



Liquidity of commercial banks in Portugal and Spain

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Abstract. Liquidity is very important for the functioning of financial markets, especially for the banking sector, because one of the critical aspects in the banking business is precisely the process of transforming short-term funds and placing them in the medium and long term. This paper aims to comprehensively assess the liquidity positions of Portuguese and Spanish commercial banks through different liquidity ratios for the period from 2002 to 2015 and understand whether the liquidity management strategy differs by bank size. To this end, unconsolidated balance sheet data were used, which were obtained from the banks annual reports. The sample includes a significant part of the Portuguese and Spanish banking sector (not only by the number of banks, but also by the representation in banks total assets). The results obtained show that Spain's banks' liquidity indicator has decreased over the last four years. In contrast, bank liquidity indicator in Portugal varied slightly positively during the period 2002-2006 but decreased sharply between 2010 to 2015. Bank liquidity increased slightly during the period of the financial crisis in both countries, namely between from 2007 to 2009. Finally, it is concluded that smaller banks have less fluctuating liquidity management, i.e., large and medium-sized banks show greater variation in bank liquidity in the period under analysis, i.e., they are less liquid.

Keywords. banking liquidity; financial entities; crisis

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1. Introduction

Studies on bank liquidity have been increasingly highlighted, particularly after the financial crisis that began in 2007 in the United States, which had the impact of the collapse of several banking entities, leading to strong turmoil in financial markets and greater pressure on the regulation of the financial system. In this sense, the Basel Committee on Banking Supervision (BCBS), in relation to bank liquidity, has been implementing a set of new standards and rules on the management and monitoring of bank liquidity.

The international financial crisis of 2007-2008 demonstrated the importance of prudent liquidity risk management in the banking system. Exposure to liquidity risk was a determining factor for the BCBS to implement common rules for banks on liquidity risk management. One of the most important additions to the Basel III banking regulations was the introduction of two minimum financial liquidity standards. These two new banking liquidity indicators follow two distinct, but complementary objectives.

Thus, quantitative regulation of liquidity risk was introduced through the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). And if, on the one hand, the LCR seeks

to ensure that banks are in a permanent position to withstand a very adverse financial shock for at least a very short period of time (one month), they should have a buffer of assets of high liquidity quality (assets that can easily be converted into cash). On the other hand, the NSFR is more structural in nature and aims to define the necessary incentives for banks to resort to rather stable financing sources, in order to ensure their resilience to prolonged financial shocks. Thus, the net stable funding ratio (NSFR), complements the liquidity coverage ratio (LCR), because while the LCR, consists in resisting a scenario of financial pressure for 30 days, the NSFR consists in overcoming a broader time horizon (1 year). Although the BCBS published the final document of the new regulatory framework for banks' liquidity requirements for the LCR in January 2013 (BCBS, 2013) and for the NSFR in October 2014 (BCBS, 2014), its implementation has been delayed throughout several countries. Thus, formal implementation in European countries will take place under the revised Capital Requirements Regulation (CRR II), which was published in June 2019 (European Commission, 2020) and is expected to come into force from June 2021.

In this context, based on the recent critical liquidity situation faced by the financial system on an international level, we aim to assess the liquidity positions of commercial banks in Portugal and Spain extensively through different liquidity ratios in the period 2002-2015 and understand whether liquidity management strategy is distinct from bank size. To achieve this objective, the unconsolidated balance sheet data of the sample banks, which were obtained from the annual reports, were used. For the purpose of analysing the liquidity positions of Portuguese and Spanish commercial banks, two liquidity indicators were used for each bank in the sample, based on bank financial ratios. These ratios make it possible to work with a significant number of variables such as loans, deposits and their modifications, and relate them to their respective assets. Specifically, we strive to answer two crucial questions:

Q1: *"The liquidity positions of the Portuguese and Spanish banking system were similar in the period under review?"*;

Q2: *"Do banks liquidity positions differ from the size of banks?"*.

The answer to these questions allows us to validate the degree of liquidity of two banking systems and to identify the divergences between bank liquidity and the different sizes of banks. It is expected that this study will provide strong contributions to research in this area:

- firstly, to contribute to combining the lessons from historical readings on banks' liquidity management with the liquidity-focused approach to their liquidity positions for the extended period from 2002 to 2015;
- secondly, to contribute to the analysis of the liquidity behaviour of banking institutions in two different financial systems, thus making it possible to portray the reality of Portuguese and Spanish banking;
- thirdly, this work allows us to analyse the problem of bank liquidity, since the recent first banking crisis of the 21st century cannot be ignored, especially as it revealed a lack of

liquidity in banks; and

- finally, fourthly, this study is relevant for the academic world, but it is also interesting for banking institutions, investors and regulators/supervisors of the banking system, as the results obtained in this study help refine and improve standards and rules on banks' liquidity management.

The final document of the research work is structured as follows: in addition to the first point of introductory, in point 2, the literature review is presented which offers, in a brief way, a review of the existing literature in this area, where the concepts of bank liquidity and liquidity risk are highlighted. Then, in section 3, the methods and data of the sample are presented where the methodology adopted in the study is described, presenting, the liquidity indices used and the specification of the model, and in section 4, the results and discussion of the descriptive statistics data are presented, throughout the period of analysis of the liquidity indices of the banks of each country, as well as the discussion of the results obtained. Finally, the main conclusions of this study are presented.

2. Literature Review

Bank liquidity has generated much interest in the research community. Bank liquidity is the ability of a bank to meet the cash demands of bank customers and honour its commitments to third parties as they fall due, thus comprising the balance between the conversion of assets and the callability of liabilities. The Basel Committee on Banking Supervision (BCBS, 2008) defines liquidity as the bank's ability to finance asset growth and meet its payment obligations within the contractual term without incurring significant losses. In the same line of convergence, (Goodhart, 2008) states that bank liquidity has two facets: the first, involves maturity transformation, i.e. the relative maturity of a bank's liabilities and assets; and the second, involves the inherent liquidity of a bank's assets, i.e. the degree to which these assets can be sold without significant loss of value under any market conditions. The authors Bryant (1980), Diamond and Dybvig (1983) and DeYoung and Jang (2016), state that the mismatch of size and maturity between assets and liabilities, both on and off the balance sheet, constitutes a structural risk of banks, thus allowing the creation of liquidity risk. Indeed, an important role of banks in the economy is to provide liquidity by funding long-term illiquid assets with short-term liquid liabilities. Therefore, banks by transforming these maturities face a liquidity risk if any liabilities invested in illiquid assets are called for in the short term (Distinguin et al., 2013).

Given its nature, for author Nikolaou (2009), it is possible to distinguish the term liquidity risk into three types of risk: central bank liquidity risk; funding liquidity risk and market or asset liquidity risk. Central bank liquidity risk is non-existent, since the central bank is always able to supply the monetary base and therefore can never be illiquid.

Table 1. Summary of the main literature review studies.

Author (Year)	Period of study	Country	Definition of dimension indicator	Conclusion
Berger and Bouwman (2009)	1993-2003	USA Commercial Banks	Natural logarithm of the value of gross asset.	- The demand for higher capital requirements, implies associated reduced liquidity for small banks but not for large banks.
Cornett <i>et al.</i> (2011)	2006-2009	USA Commercial Banks	Natural logarithm of the previous year's asset value.	- As loans grew faster at the big banks, it eventually had a reflection on the effect of the liquidity crisis on the bigger banks.
Bonfim and Kim (2012)	2002-2009	Commercial Banks from 43 Countries	Natural logarithm of the asset value.	- Excessive risk-taking in large banks implies associated reduced liquidity, as larger banks are more likely to be bailed out in cases of bankruptcy proceedings.
Cetorelli and Goldberg (2012)	2006-2010	USA Banks and Foreign Subsidiaries	-	- Sufficient liquidity throughout the organisation, i.e. funds flow regularly between banks and subsidiaries on different foreign markets.
Horváth <i>et al.</i> (2012)	2000-2010	Czech Banks	Natural logarithm of the asset value.	- Strong liquidity expansion until the financial crisis driven by the big banks.
Vodová (2012)	2001-2010	Czech and Slovak Commercial Banks	Total Assets.	- Due to increased lending activity, Czech and Slovak banks have become less liquid.
Bord and Santos (2014)	2005-2007	USA Banks	Natural logarithm of the asset value.	- Banks with greater liquidity difficulties charge higher rates on loans to companies.
Acharya and Mora (2015)	1994-2009	USA Banks	-	- The study reveals that unlike countries in Europe (UK), bank liquidity management in the US system has declined.
Khan <i>et al.</i> (2017)	1986-2014	USA Banks	Natural logarithm of the asset value.	- Larger banks take less liquidity risk compared to smaller banks when they have more deposits.
Lastuvková (2017)	2001-2013	Banks of Slovenia	Total Assets.	- With bank size activity decreases; bank creates liquidity or uses it
Mogro and Bravo (2018)	2000-2015	Banks of Ecuador	Total Assets.	- Small banks do not operate at a disadvantage compared to large banks.
Bonfim and Kim (2019)	2002-2009	Commercial Banks from 45 Countries	Natural logarithm of the asset value.	- Larger banks show weaker liquidity indicators, for the reason that they hold less liquid assets as they can more easily access markets.
Al-Naimi (2020)	2004-2015	Commercial Banks of Jordan	Natural logarithm of the asset value.	- Larger banks tend to have more operations than just their core banking business, and as such perform more efficient liquidity management and therefore require lower liquidity levels.
Hakimi <i>et al.</i> (2020)	2014-2015	Commercial Banks in the MENA Region	Natural logarithm of the asset value.	- The study shows that liquidity risk increases when the size of the bank also increases.
Kapoor and Peia (2021)	2014-2018	USA Banks	Natural logarithm of the asset value.	- Banks with a higher share of mortgage-backed securities in total assets benefit more in creating bank liquidity.

Source: Own elaboration.

Since the central bank is the monopoly supplier of liquidity, i.e. the originator of the monetary base, it can dispense liquidity as and when needed, in order to meet the equilibrium demand for liquidity in the banking system and thus avoid cases of excess or deficit liquidity according to its policy. The funding liquidity risk is the risk that the bank will not be able to meet its obligations when they fall due in a given period of time, without affecting daily operations or the financial condition of the institution. This risk translates, in practice, into situations in which cash flows (current and future cash inflows and outflows) that are not offset (Brunnermeier and Pedersen, 2009 and Wójcik-Mazur and Szajt, 2015). The market or asset liquidity risk results from the lack of opportunities to redeem or sell an asset immediately, i.e. it prevents the bank from recovering,

at a given moment, part or all of the asset applied, and sometimes this recovery is only possible by incurring price penalties or high redemption costs. Therefore, exposure to this type of risk translates into the reduced or absent possibility of selling liquid assets at a fair price or at a similar level (Tirole, 2011).

Despite the fact that much research has been conducted in the field of performance and adequacy of risks taken by commercial banks on bank liquidity management, there are only a few relevant studies and their results show that recently bank liquidity management has declined sharply in recent years, essentially in the period of the financial crisis (Crockett, 2008; Cornett et al., 2011; Strahan, 2012; Vodová, 2012; Acharya and Mora, 2015 and Lastuvková, 2017). These results, however, are divergent with the study of authors Bonfim and Kim (2019) who show that banks continued to increase liquidity even during the global financial crisis, as well as the study of authors Cetorelli and Goldberg (2012) who show that funds flowed regularly between banks' global activities. Other authors, such as Berger and Bouwman (2009), Bonfim and Kim (2012), Horváth et al., (2012), Bord and Santos (2014), Khan et al., (2017), Mogro and Bravo (2018), have evaluated in their studies the impact of bank size on bank liquidity analysis and concluded that some questions still remain open since different results were obtained (Table 1 - summary of the main literature review studies).

3. Methodology and Data

This section is composed, firstly, of the analysis and description of the data collected in the statistical publications of the banking sector entities, as well as in the sample considered and, secondly, of the methodology adopted to determine bank liquidity.

3.1. Data

For data collection in this study, we used the content analysis of the statistical publications of APB - Portuguese Banking Association, AEB - Spanish Banking Association and CECA - Spanish Savings Banks and also of the mandatory publications of BdP - Bank of Portugal and BdE - Bank of Spain. To this end, we used the Panel Data technique (Stata 13) that combines cross-section (banks) and time-series (years) data, obtaining an unbalanced panel data. In the 14 years (2002 to 2015) under analysis, there are banks that have ceased their activity, others that have started up during this time span and still others that have merged or completed acquisitions that have transformed them into distinct institutions.

The sample considered is composed of 105 commercial banks, of which 22 are Portuguese and 83 are Spanish (27 from AEB and 56 from CECA), having been analysed in this study the banks that provided the individual annual accounts during the period under analysis, i.e., 2002 to 2015. The total number of observations in the sample amounted to 2.048, for the two liquidity ratios under study, of which 489 observations concern the Portuguese banking system and 1.559

observations concern the Spanish banking system.

In order to demonstrate the size of the two banking systems under study, a characterisation is made of both systems (Table 2) consisting of banks operating in Portugal and Spain, whose volume of net assets as of 31 December 2015 amounted to:

- 407.6 thousand million euros, having been represented in the sample 85.4% (347.9 thousand million euros) for all the aggregate net assets of the Portuguese banking system; and
- 2.6 billion euros, having been represented in the sample 85.8% (2.2 billion euros) for all the aggregate net assets of the Spanish banking system.

Table 2. Characterisation of the sample in the banking system in Portugal and Spain - year 2015. Amounts in millions of euros, except where expressly indicated.

Commercial Banks	31.12.2015 Total Net Assets (individual accounts)		Commercial Banks	31.12.2015 Total Net Assets (individual accounts)	
	Value	%		Value	%
1. CGD Caixa Geral de Depósitos	90 003	22,1	1. SANTANDER Banco Santander	496 322	18,9
2. MBCP Millennium Banco Comercial Português	54 151	13,3	2. BBVA Banco Bilbao Viscaya Argentaria	397 303	15,2
3. NB Novo Banco	51 276	12,6	3. LA CAIXA CaixaBank	317 757	12,1
4. BST Banco Santander Totta	50 232	12,3	4. BANKIA Bankia	208 221	7,9
5. BPI Banco Português de Investimento	32 515	8,0	5. SABADELL Banco de Sabadell	163 630	6,2
6. MG Montepio Geral	24 335	6,0	6. POPULAR Banco Popular	148 778	5,7
7. CA Crédito Agrícola	13 060	3,2	7. BANKINTER Bankinter	58 929	2,2
# OCI Other Credit Institutions (7)	32 341	7,9	# OCI Other Credit Institutions (31)	459 622	17,5
SAMPLE (Year 2015) - 14 Commercial Banks	347 913	85,4	SAMPLE (Year 2015) - 38 Commercial Banks	2 250 562	85,8
TOTAL - BANKING SYSTEM PORTUGAL	407 589	100,0	TOTAL - BANKING SYSTEM SPAIN	2 622 000	100,0

Source: Own elaboration.

3.2. Methodology

For the methodology adopted in order to calculate bank liquidity, descriptive statistics of two liquidity indices (Table 3) were carried out for each commercial bank in the sample in both countries and subsequently, the relationship between bank liquidity and bank size were also assessed.

Table 3. Bank liquidity ratios.

Ratios	Form of Determination	
Liquidity Ratio (1)	CLDC	Net Loans to Customer / Customer Deposits
Liquidity Ratio (2)	CLAL	Net Loans to Customer / Total Net Assets

Source: Own elaboration.

- Liquidity Ratio (1) – Loan to Deposit Ratio

In order to carry out the assessment of the liquidity position of Portuguese and Spanish commercial banks, two liquidity ratios were used, the first one being the following:

$$\text{Liquidity Ratio (1) CLDC} = \frac{\text{Net Loans to Customer}}{\text{Customer Deposits}}$$

A very common indicator, having been adopted in the studies conducted by the authors (Vodová, 2012; López, 2015; Mousa, 2015; Trenca, 2015; Wójcik-Mazur and Szajt, 2015; DeYoung and Jang, 2016 and Lastuková, 2017). In the banking sector, it is regularly used by financial system supervisors to measure the liquidity of banks and is called the transformation ratio of customer funds into loans and advances to customers (know as Loan to Deposit Ratio). This indicator measures how much of customers' capital (bank deposits) is tied up in loans and advances to customers of the same banks. In general, this indicator is widely used to assess the liquidity of commercial banks (retail banking), losing much relevance when observed for specialised banking (business area: consumer, automotive, investment, real estate, among others), since its purpose is not to capture bank deposits from customers. For Dogan, 2013, this ratio between loans and deposits demonstrates the degree of conversion between the most illiquid assets considered by banks (loans) with the liquid liabilities, namely with the main source of funding of commercial banks (customer funds). The higher this ratio, the more the bank depends on borrowed funds and the less liquid the bank is. It is usually greater than 100%, which shows the bank's lending capacity. Conversely, lower values of this ratio mean that loans granted by banks are financed by customer deposits and therefore more liquid is the bank. In recent years the Portuguese and Spanish banking sector has seen a decrease in the ratio of transformation of deposits into credit, reflecting the application of economic and financial adjustments resulting from the financial crisis period, as shown in Figures 1 and 2.

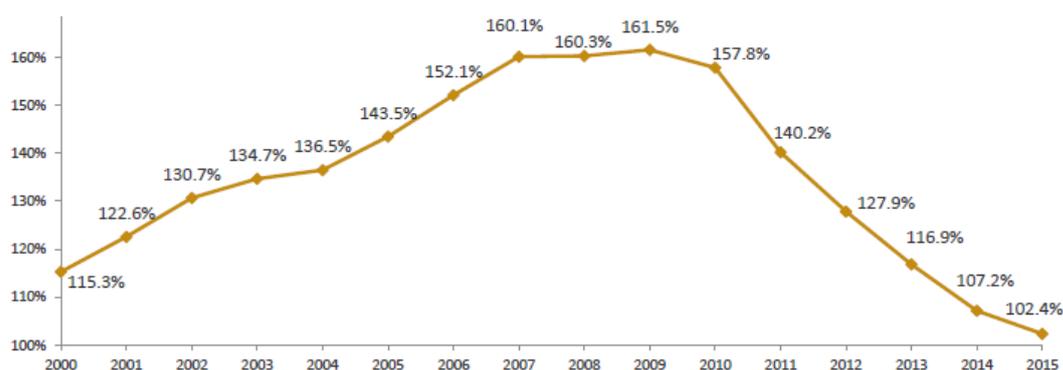


Figure 1. Loan to deposit ratio of the banking sector in Portugal.

Source: APB - Portuguese Banking Association - Overview of the Portuguese Banking System, May 2016.



Figure 2. Loan to deposit ratio of the banking sector in Spain.

Source: AEB - Spanish Banking Association - Presentation of the 2016 banking year, April 2017.

The effect of the global financial crisis, subsequently aggravated from 2010 by the emergence of the sovereign debt crisis - "euro crisis", led to a series of Economic and Financial Assistance Programmes (EFAP) to countries in the Eurozone, the so-called "European bailouts" and which also became known as PIIGS countries (Portugal, Ireland, Italy, Greece and Spain).

In the case of Portugal and Spain, the redemption requests occurred in May 2011 and June 2012, respectively. In this context, the European Stability Mechanism (ESM) played an important role, requiring a thorough assessment of the banks' credit portfolios and financial statements. In this way, the Eurogroup in both financial systems approved an agreement, reflected in the Memorandum of Understanding (MoU), which conditioned the financial assistance to compliance with certain measures reinforcing the financial stability of both countries. The main conditioning factors for the banking sector were the requirements to reinforce bank capital, review provisions, transfer assets and the strong need to control bank liquidity. As such, the regulatory authorities, taking into consideration that the banks were excessively leveraged (Figures 1 and 2), demanded a sharp reduction, which put a "brake" on lending and launched a "war" for deposits with the corresponding increase in deposit interest rates.

As observed in the Portuguese case (Figure 1), bank liquidity decreased sharply since the start of the agreement (MoU) from 2011 to 2015 went from 140.2% to 102.4% (-37.8 p.p.). In turn, the Spanish case (Figure 2), also decreased bank liquidity (less markedly than in the Portuguese case) since it made the agreement (MoU) from 2012 to 2016 went from 123% to 110% (-13 p.p.).

The restrictions imposed on Portuguese and Spanish banks as a result of the financial aid from the Eurozone, had the practical consequence of improving the liquidity indicators of the banks, enabling greater financial freedom for the banking institutions in subsequent years.

- Liquidity Ratio (2) – Loan Participation

The second liquidity indicator analysed in this study was as follows:

$$\text{Liquidity Ratio (2) CLAL} = \frac{\text{Net Loans to Customer}}{\text{Total Net Assets}}$$

The studies conducted by the authors Vodová (2011), Munteanu (2012), Vodová (2012), Roman and Sargu (2014), López (2015), Moussa (2015), Roman and Sargu (2015) and DeYoung and Jang (2016) used the indicator that measures the ratio between net loans to customers and total net assets. Indicator called loan participation that allows determining the weight of the loan portfolio in the total assets of banks. This indicator is relevant for the assessment of banks' liquidity, since loans are the most representative assets on commercial banks' balance sheets, as well as the most illiquid considering their maturity periods (medium and long term). Therefore, the higher the ratio of this indicator, the less liquid is the bank. For a better understanding of the participation of loans and advances to customers in total bank assets, we present Table 4 and Figure 4 in which we can see that the Portuguese and Spanish banking systems have similar weights of credit portfolios in relation to their assets of around 60.0%.

Table 4. Loan participation to the banking sector in Portugal.

	2014	2015	2016	2017	Average
Loans to Customers					
Total (million Euros)	220.218	211.968	208.502	203.436	-
Annual rate of change	-	-3,7%	-1,6%	-2,4%	-2,6%
As a % of total assets	58,9%	59,5%	61,9%	60,6%	60,2%

Source: APB - Portuguese Banking Association - Annual bulletin, 2017.

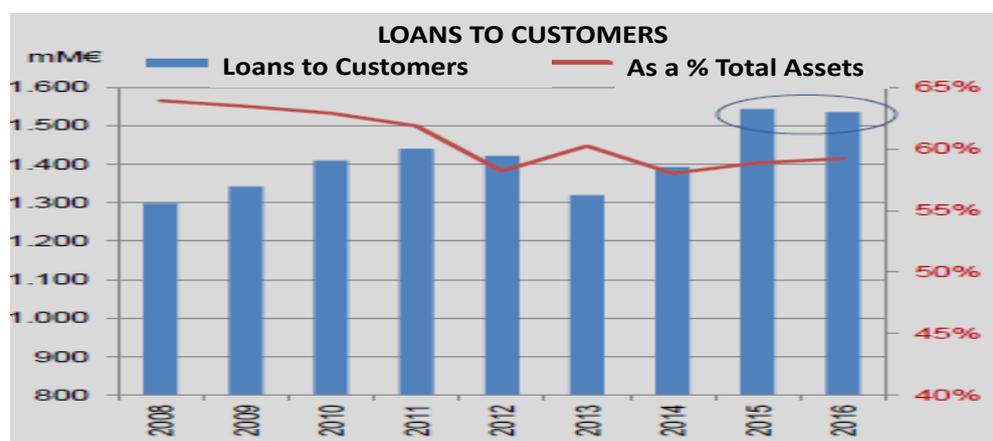


Figure 4. Loan participation to the banking sector in Spain.

Source: AEB - Spanish Banking Association - Presentation of the 2016 banking year, April 2017.

- Relationship between liquidity and bank size - model specification

In order to capture the relationship between bank liquidity and the size of commercial banks in Portugal and Spain over the period from 2002 to 2015 (14 years), we used the simple linear regression model analysis to assess whether the bank size variable has explanatory power over the two liquidity variables (Table 5). In the econometric estimation of the model, the Panel Data (Stata 13.1 - Statistics Data Analysis) technique is used, which combines cross-section (banks)

and time-series (years) data, according to the studies of authors reviewed in the literature, such as Bonfim and Kim (2012), Cetorelli and Goldberg (2012), Bord and Santos (2014), Acharya and Mora (2015), Mogro and Bravo (2018), Bonfim and Kim (2019), Al-Naime (2020) and Hakimi et al. (2020).

Table 5. Linear regression models.

$$\text{Liq(1)}_{it} = \beta_0 + \ln\beta_1 \text{DIM}_{it} + \gamma_1 \text{PMG}_{it} + \sum_{t=1}^{14} \text{ANO}_t + \varepsilon_{it}$$

$$\text{Liq(2)}_{it} = \beta_0 + \ln\beta_1 \text{DIM}_{it} + \gamma_1 \text{PMG}_{it} + \sum_{t=1}^{14} \text{ANO}_t + \varepsilon_{it}$$

where,

- **Liq(1)_{it}** dependent variable representing the transformation ratio of deposits into credit of bank *i* at moment *t*;
- **Liq(2)_{it}** dependent variable representing the loan participation ratio of bank *i* at time *t*;
- **DIM_{it}** independent variable representing the (natural) logarithm of value of net asset bank *i* at time *t*;
- **PMG_{it}** control variable representing the criterion for characterising the size of bank *i* at time *t*;
- **β₀** is the constant term;
- **ε_{it}** is the statistical error term of bank *i* at time *t*.

Source: Own elaboration.

4. Results

The results of this study include the descriptive statistics of two bank liquidity indices for each bank in the sample in both countries, as previously mentioned in section 3, and also the analysis of the relationship between bank liquidity and the size of commercial banks.

4.1. Descriptive statistics of bank liquidity ratios

The data of the descriptive statistics of liquidity measured by the liquidity indicator (1), that is, by the so-called loan to deposit ratio, can be seen in Table 6.

Table 6. Descriptive statistics for liquidity indicator (1) – Loan to Deposit Ratio.

Percentage values, except where expressly indicated.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Portugal														
Average	107.1	108.7	115.0	125.2	146.0	136.8	135.0	132.6	154.0	148.0	123.1	113.2	104.8	95.9
Median	105.8	115.7	111.1	128.3	151.7	132.1	132.1	151.4	148.7	128.2	111.7	111.2	105.8	103.8
S.D.	55.6	57.4	70.9	80.3	73.7	82.4	73.6	64.0	78.0	88.8	66.6	56.1	47.1	40.4
Minimum	0.1	0.1	0.2	0.2	16.4	7.0	6.5	12.6	8.9	4.9	3.5	3.7	3.2	3.0
Maximum	198.9	232.4	310.7	330.5	285.6	295.0	273.6	239.9	289.6	360.6	274.7	250.1	198.8	175.5
N° Obs.	18	19	20	19	17	19	18	18	17	17	15	15	15	14
Σ	241													
Spain														
Average	91.4	96.5	101.1	108.7	111.5	114.1	110.4	109.1	108.8	114.8	102.9	88.0	84.1	81.3
Median	88.0	93.5	95.3	100.1	105.7	108.9	104.9	100.6	100.5	105.0	95.4	78.9	75.4	75.4
S.D.	24.9	28.3	30.3	28.6	26.6	33.1	33.4	36.1	39.4	49.4	39.7	35.7	38.8	36.6
Minimum	8.1	10.0	3.5	4.3	3.0	4.0	5.3	2.9	9.8	7.7	12.9	13.1	1.1	0.4
Maximum	164.6	203.1	227.2	217.4	185.9	240.2	264.1	239.4	291.4	296.2	205.3	184.7	178.1	158.4
N° Obs.	72	71	71	70	70	70	66	65	56	41	35	32	30	29
Σ	778													

Source: Own elaboration.

As previously mentioned, the higher the ratio between credit and deposits, the less liquid is the bank. Thus, observing the evolution of liquidity in the two banking systems confirms that the liquidity of Portuguese and Spanish commercial banks is improving, i.e. increasing. In the case of Spain's commercial banks, between 2002 and 2007 there is a slight upward fluctuation in this indicator (in 2002, it rose on average from 91.4% to 114.1% in 2007). However, its liquidity has improved, mainly in the last four years (it rose on average from 114.8% in 2011 to 81.3% in 2015). In turn, the liquidity of banks in Portugal varied more markedly (it rose on average from 107.1% in 2002 to 146.0% in 2006). As in the Spanish banking market, bank liquidity in Portugal increased between 2010 and 2015, but also much more sharply than in neighbouring Spain, from an average liquidity of 154.0% in 2010 to 95.9% in 2015. Finally, both countries experienced a very slight increase in liquidity during the financial crisis, namely between 2007 and 2009. In the case of Spain, the average rose from 114.1% in 2007 to 109.1% in 2009, and in the case of Portugal, the average rose from 136.8% in 2007 to 132.6% in 2009. These results are convergent with the studies of Strahan, 2012, Vodová, 2012, Acharya and Mora, 2015 and Lastuvková, 2017, which find that bank liquidity has been decreasing, essentially until the period of the financial crisis. In the current study, it is observed that both Portuguese and Spanish commercial banks their liquidity decreases sharply until the years 2006 and 2007, improving substantially their liquidity after the years 2010 and 2011.

As regards the descriptive statistics for the relationship measured by the liquidity indicator (2), i.e. the so-called participation of loan to total bank assets, the respective values can be seen in Table 7.

Table 7. Descriptive statistics for the liquidity indicator (2) – Loans Participation.

Percentage values, except where expressly indicated.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Portugal													
Average	56.7	60.4	60.0	58.7	59.1	60.8	60.9	55.5	57.5	56.6	55.0	55.1	53.6	48.7
Median	67.9	72.5	71.0	68.8	69.3	69.5	68.7	61.3	61.8	61.5	58.6	55.9	57.2	58.0
S.D.	27.3	26.9	27.7	28.2	27.8	26.5	26.4	23.4	22.5	22.3	19.6	19.0	21.5	21.4
Minimum	0.0	0.1	0.1	0.1	3.0	5.2	5.6	8.9	8.0	4.3	3.3	3.5	3.0	2.7
Maximum	85.9	83.7	89.4	84.6	85.9	86.4	89.1	83.3	88.6	90.5	89.9	93.0	89.4	70.9
N° Obs.	18	19	20	19	19	19	18	18	17	18	16	16	16	15
Σ	248													
	Spain													
Average	66.5	68.9	71.0	72.3	74.1	74.5	72.8	70.3	70.3	65.1	58.5	56.7	52.7	52.4
Median	67.4	70.0	73.6	75.3	76.5	77.2	75.9	72.2	73.5	71.9	61.3	47.3	55.2	55.7
S.D.	15.5	15.5	15.4	15.4	14.6	15.0	14.5	14.1	14.8	21.6	19.7	20.2	21.9	21.3
Minimum	2.4	3.1	1.2	1.2	0.7	1.2	1.6	2.4	2.1	0.6	2.5	2.6	0.9	0.3
Maximum	90.6	92.2	93.0	94.1	94.0	93.9	87.7	86.2	90.6	90.2	89.3	93.2	88.8	80.8
N° Obs.	72	71	71	71	71	70	66	65	56	42	35	32	30	29
Σ	781													

Source: Own elaboration.

Like the liquidity indicator (1), a high value of the liquidity indicator ratio (2) means reduced bank liquidity. Thus, we can state that the increase in lending activities confirms that Portuguese and Spanish banks have become less liquid. Thus, it can be seen in the case of banks in Spain that from 2007 to 2015, lending to customers has reduced substantially, falling on average from 74.5% to 52.4%, respectively. In the case of the banking sector in Portugal, the liquidity indicator (2) has been less fluctuating, having only registered a decrease from 55.1% in 2013 to 48.7% in 2015, also revealing an improvement in bank liquidity. In relation to the period of the financial

crisis (2007-2009) in both countries, there was a slight decrease in this indicator, which also showed that bank liquidity increased during this period. In Spain, it rose from an average of 74.5% in 2007 to 70.3% in 2009, while in Portugal it rose from an average of 60.8% in 2007 to 55.5% in 2009. These results support the findings of authors Cornett et al., 2011, Strahan, 2012, Vodová, 2012, Acharya and Mora, 2015 and Lastuvková, 2017, who observe reduced liquidity until the period of the financial crisis, in contrast to the study of authors Bonfim and Kim (2019) who show that banks increased their liquidity during the period of the financial crisis.

4.2. Liquidity ratios by bank size

We now move on to the analysis of the two liquidity ratios associated with the size of commercial banks, i.e. the relationship between bank size and liquidity. Firstly, a comparative analysis is carried out between Portugal and Spain of the two bank liquidity ratios by size (small, medium and large) bank, through the graphical representation of the average of the respective liquidity ratios over the period under analysis. Secondly, the functional relationship between the two variables on bank liquidity and bank size, measured by the natural logarithm of net asset value, was analysed. To this end, the statistical technique of simple linear regression was adopted in order to model the relationship between bank liquidity and bank size.

- Graphical analysis of the evolution of bank liquidity ratios

Taking into account that the two banking systems under analysis present a very different size in terms of the values of aggregate assets of each banking system, we have also adopted different criteria to characterise the size of banks. Thus, the criteria adopted to classify the size of banks in the Portuguese banking system was as follows: large banks are those with total assets exceeding EUR 25 thousand million; medium-sized banks have total assets between EUR 2.5 thousand million and EUR 25 thousand million; and small banks are those with total assets below EUR 2.5 thousand million. The criteria adopted to classify the size of banks in the Spanish banking system was the following: large banks are those with total assets over 100 thousand million euros; medium-sized banks have total assets between 10 thousand million and 100 thousand million euros; and small banks are those with total assets under 10 thousand million euros. The characterisation of the size of banks by the two banking systems under analysis in this study is as follows, according to Table 8.

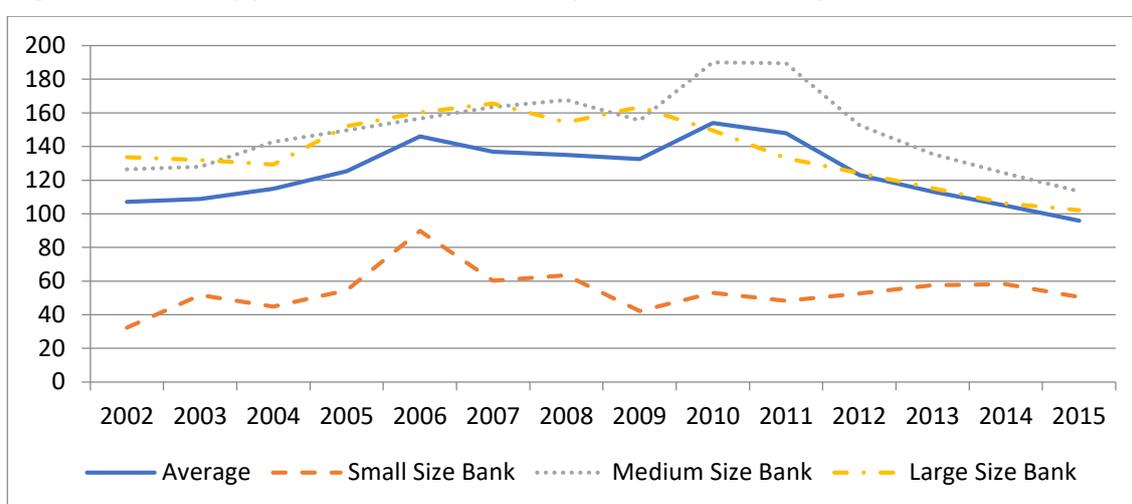
Table 8. Characterization of the size of banks in Portugal and Spain.

Dimension	N.º Banks	%	Criterion	N.º Banks	%	Criterion
Large	5	22,7	> 25 thousand million EUR	8	9,6	> 100 thousand million EUR
Medium	12	54,6	Between 2.5 and 25 thousand million EUR	43	51,8	Between 10 and 100 thousand million EUR
Small	5	22,7	< 2,5 thousand million EUR	32	38,6	< 10 thousand million EUR
	22	100,0		83	100,0	

Source: Own elaboration.

As we can see in Figure 5, the liquidity of Portuguese banks measured by the ratio between credit and deposits decreases with bank size, i.e. small banks are the most liquid. In turn, the liquidity of medium and large Portuguese banks, are less liquid, being almost always above the banking sector average. The only difference is that the liquidity of medium-sized banks is above the liquidity of large banks, i.e. medium-sized banks are the least liquid in the system. This result is in line with the authors Vodová, 2011, Bonfim and Kim, 2012, Bonfim and Kim, 2019 and Hakimi et al., 2020 who concluded that larger banks have reduced liquidity. In turn, it is divergent from the study of the authors Horváth et al., 2012, who concluded in the case of Czech banks, that large banks were more liquid.

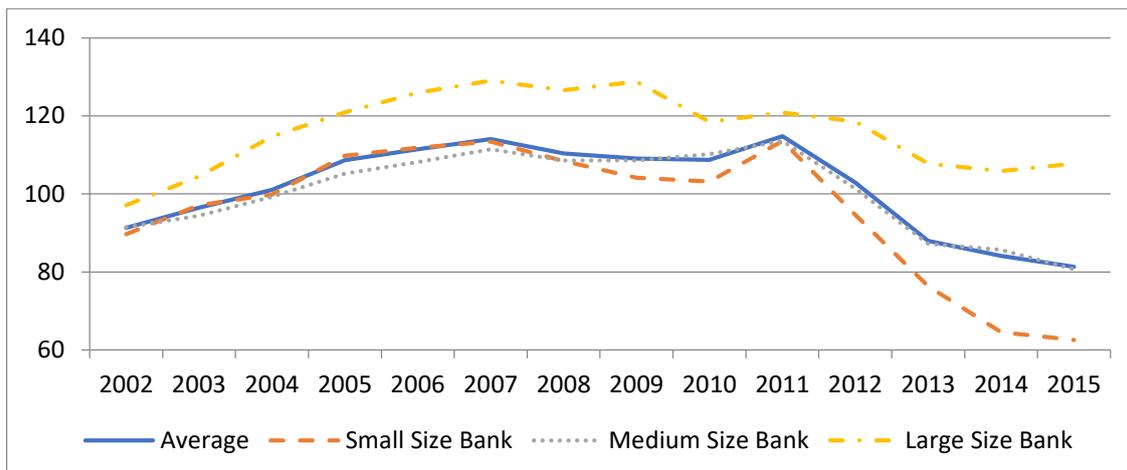
Figure 5. Ind. Liq. (1) – Loan to Deposit Ratio by Bank Size in Portugal.



Source: Own elaboration.

Figure 6 shows the liquidity of Spanish banks also measured by the ratio between credit and deposits and we can see that the liquidity of small and medium-sized banks goes hand in hand with the average for banks, with only small banks being more liquid from 2011 onwards. Unlike the Portuguese banking system, the large Spanish commercial banks are the least liquid of the system. The fact that large and medium-sized banks in both the Portuguese and Spanish banking system are the least liquid results essentially from the banks' preference for strategies related to balance sheet liabilities, i.e. large and medium-sized banks hold fewer liquid assets and rely more on the interbank market and other sources of funding other than customer resources. This result is similar to the studies of authors Vodová, 2011, Bonfim and Kim, 2012, Bonfim and Kim, 2019 and Hakimi et al., 2020.

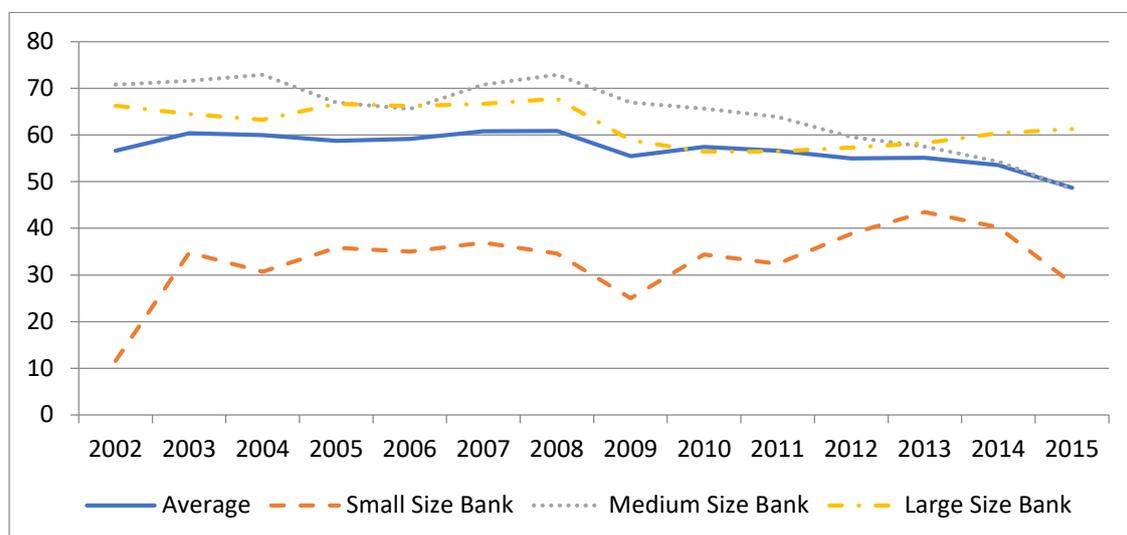
Figure 6 - Ind. Liq. (1) – Loan to Deposit Ratio by Bank Size in Spain.



Source: Own elaboration.

The results of the liquidity indicator relationship relative to the loans participation, as shown in Figure 7, reveal that in the case of the Portuguese banking system, large and medium-sized commercial banks are more willing to lend and are therefore less liquid. Only small banks have a lending activity below the banking sector average, with medium and large banks being slightly above the sector average. This result is in line with the studies of authors Cornett et al., 2011 and Vodová, 2012.

Figure 7. Ind. Liq. (2) – Loans participation by bank size in Portugal.

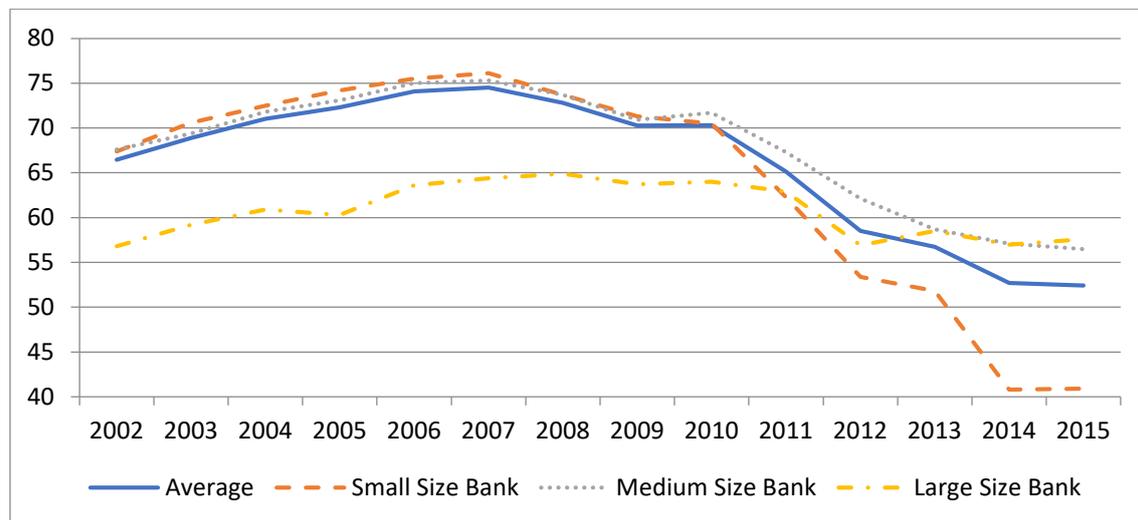


Source: Own elaboration.

Finally, Figure 8 shows the Spanish banking system's banking liquidity measured by the loans participation. The results obtained are quite surprising, since they reveal that small banks were more willing to lend until 2010 and medium-sized banks are the ones that have a lending activity that is always above the average for the sector, and are therefore less liquid. The situation observed here in small banks is indicative of the strong bank restructuring (known as Orderly Bank Settlement Fund) that has taken place in the Spanish banking system since 2009, which has

resulted in the intervention of a large number of small banks and savings banks. Thus, we can conclude that small Spanish banks lent heavily until 2010, subsequently experiencing liquidity difficulties. This result corroborates the findings of the studies by authors Khan et al., 2017 and Al-Naimi, 2020.

Figure 8. Ind. Liq. (2) - Loans participation by bank size in Spain.



Source: Own elaboration.

- Econometric results

For the estimation of the econometric results the simple linear regression model was used as a way to model the existing relationship between the variables. To this end, the panel data resource was used, through the fixed effects model of the ordinary least squares (OLS) and also through the random effects model of the generalised least squares (GLS). From the analysis carried out, it was found that the model with the highest quality is that which is used through the random effects model.

The results obtained from the regressions indicate that there is a low level of explanation of the size variable for the two bank liquidity indices used in this study, it should be noted that, in both the Portuguese and Spanish cases, the adjusted R^2 is often less than 10%. Thus, it is understood that the models applied do not have an acceptable quality of adjustment. These results are explained by the fact that the study only considers the size as a determining factor, a situation for which there are still other important factors that were not considered in the model and that influence bank liquidity, i.e., more than 90% are factors that are found in the statistical error term (ϵ). With regard to the explanatory variable used in the two models used, the results obtained recognise statistical significance in explaining bank liquidity for the two banking systems analysed, according to Table 9.

Table 9. Regressions - results of bank estimates in Portugal and Spain.

Variable	Portugal											
	Liquidity Ratio (1) – Liq1 (Loan to Deposit) (Random Effects)						Liquidity Ratio (2) – Liq2 (Loan Participation) (Random Effects)					
	Small		Medium		Large		Small		Medium		Large	
	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig
DIM	10.79	0.388	-36.67	0.086	-22.51	0,267	-8.10	0.400	6.80	0.158	-13.80	0,003
CONS	-5.44	0.944	395.30	0.007	312.12	0.047	82.12	0.162	20.09	0.541	169.0	0.000
N.º of observations:	54		119		68		56		124		68	
							$\Sigma = 489$					
N.º of banks:	5		12		5		5		12		5	
R-sq:	0.085		0.000		0.077		0.020		0.024		0.062	
	Spain											
Variable	Liquidity Ratio (1) – Liq1 (Loan to Deposit) (Random Effects)						Liquidity Ratio (2) – Liq2 (Loan Participation) (Random Effects)					
	Small		Medium		Large		Small		Medium		Large	
	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig
	DIM	41,34	0.000	30.20	0.000	14.38	0.028	5.34	0.096	8.73	0.000	3.26
CONS	-165.51	0.000	-118.95	0.003	-1.65	0.975	33.84	20.921	6.21	0.722	33.56	0.108
Nº of observations:	290		393		95		292		394		95	
							$\Sigma = 1.559$					
N.º of banks:	32		43		8		32		43		8	
R-sq:	0.126		0.024		0.022		0.087		0.001		0.257	
	<i>Note:</i> (a), (b), (c) Statistically significant results for a significance level of 0.01, 0.05 and 0.10 respectively.											

Source: Own elaboration.

In the case of the Portuguese banking sector, the results allow for the conclusion that only the medium-sized banks for variable Liq1 and the large-sized banks for variable Liq2 are statistically significant, for a significance level of 10% (Sig = 0.086) and 1% (Sig = 0.003), respectively. In turn, in the case of the Spanish banking sector, it can be concluded that for small, medium and large banks, the variables (Liq1 and Liq2) are statistically significant, with the exception of the Liq2 variable of large banks.

5. Conclusions

The objective of this study was, on the one hand, to comprehensively analyse the liquidity positions of Portuguese and Spanish commercial banks through two very common liquidity indices of the banking sector in the period between 2002 and 2015 and on the other hand, to observe whether liquidity is different from bank size.

Once the analysis is complete, the questions of the study can be answered:

Q1: "The liquidity positions of the Portuguese and Spanish banking system were similar in the period under review?";

Q2: "Do banks liquidity positions differ from the size of banks?";

The results obtained show that after the period of the financial crisis, banking institutions show a marked improvement in liquidity in both countries. Spanish banks have sharply increased their

liquidity in the last five years, while Portuguese banks have varied their liquidity slightly negatively during the period 2002-2006, increasing liquidity sharply with the worsening of economic conditions from 2010 onwards. Thus, we can state that for the first question of the study the management strategy of liquidity positions of Portuguese and Spanish commercial banks was broadly similar.

Additionally, it is observed that smaller banks have a less fluctuating liquidity management and therefore small banks are more liquid, however, in the case of the Spanish banking system, small banks until 2010 were more willing to grant credit and as such had major bank liquidity problems. Thus, we can state that regarding the second question of this study, the liquidity positions of banks can be different depending on the size of the bank, since in the case of the Spanish banking system, in a certain period (between 2002 and 2010) small banks were less liquid than medium and large Spanish banks due to the exacerbated lending.

Thus, we conclude that an increasing volume of loans also leads to a decrease in bank liquidity, being in the case of Spain, more affected by small banks. On the other hand, we can observe that in general the large banks are the least liquid. This finding is associated with the fact that large banks are "too big to fail", which motivates these banks to have reduced liquidity, because in the event of a liquidity shortage, these banks rely on the liquidity assistance of lender of last resort. Finally, we find that medium and large banks are statistically significant in the case of the Portuguese banking sector, while in the case of the Spanish banking sector, all banks, regardless of their size, influence bank liquidity.

The study carried out has, however, some limitations. Firstly, to measure the bank liquidity ratio, only two liquidity indices were used (loan to deposit ratio and loan participation), which are regularly applied by financial system supervisors. However, the new banking liquidity indicators, liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) were not applied in this study. Secondly, this current study was limited to commercial banks only. Third, the period of analysis, although long, from 2002 to 2015 (14 years), could be further extended by integrating more recent periods. Thus, the empirical conclusions of this article should be analysed taking into account all these limitations.

Thus, it is suggested, for future research, to apply other bank liquidity indices, introduce other types of banks and extend the period of analysis because they will certainly improve the results of this article.

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