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Financial Stability in the MENA Region: The Impact of Banking Capitalization and Institutional Environment on Credit Availability

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Abstract

This study aims to analyze the applicability of the supply-side credit crunch in the MENA region by investigating the influence of bank capitalization and the institutional environment on the lending activities of banks operating in the region from 1999 to 2020. Employing the generalized method of moments (GMM) panel data estimator, our analysis reveals that bank lending is shaped by specific bank-related variables, country-level macroeconomic variables, and the quality of institutions. Our findings underscore that increases in bank capitalization levels, competition levels, or banks' liquidity ratios exert a negative impact on credit availability. Conversely, the size and profitability of banks have a positive effect on the accessibility of loans. It is evident that the banks under consideration consistently expand their credit supply in tandem with economic expansion and low inflation rates, thereby positively influencing credit demand. Furthermore, our study indicates that robust anti-corruption measures, political stability, and adherence to the rule of law act as catalysts, encouraging banks to enhance their lending availability.

Keywords: Basel framework, capital requirements, credit crunch, Institutional quality, MENA region, dynamic generalized method of moments estimation

1. Introduction

Banking, as one of the most regulated industries, places significant emphasis on bank capital standards, a pivotal aspect of this regulatory framework. This emphasis arises from capital's critical role in ensuring the soundness of banks, shaping risk-taking incentives, contributing to corporate governance, and influencing bank competitiveness, as emphasized by Awdeh and Hamadi (2011). The 1990s witnessed the establishment of the Basel accord within the banking industry, a mechanism aimed at ensuring that international banks adhere to minimum capital requirements. By the close of 1992, the Basel capital accords, formulated by the Basel Committee on Banking Supervision (BCBS) in collaboration with the Bank for International Settlements (BIS), were adopted by the G10 nations, making them the focal point of global banking regulations. The BCBS, recognizing the pivotal role banks play in economic growth and potential collapse, consistently revises and updates the Accord to address the increasing complexities of banking services, operations, and emerging challenges. Despite its limitations, the risk-based capital requirements and prudential regulation rules under the Basel framework have contributed significantly to bolstering bank supervisory activities, thereby promoting global bank stability and soundness (Riaz et al., 2019).

In response to the global financial crisis of 2007-2008, bank regulators recommended substantial changes to existing prudential regulation frameworks and standards. These revisions included heightened capital requirements, notably introduced through new policy tools like the non-risk-based leverage ratio and additional capital buffers, alongside short- and long-term liquidity requirements.

The banking sector in the Middle East and North Africa (MENA) has grappled with numerous crises and challenges, necessitating significant reforms at both the sector and individual bank levels. These challenges stem from factors such as weaker law enforcement and oversight compared to other countries, impacting both the financial system and the broader economy. In addressing these issues, most MENA countries-initiated banking regulation reforms in the 2000s under the guidance of international organizations such as the World Bank, the

International Monetary Fund (IMF), and the Bank for International Settlements. These reform initiatives focus on critical aspects such as capital adequacy, risk management, disclosures, corporate governance, and prudential regulation, with the Basel Committee providing a structural framework to support these initiatives (OECD, 2009). The overarching goal of these reforms is to ensure appropriate regulation, supervision, and transparency in the banking sector, ultimately reducing bank risk-taking and enhancing efficiency. Policymakers and central banks are compelled to adopt reform strategies, policies, and tools, including the implementation of new laws and regulations as well as amendments to existing ones, to achieve these objectives. In this context, concerns have arisen regarding the potential impact of these new legislations on bank lending and, consequently, on the real economy (Awdeh and El-Moussawi, 2021).

It is noteworthy that the MENA region's financial system complexity is often linked to the adoption of Basel recommendations, as highlighted in previous studies (Rocha et al., 2011). Approximately 55% of African nations and 68% of Middle Eastern nations implemented the Basel fundamental principles, according to the IMF (2008). However, Mohseni-Cheraghlou (2012) found a higher compliance rate of 92% with the regional Basel II requirements for off-balance-sheet disclosure and risk management frameworks. The Gulf Cooperation Council (GCC) countries have made significant strides in tightening personal loan regulations, increasing provisioning rates, and adopting systems for exchanging and reporting credit information through private credit bureaus or public credit registries. Some GCC nations also have more independent regulatory authorities, although they lack the authority to dismiss management or declare a bank bankrupt. However, the MENA region faces several major challenges, including the limited political influence of central banks, weak implementation of regulatory standards, and inadequate supervision with restricted supervisory methods (Rocha et al., 2011).

Historically, an increase in bank capital has given rise to what is known as the "credit crunch" problem, originating in the early 1990s in the United States of America. The credit crisis has been explained by various stakeholders, including bankers, politicians, regulators, and borrowers, each offering unique perspectives akin to the story of the blind man examining an elephant. These perspectives, while diverse, are not entirely correct or incorrect. Clair and Tucker (1993) propose that many economists attribute the credit crunch to a cyclical decline in credit demand, often asserting that structural changes in credit demand reinforce this cyclical swing. However, these economists may overlook other critical factors that have diminished banks' ability to extend loans or increased the cost of doing so. On the contrary, Peek and Rosengren (1995) posit that credit limitations adopted by the US and other developed nations were primarily the result of Basel I regulations. Advocates of bank capitalization, such as Bernank and Lown (1991), stress its benefits in encouraging banks to reduce their risks, positively impacting their ability to provide credit. Bernank and Lown (1991) were among the first to describe the credit crunch phenomenon as a *"significant leftward shift in the supply curve of bank loans, holding constant both the safe real interest rate and the quality of potential borrowers."* This shift occurs because banks have two options to meet capital requirements: either increase equity or significantly reduce assets. However, option one is expensive, leading banks to reduce their assets (and liabilities). Recent research studies, as discussed in the following section, have shifted their focus to the profound effects of capitalization on bank behavior, demonstrating the impact of capital requirement restrictions on loan availability.

In addition to capital regulation, research findings indicate that bank behavior is influenced by the quality of a country's institutions. The World Bank has underscored the importance of high-quality public institutions for the financial environment of institutions since at least the early 1990s (World Bank, 1992). This is crucial for two main reasons: firstly, to implement effective and reliable economic policies, and secondly, to foster stability among diverse economic players. Weak institutions can exacerbate information asymmetry issues, thereby reducing credit supply (Bae and Goyal, 2009). Therefore, understanding the impact of banking requirements in conjunction with the quality of public institutions on bank behavior is crucial for comprehending a country's effectiveness (Bermpei et al., 2018).

Following the implementation of Basel capital adequacy standards, a significant body of research, both empirical and theoretical, has focused on examining the effects of risk-based capital rules on bank lending behavior and credit availability, as well as the potential occurrence of the credit crunch phenomenon. Indeed, most of the previous studies conducted have indicated that regulations and the quality of public institutions in the MENA region have influenced bank capital and credit supply. Therefore, the objective of this study is to contribute to the ongoing discussion by evaluating the potential occurrence of a supply-side credit crunch in the MENA region. Additionally, the research aims to consider the influence of the institutional environment, which may play a role in alleviating the supply-side credit crisis.

The novelty of this work is that it employs the Generalized Method of Moments (GMM) in analyzing the link between bank capitalization, institutional environment and lending activity of MENA banks. This method

addresses the issue of unobserved heterogeneity for panel data analysis compared to alternative estimators used by previous researchers (De Jonghe, Dewachter and Ongena (2020) and El-Moussawi, Kassem and Roussel (2023)) that are based on the Random Effects and Fixed Effects. The GMM technique effectively deals with endogeneity concerns by employing one lagged value of endogenous variables as instrumental variables. Furthermore, this technique can handle heteroscedasticity and autocorrelation between error terms of different time periods in panel data analysis.

This paper is organized as follows. In the following section; Section 2; we consider the related literature and hypothesis formulation. Section 3 presents the methodology and variables specification; Section 4 introduces the data set under study; Section 5 includes the interpretation of empirical results and the model's diagnostic tests. The robustness check results and tests are presented in Section 6; Section 7 is the conclusion and Section 8 is the future research recommendations.

2. Literature Review

2.1 The Impact of Bank Capitalization on Lending Activity

The focal point of both theoretical and empirical research has been the examination of capital requirements and their impact on bank lending behavior, predominantly within developed economies. For instance, Peek and Rosengren (1995) conducted a study exploring the direct relationship between capital regulation measures and the reduction in bank lending to industries reliant on banks. Their analysis centered on a group of 68 New England insured banks that remained unaffected by failures, acquisitions, or mergers with non-affiliated banks from the first quarter of 1989 to the second quarter of 1992. The findings disclosed that banks subject to stringent regulatory measures exhibited a more pronounced weakening compared to those not bound by such rules. Banks adhering to capital conservation regulations lent 2% less annually than their counterparts not governed by such rules, implying a credit crunch in New England attributable to the implementation of Basel I Accord regulations.

In a study by Fang et al. (2018), the effects of escalating bank capital requirements on credit availability were explored in an emerging economy, utilizing a sample of 14 commercial banks representing the Peruvian banking system spanning from 2005: Q1 to 2016: Q4. Their findings revealed a temporary, negative impact of increased capital requirements on bank loans in Peru, which became statistically negligible after approximately six months. This suggests that the costs for Peruvian banks to acquire more capital were relatively low. Roulet (2017) delved into an examination of 269 banks across 22 European countries from 2008 to 2015, investigating the influence of Basel III liquidity and capital requirements on bank lending supply. The results indicated that capital requirements significantly and adversely affected the retail and other lending expansion of large banks in Europe. Stricter capital adequacy laws, following Europe's post-2008 financial crisis deleveraging and "credit crunch," prompted large banks to replace retail and other lending assets with risk-free, more liquid government bond securities. Maurin and Toivanen (2012) scrutinized the impact of capital requirements on bank lending in Europe, utilizing the balance sheets and income statements of 51 commercial banks headquartered in France, Germany, Belgium, Austria, Spain, Portugal, and Italy from Q1 2005 to Q4 2011. Their findings revealed that undercapitalized banks limited credit availability due to the higher cost of bank equity, leading them to reduce debt to meet desired capital ratios. Internal target capital ratio variations reflected changes in the bank's risks and profit development, with the expected range of influence remaining considerable. Aiyar et al. (2016) conducted a study in the context of the United Kingdom, employing a sample of 88 UK banks to investigate how the responsiveness of bank loan issuance to changes in capital requirements varied depending on the bank's size. The study explored the vulnerability of banks to changes in financial regulations and interest rate policy. The findings indicated that regulatory capital policies were a more effective method for achieving financial stability objectives related to the loan supply of both large and small banks. However, the supply of bank loans from small banks was significantly influenced by monetary policy, whereas the supply from large banks was not. In contrast to small banks, large banks were more likely to work with non-depository funding sources to safeguard their loan supply against monetary policy shocks that increased the cost of backing loans with deposits. In summary, the tightening of capital requirements or monetary policy constrained the availability of loans.

Moreover, to assess whether the observed credit contraction in various East Asian countries constituted a credit crunch, Age ńor et al. (2004) proposed an alternative approach using a dynamic model for the post-crisis period of 1997-1998. Their findings indicated that the decrease in bank loans in Thailand resulted from a supply-related phenomenon, supporting the credit crunch hypothesis. As a consequence of the crisis, small and medium-sized businesses in Thailand faced significant challenges in accessing credit markets. While the effectiveness of applying the methodologies used in this study to other crisis-affected East Asian countries is yet to be determined,

it remains an avenue worth exploring. In contrast to Thailand, Indonesia did not experience a significant growth in the ratio of surplus reserves to deposits. The capital crunch theory posits that increased non-performing loans erode banks' equity capital, leading to reduced credit availability.

Hypothesis (1): Bank capitalization negatively affects the lending activity of banks operating in the MENA region.

2.2 The Impact of Economic Growth on Lending Activity

The importance and repercussions of macroeconomic conditions, particularly economic growth, on the banking sector and its constituents have been widely acknowledged and extensively demonstrated through various studies. For instance, Gambacorta and Mistrulli (2004) delve into the presence of cross-sectional variability in lending reactions to changes in monetary policy and GDP shocks, stemming from variations in bank capitalization. According to the "bank lending channel" concept, well-capitalized banks may better shield their credit supply against monetary policy shocks, as they have greater access to non-deposit financing. The authors provide compelling evidence of a "banks' capital channel," demonstrating a more significant impact on credit organizations with a higher maturity mismatch between obligations and assets, while banks' responses to GDP shocks exhibit less procyclicality. Conversely, capital crises arising from the need for high-risk banks to maintain a solvency ratio exceeding 8% lead to a 20% decline in lending after two years. These outcomes underscore the significance of bank capital in transmitting various shocks to lending, influenced by regulatory capital limits and shortcomings in the market for bank fundraising.

In her research paper, Martynova (2015) offers an overview of the literature on the impact of increased bank capital requirements on economic growth across diverse countries. The evidence suggests that the direct effect is minimal, with the majority of studies focusing on the indirect effects of bank capital regulations on loan availability, bank capital expenses, and bank asset risk—all of which can shape economic development. The key findings of this analysis are as follows. Firstly, heightened capital requirements may diminish credit availability, particularly for small businesses heavily reliant on bank borrowing, thereby impeding economic development. Secondly, increased capital requirements elevate the cost of equity while decreasing the cost of debt for banks. The augmented equity expenses may be passed on to borrowers in the form of higher interest rates, leading to a decline in credit demand and hindering economic growth. Thirdly, capitalization enhances financial health by reducing bank risk-taking incentives and providing a loss buffer. Consequently, better capitalized banks exhibit lower lending volatility. However, banks encountering rising capital requirements may curtail credit availability and loan demand by raising lending rates, ultimately slowing down economic development. Conversely, well-capitalized banks contribute to financial and monetary stability by limiting bank risk-taking incentives and enhancing their loss buffers.

Additionally, Agung et al. (2001) investigate whether the substantial decline in credit from Indonesia's banking industry is a result of weak credit demand following the recession or if it can be attributed to a credit crunch. The study's findings reveal that credit expansion remains sluggish due to supply-related factors, as suggested by the credit crunch theory. This slow growth is partly influenced by the capital crisis (capital crunch) that banks faced during the crises, the rise of non-performing loans (NPLs), an increase in credit risk in the commercial sector indicated by persistently high leverage ratios, and a lack of information on potential borrowers. Moreover, the study illustrates a significant decrease in banks' sources of financing for businesses, which is the primary reason for the ongoing credit crunch in Indonesia.

Hypothesis (2): Economic growth negatively affects the lending activity of banks operating in the MENA region.

2.3 The Impact of Institutional Environment on Lending Activity

Scholars and policymakers have long expressed interest in comprehending the effects of capital regulations on loan availability. More recently, the connection between a country's institutional environment and loan supply has gained significance. To explore the applicability of the credit crunch theory and consider the influence of the institutional environment in alleviating supply-side credit crunch, Awdeh and El-Moussawi (2021) employed the Fixed Effects methodology on a sample of 210 banks operating in 14 different MENA countries during the period 1999-2016. The findings reveal that increasing capitalization ratios significantly decrease the availability of bank loans. Additionally, the study examines the impact of institutional factors on bank lending and identifies that effective governance and political stability encourage lenders to provide credit and mitigate the credit crunch. On the other hand, a higher degree of financial freedom hinders banks from expanding loan supply and arouses the decline in credit following tightening of capital requirements.

Gani and Al-Muharrami (2016) examine how the quality of public institutions affects credit availability in four Gulf Cooperation Council (GCC) nations, namely Kuwait, Bahrain, Qatar, and Oman. By analyzing annual data from 2003 to 2012, the researchers find that the quality of institutions, represented by regulatory quality, contract enforcement time, government effectiveness, and the rule of law, has a negative correlation with bank lending. The study suggests that improving the quality of institutions in GCC countries is crucial to enhancing the effectiveness of bank lending. Moreover, El Hourani and Mondello (2019) used a dataset of 231 banks operating in the MENA region from 2000 to 2016 to explore the impact of institutional quality on commercial bank lending activities. The authors observe that strong regulatory quality and political stability encourage multinational, private, and local banks to expand their loan supply. Additionally, they find that increased financial freedom and improved government performance negatively affect capital requirements and loan supply growth in the MENA region. The study implies that when faced with higher government efficiency and certain financial flexibility, MENA banks tend to adopt a cautious approach. Also, Bermpei et al. (2018) investigate the relationship between institutional quality, bank regulations, and bank stability in developing and emerging economies. Their findings indicate that the impact of bank regulations on stability depends on the quality of institutions. Capital requirements and activity constraints have positive effects on bank safety, as measured by the z-score. Furthermore, corruption control amplifies the negative impact of activity restrictions on stability. However, when institutions that support loan repayment, such as strong creditor rights and the rule of law, are present, the positive effects of capital control become evident. The study does not find strong evidence that institutional quality modifies the negative effect of regulatory authority on bank stability.

Finally, Oyebola and Zayyad (2020) examine how institutional quality and market structure influence bank capital ratios in emerging economies. Using data from 79 publicly traded commercial banks in Africa from 2000 to 2016 and employing the generalized method of moments to address autocorrelation and endogeneity, the authors demonstrate that both market structure (as measured by bank competition) and institutional quality (as assessed by regulatory quality) contribute to reducing bank capital in the selected institutions. In less competitive regions with strong regulatory constraints, banks are not compelled to engage in excessive risk-taking, thus requiring less capital. The combination of competitiveness and regulatory quality further supports their significant impact on bank capital ratios.

Hypothesis (3): Healthy institutional environment positively affects lending activity of banks operating in the MENA region.

3. Variables Specification and Methodology

3.1 Variables Specification

3.1.1 Dependent Variable

In our empirical study, we aim to explain the credit crunch through the bank's credit supply. Therefore, we use the ratio of gross loans to total assets (LAR) as our dependent variable, representing a measure of credit supply. We conduct a regression analysis, considering a set of control and independent variables. The gross loans to total assets ratio calculate the total number of outstanding gross loans as a percentage of total assets per annum. A bank with a high credit supply exhibits a high gross loan to total assets ratio, as this ratio reflects the available amount of loans. On the other hand, a higher ratio indicates that the bank has less liquidity and is more vulnerable to defaults.

3.1.2 Explanatory Variables

Bank-specific variables. In this section, we present several bank-specific variables drawn from the bank lending literature, previously utilized by researchers. We will begin with the bank equity to asset ratio (CAR), employed by Deli and Hasan (2017) and Fang et al. (2018) to assess the impact of capitalization on bank lending behavior. Instead of using Basel Accord capital adequacy ratios, which lack sufficient information for the banks in our dataset due to various regulatory framework implementations, we opt for this traditional measure of bank capitalization. According to existing literature, bank profitability significantly influences bank lending. Higher profit margins enable banks to increase their capital ratios, safeguarding against potential liquidation and indicating a positive relationship with the supply of bank loans. The bank's return on assets ratio (ROA), defined as the ratio of net income to total assets, is widely used to quantify banks' profitability and its influence on lending choices, as seen in studies by Kim and Sohn (2017), Ben Naceur et al. (2018), and Oyebola and Zayyad

(2020). Bank efficiency, assessed through the total operating expenses to total assets ratio ($COST$), is another crucial determinant of bank lending. A higher ($COST$) ratio reflects lower efficiency, leading to a negative effect on credit supply. Additionally, bank liquidity plays a vital role in evaluating the financial health of banks, protecting against stress and bank runs. The liquid asset to total asset ratio (LIQ) measures the proportion of a bank's assets that can be readily converted into cash. It has been extensively used by authors like Gambacorta and Mistrulli (2004), Kim and Sohn (2017), and Fang et al. (2018) to examine the relationship between bank liquidity and loan supply, where liquidity is expected to positively impact credit supply. Furthermore, bank size ($SIZE$) is an important factor influencing bank credit supply, necessitating careful management. Typically, a bank's size is determined by the natural logarithm of its total assets as reported on its balance sheet. This measure is utilized by El Hourani and Mondello (2019) and Oyebola and Zayyad (2020) from our literature review chapter to differentiate between the behaviors of small and large banks. Larger banks enjoy incentives like reduced capital costs, enabling them to raise additional capital while mitigating excessive risk. Additionally, major banks are required to maintain capital above market-determined reserves to maintain excellent ratings. Consequently, we anticipate a positive coefficient for bank size in our estimation. Moreover, banks take into consideration various factors when determining credit availability, with risk being a significant concern. Specifically, credit risk is believed to have a negative impact on credit supply. To measure credit risk, we will employ the non-performing loans to gross loans ratio ($NPLs$), widely used in the banking literature by Roulet (2017), Ben Naceur et al. (2018), and others as a proxy. The NPL ratio indicates the quality of the bank's credit portfolio and the influence of credit risk on bank lending. To examine the impact of bank stability on credit supply behavior, we will use the Z-score indicator of the bank. The Z-score reveals how many standard deviations a bank's return on assets must fall below its expected value before the bank becomes insolvent and loses its equity. A higher Z-score indicates that a bank is less vulnerable and less risky. The Z-score was utilized by Klomp and de Haan (2015) and Awdeh and El-Moussawi (2021), and it is calculated as follows: $ZSCORE = \frac{CAR + ROA}{\sigma_{ROA}}$, where σ_{ROA} is the 3-years standard deviation of ROA, for years t_{-2}, t_{-1}, and t_0. To reduce the right-skewness of the raw data of Z-score, we computed the natural logarithm of this variable (LNZ). Finally, as a measure of monopoly in the banking sector, we will use the Lerner index ($LERNER$) in line with Oyebola and Zayyad (2020). The Lerner index represents market power as the proportionate mark-up of price above marginal cost divided by price (Lerner, 1934). According to Coccorese (2009), it appropriately captures the degree of market power exhibited by banks as it measures the behavioral divergence from monopoly and perfect competition. To obtain an individual measure of competition for each year in our time sample, we compute the Lerner index using the same cost function and definition of variables as Iveta (2012) (See Appendix A). Additionally, we will use the Panzer-Rosse H-statistics ($PANZ$) as another measure of market power/competition (Panzar & Rosse, 1987). This measure assesses bank competitiveness by evaluating the response of output to input prices, but it imposes certain restrictive assumptions on banks' cost function. The conclusion reached from the profit-maximizing condition, however, is only applicable if the market in question is in equilibrium.

Macroeconomic variables. Determining the credit demand amount remains a crucial topic in the empirical literature on bank lending, primarily due to limited data on credit demand. In this study, we will use two macroeconomic factors as indicators of credit demand, namely GDP per capita growth and inflation, in line with research by Gambacorta and Mistrulli (2004), Berrospide and Edge (2010), and El Hourani and Mondello (2019). The GDP per capita growth rate serves as a measure of the economic cycle, revealing the overall health of the nation's economy. Inflation, on the other hand, is best measured by the Consumer Price Index (CPI). As per the procyclicality theory of bank lending, we expect the coefficients of these macroeconomic variables to show a positive correlation. Procyclicality of credit refers to the situation where banks tend to expand lending in

response to economic changes, leading to an increased demand for new credit, and vice versa.

Institutional environment quality variables. The behavior of banks is notably influenced by the quality of their institutional environments. To address this aspect, we adopt the approach of Aiyar et al. (2016), Ben Naceur et al. (2018), El Hourani and Mondello (2019), and Awdeh and El-Moussawi (2021) by including three control variables in our model. These variables serve as proxies for a country's institutional quality and are derived from the datasets of the World Bank's Governance Indicators. The variables considered in this study are: (i) corruption control; (ii) political stability; and (iii) rule of law, with the following definitions:

- Corruption control: This score assesses the level of transparency in a bank's public performance, considering both minor and major corruption. While the exact impact of corruption remains uncertain, it is believed to influence bank supply behavior. Some researchers suggest that corruption negatively affects bank lending performance, while others argue that it may improve lending performance.
- Political stability: This indicator evaluates political instability in the MENA nations, including the presence of violence and terrorism. During periods of political uncertainty, banks are more cautious in assessing borrowers' repayment abilities, leading to a significant decrease in their loan supply. In this case, the predicted outcomes for these variables are positive.
- Rule of Law: This indicator examines the degree of trust and adherence to social norms among agents, particularly regarding property rights, law enforcement, contract enforcement quality, and the possibility of crime and violence.

3.2 Methodology

Now that all variables have been defined and analyzed, we can present the methodology employed to test our research questions. Given the dynamic nature of this study, ordinary least squares (OLS) or Within (Fixed Effects) estimation is insufficient as they yield biased and inconsistent estimates (Baltagi, 2005). To address the issue of unobserved heterogeneity in MENA banks, we employ the GMM estimation technique. Introduced by Arellano and Bond (1991) and further developed by Arellano and Bover (1995) and Blundell and Bond (1998), the generalized method of moments (GMM) offers higher efficiency for panel data analysis compared to alternative estimators. This technique effectively deals with endogeneity concerns by employing one lagged value of endogenous variables as instrumental variables. Additionally, it proves to be valuable when examining dynamic panel data models that include the lagged dependent variable as an explanatory factor. Furthermore, GMM can handle heteroscedasticity and autocorrelation between error terms of different time periods in panel data analysis. To ensure the adequacy of the instrumental variables used and avoid overidentification, we conducted the Hansen-Sargan J test, testing the null hypothesis that overidentification restrictions are valid (Baltagi, 2005; Labra and Torrecillas, 2018). Additionally, to address the potential issue of serial autocorrelation of errors in endogenous models, we performed the Arellano and Bond (1991) diagnostic test, testing the null hypothesis that second-order autocorrelation does not exist.

In light of the above, we recommend the following equation connecting the gross loans to total assets ratio (dependent variable) with bank-specific, macroeconomic, and institutional quality vector variables:

$$\boldsymbol{LAR_{i,t} = \beta_0 + \beta_1 LAR_{i,t-1} + \beta_2 INST\_QUAL_{c,t} + \gamma BANK\_DETER_{i,t} + \delta MACRO_{c,t} + \varepsilon_{i,t}}$$

In this model, we use the subscripts *i*, *c* and *t* to represent bank, country, and year, respectively. The variable $LAR_{i,t}$signifies the ratio of gross loans to total assets, while $BANK\_DETER_{i,t}$ is a vector of specific bank variables. These variables include the equity to asset ratio (CAR), return on assets ratio (ROA), total operating expenses to total assets ratio $(COST)$, the liquid asset ratio (LIQ), the non-performing loans ratio (NPL), and the bank size $(SIZE)$ determined by the natural logarithm of the bank's total assets. Additionally, we incorporate (LNZ) to examine the impact of bank stability on credit supply behavior and the $(LERNER)$ index as a measure of market power in the banking sector. Furthermore, we use the macroeconomic indicator $MACRO_{i,t}$ as a vector to track the business cycle, evaluating the demand for bank loans while representing the state of the nation's economy. The two macroeconomic variables composing $MACRO_{i,t}$are the consumer price index (CPI)-based inflation rate (INF) and the gross domestic product $(GDPC)$. Moreover, $INST\_QUAL_{c,t}$ represents a vector of institutional quality variables, which includes corruption control $(COCR)$, political stability $(POLS)$, and the rule of law $(RLAW)$. Finally, $\varepsilon_{i,t}$ represents a white noise random error with a zero

mean and constant variance, assumed to be normally distributed $\varepsilon_{i,t} \sim iid\ N(0, \sigma^2)$. The error term $\varepsilon_{i,t}$consists of two orthogonal components:(μ_i) the fixed random effect over time and (ϑ_{ij}) the idiosyncratic time-varying random shocks. Including the lagged dependent variable $LAR_{i,t-1}$as an explanatory variable in the above model, in line with the work reported by Arellano and Bond (1991), helps address correlation problems between variables.

4. Data

In this paper, we are using an unbalanced panel data of 176 banks located in 15 different countries of the MENA region, as follows: 14 banks in Algeria, 6 banks in Bahrain, 22 banks in Egypt, 8 banks in Israel, 12 banks in Jordan, 5 banks in Kuwait, 24 banks in Lebanon, 5 banks in Malta, 9 banks in Morocco, 6 banks in Oman, 4 banks in Qatar, 7 banks in Saudi Arabia, 15 banks in Tunisia, 24 banks in Turkey, and 15 banks in the United Arab Emirates. We are using annual data for all variables in the next section. The source of bank-specific data is the Orbis Bank Focus database, while the data for the variables representing institutional quality are from the World Bank database, covering the period 1999-2020. *Table 1* represents the descriptive statistics of the variables used to test the relationship between banking capitalization, institutional environment and lending activity of banks operating in the MENA region.

Table 2 displays the correlation matrix of the dependent variable, bank-specific and some macroeconomic explanatory variables. The matrix indicates a moderate correlation among the variables, implying that incorporating all these variables into a single model is unlikely to result in multicollinearity issues. In terms of the institutional variables, it is observed in *Table 3* that there is a significant correlation among corruption, political stability, and the rule of law. As a result, it is advisable to avoid simultaneous inclusion of these three institutional variables in the econometric model.

Table 1. Variables descriptive statistics

	Mean	Standard Deviation	Minimum	Maximum
Loans to total assets ratio (LAR%)	51.795	20.333	0.014	173.957
Capital ratio (CAR%)	11.935	7.840	-31.368	92.851
Profitability (ROA%)	1.180	1.811	-39.614	32.213
Bank efficiency (COST%)	2.318	1.936	0.118	38.023
Liquidity ratio (LIQ%)	31.634	24.262	0.192	780.628
Size (SIZE)	15.206	1.673	7.376	19.456
Bank stability (ZSCORE)	12.794	13.930	-0.164	166.925
Logarithm of Z-score (LNZ)	1.476	1.875	-8.168	5.118
Non-performing loans (NPL%)	3.920	6.073	0.050	117.351
Bank market power (LERNER)	0.274	0.919	-0.232	0.940
GDP per capita growth (GDPC%)	1.911	4.703	-21.116	26.170
Inflation (INF%)	3.929	18.407	-93.791	84.864
Control of corruption (COCR)	-0.072	0.615	-1.145	1.567
Political stability (POLS)	-0.529	0.846	-2.117	1.599
Rule of law (RLAW)	0.008	0.565	-1.110	1.630

Source: Orbis Bank and author's calculation.

Table 2. Correlation matrix of the dependent variable, bank-specific and some macroeconomic explanatory variables

	CAR	COST	GDPC	INF	LERNER	LIQ	ZSCORE	LNZ	NPL	LAR	ROA	SIZE
CAR	1											
COST	0.238***	1										
GDPC	0.022	0.102***	1									
INF	-0.161***	0.199***	0.02	1								
LERN	0.151**	-0.057*	0.016	-0.076*	1							

ER	*	**		**								
LIQ	0.131***	0.046***	0.08***	0.083***	-0.006	1						
ZSCORE	0.217***	0.101***	0.054***	0.08***	-0.056***	0.126***	1					
LNZ	0.167***	0.046***	0.027	0.043***	0.091***	-0.331***	0.031*	1				
NPL	-0.049***	0.148***	0.009	0.023	-0.09***	-0.068***	0.547***	0.061**	1			
LAR	-0.032*	0.016	-0.026	-0.112***	0.025	-0.552***	-0.053***	0.439***	0.289***	1		
ROA	0.321***	-0.288***	0.101***	-0.079***	0.255***	-0.021	0.041**	0.169***	-0.149***	0.01	1	
SIZE	-0.295***	-0.266***	-0.132***	0.092***	-0.006	-0.349***	-0.159***	0.314***	-0.151***	0.193***	0.044**	1

Note: ***, **, * implies significant at the 1%, 5%, and 10% level respectively.

Table 3. Correlation matrix of institutional variables

	COCR	POLS	RLAW
COCR	1		
POLS	0.693***	1	
RLAW	0.889***	0.659***	1

Note: ***, **, * implies significant at the 1%, 5%, and 10% level respectively.

5. Empirical Results

The dynamic GMM predictions of the influence of capital requirements on bank loan supply availability are provided in Tables 4 and 5, which present eight distinct regression equations for testing the influence of various combinations of independent and control factors on the dependent variable. Firstly, we conduct the Sargan J-statistic test to validate the instruments used in the one-step estimates under the null hypothesis that all the restrictions of overidentification are valid. The results in Tables 4 and 5 indicate that the used estimation instruments are valid with a probability of J-statistics greater than 0.05. Thus, our models do not suffer from the overidentification of the used instruments. Secondly, we assess the assumption of no correlation among the error terms introduced by dynamic panel data. Table 4 shows that Models I through IV have no second-order autocorrelation, as probabilities of AR (2) are greater than 0.05. Similarly, in Table 5, the results of Models V through VIII show no second-order autocorrelation among their errors. Another measure of autocorrelation among error terms is the Durbin-Watson test, conducted under the same null hypothesis. The Durbin-Watson values in Tables 4 and 5 are close to 2, indicating the absence of autocorrelation. Finally, we conduct the r-squared test to assess how well the given data fits the regression model. The results in Tables 4 and 5 show that all models have an R^2value greater than 0.9, indicating that more than 90% of the variability in bank credit supply in MENA region countries is explained by the used set of bank-specific, macroeconomic, and institutional quality variables, with less than 10% explained by other factors. Therefore, all of the results are statistically significant, and the models appear to be well-specified.

The one-year lagged dependent variable (LAR_{t-1}) exhibits a positive and statistically significant relationship with (LAR_t) in all presented models in Tables 4 and 5, confirming the dynamic nature of our model and the persistence of the supply-side credit crunch. The coefficient of 0.864 (Model I) indicates a high persistence of the lagged gross-loans to total-assets ratio, suggesting that banks' credit supply in the current year reflects, to some extent, their credit supply from the previous year. In all the presented models, the equity-to-assets ratio (CAR) indicates negative and significant effects on the supply of bank loans. This link between bank capitalization and loan growth demonstrates that when banks meet capital regulation limits, they typically reduce their growth. In other words, tightening capital requirements significantly reduce MENA bank loan availability. This clearly shows that requiring banks to improve their capital ratios leads them to restrict lending during challenging times. As a result of our empirical findings, the credit crunch theory is supported. Regarding the influence of profitability on credit growth, we discover that a crucial determinant of lending choices is bank profitability, with a positive relationship between the return-on-assets ratio (ROA) and the gross-loans-to-total-assets ratio (LAR). This implies that increased profits made during a year lead banks to expand lending during the same year in the hope of realizing additional profits. This positive association is due

to the fact that MENA area banks employ retained earnings techniques to support their investments. Indeed, funding through debt or stock can be costly in this aspect due to knowledge asymmetry issues and high transaction costs. However, the degree of significance of this positive relationship varies among our models; in Table 4, this association is not significant, while in Table 5, it is significant at the 5% level. Additionally, in Table 4, Models I through IV show that bank liquidity (LIQ) has a significant (at the 1% level) negative impact on bank credit supply (LAR), indicating a trade-off between liquidity and credit growth. Thus, banks' efforts to increase liquidity will come at the expense of lending. However, for models in Table 5, bank liquidity shows a non-significant positive relationship with bank credit supply. Moreover, the empirical findings reveal a positive and significant relationship between bank size and credit supply, with $(SIZE)$ being positively related to the gross-loans to total-assets ratio (LAR). These findings support the idea that large banks may achieve substantial scale efficiencies, reducing the cost per dollar of loans as the number of loans increases, thereby increasing their credit supply, profitability, and efficiency. These findings become strongly significant in Table 5, Models V through VIII, when we replace the $(LERNER)$ index variable, which measures market power, with (LNZ) and $(PANZ)$ variables, representing bank stability and market power/competition, respectively.

In Table 4, we use the Lerner index $(LERNER)$ as a measure of monopoly, which exhibits a positive relationship with the dependent variable, gross-loans to total-assets ratio (LAR). This relationship is significant at the 5% level in Models I, II, and III, and at the 10% level in Model IV, suggesting that higher market power/monopoly levels lead to higher amounts of bank credit supply. However, in Table 5, another model estimation adds the (LNZ) variable, a measure of bank stability, to the previously mentioned bank-specific variables and replaces the Lerner index variable $(LERNER)$ with the Panzar-Rosse H-statistic variable $(PANZ)$. Firstly, the natural logarithm of Z-Score variable (LNZ) captures a negative and significant relationship with the measure of bank credit supply. This indicates that as bank stability increases, bank credit supply will decrease. One possible explanation for this finding is that asymmetric information resulting in moral hazard is more prevalent in our dataset of economies. This information problem causes bank owners to be more cautious when granting credit, even in stable situations. Secondly, the coefficient of $(PANZ)$ captures a negative relationship between market power/competition and the gross-loans to total-assets ratio. This relationship is significant at the 5% level in Models VI and VII, and at the 10% level in Models V and VIII, suggesting that high competition levels lead to less availability of credit supply. These results are consistent with the previously suggested results of Table 4, where high market power/monopoly (i.e. low levels of competition in the MENA region banking sector) results in high amounts of bank credit supply.

Regarding the macroeconomic control variables, rising rates of GDP per capita growth appear to have a positive effect on credit supply growth. In Table 4, the findings reveal an association between rising credit supply and rising GDP per capita, significant at the 1% level in Models I and III, and at the 5% level in Models II and IV. This is explained by the bank lending strategy being tied to credit supply needs, which is related to the country's economic development. These findings confirm the hypothesis that when economic circumstances improve, the number of feasible projects grows, thus boosting loan supply demand. However, this relationship is not significant after adding the two variables (LNZ) and $(PANZ)$ in Table 5, Models V through VIII, which shows a non-significant positive relationship between economic growth and credit supply growth. Moreover, inflation coefficients capture a non-significant positive relationship with the dependent variable in all of the presented models except Model IV, which recorded a negative association between inflation rates and loan supply.

Furthermore, we aimed to detect the impact of the institutional environment's quality on bank credit supply in the MENA region, as previous studies suggest that institutional quality variables are an important determinant of credit supply growth. For this reason, we integrated three different institutional quality variables: control of corruption $(COCR)$, political stability $(POLS)$, and rule of law $(RLAW)$ successively in Table 4, Models II through IV, and Table 5, Models VI through VIII. In Table 4, the empirical results of Model II show a positive and significant relationship between the coefficient of control of corruption index $(COCR)$ and the gross-loans to total-assets ratio (LAR). This implies that in the MENA area, a high level of corruption control is connected with increasing bank loan supply. Moreover, in Model III, the political stability index $(POLS)$ captures a positive and significant relationship with bank credit supply (LAR), which aligns with our expectations that banks are less likely to evaluate their borrowers' repayment abilities in times of political unrest, and therefore they become extremely cautious, drastically reducing their credit supply. Additionally, a high level of rule of law encourages banks to increase their credit supply and lend more, as $(RLAW)$ captures a positive and significant relationship with the credit supply availability measure (LAR) in Model IV. However, these three positive relationships are not significant in Table 5, Models VI through VIII.

Table 4. The impact of explanatory control variables with Lerner index on bank lending in MENA countries - dependent variable: LAR_t

	Model I	Model II	Model III	Model IV
Constant	0.103*** (0.021)	0.129*** (0.027)	0.116*** (0.026)	0.114*** (0.023)
LAR (-1)	0.864*** (0.018)	0.847*** (0.022)	0.849*** (0.022)	0.859*** (0.019)
CAR	-0.043** (0.022)	-0.044** (0.022)	-0.046* (0.024)	-0.037 (0.015)
ROA	0.083 (0.293)	0.101 (0.323)	0.003 (0.312)	0.232 (0.310)
LIQ	-0.112*** (0.016)	-0.104*** (0.017)	-0.115*** (0.019)	-0.099*** (0.015)
SIZE	0.001 (0.001)	0.001* (0.001)	0.010** (0.005)	0.001 (0.001)
LERNER	0.032** (0.015)	0.029** (0.014)	0.020** (0.010)	0.020* (0.011)
GDPC	0.128*** (0.032)	0.083** (0.032)	0.114*** (0.032)	0.085** (0.032)
INF	0.006 (0.008)	0.005 (0.009)	0.004 (0.009)	-0.003 (0.009)
COCR		0.015*** (0.003)		
POLS			0.009*** (0.002)	
RLAW				0.014*** (0.003)
R-squared	0.952	0.952	0.949	0.954
Durbin-Watson stat	1.914	1.919	1.915	1.933
J-statistic	3.055	1.814	4.457	2.402
Prob(J-statistic)	0.217	0.404	0.179	0.301
Arellano-Bond Serial Correlation Test				
Prob. AR (1)	0.003	0.003	0.048	0.017
Prob. AR (2)	0.291	0.255	0.899	0.637
Observations	3696	3696	3696	3696

Note: Standard error in parentheses. ***, **, * implies significant at the 1%, 5%, and 10% level respectively.

Table 5. The impact of explanatory control variables with Ln (ZScore) and Panzar-Rosse statistic on bank lending in MENA countries- dependent variable: LAR_t

	Model V	Model VI	Model VII	Model VIII
Constant	-0.037 (0.097)	-0.202 (0.261)	-0.080 (0.115)	-0.086 (0.157)
LAR (-1)	1.008*** (0.083)	1.143*** (0.225)	1.038*** (0.099)	1.045*** (0.134)
CAR	-0.015*** (0.005)	-0.039*** (0.009)	-0.026*** (0.007)	-0.022*** (0.008)
ROA	0.603** (0.275)	0.639** (0.301)	0.588** (0.286)	0.573** (0.278)
LIQ	0.004 (0.066)	0.105 (0.159)	0.033 (0.080)	0.033 (0.099)
SIZE	0.005** (0.002)	0.019** (0.008)	0.006*** (0.002)	0.006** (0.003)
LNZ	-0.008*** (0.002)	-0.005** (0.003)	-0.004** (0.002)	-0.004** (0.002)

PANZ	-0.018* (0.010)	-0.021** (0.010)	-0.021** (0.010)	-0.020* (0.010)
GDPC	0.062 (0.080)	0.044 (0.084)	0.040 (0.083)	0.057 (0.086)
INF	0.023 (0.020)	0.040 (0.031)	0.029 (0.020)	0.032 (0.028)
COCR		0.012 (0.021)		
POLS			0.001 (0.006)	
RLAW				0.003 (0.012)
R-squared	0.948	0.914	0.933	0.939
Durbin-Watson stat	2.018	1.85	2.015	1.992
J-statistic	0.485	0.582	0.457	0.593
Prob(J-statistic)	0.486	0.446	0.499	0.441
Arellano-Bond Serial Correlation Test				
Prob. AR (1)	0.016	0.017	0.015	0.013
Prob. AR (2)	0.185	0.141	0.186	0.159
Observations	3696	3696	3696	3696

Note: Standard error in parentheses. ***, **, * implies significant at the 1%, 5%, and 10% level respectively.

6. Robustness Check

We re-run all the regression models shown in Table 4 after adding one new bank-specific variable using the same empirical technique, the Generalized Method of Moments, to maintain the applicability of our models and provide additional support to the newly founded empirical results presented above. Table 6 (See Appendix B) presents the results on the effects of institutional quality indicators and explanatory control variables on (LAR_t). Risk is a key component considered by banks when calculating the quantity of credit availability. Therefore, we use the non-performing loans to gross-loans ratio (NPL) as a measure of credit risk, particularly in the banking literature. The (NPL) ratio indicates the credit portfolio quality of the bank and is expected to have a negative impact on bank lending behavior. Contrary to our expectations, the estimations in Table 6 show that credit risk (NPL) captures a positive and significant relationship with bank credit supply(LAR_t). This might be explained by the high-risk tolerance of certain banks under study, which are willing to accept a high probability of borrowers defaulting to potentially achieve higher profits.

Initially, following a lack of autocorrelation in the errors, the results of each Sargan J-statistic test as well as the AR (1) and AR (2) tests indicate that there is no over-identification of the used instruments. Additionally, in all the models provided in Table 6, it is demonstrated that the lagged dependent variable (LAR_{t-1}) is positively correlated with (LAR_t) and statistically significant, highlighting the dynamic character of the models and the resilience of the supply-side credit crunch. Overall, the results in Table 6 are largely consistent with those in Table 4. This demonstrates that the results remain stable even after we add the (NPL) variable to our model. Capital requirements, in particular, have a negative and significant impact on (LAR_t)in both Tables 4 and 6, highlighting the significant and long-term effect of capital requirements on loan availability in the MENA region. Secondly, corruption control $(COCR)$, political stability $(POLS)$, and rule of law $(RLAW)$ indicators capture a positive and significant relationship with the credit supply availability measure (LAR) in Table 6, Models I through IV, similar to Table 4, which suggests that institutional quality factors have a stable effect on MENA bank credit supply growth rate.

7. Conclusion

Following the adoption of the Basel I Accord in the early 1990s, questions have been raised about the impact of risk-based capital requirements on bank lending practices, credit availability, and the overall economy. The introduction of Basel II and III, which imposed more strict and complex capital requirements and prudential limitations, exacerbated these concerns. To truly understand the effect of the Basel standards on loan availability, especially in industries reliant on banks, various theoretical and empirical studies have been conducted in response to these concerns. This paper contributes to the discussion of the potential emergence of a credit crunch due to tighter capital requirements, using a sample of 176 banks operating in 15 MENA countries over the period

1999-2020, while considering the existing institutional quality and governance level.

The findings of our study indicate that banks' credit supply expansion decisions are influenced by a variety of factors. First and foremost, these decisions are determined by specific bank characteristics, including bank profitability, liquidity, size, stability, risk, market power, and bank capitalization level. Additionally, bank lending is greatly affected by macroeconomic and demand parameters, such as the growth in GDP per capita and inflation rates. Moreover, bank lending behavior is influenced by the country's institutional quality, as measured by corruption control, political stability, and the rule of law. Firstly, an increase in the bank's capital ratio reduces the growth of its credit supply. The implementation of higher capital standard requirements, in particular, negatively affects loan supply growth in MENA banks, validating the existence of the supply-side credit crunch phenomena. According to the descriptive statistics, the MENA region's banking sector appears to be a competitive market with a non-monopolistic nature. The empirical results have shown that lower market power is generally associated with high competition levels, leading to lower amounts of bank credit supply, which supports the idea that a supply-side credit crunch might occur in this area. Secondly, banks' profitability has a positive effect on bank lending behavior, where generating higher profits pushes banks to increase lending in the aim of realizing additional profits. Conversely, banks' efforts to increase liquidity come at the expense of lending. To meet the liquidity minimum requirement implemented under Basel III, MENA countries' banks tend to decrease their credit supply. Additionally, bank size has a positive association with credit supply, as it was found that larger banks may obtain considerable economies of scale and thus increase their credit supply. Finally, regarding the impact of macroeconomic variables, banks tend to increase their credit supply in parallel with economic growth and low inflation rates, which positively affects credit demand. Thirdly, we examine the impact of three institutional variables on loan availability and their interactions with capital requirement enforcement based on the widespread belief that the majority of MENA nations have weak institutional systems and poor governance. The empirical results showed that, where banks continue to extend credit in spite of a more favorable institutional environment, high levels of corruption control, political stability, and rule of law may assist in easing the credit crunch brought on by the introduction of stricter capital requirements. Therefore, the three institutional quality variables encourage the banks under study to increase their credit supply.

8. Recommendations

This research provides valuable empirical evidence for the importance of implementing capital requirements and the quality of the institutional environment on the lending behavior of MENA banks. It establishes a framework for potential future research scenarios and directions concerning these issues. For instance, this study opens the possibility of expanding the models by incorporating additional market risk and credit risk variables. Additional measures, such as including a measure to reflect financial liberalization and financial market development, can be added. In a liberalized financial system, as financial entities are given additional opportunities for taking risks, it is more likely to result in banking crises. According to the finance-growth approach, banks would utilize the decreased funding costs brought on by market expansion to acquire new capital at the lowest possible cost. Moreover, although this study focused on the gross-loans to total-assets ratio as a measure of credit supply, it is acknowledged that this metric might not fully capture the diverse configurations of banks. Therefore, for future research, it is recommended to adopt a more comprehensive perspective on bank credit supply, possibly incorporating indicators such as annual credit growth or total risk-weighted assets. Additionally, considering the distinctive roles of commercial banks, known for their active role in credit provision, and investment banks within the sampled institutions could enhance the depth of analysis.

Furthermore, given the recently expanding body of literature on sustainability within the banking sector, it is recommended to explore the relationship between Economic, Social, and Governance (ESG) ratings and the lending behavior of banks operating in the MENA region. This avenue of inquiry could offer valuable insights into the impact of sustainable practices on lending activities, contributing to a more comprehensive understanding of the multifaceted dynamics in the financial landscape of the region.

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Appendix A

To obtain an individual measure of competition for each year of our time sample, we compute the Lerner index. The Lerner index is used to track market power evolution. According to Iveta (2012), the index is defined as the price difference divided by the marginal cost. It is a level indicator of the proportion of the price that exceeds the marginal cost, and it is calculated as follows:

$$LI_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \tag{1}$$

where P_{it} is the price of banking outputs for bank i at time t,

MC_{it} is the marginal cost for bank i at time t.

For each bank i the resulting LI_{it} is averaged over the study period. P_{it} is the total asset price proxied by the total revenue (interest and noninterest income) to total assets ratio for bank i at time t. The translog cost function Eq. (2) is used to calculate MC_{it}.

The cost function is specified as follows:

$$\ln(TC) = \alpha_0 + \alpha_1 \ln(y) + \frac{1}{2}(\ln(y))^2 + \sum_{j=1}^{3} \beta_j \ln(w_j) + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln(w_j) \ln(w_k) + \sum_{j=1}^{3} \gamma_j \ln(y) \ln(w_j) + \varepsilon \tag{2}$$

where TC is the total costs,

y is the total assets,

$w_{jk}(w_1, w_2, w_3)$ indicate three input prices (i.e. labor, capital and funds).

$w_1$represents the cost of labor, which is the ratio of personnel expenses to total assets; w_2 represents the cost of physical capital, which is the ratio of other non-interest expenses to fixed assets; and $w_3$represents the cost of borrowed funds, which is the ratio of interest expenses to total funds.

Total cost is the sum of personnel costs, non-interest costs, and interest costs. For the sake of simplicity, the indices for each bank have been removed from the equation. The estimated cost function coefficients are then

used to compute the marginal cost. Indeed, because marginal cost is the derivative of total cost to output, the derivative of total cost logarithm to output logarithm is the ratio of marginal cost to total cost multiplied by output. As a result, marginal cost equals the product of the derivative of the logarithm of total cost to output multiplied by total cost to output ratio. Using the cost function specified in Eq. (2), compute the derivative of the logarithm of total cost with respect to logarithm of output. The marginal cost is determined by estimating the cost function. A translog cost function with one output and three input prices is estimated.

The estimated coefficients of the cost function are then used to compute the marginal cost (MC):

$$MC = \frac{TC}{y}\left(\alpha_1 + \alpha_2 \ln(y) + \sum_{j=1}^{3} \gamma_j \ln(w_j)\right) \quad (3)$$

Once the marginal cost and output price are estimated, we can compute the Lerner index for each bank and obtain a direct measure of bank competition. Thus, after estimating equations 2 and 3, we can calculate the Lerner index as in equation 1. The cost function is estimated for each year to allow the cost function coefficients to evolve over time. The cost function is estimated with banks' fixed effects.

It should be noted that the Lerner index does not capture risk premia in bank product and service prices, which breaks down its positive relationship with the size of monopoly rents. It is, however, the only measure of competition computed at the bank level (Berger et al., 2009).

The Lerner index has a value between 0 and 1. When P = MC, the Lerner index is zero, indicating that the firm lacks pricing power. A Lerner index close to one indicates that the firm has a higher price mark-up over marginal costs and thus market power. Consequently, LI=0 indicates perfect competition, whereas LI=1 indicates monopoly. The Lerner index is an inverse measure of competition; a higher Lerner index indicates less competition (Iveta, 2012).

Appendix B

Table 7. The impact of explanatory control variables with Lerner index and NPL ratio on MENA bank lending

	Model I	Model II	Model III	Model IV
Constant	0.562**	0.718***	-0.578 **	0.653***
	-0.214	-0.19	-0.259	-0.112
LAR (-1)	0.765**	0.182	1.207 ***	0.235*
	-0.374	-0.21	-0.434	-0.123
CAR	-0.379**	-0.304***	-0.18**	-0.286***
	-0.144	-0.097	-0.079	-0.072
ROA	-0.272	-0.495	0.145	-0.139
	-0.719	-0.409	-0.799	-0.497
LIQ	-0.487**	-0.569***	-0.349**	-0.536***
	-0.194	-0.153	-0.138	-0.085
SIZE	0.007***	0.009***	0.008***	-0.008***
	-0.002	-0.003	-0.002	-0.002
LERNER	0.163**	0.124 ***	0.119**	0.129***
	-0.063	-0.04	-0.058	-0.025
NPL	0.636**	0.676 ***	0.649	0.713***
	-0.296	-0.241	-0.319	-0.164
GDPC	0.211	0.184	0.038	0.156
	-0.198	-0.19	-0.128	-0.199
INF	-0.001	-0.035*	0.029	-0.079***
	-0.013	-0.02	-0.037	-0.021
COCR		0.066***		
		-0.016		
POLS			0.079***	
			-0.018	
RLAW				0.068***
				-0.011
R-squared	0.934	0.801	0.888	0.816
Durbin-Watson stat	1.896	1.824	1.79	1.947
J-statistic	2.54	0.134	2.129	1.083
Prob(J-statistic)	0.528	0.714	0.145	0.298
Arellano-Bond Serial Correlation Test				
Prob. AR (1)	0	0.001	0.053	0.046

Prob. AR (2)	0.38	0.325	0.228	0.185
Observations	3696	3696	3696	3696

Note: Standard error in parentheses. ***, **, * implies significant at the 1%, 5%, and 10% level respectively.