BER www.berjournal.com ISSN: 2619-9491 BUSINESS AND ECONOMICS RESEARCH JOURNAL

Business and Economics Research Journal Vol. 10, No. 1, 2019, pp. 13-26 doi: 10.20409/berj.2019.153

Does Liquidity Matter on Bank Profitability? Evidence from a Nonlinear Framework for a Large Sample

Helmi Hamdi[a], **Abdelaziz Hakimi**[b]

Abstract: *The aim of this paper is to define the optimal level of liquidity and to investigate its impact on the overall bank profitability. To achieve these goals, we use a large sample of 127 countries over the period 2005-2015. The whole sample is divided in two sub-samples. The first covers 46 high income countries and the second includes 81 low and middle income countries. We performed the Panel Smooth Transition Regression (PSTR) as econometric approach. Empirical results show that the optimal level of liquidity that affects bank profitability is 24.18% for high income countries and 40.45% for low and middle income countries. Findings also indicate that credit risk decreases significantly the level of profitability of the two groups of countries.*

Keywords: Liquidity, Bank Profitability, PSTR Model

JEL: G21, C23

Received : 04 September 2018
Revised : 30 October 2018
Accepted : 08 November 2018

Type : Research

1. Introduction

During the past three decades, the world economy has experienced multiple banking, financial and currency crises. According to Laeven and Valencia (2012), 146 banking crises, 218 currency crises, and 66 episodes of sovereign debt crisis and debt restructuring have occurred during the period 1970-2011. Most of the banking crises triggered when banks were unable to meet the depositors and creditors requirements due to shortage of liquidity. The global financial crisis of 2007/2008 was a good example of liquidity shortage that spread out globally, upset the world financial landscape and transformed to a global financial crisis. To stop the financial disaster that triggered in 2008, governments intervened by injecting huge amount of funds to restore financial stability.

The lesson to be learned from the global financial crisis is that the shortage of liquidity by financial institutions leads to disastrous situations. To avoid the recurrence of such crisis, regulators and authorities have introduced new liquidity measures to enhance banks' capital and liquidity positions and ensure the resolvability of financial institutions. The new measures aimed at forcing banks to maintain higher level of liquidity to ensure the sustainability of their operations and to keep the overall banking system sound and safe. Therefore, banks and financial institutions were obliged to improve their risk management strategy in order to reduce excess risk taken. This could be done by for example, holding an appropriate buffer of liquid assets to minimize the risk of a maturity gap between assets and liabilities in their balance sheets by taking into account the opportunity cost of holding a buffer of liquid assets (Diamond & Dybvig, 1983).

The above statements show that liquidity is a crucial factor of risk if it is not managed appropriately. However, liquidity is also seen as a vital channel though which banks earn profit, as liquidity is the main driver

Cite this article as: Hamdi, H., & Hakimi, A. (2019). Does liquidity matter on bank profitability? Evidence from a nonlinear framework for a large sample. *Business and Economics Research Journal,* 10(1), 13-26.

The current issue and archive of this Journal is available at: ***www.berjournal.com***

[a] Assoc. Prof., Aix-Marseille University Cergam, France, helmi_aix@yahoo.fr (ORCID ID: 0000-0002-0056-3685)
[b] Assoc. Prof., University of Jendouba, Faculty of Law, Economics and Management of Jendouba, Tunisia, abdelazizhakimi@yahoo.fr (ORCID ID: 0000-0003-2715-0239)

of investment. In fact, the availability of funds encourages banks to grant credits without embellished requirements. This circuit will in turn fuels the economic activities and improves economic development and growth.

To determine the relationship between liquidity and profitability, we used the PSTR approach as the latest non-linearity technique of the model generations of Threshold Autoregressive (TAR) and the Self-Exciting Threshold Autoregressive (SETAR). The SETAR technique is used in several empirical studies. (Hansen, 1996; Peel & Speight, 1996; Peel & Speight, 1998; Peel & Speight, 2000). A generalized rendition of SETAR model is the Smooth Transition Autoregressive (STAR) model developed by Terasvirta and Anderson (1992), Granger and Terasvirta (1993), and Terasvirta (1994).

The sample used in this study is a panel of 127 countries observed during the period 2005-2015. The whole sample is divided into two sub-samples: the first covers 46 high income countries that we can consider as high income countries and the second one is related to 81 low - middle income countries. Particularly, we are interested in this article to define an optimal threshold of liquidity and how this optimal level can affect bank profitability.

This paper contributes to the existing literature since it defines the threshold of liquidity that may affect bank profitability. This threshold of liquidity can be considered as the novelty of this paper as compared to previous studies. Earlier studies tested only the impact of liquidity and/or liquidity risk on bank profitability. However, nothing was said concerning the threshold of liquidity risk that can affect bank profitability. In this study, we also compare the threshold of liquidity for the two groups of countries as there are strong differences between low- middle income and high income countries especially in bank specifics, regulatory capital, bank strategies, bank practices and risk management. Hence, there is strong need to make comparison when analysing the effect of liquidity on bank profitability.

The remainder of this paper is designed as follows. In section 2, we expose literature review. In section 3, we give an explanation of the data and the methodology used in this paper. Section 4 presents the output and discusses results and section 5 concludes.

2. Literature Review

In modern literature on banking, liquidity is considered as one of the most important determinants of bank profitability and recently, many studies underlined the relationship between liquidity and profitability. However, empirical evidence has provided mixed results. In fact, while some studies have found positive association between liquidity and profitability (Molyneux and Thornton (1992) and Barth et al. (2003)), many others have found a negative relationship (Bourke, 1989; Demirgüç-Kunt & Huizinga, 1999; Kosmidou et al., 2008; Kosmidou, 2008).

For example, to investigate the determinant of bank profitability before, during and after the international financial crisis, Adelopo et al. (2018) have used a sample of 123 commercial banks observed during the period of 1999-2013. This period was divided into three sub-periods. The first one (1999-2006) indicates *pre*-crisis period, the second one (2007-2009) relative to the crisis period and the third one (2010-2013) characterizes the *post*-crisis period. Results of panel data analysis indicate that liquidity risk decreases significantly the bank profitability during the three sub-periods.

Shen et al. (2009) have used an unbalanced panel dataset of commercial banks from 12 advanced countries over the period 1994-2006 to estimate bank liquidity and profitability. Using two-stage least squares (2SLS) estimators, their results show that liquidity has reverse impacts on bank profitability in a market-based financial system. In another study, Bordeleau and Graham (2010) employed an ordinary least squares regression analysis of panel data to study the liquidity-profitability relationship for a sample of Canadian and American banks from 1997 to the end of 2009. Their results find evidence that profitability is improved for banks that hold some liquid assets, however, there is a point at which holding further liquid assets diminishes a banks' profitability, all else equal. For the Jordanian context, Ramadan et al. (2011) examined the relationship between liquidity of 10 local banks and their profitability during the period 2001-

2010. Their empirical results suggest that liquidity is an important determinant of Jordanian bank profitability. They showed that most profitable banks in Jordan also are well capitalized and they have a low risk taking behavior.

Ali Shah et al. (2018) studied the determinants of liquidity for the Pakistani banking sector. They used a sample of 23 banks spanning from 2007 to 2017. An empirical finding indicates that internal factors like bank size, capital adequacy ratio and cost of funds are significantly associated with bank liquidity. The same impact is confirmed for external factors such as GDP and unemployment.

As for the Moroccan context, Ferrouhi (2014) studied the relationship between bank liquidity and profitability. To this end, he used a sample of Moroccan banks observed during the period 2001-2012. Results of panel data analysis show that bank profitability is explained by main bank specifics such as liquidity ratio, size of banks, market share bank capital. Also, some external factors and macroeconomic variables can be considered as key determinants of bank profitability like foreign direct investment, financial crisis and unemployment rate. The study of Osborne et al. (2012) shows that holding high level of liquidity is on the one hand costly for banks and it reduces their profitability. On the one hand, the authors they show that holding high liquidity level is the best way that prevents banks from risk and hence the premium demanded to compensate investors for the costs of bankruptcy.

In a recent study, Pop et al. (2018) investigated the liquidity-threshold effect on non-performing loans. Performing a PSTR model, findings indicate that if the threshold of loans to deposit ratio surpass 95% non-performing loans become more sensitive to management profitability and ownership concentration. Results also indicate that unemployment and budget deficit exert a significant impact however the effect of inflation is less sensitive.

Although most of the available studies have employed a linear framework, the relationship between liquidity and profitability among others, could be nonlinear. In fact, during the past decade, the behavior of economic agents was impacted by high level of uncertainty, economic and financial crises, turmoil and upheavals, information asymmetry and institutional rigidities. In this context, the studies conducted by Neftci (1984) and later on by Terasvirta and Anderson (1992), and Peel (1997) suggested that in an ambiguous environment, economic variables and relations display asymmetry and nonlinear adjustment (Seo, 2004). Therefore, linear models show their incapacity to identify these nonlinear trends, which in turn could lead to misspecification results non-liner techniques have been emerged to resolve these inconsistencies.

Since the seventies, many tools and techniques have been introduced to measure the non-linear relationship between the variables. First, the Markov regime-switching regression was introduced by Quandt (1958) and then Goldfeld and Quandt (1972). The sample in this model is generated from distinct regression equations or regimes for each period. According to Lee and Porter (1982), the switching regression model is appropriate for the study of cartel behavior when there are price wars, as the firms will change from cooperative behavior to non-cooperative behavior. Few years later, the Threshold Autoregressive model (TAR) was developed by Tong (1978) and discussed in detail by Tong and Lim (1980) and Tong (1983) considers that the regime is determined by a given variable relative to a threshold value. The empirical existence of a threshold seems plausible in various economic settings. However, TAR technique was not widely used in the literature due to the lack of a suitable modeling procedure and the inability to identify the threshold variable and estimate the threshold values (Tsay, 1989). In the early nineties, a new generation of nonlinear model called the smooth transition autoregressive (STAR) model developed by Teräsvirta and Anderson, (1992) had received a great deal of intention by scholars since it allows the business cycle indicator to smoothly shift between two distinctive regimes without abruptly jumping between them.

3. Data and Methodology

To investigate the impact of threshold of liquidity on bank profitability, we used bank data for 127 countries over the period 2005-2015. Our data are qualified as country level data. The whole sample is divided in two sub-samples. The first includes 81 low - middle income countries, while the second includes 46 high income countries. Data are collected from the World Bank Database. Based on the possible nonlinear

relationship between liquidity and profitability we specify a PSTR model which is a nonlinear homogenous fixed effect panel model with exogenous regressors. The model is an extension of the PTR model of Hansen (1999) developed González et al. (2005). The theoretical modeling of the PSTR is expressed as follows:

$$y_{i,t} = \mu_i + \beta_0^{'} x_{i,t} + \beta_1^{'} x_{i,t} g\left(liqr_{i,t}, \gamma, c\right) + \varepsilon_{i,t} \quad (1)$$

$i = 1, \ldots, N,$
$t = 1, \ldots, T$

N and *T* represent the cross-section and time dimensions of the panel. $y_{i,t}$ is the dependent variable. u_i refers to the vector of the individual fixed effects and $g\left(liqr_{i,t}, \gamma, c\right)g$ is the function of transition which depends on the transition variable of transition(q_{it}), to the parameter of threshold $(C)$and to the smooth transition parameter (γ). $x_{i,t} = (x_{i,t}^1, \ldots\ldots\ldots, x_{i,t}^k)$ is a vector of kk explanatory variables and where $\varepsilon_{i,t}$ is a random disturbance. $\beta_0$and β_1 indicate respectively the parameter vector of the linear model and the non-linear model. The transition function of the PSTR model$g\left(liqr_{i,t}, \gamma, c\right)g$ allows the system to transit gradually. To well define this transition function, González et al. (2005), like Granger and Teräsvirta (1993), Teräsvirta (1994), and Jansen and Teräsvirta (1996) propose the following logistic form of *m* orders in the equation (2):

$$g\left(liqr_{i,t}, \gamma, c\right) = \left[1 + \exp(-\gamma \prod_{j=1}^{m}\left(liqr_{i,t} - C_j\right)\right]^{-1} \quad (2)$$

Where $\gamma > 0$, $c_1 < \ldots < c_m$ and $c = (c_1 \ldots \ldots c_m)$is a vector of level parameter. γ represents the supposed positive smooth parameter. Ibarra and Trupkin (2011) reported that if γ is very high the PSTR model is considered as a model with two regimes. Hence, the transition function can be written in the equation (3) as follow:

$$y_{i,t} = \mu_i + \beta_0^{'} x_{i,t} + \sum_{j=1}^{m} \beta_j^{'} x_{i,t} g\left(q_{i,t}^j, y_j, c_j\right) + \varepsilon_{i,t} \quad (3)$$

To determine the optimal threshold of liquidity and its impact on bank profitability, we include in our econometric model three variable categories. Some bank specifics such as liquidity risk and credit risk. Bank industry specifics are proxied by bank stability and bank competition. Macroeconomic conditions are proxied by the annual growth of Gross Domestic Product (GDP) and inflation rate (INF)). The nonlinear model can be presented as follows.

$$ROA_{i,t} = \mu_i + \alpha ROA_{i,t-1} + \beta_0^1 LIQ_{i,t} + \beta_0^2 CRISK_{i,t} + \beta_0^3 STAB_{i,t} + \beta_0^4 GDPG_{i,t} + \beta_0^5 inf_{i,t} + \left[\beta_1^0 LIQ_{i,t} + \beta_1^1 CRISK_{i,t} + \beta_1^2 STAB_{i,t} + \beta_1^3 GDPG_{i,t} + \beta_1^4 inf_{i,t} + \beta_1^5 LIQ_{i,t}\right] g\left(LIQ_{i,t}, \gamma, c\right) + \varepsilon_{i,t} \quad (4)$$

Where; ROA refers to the return on Assets and it is calculated as the net profit to total Assets ratio. LIQ is the liquidity measured by the ratio of liquid assets to customer and short-term funding (Kosmidou et al. 2008). In fact, it is worth recalling that there is no standard measure for liquidity or liquidity risk yet. For example, Chen et al (2018), Saunders and Cornett (2006) and DeYoung and Jang (2016) have used the financing gap ratio to measure liquidity risk. Bourke (1989) have used the ratio of liquid assets to total assets as a measure of liquidity risk. The ratio of loans to total assets was used in the studies of Demirgüç-Kunt and Huizinga (1999) and Athanasoglou et al. (2006) as a proxy of liquidity risk. Shen et al. (2001) performed the ratio of liquid assets to deposits banks as a proxy of liquidity risk. Pasiouras and Kosmidou (2007) have used ratio of net loans to customer and short-term funding. In another study, Kosmidou et al. (2008) have employed the ratio of liquid assets to customer and short-term funding. In this study, due to data availability, we follow Kosmidou et al. (2008) to measure liquidity using the ratio of liquid assets to customer and short-term funding. *(CRISK)* is a proxy of credit risk measured by nonperforming loans. A high ratio of nonperforming loans to total granted loans indicate a more exposure on credit risk and this can affect negatively bank profitability. Otherwise, banks are less exposed to credit risk. This proxy was strongly used in several studies (Tan, 2016; Albulescu, 2015; and Cucinelli, 2015). *(STAB)* is Bank stability measured by

Zscore (ROA). A high ratio of Zscore indicates more stability of the banking system. However, the weak ratio indicates weak stability and fragile banking system. This measure was used in recent empirical studies (Laeven and Levine, 2009; Demirgüç-Kunt and Huizinga, 2010; Hakimi et *al*. 2017). GDP is a proxy of economic growth, measured as the annual growth rate of Gross Domestic Product. INF refers to the inflation rate and it is calculated as the customer price index.

The assumption that liquidity and bank profitability is nonlinear encouraged us to use the PSTR framework. In this study, we consider that an increase in the level of liquidity could not be followed by an increase of bank profitability and *vice versa*. Therefore, the introduction of this framework is subject to whether the two variables are nonlinear or not.

4. Empirical Analysis

4.1. Descriptive Statistics and Correlation Matrix

Table 1 below presents the descriptive statistics for the dependent and the explanatory variables employed in this paper. The aim is to provide an overview on the main banking and macroeconomic characteristics of the sample. For comparative reason, the descriptive statistics are presented separately for high income countries and then for low and middle income countries.

Table 1. Descriptive Statistics

High income countries					
Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	505	0,73	1,205	-8,52	4,24
LIQ	480	31.9	16.185	5.69	124.81
CRISK	471	4,829	6,023	0,1	47,75
STAB	505	12,277	7,486	-0,34	37,96
GDP	506	2,448	4,227	-14,814	26,276
INF	492	2,656	2,716	-4,86	15,52
Low and middle income countries					
ROA	918	1,535	1,164	-5,5	7,88
LIQ	911	33.09	16.632	6.11	120.98
CRISK	652	6,574	6,314	0,09	45,3
STAB	920	13,443	9,318	0,06	63,87
GDP	910	4,898	4,784	-62,076	34,5
INF	898	7,052	7,404	-35,837	109,681

Table 1 indicates that the average ROA for high income countries was 0.73 % and it reached a peak of 4.24 % and a bottom value of -8.52%. However, banks in low - middle income countries registered an average return on assets of 1.535% with a maximum of 7.88% and a minimum of -5.5%. From, these statistics, we can conclude that based on our sample, banks in low - middle income countries are most profitable than banks in high income countries.

As bank specifics, banks in high income registered on average 31.9% as liquidity level. The maximum value was 124.81%. Similarly, banks in low - middle income countries record a level of liquidity with an average of 33.09 % and a maximum of 120.98%. With regard to credit risk measured by the ratio of nonperforming loans, the average value was in high income4.82% with a maximum of 47.75%. Credit risk records in low - middle income countries 6.57% as mean value and 45.3% as maximum level.

Concerning industry specifics, statistics indicates that the average of bank stability measured by the Z-score is 12.27% in high income countries and 13.44% in low - middle income countries. Also, maximum values are respectively 37.96% and 63.87%. This means, that banks in low - middle income countries are more stable than those of high income countries.

Turing to economic growth variable, the GDP records an average of 2.44 % for high income countries and 4.89% for low and middle income countries. Maximum values are respectively of 26.27 % and 15.52%. The second indicator is the inflation rate. The average value of this variable is 4.89% for high income and 7.05% for low - middle income countries. However, there is a strong difference with regard to the maximum values. High income countries registered a level of 34.5% while this value reaches 109.68% in low - middle income countries. This means that on average, low - middle income countries are most inflationary than high income countries.

After analysing the main statistics, Table 2 reveals the different correlations between all the variables.

Table 2. Correlation Matrix

	ROA	LIQ	CRISK	STAB	GDP	INF
ROA	1.0000					
LIQ	-0.1582*	1.0000				
	0.0000					
CRISK	-0.2288*	-0.1024*	1.0000			
	0.0000	0.0007				
STAB	0.1210*	-0.1263*	-0.1720*	1.0000		
	0.0000	0.0000	0.0000			
GDP	0.3070*	-0.0507	-0.0905*	0.0299	1.0000	
	0.0000	0.0599	0.0025	0.2624		
INF	0.1772*	-0.0397	-0.0389	0.0214	0.1426*	1.0000
	0.0000	0.1448	0.1985	0.4251	0.0000	

From table 2, it can be seen that liquidity (LIQ) and credit risk (CRISK) are negatively correlated with the bank profitability. However, the rest of variables such bank stability, economic growth (GDP) and inflation are positively linked with bank profitability. We noticed from Table 2 the absence of high correlation between variables which means the absence of multicollinearity.

4.2. Results and Discussion

Before proceeding with the PSTR model, we start the analysis by testing for the stationarity of all variables then testing for the linearity or homogeneity and finally we determine the number of transition function.

Table 3 expose results of the panel unit root test. The procedures of PSTR implementation is based on the assumption that all variables are *I(0)* process. To test for stationarity, we used four tests including the Lin, and Chu (2002) test, Im, Pesaran and Shin (IPS, 2003), the Augmented Dickey Fuller tests (ADF) and the Phillips and Perron (1988) test.

Table 3. Panel Unit Root Test (PURT)

	LLC	IPS	ADF	PP
Variables	T-statistics	T-statistics	T-statistics	T-statistics
ROA	-12.501***	-5.990***	423.387***	461.266***
LIQ	-25.959****	-9.170****	497.600***	527.586***
CRISK	-20.381***	-8.574***	499.503***	518.607***
STAB	-12.589***	-4.878***	387.110***	397.927***
LERN	-12.552***	-4.115***	412.058***	292.010**
GDP	-520.122***	-35.787***	473.045***	542.359***
INF	-10.406***	-2.239**	342.569***	347.542***

Note: (***) and (**). Denote significance at 1% and 5%

Results presented in table 3 show that the four tests reject the null hypothesis at 1% and 5% significance level for all variables. Therefore, we can conclude that all data are *I(0)* process.

The second step of modelling consists of testing the non-linearity between liquidity and profitability using a linearity test against the PSTR model. The results are displayed in Table 4.

Table 4. Linearity Test

Tests	*High income countries*	*Low and middle income countries*
Lagrange Multiplier (W)	22.023	24.726
	(0.000)	(0.000)
Lagrange Multiplier (F)	5.093	5.402
	(0.000)	(0.000)
Likelihood-ratio test (LR)	22.659	25.324
	(0.000)	(0.000)

Table 4 shows that the null hypothesis is rejected at the 1% and 5% levels for the three tests. Also, linearity is rejected for the effect of liquidity on bank profitability for booth high income and low - middle income countries. The results suggest the existence of a non-linear relationship between liquidity and bank profitability. Therefore, we conduct non-linear model using the PSTR framework.

After checking the stationarity and the non-linearity hypothesis between liquidity and bank profitability, the third step consists of searching the number of transition and the threshold of liquidity that affects bank profitability. In other words, we will define the optimal level of liquidity that affect profitability of banks.

Table 5 below presents the result of the number of regime. This is done by the mean of the LM_w and LM_F statistics. We check the null hypothesis tests when the PSTR model has one (m=1) or two functions of transition (m=2).

Table 5. Test for the Number of Regimes

		High income countries		*Low and middle income countries*	
Hyposteses	Tests	Statistics	P-value	Statistics	P-value
(1)H0 : r = 0;H1 : r = 1	LM	6.316	(0.000)***	89.618	(0.000)***
	LR	41.300	(0.000)***	15.444	(0.000)***
(2)H0 : r = 1;H1 : r = 2	LM	45.827	(0.000)***	29.872	(0.091)
	LR	7.099	(0.000)***	5.141	(0.087)

****, indicates level of significance at 1%*

Results from Table 5 indicate that for the case of high income countries, coefficients are statistically significant at level of 5% for booth (m=1) and (m=2). This leads to reject the null hypothesis and we admit that it exist at least two functions of transition and one threshold. However, for the case of low - middle income countries, coefficients are only statistically significant at level of 5% for (m=1). Hence, we cannot reject the null hypothesis and we conclude that the model has one transition function.

Table 6. Threshold Values

Search for threshold level	*High income countries*	*Low and middle income countries*
γ	1.4	0.200
$\boldsymbol{C}$	**24.18**	**40.45**
AIC	-0.448	-0.405
BIC	-0.358	-0.290

Table 6 indicates that the threshold of liquidity is 24.18% for high income countries and 40.45% for low - middle income countries. The difference in threshold can be explained by strategies, practices and risk management adopted by the two groups of countries. From these levels, we can conclude that banks in high income countries are less sensitive to liquidity than banks in low - middle income countries.

4.3. Discussion of Results of the PSTR Model

Table 7 presents the estimation of PSTR model for bank data derived from 127 high income and low - middle income countries during the period 2008-2015. These countries are divided into two sub-samples. The first regroups 81low - middle income countries, while the second contains 46 high income countries. The estimation is done by applying nonlinear least squares to data eliminated the individual effects.

Table 7. Coefficient estimation of the PSTR model

ROA	**High income countries**		**ROA**	**Low and middle income countries**	
Variables	Coeff	T-statistics	Variables	Coeff	T-statistics
CRISK	-0.080	-5.676***	CRISK	-0.101	-4.908***
STAB	0.217	10.574***	STAB	0.120	4.629***
GDP	-0.001	-0.154	GDP	0.033	2.614***
INF	0.021	1.120	INF	-0.017	-1.717*
LIQ ≤ 24.18	-0.054	-3.805***	**LIQ ≤ 40.45**	-0.040	-2.480**
LIQ> 24.18	0.056	4.352***	**LIQ> 40.45**	0.016	1.053
C	24.18%		40.45%		
γ	1.4		0.2		
Obs	455		595		

****, ** and * indicate the level of significance respectively at 1%, 5% and 10%*

Results displayed in Table 7 indicate that nonperforming loans decreases significantly at 1% level of significance bank profitability for both high income and low - middle income countries. Credit decisions are considered as a key determinant for the success of financial institutions due to the huge losses that result following wrong decisions. Loans quality has been discussed in the banking literature as an important factor that influences the level of banking profitability. Bank profitability is inversely influenced by the levels of non-performing loans. Our results are similar to Iannotta et al. (2007), Barros et al. (2007), and Chiorazzo et al. (2008).

Results show that bank stability is positively and significantly associated with bank profitability. Generally speaking, the more stable the banking sector is, the more the environment is encouraging for banks to perform their activities effectively and to expand their businesses. Therefore, the stable environment is a crucial determinant of bank profitability and this result is in line with many previous studies such as Mirzaei et al. (2013), Beck et al. (2006), Berger and Bouwman (2013), and Fiordelisi and Mare (2014).

Concerning the macroeconomic conditions, GDP acts positively and significantly on the bank profitability only for low - middle income countries. This result suggests that an increase in the level of economic growth increases the level of bank profitability. In a stable economic universe, banks expand their businesses which in turn will improve their profitability. This finding is similar to the results of the study of McNamara and Duncan (1995). For the second macroeconomic variable, there is no consensus relative to the effect of inflation on the profitability or for real activity or real economy. Our results reveal that the effect of the inflation on the bank profitability is not significant for high income and Results of the effect of liquidity below the optimal thresholds show that liquidity is negatively and significantly associated with bank profitability for both high income and low - middle income countries. Apparently, holding weak liquidity level by banks in high income and low - middle income countries decreases profitability of banks and might expose them to risk. It is worth recalling that many bank run happened during the financial crisis due to a shortage of liquid and cash. The case of the bank Northern Rock failure in the United Kingdom[1] is a good example that explains the need of holding high level of liquidity. Our conclusion follows the one found by Chen et al. (2018), Osborne et al. (2012), Bordelau and Graham (2010), Ruziqa (2013), and Shen et al. (2009).

As for the liquidity above the thresholds, the results are positively and significantly associated with bank profitability in both sub-samples. This result shows that when banks are performing in a high liquid environment, they tend to well exercise their traditional functions, which generate more interest income and increase bank profitability. In addition, holding high liquidity, banks can respond partial or integral withdraw requests. This leads to increase customer confidence and bank reputation, two necessary factors for bank profitability.

5. Conclusions and Policy Implications

The purpose of this research was to study the consequences of holdings liquid assets by banks to their profitability. More precisely, we seek the optimal threshold of liquidity that affects bank profitability.This query is important since previous experiences provide conflicting results. In fact, while some study shows the need of having high level of liquidity to reduce risk and improve bank profitability, some other studies show the opposite recommendations, showing that holding liquidity is costly for small banks and this may affect negatively their profitability.

In our study, we took an extended sample of banks from 127 countries among them 46 high income countries and 81 low and middle income countries. The aim is to distinguish the behavior of banks between the two blocs of countries. The time span covers the period 2005-2015 which is a period rich of events (subprime crisis, debt crisis, economic crisis).

In the empirical part of the paper, we employ the Panel Smooth Transition Regression (PSTR) framework Empirical results demonstrate that the optimal levels of liquidity that affects bank profitability are 24.18% for high income countries and 40.45% for low - middle income countries. In the empirical part of this paper, we showed that below the optimal threshold, liquidity is found to be negatively and significantly associated with bank profitability. However, above these thresholds, liquidity exerts a positive and significant effect for both high income and low - middle income countries. This study is important for policy makers since it gives the estimated level by which high income and low - middle income countries must take into consideration to avoid liquidity shortage which leads to banking fragility and banking crisis.

End Notes

1. *The British bank faced a liquidity issue during the global financial crisis and it had approached the government for financial assistance. By lack of confidence, depositors raised concern about their money and the bank failed to reimburse all savers due to bank run*.

Acknowledgments

We are very grateful to the editor and to the two anonymous referees for the evaluation of our paper and for the constructive critics. Their comments are very valuable and certainly lead to an improved version of this paper.

References

Adelopo, I., Lloydking, R., & Tauringana, V. (2018). Determinants of bank profitability before, during, and after the financial crisis. *International Journal of Managerial Finance*, 14(4), 378-398.

Ali Shah, S. A., Khan, I., Ali Shah. S .S., & Tahir, M. (2018). Factors affecting liquidity of banks: Empirical evidence from the banking sector of Pakistan. *International Journal of Theory and Practice*, 9(1), 1-18.

Athanasoglou, P., Brissimis, S., & Delis, M. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions, and Money*, 18, 121-36.

Barros, C. P., Ferreira, C., & Willians, J. (2007). Analysing the determinants of performance of best and worst European banks: A mixed logit approach. *Journal of Banking and Finance,* 31, 2189–2203.

Barth, J., Lin, C., Ma, Y., Seade, J., & Song, F.M. (2013). Do bank regulation, supervision and monitoring enhance or impede bank efficiency? *Journal of Banking and Finance*, 37, 2879–2892.

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2006). Bank concentration, competition, and crises: First results. *Journal of Banking & Finance*, 30(5), 1581-1603.

Berger, A., & Bouwman, C. H. S. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 19,146-176.

Bordelau, E., & Graham, C. (2010).The impact of liquidity on bank profitability. WP 2010-38.

Bourke, P. (1989). Concentration and other determinants of bank profitability in Europe. North America and Australia. *Journal of Banking and Finance,* 13, 65–79.

Chen, Y. K., & Shen, C. Y. (2018). Bank liquidity risk and performance. *Review of Pacific Basin Financial Markets and Policies,* 21(1), 1-40.

Chiorazzo, V., Milani, C., & Salvini, F. (2008). Income diversification and bank performance: Evidence from Italian banks. *Journal of Financial Services Research*, 33, 181–203.

Chong, H. G. (2008). Measuring performance of small and-medium sized enterprises: The grounded theory approach. *Journal of Business and Public Affairs,* 2, 1–10.

Cucinelli, D. (2015). The determinants of bank liquidity risk within the context of euro are. *Interdisciplinary Journal of Research in Business*, 10, 51- 64.

DeYoung, R., & Jang, K. Y. (2016). Do banks actively manage their liquidity? *Journal of Banking and Finance*, 66, 143-161.

Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, 91(5), 401–19.

Ferrouhi, E. M. (2014). Bank liquidity and financial performance: Evidence from Moroccan banking industry. *Business: Theories and Practices*, 15(4), 351–361.

Fiordelisi, F., & Mare, D. S. (2014). Competition and financial stability in European cooperative banks. *Journal of International Money and Finance*, 45, 1-16.

Fowowe, B. (2017). Access to finance and firm performance: Evidence from African countries. *Review of Development Finance,* 7, 6–17.

Goldfeld, S. M; & Quandt, R. E. (1972). *Nonlinear methods in econometrics*. North-Holland, Amsterdam.

Gonzalez, A., Teräsvirta, T., & Dick, V.D. (2005). Panel smooth transmission regression models. Working Paper Series in Economics and Finance: Stockholm School of Economics.

Granger, C. W. J., & Terasvirta, T. (1993) *Modelling nonlinear economic relationships.* Oxford: Oxford University Press.

Hakimi, A., & Zaghdoudi, K. (2017). Liquidity risk and bank performance: An empirical test for Tunisian banks. *Business and Economic Research*, 7(1), 46-57.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics,* 93(2), 345–368.

Iannotta, G., Nocera, G., & Sironi, A. (2007). Ownership structure, risk and performance in the European banking industry. *Journal of Banking and Finance,* 31(7), 2127-2149.

Ibarra, R., & Trupkin, D. (2011). The relationship between inflation and growth: A panel smooth transition regression approach. Research Network and Research Centers Program of Banco Central (Working Paper).

Jansen, E., & Teräsvirta, T. (1996). Testing parameter constancy and super exogeneity in econometric equations. *Oxford Bulletin of Economics and Statistics,* 58(4), 735–763.

Kosmidou, K. (2008). The determinants of banks' profits in Greece during the period of EU financial integration. *Managerial Finance*, 34, 146–159.

Kosmidou, K., Tanna, S., & Pasiouras, F. (2008). Determinants of profitability of domestic UK commercial banks: Panel evidence from the period 1995-2002. (Economics, finance and accounting applied research working paper series no. RP08-4). Coventry: Coventry University, 1–27.

Laeven, L., & Valencia, F. (2012). *Systemic banking crises database: An update.* Washington, DC: International Monetary Fund.

Lee, L., & Porter, R. H., (1982). Switching regression models with imperfect sample separation information - With an application on cartel stability. Discussion Paper No. 165, Center for Economic Research, Department of Economics, University of Minnesota.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, 108, 1–24.

Luukkonen, R., Saikokonen, P., & Terävirta, T. (1988). Testing linearity against smooth transition autoregressive models. *Biometrica,* 75, 491- 499.

McNamara, R., & Duncan, K. (1995). Firm performance and macroeconomic variables. School of Business Discussion Paper No. 66. Retrieved from http//epublications.bond.edu.au/discussion papers/66.

Mirzaei, A; Moore, T; & Liu, G. (2013). Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies. *Journal of Banking & Finance*, 37(8), 2920-2937.

Molyneux, P., & Thornton, J. (1992). Determinants of European bank profitability: A note. *Journal of Banking and Finance,* 16(6), 1173-1178.

Oliver, B. (2000). *Macroeconomics* (2nd edition). New York: Practice Hall.

Pasiouras, F., & Kosmidou, K. (2007). Factors influencing the profitability of domestic and foreign commercial banks in the European Union. *Research in International Business and Finance,* 21(2), 222-237.

Peel, D. A., & Speight, A. E. H. (1998). The nonlinear time series properties of unemployment rates: Some further evidence. *Applied Economics*, 30, 287–94.

Peel, D. A., & Speight, A. E. H. (2000). Threshold nonlinearities in unemployment rates: Further evidence for the UK and G3 economies. *Applied Economics*, 32,705–15.

Peel, D. A., & Speight, A. E. H. (1998). Threshold nonlinearities in output: Some international evidence. *Applied Economics*, 30(3), 323-333.

Phillips, P., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika,* 75(2), 335–346.

Pop, I. D., Cepoi, C. O., & Anghel, D. G. (2018). Liquidity-threshold effect in non-performing loans. *Finance Research Letters*, 27, 124-128.

Quandt, R. E. (1958). The estimation of the parameters of a linear regression system obeying two separate regimes. *Journal of the American Statistical Association*, 53, 873–80.

Ramadan, I. Z., Kilani, A. Q., & Kaddumi, A. T. (2011). Determinants of bank profitability: Evidence from Jordan. *International Journal of Academic Research*, 3(4), 180-191.

Ruziqa, A. (2013). The impact of credit and liquidity risk on bank financial performance: The case of Indonesian Conventional Bank with total asset above 10 trillion Rupiah. *International Journal of Economic Policy in Emerging Economies*, 6(2), 93- 106.

Santos, J. B., & Brito, L. A. L. (2012). Toward a subjective measurement model for firm performance. *Brazilian Administration Review,* 9, 95-117.

Saunders, A., & Cornett, M. M. (2006). *Financial institutions management: A risk management approach*. Boston: McGraw-Hill.

Shen, C. H., & Kuo, C. J. (2001). Determinants of net interest margins in Taiwan banking industry. *Journal of Financial Studies,* 9, 47-83.

Shen, C. H., Chen, Y. K., Kao, L. F., & Yeh, C. Y. (2009) Bank liquidity risk and performance. National University of Kaohsiung, Kaohsiung.

Singh, T. (2012). Testing nonlinearities in economic growth in the OECD Countries: An evidence from SETAR and STAR models. *Applied Economics*, 44(30), 3887-3908.

Tan, Y. (2016). The impacts of risk and competition on bank profitability in China. *Journal of International Financial Markets, Institutions and Money*, 40, 85-110.

Teräsvirta, T. (1994). Specification estimation and evaluation of smooth transition autoregressive models. *Journal of the American Statistical Association* 89, 208- 218.

Terasvirta, T., & Anderson, H. M. (1992). Characterizing nonlinearities in business cycles using smooth transition autoregressive models. *Journal of Applied Econometrics*, 7, S119–36.

Tong, H. (1983). Threshold models in non-linear time series analysis. *Lecture Notes in Statistics*, 21, Springer, Berlin.

Tong, H., & Lim, K. S. (1980).Threshold autoregression, limit cycles, and cyclical data (with discussion). *Journal of the Royal Statistical Society, Series B*, 42, 245-292.

Tsay, R. S. (1989). Testing and modeling threshold autoregressive processes. *Journal of the American Statistical Association, 84(405), 231-240.*

Appendix

Appendix 1. List of High Income Countries

Countries name			
1	Argentina	24	Latvia
2	Australia	25	Lithuania
3	Austria	26	Luxembourg
4	Bahrain	27	Malta
5	Belgium	28	Montenegro
6	Canada	29	Netherlands
7	Chile	30	New Zealand
8	Croatia	31	Norway
9	Cyprus	32	Poland
10	Czech Republic	33	Portugal
11	Denmark	34	Qatar
12	Estonia	35	Romania
13	Finland	36	Russian Federation
14	France	37	Saudi Arabia
15	Germany	38	Singapore
16	Greece	39	Slovak Republic
17	Hong Kong SAR, China	40	Slovenia
18	Hungary	41	Spain
19	Ireland	42	Sweden
20	Israel	43	Switzerland
21	Italy	44	United Arab Emirates
22	Japan	45	United Kingdom
23	Kuwait	46	United States

Appendix 2. List of Low-Middle Income Countries

	Countries Name				
1	Afghanistan	28	Gabon	55	Myanmar
2	Albania	29	Georgia	56	Namibia
3	Algeria	30	Ghana	57	Nepal
4	Angola	31	Guatemala	58	Nicaragua
5	Armenia	32	Honduras	59	Nigeria
6	Azerbaijan	33	India	60	Oman
7	Bahamas, The	34	Indonesia	61	Pakistan
8	Bangladesh	35	Jamaica	62	Panama
9	Belarus	36	Jordan	63	Paraguay
10	Benin	37	Kazakhstan	64	Peru
11	Bolivia	38	Kenya	65	Philippines
12	Bosnia and Herzegovina	39	Korea, Rep.	66	Rwanda
13	Botswana	40	Kyrgyz Republic	67	South Africa
14	Brazil	41	Lebanon	68	Sri Lanka
15	Bulgaria	42	Libya	69	Sudan
16	Burkina Faso	43	Macao SAR, China	70	Syrian Arab Republic
17	Cambodia	44	Macedonia, FYR	71	Tanzania
18	Cameroon	45	Madagascar	72	Thailand
19	China	46	Malaysia	73	Trinidad and Tobago
20	Colombia	47	Mali	74	Tunisia
21	Congo, Dem. Rep.	48	Mauritania	75	Turkey
22	Costa Rica	49	Mauritius	76	Uganda
23	Cote d'Ivoire	50	Mexico	77	Ukraine
24	Dominican Republic	51	Moldova	78	Uruguay
25	Ecuador	52	Mongolia	79	Venezuela, RB
26	Egypt, Arab Rep.	53	Morocco	80	Vietnam
27	El Salvador	54	Mozambique	81	Zambia