Liquidity creation through M&As. A viable solution for the Greek banking system? Evidence from a stress test under a PVAR methodology.

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Abstract

The recent financial turmoil has distort the stability of the Greek banking sector and it's role as a financial intermediary. According to the deposit insurance hypothesis banks with higher levels of deposit insurance create higher level of liquidity around mergers. Employing new measures of liquidity creation and using a sample of all commercial banks for the period 1993-2010, we investigate whether potential M&As can be proved vital in alleviating the terms of the memorandum between Greece and the so-called Troika, enhancing the real economy, households and firms, with the creation of additional credit channels in the spectrum of a severe country default risk. We provide a comparative and an evaluating analysis of the "balance sheet forecasting method" with crucial implications regarding the trade off between shareholders' personal gains and society's economic prosperity, that triggers M&A activity. Lastly, we quote a stress test scenario in the spectrum of a panel vector autoregressive (PVAR) framework in order to examine thoroughly the robustness of the Greek banking sector on liquidity creation due to adverse macroeconomic conditions, in line with recently implemented regulations on banking supervision under the Basel III Accord.

Keywords: capital structure, liquidity creation, bank distress, M&As

JEL classification: G21, G28, G32, G34

1 Introduction

Almost five years have passed since the beginning of the financial crisis in July 2007 but the economic impact it caused to the real economy is still conspicuous. Regulators counteracted the crisis with drastic

monetary and fiscal expansion and are currently designing a stricter and more stable future financial system that would ensure less wild economic fluctuations and, hopefully, no repetition of the adverse events we are living through today. Comparing to credit risk, there are fewer literature to discuss with liquidity risk. Basel I Accord (Basel Committee on Banking Supervision, 1988) set out regulatory standards for credit risk Besides, Basel II Accord (Basel Committee on Banking Supervision, 2004) even takes operational risk into account. However, they seldom mention the liquidity risk. Landskroner and Paroush (2008) also indicated that there has been an extensive academic and regulatory discussion of the different major banking risks: credit risk, market risk and even operation risk. However relative little attention has been paid to liquidity risk that has become one of the major risks faced by banks and other financial institutions in recent years. Throughout the global financial crisis many banks struggled to maintain adequate liquidity. Unprecedented levels of liquidity support were required from central banks in order to sustain the financial system and even with such extensive support a number of banks failed, were forced into mergers or required resolution. The crisis illustrated how quickly and severely liquidity risks can crystallize and certain sources of funding can evaporate.

Bank liquidity came from abroad due to the incapability of domestic deposits to support the large expansion in credit growth. Nowadays, new liquidity is hard to come from abroad and in addition there is a crying need in shifting demand from consumption to investment. Thus, loan expansion requires domestic policy action, like reducing reserve requirements, capital increases in state-owned banks, increasing the minimum insurance on bank deposits, or come to terms with the IMF mechanism.

1.1 Greek sovereign debt crisis

In October 2008 the Greek government had announced a €28bn support package for Greek banks, consisting of €5bn of capital injections, €15bn of state loan guarantees and €8bn of liquidity in the form of special bonds. Greece's largest banks opted to participate in the capital-raising scheme, designed to bring their Tier 1 capital ratios above 8.5%. By June 2009, around 80% of the available state-supported capital injections were taken up. The banks took up 80% by June 2009, but then asked for the remaining €17bn of €28bn in the following April.

Greek banks lost access to the international wholesale market in early 2010 because of increasing perceived risks stemming from the fiscal crisis. As a result, they have relied almost exclusively on the E.C.B for funding, using government and other bonds as collateral. Greek banks drew a total of €97bn of liquidity from the E.C.B in 2010.

A number of steps have been taken to stabilise the Greek banking sector. First, the E.C.B decided in early May 2010 to waive Greece's minimum sovereign rating requirement to draw funds, ensuring that Greek banks will not be cut off from the emergency lending facility. Second, a new aid package for banks under the IMF/euro zone programme reinforces stability in the banking sector in the medium term. The package consists of an additional €15bn in loan guarantees offered by the Greek government as part of its support package, bringing the total amount of state-afforded liquidity up from €28bn to €43bn. Third, by the end of June 2010 a Financial Stability Fund (FSF) was created, consisting of a €10bn loan from the IMF/euro zone to be used to provide capital injections. Nevertheless, one year after Greece is still in serious danger of running out of cash and defaulting on its debt. The latter enforces the urgent need to find new sources of liquidity as it is globally highlighted in various articles (see, Katie Martin, June 1 2011, Wall street Journal) and is noted. that the basic problem of Greek banks is not capital but liquidity (June 7 2011, Reuters). European Central Bank (E.C.B) is the only source of lending for Greek banks. Now the banks complain that the E.C.B. is pressuring them to reduce their dependence on central bank funding, hurting not only the banks but Greek businesses and consumers who are unable to get credit. (June 21 2011, New York Times).

1.1.1 Private sector involvement (PSI)

All the aforementioned led us to March 2012 when, the new rescue plan for Greece signed in Brussels and accepted by private investors. It combines "new money" (130 billion from the EU and the IMF) with "debt recostruction".Private holders of the 177 billion Greek debt issued under Greek law (out of 206 billion of private debt) will take a 53.5 percent haircut on the debt's nominal value, with the remaining 46.5 per cent will be swapped for cash (15 percent) and for new longer term Greek debt (31.5 per cent), with an estimated present value cut of 75 percent. Yet, as pointed out by few observers (Nouriel Roubini,2012,), the direct Official Sector Involvement is also going to be considerable: the estimated 100 billion of total debt relief imposed on private creditors will be partly offset by the new 130 billion official money, which will go largely to private investors (15 billion in EFSF guarantees and about 30 billion for banks recapitalization).In addition, a positive result that emanates from the PSI was the upgrade of Greek economy from *RD* status (restricted default) to *B*- status, by one of the three largest rating agencies (Fitch).Nevertheless, the status *B*- which applies to the new bonds issued under Greek law, is still junk status, meaning they are not investment grade despite the huge cut to Greece's debt pile. However,

the upgrade of the Greek economy, boosts the confidence of E.C.B, who upgrades the collateral supplied to them by Greek banks. It is expected that this will immediately lead to an extra 25 billion euros of liquidity being available to lenders in Greece.

Nevertheless, Greece has seen a slow run on its banks, as companies and increasingly ordinary Greeks take their money out in cash, or move it to the safety of a bank account abroad. So the problem is not just that money has stopped flowing into Greece. Now money is actually flowing out of the country and that makes it even harder for the Greek banking system to fulfil its basic function of supporting the Greek economy. In turn, Greece is in a deep economic slump since banks aren't lending and consequently companies aren't investing. The latter enforces the urgent need to find new sources of liquidity in the Greek banking market.

Recently it was shown that banks with higher levels of deposit insurance create higher levels of liquidity around mergers., (Pana, Park, Query, 2010). A finding which is consistent with the *deposit insurance* hypothesis. Furthermore, Berger and Bouwman (2009) acknowledged the fact that lately banks get involved into various risky activities which are not being reported in their balance sheet. Consequently, they constructed four new measures of liquidity creation of banks that account not only for *on* but for *off* balance sheet bank activities as well. Their results, revealed that recently-merged banks create most of the industry's overall liquidity. Only a handful of empirical works focus on Greek M&As. Specifically, those papers concentrate their attention on aspects of bank's efficiency and it's productivity (see Athanasoglou, P. & Brissimis, S. 2004, , and Rezitis Anthony N. 2008), either on aspects of the possibility of a bank to be acquired according to it's performance (see Pasiouras, F., Zopounidis, C. 2008). Two more studies, investigate the impact of M&As on the performance of the Greek banking sector using an event study methodology (see Mylonidis,Kelnikola,2005 Liargovas Panagiotis, Repousis Spyridon., 2011). Our paper differentiates from the aforementioned studies on miscellaneous aspects. In turn, to the best of our knowledge, this is the first empirical work in the literature, that attempts to test the liquidity creation of all the Greek mergers and acquisitions that have taken place by using the recently developed measures of liquidity creation (Berger and Bouwman 2009), which take into consideration both *on* and *off* balance sheet activities of banks. Additionally, is the first study to address the question of whether potential M&As of Greek banks could lead to an increase of liquidity in the banking sector and consequently to the creation of new credit channels in the Greek economy, in the spectrum of a severe country default risk. The last point is of extreme importance as it highlights whether ineffec-

tual past attempts of M&As were due to limited personal potential gains of the shareholders or due to limited enhancement of the social welfare. Moreover, we provide a comparative analysis regarding the performance of the Greek banking sector in liquidity creation before and during the crisis. In the same spirit, we evaluate the power of the "*balance sheet forecasting method*". Last but not least, we quote a stress test scenario in the spectrum of a vector autoregressive (VAR) framework. in order to examine thoroughly and in a more integrated way the robustness of the Greek banking sector on liquidity creation due to adverse macroeconomic conditions. The last point is very crucial, since the new Basel III accord imposes a great emphasis on the liquidity standards of banks, and as a consequence it creates two additional ratio, the *liquidity coverage ratio* (LCR) and the *net stable funding ratio* (NSFR).

The rest of the paper is organized as follows. Section 2 offers a literature review of the merging and acquiring activity in the Greek banking sector and speculations about potential ones and the reasons that triggered them as well..In addition it quotes two competing hypotheses namely *"Financial fragility/crowding out"* hypothesis and the *"Risk absorption"* hypothesis. Section 3 provides an overview of theoretical framework and presents the methodology. Section 4 describes the data and specific endogenous and exogenous characteristics that affect liquidity and quotes the model specification. Section 5 presents and discusses the empirical evidence of applying the models to the Greek banking sector and provides robustness controls as well. In addition, we create both a comparative and a forecasting analysis, and a stress test scenario where we analyze the robustness of the Greek banking sector on liquidity creation and it's evolution before and during the crisis, while some conclusions are offered in the final section.

2 Literature review

2.1 Greek M&As

In the last two decades banking systems have displayed very high rates of consolidation via mergers and acquisitions (M&As) among different countries and regulatory environments around the world. These main causes for this unprecedented wave of M&As, which are common to most countries, are the deregulation and integration of financial markets as well as technological innovations and the development of new IT system. The main factors behind the M&A activity in the Greek banking sector during the second half of the 1990s were the country's forthcoming accession into the Economic and Monetary Union (EMU) and the

2.10 M&A Activity within Greece (1991 – 2006) (in € mn.)

The following table presents data on M&A activity in Greece in the last 16 years. It is worthy to note the involvement of foreign banks from 2004 onwards .

#	Year	Target	Buyer	Deal Size (€ mn.)	Price to Book Value	Price to PBT*
1	2006	Emporiki Bank	Credit Agricole	2,089.9	2.87	19.50
2	2006	Marfin Financial Group	Dubai Financial Group	401.6	2.03	30.24
3	2006	Egnatia	Marfin Financial Group	113.4	2.40	21.49
4	2005	Novabank	Millenium BCP Group	330.0	4.44	(19.55)
5	2005	Egnatia	Marfin Financial Group	30.6	1.42	13.85
6	2005	Panellinia	DZ Bank	8.5	2.81	65.53
7	2004	Geniki	Societe Generale	125.1	1.14	25.82
8	2002	ETBA	Pireaus	510.1	0.77	20.99
9	2002	Attica	Postal Savings	40.4	2.48	16.77
10	1999	Ergasias	Eurobank	1,821.7	15.93	27.55
11	1999	Ioniki	Alpha	798.2	5.59	42.24
12	1999	Doriki	Telesis	41.1	4.05	23.08
13	1999	Ergasias	Deutche Bank	19.7	0.95	1.76
14	1998	Xiosbank	Piraeus	243.8	15.15	51.52
15	1998	Bank of Crete	Eurobank	218.6	1.79	n/a
16	1998	Macedonian – Thrace Bank	Piraeus	80.0	3.54	n/a
17	1998	Geniki	Interamerican	51.7	3.66	34.94
18	1998	Bank of Central Greece	Egnatia	49.4	2.41	n/a
19	1998	Bank of Athens	Eurobank	26.2	3.01	n/a
20	1997	Attica	TSMEDE	27.6	2.31	107.08
21	1996	Interbank	Eurobank	47.0	1.78	n/a
22	1993	Bank of Athens	Hanwa First Investment Co.	14.2	1.21	n/a
23	1991	Piraeus	Privatisation	8.8	2.01	n/a

Source: Press Releases and Published Financial Statements
*Note: *PBT: Profit before Tax*

possible decrease in income this would cause, stronger competition in the domestic market and potential competition from foreign banks and the introduction and advancement of new technology. It's noteworthy that during 90's the strand on the greek banking market was a big wave of pritivizations and acquisitions of banks that where either directly either indirectly under state control (eg. acquisition of Macedonia-Thrace bank and Hellenic Industrial Development Bank by Piraeus bank and acquisition of Ionian bank by Alfa bank). An acquisition that caused stir in the market was that of Ergasias bank by Eurobank (1999).(see table below).

Another noteworthy fact is that after 2004, it's noticed a big wave of acquisitions of Greek banks by foreign banks, mostly French ones (eg. acquisition of Geniki bank by Societe Generale and Commercial bank(former Emporiki) by Credit Agricole..(France's Crédit Agricole group, which had a long-standing alliance with Emporiki, launched an offer to buy all of the outstanding shares in Emporiki, including the government's remaining 11% direct stake in the bank and the 29.5% held by public pension funds, in June 2006. The government and most of the pension funds accepted the offer, and Crédit Agricole came to control just under 72% of the bank's equity, with one-half of the rest held by small shareholders).(see table below).

2.9 Major M&A Activity (Jan. 2004 – Nov. 2006) (in USD mn.)

The following table presents recent mergers and acquisitions in which Greek Banks participated either on the "Buy" or the "Sell" side in the period Jan. 2004 – Nov. 2006.

#	Date Announced	Buyer	Buyer Country	Target	Target Country	% Sought	Deal Size (USD mn.)
1.	27-Nov-06[1]	Alpha Bank	Greece	Alternatifbank	Turkey	47.00%	246.30
2.	12-Oct-06[1]	EFG Eurobank Ergasias	Greece	Dominet Bank	Poland	100.00%	n/a
3.	29-Sep-06[1]	EFG Eurobank	Greece	DZI Bank	Bulgaria	74.26%	200.20
4.	11-Sep-06	ATE Bank	Greece	AIK Banka	Serbia	20.00%	n/a
5.	10-Sep-06	National Bank of Greece	Greece	Vojvodjanska Banka	Serbia	99.40%	488.60
6.	18-Jul-06	EFG Eurobank Ergasias	Greece	Universal Bank	Ukraine	99.34%	n/a
7.	23-Jun-06	ATE Bank	Greece	Mindbank	Romania	57.13%	41.07
8.	13-Jun-06	Credit Agricole	France	Emporiki Bank	Greece	63.13%	2,670.10
9.	15-May-06	Dubai Financial Group	Dubai	Marfin Financial Group	Greece	31.50%	486.55
10.	08-May-06[1]	EFG Eurobank Ergasias	Greece	Tekfenbank	Turkey	70.00%	182.00
11.	03-Apr-06	National Bank of Greece	Greece	Finansbank AS	Turkey	46.00%	2,770.00
12.	23-Mar-06	Marfin Financial Group	Greece	Egnatia Bank SA	Greece	19.49%	136.65
13.	17-Mar-06	EFG Eurobank Ergasias	Greece	National Savings Bank ad	Serbia & Montenegro	37.70%	42.30
14.	02-Feb-06	Marfin Financial Group	Greece	Laiki Bank	United Kingdom	9.98%	110.08
15.	04-Nov-05	Piraeus Bank	Greece	Atlas Banka	Serbia & Montenegro	8.23%	8.98
16.	11-Oct-05	New York Community Bancorp	United States	NBG / Atlantic Bank of New York	Greece	100.00%	400.00
17.	02-Sep-05	Marfin Financial Group	Greece	Egnatia Bank SA	Greece	10.07%	37.32
18.	25-Aug-05	EFG Eurobank Ergasias	Greece	National Savings Bank ad	Serbia	52.50%	50.88
19.	10-Aug-05	Alpha Bank	Greece	Jubanka AD	Serbia & Montenegro	11.36%	23.69
20.	18-Feb-05	Piraeus Bank	Greece	Atlas Banka	Serbia & Montenegro	80.00%	31.29
21.	25-Jan-05	Piraeus Bank	Greece	Eurobank AD	Bulgaria	99.70%	65.77
22.	25-Jan-05	Banco Comercial Português	Portugal	Novabank	Greece	50.00%	448.54
23.	12-Jan-05	Canadian Western Bank	Canada	National Bank of Greece (Canada)	Greece	100.00%	18.36
24.	31-Aug-04	Alpha Bank	Greece	Jubanka AD	Serbia & Montenegro	88.64%	183.00
25.	31-Mar-04	Societe Generale	France	Geniki	Greece	49.90%	105.44
26.	29-Feb-04	Societe Generale	France	Geniki	Greece	22.34%	44.72
27.	14-Jan-04	Societe Generale	France	Geniki	Greece	22.34%	48.02

Source: Mergerstat, Intelliner, Bloomberg, Athens Stock Exchange. Note: 1. Pending for conclusion

At present the result of all M&As that took place the last two decades is the creation of six dominant banking groups in Greece, namely National bank of Greece, EFG Eurobank, Alpfa bank, Piraeus bank, Commercial bank and Agricultural bank. Hence, markets expect the further M&As activity by the six major banks targeting smaller banks. Nevertheless, no one can be certain whether there will be any further activity. Economic theory suggests that M&As will continue mostly among small banks, since figures reveal that small banks operate under a 10% of ROE and with a 70% cost to revenue ratio, in a period when the same average figures for the Europe are 20% and 50% respectively. In turn it seems that this category of banks have not reached yet the size that will enable them to perform like their large competitors do.

2.1.1 Speculations

There is an increasing speculation in Greece about the possibility of mergers between banks, in order to give them greater clout in raising wholesale resources. In April 2010 Hellenic Postbank acquired a 32.9% in Aspis Bank. Hellenic Postbank is owned 34.4% directly by the government and 10% by Hellenic Post, which is completely owned by the Greek government. There have been rumours of Hellenic Postbank merging with NBG as part of a politically backed effort to create "one strong state bank and two to three private banks", in the words of the prime

minister, George Papandreou, in an interview in September 2010. Piraeus Bank proposed in 2010 a plan for merging with the financially strong Hellenic Postbank and ATEbank, which is problematic, yet rich in illiquid assets. The proposal was declined. National Bank of Greece submitted a proposal to Alpha Bank for a friendly merger on February 2011.The board of Alpha bank rejected unanimously the proposal Lastly (About a decade ago the same two banks tried to merge but the plan fell apart because corporate culture was very different and there were disputes over management roles between the two senior executive teams). Greece's second and third largest lenders Eurobank and Alpha bank on August 2011, rubber-stamped the deal to form the largest bank in southeast Europe, aided by a capital injection from the Qatar Investment Authority and the 23rd in Europe .The deal collapsed on March 2012 after the private sector's involvement (PSI) in debt recostruction. Nevertheless, recent announcement of Basel III rules on capital requirements and liquidity, which are intended to shore up the international banking system against further shocks, and pressures to Greek banks, by the so-called "troika" (European Union, International Monetary Fund and European Central Bank) to align with the principles if Basel III , create an expectation for further consolidation in the Greek banking sector in the recent future.

2.2 Financial fragility-crowding out" vs "Risk absorption" hypothesis

The primary reason why banks hold capital is to absorb risk, including the risk of liquidity crunches, protection against bank runs,an various other risks, most importantly credit risk. Although the reason why banks hold capital is motivated by their risk transformation role, recent theories suggest that bank capital may also affect banks' ability to create liquidity. these theories produce opposing predictions on the link between capital and the change in liquidity creation around mergers.

The"financial fragility crowding out" hypothesis – predicts that higher capital reduces liquidity creation. Diamond and Rajan (2001) model an investment bank that raises funds from investors to provide financing to an entrepreneur, in which the entrepreneur may withhold effort, which reduces the amount of bank financing attainable. More importantly, the bank may also withhold effort, which limits the bank's ability to raise funding. A deposit contract mitigates the bank's hold-up problem because depositors can run on the bank if the bank threatens to withhold effort and therefore maximises the liquidity creation. Providers of capital cannot run on the bank, which limits their willingness to pro-

vide funds, and hence reduces the liquidity creation – thus, the higher a bank's capital ratio, the less liquidity it will create. Gorton and Winton (2000) show a higher capital ratio may reduce liquidity creation through the crowding out of deposits and argue that deposits are more effective liquidity hedges for investors than investments in equity capital. Thus, the higher capital ratios shift investors' funds from relative liquid deposits to relative illiquid bank capital, reducing the overall liquidity for investors

Other hypotheses – the "risk absorption" hypotheses – argue that higher capital enhances banks' ability to create liquidity based on two strands of literature. The first argues that liquidity creation exposes a bank to risk as the more liquidity it creates, the greater the likelihood and severity of losses associated with having to dispose of illiquid assets to meet the liquidity demands of the customers (Allen and Santomero 1998; Allen and Gale 2004). The second argues that bank capital absorbs risk and expands banks' risk-bearing capacity (Bhattacharya and Thakor 1993; Repullo 2004; Von Thadden 2004; Coval and Thakor 2005). Combining these two strands yields the prediction that higher capital ratios may allow banks to create more liquidity.

3 Theoretical Framework

Liquidity creation by banks has historically been measured as the loans-to-asset ratio as shown in Hughes et al. (1996a). However this approach has been criticized for failing to consider how off-balance sheet activities are treated and how loans are classified. The existing literature indicates that there have only been two papers that measure bank liquidity creation: one by Berger and Bouwman (2009) in which a three-step approach is employed, and a second by Deep and Schaefer (2004), in which a measure of liquidity transformation is constructed and applied to data gathered from 200 of the largest US banks over the period 1997-2001. The liquidity transformation gap, or "LT gap," is defined as liquid liabilities minus liquid assets divided by total assets (Deep and Schaefer,2004). All loans with a maturity of 1 year or less are considered to be liquid in this model and loan commitments and other off-balance sheet activities are explicitly excluded due to their contingent nature. The LT gap was found to be about 20% of total assets on average for the sample of large US banks and the conclusion reached was that these banks do not appear to create much liquidity. Further tests were conducted to explain this result, for example an examination of the roles of insured deposits, credit risk and loan commitments.

Berger and Bouwman (2009) averred that the LT gap is a step forward, but argued that it is not sufficiently comprehensive by high-

lighting a few differences between their approach and the LT gap developed by Deep and Schaefer (2004). Firstly, the Berger/Bouwman model includes almost all commercial banks and compares findings for large and small banks rather than including only the largest institutions. The Berger/Bouwman model also classifies loans by category, rather than maturity and finally, the Berger/Bouwman model employs measures which include off-balance sheet activities, consistent with the arguments of Kashyap et al. (2002), and Repullo (2004)..

Berger and Bouwman(2009) as we aforementioned construct their liquidity creation measure using a three step approach. In step 1, they classify all bank balance sheet and off-balance sheet activities as liquid, semi-liquid, or illiquid based on the ease, cost, and time for banks to dispose of their obligations to obtain liquid funds to meet customers' demands. Within each category, shorter maturity items are defined as more liquid than longer maturity items because they self-liquidate without as much effort. Loans are classified by category ("cat") or entirely by maturity ("mat") because bank Call reports split loans into various loan categories and into different maturity classes.

In step 2, Berger and Bouwman assign weights to the activities classified in step 1. The weights are based on the liquidity creation theory where banks create the most liquidity when they transform illiquid assets into liquid liabilities and maximum liquidity is destroyed when liquid assets are transformed into illiquid liabilities. Therefore positive weights are applied to both illiquid assets and liquid liabilities and negative weights to liquid assets and illiquid liabilities. The magnitudes of the weights are based on simple dollar-for-dollar adding up constraints, so that $1 of liquidity is created (destroyed) when banks transform $1 of illiquid (liquid) assets into $1 of liquid (illiquid) liabilities.

In step 3, the authors combine the activities as classified in step 1, an weighted according to step 2, to construct four liquidity measures. The measures classify loans by category or maturity ("cat" vs "mat") and whether banks include off-balance sheet activities ("fat") or exclude them ("nonfat"). Thus, liquidity creation measures are constructed based on the four combinations "cat fat", "mat fat", "cat nonfat", "mat nonfat".

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Liquidity classification of bank activities and construction
of four liquidity creation measures


Step 1:
 We classify all bank activities as liquid, semiliquid, or illiquid.
For activities other than loans, we combine information on product category
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and maturity. Due to data limitations,

we classify loans entirely by product category ("cat") or maturity ("mat").

Step 2:
We assign weights to the activities classified in step 1.

Assets
Illiquid assets (weight=1/2)Category

Commercial real estate loans (CRE)

Loans to finance agricultural production

Commercial and industrial loans (C&I)

Other loans and leases financing

Receivables

Maturity

Loans and leases with a remaining maturity >1 year

Category and maturity

Other real estates owned

Customers liability on bankers' acceptances

Investment in unconsolidated subsidiaries

Intangible assets

Premises

Other assets

Semiliquid assets (weight=0)Category

Residential real estate loans (CRE)

Consumer loans

Loans to depository institutions

Loans to state and local governments

Loans to foreign institutions

Maturity

Loans and leases with a remaining maturity .≤1 year

Liquid assets (weight=-1/2)Category

Cash and due from other institutions

All securities (regardless of maturity)

Trading assets

Central bank's funds sold
Liabilities
Liquid liabilities (weight=1/2)Category

plus
Transactions deposits
equity
Savings deposits

Trading liabilities

All securities (regardless of maturity)

Trading assets

Semiliquid liabilities (weight=0)Category

Time deposits

Other borrowed money

Illiquid liabilities (weight=-1/2)Category

Bank's liability on bankers acceptances

Subordinated debt

Other liabilities

Other borrowed money

Equity

Other borrowed money
Off balance sheet
Financial Guarantees
Illiquid guarantees (weight=1/2)

equity
Unused commitments

Net standby letters of credit

Commercial and similar letters of credit

All other off-balance-sheet liabilities

Semiliquid guarantees (weight=0)

Net credit guarantees

Net securities guarantees

Liquid guarantees (weight=-1/2)

Net participations acquired
Off balance sheet
Financial Derivatives
Liquid derivatives (weight=1/2)

Interest rate derivatives

Foreign exchange derivatives

Equity and commodity derivative

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Step 3:
We combine bank activities as classified in step 1 and as weighted in step 2
in different ways to construct four liquidity creation measures
by using the ‘‘cat’’ or ‘‘mat’’ classification
for loans, and by alternatively including off-balance sheet activities (‘‘fat’’)
or excluding these activities (‘‘nonfat’’).
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In turn, the four liquidity measures obtain the following form:

$$
\begin{aligned}
&"cat\ fat":LC = \\
&\left\{\tfrac{1}{2} \times illiquidassets(cat) + 0 \times semiliquidassets(cat) - \tfrac{1}{2} \times liquidassets\right\} \\
&+ \left\{\tfrac{1}{2} \times liquidliabilities + 0 \times semiliquidliabilities - \tfrac{1}{2} \times illiquidliabilities - \tfrac{1}{2} equity\right\} + \\
&\left\{\begin{array}{c} \tfrac{1}{2} \times illiquidguarantees + 0 \times semiliquidguarantees \\ -\tfrac{1}{2} \times liquidguarantees - \tfrac{1}{2} liquidderivatives \end{array}\right\}
\end{aligned}
$$

$$
\begin{aligned}
&"cat\ nonfat":LC = \\
&\left\{\tfrac{1}{2} \times illiquidassets(cat) + 0 \times semiliquidassets(cat) - \tfrac{1}{2} \times liquidassets\right\} \\
&+ \left\{\tfrac{1}{2} \times liquidliabilities + 0 \times semiliquidliabilities - \tfrac{1}{2} \times illiquidliabilities - \tfrac{1}{2} equity\right\}
\end{aligned}
$$

$$
\begin{aligned}
&"mat\ fat":LC = \\
&\left\{\tfrac{1}{2} \times illiquidassets(mat) + 0 \times semiliquidassets(mat) - \tfrac{1}{2} \times liquidassets\right\} + \\
&\left\{\tfrac{1}{2} \times liquidliabilities + 0 \times semiliquidliabilities - \tfrac{1}{2} \times illiquidliabilities - \tfrac{1}{2} equity\right\} + \\
&\left\{\begin{array}{c} \tfrac{1}{2} \times illiquidguarantees + 0 \times semiliquidguarantees \\ -\tfrac{1}{2} \times liquidguarantees - \tfrac{1}{2} liquidderivatives \end{array}\right\}
\end{aligned}
$$

$$
\begin{aligned}
&"mat\ nonfat":LC = \\
&\left\{\tfrac{1}{2} \times illiquidassets(mat) + 0 \times semiliquidassets(mat) - \tfrac{1}{2} \times liquidassets\right\} + \\
&\left\{\tfrac{1}{2} \times liquidliabilities + 0 \times semiliquidliabilities - \tfrac{1}{2} \times illiquidliabilities - \tfrac{1}{2} equity\right\}
\end{aligned}
$$

Berger and Bouwman (2009) suggest that "cat fat" is the preferred liquidity creation measure, because in this specific category they can treat business loans as illiquid regardless of their maturity because banks generally cannot easily dispose of them to meet liquidity needs, and they treat residential mortgages and consumer loans as semiliquid because these loans can often be securitized and sold to meet demand for liquid funds. In addition, this measure includes off-balance sheet activities, consistent with the arguments in Holmston and Tirole (1998) and Kashyap, Rajan Stein (2002) who suggest that banks also create

liquidity off the balance sheet through loan commitments and similar claims to liquid funds.

To investigate whether M&As of banks lead to liquidity creation, we model changes in liquidity creation on a set of variables that describe the impact of M&As and other bank characteristics that may affect bank liquidity creation on a yearly basis. Our dependent variable ("cat fat"-liquidity measure) is divided by GTA (gross total assets). Normalization by GTA is necessary to make the dependent variables meaningful and comparable across banks and to avoid giving undue weight to the largest institutions. All financial values are expressed in real values, using the implicit GDP price deflator.

We denote as (t) the year of the merger or acquisition, and $(t-1)$ and $(t+1)$ the year before and after the merger respectively. Focarelli and Panetta (2003) mention a gestation period of three years for efficiency gains to be fully realised, Erel (2009) documents that significant changes are made within a year after the merger. Therefore, it is believed that the difference between the liquidity creation over the two-year interval $(t-1, t+1)$, where t is the year when the merger was completed, best capture the short-term impact of the merger on liquidity created by merger participants.

4 Data

For the estimation of the model we will use data that consist of an unbalanced panel of all the commercial banks that were operating in the Greek banking system for the 1993-2010 period. The sources for our data set will be based upon:

a. Bankscope database of Bureau van Dijk's company (data of 2011 are not reported in bankscope database yet).

b. The official websites of the Greek banks

c. The annual reports of the Governor of the Bank of Greece (1993-2010).

Commercial banks incorporated in Greece have been the dominant group in the banking system. Overall, our sample accounts for a significant market share in terms of assets (around 80 per cent).(Hellenic Banking association 2011).[1] Within these years we have the full liberalization of the Greek banking system and the introduction of the

[1]Specialized credit institutions are excluded from the analysis, as they operate quite differently from the commercial banks and cooperative institutions are excluded as well because their market share in terms of assets is (less than 1 per cent) and they operate under different legal form. As far as it concerns the foreign banks' branches in Greece, according to the Greek law their are not required to publish full-blown annual financial statements and thus they are excluded from our sample.

Economic and Monetary Union (EMU). Consequently, major structural changes occurred in the Greek environment coming from the macroeconomic stabilization programme, the establishment of advanced information technologies, the internalization of banking activities, which enhanced competition in both price and quality levels. Additionally, in our sample we capture the recent Greek sovereign debt crisis We will use both balance sheets and income statements. Furthermore we will use three groups of variables to pursue our empirical analysis in order to control for the impact that may have on the change in liquidity. Precisely, we control for bank specific, or merger-related variables, for market economic conditions and for supervisory and regulatory conditions.

4.1 Bank-specific variables

We control for bank size and we use the bank's real assets in order to measure this variable, for banks' risk and we use the ratio of loans to loss provisions to total assets and for capital adequacy where we use the equity to assets ratio.to measure this variable Moreover, we account for physical capital, we measure it by the bank's fixed assets and lastly we account for banks' operating expenses and we measure it by the ratio of operating activities to total assets ratio.

4.2 Market economic environment

We account for market concentration by the Herfindahl-Hirshman index(HHI) which is defined as the sum of the squares of the market shares of all banks in the particular banking market. We also account for the macroeconomic conditions of the Greek banking market using the rate of change in GDP. Macroeconomic variables are available from International Monetary Fund's (IMF) World Economic Outlook (WEO) Database.

4.3 Supervisory and Regulatory Risk Causes

After the subprime mortgage crisis, we realized that government regulation and supervisory practices are important for banking. We use official supervisory power index (OSP), private monitoring index (PMI), and overall bank activities and ownership restrictiveness (BAR) to proxy government regulation and supervisory practices. Supervisory and regulatory variables are available from Barth et al. (2004).

4.4 Model

We base our analysis on the preferred liquidity measure of Berger and Bouwman (2009), more specifically the "$catfat$". We test all the M&As that took place during our sample, to check the level of their liquidity the years after M&A activity had been completed.

Following (Pana et al. 2010), in order to examine the financial fragility-crowding out and risk absorption hypotheses, the following regression equations are estimated:

$$\left(\frac{catfat}{GTA}\right)_{i,t+1} - \left(\frac{catfat}{GTA}\right)_{i,t-1} = a_0 + a_1 \left(\frac{Uninsured\ deposits}{GTA}\right)_{i,t-1} + a_2 \left(\frac{Bank\ capital}{GTA}\right)_{i,t-1}$$
$$+ a_3 \operatorname{Re} lativesize_{i,t-1} + a_4 Risk_{i,t-1} + a_5 Physical\ capital_{i,t-1} + a_6 Operating$$
$$\exp enses_{i,t-1}$$
$$+ a_7 HHI_{i,t-1} + a_8 Rate\ of\ change\ in\ GDP_{i,t-1} + a_9 OSP + a_{10} PMI +$$
$$a_{11} BAR + \varepsilon_{i,t}$$

In order to measure the bank's ability to absorb shocks occurring from the merges and acquisitions, we use HHI of revenue diversification measure:

$$HHI_{REV=} \left(\frac{NON}{NETOP}\right)^2 + \left(\frac{NET}{NETOP}\right)^2$$

$$NETOP = NON + NET$$

where NON is non interest income, NET is net interest income, and $NETOP$ is net operating revenue.

As the HHI_{REV} rises, the bank revenue stream becomes more concentrated and less diversified. While other measures of bank risk absorption ability are more popular in the banking literature (eg the ratio of commercial real estate to total loans, or the ratio of jumbo certificates of deposit (CDs) to assets), the revenue diversification measure is preferred because it avoids the use of balance sheet items, and thus mitigates the endogeneity problem

5 Empirical results

Year	Acquirer	Target	Merged Bank
1997*	National Mortgage Bank of Greece SA (7th)	National Housing Bank of Greece SA |	(5th)
	a. 1296.55 b.1158 c. 0.517792 d. 0.5620681 e. 42.08	a. 79.0535 b. 79.0535 c.NA d. NA E. NA	a.1498.6 b.1292.55 c. 0.5056085 d. 0.5773988 e.36.97
1997	National Bank of Greece	National Mortgage Bank of Greece SA |	
	a.6327.3 b.4653.2 c. 0.2339324 d. 0.2583378 e. 29.85	a.1498.6 b.1292.55 c. 0.5056085 d. 0.5773988 e.36.97	a. 8520.55 b. 6271.6 c. 0.3123032 d. 0.3158066 e. 31.27
1998	EFG Eurobank (10th)	Creta Bank	(8th)
	a.877.35 b.730.25 c.0.4596407 d. 0.4239498 e.28.69	a. 635.75 b. 516.55 c. 0.6038727 d. 0.6672401 e.22.59	a.1528.35 b.1316.7 c. 0.3735909 d. 0.3570968 e.36.79
1998	EFG Eurobank (10th)	Bank of Athens	(8th)
	a.877.35 b.730.25 c. 0.4596407 d. 0.4239498 e. 28.69	a.151.3 b. 143.05 c. 0.6737589 d. 0.6307303 e. 27.3	a.1528.35 b.1316.7 c. 0.3735909 d. 0.3570968 e.36.79
1998	Piraeus Bank	Macedonia Thrace Bank SA	s
	a. 977.75 b. 487.7 c. 0.5739806 d. 0.6310076 e.25.92	a. 920.85 b. 640.95 c. 0.5394629 d. 0.5674378 e. 39.56	a. 3041.6 b. 1810.1 c. 0.576669 d. 0.5555058 e. 36.03
1998	Piraeus Bank	Xios Bank	
	a. 977.75 b. 487.7 c. 0.5739806 d. 0.6310076 e.25.92	a. 482.85 b. 414.8 c. 0.3700997 d. 0.392776 e. 58.21	a. 3041.6 b. 1810.1 c. 0.576669 d. 0.5555058 e. 36.03
1998	Egnatia bank (15th)	Bank of Central Greece	(10th)
	a. 338.6 b. 297.95 c 0.6259602 d 0.6251761 e.39.99	a. 240.6 b. 172.05 c 0.6073432 d. 0.5678188 e. 40.31	a. 827.2 b. 649.9 c. 0.6167493 d 0.5970004 e. 38.54
1999	Alpha Bank	Ionian and Popular Bank of Greece	
	a. 7136 b. 4960.3 c. 0.5958329 d. 0.711801 e. 19.59	a. 2726.046 b. 2726.046 c. 0.3895094 d. 0.4369779 e. 29.57	a. 13642.3 b. 9505.9 c. 0.572824 d. 0.7135509 e. 22.33
1999	EFG Eurobank	Ergobank SA	
	a.1528.35 b.1316.7 c. 0.3735909 d. 0.3570968 e.36.79	a. 1762.35 b. 1339.35 c. 0.491232 d 0.4830387 e. 45.14	a. 7020.15 b. 6087.55 c. 0.7887523 d. 0.6957919 e. 22.58
1999	TELESIS Investment Bank S.A.	DWRIKI	
	a. 67.7 b. -73.8 c. 0.5737931 d. 0.3519458 e. 63.86	a. 164.6429 b. 164.6429 c.NA d. NA e. NA	a.160.55 b.108.45 c. 0.7373599 d. 0.4940221 e. 44.49

a. cat-fat, b. cat-nonfat, c.liquidity measure I, d. liquidity measure II, e. liquidity measure III

Year	Acquirer	Target	Merged
2000	EFG Eurobank (4th)	TELESIS Investment Bank S.A.	(3rd)
	a. 7020.15 b. 6087.55 c. 0.7887523 d. 0.6957919 e. 22.58	a.160.55 b.108.45 c. 0.7373599 d. 0.4940221 e. 44.49	a. 9426.95 b. 8391.1 c. 0.8217224 d. 0.7197909 e. 15.11
2001	Piraeus Bank	Hellenic Industrial Development Bank ETBA	
	a. 6876.8 b. 5063.1 c. 0.6978155 d. 0.8214557 e.17.31	a. 360 b. 75.15 c. 1.294384 d. 0.8975853 e. 8.36	a. 7963.65 b. 7007.25 c. 0.6834169 d. 0.8291903 e. 6.24
2002	National Bank of Greece	National Investment Bank for Industrial Development SA - ETEBA	
	a.30616.8 b. 19115.85 c. 0.5787164 d. 0.6112511 e. 13.81	a.290.4 b. 284.8 c. 0.4653476 d. 1.049587 e. 11.65	a. 34333.3 b. 19367.7 c. 0.5711739 d. 0.6332874 e. 13.6
2002	EFG Eurobank	UNITBANK	(2nd)
	a. 23715.45 b. 10979.2 c. 0.7123328 d. 0.7577285 e.11.36	a. 141.585 b. 141.585 c. NA d. NA e. NA	a. 24350.6 b. 12056.55 c. 0.7943757 d. 0.7539549 e. 9.26
2004	Emporiki Bank of Greece SA	Bank of Investments	
	a.12231.3 b. 10694.95 c. 0.8682783 d. 0.9263729 e.9.05	a. -71.1735 b. -71.1735	a.12599.1 b. 11275.9 c. 0.9063804 d. 0.8746154 e. 11.06
2005	Proton Bank (24th)	Omega Bank	(15th)
	a. -140.9 b. -161.95 c. 1.401163 d. 0.3175231 e. 310.66	a. 693 b. 664.3 c. 0.7487239 d. 0.7317606 e. 21.35	a. 772.6 b. 703.4 c. 0.8201887 d. 0.6816808 e. 33.05
2006**	Marfin Bank (17th)	Egnatia bank	(7th)
	a. 31.35 b. 13.55 c. 0.5890338 d. 0.4132684 e. 42.97	a. 5218.85 b. 5224.85 c. 0.7893995 d. 0.7394179 e. 27.35	a. 8102 b. 8124.4 c. 0.8235078 d. 0.8693416 e. 24.4
2006	Marfin Bank (17th)	Laiki Bank	(7th)
	a. 31.35 b. 13.55 c. 0.5890338 d. 0.4132684 e. 42.97	a.2040.85 b. 2042.25 c. 0.842326 d. 0.8676656 e. 23.48	a. 8102 b. 8124.4 c. 0.8235078 d. 0.8693416 e. 24.4
2007	Aspis Bank (12th)	FBB First Business Bank SA	(8th)
	a. 1760.8 b. 1760.8 c. 0.8540021 d. 0.7893375 e. 24.02	a. 1032.35 b. 1032.65 c. 0.8327019 d. 0.9326067 e.23.28	a. 1903.95 b. 1798.25 c. 0.9188535 d. 0.8449065 e. 14.74
2009	TT Hellenic Postbank	Aspis***	
	a. 7163.75 b. 7147.6 c. 0.4833752 d. 0.5800318 e. 17.7	a. 1567.65 b. 1494.95 c. 0.869668 d. 0.663143 e. 11.58	a. 7551.7 b. 7528.35 c. 0.5247489 d. 0.6260116 e. 8.93

a. cat-fat, b. cat-nonfat, c.liquidity measure I, d. liquidity measure II, e. liquidity measure III

The table reports all the Mergers and Acqusitions that we examine in our analysis. We present the difference in the five liquidity creation measures between the acquirers and targets, before and after the M&A took place. There is a strong empirical evidence of increased liquidity that is created after the M&A activity. It's noteworthy to mention, that the latter result is supported in all the M&As cases that we examine and by all the different liquidity measures.

In progress "Examination the financial fragility-crowding out and risk absorption."

5.1 Robustness issues

In order to examine the robustness of our findings we will pursue the same empirical analysis using conventional measures of liquidity : $i.)\frac{total\ loans-provisions}{customers\ deposits+bank\ deposits}, ii.)\frac{total\ loans-provisions}{stable\ assets}, iii.)\frac{liquid\ assets}{deposits\ \&\ short\ term\ funding}$ (Hughes et al. 1996a, Journal of Money, credit and Banking).In terms of convenience we name them *liquidity measure I.*, *liquidity measure II.*, *liquidity measure III.* In addition, we compare our main results with the another liquidity measure "mat-fat", "cat-nonfat", "mat-nonfat" proposed by Beger and Bouwman 2009 whixh includes off-balance sheet activities. (Due to anavailabilty of data in terms of maturity we do not show results in this direction).

where as *stable assets*, we refer to the sum of customers deposits, the borrowed assets from the government or the central bank, the medium term liabilities (loans and securities with a maturity greater than a year) and the free assets (equity capital without the subsidiaries and fixed assets).

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5.2 Comparative and Forecasting analysis

We measure the liquidity creation of potential M&As according to the aforementioned "speculated" cases. As additional scenarios of M&As we create potential mergers and acquisitions among the six most important banks in terms of assets, loans and deposits (National bank of Greece, EFG Eurobank, Alpfa bank, Piraeus bank, Commercial bank (former Emporiki bank), Agricultural bank, (we exclude two cases, Ethniki-Alpha and Eurobank-Alpha as we include them in the "speculation" section).

The way to achieve that, is the following:

In the first step, we use banking data in the closing of the year 2008, when the global financial crisis didn't have an impact on Greece yet and we measure the liquidity that they create. Furthermore, we conduct

a forecasting analysis regarding the performance of the merged and a acquired banks in creating liquidity in the preceding years of the crisis. We base our analysis upon the *"balance sheet forecasting method"* which is an estimate of what a banks owes and owns at a particular time. As a second step, we repeat the same procedure of step one with the only difference now that we use banking data in the closing of the year 2010, when Greece confronts a period with crisis. In this way, we test whether the level of liquidity that had been created by the same potential M&As, has changed due to the crisis. Moreover, we manage to extract inferences regarding the predictability power of the aforementioned forecasting method.

Lastly, we create three cornerstones among banks in terms of ownership. More specifically, we construct a public, a private and a mixture of public and private cornerstone to test and compare as before, their performance in creating liquidity, before and during the crisis.

$TABLE - OF - POTENTIAL - M\&As$
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5.3 Stress test scenario

Bank liquidity was traditionally viewed as of equal importance to their solvency. Liquidity risks are inherent in maturity transformation, i.e., the usual long-term maturity profile of banks' assets and short-term maturities of liabilities. Banks have commonly relied on retail deposits, and, to some degree, long-term wholesale funding as supposedly stable sources of funding. Yet, attention to liquidity risk diminished in recent decades, was symbolized by the absence of consideration of liquidity risk in the 1988 Basel I framework. The global financial crisis has clearly shown that neglecting liquidity risk comes at a substantial price. Over the last decade, large banks became increasingly reliant on shortterm wholesale funding (especially in interbanking markets) to finance their rapid asset growth. At the same time, funding from non-deposit sources (such as commercial paper placed with money market mutual funds) soared. With the unfolding of the global financial crisis, when uncertainties about the solvency of certain banks emerged, various types of wholesale funding market segments froze, resulting in funding or liquidity challenges for many banks In the light of this experience, there is now a widespread consensus that banks' extensive reliance on deep and broad unsecured money markets pre-crisis is to be avoided Creating substantial liquidity buffers across the board is the explicit aim of a number of regulatory responses to the crisis, such as the CEBS Guidelines on liquidity buffers (CEBS 2009b) as well as the forthcoming Basel III liq-

uidity standardsthe Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR).

In order to investigate in a more appropriate way the robustness of the Greek banking sector on liquidity creation, we create a hypothetical environment, similar to a stress test scenario. The idea here is to create a stress environment which will be composed by the potential scenario of liquidity shortage faced by the banks due to adverse macroeconomic without jettison the financial condtitions as well. In turn, we use lagged and current values of the level of the growth rate of gross domestic product (GDP), the level of policy interest rates described by the three month treasury bill rate, the level of the real effective exchange rate, the level of the three month interbank rate the level of total problem loans as well, since the aforementioned variables directly affect the liquidity of banks. Thus, we want to investigate whether the liquidity created by non -merged or acquired- banks would be more or less than the liquidity that would have been created if the banks were actually merged or acquired. To perform this test we use data of the year 2007, which have not been affected by the impending crisis and we compare the results in terms of the level of the liquidity that is created by the potential merged or acquired banks, with the results deriving from actual data of those banks (where there is no M&A activity of the following years of our sample 2008, 2009,2010). Then, we repeat the test, with the only difference, that this time we use data up to the year 2009 that contain elements of the crisis and we compare the results specifically of the year 2010[2]. Hence, we forecast the liquidity creation and compare the results of the same two possible scenarios (banks to be involved or not in a M&A activity in 2010). To pursue this analysis, our econometric procedure lies upon the framework of a vector autoregressive (VAR) model to implement a stress test in banking. A vast body of literature endorses the fact that the changes in the macroeconomic conditions of any economy do impact banks' performance, simultaneously or with lag. It is also possible that the feedback effects of bank instability on real economic activity could amplify the fluctuations especially during recessions. Therefore, in order to judge the resilience of banking on various macroeconomic shocks, Vector Autoregressive (VAR) approach has been adopted as done by Hoggarth, Sorensen and Zicchino (2005), Marcucci and Quagliariello (2005) and Renato Filosa (2007). The advantage of VAR model is that, it allows to fully capture the interaction among macroeconomic and financial variables and banks' liquidity vari-

[2]Due to unavailabilty of data for the year 2011, we can only compare the results only one time horizon ahead. We intend to examine the robustness of the test, the moment data of the year 2011 are available.

able. It also captures the entailed feedback effect. We use a panel-data vector autoregression methodology (Holtz et al. 1988).This technique combines the traditional VAR approach, which treats all the variables in the system as endogenous, with the panel-data approach, which allows for unobserved individual heterogeneity [3]

In turn the VAR can be represented in the following general form:

$$Z_{t+p} = \Gamma + \sum_{j=1}^{q} \Phi_j Z_{t+p-j} + d_i + \varepsilon_{t+p}$$

where Γ is a constant vector, Φ_j are matrices, ε_{t+p} is a vector of residuals/shocks, and p denotes the forecasting time horizon. Z_{t+p-j} is the vector of endogenous variables including the growth rate of GDP, the policy interest rates, the real effective exchange rate, the three month treasury bill rate and the level of bad loans loans . In addition to the macroeconomic variables, Z_{t+p-j}also includes the level of liquidity creation using the preferred measure "$cat\ fat$", the three convetional measures of liquidity. We allow for fixed effects as well, represented by d_i The equation in the model for the preferred measure of liquidity creation and thus the equation defining the shock to the preferred measure of liquidity, is of the following form:

$$lc_{t+p} = \gamma_{lc} + \phi_{lc} Z_{t+p-1} + \varepsilon_{lc,t+p}$$

where lc_{t+p} represents the liquidity creation measure("$cat\ fat$"), $\varepsilon_{lc,t+p}$ is a white noise shock, γ_{lc} is a constant, ϕ_{lc} is a row vector parameters corresponding to the row of coefficients in Φ_p in the equation of the liquidity creation. Z_{t+p-1} is the vector of the variables included in the VAR including the liquidity creation itself. The last equation describes the determinants of the bank liquidity creation which are lagged values of the variables included in the VAR. Modelling the dynamics of the macroeconomic and the financial variables and the liquidity creation variable using a VAR has the advantage that impulse response analysis can be carried out – the stress test proposed in this paper. By estimating the system, it is possible to simulate various shocks to the macroeconomic and financial variables and consider the feedback from these shocks to the level of liquidity created by a bank and thus the aggregate level of a country's liquidity need. Equivalently, one can investigate whether

[3] The panel-data vector autoregression model was employed in Stata by using Inessa Love's PVAR code.

shocks to the liquidity of the banks have an impact on future macroeconomic or financial developments.

Since the variance-covariance matrix of the VAR residuals/shocks is unlikely to be diagonal, theresiduals need to be orthogonalised. A common procedure is to apply a Cholesky decomposition, which is equivalent to adopting a particular ordering of the variables and allocating any correlation between the residuals of any two elements to the variable that is ordered first. It is well known that these impulse response functions can be sensitive to the ordering of the variables. In turn, the variables in the model were initially ordered in ascendance according to the likely speed of reaction to any particular shock. Variables at the front end of the VAR are assumed to affect the following variables contemporaneously but only to be affected themselves by shocks to the other variables after a lag. Variables at the bottom of the VAR, on the other hand, only affect the preceding variables after a lag but are affected themselves immediately. The financial variables – three month treasury bill rate, the level of the real effective exchange rate, the level of the three month interbank rate – were ordered at the bottom of the VAR implying that they react instantaneously to shocks in the real side variables whereas the other variables (eg the growth rate of gross domestic product, the level of total problem loans and the the level of liquidity,) react only after a lag following shocks to the financial variables. The growth rate of gross domestic product was ordered after the "bad loans" reflecting priors that the economic cycle affects bank losses Economic Monetary Union. Last was ordered the variable of our interest, liquidity. As a robustness check, different orderings of the variables were considered and the impulse responses

computed using the 'generalised impulse' function described in Pesaran and Shin (1998). The latter method constructs an orthogonal set of shocks that does not depend on the variable ordering. In an attempt to extend the robustness issue we consider three more VAR models, where our variable of interest is *liquidity measure I.*, *liquidity measure II.*, *liquidity measure III* respectively, insted of $catfat$.

In applying the VAR procedure to panel data, we need to impose the restriction so that the underlying structure is same for each cross-sectional unit. Since this constraint is likely to be violated in practice, one way to overcome the restriction on parameters is to allow for "individual heterogeneity" in the levels of the variables by introducing fixed effects, denoted by d_i in the model (Love and Zicchino, 2006). Since the fixed effects are correlated with the regressors due to lags of the dependent variables, the mean-differencing procedure commonly used to eliminate fixed effects would create biased coefficients. To avoid

this problem we use forward mean differencing, also referred to as the 'Helmert procedure' (see Arellano and Bover, 1995). This procedure removes only the forward mean, i.e., the mean of all the future observations available for each bank-year. This transformation preserves the orthogonality between transformed variables and lagged regressors, so we can use lagged regressors as instruments and estimate the coefficients by system GMM. Further, to analyze the impulse response functions we need an estimate of their confidence intervals. Since the matrix of impulse-response functions is constructed from the estimated VAR coefficients, their standard errors need to be taken into account. We calculate standard errors of the impulse response functions and generate confidence intervals with 1000 Monte Carlo simulations[4] Finally, we also present variance decompositions, which show the percentage of the variation in (one) variable(s) that is explained by the shock to another variable, accumulated over time. The variance decompositions show the magnitude of the total effect. We report the total effect accumulated over the three years.

Before going ahead with PVAR approach, we analysed the stationarity property of the data by using unit root tests. Panel unit root tests that we use are ADF and PP type Fisher Chi-square tests of MW (Maddala and Wu, 1999)[5].

In the table we report the results of the analysis of panel unit root tests. We find that $catfat, cat_notfat\ and\ the real_effective_exchange_rate$ are stationary, wheread the level of total_problem_loans the three month treasury bill rate, the level of the real effective exchange rate and the level of the three month interbank rate are nonstationary in the level form. Therefore, in order analyse the dynamics between the test variables we first transformed the nonstationary variables into first difference form so that all analysed variables are stationary. This is important to obtain efficient results in PVAR framework.

[4] In practice, we randomly generate a draw of coefficients of model (1) using the estimated coefficients and their variance covariance matrix and re-calculate the impulse-responses. We repeat this procedure 1000 times (we experimented with a larger number of repetitions and obtained similar results). We generate 5th and 95th percentiles of this distribution that we use as a confidence interval for the impulse-responses.

[5] Due to the fact that we have an unbalanced data, Stata 11 allows us to conduct either the Im-Pesaran-Shin (IPS) either the Fisher-type unit-root tests. Nertherless, the IPS unit-root test requires at least 10 observations per panel, which is not the case in pour study.

Table : Unit root analysis of the variables analyzed
Constant and Trend included in the model

	Cat fat		Cat nonfat		d TPL		d GDP	
Method	Statistic	P-value	Statistic	P-value	Statistic	P-value	Statistic	P-value
ADF - Fisher $\mathcal{X}^2$	242.2898	0,000	185.7186	0.0415	1464.1028	0,000	2521.3057	0,000
PP - Fisher $\mathcal{X}^2$	225.4639	0.0007	220.4221	0.0016	2507.8929	0,000	4640.588	0,000

	d 3M Tbill		Real EER		d 3M IR	
Method	Statistic	P-value	Statistic	P-value	Statistic	P-value
ADF - Fisher $\mathcal{X}^2$	2721.9724	0,000	601.6122	0,000	2699.2809	0,000
PP - Fisher $\mathcal{X}^2$	3585.3648	0,000	447.8456	0,000	3578.542	0,000

where d GDP is d Gdp growth rate, d TPL is d Tot prob. Loans,

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6 Concluding Remarks

This is the first study that investigates the liquidity creation of Greek M&As using recently developed liquidity measures that account for both *on* and *off* balance sheet banks' activities as well. Additionally we explore whether potential M&As of Greek banks could lead to an increase of liquidity of the banking sector and in turn to an increase of the credit channels in the economy, in the spectrum of a severe country default risk. The latter, has major policy implications regarding the trade off between shareholders' personal gains and society's economic prosperity, that triggers M&A activity. Moreover we conduct a comparative and a forecasting analysis to examine the impact of the crisis on the liquidity that is created around M&As. In the spirit of Basel III, where it is given a major emphasis on liquidity and it is implemented by the introduction of two ratios, namely the *liquidity coverage ratio* (LCR) and the *net stable funding ratio* (NSFR). Moreover we provide a comparative and an evaluating analysis of the "balance sheet forecasting method". Finally, we quote a stress test scenario regarding the level of liquidity that is created around M&As. To pursue our test, we use a vector autoregressive (VAR) model. Thus, we capture in a more appropriate way the impact of adverse macroeconomic and financial conditions and thus we are able to extract unbiased inferences regarding the robustness of the Greek banking sector on liquidity creation, with crucial policy implications in the spectrum of the economic prosperity.

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