17 banks between 2005 and 2016.

Table 4 displays the evaluation of the mean values for the variables within the sample duration. The outcomes for Z-score, Return on Asset (ROA), Liquidity, Lerner Index and HHI (loan) fluctuated during the sample period. In addition, NPL decreased from 2005 until 2008, however following the financial crisis in 2008 the NPL started to increase until 2011 when it began to decrease. Meanwhile, HHI (assets) and Concentration ratio for assets decreased during the sample period. However, while the Concentration ratio (loan) decreased every year from 2005 to 2016, expect for an increase in 2007 only.⁵

2.1 Measurement of variables

2.1.1 Concentration

This research used three different measurements to measure concentration: Concentration ratio (CCR), Herfindahl-Hirschman index (HHI) and Lerner Index. Concentration ratio is a measure representing the sum of the combined market shares of the three/five/seven largest banks in the loans/assets market. While, Concentration ratio is a measure of the market share of the largest banks only. HHI focuses on the market shares (Total Loan or assets) of all the banks in the sample.

Herfindahl-Hirschman index is measured as follows:

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

⁵ Figure 1, Figure 2 and Figure 3 display a visual representation of the evolution of the Lerner index, Concentration ratio and the HHI respectively, during sample period.

Where A_i is the market share (total assets or loan) of bank i and n represent the total number of banks in the sample.

Lerner index is one of most popular measurements for market power. When the value is close to one, it means a monopoly as price diverges from marginal cost. Simply put, a low value for the Lerner index will increase the degree of competitiveness in the banking industry.

$$Lerner_{st} = \frac{P_{st} - mc_{st}}{P_{st}}$$

Where P_{st} is the price of total assets for bank s at time t ; proxy by the ratio of total revenues divided by total assets. The marginal cost is mc_{st} . As in previous studies, the following equation is used to estimate marginal cost on the basis of a translog cost function with three input prices (price of deposit, labor and fixed capital) and one output (total assets) (i.e., Demircuc-Kunt and Martinez Peria, 2010). The cost function is as follows:

$$\begin{aligned} LnCost_{st} = & \beta_0 + \beta_1 LnQ_{st} + \frac{\beta_2}{2} LnQ_{st}^2 + \sum_{k=1}^3 \gamma_{kt} lnW_{kst} + \sum_{k=1}^3 \phi_{kt} LnQ_{st} lnW_{kst} \\ & + \sum_{k=1}^3 \sum_{j=1}^3 LnW_{kst} lnW_{jst} + \varepsilon_{st} \end{aligned}$$

Where $LnCost_{st}$ is lag of total cost of the bank and includes all interest and noninterest expenses, s is bank and t is years, Q_{st} is total earning assets, and W_{kst} are the three input prices. W_k is the price of deposit (interest expenses divided by total deposits), W_s is the price of labour (total salaries expenses divided by total assets), and W_t is the price of fixed capital (measured by dividing other operating and administrative expenses to total assets). Marginal cost is calculated as follows:

$$MC_{st} = \frac{Cost_{st}}{Q_{st}} \left[\beta_1 + \beta_2 LnQ_{st} + \sum_{k=1}^3 \phi_k LnW_{kst} \right]$$

2.1.2 Dependent variable

Following González, Razia, Búa, and Sestayo, 2017 and Kasman and Kasman, 2015, this study has employed two different measures of banking risk, namely Z-score and Non-performing loan. Z-score is an inverse measure of overall bank risk. Z-score is one of the most popular ratios to test entry into bankruptcy or the probability of insolvency of individual banks. Z-score is an absolute and balanced indicator of bank vulnerability, combining accounting measures of profitability, volatility and leverage. Z-score is measured as follows:

$$Z_{it} = \frac{ROA_{it} + \left(\frac{E}{TA}\right)_{it}}{\sigma_{(ROA)_{it}}}$$

Where i is the bank, t is the year, ROA is the return on assets, E/TA is the equity to total assets ratio, and $\sigma_{(ROA)}$ denotes the standard deviation of ROA . Thus, a greater Z-score value indicates a higher bank stability and a smaller risk profile for a bank (Berger et al., 2009). The second measurement for bank risk is non-performing loans ratio which is used as the common measurement of credit risk or loan portfolio (Berger et al., 2009). Since non-performing loans damage the assets market values, profitability and the stability of the bank, having a high value of non-performing loan will lead to high risk and instability in the banking industry. The measurement of NPL is as follows:

$$NPL = \frac{Non\ performing\ loans}{total\ loan}$$

2.1.3 Control variable

Banks with high profitability face less pressure for revenue creation and are thus under less compulsion to engage in credit risk. In this study, the Return on Assets (ROA) after-tax is considered as a bank profitability indicator. This study measured the ROA using the following equation:

$$\text{Return on Asset} = \frac{\text{Net Income}}{\text{Total Assets}}$$

Return on Assets shows bank efficiency in assets employment as well as the net income generated from assets. A high value of ROA indicates better performance and gives rise to profit. Bank liquidity can simply be explained as the capability of a bank to meet its short-term obligations as well as maintaining its solvency. The measurement of the liquidity is as follows:

$$\text{liquidity} = \frac{\text{liquid assets}}{\text{total assets}}$$

The above equation considers *liquid assets* to be those assets that can be converted to cash easily in any circumstances or at any time. One of the vital properties of this ratio is that it shows the accessibility of liquidity by which a bank is able to fulfill its short-term obligations. The measure of the remaining bank-specific factor, Bank size, is calculated by taking the logs of total assets for each bank in each year (Kasman and Kasman, 2015). Meanwhile, measures of macro-economic factors, which are growth of GDP and Inflation, were obtained through the Worldbank and global economic databases.

Table 1. Descriptive Analysis

Variables	Mean	Stander deviation	Coefficient of variation
<i>Dependent Variable</i>			
Z-score	3.97768	2.727202	0.685625
NPL	8.54384	5.968919	0.6986221
<i>Independent Variables</i>			
HHI (Loan)	2445.10	400.9052	0.1639627
CCR7 (Loan)	81.4678	2.341461	0.0287409
CCR5 (Loan)	71.9143	4.258402	0.059215
CCR3 (Loan)	63.4808	2.87452	0.045282
HHI (Assets)	2715.01	622.4942	0.2292781
CCR7 (Assets)	82.8590	3.679114	0.044402
CCR5 (Assets)	75.4024	4.242993	0.056271
CCR3 (Assets)	66.5651	4.676846	0.0702596
Lerner Index	0.93162	0.014724	0.0158052
<i>Translog cost function</i>			
Marginal Cost	0.45142	0.128430	0.2845008
W1= Price of deposit	0.03092	0.013944	0.4509125
W2= Price of labour	0.00998	0.003292	0.3296761
W3= Price of fixed capital	0.01350	0.005938	0.4398779
Q = Total assets	2942.79	5467.561	1.857947
TC= Total cost	120.446	202.9643	1.685106
<i>Control variables</i>			
Earnings	1.29944	0.634883	0.4885817
Liquidity	13.8643	7.751816	0.5591172
Bank size	7.24059	1.078348	0.1489309
Inflation	4.09464	4.075629	0.995356
Growth of GDP	1.37241	0.545172	0.3972356

Notes: NPL is Non-performing loan, HHI is Herfindahl-Hirschman index (loan or assets), and CCR is Concentration ratio for the largest 3, 5 or 7 banks (loan or assets).

3. RESULTS AND DISCUSSION

Table 2 and Table 3 show the main results of this paper. We used two dependent variables to proxy financial risk (Z-score and Non-performing loan) and used different measurements of bank concentration. Moreover, we added a specification test provided through the GMM system⁶. The lagged endogenous variable showed positive and significant results in two regressions in all the models. Model 1 in Table 2 points out the impact of HHI (loan) on risk, controlling for bank specifics and macroeconomics. The results show that the relationship between HHI (loan) and Z-score is significant and negative at the 1% level, suggesting that a decrease in market power will result in more stability. In terms of HHI (assets), the result also support the concentration-fragility view, meaning that concentration in the banking industry will lead to an unstable and risky banking environment. Moreover, the concentration ratio for the biggest 3, 5 and 7 banks in the banking industry, whether from the aspect of loans or assets, is significantly negative, and therefore support the concentration-fragility view. Furthermore, the results show a significant negative relationship between the Lerner Index and Z-score. Suggesting that high market power in the banking industry will result in instability.

The outcomes, as presented in Table 2 show that the coefficients of Earnings and Inflation are positive and significant in all models, proposing that an increase in inflation and profit will increase the Z-score and will lead towards more stability. In other words, the biggest banks are gaining a high proportion of profitability and that amount will drive them to a more stable environment. Moreover, during periods of high inflation a bank will increase its interest rate which will result in higher profits causing the banks to experience less risk. Liquidity is shown to be positive and significant in Models 1, 5, 7 and 9. Therefore, it is proposed that banks with high liquidity will become less risky. However, Bank size shows a negative and significant relationship with Z-score in Model 7 only, while all other models shows the relationship to be insignificant. This suggests that an increase of the total assets will cause an unstable environment. Growth of GDP shows a negative relationship with Z-score in Model 2 and Models 5 through 9. This outcome proposes that an increase in the rate of growth of GDP will decrease stability in the banking industry.

The second dependent variable is Non-performing loan, shown in Table 3. Model 1 in Table 3 displays the outcomes of the relationship between concentration measures calculated using HHI (loan) and Non-performing loan; this result is positive and significant, suggesting an increase in market power will lead to an increase in credit risk. Similarly, results presented in Table 3 show a positive coefficient, significant at 1% level between market power of assets (HHI assets) and Non-performing loan. Furthermore, CCR 3, 5 and 3 (loan) and CCR 3, 5 and 7 (assets) show a significantly positive relationship with credit risk. However, Model 9, which presents the Lerner Index, supports the concentration-stability view as an increase in market power will negatively relate to credit risk. The findings of this research support those of Kasman and Kasman (2015) and Nguyen et al. (2018) and show the existence of a U-shaped relationship between bank concentration and bank risk. In addition, in Table 3, profitability in all Models displays a negative relationship with non-performing loan, suggesting that an increase in profit will causes a decrease in credit risk. However, the probability value of earning was insignificant in Model 9. Inflation and growth of GDP displays a negative and significant relationship with NPL in all models except Model 9 where Growth of GDP is shown to be insignificant. To reduce inflation and money circulation, the central bank will increase the interest rate, which will cause the banks to gain more revenue from the loans thereby leading to bank stability; this result matches that of Fofack (2005). Moreover, an increase in the growth of GDP will lead to an increase in income enabling borrowers to meet their obligations and resulting in less credit risk. Bank size shows a significant positive relationship with NPL in Model 5, suggesting that an increase in bank size will increase bank non-performing loan. Furthermore, Liquidity shows no relationship with non-performing loan in Models 3, 4 and 6. How-

⁶ AR(1) and AR(2) are autoregressive; where AR(1) test require a significant serial correlation. However, AR(2) test require a lack serial correlation. In addition, Hansen J-test (p-value) point to whether the instruments are unrelated to the error term.

ever, liquidity shows a significantly positive relationship with NPL in HHI (loan), CCR7 (loan), and Lerner Index, proposing that an increase in liquidity will increase the credit risk. Meanwhile, Liquidity displays a negative relationship with NPL in Models 5, 7 and 8, suggesting banks with more liquid assets will face low credit risk.

Table 2. Estimation results of the main model, dependent variables: Z-score

Dependent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Z-score	(0.4191) ^{***} 1.7513	(3.3256) ^{***} 8.9168	(0.7530) ^{***} 2.419	(1.471) ^{***} 3.9186	(0.3786) ^{***} 1.001	(1.260) ^{**} 3.219	(0.9716) ^{***} 5.4504	(0.3638) ^{***} 3.7996	(0.3599) [*] ** -0.9962
Z-score _{t-1}	(0.0415) ^{***} 0.0692 6	(0.0824) ^{***} 0.5431	(0.0535) ^{***} 0.1222	(0.0547) ^{***} 0.1623	(0.0742) ^{***} 0.6317	(0.0934) ^{***} 0.5147	(0.0791) ^{***} 0.5489	(0.0757) ^{***} 0.6131	(0.0684) [*] ** 0.61421
HHI(Loan)	(0.0001) ^{***} -0.0006								
CCR7(Loan)		(0.0466) ^{**} -0.1128							
CCR5(Loan)			(0.0113) ^{**} -0.0269						
CCR3(Loan)				(0.0271) ^{**} -0.0598					
HHI(Assets)					(0.0002) ^{***} -0.0007				
CCR7 (Assets)						(0.0179) ^{**} -0.0380			
CCR5 (Assets)							(0.0148) ^{***} -0.0773		
CCR3 (Assets)								(0.0088) ^{***} -0.0684	
Lerner Index									(0.1926) [*] ** -0.6368
Earnings	(0.2325) ^{***} 2.3911	(0.2128) ^{***} 1.6025	(0.1891) ^{***} 2.2979	(0.2327) ^{***} 2.2719	(0.2418) ^{***} 1.6758	(0.2242) ^{***} 1.4539	(0.2183) ^{***} 1.6263	(0.2221) ^{***} 1.386	(0.1729) [*] ** 2.2706
Liquidity	(0.0076) [*] 0.0147 7	(0.0245) -0.0087	(0.0068) 0.0069	(0.0069) 0.0107	(0.0093) [*] 0.0162	(0.0082) -0.0003	(0.0101) ^{**} 0.0246	(0.0268) 0.3262	(0.0066) [*] ** 0.02416
Bank Size	(0.3597) -0.3881	(0.1663) 0.08221	(0.1393) -0.0117	(0.1221) 0.02482	(0.1852) -0.0514	(0.0807) 0.07576	(0.1466) ^{***} -0.49797	(0.1374) -0.1029	(0.2164) -0.1067
Inflation	(0.0069) ^{***} 0.0240 1	(0.0081) ^{***} 0.07181	(0.0084) ^{***} 0.03362	(0.0080) ^{***} 0.03355	(0.0081) ^{***} (0.0529)	(0.0164) ^{**} 0.03877	(0.0097) ^{***} 0.06399	(0.0075) ^{***} 0.05806	(0.0089) [*] ** 0.0576
LnGDP	(0.1612) 0.1436	(0.1475) [*] -0.2552	(0.1605) -0.0373	(0.1754) -0.0147	(0.1467) ^{**} -0.2969	(0.1197) ^{**} -0.2609	(0.0983) ^{***} -0.5080	(0.1093) ^{***} -0.2982	(0.1376) [*] ** (-0.8860)
AR(1) Test (p-value)	0.053	0.010	0.020	0.024	0.023	0.057	0.009	0.013	0.018
AR(2) Test (p-value)	0.999	0.223	0.747	0.756	0.580	0.392	0.389	0.429	0.779
Hansen J-test (p-value)	0.662	0.909	0.374	0.883	0.896	0.942	0.890	0.873	0.825
Difference-in-Hansen Test (p-value)	0.817	0.600	0.401	0.551	0.646	0.580	0.489	0.482	0.467
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald chi2	623.97	2606.53	502.69	973.81	9549.53	1932.43	8084.42	4390.02	1636.61
Number of Observation	187/ 204	187/ 204	187/ 204	187/ 204	187/ 204	187/ 204	187/ 204	187/ 204	187/ 204

Notes: Z-score_{t-1} is the lag of Z-score, HHI is Herfindahl-Hirschman index (loan or assets), CCR is Concentration ratio for the largest 3, 5 or 7 banks (loan and assets) and LnGDP is the lag of growth of GDP. *** is significant at 1%, ** is significant at 5%, * is significant at 10%. Standard error appears in the brackets above estimated coefficients.

Table 3. Estimation results of the main model, dependent variables: NPL

Dependent Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
NPL									
Constant	(1.062)*** -5.5336	(13.57)*** -56.577	(4.988)*** -21.355	(10.108)*** -38.648	(0.9394) -1.349	(6.067)*** -36.449	(5.029)*** -30.762	(4.376)*** -29.650	(0.855)* (1.5885)
NPL _{t-1}	(0.018)*** 0.6740	(0.024)*** 0.6866	(0.021)*** 0.7053	(0.0228)*** 0.7320	(0.035)*** 0.6760	(0.021)*** 0.6539	(0.022)*** 0.6394	(0.0244)*** 0.6336	(0.019)*** (0.7503)
HHI(Loan)	(0.0006)** 0.0059								
CCR7(Loan)		(0.176)*** 0.7932							
CCR5(Loan)			(0.079)*** 0.40142						
CCR3(Loan)				(0.177)*** 0.7427					
HHI(Assets)					(0.0007)** 0.0036				
CCR7(Assets)						(0.080)*** 0.5350			
CCR5(Assets)							(0.075)*** 0.5235		
CCR3(Assets)								(0.0792)*** 0.5994	
Lerner Index									(0.405)** -1.0333
Earnings	(0.176)*** -1.4010	(0.272)*** -1.5631	(0.262)*** -1.4432	(0.2938)*** -1.4858	(0.366)*** -2.2875	(0.273)*** -1.6887	(0.278)*** -1.9175	(0.2999)*** -2.3489	(0.6270) -0.0159
Liquidity	(0.015)*** 0.03164	(0.009)*** 0.0260	(0.0095) 0.01011	(0.0158) 0.0074	(0.014)*** -0.0610	(0.0087) -0.0100	(0.009)** -0.0198	(0.0123)*** -0.0612	(0.010)*** 0.0448
Bank Size	(0.1286) 0.0093	(0.3565) -0.0861	(0.3937) 0.1991	(0.4787) 0.1931	(0.455)*** 2.2435	(0.235)*** 0.9429	(0.215)*** 1.3282	(0.3494)*** 2.4970	(0.130)** -0.2721
Inflation	(0.013)*** -0.1414	(0.025)*** -0.1434	(0.018)*** -0.1284	(0.0224)*** -0.1124	(0.005)*** -0.0865	(0.013)*** -0.1386	(0.012)*** -0.1456	(0.0076)*** -0.1312	(0.011)*** -0.0504
LnGDP	(0.376)*** -3.3496	(0.544)*** -2.5541	(0.415)*** -2.2726	(0.6655)*** -3.1385	(0.507)*** -1.6422	(0.369)*** -1.6679	(0.406)*** -1.8725	(0.4664)*** -2.1336	(0.2384) -0.2136
AR(1) Test (p-value)	0.001	0.001	0.002	0.002	0.005	0.003	0.004	0.005	0.001
AR(2) Test (p-value)	0.628	0.632	0.914	0.936	0.489	0.911	0.961	0.838	0.951
Hansen J-test (p-value)	0.129	0.179	0.129	0.118	0.134	0.233	0.193	0.168	0.309
Difference-in-Hansen Test (p-value)	0.833	0.446	0.377	0.116	0.342	0.320	0.339	0.437	0.910
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wald chi2	16166.8	9850.87	6655.95	6064.96	5025.15	6001.84	6965.21	6078.92	25944.7
Number of Observation	186/204	186/204	186/204	186/204	186/204	186/204	186/204	186/204	186/204

Notes: NPL_{t-1} is the lag of non-performing loan ratio, HHI is Herfindahl-Hirschman index (loan or assets), CCR is Concentration ratio for largest 3, 5 or 7 banks (loan and assets) and LnGDP is the lag of growth of GDP. *** is significant at 1%, ** is significant at 5%, * is significant at 10%. Standard error appears in the brackets above estimated coefficients.

CONCLUSION

This research investigates the association between bank concentration and risk, based on data from banks in Jordan for the period 2005–2016. We used two measures to calculate financial risk: Z-score (whole risk) and Non-performing loan (credit risk), and nine proxies for bank concentration with controlling bank specifics and macro-economics.

Our main results are consistent with the concentration-fragility view; when the dependent variable is Z-score, the outcome shows a negative and significant relationship between concentration and bank stability (Z-score), indicating that an increase in market power will result in increased risks. Meanwhile, by using Non-performing loan as a dependent variable, the outcome displays a positive and significant relationship with concentration, proposing that an increase in market power will positively increase credit risk. Moreover, this supports the argument that when there is a drop in the market power rate, there is a lower interest loan rate, which, in turn, will result in bor-

rowers paying back their loans. When this happens, credit risk will be decreased, leading to greater stability in the banking sector. The conclusion of these findings is that banks engage in less risky behaviours in a low concentrated environment. The conclusion also supports the concentration-fragility view, which can be applied to the Jordanian banking sector.

The data obtained through this research provides a number of significant implications for policy makers. Our empirical evidence proposes that a less concentrated environment contributes to less risk in the banking sector. The results support a recommendation to the Central Bank of Jordan to increase the number of banks by making changes to market entry restrictions, thereby increasing competition in the banking industry, because high market power in the banking industry will lead to greater risk. Concerning bank specifics, Earnings show a significant relationship with bank stability, and this research recommends that banks have moderate earnings as this would ensure those banks are less volatile. Additionally, as liquidity shows a positive relationship with bank stability, regulators should continue to strengthen bank liquidity.

Every research has limitations and the current research is no exception. The main limitation is poor availability of data, especially for foreign banks; it would therefore be beneficial for future research to collect more data in the Jordanian banking industry, particularly from foreign banks. Additionally, future research can assess financial risk using data from non-bank financial institutions such as insurance companies. This study did not use all the available measurements of bank concentration, such as the Boone indicator and the efficiency-adjusted Lerner index. Thus, future research can use these other measurements to determine whether similar findings can be achieved for banks operating in Jordan. The highest risk facing the Jordanian banking industry is credit risk, which may be affected by a number of factors such as Investment rate, Return to Shareholders Ratio, Net Interest Margin, and sensitivity to market risk. Future research could use these variables in addition to bank concentration. While this research only applied Z-score and non-performing loan to determine bank risk, future studies may attempt to examine other measurement of the financial risk, such as the capitalization ratio as a measure of a bank's level of capitalization (Berger et al., 2009).

REFERENCES

- Albaity, M., Mallek, R.S., Noman, A.H.M. (2019), "Competition and bank stability in the MENA region: The moderating effect of Islamic versus conventional banks", *Emerging Markets Review*, Vol. 38, pp. 310–325.
- Azmi, W., Ali, M., Arshad, S., Rizvi, S. (2019), "Intricacies of competition, stability, and diversification: Evidence from dual banking economies", *Economic Modelling*, Vol. 83, pp. 111–126.
- Beck, T., Demirgüç-Kunt, A., Levine, R. (2006), "Bank concentration, competition, and crises: First results", *Journal of Banking and Finance*, Vol. 30, No. 5, pp. 1581–1603.
- Ben Ali, M.S., Intissar, T., Zeitun, R. (2018), "Banking Concentration and Financial Stability: Evidence from Developed and Developing Countries", *Eastern Economic Journal*, Vol. 44, No. 1, pp. 117–134.
- Berger, A.N., Klapper, L.F., Turk-Ariss, R. (2009), "Bank competition and financial stability", *Journal of Financial Services Research*, Vol. 35, No. 2, pp. 99–118.
- Boyd, J.H., De Nicolo, G. (2005), "The Theory of Bank Risk Taking", *Journal of Finance*, Vol. LX, No. 3, pp. 1329–1343.
- Boyd, J.H., De Nicoló, G., Smith, B.D. (2004), "Crises in Competitive versus Monopolistic Banking Systems", *Journal of Money, Credit and Banking*, Vol. 36, pp. 487–506.
- Căpraru, B., Andrieș, A.M. (2015), "Nexus Between Concentration and Fragility Across EU Banking Systems", *Procedia Economics and Finance*, Vol. 32, pp. 1140–1147.
- Central Bank of Jordan (2017), *Financial Stability*, Amman. [http://www.cbj.gov.jo/EchoBusv3.0/SystemAssets/PDFs/EN/Financial Stability Report 2017Final 3-1-2019.pdf](http://www.cbj.gov.jo/EchoBusv3.0/SystemAssets/PDFs/EN/Financial%20Stability%20Report%202017Final%203-1-2019.pdf)

- Chang, E.J., Guerra, S.M., Lima, E.J.A., Tabak, B.M. (2008), "The stability-concentration relationship in the Brazilian banking system", *Journal of International Financial Markets, Institutions and Money*, Vol. 18, No. 4, pp. 388–397.
- Chu, K.H. (2015), "Bank consolidation and stability: The Canadian experience, 1867-1935", *Journal of Financial Stability*, Vol. 21, pp. 46–60.
- Davis, E.P., Karim, D. (2019), "Exploring short- and long-run links from bank competition to risk", *European Financial Management*, Vol. 25, No. 3, pp. 462–488.
- Degl'Innocenti, M., Fiordelisi, F., Girardone, C., Radic, N. (2019), "Competition and risk-taking in investment banking", *Finance Markets Institutions & Instruments*, Vol. 28, pp. 241–260.
- Demircuc-Kunt, A., Martinez Peria, M. (2010), "A framework for analyzing competition in the banking sector: an application to the case of Jordan", *Working paper*, No. 5499, The World Bank Policy Research, December.
- Fiordelisi, F., Mare, D.S. (2014), "Competition and financial stability in European cooperative banks", *Journal of International Money and Finance*, Vol. 45, pp. 1–16.
- Fofack, H.L. (2005), "Nonperforming loans in Sub-Saharan Africa: Causal analysis and macro-economic implications", *Working paper*, No. 3769, The World Bank Policy Research. Southern Africa, November.
- Fu, X., Lin, Y., Molyneux, P. (2014), "Bank competition and financial stability in Asia Pacific", *Journal of Banking and Finance*, Vol. 38, No. 1, pp. 64–77.
- González, L., Razia, A., Búa, M., Sestayo, R. (2017), "Competition, concentration and risk taking in Banking sector of MENA countries", *Research in International Business and Finance*, Vol. 42, pp. 591–604.
- Jordinvest (2012). *Jordanian Banking Sector*, <http://inform.gov.jo/en-us/By-Date/Report-Details/ArticleId/41/Jordanian-Banking-Sector>
- Kanas, A., Al-Tamimi, H.A., Albaity, M., Mallek, R. S. (2019), "Bank competition, stability, and intervention quality", *International Journal of Finance & Economics*, Vol. 24, No. 1, pp. 568–587.
- Kasman, S., Kasman, A. (2015), "Bank competition, concentration and financial stability in the Turkish banking industry", *Economic Systems*, Vol. 39, No. 3, pp. 502–517.
- Keeley, M.C. (1990), "Deposit Insurance, Risk and Market Power", *American Economic Review*, Vol. 80, No. 5, pp. 1183–1200.
- Li, S. (2019), "Banking Sector Reform, Competition, and Bank Stability: An Empirical Analysis of Transition Countries", *Emerging Markets Finance and Trade*, Vol. 55, No. 13, pp. 3069-3093.
- Liu, H., Molyneux, P., Nguyen, L.H. (2012), "Competition and risk in South East Asian commercial banking", *Applied Economics*, Vol. 44, No. 28, pp. 3627–3644.
- Marchionne, F., Zazzaro, A. (2018), "Risk and competitiveness in the Italian banking sector", *Economics Bulletin*, Vol. 38, No. 1, pp. 271–280.
- Nguyen, T.L., Le, A.H., Tran, D.M. (2018), "Bank Competition and Financial Stability: Empirical Evidence in Vietnam" in *International Econometric Conference of Vietnam*, Springer, pp. 584–596.
- Noah, A., Jacolin, L., Brei, M. (2018), "Credit Risk And Bank Competition In Sub-Saharan Africa", *Working paper*, No. 27, Economix, France.
- Phan, H.T., Anwar, S., Alexander, W.R.J., Phan, H.T.M. (2019), "Competition, efficiency and stability: An empirical study of East Asian commercial banks", *The North American Journal of Economics and Finance*, Vol. 50, pp. 100990.
- Schaeck, K., Cihak, M., Wolfe, S. (2009), "Are more competitive banking system more stable?", *Journal of Money, Credit and Banking*, Vol. 41, No. 4, pp. 711–734.
- Uhde, A., Heimeshoff, U. (2009), "Consolidation in banking and financial stability in Europe: Empirical evidence", *Journal of Banking and Finance*, Vol. 33, No. 7, pp. 1299–1311.

Appendix

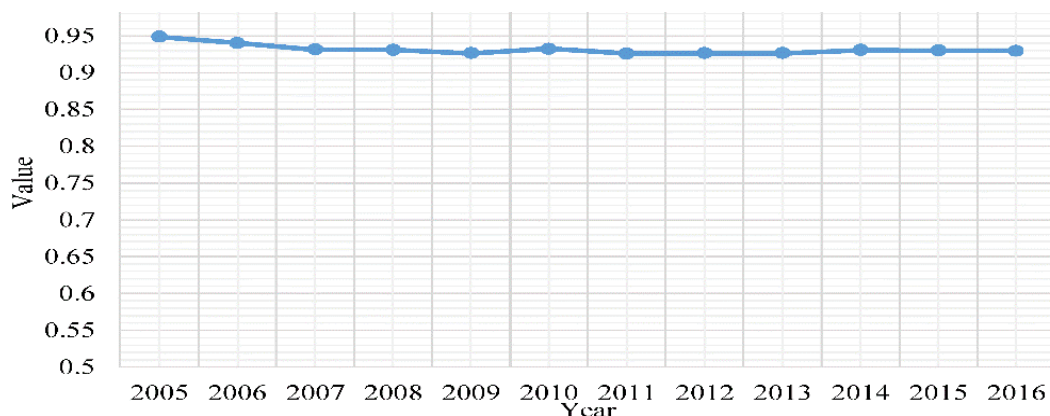


Figure 1. Evaluation of Lerner Index

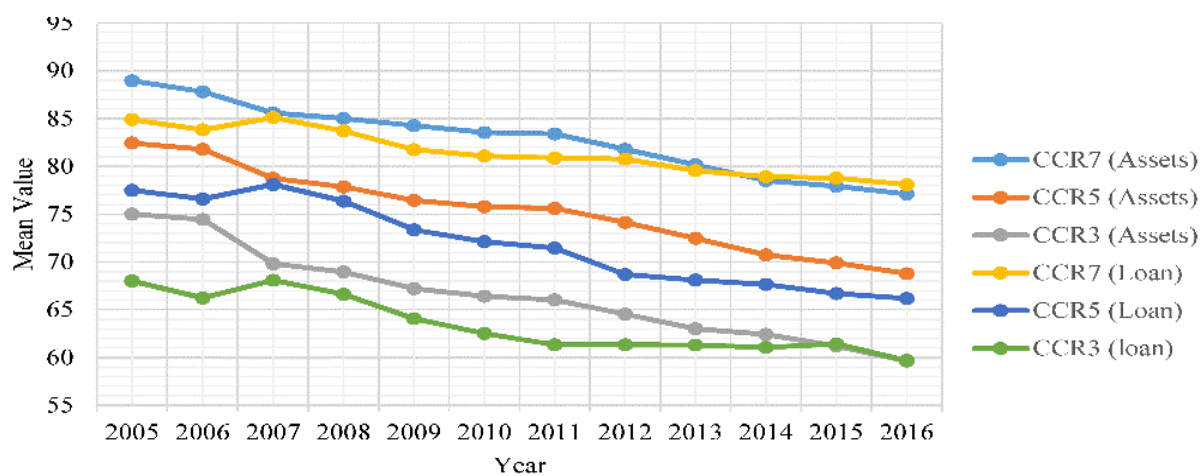


Figure 2. Evaluation of Concentration Ratio

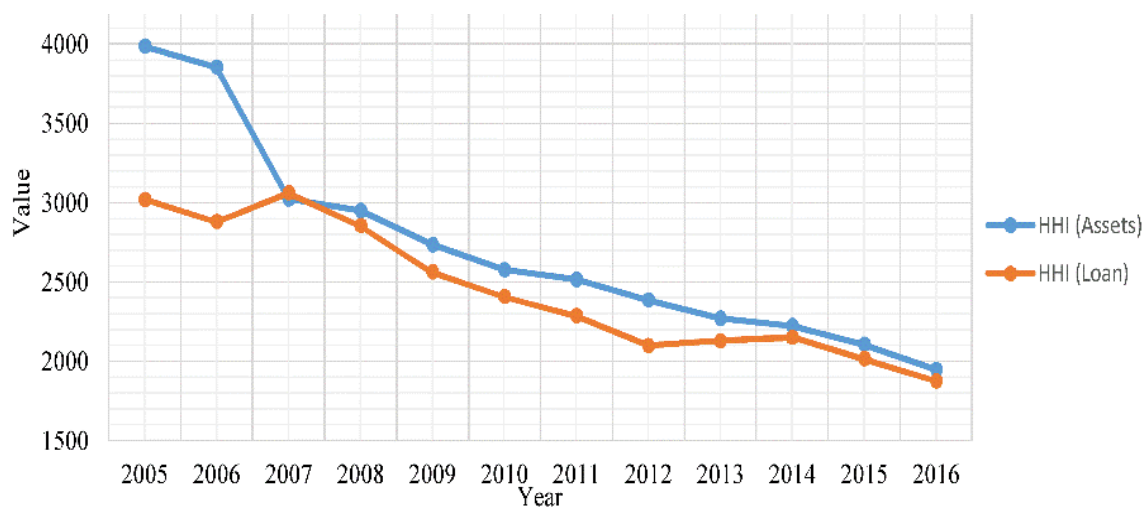


Figure 3. Evaluation of HHI

Table 4. Mean values of measures of variables

Year	Z-score	NPL	HHI (Assets)	CCR7 (Assets)	CCR5 (Assets)	CCR3 (Assets)	HHI (Loan)	CCR7 (Loan)	CCR5 (Loan)	CCR3 (Loan)	Lerner Index	ROA	Liquidity
2005	5.130	11.341	3985.327	88.973	82.453	75.021	3019.878	84.908	77.497	68.012	0.9488282	1.913	19.499
2006	4.557	9.052	3855.029	87.838	81.804	74.454	2880.835	83.854	76.610	66.235	0.9404316	1.576	14.542
2007	4.170	7.899	3023.899	85.620	78.754	69.810	3059.77	85.130	78.116	68.094	0.9315591	1.437	13.601
2008	4.333	6.461	2951.25	85.036	77.868	68.962	2854.25	83.739	76.370	66.614	0.9310187	1.417	13.355
2009	3.463	8.470	2735.452	84.287	76.473	67.232	2560.882	81.765	73.387	64.081	0.9263222	1.067	15.361
2010	3.868	9.708	2576.849	83.555	75.789	66.411	2406.969	81.094	72.128	62.521	0.932454	1.234	13.724
2011	3.483	10.527	2515.687	83.424	75.611	66.043	2286.893	80.914	71.474	61.340	0.9261557	1.043	10.755
2012	3.708	10.044	2386.324	81.807	74.142	64.543	2098.699	80.776	68.703	61.351	0.9262963	1.156	11.156
2013	3.658	8.673	2271.443	80.182	72.468	63.019	2129.739	79.590	68.111	61.324	0.9262736	1.111	11.678
2014	4.173	7.405	2223.501	78.537	70.761	62.435	2151.698	78.937	67.662	61.074	0.9306395	1.377	15.107
2015	3.700	7.002	2106.187	77.924	69.908	61.211	2015.674	78.792	66.712	61.435	0.9299977	1.190	15.423
2016	3.483	6.103	1949.272	77.119	68.793	59.634	1875.924	78.112	66.198	59.683	0.9295561	1.102	12.166

Notes: NPL is non-performing loan ratio, HHI is Herfindahl-Hirschman index (loan or assets), CCR is Concentration ratio for the largest 3, 5 or 7 banks (loan and assets), and ROA is Return of Assets after tax.