10. A Multifactorial Analysis of Bank Liquidity in the Euro Area

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Abstract

The paper reflects a multifactorial analysis examining the inter-correlations between bank liquidity and a selection of macroeconomic and bank-related indicators, within the Euro Area 19 countries. In the first two parts of the paper, we present relevant developments, from a bank liquidity perspective, as well as findings from other relevant research. The third part includes our empirical study, which is based on the use of two multiple regressions: one dedicated to analyzing the correlations between bank liquidity and macroeconomic indicators (GDP, inflation, unemployment) and the other examining the correlations between bank liquidity and bank-related indicators (Bank deposits to GDP, Bank capital to total assets, provisions to NPL's,). The fourth part highlights the results of the empirical study and the paper ends with a section of concluding remarks.

Keywords: bank liquidity, unemployment, inflation, NPLs, Euro area
JEL Classification: E51, E24, E31, E44, E60, G21, F36

1. Introduction

Our paper provides the input related to the correlations between bank liquidity and factors that influence it, which may be considered for future policy actions, to the benefit of the Euro Area real economy. It focuses on the liquidity, especially bank liquidity, being considered as a key aspect in the financial crisis that started in 2008, but also in the new post-crisis business and financial environment, with strong implications both at the macroeconomic and microeconomic level.

Because of the Euro Area specificity, as highly dependent on bank funding, bank liquidity is a relevant topic for the Euro Area context and for its future policy and development.

Authorities, regulators, and academics were involved in the efforts of examining the impact of bank liquidity and the inter-correlations with other macro and micro factors.

Our paper adds to the existing research and literature by exploring the bank liquidity in the Euro Area 19[3] countries, considering data selection for a period of 11 years, using a mixed

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[3] *As per the European Commission, the Euro Area consists of those Member States of the European Union that adopted the euro as their currency, replacing their national currencies with the single currency: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, Spain.*

set of indicators, both macroeconomic and bank-related indicators, in order to examine the relationship with bank liquidity.

As a response to the crisis, at the European level and impacting mostly the Euro Area, the regulations have changed significantly, including the development of new institutions/bodies and/or roles and agreements (three European supervisory authorities - ESAs - were established on 1 January 2011, to introduce a new supervisory architecture[4]), of new methods, instruments and mechanisms[5], of new reporting functions and new indicators to better measure and asses the various types of risks, including new approaches for liquidity risk (*e.g.*, Liquid Coverage Ratio[6], Net Stable Funding Ratio[7]).

The academics and macroeconomists paid great efforts to rethink macroeconomics after the global financial crisis. Vines and Wills (2018), in their paper "The rebuilding macroeconomic theory project: an analytical assessment", present the contributions of a number of leading macroeconomists[8] and describe how the benchmark New Keynesian model might be rebuilt, in the wake of the 2008 crisis. They emphasize that the need to change the macroeconomic theory is similar to the situation in the 1930s, at the time of the Great Depression, and in the 1970s, when the inflationary pressures were unsustainable. Within this paradigm shift project, papers drafted by Blanchard (2018), Vines and Wills (2018), and Wright (2018) reflect the liquidity constraints, the balance sheet effects of liquidity, affecting borrowing capacity.

The main question for our research is: "Which of the analyzed indicators influences, in a relevant and direct manner, the bank liquidity?" In order to answer the research question, we formulated research hypotheses that are included in the methodological part of the empirical study and tested with the research instruments.

Our empirical study focuses on identifying the relationships between liquidity and relevant factors, considering a selection of indicators specific to all the 19 Euro Area

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[4] *The European Banking Authority (EBA), in charge on bank supervision, including the supervision of the recapitalization of banks, the European Securities and Markets Authority (ESMA), which deals with the supervision of capital markets and carries out direct supervision with regard to credit rating agencies and trade repositories, and the European Insurance and Occupational Pensions Authority (EIOPA), which deals with insurance supervision.*

[5] *Banking Union, Single Supervisory Mechanism, Single Resolution Mechanism.*

[6] *The liquidity coverage ratio (LCR) refers to highly liquid assets held by financial institutions to meet short-term obligations. According to Basel Committee, the ratio is a significant stress scenario that incorporates many of the shocks experienced during the crisis that started in 2007, for which a bank would need sufficient liquidity on hand to survive for up to 30 calendar days. This stress test should be viewed as a minimum supervisory requirement for banks.*

[7] *According to the Basel Committee, the Net Stable Funding Ratio (NSFR) is defined as the amount of available stable funding relative to the amount of required stable funding. This ratio should be equal to at least 100% on an on-going basis. "Available stable funding" is defined as the portion of capital and liabilities expected to be reliable over the time horizon considered by the NSFR, which extends to one year. The amount of such stable funding required of a specific institution is a function of the liquidity characteristics and residual maturities of the various assets held by that institution as well as those of its off-balance sheet (OBS) exposures.*

[8] *Among which: Olivier Blanchard, Simon Wren-Lewis, Joseph E Stiglitz, Randall Wright, Ricardo Reis, Paul Krugman, Wendi Carlin and David Soskice, Fabio Ghironi, A G Haldane, A G Turrell, David Vines and Samuel Wills, Jesper Linde, David Hendry and John Muellbauer, Warwick McKibbin and Andrew Stoeckel; contributions collected in the Oxford Review of Economic Policy, Volume 34, devoted to the "Rebuilding macroeconomic theory project".*

countries/economies, during a period of 11 years, between 2006 and 2016. Our approach includes two categories of indicators:

1) Macroeconomic relevant indicators: Gross Domestic Product (GDP), Inflation and Unemployment;

2) Bank-related indicators: Bank deposits to GDP, Bank capital to total assets, Provisions to nonperforming loans (as percentage).

We selected three macro indicators to be included in our empirical study: the GDP, which represented a major concern for the authorities (at the global and European levels, from monetary, fiscal and economic perspectives within the post-crisis environment), the inflation, due also to the diverse monetary instruments and policies (including Quantitative Easing policies implemented by the central banks) and the unemployment, taking into account its effects, but also the strong measures to support and stimulate job creation.

The nonperforming loans (NPLs) is a top issue on the global and European agenda, the authorities, banks, investors, customers being very careful when approaching this issue.

Within a bank-fueled economy, it is very important to get a strong commitment from the banks to support the economy, via the mechanism of transforming banking liquidity, influencing as well the relevant macroeconomic indicators for a country (such as the GDP, inflation or unemployment). Not only the banks and corporate firms benefit of finance and assistance in transactions, but also individuals and economic agents (Horváth *et al*., 2014).

From a bank perspective, relevant indicators such as Bank deposits to GDP, Bank capital to total assets, Provisions to nonperforming loans (considered in our empirical study) explain the interdependency and tend also to express the awareness and reliability in case of profitability, cost of funding, capital adequacy and deposits when approaching bank liquidity (Singh, Sharma, 2016).

2. Literature Review

After the financial crisis of 2008, much has been written and explained about the new regulations imposed by authorities in the financial field, but less has been revealed about the impact of the regulations, about the correlations between different indicators and their contribution to the banking business.

The risk of liquidity transmission, from a global level to a local level across the banking system and other financial markets, is considered by the macro-prudential policy makers that are using soft tools, to enable communication to the market, through discipline and good behavior, which contribute to financial stability[9]. In this respect, an increase in demand for liquidity that may induce shocks to banks (massive demand for loans and less for deposits, on the liability structure), means also that the financial institutions are eager to sell their illiquid assets at smaller prices (Allen & Gale, 2004; Allen & Santomero, 2001).

The global crisis changed the management tools in banking, emphasizing new capital requirements as an important tool combined with a good quality structure of cash, adequate to sustain long periods of economic growth and stability (Grace *et al*., 2015).

Liquidity risk represents one of the most important risks to be managed by banks in the post crisis environment, due also to its effects on the solvency ratios of a bank and of a banking system, on the lending mechanisms and performance indicators. Regarding the bank liquidity flows, supply and demand must be fairly monitored, in order to harmonize policy within the 19 Euro Area markets and economies.

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[9] *As reflected in The European Central Bank, Monthly Bulletin, May 2002.*

Ghironi (2018) reveals the emerging consensus within rebuilding a macroeconomic theory project, that the new benchmark should make it possible to explain the roots of the crisis, the slow recovery process, and the connection between cyclical dynamics and longer-run growth. Benchmark macroeconomics can no longer afford to abstract from such features of reality as heterogeneity across agents, uninsurable risk, and unemployment. Ghironi also concludes that "Macro - whether international or not - needs micro: MNM!"

Write (2018) argues that understanding crises requires to better incorporate the factors related to money, credit, banking, and liquidity. The approach called New Monetarist economics can provide relevant support in this regard.

Vines and Willis (2018) emphasize that liquidity constraints lead to counter-cyclical risk premiums (the premium is high when aggregate demand and output are low), leading to unemployment and determining the lowering of the aggregate demand and the natural rate of interest.

Studies conducted after the 2008 crisis focused mainly on the concept of liquidity (Caruana, 2013), but also on the correlations with the capital structure of the banks (Bouwman, Christa H.S., 2013). The concept allows debates on global liquidity[10], individual bank's liquidity, liquidity indicators, "private" global[11] liquidity and central bank liquidity. Liquidity relates also to perceptions of the market participants towards risk, valuations cash flows that drive credit extension, with impact on the financial stability as well as on real economy.

Reports and studies present major differences in approaching liquidity risks and adequacy levels, both before and after the crisis. The concept of liquidity, the factors that influence liquidity and liquidity risk, are receiving extended attention in the research publications and reports of the international financial and banking institutions, of the central banks.

In this respect, we considered this important topic to be analysed on a European scale (for all the Euro Area countries), examining for the inter-correlations with two groups of relevant indicators.

3. Methodology and Database

Our empirically conducted study, structured into two parts, determines the existence of correlations between the bank liquidity and the selected indicators from the two representative categories.

In order to answer the main question of the research, we formulated and tested the following assumptions:

> Hypothesis 1 (i1): The inflation positively influences bank liquidity.
> Hypothesis 2 (i2): The unemployment rate positively influences bank liquidity.
> Hypothesis 3 (i3): The level of NPLs provisions positively influences bank liquidity.

Following the formulation of the working hypotheses, we further detail the working methodology, the database and the tools used in the analysis.

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[10] *Regarding global liquidity, it can be taken into account the interpretation: "ease of financing" in the international financial system (Caruana, 2013).*

[11] *Committee on the Global Financial System (CGFS, 2011) considers global liquidity as the sum of two parts: 1) official liquidity, which is created by central banks though both conventional and unconventional policies; and 2) private liquidity, which is generated instead by financial institutions through credit creation, as presented in IMF Policy Paper,* Global Liquidity – Credit and Funding Indicators*, July 16, 2013.*

We used a correlation analysis to determine the intensity of the link between the independent variables and the dependent variable. According to the regression model, the correlation can be simple or multiple, depending on the number of variables considered. The correlation can take on values close to the extremes of the interval [-1; 1], considering that there is a positive direct relationship between the variables when the coefficient value is close to 1 and vice versa. When the value is 0, there is no link between the analyzed factors.

We have used the multiple regression analysis to quantify the influence of one or more independent, quantitative variables on the numeric, predictive variables.

To estimate the dependence of the selected variables, we used the multiple regression model, generically expressed by the formula:

$$Y = f(\alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n) + \varepsilon$$

where:

Y - the dependent variable (resultative, random);

$X_1, ..., X_n$ - independent (factorial) variables, non-aliasing;

ε - random variable or residual variable.

In order to perform correlation tests and regression analysis, we used the Excel Statistics - Data Analysis program.

To determine the factors that influence the bank liquidity indicator within the European banking system (19 Euro Area countries) during the period of 2006-2016, we used a panel composed of two types of indicators: macro indicators (GDP, Inflation and Unemployment Rate) and bank-related indicators (bank capital to total assets (%), bank deposits to GDP (%) and provisions to NPL's (%)).

For the first group of indicators and correlations, the formula of the multiple regression model may be written as**:**

L = f $(\alpha + \beta_1 GDP \ + \beta_2 I \ + \beta_3 U) + \ \varepsilon$

where: L- liquidity, GDP – GDP, I- Inflation, U- Unemployment

The factors which influence the bank liquidity were analyzed by using a Panel Regression Model, where the dependent variable is calculated as:

Liquidity Ratio = Credits (Loans) / Total Deposits (as percentage %)

The main argument for using this type of definition is that, generally, liquidity explains the capability of a bank to meet its deposits withdrawals.

The liquidity indicator and the bank related indicators used within the model are based on data from the World Bank Data Warehouse, collected for a period of 11 consecutive years (2006-2016). The data used for the macro indicators (variables) were collected from the Eurostat database.

Concerning the above-mentioned variables, we tested the significance of the following macro indicators with regard to the bank liquidity levels. The abbreviations and units used within the model are reflected as follows:

1). *GDP - Gross Domestic Product growth rate (unit of measure: GDP expressed in market price, at current prices, million Euros).*

2). *Inflation – unit of measure: in the Euro Area, consumer price inflation is measured by the Harmonised Index of Consumer Prices (HICP inflation)**,** Annual Average Rate of Change (%).*

3). *Unemployment – unit of measure: percentage of active population (Unemployment by sex and age - monthly average [une_rt_m]).*

For the second category, reflecting the bank-related indicators, we used the followings abbreviations and units of measure:

1). *Bank Deposits to GDP **(%)** – demand, time and saving deposits in deposit money banks as a share of GDP, calculated by following deflation method: {(0.5) *[Ft/P_et + Ft-1/P_et-1]}/[GDPt/P_at], where: F is demand and time and saving deposits, P_e is end-of period CPI, and P_a is average annual CPI.*
2). *Bank capital to total assets - Liquid liabilities are also known as broad money, or M3. They are the amount of currency and deposits to the central bank (M0), plus transferable deposits and electronic currency (M1), plus time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements (M2), plus travelers' checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents.*
3). *Provisions to nonperforming loans **(%)** - Nonperforming loans are loans for which the contractual payments are delinquent, usually defined as and NPL ratio being overdue for more than a certain number of days (e.g., usually more than 90 days).*

The methodology involves two Multiple Regression Models for the two observation groups: macro indicators (group one) and bank-related indicators (group two). The first regression model (multiple) captures the correlations between the liquidity ratio and the GDP, Inflation and Unemployment Rate. The second regression model (multiple) captures the correlations between the liquidity ratio and bank-related indicators such as: bank deposits to GDP, bank capital to total assets and provisions to non-performing loans.

The F statistic tests whether all dummy variables are equal to 0 ($H0$: $\mu 1 = \cdots = \mu n - 1 = 0$). If the probability obtained from the test is below 5%, the null hypothesis is rejected (there are fixed effects, at least one of the coefficients μi is different from 0). Initially, we have also used other bank-related indicators in the model in order to reflect the correlations. After a number of tests performed in order to achieve a degree of trust over 95%, only the above-mentioned bank-related indicators were selected to be used in the study, because of the authenticity of the regression model.

4. Results and Discussions

4.1. Multiple Regression Model 1 for the Macro Indicators Category

The results are summarized in Table 1.

The regression model 1 tested the nature of correlations of the "y" dependent variable (bank liquidity) with the "x" independent variables (macroeconomic indicators presented above). Our first regression panel model consists of 44 observations (using 4 indicators for 11 years). Considering the validity of regression, some of the variables are relevant for our analysis. Regarding the model used to determine the inter-correlations between bank liquidity and the GDP, Inflation and Unemployment, the valid values reflect the following interpretations.

The results for the R Square, considered as the determination coefficient, shows that 85% of liquidity variation is explained by the following variables: the GDP, Inflation and Unemployment.

Regarding the interpretation for the Adjusted R Square, the results show 78%, which in our case is significant. The value of R Square can increase as the numbers of variables increase, so it is very important to take into consideration the value of the Adjusted R Square. As significance F is 0.27%, which is less than 5%, it indicates that the test is significant because it has a degree of confidence over 95%.

Regarding the GDP and Inflation, in direct correlation with the "y" variable, the "t stat" values are not relevant, being out of the specific interval; this means that there is no direct inter-dependency between the bank liquidity and the GDP or Inflation, when it had significant fluctuations (out of the interval).

Table 1

Multiple Regression Model 1 – Macroeconomic Indicators
Summary Regression Output

Regression statistics						
Multiple R	0.92328					
R Square	0.852446					
Adjusted R Sqaure	0.789209					
Standard Error	2.574136					
Observations	44					
Anova	df	SS	MS	F	Significance F	
Regression	3	267.9643	89.32144	13.48009	0.002702916	
Residual	7	46.38822	6.626174			
Total	10	314.3476				
	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	169.2542	18.15904	9.320657	3.4E -05	126.3149061	212.193541
Unemployment rate (annual rate)	0.586038	0.64405	0.909927	0.393113	-0.936897467	2.10897383
HICP - Inflation rate	2.821937	0.867991	3.251114	0.104036	0.769464926	4.87440923
GDP	-5.9E -06	1.92E -06	-3.06447	0.018209	-1.04187E-05	-1.343E-06

Source: Authors own calculation based on data provided by Eurostat Data Base Warehouse

The macroeconomic indicator that influences the bank liquidity rate is the Unemployment rate. The determination coefficient shows that even a small percentage as per "t stat" value, equal to 0.909927, which is in the interval, expresses the influence upon the "y" dependent variable. The liquidity variability is explained by this indicator.

In order to answer the hypothesis of our empirical study, by analyzing the regression results, we notice that there is also an inverse relationship between the bank liquidity and the Inflation and the GDP rate.

The mathematical and statistical interpretation:

β_0 = intercept parameter

$\beta_1, \beta_2, \beta_3$ = partial regression coefficients or slope coefficients.

$\hat{\beta}_0$ = 169.2542 shows that, if the explanatory variables X1, X2 and X3 are 0, the average value of "Liquid assets to deposits and short-term funding" is estimated to be around 169.25%.

$\hat{\beta}_1$ = 0.586038 shows that, while maintaining the other constant variables, when "Unemployment rate (annual)" (X1) increases by 1%, the liquidity ratio increases on average by 0.58%.

$\hat{\beta}_2$ = 2.821937 shows that, while maintaining the other constant variables, when "HICP - Inflation rate" (X2) increase by 1%, the liquidity ratio increases on average by 2.82%.

$\hat{\beta}_3$ = -5.9E -06 shows that, while maintaining the other constant variables, when "GDP (gross domestic product)" (X3) increases by 1%, the liquidity ratio decrease on average by 5.9%. Note: These interpretations may change as a result of verification of residue assumptions.

Validity model checking through Dublin-Watson and White tests:

Checking the autocorrelation hypothesis of residues

From the Data Excel Regression model – including Residual output of the multifactor regression model, the Durbin-Watson value = -1.44729E+13 is taken. Critical DW Values for n = 44 observations, k = 3 exogenous variables are:

d1 = 1.383 and d2 = 1.666; d1 > DW = -1.44729E+13 < d2 => decision regarding self-correlation but indicates positive autocorrelation.

As a conclusion: Testing the validity of the model and the validity of the parameters

$H_0 : \beta_0 = 0$, (the free term β_0 is not statistically significant)

$H_1 : \beta_0 \neq 0$, (the free term β_0 is statistically significant)

As for the free term, it is not significantly different from 0 (probability 3.4 > 0.05).

$H_0 : \beta i = 1$, (the slope parameter β_i is not significantly different from 1)

$H_1 : \beta i \neq 1$ (slope parameter β_i is significantly different from 1)

The slope parameters β_1, β_2 are not significantly different from one (p-value of 0.393113 and 0.104036 > 0.05).

The slope parameter β_3 is significantly different from one (probability 0.018209 < 0.05).

H0: The model is not statistically valid; H1: The model is statistically valid.

F calculation = 13.48009; $F_{\text{table}} = F_{\text{critical}} = F_{\alpha;4,n-k-1} = F_{0,05;12;14} = 12.98$

Because $F_{\text{calculation}} > F_{\text{critical}}$ we reject H0 and accept H1, $\Rightarrow$ the model is statistically valid.

We have also tested for stationarity, which represents an essential property of the data series we used. This implies that the statistical rules under which the data series evolve do not change fundamentally (the average and variance are constant), so that a potential shock to the series can be absorbed over time without having a permanent character and a negative impact on the econometric outcomes.

The next three figures illustrate the relationship between liquidity and the 3 macro-variables we used.

Figure 1 reflects the direct correlation between the bank liquidity and the unemployment rate, including percentages for both indicators. The tendency for liquidity is in line with unemployment, mainly due to the access to funding (loans/credits) of people that are employed and have the capability to reimburse the debts. In this respect, when unemployment rate is low, liquidity tends also to be at relatively small level (the other way around being also applicable); the only period when the model is out of trend is between 2015 and 2016, when even liquidity rises slightly higher than unemployment due to strong growth of the Euro Area economies.
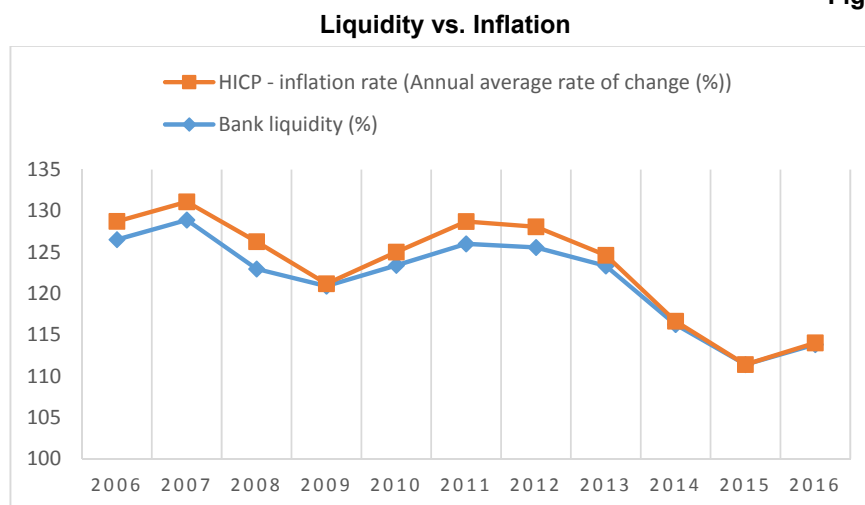
Figure 1

Liquidity vs. Unemployment
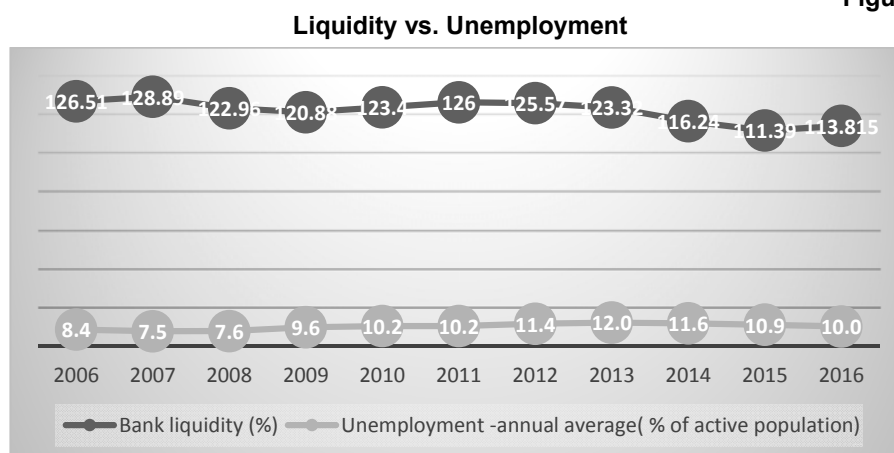
Source: Authors' own calculations, data source Eurostat database

The annual average rate of change, percent, related to the HICP Inflation rate versus the banks liquidity shown in Figure 2 presents a cyclical propagation direct connectivity for the analyzed period, during all the ten-eleven years. When inflation tends to regress and indicates a lower level, liquidity follows the same pattern, illustrating a direct link between the two variables.

Figure 2

Liquidity vs. Inflation

Source: Authors' own calculations, data source Eurostat database.

In Figure 3, we replicate and present the behavior of bank liquidity in comparison and direct determination with GDP at market price, which shows the imbalance between the two variables/indicators. We may say that even if there is balance between the public and private

demand and supply, regardless of its fluctuations, concerning GDP, bank liquidity grows in the 19 Euro Area countries, when economic growth exists (even at low y-t-y levels).

Figure 3

Liquidity vs. GDP
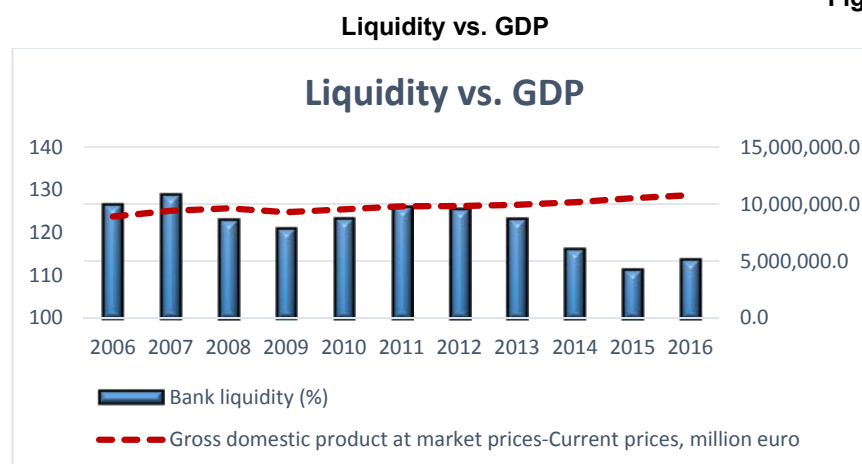
Source: Authors' own calculations, data source Eurostat database.

4.2. Multiple Regression Model 2 for the Category of Bank-related Indicators

The results are summarized in Table 2:

The regression model 2 tested the correlation degree between the "y" dependent variable (bank liquidity) and the "x" independent variables from the bank-related indicators category; our regression model consists of 44 observations (using 4 indicators for 11 years).

Considering the validity of the regression, some of the variables are relevant for our analysis and reflect the following interpretations.

The results for the R Square, considered as the determination coefficient, shows that 86% of the liquidity variation is explained by the following variables: bank capital to total assets (%), bank deposits to GDP (%) and provisions to NPL's. Regarding the interpretation for the Adjusted R Square, the results show 80%, which in our case is significant. The value of R Square can increase as the numbers of variables increase. As significance F is 0.19 %, which is less than 5%, it indicates that the test is significant because it has a degree of confidence above 95%.

The banks-related indicator that influences the bank liquidity rate is the NPLs' provisioning rate. The determination coefficient shows that even a small percentage as per "t stat" value expresses the influence upon the "y" dependent variable. The bank liquidity variability (in our particular model) is explained by this rate. The results reflect that t Stat is (- 1.03137), which is within the specific interval, being relevant for the regression model 2.

In order to answer the hypothesis of our empirical study, analyzing the regression results for the second category of indicators, an inverse relationship between the bank liquidity rate and the other independent variables "x", such as Bank capital to total assets and Bank deposits to GDP, persists.

Table 2

Multiple Regression Model 2 – Bank-related Indicators
Summary Regression Output

Regression statistics						
Multiple R	0.9309945					
R Square	0.8667508					
Adjusted R Sqaure	0.809644					
Standard Error	2.4461797					
Observations	44					
Anova	df	SS	MS	F	Significance F	
Regression	3	272.4609846	90.82033	15.17771	0.0019035	
Residual	7	41.88656536	5.983795			
Total	10	314.34755				
	Coefficient	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	266.2057	48.74631192	5.461043	0.000945	150.9389	381.4724
Bank Capital to total assets (%)	-4.358974	2.214875122	-1.96805	0.089749	-9.596321	0.878373
Bank Deposits to GDP (%)	-1.1649495	0.460992653	-2.52704	0.039403	-2.255019	-0.074871
Provisions to non-performing loans	-0.55508	0.538198049	-1.03137	0.33668	-1.827716	0.717556

Source: Authors' own calculation based on data provided by The World Bank Data Base.

The mathematical and statistical interpretation:

β_0 = intercept parameter

$\beta_1, \beta_2, \beta_3$ = partial regression coefficients or slope coefficients.

$\hat{\beta}_0$ = 266.2057 shows that if the explanatory variables X1, X2 and X3 are 0, the average value of "Liquid assets to deposits and short-term funding" is estimated to be around 169.25%.

$\hat{\beta}_1$ = -4.358974 shows that, while maintaining the other constant variables, when "Bank Capital to total assets (%)" (X1) increases by 1%, the liquidity ratio decreases on average by 4.35%.

$\hat{\beta}_2$ = -1.1649495 shows that, while maintaining the other constant variables, when "Bank Deposits to GDP (%)" (X2) increase by 1%, the liquidity ratio decreases on average by 1.16%.

$\hat{\beta}_3$ = -0.55508 shows that, while maintaining the other constant variables, when "Provisions to non-performing loans" (X3) increases by 1%, the liquidity ratio decrease on average by 0.55%.

Note: These interpretations may change as a result of verification of residue assumptions.
Validity model checking through Dublin-Watson and White test:
Checking the autocorrelation hypothesis of residues

From the Data Excel Regression model – including Residual output of the multifactor regression model, the Durbin-Watson value = -2.181129E+11 is taken. Critical DW Values for n = 44 observations, k = 3 exogenous variables are:
d1 = 1.383 and d2 = 1.666; d1 > DW = -2.181129E+11 < d2 => decision regarding self-correlation; but indicates positive autocorrelation.
As a conclusion: Testing the validity of the model and the validity of the parameters

$H_0 : \beta_0 = 0$, (the free term β_0 is not statistically significant)

$H_1 : \beta_0 \neq 0$, (the free term β_0 is statistically significant)

As for the free term, it is significantly different from 0 (probability 0.000945 < 0.05).

$H_0 : \beta i = 1$, (the slope parameter β_i is not significantly different from 1)

$H_1 : \beta i \neq 1$, (slope parameter β_i is significantly different from 1)

The slope parameters β_1, β_2 are significantly different from one (p-value of 0.089749 and 0.039403 < 0.05). The slope parameter β_3 is not significantly different from one (probability 0.33668 > 0.05).
H0: The model is not statistically valid
H1: The model is statistically valid

F calculation = 15.1777; $F_{table} = F_{critical} = F_{\alpha;4,n-k-1} = F_{0,05;12;14} = 12.98$

Because $F_{calculation} > F_{critical}$ we reject H0 and accept H1, $\Rightarrow$ the model is statistically valid.

The following figures illustrate the comparative evolutions of liquidity and the three bank-related indicators/variables, during the 2006-2016 period.

Figure 5
**Evolution of the Bank-related Indicators (for Model Regression 2)**
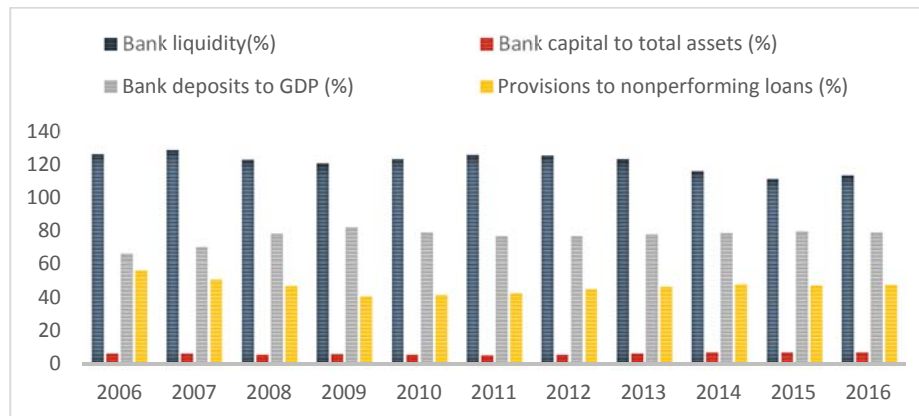
Source: Authors' own calculation, data selected from World Bank database.

Figure 5 presents the correlation between one dependent variable (y), which is bank liquidity, considered for the entire banking system of the 19 Euro Area countries, and three bank-related indicators as independent variables (x); this hypothesis was econometrically tested with multiple linear regression, indicating a strong confidence degree of over 98%. These

results mean that when bank liquidity is high the NPL provisions tend to reach lower levels, capital to total assets a stable level (constantly mentioned) and deposits to GDP a constant and parallel evolution related to liquidity (which actually means that when primary funding is available from deposits and economy through GDP shows signs of strength, illiquid assets tend to get more liquid and rise the liquidity ratio of the banks).

Figure 6
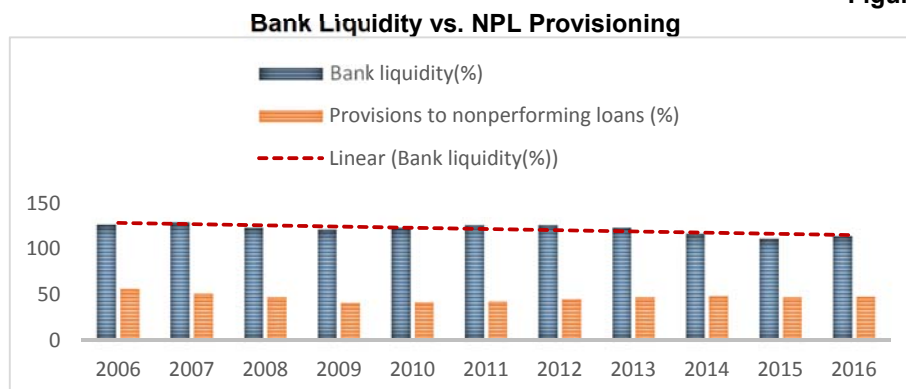
Source: Authors' own calculation, data selected from World Bank database.

One of the most relevant indicators for the banking liquidity, as reflected in our empirical study, is the provisioning of NPL. As shown in Figure 6, there is a linear valid and direct connection between the two variables. It means that when bank liquidity grows or is at a stable level, the same trend registers the cost that the bank makes in order to provision the non-performing loan in its portfolio; the inverted relation being also valid as revealed the regression model 2 of our study.

The results of our empirical study and the complex correlations of bank liquidity, both at the macroeconomic level and bank's individual level, reflect the importance of studying the effects, implications and potential synergies, when managing this relevant indicator.

Other studies conclude also that, within the global crisis context, the lack of bank liquidity was one of the main catalysts of the negative events, for macro-instability and poor sustainability of the business (see Munteanu, 2013).

Liquidity is also related to expectations and attitudes, its predictions for the future being related to risks and regulations (see Single Resolution Board on resolution planning, 2016), influencing, via perceptions, and being influenced as well.

Banks that reported substantial profits also faced difficulties in managing their funds, misleading the equilibrium for banking liquidity.

Due to important influential factors, both on the macroeconomic side and bank side, but also due to their ability to arrange funds from the parent branches (Dinger, 2009), banks maintained less liquidity before the crisis time.

Factors that influence bank liquidity emerge through both common and different determinants, from the pre-crisis period to the post-crisis environment.

5. Conclusions

Bank liquidity represents a key indicator that influences and is influenced by a variety of factors, which determine the basics of financial markets and economies. The important role of banking liquidity was highly reflected within the post-crisis environment. Our research, focused on the Euro Area reveals that a deeper understanding of the nature and correlations between banking liquidity and other relevant indicators, together with an adequate reflection within the rules and regulations, is critical to support the development of a more resilient Euro Area, in the face of future asymmetric shocks.

Within our empirical study, in order to answer the key question of the research, we have formulated and tested, with specific instruments, three-research hypotheses.

The results of the empirical study are robust, hypothesis 1 is not confirmed, while hypothesis 2 and 3 are confirmed. During the analyzed period of 11 years, considering the selected panel of 19 Euro Area countries:

- inflation does not positively influence bank liquidity,

- unemployment rate positively influences bank liquidity,

- NPLs rate positively influences bank liquidity.

Other results of the empirical study reflect that, during the examined period and for the selected panel of data and countries, indicators such as GDP and Inflation, as well as Bank capital to total assets and Bank deposits to GDP, do not directly and consistently influence the bank liquidity.

The direct and relevant correlations between bank liquidity and unemployment and nonperforming loans provide valuable ground to understand some of the causes, but also of the premises for the financial crisis, at European level. The results of the empirical study might be also influenced by the economic cycle taken into consideration, respectively the 2006 – 2016 period.

The strong correlations, in a positive or negative manner, between bank liquidity and different factors, the impact of these correlations on a specific financial market and economy, reflect the necessity to assess and measure the implementation effects of the new instruments and mechanisms developed within the post-crisis environment, to strengthen all the efforts to contribute and insure the macro-financial stability, to integrate and harmonize the macroeconomic policies.

The results and findings of our research are relevant also for the future policy implications, for the authorities in charge with designing the new mix of instruments (monetary, fiscal, economic) but also for the investors, regulators, bankers, when analyzing the factors and ingredients that have an impact, at the bank's or system level, on bank liquidity.

Due to the complex relationships and synergies between different factors, considering also the dynamic financial environment and changes in regulations, changes in behaviors, changes in societies, the bank liquidity is offering new and relevant topics for future research.

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