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Bank capital and liquidity creation. An empirical study of the Scandinavian Banks

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Abstract

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Little is known about the impact of capital regulation on the liquidity creation capabilities of Scandinavian banks. This thesis attempts to examine the relationship between bank capital and liquidity creation based on an unbalanced panel data of 28 banks using quarterly data for the period 2009 to 2016. Based on our measure of liquidity creation, we find that banks on average have managed to consistently increase liquidity creation during the sample period. Using fixed effect regressions on two separate independent variables as proxy for bank capital, we find evidence of a positive relationship between bank capital and liquidity creation for the big Scandinavian banks. This evidence lends credence to the risk absorption hypothesis. However, we find a negative relationship between capital and liquidity creation for the small banks consistent with the financial fragility-crowding out hypothesis. Taken together our results suggest that bank size is an important characteristic in determining an average bank's responsiveness to capital regulations.

Keywords: *liquidity creation, capital requirements, Basel III regulations, big and small banks, credit intermediation, Scandinavian countries*

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1. Introduction

Banks are important financial intermediary institutions and play a central role in the efficient allocations of funds from savers to borrowers in the economy. This key characteristic of banks initiates the process of liquidity creation and risk transformation. Berger & Bouwman (2009) define liquidity creation as when $1 of illiquid assets are converted into $1 of liquid liabilities. On the contrary, liquidity is destroyed when $1 of liquid assets are converted into $1 of illiquid liabilities. Fundamentally, banks initiate liquidity transformation using short-term liquid deposits to fund long-term illiquid loans. Thereby, the banks take on a significant amount of liquidity risk.

Cornett et al. (2011) suggest that during the global financial crisis of 2008 several banks facing liquidity risk attempted to hoard liquid assets and decreased lending activities. The inter-bank market froze due to lack of trust between banks as most financial institutions became reluctant to lend to each other, fearing solvency concerns. Overall, this caused severe negative repercussions for the inter-bank market. The introduction of Basel III framework in 2010 attempts to address the weakness in the banking system by providing impetus to liquidity and capital of banks. Horváth, Seidler & Weill (2013) mention that the Basel committee on banking supervision proposed stringent capital requirements in Basel III to improve the financial stability of the banks. The effect of low bank capital curtailed bank's ability to issue loans during the global financial crisis (Horváth et al. 2013). Although some academic studies (Cornett et al. 2011; Ivashina & Scharfstein 2010; Kim & Sohn 2017) mention that bank's attempt to manage liquidity risk, by holding more liquid assets, reduced bank lending. In essence, Basel III reforms introduce strict risk assessment procedures to manage liquidity risk and strengthen bank capital requirements.

The purpose of capital regulations proposed in Basel III is to enhance financial stability of the banking system. It is worthwhile to evaluate the impact of capital on the core function of bank which is to create liquidity. The interaction between capital and liquidity creation is a question of interest for financial institutions, bank regulators and other stakeholders. The impact of bank capital on liquidity creation, has focused on US banks in most former studies. There is a scare literature on this subject for the European banks and especially the Scandinavian banks. Few notable academic studies on the European banks, Asian banks and BRICS include (Distinguin, Roulet & Tarazi 2013; Horváth et al. 2013; Lei & Song 2013; Fungáčová & Weill 2012; Umar & Sun 2016). According to our knowledge, the subject of bank capital and liquidity creation has not been studied by many on the Scandinavian banks. Our research will be amongst the very few if not the first in investigating the impact of bank capital on liquidity creation for the Scandinavian banks. This study is a modest attempt to enrich our understanding of the Scandinavian banking landscape and provides useful insights into the key mechanisms underlying bank's liquidity creation capability in the face of tightening regulatory developments.

1.1. Problem Discussion

In the early 1990s, the Scandinavian countries witnessed a surge in unemployment and shrinking output growth resulting in a severe economic downturn. The market deregulation in Scandinavia, in the mid-1980s, made banks increasingly competitive and increased their loan volume by exploring alternative lending avenues. Honkapohja (2009) finds that the deregulation activity increased the competitiveness of banks with focus towards customer-oriented banking by providing easy access to loans. However, the credit allocation decision made by seemingly inexperienced branch managers with their emphasis on increasing loan volume without comprehending the underlying economics of credit risk exposure, ultimately led to a severe banking crisis in Scandinavian countries in the early 1990s. According to Agarwal, Mordonu & Shirono (2013), the effect of the banking crisis in the Scandinavian countries made surplus public finances suffer large deficits. The three major Scandinavian countries, i.e. Denmark, Norway and Sweden, are strongly interconnected, and largely open to global trade with similar policies. As a result, the three countries are exposed to similar financial risks.

The interconnectedness of financial institutions has become a relevant topic in the recent past. The rise of the syndicated loans serves as an example of the deep interconnectedness between institutions, where two or more institutions jointly make a loan to a borrower (Dennis & Mullineaux, 2000). Until the global financial crisis, market for syndicated loans served as a main vehicle through which banks lend to large corporations. Ivashina & Scharfstein (2010) find that the banks co-syndicated most of their credit lines with Lehman Brothers and after the failure of the corporation banks reduced their lending to a huge extent. The first reason is that the banks, which relied on short-term debt rather than insured deposits as a main source of funding, faced problems in rolling over short-term debt due to insolvency and liquidity fear in the banking system. Secondly, the borrowers utilized their existing credit lines which reflected in the increase in industrial and commercial loans reported on US banks' balance sheet. To sum up, these factors increased the need for liquidity and forced banks to cut lending.

The main critical lesson learned from the global financial crisis is the strong interconnectedness between the financial institutions. The failure to acknowledge this idea may again lead to substantial distress in the entire financial system during adverse circumstances. On a similar rationale, all Scandinavian countries constitute of few big banks holding more than 80% of total assets, and remaining assets are held by medium to small banks. As Agarwal et al. (2013) mention that the banking sectors of the Scandinavian countries with total assets worth more than three to four times of the country's GDP and in an event of economic vulnerability may potentially result in huge liabilities for the entire region. The Economy of Iceland (2012) report states that during the global financial crisis nearly 90% of Icelandic banks collapsed where the banking system was approximately ten times the size of country's GDP (in terms of assets). The bankruptcies of the three largest Icelandic cross-border banks undermined the entire economy, where the banking crisis coupled with currency devaluation required bailout package from the IMF and support from other Nordic countries to restore stability.

From the banking crisis in the Scandinavian countries in the early 1990s to the recent global financial crisis of 2008, bank regulations have been the cornerstone of policy makers. Banking regulation in the form of Basel III was introduced in 2010 and will be implemented in steps until 2019. The objective is to safeguard the global economy by preventing systemic risk to banks rather than individual risk of each bank. Basel III framework seeks to address the shortcomings of earlier frameworks by giving more focus to capital and liquidity of banks by outlining requirements on how to quantify (CET1) capital. The question to consider is whether the banks are being over-regulated under Basel III, which is potentially hampering the ability of banks to contribute to the economy in an efficient manner by compromising their traditional role of credit intermediation. Basel Committee on Banking Supervision (BCBS) have included new capital measures in Basel III in response to the global financial crisis, but the question to consider is whether or not these regulations are sufficient to prevent future crises.

In the academic literature, there are mixed opinions in terms of capital regulation impact on bank's lending, where some argue that higher capital requirements make banks hold more capital which is costly, limits risk-weighted assets and lowers lending. (Berrospide & Edge, 2010; Cohen, 2013; De Nicolo, 2015). While others suggest, stringent capital requirements make banks protect themselves in crises by holding more capital and limit extending risky loans as well as ensuring high quality lending in the long run (Deli & Hasan, 2017; Valencia 2016; Khan, Scheule & Wu, 2017). The impact of capital and bank lending varies according to bank size. Essentially, banks enhance their lending capability by issuing long-term illiquid loans with short-term deposits, which in turn increases liquidity creation (Berger & Bouwman, 2009; Ivashina & Scharfstein, 2010).

In the Scandinavian banking sector, the big banks lead in the role of credit intermediation in comparison to the small banks whereby there is a strong competition between banks especially using technology to ensure efficient transactions between agents and with stringent capital regulations in place. The question of interest is to find the impact of capital on banks liquidity creation for the Scandinavian banks.

1.2. Aim

The first objective is to measure the liquidity creation of the Scandinavian banks following the framework of Berger & Bouwman (2009) and analyze how liquidity creation has changed over time. The second and most important objective is to investigate the relationship between capital and liquidity creation for the Scandinavian banks. The strict capital regulations requiring banks to hold more capital enables us to improve our understanding of the relation between capital and liquidity creation.

1.3. Limitation of the aim

The one limitation of our aim is not to include time period of 2007 and 2008 in our research. During the financial crisis of 2008 most banks faced a liquidity constraint and Cornett et al. (2011) mention that banks reduced their lending activities significantly during the financial crisis because of high liquidity risk and financial instability in the system. Horváth et al. (2013) include financial crisis time period and mention liquidity creation of the banks decreased during the period of 2007 and 2008. Distinguin et al. (2013) do not include the financial crisis period to avoid the potential bias in the results of liquidity creation. Thereby, in our liquidity creation measure, we opt to exclude the year of 2007 and 2008 and not considering the role of capital and liquidity creation during the global financial crisis.

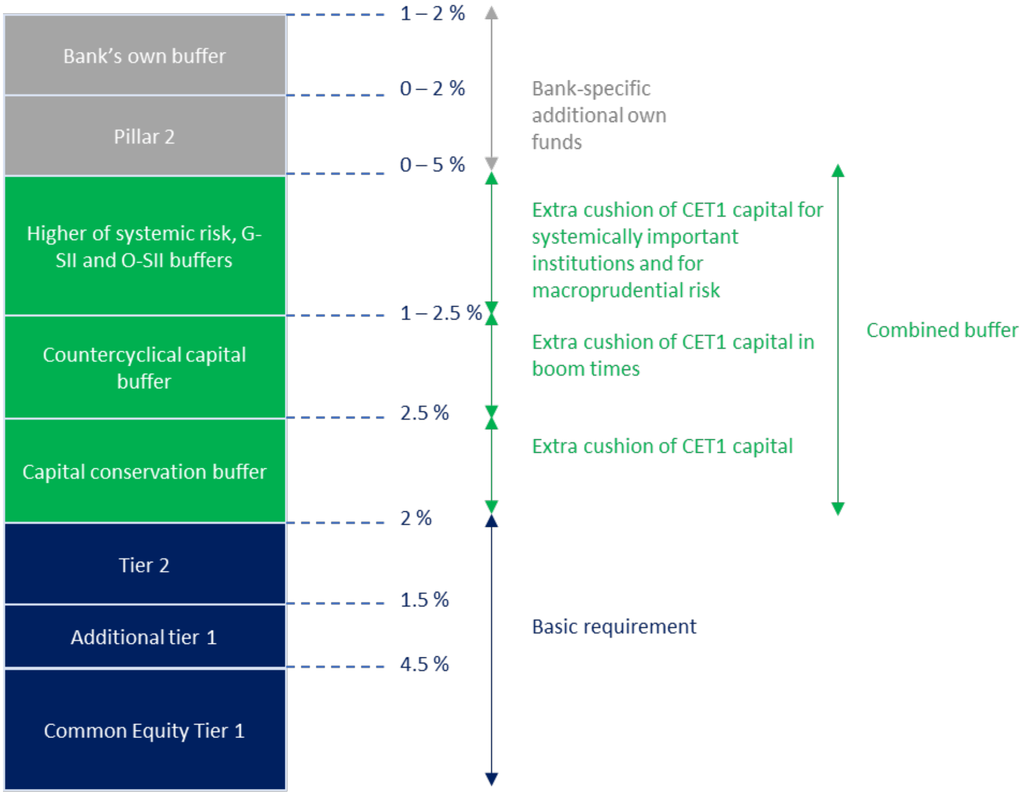
2. Regulations and the Scandinavian banking sector

Banks are regulated to insure financial stability and prevent systemic risk that can bring negative fallout for any economy. In this section, we present the regulations of Basel III framework and an overview of the Scandinavian banking sector

2.1 Basel III Regulation

The regulatory response after the financial crisis of 2008 came in the shape of Basel III accord in September 2010. The Banking Committee on Banking Supervision (BCBS) introduced Basel III as a global regulatory framework. According to BCBS (2011) Basel III aims at increasing banks' ability of absorbing losses and safeguarding the Systemically Important Financial Institutions (SIFIs). The Basel III framework focuses largely on two components that are capital and liquidity regulations. For the purpose of this research, we are only interested in the capital regulations of Basel III which is examined under three pillars. In Figure 1, we present the Basel III capital requirements.

Figure 1. Basel III capital requirements



Source: BCBS-2011

2.1.1 Pillar 1: Capital Requirements

Pillar 1 rule of 8% of capital has remained constant from the inception of Basel I. However, the numerator and the denominator for the regulatory framework of capital has been evolving over the years. The reforms in Basel III increases the standards on the quality and quantity of the regulatory capital base to limit risk exposure of the banks. The following are the characteristics of capital regulations shown in Figure 1 under Basel III as set by BCBS (2011):

- The minimum capital requirement of 8 percent of the Risk Weighted Assets (RWA). Of which 4.5 percent comprises of Common Equity Tier 1 (CET1) capital, 1.5 percent of Additional Tier 1 (AT1) capital and 2 percent of Tier 2 capital.
- Capital buffer requirements constituting of CET 1 capital to maintain stability in financial institutions under financial distress such as capital conservation buffer of 2.5 percent, counter-cyclical capital buffers between 0 and 2.5 percent and higher systemic buffer ranging between 0 and 5 percent.
- Individual capital requirements based on yearly supervisory assessments to protect the Systemically Important Financial Institutions (SIFIs) and holding extra capital between the range of 1 and 3.5 percent.

Basel III puts focus on high quality capital base such as common equity which must be at 4.5 percent of RWA at all times. According to BCBS (2011) the total regulatory capital under Basel III is divided into two components that are Tier 1 (going concern basis) and Tier 2 capital (gone concern basis). In essence (Tier 1 plus Tier 2) capital must be at least 8 percent of RWA at all times. The Common Equity Tier 1 (CET1) capital is made up of reserves, shares and retained earnings which acts as a first line of defense against losses. The Additional Tier 1 (AT1) capital is made up of hybrid capital instruments and can be classified as second ranked capital in a case of liquidation. The role of the Tier 2 capital is to ensure loss absorption on a gone concern basis by protecting senior creditors. Chun, Kim & Ko (2012) mention that the 8% rule is unchanged, but under Basel III tighter standards are set for banks to meet the capital requirements. Similarly, the other characteristics such as capital buffer requirements are introduced in Basel III to ensure financial stability during crisis times.

The capital conservation buffer aspect of Basel III is to ensure that the banks are holding buffers of capital above the minimum requirements, especially during the non-crisis period. The purpose of capital conservation buffer is to soften the blow on banks' capital during crisis times, where losses can be taken out of capital buffers. The idea of stringent capital regulations extends further to mitigate the chance of SIFIs liquidation and thereby important institutions in each country are subjected to extra capital charge. Salmon (2011) finds that the important financial institutions are subject to a capital surcharge within the range of 1% to 3.5% and argues that such capital requirements may not prevent future crisis nevertheless makes the global banking system robust and less prone to disastrous fiasco.

2.1.2 Pillar 2: Risk Management and Supervision

The BCBS (2016) points out that pillar 2 of Basel III is aimed towards issues of governance and risk management and in specific to control for off-balance sheet exposures and securitization activities. In essence, the risk management and supervision aspect of Basel III is to create incentives for banks to better manage risk and return over a long horizon and improve internal monitoring system. Basel III requires banks to go through regular stress testing to evaluate the strength of financial institutions and adopting accurate accounting standards for financial instruments.

2.1.3 Pillar 3: Market discipline

Pillar 3 under Basel III requires enhanced disclosures on the components of the regulatory capital and faithful representation of accounting principles in calculating bank's regulatory capital ratios. In general, the purpose of pillar 3 is to provide accurate information to the market regarding the risk exposure of a bank.

2.2 The Scandinavian Banking Sector

The Scandinavian countries constitute of Denmark, Norway, Sweden, Finland and Iceland. In terms of size of assets and proportion of large commercial banks, Denmark, Sweden and Norway dominate the industry. The banks in Finland and Iceland struggled immensely after the financial crisis of 2008, where in Iceland, bankruptcies of large banks wiped off the entire banking system. In Finland, the economy has been struggling as a consequence of shrinking exports within the manufacturing sector since the global financial and euro crisis (World Economic Forum, 2015). Also, in Finland and Iceland most of the subsidiaries of Swedish, Norwegian and Danish banks are largely in business. Thereby, for the purpose of this research we are analyzing the banks of three Scandinavian countries that are Denmark, Norway and Sweden.

The banking crisis in the early 1990s severely hit banks in Norway and Sweden, while banks in Denmark managed to recover relatively well with little public support compared to Norway and Sweden. The crisis in Sweden and Norway became systemic and according to Møller and Nielsen (1995), the loss provision expressed as a percentage of lending increased for all the Scandinavian countries. The primary reasons for Denmark avoiding a systemic crisis after market deregulation was prudential supervision, disclosure rule and strict capital requirement (Honkapohja, 2009). For Sweden and Norway, the significant growth in credit expansion after the banking deregulation did not take into account the high credit risk exposure faced by these institutions. As a consequence, the banks in Sweden and Norway had to rely on government support and bailout packages in order to restore financial stability in the region.

The management of the banking crisis in the Scandinavian countries was achieved quite efficiently. Honkapohja (2009) describes the role of crisis resolution in the Scandinavian countries as an important factor, in providing capital injections to the troubled banks and directing the restructuring of the banking system. To avoid liquidation of the several troubled banks, they were merged with the stable ones as a part of a restructuring plan. The central banks such as Norges Bank and Riksbanken in Norway and Sweden respectively, played their role in providing liquidity to the struggling banks as a general support system. To limit the effect of the crisis, the political parties in these countries issued guarantees to banks' obligations and rendered support to restore confidence in the banking system and prevent large scale bank runs.

2.3 Institutional settings of Scandinavian Banks

Scandinavian countries share quite similar characteristics in terms of economic linkages, strong banking ties and regulations. According to Agarwal et al. (2013), the deep interconnectedness between the financial institutions of the Scandinavian countries makes them susceptible to contagion during an event of a regional or a global shock where a crisis in one country spills to another. The banking crisis of 1990s in the Scandinavian banking system reveals the deep rooted interconnectedness between financial institutions in the region. This warrants a discussion on the role of regulatory authorities in Denmark, Norway and Sweden.

2.3.1 Denmark

Danmark Nationalbank is the Central Bank of Denmark and is responsible for maintaining fixed exchange rate policies against the Euro, ensuring safe payments and monitoring the financial stability in Denmark (Danmarks National Report, 2016). The role of the Financial Supervisory Authority, known as Finanstilsynet, is to ensure that the banks are in compliance with the regulations and follow appropriate methods in adhering to the banking regulation aimed at achieving financial stability in Denmark.

The IMF Country Report on Denmark (2014) states that the minimum capital requirements of 8% is required for banks to follow as prescribed in the pillar I capital requirements of Basel III. Additionally, the Pillar II capital requirements are assigned to individual banks according to the risk exposure faced by a bank. The Basel III framework is applied in EU banks through Capital Requirement Directive (CRD IV) and Denmark is included in it. In Denmark, there are four Systemically Important Institutions (SIFIs) and CRD (IV) framework enforces that financially important institutions should comply with capital conservation buffers which should consist of 2.5% of Risk Weighted Assets (RWA) and Common Equity Tier 1 (CET 1) capital.

2.3.2 Norway

Norges bank is the Central bank of Norway and in collaboration with Finanstilsynet, which is the Financial Supervisory Authority in Norway, the Norges bank is responsible for financial stability in the banking system. The aim of the Norges bank and the Finanstilsynet, as regulatory bodies, is to ensure efficient repayment of deposits and other funds from the public and redistributing risk in a satisfactory way.

According to Norges bank (2016), the banks' loan losses, especially in the oil related loans, have increased over the past year due to falling oil prices, but the profitability for the banking sector in general has been stable. The banks have used their profits to strengthen their equity capital. The report by Finans Norge (2015) indicates that the capital adequacy framework (CRD IV), which creates an additional risk buffer to limit exposure to the entire financial system, became a part of Norwegian Banking Law in June 2013. Furthermore, since the financial crisis of 2008, the Common Equity Tier 1 (CET1) capital has increased at the same time as the Risk Weighted Assets (RWA) have decreased especially for the systemically important banks. The major source of funding for the Norwegian banks are deposits and they rely heavily on wholesale funding through covered bonds to sponsor domestic lending activities. The major risks in the banking system, due to macroeconomic shock, rests on loans to the housing and real estate where wholesale funding is being used to issue mortgage loans.

2.3.3 Sweden

In Sweden, the role of monitoring and enforcement of regulations is collaborated by three departments i.e. Finansdepartementet (the Ministry of Finance), Finansinspektionen (the Financial Supervisory Authority) and Riksbanken (the Central Bank). The role of the Finansdepartementet is to oversee economic policy, taxes and budgeting of the Riksbanken. The Finansinspektionen makes an assessment of the financial stability in the economy by ensuring regulations are adhered to by the institutions. The Riksbanken ensures safe and efficient payment system as mandated by the government.

According to the Riksbanken (2016), the major banks in Sweden are profitable with low credit losses. However, there are significant risks in the banking system of Sweden which makes it sensitive to shocks. For instance, commercial and household loans amount to 70 percent of lending and the loans are funded mainly by deposits and securities. Further, Riksbanken holds the opinion that the big Swedish banks are susceptible to structural liquidity risk due to continuous mismatch between assets and liabilities of banks. The report by Finansinspektionen (2016) mentions that the aim is to keep banks well-capitalized, in response to risk operations and in an event of a bank capital below 8% threshold, can result in potential liquidation of the bank to prevent transmitting shock to the entire financial system.

3. Theoretical Framework, Empirical Studies and Hypotheses

In this section, we present the important concepts relevant to our topic. In essence, we define liquidity creation, theory of financial fragility, crowding out deposits and risk transformation. Then, we review the literature and discuss relationship between capital and liquidity creation in earlier studies. Finally, we present our two main hypotheses.

3.1 Defining liquidity creation

Liquidity creation can be defined as the ability of banks to finance illiquid assets with liquid liabilities. More precisely, banks use short-term deposits to provide long-term lending. In constructing liquidity creation measures, Berger & Bouwman (2009) assign weights by classifying items as liquid, semi-liquid and illiquid "based on the ease, cost and time for banks to dispose of their obligation to obtain liquid funds and be able to meet the demand of their customers". They state that most liquidity is created when illiquid assets are converted into liquid liabilities and most liquidity is destroyed when liquid assets are converted into illiquid liabilities or equity. For instance, they apply positive weight to illiquid assets such as business loans and liquid liabilities such as transaction deposits as liquidity is created by the bank. On a similar note, they apply negative weight to liquid assets, illiquid liabilities and equity, based on the argument that liquidity is destroyed. They comprehensively calculate liquidity creation for all US banks by breaking down all the balance sheet and off-balance sheet items, either by category or maturity for the period between 1993 and 2003. The estimated liquidity creation for the US banks amounted to $2.3 trillion and most liquidity was created by the big banks.

Another closely related definition of liquidity creation is coined by Deep & Schaefer (2004), where they use the term Liquidity Gap (LT GAP), which is simply taking the most important assets and liabilities for a bank and classifying them either as liquid or illiquid. By using a quarterly data on 200 sample banks in US between 1997 and 2001, they conclude that banks do not create significant liquidity due to the role of deposit insurance, credit risk and loan commitments. In comparison, Berger & Bouwman (2009) provide a comprehensive measure of classifying each item by the degree of its liquidity and assigning weights according to the positive or negative effect it has on liquidity creation.

3.2 Theory of financial fragility

The definition of a fragile financial institution is when "a small shock has a disproportionately large effect" (Allen & Gale, 2004). The theory originates from the notion that the financial institutions are susceptible to crisis. The idea of financially fragile capital structure gained popularity with the research on “A theory of Bank Capital” by Diamond & Rajan (2000). The authors presented the theory of bank capital by modelling the essential role banks perform and considering the role of capital in it. Banks vulnerability to a crisis stems from the fragile capital structure of deposits i.e. in the event of a crisis, depositors may require immediate claim to their funds and the inability of a bank to meet this obligation can induce a bank run.

Diamond & Rajan (2000, 2001) mention that the banks are a source of liquidity for both depositors and entrepreneurs. In an event of a shock which may not necessarily be a crisis, a bank can return money to depositors by obtaining money from new depositors. Similarly, banks are able to create liquidity on the asset side by issuing long-term loans with relatively short-term demand deposits. Horváth et al. (2013) mention that banks have an informational advantage by monitoring borrowers and this can lead to a potential agency problem, where the bank may charge premium from the depositors because of the illiquid nature of loans. This creates a mistrust for the depositors to keep funding the bank. The banks cannot keep extracting premium from the depositors, as issued loans are illiquid and banks face liquidity risk, thereby banks need to hold high amount of liquid deposits by adopting a fragile financial structure (Diamond & Rajan, 2001). Consequently, the fragile nature of deposits can be used as a disciplinary mechanism that commit banks to monitoring the borrowers and hence increases the liquidity creation. The idea put forth by Berger & Bouwman (2009) is a fragile capital structure makes banks committed to monitoring its borrowers and allows to extend loans. However, additional capital makes it harder for the less-fragile bank to monitoring which in turn confines banks liquidity creation

3.3 Idea of crowding out deposits

Gorton & Winton (2000) describe bank capital as a source of cost for banks, although it reduces the likelihood of a bank failure. The authors incorporate bank lending and deposit in their model to analyze in general equilibrium and establish that it is difficult to set optimal level of bank capital. In their benchmark model, raising capital suggests banks produce less debt causing welfare loss. Bank capital serves to prevent bank failures during stressful economic times. From the perspective of banks, holding or raising capital is costly. Gorton & Winton (2000) mention the private liquidity costs of raising bank capital exceed the social costs. A system wide increase in required bank capital makes investors to lower their deposits in favor of equity. Berger & Bouwman (2009) also mention capital may also reduce liquidity creation as it crowds out deposits. Distinguin et al. (2013) suggest that deposits are more effective liquidity hedges than investments in capital. Moreover, deposits are insured and withdrawable whereas capital holders are not subject to immediate collection problem and can be renegotiated. Consequently, higher capital requirements shift investors from liquid demand deposits to illiquid bank capital and reduces liquidity creation.

3.4 Banks role of risk transformation

The role of financial intermediation of a bank entails it to act as risk transformers. Banks in general achieve the role of risk transformation by diversifying their investment funds, monitoring borrowers and maintaining capital reserves to account for unexpected losses in such a way that the providers of funds are not harmed in financing the lenders of funds. Allen & Gale (2004) point out that liquidity creation increases banks' exposure to risk, since the more liquidity is created, the higher the chances of exhibiting losses that comes from holding illiquid assets to satisfy liquidity demands.

Some authors argue that this risk may be absorbed by holding more capital. Holding higher capital reduces banks incentive to engage in excessive risk-taking. Since, banks are entitled to act in the best interest of the shareholders and capital at risk implies high shareholder's losses in case of default. For instance, Bhattacharya & Thakor (1993) mention that capital deters banks from choosing riskier assets. The authors further advocate the notion of capital absorbing risk in banks and increasing their risk bearing capacity. Banks role in risk transformation is also studied by Repullo (2004) by incorporating capital requirements and deposit rate ceilings as proxies for banking regulations in an imperfectly competitive banking model to evaluate the effect on risk-taking. The author concludes that the higher capital requirement reduces the likelihood of banks investing in "gambling" assets. In particular, stringent risk weighted capital requirements and deposit rate ceilings channel banks investment towards less risky assets and ensures prudent equilibrium in the model. Based on these arguments, Berger & Bouwman (2009), elaborate the hypothesis of "risk absorption" where higher capital increases banks' ability to absorb risk which in turn increases liquidity creation.

3.5 Empirical literature on capital and liquidity creation

The topic of interest for our research is the relationship between capital and liquidity creation. Berger & Bouwman (2009) use liquidity creation measures on capital to find a positive relationship for big banks and negative for small banks. In the context of academic research on the European banks, there is a scare literature. One study that stands out is conducted by

Horváth et al. (2013). This study investigates bank capital and liquidity creation for the Czech banks by using a dynamic GMM framework. Moreover, the authors, using Granger-causality tests, analyze the effect of liquidity creation on capital. The concept of liquidity creation as put forth by, Berger & Bouwman (2009), is a comprehensive measure of a bank's overall ability to transform maturity in the economy. Similarly, Horváth et al. (2013) construct liquidity creation measures following Berger & Bouwman (2009) framework by including on-balance sheet activities and off-balance sheet activities and using maturity as the sole classification criteria. The authors use data for all the Czech banks for the period between 2000 and 2010 and their results suggest a strong expansion in liquidity creation for banks in Czech Republic until the financial crisis of 2007 and 2008 disrupted the entire financial stability of the world. Horváth et al. (2013) observe that capital negatively impacts liquidity creation for small banks and find no causal relationship for large banks. The authors also state liquidity creation using granger causality result in a reduction of capital. In essence, the evidence on Czech banks liquidity creation, decreasing with more capital, reflects the trade-off between the incentive of achieving financial stability at the expense of lower liquidity creation.

A study conducted on both US and European banks by Distinguin et al. (2013) investigates the relationship between bank regulatory capital and bank liquidity measured from on-balance-sheet items. They take the approach of analyzing if banks increase or maintain their regulatory capital ratios at the time of higher illiquidity or reciprocally decrease capital ratios when creating more liquidity. This research contributes to academic literature on other fronts as well, by using simultaneous equations model to jointly determine bank capital and liquidity. The dataset is chosen for 665 US and 225 European publicly traded commercial banks for a period ranging between 2000 and 2006 and omit the crisis era of the years 2007 and 2008 to prevent bias in the analysis. Horváth et al. (2013) also note drop in liquidity creation of the Czech banks during the financial crisis. The main result by Distinguin et al. (2013) show that the increase in liquidity creation negatively impacts regulatory capital as defined in Basel III accord.

There have been few studies conducted on the subject of liquidity creation besides US and EU banks. A research by Fungáčová &Weill (2012) use the methodology outlined by Berger & Bouwman (2009) regarding construction of liquidity creation measures for the Russian banks during 1999 and 2009. The distinguishing feature of the paper by Fungáčová & Weil (2012) is to see how bank size affect liquidity creation parameters. They base their research around types of banks such as private, state-owned or foreign banks creating most liquidity. Their results show that liquidity creation is created the most by state-controlled banks rather than the private banks, which is quite different from the academic research for US banks. The subject of liquidity creation and bank capital structure has been investigated in emerging economies such as China and India. Lei & Song (2013) test the financial fragility-crowding out hypothesis and risk absorption hypothesis on Chinese banks. The case of Chinese banks is interesting as they have experienced intense privatization during the transformation from planned economy to a socialist private economy. However, the banking sector is heavily controlled by the state. The authors use annual dataset for the period between 1988 and 2009 on 117 banks including state-owned, private and foreign banks. The results indicate capital negatively impacts liquidity creation for the Chinese banks and lend support to the financial fragility crowding out hypothesis. In another research by Umar, Sun & Majeed (2017), they test the financial fragility-crowding out hypothesis and risk absorption hypothesis on 136 listed Indian banks between 2000 and 2014. They find a negative relationship between bank liquidity creation and capital. The authors employed the same framework of Berger & Bouwman (2009) to construct liquidity creation measures.

The review of academic literature reveals that the impact of capital on liquidity creation is negative for small banks and positive for big banks. Berger & Bouwman (2009) find a positive relationship between capital and liquidity creation for the big banks, which is in line with the risk absorption theory of (Bhattacharya & Thakor 1993; Repullo 2004) and negative relationship for small banks. Although other studies (Horváth et al. 2013; Distinguin et al. 2013; Lei & Song 2013), mostly using small banks, find a negative relationship between capital and liquidity creation which is in line with the theories of financial fragility and crowding out deposits by (Diamond & Rajan 2000; Gorton & Winton 2000). The Basel III framework requires banks to hold more capital and it is interesting to investigate the impact of increased capital regulations on liquidity creation for the Scandinavian banks.

3.6. Hypotheses

As discussed earlier, the purpose of this research is twofold. First, we create a liquidity creation measure for the Scandinavian banks. Second, we investigate the relationship between capital and liquidity creation. The empirical studies section provides us with the basis to develop our main hypotheses. In the following discussion, we present the two main hypotheses.

3.6.1 Risk absorption Hypothesis

The first point of view stems from the idea that creating liquidity makes a bank exposed to more risk (Allen & Gale, 2004). In addition, Bhattacharya & Thakor (1993) and Repullo (2004) advocate higher capital to increase bank's risk bearing capacity. Consequently, capital increases liquidity creation. The process of creating liquidity by a bank increases its exposure to losses when illiquid assets have to be sold off in order to meet liquidity demand of depositors. In general, bank capital serves to provide a buffer against such losses and contributes to the overall solvency, therefore higher capital implies higher risk tolerance of the bank.

The *first hypothesis (H1)* is the "risk absorption". According to H1, tighter capital requirements should increase liquidity creation ability of the banks

3.6.2 Financial fragility-crowding out Hypothesis

The second point of view advocates the idea that a fragile capital structure (deposits) acts as a disciplinary mechanism which makes banks committed to monitoring its borrowers and hence increases liquidity creation. On the contrary, a less fragile capital structure (equity) hampers bank ability to monitor borrowers and reduces liquidity creation (Berger & Bouwman, 2009). Also, Diamond & Rajan (2000) posit the notion of bank capital reduces liquidity creation by making bank's capital structure less fragile. The idea put forth by Gorton & Winton (2000) suggest that higher capital requirement crowds out deposits by making investors reallocate their funds from liquid deposits to illiquid equity and adversely affecting liquidity creation.

This view point can be jointly described as our *second hypothesis (H2)* "financial fragility-crowding out". According to H2, tighter capital requirements should reduce liquidity creation ability of banks.

4. Research Methodology

In this section, we present our dependent variable, independent variables and control variables. Furthermore, we describe our dataset and then proceed to our testable hypotheses. We conclude this section by presenting a discussion on a panel data analysis and our research model.

4.1 Dependent variable

Liquidity creation measure is the dependent variable in our model. As discussed earlier, there are limited number of academic studies that have focused on methods to measure banks liquidity creation. We prefer the method used by Berger & Bouwman (2009), which is detailed and comprehensive by taking into consideration all the balance sheet items to measure a bank's liquidity creation ability, instead of limiting the analysis to only the most important assets and liabilities as suggested by Deep & Schaefer (2004).

Berger & Bouwman (2009) construct four types of liquidity creation measures derived using two classification methods (maturity and category) i.e. maturity with off-balance sheet items, maturity without off-balance sheet items, category with off-balance sheet items and category without off-balance sheet items. Due to limitations of our data, we estimate only one proxy for liquidity creation measure, where we exclude off-balance sheet commitments and combine both classification methods i.e. maturity and category. Specifically, we classify loans and deposits by maturity and the rest of the balance sheet items by category, given that our dataset does not provide detailed information about the category of loans and deposits. Berger & Bouwman (2009) argue that the category classification is preferred over the maturity classification since some category of loans (e.g. mortgage loans) are relatively quicker and easier to securitize even though they mature in the long run. However, both classification methods lead to the same conclusions which explains our choice of combining the two methods.

The liquidity creation measure implemented by Berger & Bouwman (2009) requires three steps. In Table 1, we present the classification details of items from balance sheet according to liquidity and weights assigned.

Table 1. Liquidity classification and weighting of bank balance sheet items

Assets		
Illiquid (Weight = ½)	**Semiliquid (weight = 0)**	**Liquid (Weight = -½)**
Maturity Classification: Loans maturing in more than 5 years **Category Classification:** Intangible assets Tangible assets Premises Investment in associates Prepaid expenses and accrued income Other assets	**Maturity Classification:** Loans maturing in 3-12 months **Category Classification:** Loans to central bank Loans to other credit institution	**Maturity Classification:** Loans maturing in less than 3 months Loans payable on demand **Category Classification:** Cash and balances with central bank Trading assets Assets held for sale Other securities and derivatives
Liabilities and Equity		
Liquid (Weight = ½)	**Semiliquid (weight = 0)**	**Illiquid (Weight = -½)**
Maturity Classification: Deposits available on demand Deposits maturing in less than 3 months **Category Classification:** Trading liabilities Derivative instruments	**Maturity Classification:** Deposits maturing in 3-12 months **Category Classification:** Due to central bank Due to other credit institutions	**Maturity Classification:** Deposits maturing in more than 5 years **Category Classification:** Subordinated liabilities Accrued expenses and deferred income Other liabilities Equity

Source: Berger & Bouwman (2009)

In the first step, we classify all balance sheet items as liquid, semi liquid or illiquid, depending on the type of classification and whether the item is an asset or a liability. As shown in Table 1, by using the maturity classification, loans and deposits that mature in less than three months are classified as liquid, those between three and twelve months are considered as semi-liquid and the rest are illiquid. For category classification, Table 1 shows that if the item is an asset, the level of liquidity assigned is decided based on how quickly a bank can sell off the asset to obtain liquid funds. Whereas, if the item is a liability, the classification is based on the ease for clients to obtain liquid funds back from the bank. Equity, on the other hand, is always classified as illiquid because of its long maturity and it cannot be readily converted into liquid funds by the shareholders.

The second step of liquidity creation method involves assigning weights to all the balance sheet items classified in the first step. Weights are assigned based on the definition of liquidity creation, which implies liquidity is created when illiquid assets are financed by liquid liabilities and liquidity is destroyed when liquid assets are converted into illiquid liabilities and equity. Thereby as shown in Table 1, positive weights are assigned to both illiquid assets and liquid liabilities, whereas negative weights are given to liquid assets, illiquid liabilities and equity. Following the same level of weights used by Berger & Bouwman (2009), we assign a weight of ½ to illiquid assets and liquid liabilities, and -½ to liquid assets, illiquid liabilities and equity. A weight of 0 is allocated to semiliquid assets and liabilities, based on the idea that they are neither liquid nor illiquid, rather they are considered to be an intermediate item.

The third step for constructing the liquidity creation measure is to combine the balance sheet items as classified and weighted in previous steps. This is accomplished by simply multiplying the weights by the corresponding balance sheet items and summing up all the weighted amounts to estimate the aggregate amount of liquidity creation for each bank in our dataset.

In the final step, our liquidity creation measure is normalized by the total assets to make the dependent variable comparable between different banks regardless of the size.

4.2 Independent variables

Our two independent variables are equity ratio and capital adequacy ratio, used as proxies for the bank capital. Firstly, in line with the Berger & Bouwman (2009) framework, we use the ratio of total equity to total assets as our independent variable, denoted by EA. Equity is the most basic type of capital that is not freely accessible by shareholders. According to Berger et al. (2008) most bankers assert that higher equity ratio hinders bank competition as equity is an expensive source of financing comparing to debt and tend to keep it relatively low.

Secondly, we use capital adequacy ratio as an alternate independent variable, which is the ratio of Tier 1 and Tier 2 capital to total risk weighted assets, denoted by CAR. Bank capital has a broader definition under capital adequacy ratio, which is an important measure of capital requirements set by regulators, as it divides capital into two components that are Tier 1 capital (core capital) and Tier 2 capital (supplementary capital). As described by Berger et al. (2008) Tier 1 capital is basically common shareholders equity and preferred stock, whereas Tier 2 capital includes long term subordinated debts and hybrid securities. Basel III accord, among other restrictions, requires banks to satisfy a minimum capital adequacy level of 8%. Hence, capital adequacy can be used as a good alternative for equity ratio, as it allows to assess the regulatory effect of capital on liquidity rather than the conventional equity capital. Another incentive for using a broader definition of capital is that it follows previous studies. For instance, Diamond & Rajan (2000, 2001) define capital as a long-term claim that does not follow the priority order to cash flows. Hence, they argue that besides equity where the shareholders can always liquidate, long-term debt can also be considered as capital where debt holders have the right to liquidate only in case of bankruptcy.

4.3 Control Variables

4.3.1 Bank risk

The inclusion of bank risk in our model is relevant, since it reflects one of the core function of capital to mitigate risk. By controlling for risk measures, we disentangle the role of capital in aiding the two main functions of the bank i.e. liquidity creation and risk transformation. In this paper, we use three different variables for financial risks that primarily measure insolvency risk and credit risk.

STD-ROA: The volatility of earnings is calculated by taking the standard deviation of the return on assets over the past eight quarters. Previous studies state that 8 months is the minimum time period that has to be used to get relevant volatility measures. For instance, Bergen & Bouwman (2009) used 12 months for a time series of 40 quarters, while Lei & Song (2013) used 8 months for a shorter time series of 20 years.

Z-Score: Z-Score is a very popular risk measure frequently used in empirical studies that indicates bank's distance from default (Hannan & Hanweck 1988; Boyd & Graham 1986). The popularity of this measure is due to the fact that it is easy to compute as it requires accounting data only. It is calculated as the return on assets (ROA) plus the equity ratio (equity to total assets) divided by the volatility of earnings (STD-ROA). A low Z-Score shows that the bank is less stable and is taking on more risk, since its distance from default is smaller. It is discussed by Laeven & Levine (2009) that one should take the natural logarithm of Z-score, due to the variable high skewness. However, we prefer to keep it without the natural logarithm as it may be infeasible when we have negative values for Z-score.

C-RISK: Credit risk is defined as the risk of default on a debt or the risk of the decrease in market value of debts that arises when the credit quality is modified (Duffie & Singleton, 2003). Credit risk is significantly related to risk weighted assets (RWA). In fact, Berger & DeYoung (1997) find that there is a strong relationship between RWA and credit risk. Therefore, one way of measuring credit risk, which is very commonly used in literature, is by dividing the risk weighted assets by the total assets of the bank (Van Roy, 2008). The risk weighted assets are calculated by adjusting every asset class according to risk. The data is found available on SNL as well as annual reports.

4.3.2 Bank size

In accordance with previous studies on liquidity creation, big banks are able to create more liquidity than small banks (Berger & Bouwman 2009; Lei & Song 2013). For instance, Fungáčová & Weill (2012) find that the mean ratios for the liquidity creation over total assets represent 55% for big banks against 34% for small banks.

The size of a bank or a firm is often measured in empirical literature by applying the natural logarithm of the total assets. As discussed by Berger & Bouwman (2009), the natural logarithm is used to bypass any specification distortion and to correct for skewness, since the total assets values are relatively large compared to the dependent variables values that vary only between 0 and 1.

4.3.3 Transaction history

We define a dummy variable that takes the value of 1, if the bank has been part in at least one merger and acquisition transaction during the previous three years, and zero otherwise. Such information is available on SNL using the transactions filter. It is interesting to control for M&A activities as argued by Berger & Bouwman (2009), since banks adjust their lending policies as soon as such transactions happen.

4.3.4 Asset quality

We use two different measures for asset quality that reflect the performance of lenders and the effectiveness of bank in getting the repayments from current loans, PLCL and PLRWA. The higher these ratios the poorer the asset quality. We expect these measures to have a negative relationship with bank liquidity creation, since lower these ratios (superior quality loans) imply more liquidity creation in the long run.

PLCL: The ratio is defined as problems loans as a percent of gross customer loans, where problem loans are loans overdue for more than 90 days. It is argued by Noman, Pervin & Chowdhury (2015) that non-performing loans ratio can serve as a credit risk measure, since the higher the ratio, the more bad loans the bank has, the more credit risk.
PLRWA: The ratio is defined as problems loans as a percent of total risk weighted assets.

4.3.5 Profitability

We include two measures of accounting performance as control variables, because we expect a strong relationship between bank profitability (in accounting terms) and liquidity creation. In the literature there are two opposing arguments. Tran et al. (2016) point out a negative relationship. They argue that to manage liquidity risk, banks create less liquidity by increasing the proportion of liquid assets. This can in turn reduce banks returns since liquid assets are less profitable than illiquid assets. However, Bordelau & Graham (2010) argue that banks profitability can be positively related to liquidity creation. This is explained by the fact that holding more liquid assets decreases banks solvency risk which in turn reduces the bankruptcy costs and generates higher income.
CI: Following Lei & Song (2013) we control for cost to income which indicates the bank management efficiency. It is calculated as the operating expenses divided by the operating income.
RRWA: The return on average risk-weighted assets is measured as the net income of the bank divided by the average total risk-adjusted assets. It is considered as a broader measure for ROA, that is adjusted for risk.

4.3.6 Macroeconomy

The macroeconomic data is available through the statistical website of each country in our sample. We follow the same exogenous variables used by Lei & Song (2013) and Berger & Bouwman (2009). We control for the GDP rate (GDP), as well as the market share of deposit (MSD) calculated by dividing the bank's total amount of deposit by the country's total deposit. It is important to include the market share of deposits in order to control for the market competition factor. In fact, Petersen & Rajan (1995) demonstrate that the credit market competition affects the lending relationships between firms and creditors, which can in turn affect liquidity creation through the lending behavior of the banks i.e. the volume and the characteristics of loans (e.g. level of interest rate). We also control for unemployment rate following Horváth et al. (2013).

4.4 Data Description

Our sample consists of quarterly data on 28 Scandinavian commercial banks between the time period of 2009 and 2016. We use SNL database and annual reports of the banks to collect the accounting data. The data on macroeconomics indicators is extracted from official statistics platforms such as Statistics Denmark, Statistics Norway and Statistics Sweden respectively. Each Scandinavian country has its own currency and to obtain our accounting numbers we opted to convert all the data into common Euro currency by using the closing spot exchange rate provided by SNL database of every quarter between 2009 and 2016.

The financial crisis period between 2007 and 2008 has been omitted from our analysis to avoid any disruption or variation in our data. In fact, Berger & Bouwman (2008) argue that the impact of capital on banks may differ from regular period and recession period. They examine the behavior of banks liquidity creation during the five main financial crises in US between 1984 and 2008 and conclude that there is an "abnormal" increase and decrease in liquidity creation prior to each crisis. For instance, they find that the subprime mortgage crisis was preceded by a significant "abnormal" volume of liquidity creation. We exclude all banks with less than three years (12 quarters) observations, as well as banks with relatively small deposits. Similarly, we exclude banks that have missing data in terms of maturity analysis or banks with unavailable data for some of the control variables. By imposing all these restrictions, we obtain an unbalanced panel data of 732 observations for 28 banks.

Our dataset is divided by size into two groups, small banks with total assets lower than €100 billion (21 banks, 524 observations) and big banks with total assets higher than €100 billion (7 banks, 208 observations). Banks are commonly classified by size according to total assets and a similar approach has been adapted by Berger & Bouwman (2009). For instance, in Sweden, Nordea, Swedbank, SEB and Handelsbanken are considered as the four big banks and the rest are classified as small banks (Swedish Bankers' Association, 2013). In the academic literature, bank size is considered an important factor in analyzing the liquidity generation ability. Berger & Bouwman (2009) claim that small banks and big banks assess risk and credit information differently and will therefore establish different types of loans. Kashyap, Rajan & Stein (2002) demonstrate that the causality between loan commitments and current deposits varies with the size of the bank. Berger & Bouwman (2009) find that the impact of capital on liquidity differs with the size of the bank i.e. the effect of capital on liquidity creation is positive for big banks whereas it is negative for small banks.

Table 2. Descriptive statistics on variables used in the regression model

	Small Banks				Big Banks			
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max
LCA	0.31	0.25	-0.25	0.77	0.37	0.16	0.15	0.75
EA	0.09	0.03	0.02	0.17	0.05	0.01	0.03	0.08
CAR	0.18	0.06	0.00	0.52	0.19	0.04	0.10	0.32
STDROA	0.81	4.56	0.01	54.43	0.16	0.13	0.02	0.66
CRISK	7.93	39.02	0.10	257.20	0.28	0.09	0.16	0.63
ZSCORE	0.54	0.59	-0.02	3.53	0.53	0.38	0.05	2.23
LNA	8.44	1.40	5.61	11.28	12.63	0.40	12.02	13.50
MA	0.53	0.50	0.00	1.00	1.00	0.00	1.00	1.00
MS	0.02	0.02	0.00	0.17	0.31	0.23	0.04	0.88
EMP	0.06	0.02	0.03	0.10	0.07	0.02	0.03	0.10
GDP	0.01	0.01	-0.03	0.03	0.01	0.01	-0.03	0.03
CI	5.68	16.90	0.09	89.31	0.51	0.09	0.27	0.98
RRWA	0.17	0.59	-0.89	3.98	0.02	0.01	-0.03	0.06
PLCL	0.08	0.09	0.00	0.40	0.02	0.01	0.00	0.06
PLRWA	0.13	0.20	0.00	0.99	0.05	0.03	0.01	0.14

Table 2 presents the descriptive statistics for all the variables included in our analysis divided by size i.e. small banks and big banks. As shown, the dependent variable i.e. liquidity creation over total assets (LCA), records a positive mean of 31% and 37% for small banks and big banks respectively with relatively low standard deviations. In addition, by looking at the minimum and maximum values it seems that our dependent variable does not suffer from extreme outliers. Our independent variables, EA and CAR, record even lower standard deviations, where the means are as expected higher for CAR. This is explained by the fact that CAR is considered as a broader measure of equity that includes subordinated debts and other liabilities items in addition to total equity, as discussed earlier. For the control variables, we note that the standard deviations are relatively low for big banks as opposed to small banks. More specifically, the risk measures record very high standard deviations of 4.56 for STDROA and 39.02 for CRISK and are on average higher for smaller banks. Seemingly, small banks take on higher risk compared to big banks and more importantly we believe that the sample may include extreme outliers by looking at the minimum and maximum values. In section 7.4, we check for the robustness of our data with regards to large outliers by winsorizing the data. It is also worth mentioning that the variables PLCL and PLRWA are higher for smaller banks which indicates that the proportion of loans that cannot be easily recovered are relatively higher and hence the quality of the loans is poorer for smaller banks.

4.5 Testable Hypotheses

The main hypotheses of this research is to check if bank capital increases liquidity creation (H1: risk absorption hypothesis) or bank capital decreases liquidity creation (H2: financial-fragility-crowding out hypothesis) for the Scandinavian banks. Based on our discussion earlier, we are using two independent variables as a proxy for bank capital which are Equity to Total Assets (EA) and Capital Adequacy Ratio (CAR). We expect the relationship between capital and liquidity creation to be positive for big banks and negative for small banks in line with (Berger & Bouwman 2009; Distinguin et al. 2013; Horváth et al. 2013; Lei & Song, 2013). By using our panel dataset, the testable hypotheses are formulated as below:

- H1a: A positive relationship between equity ratio and liquidity creation for the big banks.
- H1b: A positive relationship between capital adequacy ratio and liquidity creation for the big banks.
- H2a: A negative relationship between equity ratio and liquidity creation for the small banks.
- H2b: A negative relationship between capital adequacy ratio and liquidity creation for the small banks.

4.6 Panel Data Analysis

To test our hypotheses, we conduct a panel data analysis as we are dealing with a longitudinal data that includes both time-series (quarters) and cross-sectional (banks) dimensions. Panel data analysis is preferred over other conventional methods like cross-sectional or time-series data analysis. According to Hsiao et al (2003), panel data improves the accuracy of the estimates by including more degrees of freedom and reducing multicollinearity issue between the variables by combining time series of cross-section observations. Panel data helps to analyze complex economic models more effectively in contrast to cross-section or time series data by controlling for omitted variable bias that might occur if we aggregate entities into broad aggregates (Baltagi, 1995).

The most popular panel data models used throughout the empirical literature are the pooled OLS model, the fixed effect model and the random effect model. We first go through each model, then we design our baseline regression model. For the pooled OLS model, we simply aggregate all the observations and estimate a "grand" regression, without considering the cross-sections and time series nature of our data. The major downside of this model is that by grouping different banks together at different times neglects the heterogeneity (uniqueness) that may exist among the banks. Hence, the uniqueness of each entity may be omitted in the error term which makes it possible to be correlated with other independent variable included in the model (Gujarati and Porter, 2009). The pooled OLS method is not suitable in our case as there might be bank-specific factors that have to be controlled for and ignoring them might bias our model.

The second model is the fixed effect model, which is also known as the Least-squares Dummy Variable (LSDV). This model allows for heterogeneity among different entities since each bank has its own intercept value ($\beta_i = \beta_1 + \beta_2 + \cdots + \beta_n$ $where$ i: $banks$). However, even though the intercept varies across entities, it is time-invariant (Gujarati and Porter, 2009).

The third model is the Random Effect Model (REM), which is similar to the LSDV model in the way that it allows for heterogeneity among entities. However, unlike LSDV, where each entity has its own (fixed) intercept value, REM, has a common intercept ($\beta_i = \beta + \varepsilon_i$) that serves as the mean value of all the entities intercepts. The error term, ε_i, included in the intercept value, indicates the random deviation of separate intercept from this mean value (Gujarati and Porter, 2009).

It is often argued that REM is more plausible and will bring more efficient estimates, because the entities in the sample are randomly chosen from the population and the model includes less estimators since it excludes dummies (Gujarati and Porter, 2009). However, REM may have a downside of being valid only when the error term is uncorrelated with the independent variable (Brooks, 2014). We have already argued that pooled OLS may not be efficient for the purpose of our analysis, which leaves us with either the fixed effect model or the random effect model. To decide between the two models, we run a Hausman test, where the null hypothesis is that REM and LSDV estimators do not differ to a large extent. The test uses a chi-square distribution. If the probability value is less than 5%, which implies that the null hypothesis cannot be accepted, the random effects are most likely to be correlated with the regressors. Thus, we conclude that it is appropriate to use LSDV. If the opposite holds true, we accept the null hypothesis and favor the REM over the LSDV (Gujarati and Porter, 2009).

4.7 Research Model

Based on our discussion for the different types of panel data analysis and in line with Lei & Song (2013), we develop the following baseline regression models in order to test the hypothesis presented earlier:

$$\boldsymbol{LCA_{i,t} = \beta_0 + \beta_1 EA_{i,t-1} + \sum_{j}^{n} \beta_j C_{j,i,t-1} + \varepsilon_{i,t}}, \qquad (1)$$

$$\boldsymbol{LCA_{i,t} = \beta_0 + \beta_1 CAR_{i,t-1} + \sum_{j}^{n} \beta_j C_{j,i,t-1} + \varepsilon_{i,t}}, \qquad (2)$$

where:

- $LCA_{i,t}$: The dependent variable, Liquidity creation to total assets
- $EA_{i,t-1}$: The lagged one-period independent variable for the first regression, Equity to total assets
- $CAR_{i,t-1}$: The lagged one-period independent variable for the second regression, Capital adequacy ratio
- $C_{j,i,t-1}$: The j^{th} lagged one-period control variable, where j stands for the list of control variables described in section 1.2.3 include: Volatility of earnings (STD-ROA), Z-score, Credit risk (C-RISK), Bank Size (LNA), Merger and acquisition dummy (MA), Problem loans to customer loans (PLCL), Problem loans to risk weighted assets (PLRWA), Cost to income (CI), Return on risk weighted assets (RRWA), GDP rate (GDP), unemployment rate (EMP), Market share (MS).
- β_j: The coefficient of the regressors where β_0 is the intercept and β_1 is the coefficient of interest that answers our research question.
- i: The entity (bank) unit where i = 1, 2 … 21 for small banks and i = 1, 2 … 7 for big banks.
- t: The time period (quarter) where t = 1, 2 … 32

Important to note, is that we are using lagged variables for the independent variables and all the control variables to control for endogeneity issues that may arise in our model. We arbitrarily use one lagged-period, which is in line with Lei & Song (2013). Although, Horváth et al. (2013) use four lagged-period since they have higher time frequency (monthly data). They also extend their restriction to twelve lagged-period to check the robustness of their findings and report similar results. It is worth mentioning that all the bank risk measures in our model may be highly collinear since they all estimate the same underlying parameter i.e. risk and to overcome this issue, we orthogonalize two of our risk measures i.e. C-risk and Z-score. This is achieved by regressing Z-score variable with respect to the other risk measures and extracting out the residuals. Similar procedure is carried out for C-risk variable. In our regression model, we control for heteroscedasticity and autocorrelation issue by using robust standard errors.

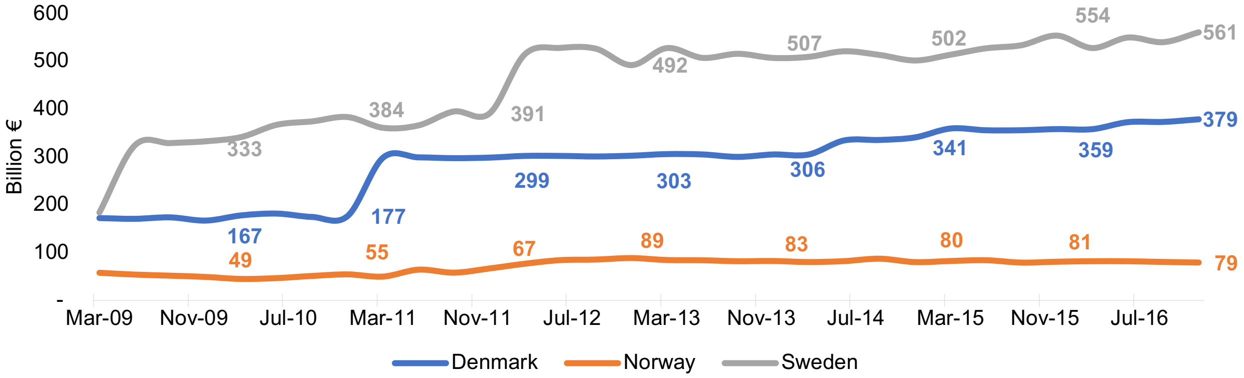
5. Empirical finding and analysis

In this section, we first analyze our liquidity creation measure for the Scandinavian banks. Then, we discuss the validity tests to form the basis of the chosen regression model. This leads us to the main regression analysis and the discussion of our results. Finally, we test for the robustness of our main findings.

5.1 Liquidity Creation Analysis

We use the Berger and Bouwman (2009) framework to calculate our liquidity creation measure. In Graph 1, we present the liquidity creation analysis by country for the observation period. In terms of liquidity creation amount, Swedish banks created the most liquidity of €561 billion in 2016 followed by the Danish banks of €379 billion and Norwegian banks of €79 billion. In terms of liquidity creation growth, Denmark record an average annual growth rate of 14.2% since 2009, while the corresponding average rates for Norway and Sweden are 7.9% and 8.1% respectively. Graph 1 shows the liquidity creation of banks in different countries. During 2011 and 2012, we observed a strong expansion of liquidity creation in Denmark (2011 annual growth rate: 70%), Sweden (2012 annual growth rate: 26%) and Norway (2012 annual growth rate: 32%). These peaks were highly stimulated by the microenvironment conditions in which the European market was at its recovery phase after the debt crisis. Overall, the trend in Graph 1, reflects a positive environment and the liquidity creation increased for all the Scandinavian banks. The same increasing trend can be observed for the liquidity creation over total assets as illustrated in Graph A1 in the appendix. Based on the latest available data, the Norwegian banks recorded a slight drop between 2015 and 2016 (-2%), which could be justified by the excessive volatility of the oil prices leading to an increasing loan loss provision in all industries related to oil and gas sector.

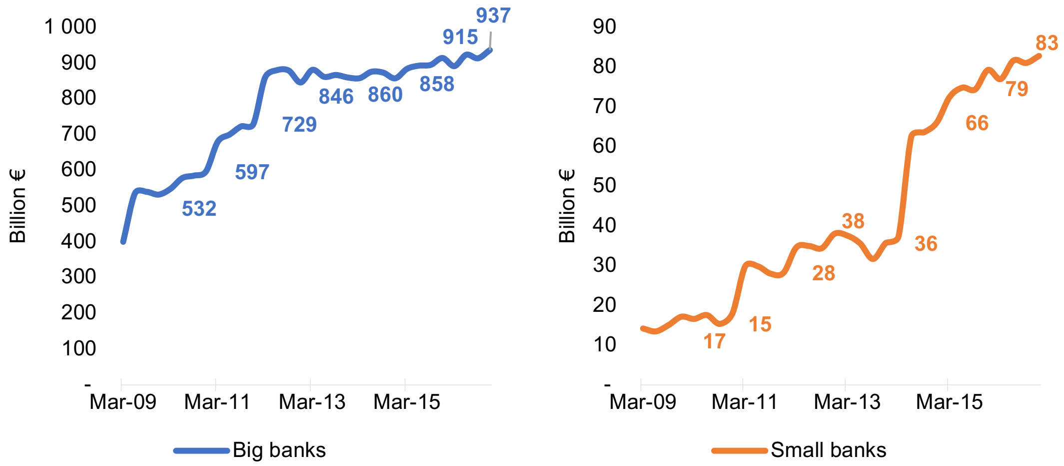
Graph.1 Liquidity creation by country 2009-2016



Source: SNL and analysis

To measure how much liquidity is created by banks based on size, we split our sample into big and small banks. By dividing our sample into two categories, we gain insights on the type of banks contributing the most in liquidity creation. Graph 2 distinguishes the liquidity creation volumes of both big and small banks. In 2009, big banks' liquidity creation reached €532 billion and small banks' liquidity creation was €17 billion. The trend for these two lines is positive but the growth recorded on the small banks is considerable comparing to the development of the big banks' liquidity creation given the continuous expansion in liquidity for such banks (average growth rate since 2009: 29% small banks vs. 9% big banks). The critical phase mentioned earlier of the European debt crisis could be observed again, as the growth rates during that period were relatively higher than the average and especially in the case of small banks (for 2011, growth rate: 22% big banks vs. 57% small banks and for 2012, growth rate: 16% big banks vs. 35% small banks).

Graph 2. Liquidity creation big banks vs small banks, 09-16



Source: SNL and analysis

Source: SNL and analysis

In Table 3, we observe that big banks contribute significantly in creating liquidity as compared to small banks. In 2009, the ratio of liquidity creation over total assets (LCA) for big banks is 31% and small banks is 16%. In 2016, our total sample of banks generated a total liquidity of €1019 billion out of which €937 billion is contributed by big banks and €83 billion by small banks. However, the ratio of LCA improved for small banks from 18% in 2012 to 32% in 2016 implying small banks doubled liquidity creation by holding substantial amount of liquid deposits. Comparing our measure of liquidity creation in Scandinavia with Berger & Bouwman (2009) US results and Lei & Song (2013) China results, the average LCA for big banks is around 35% for big banks which is slightly lower than 40% LCA in US and higher than 30%

LCA in China. Moreover, we obtain an average LCA of 22% for small banks in Scandinavia as compared to 21% LCA in US. For more details of liquidity creation of large and small banks over the whole period, please see appendix A2.

Table 3. Summary of liquidity creation for different categories of banks 2009-2016

	Dec-09		Dec-12		Dec-16	
	LC	LC/A	LC	LC/A	LC	LC/A
All banks	550	*30%*	884	*34%*	1019	*40%*
Big banks	532	*31%*	846	*35%*	937	*41%*
Small banks	17	*16%*	38	*18%*	83	*32%*

Source: SNL and Analysis

5.2. Validity test

Before analyzing the regression results, we run some tests to check for the validity of our results and the relevance of our models. All the tests are performed for big banks and small banks, separately, rather than on the entire sample. The important tests carried out are Hausman test, testing for multicollinearity, heteroskedasticity, autocorrelation and unit root.

Table 4. Regression results fixed effect vs random effect for big banks and small banks

The Table presents the regression results for our four models. The first two models represent estimations of liquidity creation for big banks with the only difference being the independent variable: Lagged equity to total assets for model 1 and lagged capital adequacy ratio for model 2. The last two models represent the estimations of liquidity creation for small banks with the only difference being the independent variable: Lagged equity to total assets for model 3 and lagged capital adequacy ratio for model 4. For each model we run a regression with fixed effect against random effect. The asterisks indicate the significance level of each coefficient.

	Big banks				Small banks			
	Model 1		Model 2		Model 3		Model 4	
	Fixed	Random	Fixed	Random	Fixed	Random	Fixed	Random
VARIABLES	LCA	LCA	LCA	LCA	LCA	LCA	LCA	LCA
EA_{t-1}	1.740**	-1.266			-0.087	-0.128		
CAR_{t-1}			0.316**	-0.143			-0.845***	-0.763***
$STDROA_{t-1}$	0.035	0.094	0.038	0.087	0.001	0.001	0.001	0.001
$CRISK_{t-1}$	-11.676**	-40.314***	-11.475*	-42.231***	-0.047**	-0.037*	-0.089***	-0.063***
$Zscore_{t-1}$	-0.017**	-0.022	-0.015**	-0.025	0.015*	0.013*	0.017**	0.015**
LNA_{t-1}	0.051	-0.127***	-0.000	-0.114***	0.030	-0.013	0.012	-0.019
MA_{t-1}		-4.423***		-4.942***	0.004	0.000	-0.005	-0.006
MS_{t-1}	-0.033	-0.213***	0.017	-0.232***	2.601***	2.752***	3.236***	3.187***
EMP_{t-1}	-0.042	-3.746***	0.084	-3.783***	-1.659***	-1.881***	-1.023*	-1.268**
GDP_{t-1}	-0.842***	-1.187	-0.861***	-1.265	0.816*	0.855**	0.915**	0.924**
CI_{t-1}	-0.013	0.032	-0.018	0.046	0.007***	0.007***	0.004***	0.004***
$PLCL_{t-1}$	7.766***	1.889*	8.228***	1.716	0.044	-0.050	-0.095	-0.210
$PLRWA_{t-1}$	-3.504***	0.663	-3.599***	0.873**	-0.013	-0.018	-0.000	0.031
Constant	-2.245***		-1.561***		0.067	0.494**	0.353	0.658***

Observations	208	208	208	208	524	524	524	524
R-squared	0.477		0.476		0.191		0.230	
Number of Bank1	7	7	7	7	21	21	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

- **Hausman test**

We first employ the Hausman test for the four models separately to decide whether the fixed effect or the random effect is more suitable for every model. Table 4 presents a comparison between fixed effect and random effect regressions for all the four models. As shown in Tables B1a, B1b, B1c and B1d in the appendix, there is a strong evidence against the null hypothesis for model 1, 2 and 4. That is, the null hypothesis that supports the use of the random effect regression is rejected for the three models. Thus, the fixed effect regression is more appropriate to consider for these models. In contrast, we fail to reject the null hypothesis for model 3 and conclude that the random effect regression is more suitable for this model.

- **Multicollinearity**

It is also crucial to test for multicollinearity among the explanatory variables in our regressions. High correlation implies that the coefficients cannot be estimated with great precision and accuracy. One way of checking for this is by employing a correlation matrix for all the variables and removing the ones that are causing collinearity problem in the data.

For big banks, Table B6a in the appendix shows that there is no serious multicollinearity issue among the variables. The correlations are roughly less than 0.5 between most of the variables. To support our results, we perform a test called Variance Inflator Factor (VIF). As a rule of thumb, a variable is considered highly collinear if its VIF is higher than 10. As indicated in Tables B2a and B2b in the appendix, the average VIF for the models 1 and 2 are 3.14 and 3.40 respectively and the maximum VIF values are 5.62 and 6.77 respectively, showing that these models do not suffer from multicollinearity bias.

For small banks, the correlation matrix attached in the appendix (B6b), shows that except the variable PLRWA, there is no high correlations among the variables. In fact, the correlations are roughly less than 0.5 between most of the variables, whereas the correlation between the variable PLRWA and the variables CI, RRWA and PLCL is 0.84, 0.69 and 0.66 respectively. The results of VIF test shown in Tables B2c and B2d in the appendix support our observations from the correlation matrix. The average VIF for the two models is 2.93 and 3.63 respectively, and the variable PLRWA records the highest VIF with 7.4 for model 3 and 13.8 for model 4. Hence, we decide to exclude the variables PLRWA from the regression results of the small banks to avoid multicollinearity issue in our models.

- **Testing for heteroskedasticity**

We test our data for presence of heteroscedasticity that is we check if the variance of the residual is constant over time as it is one of the basic assumption of OLS. Violating the homoscedasticity assumption, unless controlled for, may result in biased estimators. In this regard, a Wald test is performed to check for heteroskedasticity in fixed effect and random effect models. This test allows for both balanced and unbalanced data. The null hypothesis under Wald test is that the residuals are homoscedastic. Figures B3a, B3b, B3c and B3d in the appendix indicates that the null cannot be accepted for our models and we conclude that heteroskedasticity is present in our data. However, we use heteroskedasticity-consistent standards errors, also known as White standard errors, to control for heteroscedasticity.

- **Testing for autocorrelation**

The robust standard errors are also used to control for autocorrelation patterns in our data. By employing a Wooldridge test on our fixed effect models, as illustrated in Figures B4a, B4b, B4c and B4d in the appendix, we conclude that the null hypothesis of no first-order correlation is rejected, implying that serial correlation exists in our data. Serial correlation produces smaller standard errors and higher R-squared, therefore it is important to control for it to avoid misleading results.

- **Testing for unit root**

Our final test is to check for data stationarity. Non-stationary panel data may cause unreliable and spurious findings, hence it is important to test for it in our data. We use fisher test for unit root as it allows for unbalanced data, where the underlying test is the augmented dicky fuller. The null hypothesis of unit root is strongly rejected for both big banks and small banks as shown in Figures B5a and B5b in the appendix. Thus, our dependent variable is stationary at a 1% significance level and has no trend.

5.3. Regression analysis

The first observation of Table 5 indicates that our main variable of interest is significant in three out of four models. We obtain significant results for models 1, 2 and 4, whereas nothing can be concluded for model 3 as the corresponding coefficient of interest is insignificant. From models 1 and 2, we can draw conclusion that capital seems to have an impact on the liquidity creation for the big banks. For the small banks, we find insignificant result in model 3 and significant result in model 4. The alternative independent variable of capital adequacy ratio used to capture regulatory capital seems to be an appropriate measure of capital in model 4 as compared to model 3. We can conclude that capital impacts liquidity creation for small banks. The second observation is that amongst the control variables from Table 5, the lagged control variables of CRisk, Zscore and GDP explain variation in liquidity creation for all four models, while PLCL and PLRWA explain variation in liquidity creation for models 1 and 2, only. The control variables MS, EMP and CI explain the variation in liquidity creation for models 3 and 4, only.

Table 5. Regression results big banks vs small banks

The Table reports the final version of regression results for our four models after controlling for the issues discussed in the previous section. The first two columns represent estimations of liquidity creation for big banks with the only difference being the independent variable. Lagged equity to total assets for model 1 and lagged capital adequacy ratio for model 2. The last two columns represent the estimations of liquidity creation for small banks with the only difference being the independent variable. Lagged equity to total assets for model 3 and lagged capital adequacy ratio for model 4. Models 1 and 2 are used to test hypothesis H1a and H1b, Models 3 and 4 are used to test hypothesis H2a and H2b. The fixed effect regression is employed for models 1, 2 and 4, whereas the random effect model is used for model 3 as explained in the previous section. The standard errors are presented in parenthesis and the asterisks indicate the significance level of each coefficient.

	Big banks		Small banks	
	Model 1	**Model 2**	**Model 3**	**Model 4**
VARIABLES	**LCA**	**LCA**	**LCA**	**LCA**
EA_{t-1}	1.740**		-0.086	
	(0.814)		(0.380)	
CAR_{t-1}		0.316**		-0.845***
		(0.154)		(0.169)
$STDROA_{t-1}$	0.035	0.038	0.001	0.001
	(0.034)	(0.033)	(0.001)	(0.001)
$CRISK_{t-1}$	-11.676**	-11.475*	-0.047**	-0.089***
	(5.680)	(5.834)	(0.022)	(0.023)
$Zscore_{t-1}$	-0.017**	-0.015**	0.015*	0.017**
	(0.007)	(0.007)	(0.008)	(0.007)
LNA_{t-1}	0.051	-0.000	0.029	0.012
	(0.074)	(0.062)	(0.025)	(0.024)

MS_{t-1}	-0.033	0.017	2.595***	3.236***
	(0.044)	(0.041)	(0.499)	(0.479)
EMP_{t-1}	-0.042	0.084	-1.667***	-1.023*
	(0.352)	(0.366)	(0.572)	(0.569)
GDP_{t-1}	-0.842***	-0.861***	0.818*	0.915**
	(0.290)	(0.292)	(0.429)	(0.419)
CI_{t-1}	-0.013	-0.018	0.007***	0.004***
	(0.037)	(0.037)	(0.001)	(0.001)
$PLCL_{t-1}$	7.766***	8.228***	0.027	-0.096
	(0.919)	(0.901)	(0.111)	(0.111)
$PLRWA_{t-1}$	-3.504***	-3.599***		
	(0.383)	(0.375)		
MA_{t-1}			0.003	-0.005
			(0.014)	(0.013)
Constant	-2.245***	-1.561***	0.069	0.353
	(0.450)	(0.541)	(0.226)	(0.217)
Observations	208	208	524	524
R-squared	0.477	0.476	0.191	0.230
F-Value	15.74	15.68	10.54	13.34
Prob > F	0	0	0	0
Number of Banks	7	7	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In model 1, we find that the equity ratio EA has a positive impact on liquidity creation. As EA increases by 1%, the liquidity creation increases by 1.740%. The coefficient is significant at a 5% level. Similarly, in model 2, the use of alternative independent variable of capital adequacy ratio (CAR) has a positive impact on liquidity creation. As CAR increases by 1%, the liquidity creation increases by 0.316%. The result is significant at a 5% level. The results of models 1 and 2 confirm the first hypothesis (*H1)* of risk absorption (Bhattacharya & Thakor 1993: Repullo 2004). The findings do not reject our testable hypotheses H1a and H1b, as the increase in capital increases liquidity creation for the big Scandinavian banks which is in line with Berger & Bouwman (2009) findings for big US banks. In models 1 and 2, the lagged control variable of CRISK is negative and significant at a 5% and 10% level respectively. As Deli & Hasan (2017) mention, higher credit risk negatively effects loan growth and consequently lowers liquidity creation. The coefficient of lagged Zscore is significant at a 5% level and negative in models 1 and 2, which means the higher the probability of banks default, the lower the liquidity creation. The coefficient of PLRWA is significant at a 1% level in both models and correctly specifying that the lower problem loans to risk-weighted assets the higher the liquidity creation. The lagged control variable of GDP is significant at a 1% level in models 1 and 2, but not as expected since the growth in GDP should increase a bank's lending and increase liquidity creation. Similarly, the lagged control variable of PLCL is not as expected for the two models, instead, the increase in problem loans to consumer loans increases liquidity creation. The MA coefficients have been omitted from models 1 and 2 as the dummy variable takes the value of 1 for all the big banks during the period between 2007 and 2016 indicating that all the big banks have been involved in M&A activities at least every three years.

Hypothesis 2 is tested using models 3 and 4. As mentioned earlier, in model 3 the coefficient of our main independent variable is small and insignificant. Thereby, we cannot establish causality between EA and liquidity creation and fail to accept our testable hypothesis H2a. To evaluate if there is any relationship between capital and liquidity for the small banks, we consider model 4, which uses a broad measure of regulatory capital as a main independent variable. In model 4, the coefficient of interest is negative as expected and significant. As CAR increases by 1% liquidity creation decreases by 0.845%. The result is significant at a 1% level. From model 4, we can draw the conclusion that capital decreases liquidity creation in line with financial fragility crowding out hypothesis (Diamond & Rajan 2000; Gorton & Winton 2000). The finding only supports our testable hypothesis H2b i.e. capital decreases liquidity creation for the small Scandinavian banks, which is in line with previous literature. For instance, Berger & Bouwman (2009) establish a negative relationship between capital and liquidity creation when applied in the context of all US small banks. Horváth et al. (2013) find the same conclusion using a sample of 31 Czech banks, where they argue that majority of the banks in their sample are considered as small banks. Similarly, Lei & Song (2013) find the same causality relationship in the Chinese banking industry.

The key driver of liquidity creation for models 3 and 4 is the MS control variable, which is positive and significant at a 1% level. Unlike big banks, the competition seems to be fiercer among small banks. In fact, the magnitude of the coefficients is relatively higher for models 3 and 4 with an estimate of 2.595 and 3.236, respectively. It follows that higher market share of deposits as source of funding used by a bank, the higher is the liquidity creation. Moreover, risk control variables explain variation in liquidity creation for the two models. The CRISK variable records a negative coefficient for models 3 and 4 with a significance level of 5% and 1%, respectively. As expected, lower credit risk exposure increases liquidity creation. However, the coefficient of the Zscore variable, for models 3 and 4, is positive and significant at a 10% and 5% level, respectively. This positive relationship is not in line with our expectations and may be explained by the fact that excessive risk taking, by investing in more risky loans, results in a larger proportion of illiquid assets and therefore more liquidity creation. Unlike big banks, the EMP coefficient on liquidity creation for models 3 and 4 is negative and significant at a 1% and 10% level respectively. This means that higher unemployment rate reduces the banks solvency risk as bank's lending is expected to decrease during unfavorable economic times. Essentially, higher unemployment rate destroys liquidity creation for small banks (Horváth et al. 2013). Another notable feature is the significantly positive estimate for GDP in both models. This means higher growth in the economy increases business and consumer activities, which leads to increasing banks' lending, hence more liquidity is generated. The regression indicates that cost to income CI is positive and significant at a 1% level, however the magnitude of the coefficient is near zero for both models that makes us believe that the impact is quite small.

5.4. Robustness check

In this sub-section, we perform two different robustness checks to examine if our findings are robust under different specifications such as large outliers and alternative dependent variable.

5.4.1 Controlling for large outliers

In line with Ongena, Peydro & Horen (2013), we winsorize all our variables below the 5th percentile and above the 95th percentile for every quarter. Table C in the appendix provides summary statistics of the winsorized data against the original data, we can clearly notice the presence of extreme data for some variables which may influence our estimates in the regression models. For instance, for the control variable lagged Zscore, the standard deviation was reduced to 0.68 (against 0.70) after winsorization resulting in a maximum value of 2.23 (against 3.13) and a minimum value of 0.88 (against 0.91).

Table 6. Regression results original vs winsorized for big banks and small banks

The Table presents the regression results for our four models where we provide a comparison between original data and winsorized data. The first two models represent estimations of liquidity creation for big banks with the only difference being the independent variable: Lagged equity to total assets for model 1 and lagged capital adequacy ratio for model 2. The last models represent the estimations of liquidity creation for small banks with the only difference being the independent variable: Lagged equity to total assets for model 3 and lagged capital adequacy ratio for model 4. The asterisks indicate the significance level of each coefficient.

	Big banks				Small banks			
	Model 1		Model 2		Model 3		Model 4	
	Orig	Win	Orig	Win	Orig	Win	Orig	Win
VARIABLES	LCA	LCA	LCA	LCA	LCA	LCA	LCA	LCA
EA_{t-1}	1.740**	2.031**			-0.086	-0.089		
CAR_{t-1}			0.316**	0.326**			-0.845***	-0.896***

$STDROA_{t-1}$	0.035	0.024	0.038	0.029	0.001	0.001	0.001	0.001
$CRISK_{t-1}$	-11.676**	-10.752*	-11.475*	-11.654**	-0.047**	-0.048**	-0.089***	-0.092***
$Zscore_{t-1}$	-0.017**	-0.022***	-0.015**	-0.020***	0.015*	0.015**	0.017**	0.018**
LNA_{t-1}	0.051	0.075	-0.000	0.008	0.029	0.027	0.012	0.009
MA_{t-1}					0.003	0.003	-0.005	-0.006
MS_{t-1}	-0.033	-0.038	0.017	0.021	2.595***	2.780***	3.236***	3.497***
EMP_{t-1}	-0.042	0.007	0.084	0.133	-1.667***	-1.722***	-1.023*	-1.057*
GDP_{t-1}	-0.842***	-0.917***	-0.861***	-0.924***	0.818*	0.851*	0.915**	0.940**
CI_{t-1}	-0.013	-0.006	-0.018	-0.010	0.007***	0.007***	0.004***	0.004***
$PLCL_{t-1}$	7.766***	7.967***	8.228***	8.515***	0.027	0.004	-0.096	-0.130
$PLRWA_{t-1}$	-3.504***	-3.645***	-3.599***	-3.758***				
Constant	-2.245***	-2.403***	-1.561***	-1.698***	0.069	0.094	0.353	0.390*
Observations	208	208	208	208	524	524	524	524
R-squared	0.477	0.493	0.476	0.488	0.191	0.190	0.230	0.232
Number of Banks	7	7	7	7	21	21	21	21

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As reported in Table 6, the sign of the coefficients as well as the significance level for all the exogenous variables remained unchanged amongst the four models. The magnitude of the estimates for our independent variables is slightly higher for model 1 and lower for model 2. For model 1, the coefficient on equity to total assets moved from 1.740 to 2.031 and remained significant at a 5% level. For models 2 and 4, the coefficient on capital adequacy ratio moved from 0.316 to 0.326 and from -0.845 to -0.896, respectively with the same significance level of 5% and 1%. Model 3 remains insignificant and we are still unable to draw any conclusions about the impact of EA on LCA. Therefore, we conclude that our models are not sensible to large outliers, as shown by using winsorized data, we obtain consistent results. The coefficient on EA and CAR for big banks is still positive which is in line with hypothesis *(H1)* and the coefficient on CAR for small banks remains negative which is in line with hypothesis *(H2)*.

5.4.2 Excluding equity from the dependent variable

Following Berger & Bouwman (2009), we use an alternative measure for liquidity creation where we exclude equity from our dependent variable, in order to check for the robustness of our findings. The authors argue that liquidity is destroyed when liquid assets are converted into illiquid liabilities and because equity is considered as an illiquid claim, a negative weight has to be assigned for it. In contrast, holding more equity can endorse banks to issue more illiquid loans and thus increase liquidity creation. Therefore, to avoid penalizing banks for holding equity they exclude it from liquidity creation measure. Another explanation in removing equity from the liquidity creation measure is that equity is included in both the dependent (equity ratio) and the independent variable (liquidity creation over assets) which may result in perfect correlation between the exogenous and the endogenous variable. Excluding equity from the liquidity creation measure addresses our concern and serves to be a good robustness check to our results. The alternative proxy for liquidity creation is obtained following the same steps introduced in section 4.2.1, where the only difference is to assign 0 weight for equity instead of (-0.5).

Table 7. Regression results liquidity creation with equity vs without equity for big banks and small banks

The Table presents the regression results for our four models where we provide a comparison between liquidity creation measure including equity and liquidity creation measure excluding equity. The first two models represent estimations of liquidity creation for big banks with the only difference being the independent variable: Lagged equity to total assets for model 1 and lagged capital adequacy ratio for model 2. The last two models represent the estimations of liquidity creation for small banks with the only difference being the independent variable: Lagged equity to total assets for model 3 and lagged capital adequacy ratio for model 4. The asterisks indicate the significance level of each coefficient.

	Big banks				Small banks			
	Model 1		Model 2		Model 3		Model 4	
VARIABLES	LCA	LCA_NoE	LCA	LCA_NoE	LCA	LCA_NoE	LCA	LCA_NoE
EA_{t-1}	1.740**	2.125**			-0.086	0.348		
CAR_{t-1}			0.316**	0.348**			-0.845***	-0.774***
$STDROA_{t-1}$	0.035	0.037	0.038	0.042	0.001	0.001	0.001	0.001
$CRISK_{t-1}$	-11.676**	-11.991**	-11.475*	-12.652**	-0.047**	-0.047**	-0.089***	-0.084***
$Zscore_{t-1}$	-0.017**	-0.017**	-0.015**	-0.015**	0.015*	0.014*	0.017**	0.017**
LNA_{t-1}	0.051	0.053	-0.000	-0.016	0.029	0.032	0.012	0.009
MA_{t-1}					0.003	0.005	-0.005	-0.004
MS_{t-1}	-0.033	-0.034	0.017	0.025	2.595***	2.588***	3.236***	3.361***
EMP_{t-1}	-0.042	-0.031	0.084	0.096	-1.667***	-1.643***	-1.023*	-0.973*
GDP_{t-1}	-0.842***	-0.857***	-0.861***	-0.870***	0.818*	0.806*	0.915**	0.914**
CI_{t-1}	-0.013	-0.014	-0.018	-0.020	0.007***	0.007***	0.004***	0.004***
$PLCL_{t-1}$	7.766***	7.754***	8.228***	8.310***	0.027	0.032	-0.096	-0.088
$PLRWA_{t-1}$	-3.504***	-3.500***	-3.599***	-3.627***				
Constant	-2.245***	-2.314***	-1.561***	-1.552***	0.069	0.055	0.353	0.399*
Observations	208	208	208	208	524	524	524	524
R-squared	0.477	0.483	0.476	0.479	0.191	0.195	0.230	0.226
Number of Bank1	7	7	7	7	21	21	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As Table 7 indicates, the sign and the significance level of the coefficients of interest remain the same for all our models, after we exclude the equity from the liquidity creation measure. As expected, the magnitude of the coefficients on the independent variables increased to some extent. Since, the new liquidity creation variable does not penalize holding equity (0 weight) contrary to liquidity creation measures (-0.5 weight) in section 5.1. For model 1, the coefficient on equity ratio moved from 1.740 to 2.125 and remained significant at a 5% significance level. For models 2 and 4, the coefficient on capital adequacy ratio moved from 0.316 to 0.348 and from -0.845 to -0.774, respectively, with the same significance level of 5% and 1%. Model 3 remains insignificant and we can still not establish any causality between EA and LCA. Therefore, we can conclude that our models are robust by excluding equity from liquidity creation measure. That is, the coefficient on EA and CAR for big banks is still positive, which is in line with hypothesis *(H1)* and the coefficient on CAR for small banks remains negative which is in line with hypothesis *(H2)*.

6. Conclusion

This paper has examined the impact of capital on liquidity creation for the Scandinavian banks. Using quarterly data of 28 commercial banks in Scandinavia and splitting them into big and small banks for the period between 2009 and 2016. First, we construct our liquidity creation measure following Berger & Bouwman (2009) framework and second, we explore whether the risk absorption hypothesis or the financial fragility crowding out hypothesis explains the relationship between capital and liquidity creation. In our study, we test our hypotheses by using two different independent variables that are the equity ratio and the capital adequacy ratio as a proxy for capital by employing a fixed effect regression model.

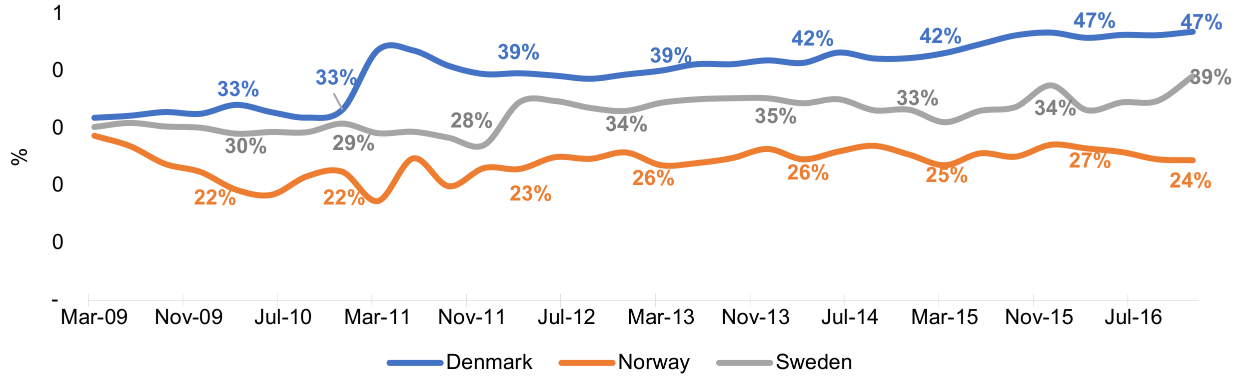
Our results, on average indicate that liquidity creation has increased in the Scandinavian banks where the big banks generate an average liquidity over total assets of 35% compared to small banks of 22%. We then find a positive relation between capital and liquidity creation for the big banks and giving credence to the risk absorption hypothesis stating tighter capital requirements increase bank's risk tolerance and increases liquidity creation. However, we do not find evidence that equity over total assets has a negative relationship with liquidity creation for the small banks. The other capital measure of capital adequacy ratio shows a negative relation between capital and liquidity creation for the small banks and lends support to the financial fragility-crowding out hypothesis. These findings suggest that the capital requirements in Basel III may have different outcomes for different sizes of banks. In addition, one can argue that the big banks are systemically important institutions facing more scrutiny from regulators and have better equipped themselves in finding optimal capital ratios. In case of small banks, tighter capital requirements are negatively affecting their ability to create liquidity.

We consider our research to contribute to the scare literature on the Scandinavian bank's liquidity creation ability and its interaction with capital. Additionally, our results indicate that banks respond differently based on their respective size to capital regulations, and it is crucial for policy makers to account for this underlying heterogeneity when introducing regulatory reforms. One drawback of our study has been the inability to include off-balance sheet activities due to data constraints. For future research, these remain open questions by including off-balance sheet commitments and analyzing the impact of both capital and liquidity regulations on liquidity creation during crisis and non-crisis periods.

Appendix

A. Liquidity creation analysis

A1. Liquidity creation to total assets by country 2009-2016



Source: SNL and analysis

A2. Details of liquidity measures 2009 - 2016

%	LCA		LC	
	Big Banks	Small banks	Big banks	Small banks
Mar-09	*32%*	*14%*	400	14
Jun-09	*32%*	*13%*	536	13
Sep-09	*31%*	*15%*	540	15
Dec-09	*31%*	*16%*	532	17
Mar-10	*30%*	*15%*	548	17
Jun-10	*30%*	*14%*	579	18
Sep-10	*30%*	*13%*	585	15
Dec-10	*31%*	*15%*	597	18
Mar-11	*33%*	*23%*	680	30
Jun-11	*34%*	*22%*	700	30
Sep-11	*32%*	*22%*	723	28
Dec-11	*31%*	*20%*	729	28
Mar-12	*36%*	*18%*	860	35
Jun-12	*36%*	*17%*	880	35
Sep-12	*35%*	*17%*	879	34
Dec-12	*35%*	*18%*	846	38
Mar-13	*36%*	*18%*	881	38
Jun-13	*37%*	*17%*	862	36
Sep-13	*37%*	*16%*	867	32
Dec-13	*38%*	*18%*	860	36
Mar-14	*37%*	*19%*	858	37
Jun-14	*37%*	*26%*	876	63
Sep-14	*36%*	*27%*	873	64
Dec-14	*36%*	*27%*	858	66
Mar-15	*34%*	*29%*	884	72
Jun-15	*36%*	*30%*	893	75
Sep-15	*37%*	*31%*	895	74
Dec-15	*40%*	*32%*	915	79
Mar-16	*37%*	*31%*	892	77
Jun-16	*38%*	*32%*	924	82
Sep-16	*38%*	*32%*	914	81
Dec-16	*41%*	*32%*	937	83
Average	***35%***	***22%***	**775**	**43**

Source: SNL and Analysis

B. Validity Tests

B1a. Hausman test Model 1 for big banks

	Coefficients			
	(b) Model 1 (Fixed effect)	(B) Model 1 (Random effect)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
L1_EA	1.740	-1.266	3.006	1.698
L1_STDROA	0.035	0.094	-0.059	0.048
L1_oCRISK	-11.676	-40.314	28.638	16.245
L1_oZSCORE	-0.017	-0.022	0.005	0.007
L1_LNA	0.051	-0.127	0.179	0.212
L1_MS	-0.033	-0.213	0.180	0.105
L1_EMP	-0.042	-3.746	3.704	0.745
L1_GDP	-0.842	-1.187	0.345	0.164
L1_CI	-0.013	0.032	-0.046	0.041
L1_PLCL	7.766	1.889	5.878	2.452
L1_PLRWA	-3.504	0.663	-4.167	1.027

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(**6**) = (b-B)'[(V_b-V_B)^(-1)](b-B) = **174.07**
Prob>chi2 = 0.0000

B1b. Hausman test Model 2 for big bank

	Coefficients			
	(b) Model 2 (Fixed effect)	(B) Model 2 (Random effect)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
L1_CAR	0.316	-0.143	0.458	0.236
L1_STDROA	0.038	0.087	-0.049	0.049
L1_oCRISK	-11.475	-42.231	30.756	15.665
L1_oZSCORE	-0.015	-0.025	0.010	0.008
L1_LNA	0.000	-0.114	0.114	0.179
L1_MS	0.017	-0.232	0.248	0.097
L1_EMP	0.084	-3.783	3.867	0.769
L1_GDP	-0.861	-1.265	0.403	0.212
L1_CI	-0.018	0.046	-0.063	0.043
L1_PLCL	8.228	1.716	6.512	2.398
L1_PLRWA	-3.599	0.873	-4.472	1.042

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(**12**) = (b-B)'[(V_b-V_B)^(-1)](b-B) = **174.08**
Prob>chi2 = 0.0000

B1c. Hausman test Model 3 for small banks

	Coefficients (b) Model 1 (Fixed effect)	(B) Model 1 (Random effect)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
L1_EA	-0.087	-0.128	0.041	0.065
L1_STDROA	0.001	0.001	0.000	0.000
L1_oCRISK	-0.047	-0.037	-0.010	0.011
L1_oZSCORE	0.015	0.013	0.002	0.001
L1_LNA	0.030	-0.013	0.043	0.013
L1_MA	0.004	0.000	0.003	0.002
L1_MS	2.601	2.752	-0.151	0.098
L1_EMP	-1.659	-1.881	0.222	0.120
L1_GDP	0.816	0.855	-0.039	0.029
L1_CI	0.007	0.007	0.001	0.000
L1_PLCL	0.044	-0.050	0.094	0.042
L1_PLRWA	-0.013	-0.018	0.005	0.026

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(**12**) = (b-B)'[(V_b-V_B)^(-1)](b-B) = **18.89**
Prob>chi2 = **0.0912**

B1d. Hausman test Model 4 for small banks

	Coefficients (b) Model 2 (Fixed effect)	(B) Model 2 (Random effect)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
L1_CAR	-0.845	0.763	-0.082	0.067
L1_STDROA	0.001	0.001	0.000	0.000
L1_oCRISK	-0.089	-0.063	-0.026	0.013
L1_oZSCORE	0.017	0.015	0.001	0.001
L1_LNA	0.012	-0.019	0.030	0.013
L1_MA	-0.005	-0.006	0.001	0.002
L1_MS	3.236	3.187	0.049	0.129
L1_EMP	-1.023	-1.268	0.245	0.116
L1_GDP	0.915	0.924	-0.008	0.032
L1_CI	0.004	0.004	0.000	0.001
L1_PLCL	-0.095	-0.210	0.114	0.038
L1_PLRWA	0.000	0.031	-0.031	0.023

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(**12**) = (b-B)'[(V_b-V_B)^(-1)](b-B) = **21.52**
Prob>chi2 = **0.0432**

B2a. VIF test model 1 big banks

Variable	VIF	1/VIF
L1_MS	5.620	0.178
L1_LNA	4.970	0.201
L1_PLCL	4.190	0.239
L1_PLRWA	3.840	0.260
L1_EA	3.170	0.316
L1_oZSCORE	2.990	0.334
L1_EMP	2.780	0.360
L1_STDROA	2.360	0.423
L1_oCRISK	2.140	0.467
L1_CI	1.400	0.715
L1_GDP	1.110	0.904
Mean VIF	3.140	

B2b. VIF test model 2 big banks

Variable	VIF	1/VIF
L1_oCRISK	6.770	0.148
L1_MS	4.840	0.207
L1_CAR	4.770	0.210
L1_PLCL	4.150	0.241
L1_LNA	3.810	0.262
L1_EMP	3.070	0.326
L1_oZSCORE	2.770	0.361
L1_PLRWA	2.430	0.412
L1_STDROA	2.340	0.428
L1_CI	1.360	0.735
L1_GDP	1.090	0.918
Mean VIF	3.400	

B2c. VIF test model 3 small banks

Variable	VIF	1/VIF
L1_PLRWA	7.35	0.14
L1_CI	5.76	0.17
L1_LNA	4.67	0.21
L1_PLCL	2.92	0.34
L1_MS	2.78	0.36
L1_EA	2.51	0.40
L1_EMP	2.48	0.40
L1_oZSCORE	1.83	0.55
L1_MA	1.38	0.73
L1_oCRISK	1.37	0.73
L1_STDROA	1.10	0.91
L1_GDP	1.04	0.97
Mean VIF	**2.93**	

B2d. VIF test model 4 small banks

Variable	VIF	1/VIF
L1_PLRWA	13.840	0.072
L1_CI	6.590	0.152
L1_PLCL	5.080	0.197
L1_LNA	3.770	0.265
L1_MS	2.780	0.360
L1_CAR	2.670	0.375
L1_EMP	2.290	0.437
L1_oZSCORE	1.620	0.618
L1_oCRISK	1.550	0.647
L1_MA	1.330	0.754
L1_STDROA	1.070	0.932
L1_GDP	1.030	0.966
Mean VIF	**3.63**	

B3a. Wald test for model 1 (big banks)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i
chi2 (7) = **176.31**
Prob>chi2 = **0.0000**

B3b. Wald test for model 2 (big banks)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i
chi2 (7) = **337.32**
Prob>chi2 = **0.0000**

B3c. Wald test model 3 (small banks)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i
chi2 (21) = **12596.15**
Prob>chi2 = **0.0000**

B3d. Wald test model 4 (small banks)

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i
chi2 (21) = **2282.95**
Prob>chi2 = **0.0000**

B4a. Wooldridge test for Model 1 (big banks)

Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation
F(1, 6) = **22.767**
Prob > F = **0.0031**

B4b. Wooldridge test for Model 2 (big banks)

Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation
F(1, 6) = **6.830**
Prob > F = **0.0399**

B4c. Wooldridge test for Model 3 (small banks)

Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation
F(1, 20) = **240.639**
Prob > F = **0.0000**

B4d. Wooldridge test for Model 4 (small banks)

Wooldridge test for autocorrelation in panel data

H0: no first-order autocorrelation
F(1, 20) = **277.721**
Prob > F = **0.0000**

B5a. Fisher test for big banks

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lag)

Ho: unit root
chi2(14) = **37.0659**
Prob > chi2 = **0.0007**

B5b. Fisher test for small banks

Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lag)

Ho: unit root
chi2(42) = **88.4560**
Prob > chi2 = **0.0000**

B6a. Correlation matrix for big banks

	LCA	L1_EA	L1_CAR	L1_STD~A	L1_oCR~K	L1_oZS~E	L1_LNA	L1_MA	L1_MS	L1_EMP	L1_GDP	L1_CI	L1_RRWA	L1_PLCL	L1_PLRWA
LCA	1.000														
L1_EA	-0.168	1.000													
L1_CAR	0.439	0.040	1.000												
L1_STDROA	0.196	0.120	-0.172	1.000											
L1_oCRISK	-0.448	0.385	-0.779	0.231	1.000										
L1_oZSCORE	-0.183	-0.038	0.310	-0.723	-0.312	1.000									
L1_LNA	-0.449	-0.267	-0.085	-0.367	-0.137	0.386	1.000								
L1_MA	.	.	.	.	.	.	.	.							
L1_MS	-0.428	0.149	-0.272	-0.028	0.341	0.020	0.596	.	1.000						
L1_EMP	0.177	-0.515	0.260	-0.059	-0.625	0.137	0.049	.	-0.509	1.000					
L1_GDP	-0.001	-0.014	0.173	-0.052	-0.180	0.051	0.072	.	-0.084	0.154	1.000				
L1_CI	0.091	-0.363	-0.193	0.059	-0.070	-0.173	0.008	.	-0.062	0.237	0.043	1.000			
L1_RRWA	-0.056	0.308	0.538	-0.363	-0.360	0.411	0.053	.	-0.124	0.061	0.123	-0.522	1.000		
L1_PLCL	-0.046	-0.182	-0.350	0.330	0.264	-0.361	0.197	.	0.557	-0.155	0.020	0.275	-0.543	1.000	
L1_PLRWA	0.291	-0.510	0.120	0.088	-0.211	-0.020	-0.021	.	0.129	0.197	0.057	0.158	-0.2923	0.571	1.000

B6b. Correlation matrix for small banks

	LCA	L1_EA	L1_CAR	L1_STD~A	L1_oCR~K	L1_oZS~E	L1_LNA	L1_MA	L1_MS	L1_EMP	L1_GDP	L1_CI	L1_RRWA	L1_PLCL	L1_PLRWA
LCA	1.000														
L1_EA	-0.060	1.000													
L1_CAR	0.009	-0.097	1.000												
L1_STDROA	0.014	-0.023	-0.032	1.000											
L1_oCRISK	-0.086	-0.169	0.364	-0.029	1.000										
L1_oZSCORE	0.072	-0.019	0.011	-0.134	0.005	1.000									
L1_LNA	-0.323	-0.631	0.123	-0.086	0.084	0.066	1.000								
L1_MA	-0.011	-0.138	0.018	0.075	-0.201	-0.094	0.357	1.000							
L1_MS	-0.247	-0.310	-0.137	-0.037	-0.139	-0.227	0.651	0.349	1.000						
L1_EMP	-0.449	-0.197	0.260	0.105	0.178	-0.232	0.466	0.212	0.214	1.000					
L1_GDP	-0.027	-0.020	0.071	-0.020	0.046	-0.049	0.050	0.016	-0.016	0.160	1.000				
L1_CI	0.072	-0.446	0.283	-0.052	-0.063	0.374	0.362	0.235	-0.094	0.357	0.032	1.000			
L1_RRWA	0.038	-0.358	0.680	-0.047	-0.053	0.251	0.337	0.238	-0.065	0.235	0.063	0.600	1		
L1_PLCL	-0.3281	0.0174	-0.0475	0.0015	-0.1487	-0.1067	0.0034	0.0722	-0.0579	0.4072	0.0396	0.3491	0.141	1	
L1_PLRWA	-0.0771	-0.3731	0.4002	-0.0384	-0.0897	0.1731	0.3153	0.2033	-0.0639	0.4404	0.0491	0.8352	0.6881	0.6611	1

C. Robustness check

C. Summary statistics original data vs winsorized data for all the banks

Stats	mean	sd	min	max	p25	p50	p75
LCA	0.374792	0.161962	0.148452	0.747414	0.239027	0.347672	0.479253
LCA_w	0.374929	0.161802	0.178702	0.742366	0.239027	0.347672	0.479253
L1_EA	0.045963	0.007879	0.029761	0.073479	0.041585	0.044812	0.049788
L1_EA_w	0.045915	0.00779	0.030423	0.073283	0.041585	0.044861	0.049696
L1_CAR	0.188015	0.042359	0.096112	0.3028	0.159595	0.186639	0.208707
L1_CAR_w	0.188054	0.041648	0.100572	0.292806	0.160883	0.186639	0.208707
L1_STD~A	0.163226	0.133546	0.019626	0.658231	0.06456	0.119725	0.208394
L1_STD~w	0.163184	0.132834	0.024015	0.636998	0.06456	0.119725	0.208394
L1_oCR~K	-0.1663	0.002765	-0.16999	-0.15567	-0.16796	-0.16714	-0.16526
L1_oCR~w	-0.16631	0.002749	-0.1699	-0.15621	-0.16796	-0.16714	-0.16526
L1_oZS~E	-0.02018	0.707402	-0.91166	3.136393	-0.53687	-0.24212	0.421778
L1_oZS~w	-0.02839	0.680991	-0.88658	2.235192	-0.53687	-0.24212	0.421778
L1_LNA	12.62961	0.402719	12.0154	13.4951	12.31006	12.55904	12.995
L1_LNA_w	12.62953	0.402167	12.02448	13.47436	12.31006	12.55904	12.995
L1_MA	1	0	1	1	1	1	1
L1_MA_w	1	0	1	1	1	1	1
L1_MS	0.309768	0.232653	0.035341	1.038596	0.127187	0.208	0.519266
L1_MS_w	0.309521	0.232262	0.036628	1.014015	0.127187	0.208	0.519266
L1_EMP	0.071221	0.017359	0.029	0.098	0.065	0.075	0.083
L1_EMP_w	0.071337	0.017214	0.03	0.096	0.0665	0.075	0.083
L1_GDP	0.005195	0.009393	-0.02586	0.028	0.001	0.005491	0.010079
L1_GDP_w	0.005348	0.008504	-0.02232	0.022	0.001	0.005491	0.010079
L1_CI	0.509818	0.088602	0.272025	0.976672	0.458514	0.492804	0.557808
L1_CI_w	0.50999	0.086301	0.346559	0.974036	0.459304	0.492804	0.556154
L1_PLCL	0.017402	0.013436	0.003293	0.061245	0.006593	0.015147	0.022263
L1_PLC~w	0.0174	0.01341	0.003826	0.060472	0.006593	0.015147	0.022263
L1_PLRWA	0.048124	0.031773	0.01245	0.138374	0.02228	0.034301	0.068617
L1_PLR~w	0.048069	0.031604	0.013627	0.132629	0.02228	0.033865	0.067932

The suffix "_w" refers to winsorized variables

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