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Bank-Specific and Macroeconomic Determinants of Bank Liquidity Creation: Evidence from MENA Countries

Abstract: This study measures liquidity creation within a sample of 153 banks operating in 12 Middle Eastern and North African (MENA) countries from 2008 to 2017. We found that these banks created a total of $461.32 billion in liquidity in 2017, approximately 1.51 times the total liquidity created in 2008, mainly driven by commercial banks in Gulf Cooperation Council (GCC) countries. We also conducted an econometric analysis to investigate the internal and external factors affecting bank liquidity creation, applying a Fixed Effects model and the new Method of Moments Quantile Regression (MMQR). The results show that, among bank-specific factors, bank liquidity creation in MENA countries is related to capital, size, bank risk, deposits and profitability whilst market concentration does not appear to play a significant role. Regarding macroeconomic factors, inflation, unemployment, savings and monetary policy explain the variations in bank liquidity creation.

Keywords: bank liquidity creation, bank-specific and macroeconomic determinants, Method of Moments Quantile Regression, MENA region.

JEL Classification: G21, G28, E44, E50.

1. Introduction

According to the modern theory of financial intermediation, banks fulfil two crucial missions in the economy; they create liquidity and transform risks (Bhattacharya & Thakor, 1993). Diamond and Dybvig (1983) define liquidity creation

as the process wherein banks provide liquidity by financing illiquid, long-term assets with short-term liquid liabilities.

Banks can also create liquidity through their off-balance sheet activities such as loan commitments and letters of credit to the customers (Holmstrom & Tirole, 1997; Kashyap, Rajan and Stein, 2002).

In recent years, theoretical and empirical studies on liquidity creation have drawn greater interest. Based on the seminal research of Bryant (1980) and Diamond and Dybvig (1983), Deep and Schaefer (2004) wrote the first empirical paper to develop a methodology that determined the absolute amounts of liquidity created by banks. The authors focused on maturity transformation alone and included on-balance sheet activities. Later on, Berger and Bouwman (2009) built four new measures to proxy bank liquidity creation based on assets, liabilities and equities categories and also included off-balance sheet activities in addition to other measures based on maturity transformation.

The Middle East and North Africa (MENA) region includes oil-exporting countries that benefit from oil revenues mainly constituted of the Gulf Cooperation Council (GCC) countries and oil importers composed by Arab nations in the Near East and North Africa. The financial system of the entire MENA region is bank-based. Despite the numerous reforms undertaken to establish a market-based financial system, banks still play a dominant and crucial role in financing economic activities. Over the past 30 years, MENA countries have witnessed the emergence of Islamic banks, which have grown considerably. Many conventional banks now offer Islamic services through their Islamic windows. Conventional as well as Islamic banks engage in similar asset transformation activities and liquidity creation functions. Therefore, understanding the main internal and external drivers of bank liquidity creation is fundamental to ensure the economic and financial prosperity of the MENA region.

Our study builds on previous research and adds further insights and additional information to the existing body of literature. The aim of our paper is twofold: first, we measure the liquidity creation of 153 banks in 12 MENA countries based on their on- and off-balance sheets for 2008–2017. Using the methodology of Berger and Bouwman (2009), we measure how much liquidity is created. In order to gain deeper insight into the role of banks in the MENA region as liquidity creators, we also analyse how much liquidity is created in non-GCC and GCC countries. Second, to determine the main internal (such as bank-specific variables) and external factors (such as macroeconomic indicators) influencing bank liquidity creation in the MENA region, we develop a multivariate panel regres-

sion using a Fixed Effects (FE) model and a new econometric approach based on the Method of Moments Quantile Regression (MMQR) proposed by Machado and Santos Silva (2019). Unlike the FE model, this approach has the advantage of depicting the full picture of the impact of internal and external factors on bank liquidity creation distribution, taking into account the heterogeneity across banks.

The remainder of this paper is structured as follows. The second section reviews the literature and presents bank-specific and macroeconomic variables affecting bank liquidity creation. The third section outlines the data and methodology. The next sections describe and discuss the empirical results. The final section concludes the paper.

2. Literature review

Banks play a crucial role in sustaining and financing the economy through their liquidity transformation function. The latter is also considered a primary source of banks' vulnerability. The incarnation of the idea behind the role of banks as liquidity transformers finds its origin in the pioneering work of Bryant (1980) and Diamond and Dybvig (1983), in which they stated that banks create liquidity by transforming liquid short-term claims on the liabilities side to illiquid long-term assets on the assets side. Holmstrom and Tirole (1997) and Kashyap et al. (2002) argue that banks also create liquidity through their off-balance sheet activities such as loan commitments and letters of credit to their customers.

Deep and Schaefer (2004) were the first to develop a liquidity transformation measure, known as the "LT gap," linked to the concept of liquidity creation. They calculated it as the ratio of the difference of liquid liabilities and liquid assets, divided by total assets. Nevertheless, the Deep and Schaefer (2004) measure is not considered a complete proxy of bank liquidity creation as it did not include all balance sheet items and exclude off-balance sheet activities (Berger, Molyneux and Wilson, 2015). The second attempt to construct a comprehensive bank liquidity creation measure was undertaken by Berger and Bouwman (2009). They developed four measures: "catfat" and "catnonfat," which classify bank activities by category and include or exclude off-balance-sheet activities; and "matfat" and "matnonfat," which categorize them by maturity and include or exclude off-balance-sheet activities.

After the groundbreaking work of Berger and Bouwman (2009), studies regarding liquidity creation have drawn greater attention. Many of the empirically con-

ducted research have focused mainly on the relationship between bank capital and liquidity creation (Casu, Pietro and Trujillo-Ponce,, 2018; Distinguin, Roulet and Tarazi, 2013; Fu, Lin and Molyneux, 2015; Horváth, Seidler and Weill, 2014; Le, 2018; Lei and Song, 2013; Mazioud Chaabouni, Zouaoui and Ellouz, 2018; Toh, 2019; Umar et al., 2016, 2017).

To the best of our knowledge, few studies have focused on the internal and external factors affecting bank liquidity creation. (Hackethal, Rauch, Steffen and Tyrell, 2010) studied the liquidity creation determinants for German banks over the period of 1997 to 2006 using Berger and Bouwman (2009) and Deep and Schaefer's (2004) methodologies. They found that liquidity creation is strongly and negatively influenced by monetary policy and positively related to economic health. However, the authors did not uncover any influence of bank-specific factors such as performance or size. Umar and Sun (2016) studied the determinants of different types of bank liquidity, namely liquidity creation, funding liquidity and stock market liquidity in BRICS countries from 2002 to 2014. They illustrated that in the case of these emerging economies, bank liquidity creation is influenced by bank-specific variables such as regulatory capital and profitability and macroeconomic variables like monetary policy, unemployment, savings and population.

2.1. Bank capital and liquidity creation

Berger and Bouwman (2009) suggested two opposing points of view concerning the link between bank liquidity creation and capital. The first is known as "financial fragility structure – crowding-out of deposits," which was originally developed by Diamond and Rajan (2001) and Gorton and Winton (2002). This argument posits that bank capital is negatively related to bank liquidity creation. Accordingly, a fragile financial structure can be used as a disciplinary device to promote bank liquidity creation because depositors have the right to make a run on bank if it threatens to withhold its services. Therefore, fragility commits banks to liquidity creation. Also, higher capital may shift investors' funds from liquid deposits to illiquid equities and hence hampers bank liquidity creation function. The second argument, known as "risk absorption," was adapted from Bhattacharya and Thakor (1993), Coval and Thakor (2005) and Repullo (2004); it suggests that bank capital positively affects bank liquidity creation. Liquidity creation implies more illiquid and risky assets, but capital may be used to absorb risks. Therefore, holding high capital ratios may allow banks to create more liquidity for the economy.

2.2. Bank size and liquidity creation

There are two strands of literature regarding the effect of bank size on liquidity creation. First, Berger and Bouwman (2009) claimed that large banks are able to provide loans to small investors at low costs, which leads them to attract additional investors and therefore expand lending activities. In addition, Distinguin et al. argue that because of their "too big to fail" position, large banks will be encouraged to create higher amounts of liquidity for the economy by investing in risky and illiquid assets. Furthermore, they claim that large banks tend to create more liquidity compared to small banks because of their ability to more easily access the lender of last resort. The second strand of literature suggests that small banks tend to create more liquidity relative to their total assets because they have a comparative advantage over large banks in dealing more with entrepreneurial small businesses by using more flexible techniques to evaluate credit based primarily on soft qualitative information (Berger & Black, 2011).

2.3. Bank risk and liquidity creation

As suggested by Zheng, (Wai Kong) Cheung and Cronje (2019), there are two opposing views regarding the relationship of bank failure risk and liquidity creation. The first argument states that liquidity creation is associated with higher exposure to illiquidity risk, and that therefore, the more banks create liquidity, the higher their likelihood of failure (Allen and Santomero, 1998; Diamond & Dybvig, 1983; Allen and Gale, 2004). The second view stresses that, since liquidity is considered one of the main raisons *d'être of banks*, through which they finance and support the economy by transforming the maturities of assets and liabilities, a decrease in liquidity creation could be perceived as an alarming signal of a bank's soundness (Chatterjee, 2018; Fungáčová & Weill, 2013). Hence, a decrease in liquidity creation may be associated negatively with bank risk failure.

2.4. Bank deposits and liquidity creation

Bank deposits are considered a fundamental component of the liquidity creation process, as the main role of banks is to take deposits from the public and provide financing through loans. Diamond and Rajan (2000, 2001) stated that the main funding sources for small banks are constituted from deposits collected from local residents and corporations. Hence, an increase of bank deposits promotes liquidity creation. Umar, Sun, Shahzad, and Rao (2017) found that the association between bank deposits and bank liquidity creation is insignificant for listed banks in BRICS countries.

2.5. Bank profitability and liquidity creation

The literature lacks consensus on the impact of bank profitability on liquidity creation. Umar et al. (2017) mentioned that the effect of profitability on liquidity creation is ambiguous. The authors pointed out that the ambiguity of this relationship can be explained by two opposing arguments: first, higher profitability is related with higher amount of available funds. Therefore, banks can create higher amount of liquidity. Second, higher profitability may induce higher levels of non-performing loans and lower liquidity creation. Previous empirical studies like Umar & Sun (2016), Umar, Sun, and Majeed (2016) and Umar et al. (2017) found that bank profitability is significantly and positively related to bank liquidity creation. While Berger, Bouwman, Kick, & Schaeck (2016) found that there is a negative relationship between profitability and liquidity creation.

2.6. Market competition and bank liquidity creation

Horvath, Seidler and Weill (2016) have outlined opposing points of view in terms of market competition and the creation of liquidity. The first indicates that higher market competition may reduce banks' profits and lead to a fragile position, which incites banks to use capital to absorb risks. Therefore, banks reduce the amount of granted loans and collected deposits, which hampers bank liquidity creation. This argument is in line with the findings of Jiang, Levine and Lin (2016). The second point of view suggests that increased competition promotes bank liquidity creation by reducing the pricing policies of banks, which incentivizes them to provide loans at attractive prices to their customers. This hypothesis is supported by the findings of Cetorelli & Strahan (2006).

2.7. Economic health and bank liquidity creation

It is important to consider economic health when attempting to capture the effect of variations in economic cycles on bank liquidity creation. Using unemployment rates and average annual savings quotas as proxies for general economic health, Hackethal et al. (2010) illustrated a positive relationship between these macroeconomic variables and liquidity creation, suggesting that banks create more liquidity in times of an expanding economy. It is undeniable that during periods of economic euphoria the demand for loans increases and credit risk decreases. In contrast, during economic recessions, the quality of credit deteriorates, which discourages banks from granting more loans, thus negatively influencing their

liquidity creation function (Levine, Zervos and Levine, 2008). In a recent study, Berger and Sedunov (2017) argued that bank liquidity creation has significant positive effects that are statistically and economically related to real economic output.

2.8. Monetary policy and bank liquidity creation

Berger and Bouwman (2017) have maintained that monetary policy may influence bank liquidity creation in both on- and off-balance sheets. Indeed, a loose (tight) monetary policy may increase (decrease) bank loans as well as deposits, which can positively (negatively) affect bank liquidity creation. Hackethal et al. (2010) found a highly significant negative association between monetary policy and bank liquidity creation. Consistent with this finding, Casu et al. (2018) illustrated that monetary policy is negatively related to bank liquidity creation in Eurozone banks.

3. Data and methodology

To conduct this research, data of the annual on- and off-balance sheets of commercial banks operating in 12 countries in MENA region comprising Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Qatar, Saudi Arabia, Tunisia, and the UAE was collected from the period 2008–2017. Our study sample is based on unbalanced panel data that includes 153 commercial banks, with a total of 1,425 bank-year observations. The bank-specific data were all obtained from the Fitchconnect database; the macroeconomic data were obtained from the World Bank and International Monetary Fund databases.

In order to establish the determinants of bank liquidity creation in the MENA region, this study uses catfat and catnonfat measures normalized by total assets as dependent variables. Internal factors such as bank-specific variables, and external factors like macroeconomic variables, have been used as independent variables.

3.1. The construction of bank liquidity creation measures

We construct two alternative measures of bank liquidity creation based on the three-step methodology of Berger and Bouwman (2009). First, we classify all on- and off-balance sheet activities as liquid, semi-liquid or illiquid based on the ease,

cost and time needed for the bank to meet its liquidity obligations and demands[1]. Second, we follow the theory regarding the creation or destruction of liquidity by assigning a weight of $\frac{1}{2}$, 0 or $-\frac{1}{2}$ to each classified activity. Hence, since banks create liquidity for the economy by financing illiquid assets (e.g., commercial loans) with liquid liabilities (e.g., deposits), illiquid assets and liquid liabilities are assigned a weight of $\frac{1}{2}$. Similarly, illiquid liabilities (e.g., equities) and liquid assets (e.g., cash) are weighted $-\frac{1}{2}$ because banks destroy liquidity by financing liquid assets with illiquid liabilities. Semi-liquid assets and liabilities are assigned a 0 weight. Third, we combine all the classified and weighted items to construct two liquidity measures: the first includes on- and off-balance-sheet activities "catfat," and the other excludes off-balance sheets items "catnonfat." Thus, catfat and catnonfat measures are calculated as:

$$\text{catfat} = \frac{1}{2} \times (\text{Illiquid assets} + \text{liquid liabalities} + \text{illiquid OBS activities}) + 0 \times (\text{semiliquid assets} + \text{semiliquid liabilities} + \text{semiliquid OBS activities}) - \frac{1}{2} \times (\text{liquid assets} + \text{illiquid liabilities} + \text{equities} + \text{liquid OBS activities})$$

$$\text{catnonfat} = \frac{1}{2} \times (\text{Illiquid assets} + \text{liquid liabalities}) + 0 \times (\text{semiliquid assets} + \text{semiliquid liabilities}) - \frac{1}{2} \times (\text{liquid assets} + \text{illiquid liabilities} + \text{equities})$$

3.2. Bank liquidity creation in the MENA region

Graph 1 and Table 1 illustrate the evolution of bank liquidity creation in terms of aggregated volume. We observe that banks in the MENA region created $3.68 tr of liquidity throughout the sample period when using the catfat measure. Bank liquidity creation expanded strongly across the sample: it increased by 51% from $304.53 bn in 2008 to $461.32 bn in 2017. While using the catnonfat measure, these banks created $2.38 tr during the entire sample period, increasing 43% from $194.41 bn in 2008 to $278.1 bn in 2017. This also demonstrates the importance of the amount of liquidity created from off-balance sheet activities ($1.299 tr). When analysing bank liquidity creation in GCC and non-GCC countries (Table 1), we observe that the banks in GCC countries are the largest contributors ($2.739 tr) to the aggregated liquidity creation in the MENA region, while banks in non-GCC countries created $946.96 bn during the sample period.

[1] The on- and off-balance sheets activities classification is not presented to save space, but is available upon request.

Table 1: Aggregated bank liquidity creation in the MENA region

	Total assets (bn$)	Catfat (bn$)	Catnonfat (bn$)	CATTA	CATNONTA
All MENA region	18391.22	3686.81	2388.24	0.17	0.11
Non-GCC banks	7278.13	946.96	514.49	0.15	0.08
GCC banks	11113.09	2739.85	1873.75	0.24	0.15

Note: Authors' elaboration.

4. Econometric model specifications

In order to study the main internal and external drivers influencing bank liquidity creation in the MENA region, a multivariate regression model is developed and expressed as follows:

$$LC = \int(Bank - specific\ variables; Macroeconomic\ variables) \quad (1)$$

Our regression framework uses two specifications: each model contains the same 12 independent variables with two different dependent variables, namely CATTA and CATNONTA. Table 2 presents the definition of all variables used in this study. The model is formulated as follows:

$$Y_{it} = \alpha + \beta.(X)_{it} + \varepsilon_{it} \quad (2)$$

where Y_{it} designates the dependent variable, $i = 1, \ldots, I; t = 1, \ldots, T$, α indicates the intercept term, β indicates a k-vector of coefficients to be estimated and $(X)_{it}$ is the k-vector of independent variables.

5. Empirical findings

5.1. Descriptive statistics and multicollinearity test

Table 3 presents descriptive statistics for the dependent and independent variables used in this study. Table 4 reveals the correlations between the dependent and independent variables. The results demonstrate that there is no correlation above 0.7 between independent variables. Table 4 also illustrates the variance inflation factor (VIF) and shows that there is no multicollinearity problem because all VIF values fall below five (Hair, Black, Babin & Anderson, 2019).

Table 2: Definition of dependent and independent variables

Variables	Acronyms	Measure	Prior studies	Data sources
Bank liquidity creation	CATTA CATNONTA	$\frac{\text{Catfat}}{\text{Total assets}}$ $\frac{\text{Catnonfat}}{\text{Total Asset}}$	(Alaoui Mdaghri, 2021; Berger & Bouwman, 2009; Fu et al., 2015; Hackethal et al., 2010; Le, 2018; Lei & Song, 2013; Umar et al., 2016)	Authors' Calculations using Fitchconnect data
Bank capital	CAP	$\frac{\text{Total equities}}{\text{Total Assets}}$	(Abbas & Younas, 2021; Berger & Bouwman, 2009; Casu et al., 2018; Fu et al., 2015; Horváth et al., 2014; Le, 2018; Lei & Song, 2013; Mashamba, 2022; Toh, 2019; Umar et al., 2016)	Authors' Calculations using Fitchconnect data
Size	SIZE	Natural logarithm of total assets	(Berger & Bouwman, 2009; Fu et al., 2015; Hackethal et al., 2010; Le, 2018; Lei & Song, 2013; Umar et al., 2016)	Authors' Calculations using Fitchconnect data
Bank risk	ZSCORE[2]	$\text{Zscore} = \frac{\text{ROA} + \text{CAP}}{\sigma(\text{ROA})}$	(Berger & Bouwman, 2009; Fu et al., 2015; Umar et al., 2016; Umar & Sun, 2016)	Authors' Calculations using Fitchconnect data
Deposits	DEP	$\frac{\text{Deposits}}{\text{Total Assets}}$	(Alaoui Mdaghri & Oubdi, 2021; Lei & Song, 2013; Umar et al., 2017)	Authors' Calculations using Fitchconnect data
Profitability	ROE ROA	$\text{ROE} = \frac{\text{Net profit}}{\text{Total equities}}$ $\text{ROA} = \frac{\text{Net profit}}{\text{Total assets}}$	(Hackethal et al., 2010; Karaduić & Crossed D Signalović, 2021; Lei & Song, 2013; Mazioud Chaabouni et al., 2018; Umar et al., 2016, 2017)	Authors' Calculations using Fitchconnect data
Market concentration (Hirschman-Herfindahl Index)[3]	HHI	$\text{HHI} = \sum_{i=1}^{n} \left(\frac{\sum \text{Deposits}_{it}}{\sum \text{Market deposits}_{t}}\right)^2$	(Berger & Bouwman, 2009; Fu et al., 2015; Hackethal et al., 2010; Lei & Song, 2013)	Authors' Calculations using Fitchconnect data
Economic growth	GDP	Annual real GDP growth rate	(Berger & Bouwman, 2009; Casu et al., 2018; Fu et al., 2015; Umar et al., 2016)	World Bank data
Inflation	INF	Annual inflation rate	(Horváth et al., 2014; Umar & Sun, 2016)	World Bank data
Unemployment	UNEMP	Annual unemployment rate	(Casu et al., 2018; Hackethal et al., 2010; Horváth et al., 2014; Umar & Sun, 2016)	World Bank data
Gross savings	SAV	Annual gross savings (% GDP)	(Hackethal et al., 2010; Umar et al., 2016; Umar & Sun, 2016)	World Bank data
Monetary policy	INTERATE	Central Bank Policy Rate	(Casu et al., 2018; Hackethal et al., 2010)	IMF data

[2] ZSCORE measures the distance to default. A higher ZSCORE level indicates a low bank risk level. σ(ROA) is the standard deviation of ROA over each bank's whole sample.

[3] A market is considered highly concentrated when HHI>0.18 and unconcentrated when HHI<0.1. A lower concentration designates higher market competition.

Table 3: Descriptive statistics for all variables

Variable	OBS	Mean	Std. Dev.	Minimum	Maximum
CATTA	1425	0.17	0.28	-0.92	0.97
CATNONTA	1425	0.11	0.25	-0.92	0.79
CAP	1425	0.13	0.09	-0.05	0.95
SIZE	1425	22.31	1.48	17.84	26.13
ZSCORE	1425	41.38	37.28	-4.35	292.33
ROE	1425	0.11	0.15	-2.26	1.29
ROA	1425	0.01	0.02	-0.11	0.17
DEP	1425	0.70	0.15	0.003	0.96
HHI	1425	0.20	0.11	0.09	0.58
GDP	1425	0.03	0.10	-0.62	1.23
UNEMP	1425	0.09	0.05	0.001	0.19
INF	1425	0.04	0.09	-0.26	0.23
SAV	1425	0.26	0.19	-0.25	0.78
INTERATE	1425	0.05	0.04	0.00	0.19

Note: Authors' elaboration.

Graph 1: Bank liquidity creation in the MENA region

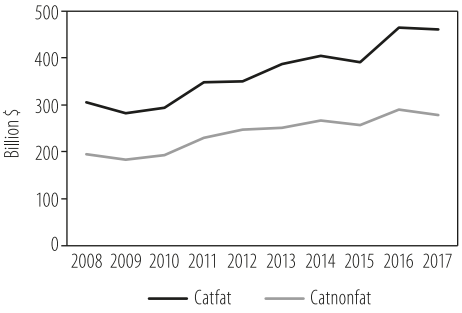

Table 4: Correlation matrix and VIF indicator

Variables	CATTA	CATNONTA	CAP	SIZE	ZSCORE	DEP	ROE	ROA	HHI	GDP	UNEMP	INF	SAV	INTERATE
CATTA	1.00													
CATNONTA	0.94	1.00												
CAP	-0.10	-0.16	1.00											
SIZE	0.07	0.10	-0.38	1.00										
ZSCORE	-0.18	-0.18	0.13	0.19	1.00									
DEP	-0.05	0.02	-0.68	0.25	-0.04	1.00								
ROE	-0.04	-0.04	-0.06	0.16	0.07	0.12	1.00							
ROA	0.07	0.03	0.28	0.00	0.07	-0.18	0.56	1.00						
HHI	0.01	-0.06	0.23	0.04	0.02	-0.39	-0.03	0.09	1.00					
GDP	-0.03	-0.02	0.00	0.01	-0.00	0.01	0.03	0.04	0.06	1.00				
UNEMP	0.07	0.07	-0.12	-0.34	-0.16	0.16	-0.05	-0.15	-0.24	-0.02	1.00			
INF	-0.11	-0.10	-0.06	-0.10	-0.09	0.14	0.07	0.01	-0.10	0.13	0.18	1.00		
SAV	0.35	0.29	0.29	0.26	0.03	-0.35	-0.02	0.15	0.36	-0.05	-0.42	-0.10	1.00	
INTERATE	-0.44	-0.40	-0.28	-0.17	-0.14	0.43	0.19	-0.03	-0.36	0.02	0.25	0.37	-0.62	1.00
VIF (1.73)	-	-	2.46	1.76	1.15	2.34	1.70	1.74	1.32	1.04	1.41	1.26	2.24	2.31

Note: Authors' elaboration.

5.2. Regression results

5.2.1. Bank liquidity creation determinants in MENA countries

In order to determine the internal and external factors affecting bank liquidity creation, a panel data regression analysis is used to estimate the equation. We run the Hausman test to decide between the more appropriate estimation method (fixed effects or random effects). The results reject the null hypothesis (p-value=0.000<5%), which means that the fixed effects model is more suitable for our study. Table 5 represents the fixed effects model results for the determinants of bank liquidity creation in MENA region countries using CATTA and CATNONTA as dependent variables in columns 1 and 2, respectively.

Regarding internal factors, bank capital (CAP) has a negative and significant effect (at the 1% level) on bank liquidity creation (CATTA and CATNONTA), supporting the "financial fragility structure – crowding-out of deposits" hypothesis of D. W. Diamond and Rajan (2001) and Gorton and Winton (2002). This indicates that an increase in a bank's capital may hamper liquidity creation in the MENA region. Hence, tighter capital requirements may lead to more stringent scoring and screening for borrowers, which results in more credit rationing and therefore a reduction in the liquidity created. This finding is consistent with a number of studies (Fu et al., 2015; Horváth et al., 2014; Lei & Song, 2013; Umar & Sun, 2016). On the other hand, bank size (SIZE) negatively and significantly affects bank liquidity creation (at the 1% level), showing that small banks in the MENA region create more liquidity per total assets than larger banks. This result is supported by Fu et al. (2015), Le (2018), Lei and Song (2013) and Toh (2019) and suits the assumption that small banks deal more with entrepreneurial small businesses using "soft" qualitative information. Consistent with the findings of Berger and Bouwman (2009) and Umar and Sun (2016), we observe that bank risk (ZSCORE) has a positive and significant impact on bank liquidity creation (at the 1% level), suggesting that banks with lower risk create more liquidity. This finding indicates that soundness and stability is fundamental for banks to function well and ensure their liquidity creation for the economy. We found that bank deposits (DEP) have a positive and significant relationship with bank liquidity creation (at the 10% and 1% for CATTA and CATNONTA, respectively), demonstrating that the more banks collect deposits, the more they create liquidity, which is inconsistent with Umar et al. (2017). It is understandable that liquidity creation depends on deposits since the former is the process by which banks transform liquid liabilities (e.g., deposits) to illiquid assets (e.g., commercial loans), thus an increase in collected deposits will promote liquidity creation. In line with Berger et al. (2016), we observe a significantly negative coefficient on return on equity

(ROE) for both CATTA and CATNONTA (at the 10% and 5% level, respectively), indicating that an increase in ROE hampers bank liquidity creation. Whereas we find a positive and significant (at the 5% level) impact of (ROA) on CATNONTA alone, which means that an augmentation of ROA may help banks to create more liquidity for the economy. This finding is consistent with Fu et al. (2015) and Umar et al. (2017). However, the coefficient on the market concentration (HHI) is insignificant in both models.

Table 5: Determinants of bank liquidity creation in the MENA region

Bank liquidity creation	CATTA	CATNONTA
Bank-specific variables		
CAP	-1.4242*** (0.2557)	-1.2091*** (0.1919)
SIZE	-0.0891*** (0.0332)	-0.0887*** (0.0289)
ZSCORE	0.0031*** (0.0008)	0.0024*** (0.0005)
DEP	0.2065* (0.1208)	0.2389*** (0.0907)
ROE	-0.0890* (0.0463)	-0.0832** (0.0343)
ROA	1.2839 (0.7869)	1.2314** (0.5618)
HHI	1.7946 (1.2899)	1.0210 (1.0214)
Macroeconomic variables		
GDP	-0.0436 (0.0577)	0.0105 (0.0271)
INF	0.0030 (0.0579)	-0.0848** (0.0370)
UNEMP	-1.3571** (0.5604)	-1.3529** (0.5200)
SAV	-0.1613* (0.0920)	-0.0960* (0.0520)
INTERATE	-0.6809 (0.4143)	-0.7133* (0.3730)
Constant	1.9168** (0.8574)	1.9769*** (0.7285)
Observations	1425	1425
R-squared	0.1739	0.1969
Year Dummies	YES	YES
Hausman Test (p-value)	0.0000	0.0000

Notes: The dependent variable is CATTA in column 1 and CATNONTA in column 2. Standard errors are in parentheses and adjusted for heteroskedasticity and clustered at the bank level. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Among external determinants, inflation (INF) has a negative and significant impact on bank liquidity creation (for CATNONTA only), supporting the finding of Umar and Sun (2016). Indeed, periods of high inflation could negatively impact the whole macroeconomic environment and, therefore, negatively impact the ability of banks to create liquidity. Furthermore, the coefficients of unemployment (UNEMP) are significantly negative for both bank liquidity creation measures, suggesting that rising unemployment rates may hinder the liquidity function of banks in MENA countries. This finding signifies that an increase in the unemployment rate could be synonymous with the deterioration of global economic health since a decrease in economic activity would correlate to a lessening of investments that trigger loan demands, therefore hampering the bank liquidity creation function. Our result is in line with multiple studies (Casu et al., 2018; Hackethal et al., 2010; Horváth et al., 2014). Surprisingly, we found that gross savings (SAV) is negatively related to bank liquidity creation for both models. This finding means that, in the short run, an increase of national savings is accompanied by a decrease in the consumption spending of economic units. However, a reduction in national consumption indicates a difficult macroeconomic period, where investments decrease and the demand for credits shrinks, thus impacting the function of bank liquidity creation. Finally, monetary policy appears to negatively affect bank liquidity creation in the second model (catnonfat), suggesting that a tighter monetary policy of central banks in MENA countries would impede commercial banks' ability to create liquidity. Since higher monetary policy rates mean that refinancing would be costly, banks adjust downward accordingly in terms of the amount of liquidity created in the economy. This finding is also supported by Casu et al. (2018) and Hackethal et al. (2010). Therefore, we assume that bank liquidity creation is related to economic health in MENA region countries.

5.2.2. Method of Moments Quantile Regression

Our study performs an additional analysis in order to gain a deeper understanding of the main determinants of bank liquidity creation. We employ quantile regressions (QR) developed initially by Koenker and Bassett (1978). This approach is an extension of the ordinary least squares (OLS) estimation. It offers a comprehensive strategy for completing the traditional regression picture by providing more precise and accurate results (Koenker, 2005).

QR allows for the observation of the different effects of independent variables (i.e., internal and external factors) on the entire conditional distribution of the dependent variable (i.e., bank liquidity creation) by fragmenting it into segments.

However, traditional QR does not consider unobserved heterogeneity across individuals within a panel. Therefore, the MMQR introduced by Machado and Santos Silva (2019) is implemented to account for heterogeneity and distributional heterogeneity. The advantage of this approach is that it allows us to determine the influence of internal and external factors on bank liquidity creation at different quantiles, taking into consideration the heterogeneous covariance effects. The MMQR approach is perfectly suitable in the case of a panel data model with fixed effects. Following Machado and Santos Silva (2019), the conditional quantile fixed effects estimator of Y, $Q_Y(\tau|X)$ for a model of location-scale is given by the following equation:

$$Y_{it} = \alpha_i + X'_{it}.\beta + (\delta_i + Z'_{it}\gamma)U_{it} \quad (3)$$

where Y is the dependent variable (bank liquidity creation) and X represents a vector of independent variables (internal and external factors). The probability $P\{\delta_i + Z'_{it}\gamma > 0\} = 1.(\alpha_i, \delta_i), i = 1, \ldots, n$ indicates the individual i (bank) fixed effects Z is a k-vector of known differentiable transformations of the components of X. β represents the vector of parameters to estimates, varying on different quantile τ from 0 to 1 of Y. U_{it} is independently and identically distributed (i.i.d.) across bank i and through time t, statistically independent of X_{it} and normalized to satisfy the moment conditions: $E(U) = 0$, $E(|U|) = 1$. From the equation (3) we thus specify the conditional quantile function as follows:

$$Q_Y(\tau|X_{it}) = (\alpha_i + \delta_i q(\tau)) + X'_{it}.\beta + Z'_{it}\gamma q(\tau) \quad (4)$$

where X'_{it} indicates a vector of independent variables which in our study are the internal and external factors. $Q_Y(\tau|X_{it})$ designates the quantile distribution τ of the dependent variable Y, which is bank liquidity creation. $\alpha_i(\tau) = \alpha_i + \delta_i q(\tau)$ $q(\tau)$ is the τ^{th} quantile fixed effect for bank i. $q(\tau)$ denotes the τ^{th} sample quantile.

In order to estimate the equation, we implement the technique developed by Machado and Santos Silva (2019) by using the xtqreg command on Stata 15. Table 6 lists the panel quantile estimation results of the internal and external drivers of bank liquidity creation at different quantiles.

Table 6: Panel quantile estimation results for CATTA and CATNONTA using MMQR approach

	CATTA			CATNONTA		
	Q.25%	Q.50%	Q.75%	Q.25%	Q.50%	Q.75%
Bank-specific variables						
CAP	-1.3906***	-1.3725***	-1.3906***	-1.1584***	-1.1390***	-1.1282***
	(0.2852)	(0.2518)	(0.2852)	(0.2129)	(0.1362)	(0.1641)
SIZE	-0.0381	-0.0642***	-0.0381	-0.0158	-0.0526***	-0.0730***
	(0.0268)	(0.0237)	(0.0268)	(0.0212)	(0.0137)	(0.0164)
ZSCORE	0.0034***	0.0032***	0.0034***	0.0028***	0.0025***	0.0024***
	(0.0009)	(0.0008)	(0.0009)	(0.0007)	(0.0004)	(0.0005)
DEP	0.2139	0.2272*	0.2139	0.2692***	0.2608***	0.2562***
	(0.1504)	(0.1328)	(0.1504)	(0.0997)	(0.0638)	(0.0768)
ROE	-0.1285**	-0.0965*	-0.1285**	-0.1143**	-0.0869***	-0.0717**
	(0.0562)	(0.0497)	(0.0562)	(0.0469)	(0.0301)	(0.0362)
ROA	1.6666**	1.3290*	1.6666**	1.5587**	1.2225***	1.0366**
	(0.8125)	(0.7176)	(0.8125)	(0.6241)	(0.3998)	(0.4812)
HHI	1.4638	1.6190	1.4638	0.6126	0.7489	0.8243
	(1.3728)	(1.2121)	(1.3728)	(0.9344)	(0.5977)	(0.7202)
Macroeconomic variables						
GDP	-0.0519	-0.0541	-0.0519	-0.0462	-0.0012	0.0237
	(0.1069)	(0.0944)	(0.1069)	(0.0628)	(0.0402)	(0.0484)
INF	0.0405	0.0897	0.0405	-0.0061	0.0118	0.0216
	(0.0932)	(0.0823)	(0.0932)	(0.0579)	(0.0371)	(0.0447)
UNEMP	-0.5805	-0.8609*	-0.5805	-0.5459	-0.8376***	-0.9989***
	(0.5696)	(0.5030)	(0.5696)	(0.4853)	(0.3109)	(0.3742)
SAV	-0.2520**	-0.1718*	-0.2520**	-0.1715***	-0.1308***	-0.1083**
	(0.1105)	(0.0976)	(0.1105)	(0.0582)	(0.0373)	(0.0449)
INTERATE	-0.6235	-0.6118	-0.6235	-0.2822	-0.4181*	-0.4933*
	(0.4401)	(0.3885)	(0.4401)	(0.3510)	(0.2246)	(0.2705)

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

As we can see in Table 6, the MMQR approach provides a more comprehensive picture of the relationship between the internal and external factors affecting bank liquidity creation. In comparison with the OLS fixed effects (FE) estimates in Table 5, the results are similar for the coefficients' signs but differ in terms of significance. Regarding internal factors, using CATTA as a dependent variable, we found that bank capital has a significant and negative association with bank liquidity creation across all quantiles. According to OLS FE, bank size negatively and significantly impacts bank liquidity creation, which is consistent with MMQR estimates for only the 50% quantile. As with OLS FE, the associa-

tion between bank risk and liquidity creation is positive and significant for the whole distribution, whereas the deposits ratio is positive and significant only for the 25th percentile. MMQR finds similar and significant results for ROE for the quantiles 25%, 50% and 75%.

Interestingly, the results derived from MMQR indicate a negative and significant of ROA on liquidity creation all quantiles, whereas this association is insignificant for the OLS FE estimates. In terms of external factors, the relationship between unemployment and bank liquidity creation remains negative but significant only in terms of the 50% quantile. Similarly, gross savings negatively and significantly affect bank liquidity creation for all quantiles. When using CATNONTA as a dependent variable, we observe that the results remain similar to the OLS FE estimates and CATTA model in terms of the signs of the parameters, but vary in terms of significance especially for bank size, bank profitability, unemployment, gross savings and monetary policy.

6. Conclusion

This study analyses the liquidity creation of 153 banks operating in 12 MENA countries and examines the main internal (bank-specific factors) and external (macroeconomic factors) drivers of bank liquidity creation over the 2008–2017 period. To do so, this research has used two technical regression analyses: the fixed effects regression model and the new econometric approach MMQR, which was recently developed by Machado and Santos Silva (2019). The findings show that banks in the MENA region created a total of $461.32 billion in liquidity in 2017, approximately 1.51 times the total liquidity created in 2008. This was mainly driven by commercial banks operating in GCC countries.

The results of the regression analyses suggest that in the case of the MENA region, bank liquidity creation is affected either by internal or external factors. With respect to bank-specific factors, capital, size, bank risk, deposits and profitability have a significant effect, while market concentration has no statistically significant effect. Among macroeconomic factors, the findings show that the variation of bank liquidity creation is explained by inflation, unemployment, savings and monetary policy, whereas the annual GDP growth rate has insignificant impact on bank liquidity creation.

This study also carried out an analysis using the new MMQR approach in order to examine the significance of the internal and external determinants across different quantiles of bank liquidity creation. The results demonstrate that bank

capital, bank risk, profitability and gross savings are significant at all percentiles, while other factors significantly impact bank liquidity creation but not overall distribution.

This research has important implications for regulators, policy makers and bank managers. For example, the finding that bank capital negatively impacts liquidity creation means that the implementation of Basel III requirements may reduce the ability of banks to create liquidity. In addition, the positive relationship of bank risk indicates that financial stability could prove to be crucial for bank liquidity creation. Finally, this study fills a gap in the literature by adding new insights and providing new empirical findings regarding the possible influence of internal and external factors of bank liquidity creation in the MENA region.

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