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The Impact of Basel III Indexes of Leverage and Liquidity CRDIV/CRR on Bank Performance: Evidence from Greek Banks

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Abstract

The recent global financial crisis (GFC) of 2007-2008 revealed several critical shortcomings in the existing Basel II international banking supervisory framework. The Basel Committee adopted a set of reform measures inclusive of additional solvency and liquidity rules, known as "Basel III". Through a new Directive and Regulation known as the CRD IV and CRR package, the European Union implemented Basel III in January 2014. We investigate the effects of the new liquidity and leverage requirements (CRDIV/CRR) under Basel III on the performance of Greek banks for the period 2004 to 2013 which includes both the GFC and the Sovereign Debt Crisis in Europe. We find that the leverage ratio shows a statistically significant albeit positive association with performance indicators (ROA and ROE) during the crisis period, indicative of the fact that higher values of performance ratios due to increased leverage imply increased solvency risk for banks. The effect of the liquidity ratio on bank performance is positive both in the period of crisis and the preceding credit boom period, reflecting the fact that the increased liquidity of banks helps to exploit opportunities presented directly and at lower cost, thereby increasing their profitability. However, the net stable funding ratio (NSFR) has a negative effect on both ROA and ROE in the crisis period. Reduced lending activity or recapitalizations are likely to adversely affect bank profitability during a stress period. Our findings provide some guidance on the unintended consequences of new solvency and liquidity standards, viz., new leverage requirements may force banks to shed highly liquid assets from their balance sheet thereby compromising their ability to manage liquidity when under stress.

Keywords: bank performance, liquidity coverage ratio (LCR), net stable funding ratio (NSFR), Basel III, leverage ratio, Greek banks.
JEL Classification: G01, G21, G28.

1. Introduction

The recent global financial crisis (GFC) of 2007-2008 revealed several critical shortcomings in the existing Basel II international banking supervisory framework adopted in mid-2006 by all Member States of the European Union. After strengthening the Basel II market risk framework in 2009, the Basel Committee on Banking Supervision adopted a comprehensive set of reform measures inclusive of additional solvency and liquidity rules and recommendations, known as "Basel III" in 2011. Through a new Directive and Regulation known as the Capital Requirements Directive IV (CRD IV) and Capital Requirements Regulation[1] (CRR) package, the European Union implemented Basel III in January 2014. Basel III aimed to make the global financial system safer by generating a new system for determining the level of banks' capital and liquidity and this will create a much more challenging environment for banks to operate within.

The desirability of the Basel III regulations and the impact of new capital regulations on the profitability of banks is highly debated. On the one hand a strand of literature argues that there are significant macroeconomic benefits from raising bank equity: higher capital requirements lower leverage and the risk of bank bankruptcies (Admati et al., 2010, Vighneswara 2014). On the other hand, there is another strand of literature (BIS, 2010, Angelini et al., 2011 among others), which argues that there could be significant costs of implementing a regime with higher capital requirements: higher capital requirements will increase banks the cost of equity financing relative to debt financing. The latter will induce banks to raise the cost of lending which will have negative effects on economic growth.

Our aim is to examine the role and impact of liquidity and leverage variables on the profitability ratios (ROE, ROA) of Greek banks within the CRD IV/CRR framework between 2004 and 2013. The new Basel III accords restrict the definition of bank capital and entail that banks hold a larger amount of capital for a given amount of assets and expand the coverage of bank assets. The purpose of our paper is to analyze to what extent these higher capital requirements will affect banks' profitability. During this period, there was both a notable increase in credit growth (2004-2008) following the accession of Greece into the euro zone and a period of prolonged recession (2009-2013) which followed the outbreak of the global financial crisis and the fiscal crisis within Greece. We attempt to reach useful conclusions in regards to the policies that should be adopted by banks' management under the scope of new rules of micro prudential monitoring and the ability to manage liquidity in periods of crisis. Our results have important policy implications for shareholders and debtholders as new capital requirements may affect bank profitability. Country specific studies are important in order to examine the impact of new capital regulations of Basel III on banks' profitability and underline the uniqueness of country specific features and the ability of the banking sector to absorb shocks arising from the economic and financial sector.

[1]Basel II was replaced by the Capital Requirements Directive (CRD) 2006/48/EC and 2006/49/EC. The original Capital Requirements Directives (2006/48 and 2006/49) have been replaced by a new legislative package known as "CRD IV". The package, which applies from 1 January 2014, includes a regulation (CRR) and a directive (CRD IV). They constitute another major step towards creating a sounder and safer financial system. The directive governs the access to deposit-taking activities while the regulation establishes the prudential requirements institutions need to respect.

A recent literature is devoted to the impact of new types of bank regulation on bank profitability and performance that have emerged with Basel III Accords (Gortsos 2011, Sanio 2011, Fekkas 2014, Gaston and Schumacher 2012, Cosimano and Hakura 2011, among others). In a cross-country study conducted among 503 credit institutions in 32 countries, Beltratti and Stulz (2012) found that banks with higher leverage before the global financial crisis of 2007-2008 and greater dependence on short-term borrowing, performed worse during the recent crisis when compared to banks with comparable size and lower leverage. The Basel III framework is expected to burden the equity of banks since their return on equity is very likely to be reduced, as they will need to draw enormous amounts of equity from the capital market. More specifically, according to Sanio (2011), the systemic banks, on which further capital requirements are expected to be imposed, might need to increase their shareholders' equity by eight times in the next few years. In a recent study Fekka (2014) found that the implementation of Basel III rules will reduce more than 20% bank's return on equity (ROE) due to lack of funds and hence non-distribution of dividends to shareholders, while Gaston and Schumacher (2012) found that Basel III will reduce the credit risk of banks' portfolios and consequently will reduce their profits. More precisely, according to Jayadev (2013) the implementation of the leverage ratio of 3% according to Basel III, will have a negative impact on ROE. In another study, KPMG (2011) mentions that the increased capital requirements and the increased financing costs will limit banks' profit margins. A possible shift towards investments might decrease the profitability of equity. Moreover, in a recent McKinsey study by Härle et al. (2014) on the effect of Basel III on European banks it appears that a considerable amount of banks face a significant funding gap, estimated around €1.1 trillion additional Tier 1 capital and €2.3 trillion in long-term borrowing until 2019. Furthermore, a recent survey conducted by Cosimano and Hakura (2011) for the International Monetary Fund reveals that the consequences of the new capital requirements of Basel III are heterogeneous concerning their influence on marginal borrowing costs of banks of developed economies. This heterogeneity is interpreted as a difference in the increase of interest rates, based on which banks lend the economy.

According to the above, this paper examines the extent to which the leverage ratio and liquidity ratios (liquidity coverage ratio and net stable funding ratio) of CRD IV/CRR affect the profitability of banks in general during the period of credit growth (2004-2008) as well as during the period of crisis (2009-2013). Among the three variables that are being considered, the leverage ratio is the one which appears to have a statistically significant correlation with the profitability ratios, indicating that a higher level of debt funding is related to higher profitability rates, which is more intense during a period of crisis. As far as the other two variables are concerned, i.e. the net stable funding ratio and the liquidity coverage ratio, econometric analysis did not indicate a statistically significant relation with profitability for the total time period nor for the individual subperiods.

The structure of the paper is as follows. Section 2 analyses the new recommendations of CRDIV/CRR. Section 3 describes the definition of variables, and the data used. Section 4 presents the methodology employed and the empirical results. Section 5 concludes the paper.

2. Capital requirements regulation and directive – CRR/CRD IV

The recent financial crisis of 2007-2008 highlighted the importance of the liquidity issue facing credit institutions. During the period of crisis, banks with sufficient capital reserves faced liquidity problems due to inefficient asset management. The Basel Committee on Banking Supervision, in the context of Basel III (BIS 2013), introduced two new liquidity measurement tools First, the Liquidity Coverage Ratio (LCR), with which a sufficient reserve of high quality liquid assets is assured. These high quality liquid assets can shield a bank for a maximum period of 30 days in case of a sudden event that will lead to a liquidity crisis[2]. The LCR is calculated (BIS 2013) as the ratio of stock of High Quality Liquid Assets (HQLA) to total net cash outflows over the next 30 calendar days[3].

$$LCR = \frac{Stock\ of\ HQLA}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ calendar\ days} \geq 100\%$$

The second variable is the Net Stable Funding Ratio (NSFR), which complements the LCR and seeks to ensure sufficient and stable funding of banks by assets and off-balance sheet items, thus reducing the chances of bankruptcy from disorder that would affect their funding. Besides these two tools, CRD IV also introduces more tools that enable the liquidity risks to be monitored by supervisory authorities so that they, according to Gortsos (2011), "obtain sufficient and specific information regarding the liquidity conditions within the banking system and individual banks". According to the same author this coefficient aims to deal with the deferment in the liquidity of assets and liabilities (liquidity mismatch) and the development of incentives for banks to utilize stable sources of funding. It is calculated as:

$$NSFR = \frac{Available\ amount\ of\ stable\ funding}{Required\ amount\ of\ stable\ funding} \geq 100\%$$

According to BIS (2014b), the available amount of stable funding of banks should be at least equal to the required amount of stable funding. With the term "available amount of stable funding" BIS (2014 b) refers to the amount of capital and liabilities expected to be available for one year and is calculated by dividing banks' capital and liabilities into five categories and multiplying them with an indicator depending on the category they belong to. The "required amount of stable funding" is estimated based on the liquidity profile of a bank and its off-balance sheet exposure. For its calculation, assets as well as off-balance sheet items are multiplied with indicators depending on the category they belong to. The required stable funding is the sum of

[2] The stress scenario to which BIS refers to, involves among others the credit institutions, the intense private deposit outflows, the partial loss of financing capacity from the interbank market and bond market (wholesale funding), the partial loss of secured short-term financing with the use of specific types of collateral from specific creditors, the increase of market volatility which will be such to lead to increased liquidity requirements, the unexpected outflow of reserved but unused credit and liquidity facilities towards clients, and the possible need of the bank for repurchasing of debt to moderate reputational risk.

[3] Its implementation began on January 1st, 2015, with 60% of the Ratio and an annual gradual increase by 10% is expected until January 1st, 2019, when it will be fully implemented.

risk-adjusted assets and risk-weighted off-balance sheet exposure. The uniform application of the NSFR throughout all countries is subject to internationally agreed adaptations which are currently in progress. The NSFR will be implemented starting January 1st, 2018.

The last indicator used in this analysis is the leverage ratio, introduced by CRD IV (BIS 2014a). This is applied as a complement to the capital adequacy requirements and is expected to act preventively to the procyclicality of bank behavior, i.e. the abrupt deleveraging noticed in periods of economic recession, which follows a period of excessive credit expansion. Based on BIS (2014a), it is calculated as:

$$Leverage\ Ratio = \frac{Capital\ Measure}{Exposure\ Measure} \geq 3\%$$

"Capital Measure" refers to Tier 1 Capital and "Exposure Measure" refers to on- and off-balance sheet exposures, derivative exposures, and securities financing transactions exposures[4].

3. Data and variables

The data used in this paper were extracted from the Bankscope database for the period 2004-2013. The data comprised samples of 19 commercial and cooperative banks. We end up with 162 observations in an unbalanced panel. The variables used in our study are in annual basis[5].

3.1 Dependent variables

For the profitability of Greek commercial banks, i.e. their ability to generate profits, two widely used ratios are considered; the Return on Equity (ROE) and Return on Assets (ROA). The first ratio is commonly accepted as the main measure of banks' profitability since both net income (the numerator) and equity (the denominator) reflect all of the bank's on- and off-balance sheet activities (Berger and Bouwman, 2013). Yet as emphasized by Moussu and Romec (2013), extra focus on this particular ratio may have been an aggravating factor in the recent financial crisis as bank management's attempts to maintain ROE at an appropriate level led to them taking high-risk decisions. As an example, the management of a bank may increase its expected profitability by increasing lending through debt and therefore its leverage while increasing the funding risk exposures and subsequently the possibility of bankruptcy. Despite the above, the common interpretation is that the higher the ROE, the greater the ability of administrators in enhancing shareholders' funds. ROA is the ratio used to measure the ability of a company in generating profit from exploiting its

[4]Banks are obliged to provide data on the level of their indicator to the competent authorities (Bank of Greece) as of January 1st, 2013. To determine the appropriate level of the index, as well as the items that constitute it, there is a trial period until the end of 2017, when the Basel Committee will finalize the results. The implementation of the index within the Pillar I framework will begin on January 1st, 2018.

[5]In order to economize space we do not include data for the period 2004-2013 of banks. They are available upon request.

assets. According to Demirgüç-Kunt and Huizinga (2010) this ratio measures managerial efficiency, as it indicates the ability of management to convert assets into net profit[6]. This happens because, contrary to the return on equity ratio, ROA considers the total size of the bank and therefore depicts the chances of profitability per unit of investment. As a result, comparison through this specific ratio renders it more homogeneous. Nevertheless, the combined examination of the two above ratios provides a complete view as far as the potential profitability of each bank is concerned.

According to Georgoutsos and Staikouras (2008) for banks with the same degree of risk, it constitutes a reliable evaluation index of the followed policies as it shows the return on total capital employed. For example, among two banks with the same degree of risk, the more rational choice in policy for managing capital employed is made by the bank with higher ROA.

3.2 Independent variables

3.2.1 The CRDIV/CR indexes

In section 2 we presented the Leverage Ratio (LR), the Liquidity Coverage Ratio (LCR), and the Net Stable Funding Ratio (NSFR) according to the CRDIV/CRR requirements. To calculate the LCR we proceeded approximately, as many of the elements were confidential. As High Quality Liquid Assets (HQLA) we consider the liquid assets, the reverse repo and cash collateral, the government securities and cash due from banks. The total net cash outflows is the sum of the 5% of the total customer deposits, the 10% of the total deposits from banks, the 25% of other deposit and short-term funding, and the 100% of the total deposits, money market and short-term funding. The next variable in our analysis is the NSFR. This ratio is calculated approximately and is measured by the ratio Total Long Term Funding to Total Assets. According to Basel III the risk weight for the long term funding is 100%, while for the medium term funding is 50% (BIS 2013). Finally, the last variable used in this study is the LR. To calculate the LR we consider the Total Equity variable instead of Tier 1 as this data was missed for many banks[7] over Total Assets.

3.2.2 Other Control Variables

In our analysis we consider other control variables that may affect bank profitability and liquidity such as size (total assets), Non-Performing Loans Ratio, deposits, non-core liability, non interest earnings and others that appear to have been the most successful in previous studies (e.g Vagias and Andersson, 2013).
The variable *total Assets* that is largely used in the literature (e.g. Beltratti and Stulz 2012) in order to consider bank size is included in our specification as well. The next explanatory variable we use is the *Non-Performing Loans Ratio* (NPLs Ratio) measured by non-performing loans to total loans may affect bank performance (Aziz et al. 2008). An increase in the NPLs ratio leads to reduced recovery of loans and lower return from lending which negatively affects the liquidity of banks and

[6]Georgoutsos and Staikouras (2008).
[7] However the conclusions of the analysis remain qualitatively unchanged when we consider Equity Tier 1.

consequently banks' performance as the borrowing activity decreases (Haneef et al., 2012). The next explanatory variable we use (*Control Variable 1*, CV1) is the ratio of the total amount of cash and deposits of banks to central bank to their total asset. This ratio reflects the degree of liquidity which has a credit institution in relation to the size of its balance sheet. During a crisis period where financing costs are high, financial institutions with higher liquidity face less negative impact to their profitability. Furthermore, high liquidity often leads to risky decisions by the managers due to access to "cheap" cash. The next control variable (*CV2*) we consider is the ratio of non-core liabilities such as deposits from other banks, loans, repos, short term debt and debt from money market, to total short term borrowing which according to Demirgüç-Kunt and Huizinga (2010) and Beltratti and Stulz (2012) measures "*funding fragility*". We expect that banks with more deposit financing and with less funding fragility to perform better under stress: any important reliance of financial institutions on funding from secondary sources (non-core funding) may expose banks to a significant refinancing risk (rollover risk), and consequently financing instability. According to a recent experience from the GFC (Ivashina and Scharfstein. 2008, Cornett et al. 2011 among others) non-core funding is very sensitive to economic and market conditions making the bank more prone to resort to borrowing from the interbank market and the bond market. However, we have to consider that in periods where the supply of deposits is limited, banks with greater access to interbank lending or bond market are able to adjust the structure of financing faster and thus reap greater proportion of the opportunity to be financed when liquidity in the interbank market and the bond market is increased (Adrian and Shin 2008). Another control variable *(CV3)* we use is the ratio non-interest income to operating income to capture the extent of diversification of income in each bank. According to Demirgüç-Kunt and Huizinga (2010) non-interesting earning, may increase return as well as diversify risks, therefore boosting performances. Alternatively, according to Stiroh (2004) greater reliance on noninterest income and trading revenue is associated with higher risk and lower risk-adjusted profits particularly under stress. Finally the last control variable (*CV4*) we consider is the ratio loans and committed credit lines to total assets**.** This ratio measure captures banks' exposure to credit risk, ie. the risk that their customers (governments, other banks, firms, households, etc.) don't reimburse their loans or revolving credits. According to Cornett et al. (2011) in times of recession, where the demand for credit increases, banks may face liquidity risk. Non-use of credit lines in the analysis would underestimate the exposure of banks to credit risk.

4 Methodology and empirical results

4.1 Methodology

In our analysis, all variables were normalized by subtracting their value from the arithmetic mean of the variable and dividing the result by the standard deviation.

$$z = \frac{\chi - \mu}{\sigma} \quad (1)$$

All values referred to in section 2 and 3 are in normal standardized form. With normalization, the values used in models are homogenized and are therefore comparable, since they are not subject to different sizes of measurement, which

facilitates the reading and better interpretation of the results. The normalized values are shown in Table 1.

Table 1: Normalized values

. sum ROA ROE LCR NSFR LR Total Assets NPLs CV1 CV2 CV3 CV4

Variable	*Obs*	Mean	Std. Dev.	Min	Max
ROA	162	-1.05e-16	1	-7.873933	2.477744
ROE	161	1.87e-18	1	-10.14861	2.108511
LCR	152	-6.53e-16	1	-.9219516	10.44738
NSFR	111	-1.06e-16	1	-1.005676	3.635011
LR	162	-5.13e-18	1	-1.348033	6.271023
Total Assets	162	3.38e-16	1	-.7138797	3.316378
NPLs	111	-2.40e-16	1	-.9151453	5.7706
CV1	162	1.32e-16	1	-.4483346	5.007376
CV2	136	-2.28e-17	1	-1.582741	1.922657
CV3	155	-1.06e-17	1	-9.884357	7.020192
CV4	113	8.95e-16	1	-2.455506	3.06112

4.2. Estimation of the Coefficient of Correlation

In our analysis the dependent variables are ROA and ROE. The independent variables used are the LCR and NSFR, which depict the liquidity situation, as well as the leverage ratio, accompanied by the rest of the variables that are used to avoid hasty results due to omitted variable bias. With the estimation of the correlation coefficient (Table 2), the level of synchronization between dependent and independent variables are examined in order to decide on whether the selection of variables is appropriate as well as if the synchronization between the independent variables generates safe results in regards to multicollinearity.

Table 2 Correlation between variables

. pwcorr ROA ROE LCR NSFR LR Tota1Assets NPLs CV1 CV2 CV3 CV4

	ROA	ROE	LCR	NSFR	LR Total Assetss		NPLs
ROA	1.0000						
ROE	0.5772	1.0000					
LCR	0.3642	0.1165	1.0000				
NSFR	0.1397	0.0887	0.3605	1.0000			
LR	0.0401	0.1601	0.7234	-0.0808	1.0000		
Total Assets	0.0386	-0.0013	-0.0224	0.1314	-0.2773	1.0000	
NPLs	-0.7056	-0.1660	-0.3746	-0.2679	0.2457	-0.0877	1.0000
CV1	-0.0246	-0.0050	-0.2244	-0.1334	-0.1021	-0.1085	-0.0352
CV2	-0.3299	-0.2569	-0.1950	0.0119	-0.2190	0.2189	0.0694
CV3	-0.0517	-0.0250	0.0232	-0.0766	0.0189	-0.0197	0.0755
CV4	-0.3205	-0.1817	-0.6682	0.1546	-0.1569	0.1761	0.5627
	CV1	CV2	CV3	CV4			
CV1	1.0000						
CV2	0.2170	1.0000					
CV3	0.0273	-0.1118	1.0000				
CV4	0.2256	0.2696	-0.0139	1.0000			

According to the results of Table 2, it is noticed from the independent variables that there is a positive correlation between the two profitability ratios and the new CRD IV/CRR ratios examined (LCR, NSFR, LR), as well as between the total assets and the ROA ratio. This means that the more the independent variables increase, the more the profitability ratios will increase. However, according to table 2 independent variables do not appear to have a strong effect on the profitability ratios. All the other variables have a negative correlation with ROA and ROE. Also, the variable with the largest correlation with the ROA ratio is the NPL index (-70.56%), which is expected, since non-performing loans strongly affect the profitability of assets, and for the ROE ratio it is the CV2 index (-25.69%). This result is in line with Pagratis et al. 2014 who investigate the relationship between leverage and ROE using data from one thousand bank holding companies from 23 countries, including the Eurozone, UK, US, Switzerland, Nordics and Canada, for the period 2001-2013 and find a negative relationship between ROE and NPL, Athanasoglou et al. 2008 and Petria et al. 2015 who find also a negative relationship between these variables, but in contradiction with Mamatzakis and Remoundos 2003 who found no significant relationship between these two variables.

Lastly, according to the results the ranking of correlations between independent variables (except for CRD IV ratios) in decreasing order is, for the ROA index: NPLs (-0,71), CV2(-0,33), CV4(-0,32), CV3 (-0,05), Total Assets (-0,04) CV1 (-0,02), and for the ROE index: CV2(-0,26), CV4 (-0,18), NPLs (-0,17), CV3 (-0,03), CV1 (-0,005), Total Assets (-0,001). It is thus noticed that in the top three spots with the largest correlation with both indices are the variables NPLs, CV2, and CV4, in different order.

4.3 Regression

The models on which the analysis was based were developed gradually. Different models were developed for the three CRD IV indices (LCR, NSFR, LR) per profitability ratio (ROE & ROA). In this way, a gradual examination of the results made it possible to see whether the results of the study were sensitive to any combination of independent variables used and decide whether the outcome of the study was statistically reliable[8]. For instance, a possible change in the level of significance of one of the variables of interest among models would create a sense of correlation of the variable with one of the independent variables in the extensive model or even a possible internal relation with the dependent variable. The results however, as shown below, do not support such hypotheses.

Initially, besides the variables LCR, NSFR, and LR, the three variables with the highest correlation, i.e. CV2, CV4, and NPLs, were also used in the models, based on the conclusion of sub-section 4.2 (Stage A)[9].

In a second phase, the exact same procedure as the first stage was followed, with the addition of a dummy variable, which took the value 1 for the 2009-2013 period of crisis and 0 for the 2004-2008 period. The purpose of the dummy variable is to indicate the extent to which the financial crisis impacted the average profitability of Greek banks compared to the regular period (Stages C and D which includes all independent variables). In a third phase, we created interaction variables between the time indicator of the crisis and the independent variables of interest to examine the extent to which the CRD IV coefficients differ in their effect on the profitability of banks during the period of crisis compared to the period of credit expansion.. Lastly we examine the extent to which the CRD IV/CRR coefficients differ in their effect on the profitability of banks during the period of crisis compared to the period of credit expansion, in other words how much the impact of the independent variables changed during the period of the crisis (Stage E),.

4.4 Empirical Results

For Stage A our results are shown in table 3 and Table 4.

[8]After testing the significance of bank specific fixed effects using an F-test in STATA we conclude that pooled OLS is sufficient for our purposes.

[9]We included a dummy to indicate whether the bank continues to operate or not (Stage B) but it was highly collinear and its effect was insignificant.

Table 3: Stage A- Results for ROE

- ROE= 0.004-0.1 LCR -0.55CV2 -0.008CV4 -0.20NPLs +e

VARIABLES	ROE
LCR	-0.0975
	(0.464)
CV2	-0.550**
	(0.211)
CV4	-0.0079
	(0.279)
NPLs	-0.200
	(0.257)
cons	0.0044
	(0.199)
Observations	64
R-squared	0.1374
Adj R-squared	0.0789

- ROE= 0.15 -0.18 NSFR -0.62CV2 -0.15CV4 +0.01NPLs +e

VARIABLES	ROE
NSFR	-0.1875
	(0.217)
CV2	-0.617**
	(0.235)
CV4	-0.150
	(0.312)
NPLs	0.0148
	(0.390)
cons	0.148
	(0.249)
Observations	59
R-squared	0.1548
Adj R-squared	0.0921

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 4: Stage A-Results for ROA

• ROE= 0.57 +1.53LR -0.25CV2 -0.14CV4 -0.16NPLs +e		• ROA= 0.089 +0.005LCR -0.32CV2 -0.16CV4 -0.246NPLs +e	
VARIABLES	ROE	VARIABLES	ROE
LR	1.531***	LCR	0.0048
	(0.536)		(0.209)
CV2	-0.250	CV2	-0.323***
	(0.209)		(0.093)
CV4	-0.147	CV4	-0.160
	(0.256)		(0.124)
NPLs	-0.165	NPLs	-0.246**
	(0.240)		(0.115)
cons	0.570**	cons	0.089
	(0.271)		(0.089)
Observations	64	Observations	65
R-squared	0.2416	R-squared	0.3787
Adj R-squared	0.1902	Adj R-squared	0.3373

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

- ROA= 0.16 +0.15NSFR -0.34CV2 -0.28CV4 -0.18NPLs +e

VARIABLES	ROA
NSFR	0.151
	(0.093)
CV2	-0.345***
	(0.099)
CV4	-0.286**
	(0.133)
NPLs	-0.188
	(0.167)
Cons	0.165
	(0.106)
Observations	60
R-squared	0.4365
Adj R-squared	0.3956

- ROA= 0.48 +1.06LR -0.11CV2 -0.28CV4 -0.21NPLs +e

VARIABLES	ROA
LR	1.065***
	(0.536)
CV2	-0.114
	(0.209)
CV4	-0.282***
	(0.256)
NPLs	-0.217**
	(0.240)
Cons	0.486***
	(0.271)
Observations	65
R-squared	0.5581
Adj R-squared	0.5286

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 4 shows that the model explains more of the variation in ROA compared to ROE recognizing that R-square values of dependent variables are not directly comparable. The LR and NSFR coefficients have a positive value, indicating that their increase also implies an increase in banks' profitability. On the contrary, the LCR indicator is positive only for the profitability indicator ROA but not for ROE, which cannot be explained economically.

For Stage B and according to table 5 and table 6 our results show that comparing with stage A, adjusted R-square displays an increase, indicating that the addition of further variables improved the explanation of changes in profitability indicators from the independent variables. In all models, the dummy1 variable showed multicollinearity, i.e. a high degree of correlation with one of the variables, and was therefore not taken into account. Among the CRD IV indicators, only LR appears to be statistically significant for the ROA profitability indicator (p-value: 0% <5%) and ROE (p-value: 1.8% <5%), and the NSFR indicator for the ROA profitability indicator. Similarly to Stage A, the F-Statistic value is statistically significant for all ROA equations and for the ROE-LR equation (p-value <5%), indicating that the combination of independent variables explains an important part of the profitability indicators. As far as the figures of the coefficients of variation are concerned, it is noticed that when compared with Stage A, the figure of the coefficient of variation of LCR in the ROE equation has changed from negative to positive.

For stage C from tables 7 and 8 we conclude that the adjusted R-square only of ROA is shown to be marginally larger than the corresponding indicators of Stage A, indicating that the variable dummy2 did not significantly change the result, as was expected. Similarly to Stage A, among the CRD IV indicators, only LR appears to be statistically significant for the profitability indicator ROA (p-value: 0% < 5%) and ROE (p-value: 0.6% < 5%). As in Stage A, the F-Statistic value is statistically significant for all equations of ROA and for the ROE-LR equation (p-value <5%), indicating that the combination of independent variables explain an important part of the performance indicators. The LR and NSFR variables have a positive figure, showing that an increase in their values implies an increase in banks' profitability. On the contrary, the correlation of variability of the LCR has a negative figure for the ROA and ROE profitability indicators. The dummy2 variable is negative, as expected, since during the crisis the average level of profitability was drastically decreased compared to the normal period, possibly due to the increase in non-performing loans, investment portfolio losses, etc.

Table 5: Stage B-Results for ROE

- ROE=-0.25+0.25LCR+0.30CV1-0.72CV2-0.09CV3+0.03CV4-0.04NPLs+0.29Total Assets+e

VARIABLES	ROE
LCR	0.258
	(0.560)
CV1	0.307*
	(0.176)
CV2	-0.728***
	(0.232)
CV3	-0.094
	(0.115)
CV4	0.039
	(0.288)
NPLs	-0.046
	(0.284)
Total Assets	0.292
	(0.182)
cons	-0.253
	(0.262)
Observations	63
R-squared	0.1965
Adj R-squared	0.0943

- ROE=-0.03+0.31NSFR-0.33CV1-0.86CV2-0.10CV3+0.27CV4+0.33NPLs+0.24Total Assets+ e

VARIABLES	ROE
NSFR	0.315
	(0.236)
CV1	-0.336*
	(0.169)
CV2	-0.864***
	(0.265)
CV3	-0.107
	(0.121)
CV4	0.272
	(0.356)
NPLs	0.335
	(0.463)
Total Assets	0.242
	(0.200)
cons	-0.031
	(0.349)
Observations	58
R-squared	0.2217
Adj R-squared	0.1127

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 6: Stage B- Results for ROA

- ROE=0.31+1.38LR+0.16CV1-0.44CV2-0.08CV3-0.10CV4-0.11NPLs+0.21Total Assets+e

VARIABLES	ROE
LR	1.387**
	(0.570)
CV1	0.167
	(0.152)
CV2	-0.448*
	(0.249)
CV3	-0.086
	(0.109)
CV4	0.107
	(0.271)
NPLs	-0.113
	(0.260)
TotalAssets	0.216
	(0.176)
cons	0.310
	(0.342)
Observations	63
R-squared	0.2718
Adj R-squared	0.1791

- Roa=-0.04+1.17LCR+0.15CV1-0.41CV2-0.08CV3-0.15CV4-0.14NPLs+0.16Total Assets+e

VARIABLES	ROA
LCR	1.177
	(0.245)
CV1	0.159**
	(0.077)
CV2	-0.417***
	(0.099)
CV3	-0.087*
	(0.051)
CV4	-0.151
	(0.124)
NPLs	-0.145
	(0.124)
TotalAssets	0.161**
	(0.080)
cons	-0.043
	(0.114)
Observations	64
R-squared	0.4450
Adj R-squared	0.3756

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

- Roa=0.08+0.21NSFR+0.16CV1-0.47CV2-0.08CV3-0.35CV4-0.001NPLs+0.13Total Assets+e

VARIABLES	ROA
NSFR	0.214**
	(0.099)
CV1	0.167**
	(0.070)
CV2	-0.470***
	(0.107)
CV3	-0.086*
	(0.050)
CV4	-0.358**
	(0.148)
NPLs	-0.0016
	(0.193)
Total Assets	0.130
	(0.083)
cons	0.080
	(0.145)
Observations	59
R-squared	0.5029
Adj R-squared	0.4346

- Roa=0.37+1.01LR+0.05CV1-0.19CV2-0.08CV3-0.26CV4-0,18NPLs+0.10Total Assets+e

VARIABLES	ROA
LR	1.012***
	(0.224)
CV1	0.056
	(0.060)
CV2	-0.199**
	(0.097)
CV3	-0.081*
	(0.043)
CV4	-0.266**
	(0.148)
NPLs	-0.185*
	(0.102)
Total Assets	0.104
	(0.070)
cons	0.377***
	(0.136)
Observations	64
R-squared	0.5895
Adj R-squared	0.5382

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 7: Stage C- Results for ROE

- Roe= 0.10 -0.10LCR -0.5CV2 -0.02CV4 -0.13NPLs -0.19dummy2+e

VARIABLES	ROE
LCR	-0.105
	(0.467)
CV2	-0.501**
	(0.246)
CV4	-0.021
	(0.283)
NPLs	-0.133
	(0.310)
dummy2	-0.198
	0.500
cons	0.109
	(0.332)
Observations	64
R-squared	0.1397
Adj R-squared	0.0656

- Roe= 0.17 +0.17NSFR -0.6CV2 -0.14CV4 +0.03NPLs -0.06dummy2+e

VARIABLES	ROE
NSFR	0.178
	(0.234)
CV2	-0.602**
	(0.274)
CV4	-0.149
	(0.316)
NPLs	0.030
	(0.417)
dummy2	-0.061
	0.557
cons	0.178
	(0.374)
Observations	59
R-squared	0.1549
Adj R-squared	0.0752

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 8: Stage C- Results for ROA

- Roe= 0.73 +1.55LR -0.17CV2 -0.16CV4 -0.06NPLs -0.29dummy2+e

VARIABLES	ROE
LR	1.557***
	(0.540)
CV2	-0.170**
	(0.245)
CV4	-0.167
	(0.259)
NPLs	-0.063
	(0.290)
dummy2	-0.297
	0.469
cons	0.737
	(0.379)
Observations	64
R-squared	0.2468
Adj R-squared	0.1819

- Roa= 0.20 -0.004LCR -0.26CV2 -0.17CV4 -0.17NPLs -0.22 dummy2+e

VARIABLES	ROA
LCR	-0.004
	(0.210)
CV2	-0.269**
	(0.107)
CV4	-0.174
	(0.125)
NPLs	-0.171
	(0.137)
dummy2	-0.224
	0.224
cons	0.207
	(0.148)
Observations	65
R-squared	0.3891
Adj R-squared	0.3374

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

- Roa= 0.21 +0.13NSFR -0.32CV2 -0.28CV4 -0.16NPLs -0.09dummy2+e

VARIABLES	ROA
NSFR	0.137
	(0.101)
CV2	-0.321***
	(0.115)
CV4	-0.284
	(0.134)
NPLs	-0.164
	(0.178)
dummy2	-0.098
	0.239
cons	0.213
	(0.160)
Observations	60
R-squared	0.4383
Adj R-squared	0.3863

- Roa= 0.65 +1.09LR -0.03CV2 -0.30CV4 -0.11NPLs -0.30 dummy2+e

VARIABLES	ROA
LR	1.094***
	(0.213)
CV2	-0.034
	(0.097)
CV4	-0.301***
	(0.102)
NPLs	-0.114
	(0.115)
dummy2	-0.304
	0.187
cons	0.658***
	(0.151)
Observations	65
R-squared	0.5771
Adj R-squared	0.5412

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

For Stage D from table 9 and Table 10 it appears that the adjusted R-square of all models appears to be marginally different compared with the corresponding indicators of Stage B, indicating that the dummy2 variable did not significantly change the result. From the CRD IV indicators, only LR appears to be statistically significant for the ROA profitability indicator (p-value: 0% <5%) and ROE (p-value: 1,7% <5%). Similarly to Stage B, the F-Statistic value is statistically significant for all ROA equations and the ROE-LR equation (p-value <5%), indicating that a combination of the independent variables explains an important part of the profitability indicators. As far as the figures of the coefficients of variation are concerned, it is noticed that the signs remain the same as in Stage B.

Finally, for Stage E where we consider all variables, our results from Tables 11 and 12 show that only the LR2 variable, which shows the extent of change in the impact of LR during the crisis, is statistically significant in both models (p-value <5%). Concerning the ROE equation, the LR correlation coefficient is 0.79 during the period of credit expansion and 3 (=2.21+0.79) during the period of crisis. Respectively, for the ROA equation, the correlation coefficient of LR is 0.29 during the period of credit expansion and 1.25 (=0.29+0.96) during the period of crisis. Consequently, in both cases it has a positive value, which is explained by the fact that banks with a higher leverage ratio use greater amounts of private equity to finance their assets and therefore have greater motives to make the right decisions. Respectively, the correlation coefficient of the LCR is positive both during the period of crisis and the period of credit expansion. The increased liquidity of banks allows them to immediately, and at a lower cost, seize the opportunities that appear, which contributes to the increase in profitability. Lastly, the correlation coefficient of NSFR is negative during the period of crisis, in both equations, but during the period of credit expansion it is positive for ROA and negative for ROE, which does not allow for a safe conclusion. The negative value indicates that a possible high value is combined with long-term borrowing, which has greater cost for the bank and therefore contributes to a decrease in its profitability.

Table 9: Stage D- Results for ROE

- ROE=-0.2+0.23LCR+0.29CV1-0.70CV2-0.09CV3+0.03CV4-0.016NPLs+0.29TotalAssets-0.10dummy2 +e

VARIABLES	ROE
LCR	0.231
	(0.580)
CV1	0.298
	(0.182)
CV2	-0.701**
	(0.268)
CV3	-0.0926
	(0.116)
CV4	0.0326
	(0.292)
NPLs	-0.0166
	(0.324)
TotalAssets	0.296
	(0.184)
Dummy2	-0.103
	(0.532)
cons	-0.202
	(0.372)
Observations	63
R-squared	0.1971
Adj R-squared	0.0781

- ROE=-0.14+0.37NSFR+0.36CV1-0.94CV2-0.11CV3-0.31CV4+0.31NPLs+0.20TotalAssets+0.26dummy2+e

VARIABLES	ROE
NSFR	0.374
	(0.275)
CV1	0.361*
	(0.180)
CV2	-0.947**
	(0.330)
CV3	-0.110
	(0.122)
CV4	-0.309
	(0.368)
NPLs	0.310
	(0.469)
TotalAssets	0.228
	(0.203)
Dummy2	0.267
	(0.617)
cons	-0.140
	(0.432)
Observations	58
R-squared	0.2247
Adj R-squared	0.0981

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses

Table 10: Stage D- Results for ROA

- ROE=-0.46+1.41LR+0.15CV1-0.36CV2-0.084CV3-0.11CV4-0.025NPLs+0.22TotalAssets-0.27dummy2+e

VARIABLES	ROE
LR	1.418**
	(0.576)
CV1	0.151
	(0.155)
CV2	-0.366
	(0.290)
CV3	-0.0844
	(0.109)
CV4	-0.118
	(0.273)
NPLs	-0.0253
	(0.306)
Total Assets	0.224
	(0.177)
Dummy2	-0.273
	(0.494)
cons	-0.461
	(0.439)
Observations	63
R-squared	0.2759
Adj R-squared	0.1686

- ROA=0.06+0.12LCR+0.14CV1-0.36CV2-0.085CV3-0.16CV4-0.08NPLs+0.17TotalAssets-0.21dummy2+e

VARIABLES	ROA
LCR	0.125
	(0.252)
CV1	0.142
	(0.790)
CV2	-0.366***
	(0.113)
CV3	-0.0851*
	(0.507)
CV4	-0.162
	(0.125)
NPLs	-0.085
	(0.139)
Total Assets	0.169***
	(0.080)
Dummy2	-0.210
	(0.230)
cons	0.060
	(0.160)
Observations	64
R-squared	0.4533
Adj R-squared	0.3738

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

- ROA=0.07+0.21NSFR+0.16CV1-0.47CV2-0.08CV3-0.36CV4-0.003NPLs+0.12TotalAssets-0.02dummy2+e

VARIABLES	ROA
NSFR	0.217*
	(0.114)
CV1	0.168**
	(0.749)
CV2	-0.476***
	(0.133)
CV3	-0.086*
	(0.510)
CV4	-0.360**
	(0.153)
NPLs	-0.003
	(0.196)
TotalAssets	0.128
	(0.852)
Dummy2	0.019
	(0.256)
cons	0.0725
	(0.179)
Observations	59
R-squared	0.5029
Adj R-squared	0.4234

- ROA=0.56+1.05LR+0.038CV1-0.10CV2-0.79CV3-0.27CV4-0.08NPLs+0.11TotalAssets-0.33dummy2+e

VARIABLES	ROA
LR	1.054***
	(0.221)
CV1	0.038**
	(0.059)
CV2	-0.101
	(0.110)
CV3	-0.079*
	(0.042)
CV4	-0.278***
	(0.104)
NPLs	-0.078
	(0.117)
TotalAssets	0.114
	(0.687)
Dummy2	-0.335*
	(0.190)
cons	0.561**
	(0.169)
Observations	64
R-squared	0.6114
Adj R-squared	0.5549

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses.

Table 11: Stage E- Results for ROE

- ROE=0.27+0.26LCR2+0.20LCR-0.03NSFR2-0.006NSFR+2.21LR2+0.08LR+0.41dummy2

VARIABLES	ROE
LCR2	0.261
	(0.627)
LCR	0.199
	(0.379)
NSFR2	-0.035
	(0.326)
NSFR	-0.006*
	(0.141)
LR2	2.214***
	(0.664)
LR	0.079
	(0.448)
Dummy2	0.410
	(0.360)
cons	0.275**
	(0.194)
Observations	102
R-squared	0.2745
Adj R-squared	0.2204

Table 12: Stage E- Results for ROA

- ROA=0.38+0.48LCR2+0.28LCR-0.11NSFR2+0.013NSFR+0.96LR2+0.29LR-0.018dummy2

VARIABLES	ROA
LCR2	0.477
	(0.366)
LCR	0.283
	(0.221)
NSFR2	-0.116
	(0.190)
NSFR	0.013
	(0.828)
LR2	0.969**
	(0.381)
LR	-0.294
	(0.261)
Dummy2	-0.018
	(0.209)
cons	0.384***
	(0.113)
Observations	103
R-squared	0.4115
Adj R-squared	0.3681

***, ** and * indicate 1%, 5% and 10% significance levels respectively. Robust Standard errors are in parentheses

Over all our results are in line with other studies (e.g. (Gavalas and Syripoulos 2014) that examine the impact of the new Basel Accords on bank performance and suggest that (Gavalas and Syripoulos 2014, p. 43) "banks' responses will vary considerably from one European economy to another reflecting cross-country variations in the tightness of capital constraints, banks' net cost of raising equity, and elasticities of loan demand with respect to changes in loan rates".

5. Conclusion

In this paper, we examined the role and impacts of the liquidity and leverage variables on the profitability indicators (ROE, ROA) of Greek banks within the CRD IV/CRR framework and the new regulatory framework of Basel III, for the years 2004-2013, which include a period of credit expansion (2004 to 2008) and a period of (2009-2013), in order to reach useful conclusions regarding the policies that may be followed by bank administrators in order to be more competitive in the new economic environment.

Among the three variables examined, i.e. the leverage ratio, the liquidity coverage ratio, and the net stable funding ratio, the leverage ratio is the one which displays a statistically significant association with the profitability ratios in all models, indicating that banks with a higher leverage ratio use greater amounts of private equity to finance their assets, and therefore have greater motives to make the right decisions (i.e. banks with more debt may make better loans that are less likely to default and cause bank failure). This particular result is consistent with the financial theory, which indicates that debt is one of the most powerful mechanisms of controlling and disciplining the management of a bank, which consequently has less ability to use private equity to reward bad managerial decisions. This happens since the ability to repay debt requires higher profitability rates, which results in an increasing possibility of a proper investment plan. Greek banks, during the period of the credit crisis, displayed a high exposure to debt and faced a higher possibility of bankruptcy due to the fact that investors demanded high returns to refund maturing debt. Consequently, in both periods, the leverage ratio has a positive figure, which is explained by the fact that the greater the leverage banks have, the greater the risk they undertake, and therefore the greater the profit margin.

As far as the other two variables are concerned, i.e. the liquidity coverage ratio and the net stable funding ratio, the econometric analysis did not demonstrate any statistically significant relationship with profitability, neither for the total time period nor for the individual subperiods. An explanation to this may be that the model of bank funding in the Greek banking system is much more homogeneous compared with other banking systems, depicting a small dependence on interbank lending and greater dependence on more stable forms of funding, especially from deposits. The same may apply for the investment model followed by the Greek banking system, which was based on mortgage loans funding the real estate market. Consequently, the above variables show a possibly small differentiation between banks and small changes over time, and as a result do not correlate significantly with the profitability indicators. Of course, a different explanation, which cannot be examined in the present analysis, is the existence of a measurement error, which usually statistically weakens the relation between the stated variables of interest and the dependent

variables. Despite the above, the approximate computation of the specific independent variables is not a result of choice, but a compromise imposed by the lack of required data.

Regarding the other variables, the one with the strongest statistical correlation is the percentage of non-performing loans, which as was expected, shows a negative correlation with the profitability indicators. Moreover, an important negative correlation with profitability is shown by the percentage of funding from alternative sources over the total amount of short term funding, which is also consistent with the predictions of banking theory, since alternative forms of financing are the most unstable as they are the first to be interrupted in periods of financial crises, and as a result institutions with great exposure present a high risk of bankruptcy. Lastly, concerning the independent variables of secondary interest, the examination of their role in each of the sub periods (period of crisis and normal period) does not present important variations, since their importance as factors explaining profitability is limited.

As a result, the negative effects of a banking system with high exposure to debt from a macro-prudential view should always be weighted with the positive effects which are attributed to the discipline that debt imposes as a form of funding which as a result effectively aligns the motives of the management of banks with those of the shareholders which are none other than to maximize profit.Our findings provide some guidance on the unintended consequences of new solvency and liquidity standards, viz., new leverage requirements may force banks to shed highly liquid assets from their balance sheet thereby compromising their ability to manage liquidity when under stress.

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