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The liquidity risk-credit risk-profitability trilogy: A comparative study between Islamic and conventional banks

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Abstract

We offer a comparative analysis between Islamic and conventional banks in terms of the effects of credit and liquidity risks on profitability. We firstly compare the relationships between credit risk-liquidity risk-profitability in both banking systems. Employing a simultaneous structural equation approach on a comprehensive dataset of 25 Islamic banks and 49 conventional banks operating in the MENA region over the period 2006-2015 and using financial ratio analysis, we show that credit risk, liquidity risk and profitability have reciprocal relationships within both types of banks. We then examine the effect of liquidity and credit risks on profitability, and find that both risks are detrimental for bank profitability. Nevertheless, our findings reveal that there is no difference between the two types of banks in terms of the effects of credit and liquidity risks on profitability. These results remain robust to alternative estimators. Finanlly, our study allows decision-makers and banks managers to improve the banking performance by effectively managing and controlling levels of both credit and liquidity risks.

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Abstract

The aim of this research is to examine the differences between Islamic and conventional banks in terms of the effect of credit and liquidity risks on profitability. We firstly compare the credit risk-liquidity risk-profitability in both banking systems. Employing a simultaneous structural equation approach on a comprehensive dataset of 25 Islamic banks and 49 conventional banks operating in the MENA region over the 2006-2015 period and using financial ratio analysis, we show that credit risk, liquidity risk and profitability have a reciprocal relationship within both types of banks. We then examine the effect of liquidity and credit risks on profitability, and find that results depend on the financial ratio employed to measure banking performance. Nevertheless, we find there is no difference between the two types of banks in terms of the effect of credit and liquidity risks on profitability. This research allows policymakers and banks managers to better manage the liquidity risk and credit risk and serves as an underpinning for recent regulatory efforts aimed at strengthening the joint risk management of both types of risks.

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1. Introduction

Since the recent financial crisis, everyone knows that bank failure has great adverse effects on real economic activity as it threatens the whole systemic stability. According to Berger and Bouwman (2013), the higher liquidity risk, credit risk, and capital risk of large banks before the crisis were associated with their inferior performance and greater risk during the crisis. Furthermore, economic failures in the MENA region have also strongly been attributed by the Arab Spring (Brisson and Kate 2012), which disrupted the recovery, plummeted the profitability of the financial services industry and hence took a significant toll on economic activity in this region. In this respect, Ghosh (2015) shows that Arab Spring lowered bank profitability and raised the risk. Therefore, exploring the risks that affect bank performance is an important issue for regulatory authorities in order to maintain economic stability, and drive banks to pursue responsible management.

The classic theories of the microeconomics of banking and both industrial organization models of banking, namely the Monti-Klein framework and the financial intermediation perspective of Diamond and Dybvig (1983) and Bryant (1980) show that liquidity and credit risks are closely linked. Nevertheless, these risks are not only the most important risks that banks face, but they are also directly linked to stability, efficiency and performance of banks.

Investigating the relationship between risk and financial profitability in the banking sector allows bankers and policy-makers to identify the reasons behind the fall in earnings, and thus applying more strategies to avoid loss. Consequently, it is very important to understand and distinguish the main determinants of bank profitability by knowing their strength and weakness points. On the other hand, studying the profitability in Islamic banks and conventional banks and its relationship with credit and liquidity risks is imperative because better profitability in banking has positive effects on economy and financial stability.

To that effect, the objectives of this study are twofold. First, we intend to analyze and compare the causality between credit risk-liquidity risk-profitability of Islamic and conventional banks, being two different banking business models. Second, we propose to examine the individually and/or jointly impact of credit and liquidity risks on bank profitability. We chose the MENA region where the banking sector is well integrated into the global financial markets and exposed to the shocks which affect international capital markets. Moreover, the MENA region is characterized by countries where Islamic banks operate alongside and compete with their conventional peers. Our choice to compare the two types of banking system is not arbitrary. Actually, Islamic banks operate in an interest-free system and this is one of the important factors which differentiate them from their conventional counterparts. During the recent financial crisis, Islamic banks have been able to protect themselves against abuses and shocks thanks to their undertaken moral values and a set of ethics. In this context, Khan and Mirakhor (1989) argue that Islamic banks are capable to absorb external shocks as compared to their conventional counterparts and thus have the capacity of adding to the overall economic growth.

Prior studies examined the issue of Islamic bank performance determinants (Sohel Azad et *al.* 2019, and Yanikkaya *et al.* 2018), the effect of liquidity risk or credit risk on bank performance (Adelopo *et al.* 2018, and Laryea *et al.* 2016), the relationship between capital, risk and bank profitability (Bitar *et al.* 2017, Lee and Hsieh 2013, and Tran *et al.* 2016), and the impact of securitization on bank profitability (Bakoush *et al.* 2019). The most previous studies focused on Islamic or conventional banks. To our knowledge, studies on bank risk and profitability carrying out a comparative analysis between the two types of banking system are almost inexistant.

Our current study contributes to the range of previous studies by being conducted in a very special context, i.e. Islamic banks. Moreover, we focus on the impact of financial crisis

and political instability caused by the Arab Spring in 2011 on the risk and profitability behavior of conventional and Islamic banks. Furthermore, most studies focus mainly on the relationship between risk and profitability but no study on the bidirectional relationship between credit risk, liquidity risk and bank profitability using 3SLS, and the individually and/or jointly impact of these risks on bank profitability. Next, to test the effects of both categories of risk on bank profitability, this study uses the GMM method which resolves the problems of potential endogeneity, heteroskedasticity, and autocorrelation problems in the data. Finally, we use the interaction term (credit risk*liquidity risk) which is a new variable as a determinant of bank performance.

The remainder of our study will be organized as follows. Section 2 presents the literature review and hypothesis development. Section 3 describes the data and reserch methodology. Section 4 reports the main results. Section 5 concludes the study.

2. Literature review and hypotheses development

2.1 The liquidity risk-credit risk relationship

According to the financial intermediation theory (Bryant 1980, and Diamond and Dybvig 1983) and the industrial organization approach to banking, which features in the Monti-Klein model of banking organizations (Prisman *et al.* 1986), liquidity risk is related to credit risk.

Islamic banks are similar to conventional banks in their services but the structure of their operations is very different. Consequently, the theory of financial intermediation has also a well established record in Islamic finance. Indeed, financiers (Sarrafs) and conventional banks execute many transactions in the same way but in an informal way for financiers. According to Udovitch (1981), Sarrafs are 'Bankers without Banks'. They were involved in domestic operation and cross border payment system. Therefore, these financial intermediaries succor each other to overcome liquidity shortage. Consequently, basing on the same literature of conventional banks (theory of financial intermediation and Monti-Klein framework), we assume that there is a relationship between liquidity and credit risks in Islamic banks.

A review of the empirical literature reveals few attempts examining the relationship between liquidity risk and credit risk within both banking systems. Hassan *et al.* (2019) are the first who investigate and compare the relationship between credit risk, liquidity risk and stability in both types of banking systems over the period 2007-2015. Using a simultaneous structural equation approach, they find that credit risk and liquidity risk have a negative relationship during the financial crisis period for Islamic banks but a negative relationship between liquidity and credit risks during the post financial crisis not only in Islamic banks but also in conventional banks. This relationship could be due to high or low credit/liquidity risks in banks.

A growing body of literature, especially after the global financial crisis, shows the positive relationship between credit and liquidity risks in conventional banks (Cai and Zhang 2017, and Imbierowicz and Rauch 2014). In this context, Ghenimi et *al.* (2017) examine the relationship between credit and liquidity risks and its impact on bank stability operating in the MENA region over the period 2006-2013. They show that credit risk and liquidity risk are positively linked. This leads us to formulate our first hypotheses:

H 1: Liquidity risk and credit risk are interconnected.
H 2: Liquidity risk is positively related to credit risk.

2.2 The liquidity risk and bank profitability

Kahneman and Tversky (1979) propose the prospect theory which is essentially based on the criticism of the expected utility in decision making under risk. That is, when individuals are confronted with events involving a set of choices, their real responses may not necessarily follow the rational calculation of expected utility on the basis of the objective notion of risk-return (Kahneman and Tversky 2000). They document that participants were generally asked to choose a preferred alternative from a set of choices. In this line, some studies focus on liquidity risk and profitability in conventional banks. For instance, Musiega et *al.* (2017) show that higher liquidity risk appears to have a positive impact on bank performance in Kenya over the period 2006-2016. Adelopo et *al.* (2018) find that least efficient of the examined banks tend to take more liquidity risk. Moreover, Tabari et *al.* (2013) examine the effect of liquidity risk on performance of commercial banks over the period 2003-2010, and show a negative relationship between liquidity risk and banking performance, suggesting that a bank without enough liquidity is not able to obtain the sufficient funds to compensate the needs and demands, and therefore will make lower performance. This result is also obtained by Hakimi and Zaghdoudi (2017) by examining in Tunisian commercial banks.

While Chowdhury and Zaman (2018) assess the effect of liquidity risk on bank performance through a sample of Bangladesh Islamic banks from the period 2012 to 2016. They find a significant and negative relationship between liquidity risk and bank performance. This led us to the following hypotheses:

H 3: Liquidity risk and bank performance are interconnected.
H 4: Liquidity risk is negatively related to bank performance.

2.3- The credit risk and bank profitability

According to the prospect theory, Bowman (1980) examines the risk-return paradox in strategic management and concludes that in the context of underperforming firms, they also have higher risks. In this line, some studies focus on credit risk and bank profitability in conventional banks. For instance, Hakimi *et al.* (2011) reveal that a positive relationship between credit risk and bank profitability indicates that shareholders are looking for larger earnings to compensate higher credit risk. While Noman *et al.* (2015) analyze the effect of credit risk on profitability of 18 Bangladesh banks over the period 2003-2013. Using OLS random effect model, GLS and GMM system, they find a significant and negative relationship between credit risk and bank profitability. Credit risk is thus an imminent determinant of the profitability suggesting that high credit risk reduces profitability and a sound credit risk management is a precondition for ensuring the banking profitability. Similarely, they investigate the effect of NPLs (Non Performing Loans) on bank profitability in Ghanaian over the period 2005-2010 and find a negative relationship between credit risk and profitability.

In the Islamic context, Wasiuzzaman and Tarmizi (2010) examine the impact of bank characteristic and macroeconomic determinants on the profitability of 16 Islamic banks in Malaysia. Using Ordinary Least Squares (OLS) method, they show that asset quality influences negatively the bank profitability. Hence, we propose the following hypotheses:

H 5: Credit risk and bank profitability are interconnected.
H 6: Credit risk is negatively related to bank profitability.

2.4 The jointly influence of credit and liquidity risks on bank profitability

In this section, we report studies which analyze the jointly impact of credit and liquidity risks on banks' default probability. This hypothesis has never been examined for bank profitability concept.

In the context of corporate debt renewal, He and Xiong (2012) find that the deterioration of the market liquidity leads to an interaction between liquidity risk and credit risk. They also show that this interaction leads to the increase of business failure risk. In this same line, Imbierowicz and Rauch (2014) and Acharya and Mora (2013) report that credit and liquidity risks jointly influence the banks' default probability. More recently, Ghenimi et *al.* (2017) investigate the relationship between credit risk and liquidity risk and its impact on bank stability for a sample of 49 banks operating in the MENA region over the period 2006-2013. They show that the interaction between credit and liquidity risks contributes to bank instability. Therefore, the finaly hypothesis is as follows:

H 7: Liquidity risk and credit risk jointly negatively influence the bank profitability.

3. Data and Models

Our sample consists of 74 banks, including 25 Islamic and 49 conventional banks in countries of the MENA region over the period 2006-2015. Our study is based on real data for each bank available in the database of bankscope provided by Bureau Van Dijik and the World Bank development indicators. Table I defines all variables of our study.

Table I- Definition of variables

Variables	Notation	Definition	References	Expected relation (+/-)
Variables used to test the various hypotheses				
Credit risk	CR	Impaired loans to gross loan	Kabir *et al.* (2015)	-
Liquidity risk	LR	1/Liquid assets to total assets ratio	Aydemir and Guloglu (2017)	-
Profitability	PROF			-
	Return on average assets (ROA)	Net income to total assets	Abedifar *et al.* (2013), Iqbal (2012)	
	Return on average equity (ROE)	Net income to equity		-
Control Variables				
Capital Adequacy Ratio	CAR	Equity to total assets	Altunbas et *al.* (2007)	
Size	Size	Natural logarithm of total assets	Chaibi and Ftiti (2015)	
Cost efficiency	CE	Cost to income ratio	Srairi (2019)	
Income diversity	ID	$\frac{\text{Non} - \text{interest income}}{\text{Total operating income}}$	Srairi (2013)	
Loan assets	LA	Net loans to total assets	Kabir et *al.* (2015)	
Dummy variables		Islamic = 1 for Islamic banks and Islamic = 0 for conventional banks.		
Financial crisis	Crisis	Financial crisis: 1 for years 2007, 2008 0 if not.	Ben Salah and Boujelbene (2017)	
Spring	Spring	Spring : binary variable to capture the impact of Arab revolutions: 1 for years 2011, 2012, 2013; 0 if not.		
GDP growth	GDP	GDP Relative real Growth GDP	Munteanu (2012)	
Inflation	INF	Consumer Price Index	Munteanu (2012)	

To test our hypotheses, we firstly employ the structural equation approach through the three stage least squares method (3SLS), taking into account the recent crises factor (crisis and spring) and bank type to test the relationship of liquidity risk, credit risk with bank profitability.

$$PROF_{i,t} = C + \beta_1 PROF_{i,t-1} + \beta_2 CR_{i,t} + \beta_3 LR_{i,t} + \beta_4 Size_{i,t} + \beta_5 CAR_{i,t} + \beta_6 CE_{i,t} + \beta_7 ID_{i,t} + \beta_8 GDP_{i,t} + \beta_9 INF_{i,t} + \beta_{10} Crisis_{i,t} + \beta_{11} Spring_{i,t} + \mathcal{E}_{i,t} \quad (1)$$

$$CR_{i,t} = C + \beta_1 CR_{i,t-1} + \beta_2 PROF_{i,t} + \beta_3 LR_{i,t} + \beta_4 Size_{i,t} + \beta_5 CE_{i,t} + \beta_6 LA_{i,t} + \beta_7 ID_{i,t} + \beta_8 GDP_{i,t} + \beta_9 INF_{i,t} + \beta_{10} Crisis_{i,t} + \beta_{11} Spring_{i,t} + \mathcal{E}_{i,t} \quad (2)$$

$$LR_{i,t} = C + \beta_1 LR_{i,t-1} + \beta_2 PROF_{i,t} + \beta_3 CR_{i,t} + \beta_4 Size_{i,t} + \beta_5 CAR_{i,t} + \beta_6 GDP_{i,t} + \beta_7 INF_{i,t} + \beta_8 Crisis_{i,t} + \beta_9 Spring_{i,t} + \mathcal{E}_{i,t} \quad (3)$$

Secondly, we use the generalized method of moment (GMM) system estimator developed by Blundell and Bond (1998) to test the individual and/or jointly effects of liquidity and credit risks on the bank profitability.

$$PROF_{i,t} = C + \beta_1 PROF_{i,t-1} + \beta_2 CR_{i,t} + \beta_3 LR_{i,t} + \beta_4 CR * LR_{it} + \beta_5 Size_{i,t} + \beta_6 CAR_{i,t} + \beta_7 CE_{i,t} + +\beta_8 ID_{i,t} + \beta_9 GDP_{i,t} + \beta_{10} INF_{i,t} + \beta_{11} Crisis_{i,t} + \beta_{12} Spring_{i,t} + \mathcal{E}_{i,t} \quad (4)$$

4. Results and interpretations

4.1 Descriptive statistics

We employ mean value from descriptive statistics to compare the liquidity risk, credit risk and profitability of Islamic banks with respect to their counterparts. Table II reports descriptive statistics.

The descriptive analysis shows that, for Islamic banks, the mean value of CR is 5.385, LR is 0.057 and CR*LR is 0.611 while for conventional banks, the mean value of CR is 10.342, LR is 0.094 and CR*LR is 0.651, respectively. These results implie that conventional banks have a higher credit and liquidity risks than their Islamic peers, which presumably due to the global financial crisis. The results of Islamic banks are more pronounced, which is better compared to conventional banks. Noteworthy, conventional banks are slightly more profitable compared to Islamic banks. This is can be explained by the fact that the Islamic banks based on Sharia does not use risky assets and all transactions are based on the principle of profit and loss sharing.

Table II- Descriptive statistics

Categories of banks		**Descriptive statistics**				
		CR	**LR**	**CR*LR**	**ROA**	**ROE**
Islamic banks	**Obs.**	250	250	250	250	250
	Mean	5.385	0.057	0.611	1.956	5.709
	S.D.	17.411	0.083	1.436	2.520	16.094
Conventional banks	**Obs.**	490	490	490	490	490
	Mean	10.342	0.094	0.651	1.966	11.116
	S.D.	9.437	0.091	2.200	2.388	25.749

This table explains the descriptive statistics variables used to test the hypotheses of the study within both types of banks. LR is liquidity risk, CR is credit risk, ROE is return on equity and ROA is return on asset.

According to Pearson correlation coefficients of all explanatory variables introduced in our model, we note that given the weak correlation between all variables, there is not a multicollinearity problem[1].

4.2 Credit risk and liquidity risk relationship

In this subsection, we examine the causal relationship between credit and liquidity risks using simultaneous equations. The structure of the products used by Islamic banks is different than their conventional counterparts, so it is likely that credit and liquidity risks have different patterns of relationship.

According to the table below, we find statistically significant negative reciprocal relationship between liquidity and credit risks for Islamic banks. This result could be explained by the fact that these banks are mainly based on the deposits that they receive on the liability side. However, they channelize and park the all deposits en employing disposable sources on the asset side of their balance sheets. Liquidity and credit risks decrease profitability of the bank, which lead to reduce the banking stability. If the credit risk is high, the bank has to decrease liquidity risk and to invest in low yield highly marketable securities at same level of tolerable level of profitability. Conversely, if the credit risk is low, the bank has to increase liquidity risk and to invest in less liquid relatively high yield securities at same level of tolerable profitability. Furthermore, according to Mollah and Zaman (2015), this result is also due to extra Sharia monitoring by the Sharia Supervisory Board which decreases credit risk and attitude of Islamic bank customers who timely honor their commitments (Baele et *al.* 2014). Thus, our first hypothesis, H1, is supported but not hypothesis, H2. Our results are consistent with the findings of Hassan *et al.* (2019) and Imbierowicz and Rauch (2014).

Regarding conventional banks and unlike their Islamic counterparts, we find a statistically significant positive reciprocal relationship between credit and liquidity risks, supporting our hypotheses, H1 and H2, and the findings of Ghenimi et *al.* (2017). This result can be explained by the fact that liquidity deterioration, due to a large number of bad debts, causes bank cannot meet the demand of the depositors and further suffer losses in rolling over its maturing debt.

4.3 Liquidity risk-profitability relationship

Regarding to the conventional banking sector, and on the basis of results mentioned in table III, there is a negative and statistically significant relationship between liquidity risk and profitability measured by ROA and ROE (dependent variable) and liquidity risk (independent variable) with the values (-1.501 and -20.665, respectively) and p-values less than 0.1 (0.053 and 0.055, respectively). This result can be explained by the fact that banks with a greater liquidity risk lack stable and cheap funds, and they have to use liquid assets or more external funding to meet the demand for funding. This result is also explained by the fact that these banks face higher liquidity risk because they shift their portfolio about more profitable assets in order to increase their earnings. However, we observe a positive relationship when liquidity risk is used as dependent variable with the values (0.005 and 0.003, respectively) and p-values less than 0.1 (0.079 and 0.077, respectively). This confirms the reverse causality between the two variables. This result implies that to enjoy more income, banks have to be involved in risk-taking activities which indirectly increases their exposure to long term liquidity risk. These results support our hypotheses, H3 and H4, and consistent with the results of Beck et *al.* (2013) and Effendi and Disman (2017).

[1] Results are available upon request.

Table III- Bank profitability, credit risk and liquidity risk relationship: simultaneous equations

Credit risk, liquidity risk and ROE relationship							Credit risk, liquidity risk and ROA relationship					
	Islamic banks			Conventional banks			Islamic banks			Conventional banks		
Variable	CR	LR	ROE	CR	LR	ROE	CR	LR	ROA	CR	LR	ROA
Constants	-25.579	-0.482^{a}	-11.139	-3.496	-0.553^{a}	60.113^{c}	-23.887	-0.482^{a}	0.512	2.224	-0.563^{a}	7.219^{a}
	(0.318)	(0.001)	(0.715)	(0.787)	(0.000)	(0.065)	(0.358)	(0.001)	(0.915)	(0.864)	(0.000)	(0.002)
CR	-	-0.001^{a}	-0.188^{b}	-	0.002^{a}	-1.037^{a}	-	-0.001^{a}	-0.005^{c}	-	0.002^{a}	-0.096^{a}
		(0.002)	(0.010)		(0.000)	(0.000)		(0.001)	(0.066)		(0.000)	(0.000)
LR	-22.824^{b}	-	-21.266^{c}	15.287^{a}	-	-20.665^{c}	-27.046^{a}	-	-0.968^{c}	14.827^{a}	-	-1.501^{c}
	(0.024)		(0.076)	(0.000)		(0.055)	(0.007)		(0.061)	(0.000)		(0.053)
ROE	-0.141^{a}	0.007^{c}	-	-0.082^{a}	0.003^{c}	-	-	-	-	-	-	-
	(0.008)	(0.055)		(0.000)	(0.077)	-	-	-	-	-	-	-
ROA	-	-	-	-	-	-	-0.129^{c}	0.006		-1.041^{a}	0.005^{c}	-
	-	-	-	-	-	-	(0.079)	(0.801)	-	(0.000)	(0.079)	
Size	1.481	-0.007	5.217^{a}	-1.108^{a}	-0.007	-0.255	0.868	-0.005	0.512^{a}	-1.088^{a}	-0.007	-0.043
	(0.113)	(0.149)	(0.000)	(0.007)	(0.119)	(0.821)	(0.349)	(0.268)	(0.002)	(0.008)	(0.122)	(0.595)
LA	-9.592^{a}	-	-	-0.859	-	-	-9.056^{a}	-		-1.610	-	-
	(0.000)			(0.601)			(0.000)			(0.330)		
ID	3.804^{c}	-	-2.358^{a}	-4.593^{a}	-	-1.313	3.525^{c}	-	-0.312^{a}	-4.298^{a}	-	-0.070
	(0.052)		(0.001)	(0.003)		(0.347)	(0.076)		(0.006)	(0.005)		(0.483)
CE	18.822^{a}	-	-10.730^{a}	-7.699^{a}	-	-17.064^{b}	20.134^{a}	-	-2.200^{a}	-9.455^{a}	-	-1.786^{a}
	(0.000)		(0.004)	(0.003)		(0.037)	(0.000)		(0.000)	(0.000)		(0.002)
CAR	-	0.002^{b}	0.034^{b}	-	-0.001^{a}	1.329^{a}	-	0.001^{b}	0.005^{b}	-	-0.002^{a}	0.160^{a}
		(0.041)	(0.026)		(0.002)	(0.000)		(0.037)	(0.023)		(0.003)	(0.000)
Crisis	1.718	-0.010	5.948	-1.602^{b}	0.003	-4.330^{c}	1.038	-0.006	1.004^{B}	-1.492^{C}	0.003	-0.246
	(0.424)	(0.448)	(0.18)	(0.048)	(0.782)	(0.079)	(0.635)	(0.654)	(0.011)	(0.063)	(0.803)	(0.164)
Spring	-0.630	0.004	-2.596	-0.596	0.010	-1.249	-0.291	0.002	-0.388	-0.587	0.0104	-0.127
	(0.742)	(0.766)	(0.247)	(0.419)	(0.274)	(0.574)	(0.881)	(0.864)	(0.275)	(0.423)	(0.265)	(0.428)
INF	15.002	0.288^{a}	10.191	21.671^{a}	0.323^{a}	-13.562	13.388	0.287^{a}	1.465	21.662^{a}	0.328^{a}	-1.943
	(0.217)	(0.000)	(0.472)	(0.000)	(0.000)	(0.413)	(0.277)	(0.000)	(0.514)	(0.000)	(0.000)	(0.103)
GDP	-0.134	-0.001	-0.049	-0.341^{a}	-0.005	0.072	-0.137	-0.001	0.010	-0.342^{a}	-0.001^{c}	0.014
	(0.394)	(0.236)	(0.800)	(0.000)	(0.101)	(0.727)	(0.391)	(0.292)	(0.746)	(0.000)	(0.091)	(0.339)
R2 test	0.88	-1.21	1.09	1.28	-1.69^{c}	-1.46	0.78	-1.20	1.19	1.14	-1.74^{c}	-2.01
	(0.379)	(0.227)	(0.277)	(0.199)	(0.092)	(0.145)	(0.438)	(0.230)	(0.233)	(0.253)	(0.081)	(0.044)
Hansen J-test	14.75	16.47	22.15	36.12	31.16	41.84^{b}	14.57	12.33	18.51	35.69	31.19	41.98^{b}
	(0.973)	(0.958)	(0.681)	(0.113)	(0.310)	(0.026)	(0.975)	(0.995)	(0.857)	(0.122)	(0.309)	(0.025)
DWH test	41.549 ^{a}	89.71^{a}	105.214^{a}	177.657 ^{a}	198.213^{a}	149.645^{a}	31.309^{a}	69.51 ^{a}	65.214^{a}	187.657^{a}	167.708^{a}	159.345^{a}
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Hansen-test refers to the over-identification test for the restrictions in GMM estimation. AR (2) test is the test of the second-order autocorrelation in first differences. Durbin-Wu-Hausman (DWH) test of the endogeneity. () indicate p-value. a, b, c denote 1%, 5% and 10% significance levels, respectively.

For Islamic banks, we find the same results obtained for conventional banks. This implies that required liquidity may ovoid banks from quick fail or insolvency. To enjoy more profitability, Islamic banks are mainly dependent on investment in illiquid assets which raises the liquidity risk and hence reduces the bank profitability. Moreover, the reverse result implies that the bank can use its good revenue to cover its short-term obligation. Thus, our hypotheses, H3 and H4 are supported but using ROA as independent variable, the hypothesis, H3, is not supported. This result confirms the finding of Iqbal (2012) and Chowdhury and Zaman (2018). Finally, the results suggest the existence of significant simultaneous interdependencies between liquidity risk and profitability for both Islamic banks and conventional banks.

4.4 Credit risk-profitability relationship

Regarding conventional banks, the results exposed in table III reveal well that a statistically significant negative reciprocal relationship prevails between credit risk and bank profitability, using ROA and ROE. The negative reciprocal relationship between credit risk and bank profitability supports our hypotheses, H5 and H6, and is in line with the finding of Chitan (2012), Chaibi and Ftiti (2015) and Kabir *et al.* (2015). This result may be explained by an increase of credit risk suggests greater monitoring efforts, which are likely to lead to a rise in the expenses and, hence, to a further decrease of profitability. This seems to be in line with our expectations providing that profitable banks have better risk management skills. The

reverse result when credit risk is used as dependent variable can be explained by the fact that higer returns decrease the credit risk which means that the growth in lending leads to score better performance and that performance serves as a proxy for the quality of management.

For Islamic banks, according to table III, we find statistically significant and negative reciprocal relationship between credit risk and bank profitability using ROA and ROE, implying that higher credit risk reduces bank profitability. Our finding supports our hypotheses, H5 and H6, and is in line with those of Chaibi and Ftiti (2015) and Trad *et al.* (2017). This could be explained by the fact that information asymmetry between the loan providers and their customers is likely to result into a high credit risk which reduces bank profitability. The reverse result when credit risk is used as dependent variable seems to be in line with our expectations of profitable banks that have better risk management skills. Therefore, our 3SLS findings confirm negative significant simultaneous interdependencies between credit risk and profitability within both banking systems.

4.5 Impact of liquidity and credit risks on bank profitability

In order to test the validity of the instruments, we use the Hansen test for the over-identifying restrictions in the GMM estimation. Results presented in Table IV show that the model is valid and does not suffer from any over-identifying problem and that the non-significance of the AR (2) statistics indicates the consistency of the GMM estimates. In addition, the lagged dependent variable is statistically significant with a positive sign for Islamic banks but negative for conventional banks. Table IV displays values of (0.147, 0.044) and (-0.284, -0.359), respectively, with p-values < 0.1, which proves the dynamic character. Therefore, we validate the choice of a dynamic specification for our model. Results are presented in Table IV below.

First, it seems that the liquidity risk variable has a negative and significatif influence on both measures of dependent variables (ROA and ROE) in Islamic and conventional banks. This result implies that the negative sign of liquidity risk depends on whether or not at times of uncertainty banks decide to diversify their portfolios, which leads to an increase in their liquidity holding to compensate their risks, and hence lower returns (Christos Staikouras *et al.* 2008). These results indicate that the available liquidity may also be channeled into other activities and financial instruments for generating higher profits. This result supports our hypothesis, H4, and the findings of Iqbal (2012) and Beck et *al.* (2013).

Second, credit risk has a negative and highly significant effect on profitability within both banking systems using ROA and ROE. This can be explained by the fact that higher levels of non-performing loans increase the non-payments of credits, which decrease banking income and could even lead to a decrease in bank's profitability. In the other hand, banks become more rigid and more restrictive towards credit distribution when borrowers are unable to fulfil their commitments, which reduce interest revenues and eventually leads to low levels of bank profitability. This result can also be explained by the fact that extra Sharia monitoring on the part of Sharia Supervisory Board reduces credit risk. These results support our hypothesis, H6, and the findings obtained by Trad *et al.* (2017) and Chitan (2012).

Then, the interaction term of the credit risk with the liquidity risk has a significant negative effect on both banking systems' profitability, not supporting our hypothesis, H 7. This negative interaction between credit risk and liquidity risk indicates that the increase of credit risk will decrease the significance effect of liquidity risk on profitability. Likewise, seeing that the impact of liquidity risk on bank profitability is negative, this effect will be less negative with increasing credit risk. As a result, the association between credit risk and liquidity risk will reduce the value of the effect of each risk on profitability.

Table IV- The GMM results

	Conventional banks		Islamic banks	
	ROA	**ROE**	**ROA**	**ROE**
ROA-1	-0.284***		0.147***	
	(0.000)		(0.000)	
ROE-1		-0.359***		0.044***
		(0.000)		(0.000)
LR	-0.737*	-3.836**	-3.686***	-4.695**
	(0.062)	(0.050)	(0.000)	(0.034)
CR	-0.183***	-2.374***	-0.037***	-0.558***
	(0.000)	(0.000)	(0.000)	(0.000)
CR*LR	-0.189***	-3.200***	-0.466***	-0.852***
	(0.000)	(0.000)	(0.000)	(0.001)
Size	-0.096*	-2.199***	0.345***	4.480***
	(0.089)	(0.003)	(0.000)	(0.000)
CAR	0.195***	1.672***	0.0113***	0.066***
	(0.000)	(0.000)	(0.000)	(0.000)
CE	-2.281***	-25.137***	-1.282***	-6.071***
	(0.000)	(0.000)	(0.000)	(0.000)
ID	-0.279***	-4.482***	-0.398***	-3.762***
	(0.000)	(0.000)	(0.000)	(0.000)
INF	0.517	22.730***	-1.850***	9.032**
	(0.128)	(0.000)	(0.000)	(0.030)
GDP	0.002*	0.127***	0.021***	0.040*
	(0.095)	(0.005)	(0.000)	(0.066)
Crisis	-0.470***	-7.083***	0.398	3.316
	(0.000)	(0.000)	(0.930)	(0.402)
Spring	-0.166***	-1.592***	0.094	1.321
	(0.000)	(0.000)	(0.292)	(0.130)
Constant	4.275***	21.759***	6.574***	-5.719
	(0.000)	(0.008)	(0.000)	(0.402)
Obs.	441	441	225	225
Instruments	39	39	39	39
AR (1)-p-value	-2.18 (0.029)	-1.78 (0.075)	-1.74 (0.082)	-1.34 (0.181)
AR(2)-p value	-1.60 (0.109)	-1.25 (0.212)	1.21 (0.227)	1.04 (0.299)
Hansen test–p value	42.03 (0.24)	38.35 (0.56)	17.11 (0.906)	20.08 (0.788)

Notes: LR is liquidity risk, CR is credit risk, CAR is Capital Adequacy Ratio, ROE is Return On Equity, ROA is Return On Asset, CE is cost efficiency, ID is income diversity, FC is financial crisis. Hansen test, if more-identifications restrictions are valid, the null hypothesis is valid. The AR (1) and (2) test of first and second order serial correlation, and the null hypothesis is that there is no serial correlation. *, **, *** indicate 10%, 5% and 1% significance levels, respectively. () indicate p-value

Regarding control variables, Table IV highlights that bank size is negative and statistically significant across all profitability measures for conventional banks and positive for Islamic banks. This implies that Islamic banks have a better position to diversify their investments and asset portfolio, allowing them to reduce risk and thus enhance their profitability. For conventional banks, the negative relationship between bank size and profitability can be explained by the fact that large banks are hard to manage and their growing need for management costs leads to lower profits. This result supports the findings of Akhtar *et al.* (2011) for Islamic banks and those of Tan (2017) for conventional banks.

The capital adequacy ratio has a positive and statistically significant across all measures of profitability for both banking systems. Actually, a high capital adequacy may reduce the borrowing cost and risks, which further enhances bank profitability and, hence improves the investors' confidence level in the bank, allowing them to more invest in stock markets. This result supports the findings of Ouerghi (2014) for conventional banks and those of Choong *et al.* (2012) for Islamic banks.

The income diversity has a negative and significant effect on ROE and ROA within both banking systems, which supports with the findings of Laeven and Levine (2007) and Tan (2017). This result supports that when the level of diversification is higher, the agency problems emerging from financial conglomerates increase in severity, such that the diversification affects negatively the bank profitability.

Cost efficiency appears to be an important determinant of profitability within both types of banks. However the negative effect means that there is a mismanagement of efficiency in expenses since banks pass on part of increased cost to customers and the remaining part to profits. This is in contrast to the results of Mbella and Magloire (2017).

In regards to both Islamic and conventional banking systems, reached results notice that inflation turns out to be positively related to bank profitability except for Islamic banks when ROA is used, the coefficient is not statistically significant. This is consistent with the findings of Wasiuzzaman and Tarmizi (2010) in Malaysian Islamic banks. The negative impact of inflation may indicate that currency collapse helps engender a decrease in deposit volumes which leads to a tightening of credit, and therefore a decrease of bank profitability. For conventional banks, the result can mean that high inflation rate generally leads to higher loan rates, and consequently higher revenues.

The GDP coefficient relevant to both banking systems were revealed to be significantly and positively linked to bank profitability. This implies that if economy grows, the demand for lending increases and the credit quality will be improved and this further leads to an increase of banks' profitability. This result supports the findings of Sufian and Habibullah (2010).

The financial crisis as well as Arab spring has a negative effect on the profitability of conventional banks, confirming the finding of Hamdi *et al.* (2018). This result can be explained by the fact that these crises certainly cause an increase in toxic loans, which prompt the majority of depositors to withdraw their funds, thus led to an inability to repay, a lack of bank liquidity, and hence a decrease in profitability. Note that Islamic banks show a positive effect of financial crises on profitability, but not significant. These results may indicate that Islamic banks are less risky but still able to generate high profits. For this reason, the Islamic products become closely linked to the real economy.

Finally, we follow three stages robustness checks to ensure whether the empirical results remain unchanged. We re-estimate our model firstly by integrating the financial crisis with other independent and control variables and secondly, by integrating the spring with other independent and control variables. Then, we eliminate the GDP, inflation rate, financial crisis and spring from our control variables set. We employ a system-GMM estimator to check the robustness of our results. This method is employed to verify the credit and liquidity risks have influence on the bank profitability. As expected, the findings of these robustness tests further validate our main results. Therefore, the system-GMM estimator supports our previous results obtained by the system-GMM and 3SLS approaches, which suggests that our empirical results are robust.[2]

5. Conclusion

We investigate the effect of liquidity and credit risks on bank profitability using a panel dataset of 25 Islamic banks and 49 conventional banks operating in the MENA region over the period 2006-2015. Using the 3SLS estimator, we find that credit risk-liquidity risk, liquidity risk- profitability, and credit risk-profitability have reciprocal relationships in Islamic and conventional banks. Moreover, using system-GMM, we show that each risk category has a significant impact on bank profitability. We also document that the interaction between both types of risks has a significant impact on bank profitability. In most of the results, no difference between both banking systems was found. The absence of differences between both banking systems can reflect the similarity in terms of practices. Hence, these results reveal that credit and liquidity risks are important in understanding bank profitability. In this sense, a

[2] Robustness test results are available upon request

decrease in liquidity and an increase in credit risk reduce bank profits and leads to instability in banking system. Moreover, we find that the negative interaction term between credit risk and liquidity risk reduces the value of the effect of each risk on profitability.

Our study has many contributions. Firstly, we use the interaction between credit risk and liquidity risk rather than the commonly used one of the two risks as the determinants of profitability in the literature. We argue this choice that the banks are exposed to more credit (liquidity) risk over the business cycles and are received a great deal of attention during the past years as documented in prior literature (Imbierowicz and Rauch 2014, and Ghenimi *et al.* 2017). These terms help us to understand how liquidity (credit) risk affects profitability. Secondly, on the empirical side, this study is the first to use two complementary approachs such as the structural equation approach through 3 stage least squares method (3SLS) and dynamic panel data approach compared to other studies that use the ordinary least squares (OLS) estimator (with fixed and random effects) which has a problem parameter estimates which are bias and inconsistent or potential endogeneity problem. Hence, the advantage of two approachs is to solve these problems. Thirdly, our study is conducted in an important period of time crises. Our period of study began in the year 2006 and ended in the year 2015, taking into account the effect of financial crisis and spring (Arab revolutions). So, taking into account the variability of the credit and liquidity risks in such long periods and its effect on the change of profitability and on the direction of the change seems to be interesting.

Finally, our study also has some recommendations for policymakers, risk managers in banks and regulators. First, it is intended to help bank managers to improve the banking performance by more effectively managing through monitoring the levels of the credit risk and liquidity risk. However, Islamic banks should also launch research and development programs to develop and create Islamic financial markets to resolve the problems of excess liquidity. Second, our results imply that a joint management of liquidity and credit risks in a bank could substantially increase bank profitability. Finally, our results support recent regulatory efforts established by Basel III framework which put more emphasis on the importance of the liquidity risk management.

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