Liquidity in the banking sector

Laurent Salé

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Laurent SALÉ
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Directeur de Recherche :	M. Franck BANCEL, Professeur - ESCP Europe.
Membres du jury	M. Hervé ALEXANDRE, Professeur des Universités, Université de Paris IX Dauphine (rapporteur).
	M. Alexis COLLOMB, Professeur des Universités, Conservatoire National des Arts et Métiers (rapporteur).
	M. Jean Paul LAURENT, Professeur des Universités, Université Paris I Panthéon Sorbonne.
	M. Laurent QUIGNION, Head of Economie Bancaire, Group Economic Research, BNP Paribas.

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Sommaire

Finally, we have learned that for regulators to make accurate predictions requires a comprehensive picture of capital flows, liquidity and risks throughout the system. But coordination among regulators, which is so important, is enormously difficult in the current Balkanized regulatory system.

Alan Greenspan, Chairman of the Federal Reserve of the United States from 1987 to 2006. October 23rd 2008 testimony before the U.S. House of Representatives, 110th Congress.

Préambule sur l'origine de la thèse : Un étonnement, une interrogation

La présente thèse a pour origine l'étonnement de la crise financière de 2007/2008 et de son ampleur. En tant que cadre au sein d'une grande banque Française, j'ai en effet été témoin de la suite d'évènements qui a abouti à ce qui est reconnu comme la plus grave crise financière depuis 1929. Cette crise du système financier a largement remis en cause la vision selon laquelle les banques étaient solides et résilientes mais aussi l'hypothèse implicite que la liquidité est disponible à tout moment sur les marchés dans les économies modernes. Il faut rappeler que cette crise trouve ses racines dans la rupture de la traçabilité des risques des actifs, en particulier via les mécanismes de titrisation (Gorton and Metrick (2012)). Les premières banqueroutes pour cause de manque de liquidité, en particulier celles de Northern Rock en 2007, de Bear Sterns en 2008 ainsi que des organismes américains de refinancement du crédit immobilier Fannie Mae et Freddie Mac, des prêteurs Countrywide et Indyman et de l'assureur AIG, ont contribué à montrer l'ampleur de cette opacification. L'arrêt brutal de la liquidité disponible sur les marchés et qui permet en temps normal le refinancement des banques à court terme et d'ajuster ainsi leur risque idiosyncratique a conduit à un scénario dont l'amplitude est comparable à celle de 1929. L'exemple le plus saillant est celui de la faillite de la banque Lehmann Brothers en 2008 qui détenait une dette de 619 milliards de dollar et employait 25 000 personnes, alors qu'en février 2007 cette banque avait un cours historique de 85,80$ et une capitalisation d'environ 60 milliards de dollars. L'impact systémique de ces faillites et sa contamination auprès des marchés a causé leurs blocages (Iyer, Lopes, Peydro and Schoar (2010) ; Acharya and Merrouche (2013)).

Cette suite d'évènements m'a amené à m'interroger sur la liquidité dans le secteur bancaire et d'en explorer ses différentes facettes. Etant de par mon activité professionnelle au cœur des problématiques de la liquidité dans le secteur bancaire, j'ai souhaité en rédigeant cette thèse empirique[1] par articles apporter de nouveaux éclairages et contribuer ainsi à améliorer la compréhension du concept de liquidité dans ce secteur.

[1] Afin d'assurer la reproduction des résultats, l'ensemble des calculs présentés ont été effectués avec STATA®. Les do-files et fichiers log constitués sont disponibles sur demande.

Introduction

As one determinant of a bank's survival during the financial crisis of 2007-2008, liquidity in the banking sector presents a challenge for the financial and academic communities and has recently become a central point of interest. The three articles presented in this thesis focus on the two main facets of liquidity in the banking sector: the holding of liquid assets (i.e., cash and assimilated resources) and the process of liquidity-creation in banks used to fund loans. As will be discussed in the articles, these two aspects of liquidity can be viewed as two sides of the same coin. I acknowledge that liquidity in banking is linked to the creation of money; however, this thesis focuses on the aforementioned two aspects of liquidity.

First, this section presents how ideas about liquidity in the banking sector have evolved in mainstream economic thought. Second, it considers the revival of cash-holding that has been observed since the financial crisis of 2007-2008. Third, it discusses the properties of liquidity. Fourth, it explores what we do not know about liquidity. Fifth, it identifies the fundamental issues analyzed in the three articles. Finally, it presents the methodology used in the articles to address these issues.

An overview of the evolution of concepts of liquidity

This section provides an overview of the evolution of mainstream economic thought regarding the status of liquidity. It first discusses the status of cash holdings and finishes with a consideration of the latest concepts of liquidity in the banking sector.

a) Prior to the neoclassical tradition

Neither mercantilism nor the classical economic thought of such theorists as Adam Smith (1723-1790), Thomas Malthus (1766-1831), David Ricardo (1772-1823) and Jean-Baptiste Say (1762-1832) attended to agents' motives for cash holding: money was primarily used in physical form, composed of different valuable metals. One of the important features of precious commodities in this era was that they served as a standard of value that was immune to various risks, such as inflation. The first attempt to conceptualize money dates to the classical period, during which money was considered to be a "simple vehicle of transaction" (Say and Say (1803)). In this view, cash-holding was driven mainly by transactional motives, intended to further an individual's objective of maximizing his own satisfaction while minimizing his effort. At the beginning of the 19th century, the *Quantity Theory of Money* of Say and Say (1803) was augmented by Fisher (1911) famous equation.[2] The neoclassical tradition, which emerged in the second half of the 19th century with the works of Léon Walras (1834-1910), Wilfredo Pareto (1848-1923) and Alfred Marshall (1842-1924), completed the classical view and provided a framework to explain economic phenomena at the individual level. As an alternative approach to the classical *Quantity Theory of Money*, the well-known Cambridge[3] equation shed new light on cash-holding, particularly

[2] M*v = P*Y, where M is the Quantity of Money (stock of money present in the economy); v is the speed at which the money circulates; p is the price index; and Y is the total volume of transactions performed in that period.

[3] Attributed to the common works of A. Marshall, A.C. Pigou and John Maynard Keynes: M=k.p.Y, where M is the Supply of Money; Y is the total resources; p is the price of the good; and k is the proportion of revenue that the agents want to hold in the form of money.

through its conceptualization of the factor *k,* representing the amount of money that agents wish to hold. None of these equations, however, provided a comprehensive framework of the factors causing agents to hold cash.

b) Keynesianism and motives for holding cash

In response to comments on *The General Theory of Employment, Interest and Money* (Keynes (1936)), John Maynard Keynes, in *The general theory of employment* (Keynes (1937)), completed his hypothesis regarding the preference for liquidity, positing four motives for holding cash: transaction, precaution, speculation and financing. To these four motives, the author added a degree of agents' preference for liquidity, corresponding to the degree of agents' confidence in the development of the economy.

c) Monetarists and the reduction of banking regulation

The Chicago school of economics, and particularly the *Monetarists* led by M. Friedman (1912-2006), observed inefficiencies in public policies, and in response, questioned the effects of government intervention (Friedman and Friedman (1980)). This school of economic thought demonstrated the complexity of implementing policies to stabilize the economy, leading them to argue for minimal governmental intervention (Friedman and Schwartz (2008)). Regarding financial stability, this view supported the deregulation of banking activity and was largely supported by the Federal Reserve until the financial crisis of 2007-2008. In his 2008 testimony before the House of Representatives (110th Congress), Alan

Greenspan[4] admitted to having put too much faith in the self-correcting power of the free market. In essence, his testimony argued for a unified framework of banking regulations needed to reduce market friction and minimize the biases generated by existing heterogeneous regulations. It also stressed the importance of better understanding liquidity in the banking sector, among other things. The Basel III regulatory framework has since been approved by the G20 countries.

d) A revival of the concept of liquidity: The relationship between liquidity created by banks and their structural fragility

The idea of liquidity in the banking sector was revived with the works of Bryant (1980) and Diamond and Dybvig (1983), which provided a framework for establishing the relationship between liquidity and the intrinsic fragility of banks. Liquidity is created when liquid liabilities (i.e., deposits) are transformed into illiquid assets (i.e., loans). Once this transformation occurs, however, a disconnection of maturities is also created: the expected inflows from loan reimbursements – which are, by nature, scheduled - may be desynchronized with potential depositor outflows, which can occur at any time. Under stressed conditions, depositors may "run" to the banks and withdraw their deposits, generating massive bank runs. This shortage of liquidity becomes the main trigger forcing banks into bankruptcy. Despite this issue, the creation of liquidity is the cornerstone of banking activity; however, it also accounts for their structural fragility (Diamond and Rajan (2001); Kashyap, Rajan and Stein (2002)). The financial crisis of 2007-2008, which entailed serial bankruptcies of major banks,

[4] Alan Greenspan, October 23rd 2008, testimony before the U.S. House of Representatives, 110th Congress.

has validated this theoretical framework (Shin (2008); Goldsmith-Pinkham and Yorulmazer (2010)).

A change in the status of liquidity in the literature

This section analyzes the evolution of the status of liquidity in the literature over the last decades, considering liquidity first in non-financial firms and second in banks.

a) Corporations

During the 1990s, a sharp increase in corporate cash-holding was observed. This unexpected increase challenged the academic community to account for the causes of this excessive stockpiling of cash (Ferreira and Vilela (2004); Saddour (2006); Fritz Foley, Hartzell, Titman and Twite (2007); Bates, Kahle and Stulz (2009)); Frésard and Salva (2010)). In addition to these studies, which mainly focused on the motives for cash-holding, other authors examined whether cash-holding is adjusted over time and hence whether it is subject to optimality (Venkiteshwaran (2011); Akbari, Rahmani, Ahmadi and Shababi (2014); Martínez-Sola, García-Teruel and Martínez-Solano (2013); Subramaniam, Tang, Yue and Zhou (2011); Ozkan and Ozkan (2004)), beyond which agency effects could be detected.

b) Banks

Following the work of Bernanke and Gertler (1995), who established the importance of interest rate structure on loan creation, other authors have analyzed liquidity created by banks, proposing their own metrics. For example, Deep and Schaefer (2004) propose the "LT Gap." Berger and Bouwman (2009) offer a three-step procedure for constructing measurements based on the category of product (CAT) or on their maturities (MAT), with off-balance-sheet information (FAT) or without (NONFAT). Fungáčová, Weill and Zhou (2010) offer a measurement derived from the latter, and Brunnermeier, Gorton and Krishnamurthy (2014) offer a method to measure the risks of illiquidity by taking into account its endogenous nature and the stochastic movements of the market.

Since the introduction of these metrics, other studies have been produced that measure liquidity-creation in different countries and periods or estimate the effects of certain factors, such as a new regulatory framework, on liquidity-creation. For instance, Berger and Bouwman (2009) studied the creation of liquidity in the US between 1993 and 2003; Hackethal, Rauch, Steffen and Tyrell (2010) in Germany between 1997 and 2006; Lakštutienė and Krušinskas (2010) in Lithuania from 2004 to 2008; Berger, Bouwman, Kick and Schaeck (2011) in Germany between 1999 and 2009; Fungáčová and Well (2012) in Russia between 1999 and 2007; Al-Khouri (2012) in GCC countries between 1998 and 2008; Horváth, Seidler and Weill (2014) in the Czech Republic between 2000 and 2010; and Lei and Song (2013) in China between 1988 and 2009. All of these studies, conducted in various countries at different periods, provide a mosaic of views on banking liquidity-creation, sometimes offering contradictory results (Bancel and Salé (2016)).

Fundamental properties of liquidity and definitions

Liquidity is an ambiguous concept that holds two fundamental properties: immediacy and transferability (Diamond and Rajan (2005)). From these properties, it is possible to define liquidity for each type of intermediation.

a) Financial intermediation

The liquidity of financial intermediation refers to the speed at which securities can be traded (Myers and Rajan (1998)). This is traditionally conducted through investment banking. The speed of exchange ensures the fluidity of the market, enabling an optimal balance between the supply of capital and the demand for it. Moreover, this form of liquidity has an endogenous property caused by the behavior of agents: under stressed conditions, loss aversion tends to lead agents to strongly prefer avoiding losses over pursuing gains. Given the interactions between funding and market liquidity (Brunnermeier and Pedersen (2009)) and also given capital and liquidity problems (Allen and Gale (2004)), this aversion to the prospect of loss is multiplied; it can lead to a loop effect, in which agents sell their positions because they witness everyone else doing the same. The level of liquidity is measured by the spread between selling and buying prices as well as by the volume of transactions. A high spread indicates that the security is not liquid, which also contributes to reducing the volume of transactions.

b) Balance-sheet intermediation

The liquidity of balance-sheet intermediation refers to the transformation effected by the traditional banking model. Deposits (liquid liabilities) are transformed into loans (illiquid assets), the maturation of which varies from middle- to long-term. Although different measures have been created - as detailed in the second article presented in this thesis – the liquidity created can be (roughly) summarized as the difference between liquid liabilities and illiquid assets.

It should be noted that the functional separation of investment banking from traditional banking is, in the context of liquidity, porous. Traditionally, money is created when a bank grants a loan, under the condition that compulsory reserves are set aside in the central bank (Le Bourva (1962)). In addition to this classical scheme, banks can sell or pledge securities that they hold to obtain cash to fund loans. Consequently, investment banking provides additional services to customers, such as guarantees and currency coverage, and directly supports the traditional banking business. As a result of the complexity of the relationship between investment banking and traditional banking businesses and to mitigate market friction, banking groups tend to develop their own internal capital markets (Houston, James and Marcus (1997); Campello (2002)).

These different concepts of liquidity are related, however: as examined in the second article, liquid assets reduce the quantity of liquidity-creation performed in traditional banking. While holding cash and assimilated resources improves the liquidity ratio, it also reduces resources that could be allocated to illiquid assets (i.e., loans), hence reducing liquidity creation. Overall, liquidity in the banking sector can take various forms that interact,

ultimately requiring the bank manager to make complex trade-offs. The complexity of these interactions and constraints, added to the fact that illiquidity risk may contribute to the creation of an intense financial crisis, has attracted the scrutiny of the academic community.

What we do not know about liquidity

Although cash can be considered as a trivial question for practitioners, there remain theoretical aspects that are not fully understood. This section presents what we do not really know about liquidity. Because the list of what we do not know about liquidity could be never-ending, I briefly discuss the most important issues that relate to liquidity in banking sector.

There are several facets of the liquidity that are not yet fully understood.

The first is how to value the liquidity service of cash. For instance, unlike holding T-bills, holding cash does not provide interest. Cash, however, is more liquid than T-bills. Hence, it can be assumed that holding cash provides an additional service that offsets the loss of interest that the T-bills provide. Said differently and in a state of equilibrium, the marginal value of additional liquidity equals the interests of the T-bills. Theoretically, there are two possibilities for banks to hold cash and cover against the lack of synchronicity between inflow and outflows. The first is to finance this shortfall on the market. This "finance as you go" strategy assumes that cash is available at any point of time and thus implies that the markets are perfect or "agency-cost-free." The other way around is to hoard cash to reducing the moral hazard of market imperfections. For the latter case, it implies that holding cash beyond an optimal level is triggered by two potential causes. The first is strategic. Agents may anticipate a sudden recession and a dramatic fall of the capital markets, making it difficult to find cash.

By holding cash, non-distressed banks effectively force their competitors to sell assets at fire prices. Banks that anticipate a financial crisis and decide to accumulate cash may buy assets at fire prices and then hold a dominant position (Acharya, Shin and Yorulmazer (2011)). Thus, by building such a dominant position, cash holding can create value to a bank. In that sense, the additional value of liquidity is composed of a predatory motive that can be assimilated to an option or more precisely a call on the assets of competitors underlain by the freeze of the capital market. The second is agency. Jensen (1986) argues that in the context of poor investment opportunities, anchored managers are likely to keep cash instead of paying dividends out to shareholders. Harford, Mansi and Maxwell (2008) document that managers tend to stockpile excess cash and spend it quickly. To sum up this aspect: holding cash beyond the minimum required to hedge against the idiosyncratic risk can be caused by predatory or agency motives. In both cases, the additional liquidity is valued more than the interest that could be provided if this cash were invested in T-bills. Holding liquidity for a strategic (or predatory) motive can finally be assimilated to an option. It poses the question of how to value this option: does it mean that the value of liquidity service of cash is countercyclical?

The second facet is a matter of degree that is composed of two aspects. The first is the degree of liquidity of the assets. Even if the T-bill is less liquid than cash, it is still more liquid than corporate bonds, which are more liquid than other types of assets, such as specialized machinery. In this view, an asset is liquid if the transaction cost for buying the asset is low. The second is the degree of market liquidity, which is commonly measured by the difference between the bid and ask, the market depth that corresponds to the volume of the transactions and the market resilience that indicates the speed at which the prices revert to

their equilibrium level (Bervas (2006)). In this view, the market is liquid because three indicators indicate there is a quasi-absence of transaction costs on the capital market. To summarize this dimension, the transaction cost lies at the heart of liquidity. Even very illiquid assets, however, can be converted into cash if the holder accepts the need to keep this asset a certain amount of time and pay for the transaction cost that the selling of such illiquid asset implies. In this vein, holding an excess of cash can be viewed as a way to hedge against transactions costs. This poses the question of whether the excess of liquidity held corresponds to the sum of the transaction costs. Further, if there is an excess of cash, what is the optimal amount of cash for banks to hold?

The third dimension is the close relationship between liquidity and the value of an asset. In the liquidity-asset-pricing-model (LAPM), Holmström and Tirole (2001) have documented that the value of the assets is not only triggered by the consumer sector but also by the corporate demand for stores of values. As a driver of asset valuation, the liquidity constraint measures the level of confidence of the agents in the future and in market uncertainties. This liquidity-risk dimension poses the question of how close the relationship is between liquidity and confidence of the economy. This interrogation is particularly echoed by the endogenous property of liquidity. Under stressed conditions, liquidity shortfall acts as a loop that amplifies the negative effects of market falls. The prospect of loss generates the freeze of the liquidity, which contributes to the panic. Is there any limit to this endogenous effect beyond which the confidence of the market is reestablished? It finally poses the question of how the governments can mitigate the effect of the erosion of liquidity to stabilize the financial system.

The fourth dimension concerns the effect of public policy on liquidity. The close relationship between market liquidity and financial stability has obliged governments to impose various regulations on the financial sector. The first issue with regulation is to define a proper objective, and the second issue is whether adequacy between the goal and the measures is reached. There is a large strand of literature on the effect of regulation on liquidity, but fundamentally there are three views. The first contends that the regulation has a negative effect, or can create more harm than good. For example, and under this view, the lender-of-last-resort mechanism reduces the incentive for banks to self-insure against payment shocks, which weakens overall financial stability. The second view contends that the regulation has a positive effect and is thus necessary to stabilize the market and reduce the social cost that such instability generates. The third view contends that regulation is not a matter of thresholds that enforces minima or maxima or mechanisms that imply a governmental intervention. Under this view, regulations and supervisory practices that force accurate information disclosure, empower private-sector corporate control of banks and foster incentives for private agents to exert corporate control work best to promote bank development, performance and stability (Sharma (2012)). The blurred distinction between liquidity and solvability complicates the story. An insolvent bank can quickly become illiquid and an illiquid bank insolvent. Is the solvability the cause of the liquidity issue or is it the opposite? How exactly do they interact? The fact that the Basel III regulatory framework has enforced liquidity ratios within the banking sector tends to demonstrate that the solvability ratios enforced with the previous versions of Basel were not sufficient to stabilize the financial sector. It finally poses the question of what are the effects of the Basel III regulatory framework on the liquidity created by banks.

Indeed, the fifth and final dimension is the liquidity created by banks. The central role of banks is to create liquidity (Diamond and Dybvig (1983)). Despite the existence of empirical studies on banking liquidity creation, there is no homogeneous data on banking liquidity creation over a long period of time and across several regions. The lack of such comprehensive observations reduces our vision on liquidity created by banks. How much has been created over a long period of time? Which regions have created most? Do European banks perform better than their peers from Asia or North America?

From these different facets, different definitions of liquidity can be established. Liquidity can first be viewed as a measure at which an asset can be sold without significant transaction costs. Liquidity can also be regarded as a measure of the health of the financial sector. Additionally, the value of the liquidity of cash has a value can be assimilated to an option that is countercyclical. Liquidity creation as the central role of banking activity is also its structural weakness that obliges governments to regulate banks and thereby stabilize the financial sector. Consequently, liquidity in the banking sector is at the core of the complexity of the financial system where conflicting objectives cohabitate. As a central point of financial crisis, is the liquidity the cause, the effect or the symptom of the financial crisis? Finally, all of these interrogations are linked to one crucial point: the absence of a comprehensive theory on liquidity.

The next sections explain which issues this thesis explores and what methodologies have been used.

Liquidity in the banking sector: What is at stake?

This section considers the most important questions at the center of the financial and academic communities' discussions of liquidity in the banking sector. I present first how the agency effects could potentially hamper the efficient transmission of monetary policy and then discuss the effects of regulation on liquidity.

a) Determining the existence of agency effects that may hamper the efficient transmission of monetary policy.

Agents in the banking sector are bounded by a number of constraints, making it difficult to identify their preferences and therefore to optimize their utility. Additional effects, such as game theory (Thakor (1991)) and market signaling theory ((Ross (1977); Campbel and Kracaw (1980)), complicate the story: the open market acts as a peer-to-peer surveillance system for competitors (Mosebach (1999)), informing banks of the financial situations of their peers. Under conditions of stress, the banks may eventually use that information to force their competitors to sell assets at fire-sale prices, thus acquiring a dominant position (Acharya, Shin and Yorulmazer (2011)). The paradox of liquidity results from this complexity; deviations from value-maximizing are difficult to detect because of potential agency effects (Myers and Rajan (1998)). Overall, the financial crisis of 2007-2008 has shed light on the risks of illiquidity, with the systemic risk it implies. The crisis finally forced the academic community to question the nature of liquidity: are the fundamental properties of liquidity (transferability and immediacy) (Diamond and Rajan (2005)) completely understood? Given the bounded rationality of cash-holding, is the utility function of cash subject to optimality? If that is the case, are there agency effects (Jensen (1986))?

b) What are the effects of the regulatory framework on banking liquidity-creation?

The financial crisis has also challenged policymakers in addressing liquidity created by banks, which exists for the purpose of financing the economy. The inherent fragility of banks (Diamond and Rajan (2001)) forces authorities to impose a regulatory framework to reduce it. The ultimate objective of the regulatory framework is to mitigate systemic risk, which represents a social cost that governments - and by extension taxpayers - do not wish to face. Regulatory constraints may also generate negative effects, however, or even increase the probability of bank failures (Wagner (2007). Because there is no consensus on whether regulation has positive (or negative) effects on the banking sector (Bancel and Salé (2016)), it is thus important to determine the effects of increasing levels of capital and banking regulations on liquidity created by banks. If liquidity creation is reduced by constraints (such as an increase of capital or liquidity ratios) that mobilize resources instead of using them to fund projects (Alexandre and Buisson-Stéphan (2014), it may potentially obstruct the path to economic recovery and ultimately contribute to greater financial fragility. Consequently, is increasing capital the appropriate response? How does the new regulatory framework affect banking liquidity-creation? All of these questions place banking liquidity creation at the center of the debate on financial stability, and ultimately raise questions about the most appropriate method of regulation.

The three issues studied and the methodology used in this thesis

This thesis, composed of three articles,[5] uses an empirical approach to address some of the issues discussed above. In the article "*Why do banks hold cash?*", I examine bank cash-holding over a long period (35 years) to determine if the liquidity held by banks is subject to agency issues (Jensen (1986)). To achieve this aim, I use advanced econometric models to determine whether cash optimality exists in the banking sector. This question is of concrete importance: in the case that banks hold cash beyond this optimality, this idle money would not only represent an opportunity cost for the bank (Baumol (1952); Whalen (1966)) but also would not be used to fund the economy, hence representing an overall cost to society.

The second article, "*Does an increase in capital negatively impact banking liquidity-creation?*", explores liquidity created by banks in several countries over a period of 35 years for the purpose of determining which hypothesis prevails, the "crowding out" or the "risk absorption" hypothesis. It is the first study offering a unified vision of banking liquidity-creation over a long period of time and encompassing Asian & Pacific, European and North American banks. It uses advanced econometric models that enable us to identify the types of banks that create the most liquidity versus those that create less. Furthermore, these models allow us to estimate the effect of increasing levels of capital on liquidity created by banks.

[5] Although unpublished, none of the articles have been desk rejected. They all have been subject to blind review and have received comments of reviewers from the following journals, respectively: the JFQA (Journal of Financial and Qualitative Analysis), the JBF (Journal of Banking and Finance) and the JOEF (Journal of Empirical Finance). In addition, the second article has been presented to the 33rd International Symposium on Money, Banking and Finance on 7-8 July 2016 at Clermont-Ferrand and the third article to the Labex Refi doctoral college on June 22nd 2016. All the articles integrate the comments of the reviewers of the aforementioned journals or public presentations.

The new Basel III regulatory framework, however, is not only about the increase of capital. It is composed of several components, some of which aim to reduce risk in the banking sector. Considering all of these components, what effects will Basel III have on banking liquidity-creation? To address this issue, the third article, "*Positive effects of Basel III on banking liquidity creation*", uses advanced econometric models, such as the "D-in-D,"[6] life table and semi-parametric regressions, to estimate these effects.

The three articles presented in this thesis will contribute to increasing our understanding of how specific banking factors affect the transmission of monetary policy and the efficiency of regulatory constraints.

Overall, this thesis is composed of the following three axes of research:

- The first axis of my research examines the two main facets of liquidity. The first is cash and assimilated, the main purpose of which is to hedge against the risk of illiquidity. This aspect is explored in article 1, "Why do banks hold cash?". The second aspect relates to liquidity creation, which is the primary purpose of banks. This aspect of liquidity is studied in article 2, "Does an increase in capital negatively impact banking liquidity creation?", which studies banking liquidity creation over a long period of 35 years and across several countries.
- The second axis of my research explores the effects of regulation in the banking sector. For instance, the third article estimates the effects of Basel III on banking liquidity creation.

[6] "Difference in difference"

- The third axis of my research is based on empirical observations that may challenge existing theories. Each article in this thesis uses datasets and advanced econometric tools to elaborate robust estimates and provide solid evidence, i.e., GMM, semi-parametric regressions, survival functions, sensitivity analysis and D-in-D.

Chapter 1. Why do banks hold cash?

1.1 Abstract, keywords and JEL classification

This paper investigates the determinants of bank cash holding by using international data for the period 1981-2014. The results do not seem to provide support for the substitutability hypothesis regarding the substitutive relation between cash and debt levels. Further, using the GMM-system estimation method, we find no support for the dynamic optimal cash model, suggesting that cash management in the banking sector is bounded by number of constraints that make it difficult for the agents to optimize their utility.

Keywords: Banks; Cash holding motives; GMM

JEL Classifications: C3 - Econometric Methods: Multiple/Simultaneous Equation Models; C53 -Forecasting and Other Model Applications; G21 - Banks; Other Depository Institutions; Mortgages.

1.2 Introduction

Cash has a value that is more complex than what is commonly accepted: as part of its liquidity, cash has properties of transferability and immediacy (Diamond and Rajan (2005)) that can not only generate wealth in specific situations but also annihilate value because of the related agency costs or tendency of banks to stockpile cash during stressful market conditions. This dilemma has attracted the scrutiny of nonbanking firm researchers

and, more recently, those studying banks. Moreover, the recent global financial crisis has demonstrated that cash holding is a major determinant in banks' chances of survival; for example, the Bear Stearns collapse in 2008 publicly revealed that banks at the time were unable to fulfill liquidity stress test requirements and that both secured and unsecured funding could vanish very quickly.

The classical theoretical view is that an optimal point exists beyond which holding cash generates an opportunity cost (Baumol (1952); Whalen (1966)). Hence, if agents act rationally, they should not stockpile cash, meaning that cash should be available at any point in time in the market. However, this paper documents a secular increase in bank cash holding over a 35-year period and examines the reasons why banks have to hold cash if they can meet the financial demands thrown at them by whatever economic conditions they might face.

Overall, why is such an examination important? First, it examines whether an optimal level of cash holding financing structure exists. If the existence (or otherwise) of cash optimality can be determined, any excess of cash can be established, facilitating an assessment of the existence of agency problems (Jensen (1986)). Second, it is important to understand the factors that influence banks' cash holding decisions. Indeed, current studies document that precautionary holdings of cash substantially increased during the recent financial crises. Thus, banks' lending to households and corporations exhibited substantial stagnation. During times in which banks show extreme precautionary hoarding of liquidity, central banks' transmission mechanisms of monetary policy could ultimately diminish their effectiveness. This paper thus aims to improve our understanding of how banks decide about their cash holdings in an international context and thus to contribute to a better transmission mechanism of monetary policy.

With regards to banking sector, causes of cash holding have recently drawn the attention of the academic community. For instance, Acharya and Skeie (2011) explore the relation between cash holding and counterparty risk by modelling three states ranging from "normal" to "market with liquidity hoarding" and by addressing causes of cash holding in the context of financial crises. Moreover, Acharya and Merrouche (2013) show that a regime shift occurred in 2007 that forced banks to hold cash mainly for precautionary measures, which in turn generated spillover effects. These studies show that an increase in counterparty risk was the main reason explaining banks' cash holding and that stressful conditions create a favorable environment that encourages banks to hold important buffers (Ashcraft, McAndrews and Skeie (2011)). This significant increase in aggregate liquidity aims to ensure that banks have the ability to face unpredictable payment shocks; however, the authors' data requirements restrict their sample size to limited periods (2007-2009), rendering generalization of their results difficult. In addition, Ashcraft, McAndrews and Skeie (2011) acknowledge that reasons other than precautionary motives could play a role in cash holding. Hence, what motivates banks to hold cash, and how persistent are these motives over a long period of time?

To fill this research gap, the present article first explores the determinants of bank cash holding, and following Opler, Pinkowitz, Stulz and Williamson (1999), I present variables in this respect. The results reveal that the regulatory and institutional framework, bank size, government monetary policy and the macroeconomic environment exert a significant influence over cash holding by banks. Additionally, for specific cases, the spread that measures the difference between interbank loans over 3 months and T-bills over 3 months and that proxies for interbank liquidity shocks also plays a role in banks' cash

holding. The findings also do not support the substitutability hypothesis regarding the substitutive relation between cash holding and leverage ratios. Second, I test for the existence of cash optimality. For robustness considerations, I follow Ozkan and Ozkan (2004) and adopt the generalized moment of method (GMM) approach, which accounts for the dynamic behavior of cash optimality. I find evidence that the dynamic nature of cash optimality is rejected in the banking industry. These findings contrast with nonbanking sector where the dynamic nature of cash optimality is observed (Ozkan and Ozkan (2004); Venkiteshwaran (2011); Subramaniam, Tang, Yue and Zhou (2011)).

By defining variables tailored to the banking industry and by using data from a large panel of 943 listed banks, this paper documents the evolution of cash holding in the banking sector over a 35-year period. This cross-country research helps to identify the main driving forces that induce each type/category of bank to hold cash. Considering the particular risk that major banks created during the liquidity crisis, I separate banks based on their asset size. The paper is organized as follows. The first part of the paper analyses the related literature on the causes and implications of cash holding in the banking sector by focusing on bank cash holding as part of banking liquidity. The second part describes the methodology and data used in this research and presents the evolution of cash holding by Asian and Pacific, European and North American listed banks over a 35-year period. The third part presents the main results of the regression and GMM models, and the conclusion sums up the findings.

1.3 Theoretical considerations and econometrical proxies

This section reviews the literature on bank cash holding and its determinants.

Why do banks hold cash? Although a large strand of empirical research on corporate cash holding (Kim, Mauer and Sherman (1998); Opler, Pinkowitz, Stulz and Williamson (1999); Bates, Kahle and Stulz (2009)) that validates trade-off theory exists, research on the determinants of cash holding in the banking sector is relatively recent, and studies in this area have focused ostensibly on specific periods, such as the financial crisis (Acharya and Skeie (2011); Acharya and Merrouche (2013); Ashcraft, McAndrews and Skeie (2011)) and cash flow risks. On the one hand, trade-off theory argues for debt optimality. This is mainly supported by the trade-off between benefits and costs of debt (Scott (1976)) and by trade-off between tax benefits with expected distress costs or personal tax costs (Miller (1977)). Similarly to debt, cash holding, produces costs and benefits. The two main costs associated with cash holding depend on whether managers' interests are in line with shareholders' interests: if managers maximize shareholder profits, the cost is a lower return relative to another investment with a similar risk profile; if, however, managers do not maximize shareholder profits, they tend to increase the size of assets under their control to broaden their managerial discretion (Jensen (1986). The only benefit to holding cash is therefore to obtain a safety buffer, which helps to finance growth opportunities while avoiding increases in external funds or the liquidation of existing assets. Given the trade-off between costs and benefits, there is no rationale for holding cash beyond this optimal cash point, apart from rationale related to agency. On the other hand, the POH of Myers and Majluf (1984) posits that no optimal debt level exists. Because increases in financing costs are positively correlated with information asymmetry, issuing new equities is costly; hence, firms finance their projects by following a preference hierarchy that is (1) using internal funds, (2) indebting and (3) issuing new equity. Under this view, cash holding results from financing and

investment decisions, and it is utilized as a buffer between retained earnings and investment needs.

But including capital markets frictions and financial constraints complicates the story. The market frictions that are caused by taxes, transaction costs and information asymmetries (between lenders and borrowers) can make external funding sources more expensive than internal funding source. From these market imperfections external funding sources is not equally available or in favorable terms to all. This shortage of internal sources of funding causes constraints on investments and oblige banking group to develop internal capital market (Houston, James and Marcus (1997)). If a bank identifies activity sector with growth opportunities that would rise its value and finds itself being short of resources to finance these investments, it may loses some of these investment opportunities. Consequently, the level of internal funding is potentially an important determinant of growth opportunities.

1.3.1 What are the possible motives for banks to hold cash?

The first motive is precautionary, whereby a bank aim to ensure that its level of cash holding complies with the level of risk that it assumes. As part of this motive, the transactional motive is included, where the high volume of transactions within payment systems and cash management complexity are also sources of additional uncertainty (Armakola and Laurent (2015). Both transactional and precautionary motives concern the cost of illiquidity; thus, banks are likely to retain extra cash as a guarantee to ensure smooth payment capabilities against cash in- and outflow shock waves, also known as “idiosyncratic risk”. In this vein, banking groups establish internal capital markets. As shown by Cetorelli and Goldberg (2012), the internal capital market within a banking group is a function of bank

size and the distance between the headquarters and its subsidiaries and branches. By establishing an internal capital market, banks aim to reduce the cost of external financing and of idiosyncratic risk within their banking group, especially during periods of interbank liquidity shocks. What proxy can best measure a bank's cash flow risk? In this paper, bank risk is measured by using the approach of Laeven and Levine (2009), who use the ROA through the z-score (as originally proposed by Roy (1952)). One disadvantage in using equity volatility as a measure of risk reduces the sample of 50 banks in average per year. To account for that risk and for robustness reason, I also included the non-performing loans banking variable that indicates an increase of the credit risk and accumulation of the bank's reserves.

The second motive is regulatory compliance, as banking regulatory frameworks oblige banks to hold cash for liquidity ratio requirements. As Berger, Bouwman, Kick and Schaeck (2011) argues, risk taking is affected by the applicable supervisory regime. Moreover, as highlighted by Acharya, Gromb and Yorulmazer (2011), differences in the institutional framework between central banks may have implications for bank reserve balances because such institutional differences affect the interbank market competition and, by extension, banks' cash holdings. To control for the differences, I have built a supervisory index similar to that used by Shehzad, de Haan and Scholtens (2010), which is composed as follows: Before the deployment of the Basel regulatory framework (1997), I use the data from La Porta, Lopez-De-Silanes, Shleifer and Vishny (1997), who find a positive relationship between capital market development and legal enforcement. A grade is provided for the level of property rights protection from 0 to 4 corresponding to not protective to most protective, respectively. After the deployment of the Basel regulatory framework (1998), I use the data of Barth, Caprio Jr and Levine (2001); Barth, Caprio and Levine (2004); Barth, Caprio and Levine (2008); Barth, Caprio Jr and Levine (2013), which made it possible to measure the

effect of the legal environment and institutional differences on liquidity requirements per period. I have computed these data and averaged the capital stringency as well as capital activity and restrictiveness per period and per country. Tight regulations and scrutiny from regulatory agencies oblige banks to reduce their risk exposure and to thus manage their liquidity needs more efficiently. Because a decrease in risk implies a reduction in the liquidity ratio, the relation between cash holding and the legal environment is expected to be negative.

The third motive is signaling. In the context of non-cooperative players, such as those modelled by Thakor (1991), cash holding can be viewed as a signal. During downturn periods, banks in severe need of cash submit unusually high refinancing rates to the central bank, thus revealing the need to fund their liquidity risk. The interbank market, which plays a role in liquidity insurance during normal periods, is then totally frozen because no bank is willing to lend to other banks. As a result, an open market with a central bank is the only place to find cash, and this market adjudication procedure provides information on counterparty risk (Acharya and Merrouche (2013)). The open market also acts as a peer scrutinizer for competitors (Mosebach (1999)), whereby non-cooperative players are informed of the financial situation of their competitors. This observation is reinforced by market signaling theory (Campbel and Kracaw (1980)), according to which insiders in a bank have information to which the market does not have access. What metric could proxy this motive? Ohlson (1995) conclude that dividends paid out provide information to the market that is then reflected in the market price of stocks. If, by generating income that serves to establish the dividend paid to shareholders, a bank gives a positive signal to the market about its financial health, the bank is thus viewed as less risky and is more likely to have better access to external finance. In this paper, the net income (before extraordinary items) that is used to calculate earnings per share is used as a proxy to measure the signaling motive. The measure

is scaled over assets, and the relationship between this variable and cash holding is expected to be negative.

The fourth motive is strategic, and it has two dimensions. The first dimension involves cash holding to avoid value destruction. Tensions in financial markets can be amplified and can lead to a major financial crisis when liquidity fades away. Diamond and Rajan (2001) establish that liquidity is a major element of value destruction, while Carlson, Mitchener and Richardson (2011) demonstrate that the liquidity problem exacerbates solvency issues, thereby generating massive bank runs. This shortage of liquidity was the main trigger that forced the British bank Northern Rock into bankruptcy and that led to widespread banking panic. Such a shortage was repeated on a larger scale in 2008, during the collapse of Lehman Brothers, AIG, Freddie Mac and Fannie Mae. The second dimension is a predatory motive. By holding cash, nondistressed banks effectively force their competitors to sell assets at fire prices. Banks that anticipate a banking crisis and that decide to accumulate cash may buy assets at fire prices and then hold a dominant position (Acharya, Shin and Yorulmazer (2011)). Thus, by building a dominant position, cash holding can create value for a bank. Two hypotheses model the funding deficit and substitutability between debt, equity and internal funding sources. The first hypothesis is the POH from Myers and Majluf (1984), which models the funding deficit and substitutability between debt, equity and internal funding sources. The second hypothesis is the trade-off theory, which implies that an optimal debt ratio exists. In both cases, the leverage ratio is the metric used to determine this substitutability effect. Following Bates, Kahle and Stulz (2009) and Graham and Harvey (2001), this paper uses the commonly accepted leverage ratio, that is, the debt over equity ratio, to measure a bank's preference for indebtedness and its strategic motive. In trade-off theory, the substitutability between cash and debt implies a negative relationship. However, if

the relationship is positive or if the sign is not constant over time, trade-off theory must be rejected. Because banks are financially constrained, the substitutability between various sources of financing is more sensitive when growth opportunities arise. These growth opportunities are proxied by two metrics: first, the loan growth that represents a bank's ability to invest, in line with Caprio, Laeven and Levine (2007), and second, the market-to-book ratio, whereby a low ratio indicates weak growth opportunities (Tobin (1969)).

The fifth motive is agency. Jensen (1986) argues that if poor investment opportunities exist, anchored managers are likely to keep cash instead of paying dividends out to shareholders. Harford, Mansi and Maxwell (2008), for instance, document that managers tend to stockpile excess cash and then spend it quickly. Because entrenched managers tend to avoid paying dividends and to spend cash quickly, the dividend paid to shareholders over the shareholders' equity ratio is the proxy that measures this motive in this paper. This research follows Opler, Pinkowitz, Stulz and Williamson (1999), who document that the expected relations between dividends paid and cash holding is expected to be positive. A negative and significant coefficient can reveal that banks engage in profitable investment opportunities, which in turn diminishes cash holding and thereby engender a negative relationship.

1.3.2 What other factors might influence cash holding behavior?

First, the size of the bank may influence cash holding behavior because, depending on their size, banks behave differently; for instance, larger banks are more likely to have a high volume of transactions and thus a higher risk of in- and outflow cash mismatches. Hence, a bank's size affects its precautionary motive. Additionally, as documented by Houston, James and Marcus (1997), larger banks are more likely than smaller banks to develop internal capital markets. Finally, as argued by Myers and Rajan (1998), the more

liquid assets a bank hold, the more likely it will face agency costs. Demirgüç-Kunt and Huizinga (2011) consider the log of total assets to be an acceptable proxy for bank size. In this paper, the relationship between bank size and cash holding is expected to be positive, in that larger banks are expected to be more likely to hold cash than smaller banks. Furthermore, three types of banks are defined: small banks (when an asset size lower than $US 50 billion), medium banks (with an asset size between $US 50 billion and $US 250 billion), and large banks (with an asset size higher than $US 250 billion).

Second, government monetary policy may influence cash holding behavior. The close relationship between liquidity creation and monetary policy has been established by Bernanke and Gertler (1995), in that a relatively low government-set interest rate encourages credit supply, which ultimately positively increases bank liquidity capabilities. A positive relationship between government monetary policy and cash holding is expected whereby banks will tend to hold more government bonds when government bond rates are high. These bonds are liquid and are hence equated to cash.

Finally, the macroeconomic environment may influence cash holding behavior, as cash holding may also depend on where the bank is located and its economic perspectives. GDP growth measures the economic growth rate of a bank's locale. In addition, access to the interbank market might be subject to liquidity shocks, which could play an important role in banks' cash holding decisions. For instance, during the recent financial crisis, interbank markets froze, and banks increased their precautionary cash holdings once they were cut from interbank markets. To control for the "interbank liquidity shock effect", I follow Cornett, McNutt, Strahan and Tehranian (2011) and use the TED spread indicator. A positive relation between this indicator and cash holding is expected whereby a higher spread indicates a greater cash stockpile.

1.4 Data and descriptive statistics

This section begins with a short description of the data sources, and the next section undertakes a descriptive analysis of bank cash holding.

1.4.1 Bank sample

Accounting and market data for the banks were extracted from the Thomson Reuters (Bankscope) database on an annual basis for the last 35 years. Data on foreign exchange rates and GDP growth, at closing end of year since 1981, were derived from the IMF. From the original number of listed bank identifiers available from Thomson Reuters, I found 943 unique institutions. Each bank has a minimum of five reporting years, and the number of banks varies per year because newcomers come in and closed banks move out every year.

Because the panel data set is composed uniquely of listed banks, it is dominated by US banks that represent 60% of the number of banks toward the end of the sample period. However, 95 % of the US banks have a small size of less than $10 bln and represent around 15% of the sum of assets of all US banks (figures not displayed). Besides, the coverage of the initial year is rather limited to 60 banks in 1981. This coverage is much improved in 2000 with 687 banks. As a result, the results are broken down per geographical zones (Asia & Pacific, Europe and North America) per period and types bank (small, medium and large).

Following Berger and Bouwman (2008), I include data from consolidated financial statement of mother companies, which includes the financial statement of branches and subsidiaries but eliminates intragroup activities. By excluding subsidiaries and branches, I

avoid double counting the cash hold by banks that belong to the same group, which would have inflated the results otherwise. But this exclusion does not obstruct the results because the panel is sufficiently representative. As can be observed in the table 2 below, the panel dataset indeed covers a substantial fraction of Asia & Pacific, European and US market.

Table 1 shows a breakdown of the number of banks by geographical zone, country and year.

Insert Table 1.

To provide a better view on the fraction of the market covered by the sample used in this study, table 2 compares the total amount of deposits of loans of the database vs. that of each country for the year 2011 (except for Canada, for which the year is 2013). Data were extracted from local or regional bankers associations, when available. Overall, the sample in this study covers 55% and 54% of the total deposits and loans, respectively, of the banks in Asian, European and North American countries.

Insert Table 2.

1.4.2 Evolution of cash holding per geographical zone and type of bank

This section documents the evolution of first the cash ratio and second of the aggregated cash holding in amount in the banking sector.

1.4.2.1 Cash ratio

This section shows the evolution of cash holding in the banking sector, documenting the evolution of the cash to net asset ratio and of the aggregated cash holding of

banks per geographical zone. This dissociation per geographical zone is justified by the potential effect of differences in accounting rules and bank size against the cash ratio. As shown by a study initiated by the ISDA in 2012[7] on height major banks, the magnitude of the difference between US GAAP and IFRS accounting netting rules substantially affects the amount of total assets, thereby generating bias in comparisons of these institutions. Banks using US GAAP net more than their peers using IFRS. Because of this netting effect, the cash ratio is mechanically higher for banks using IFRS than for those using US GAAP.

The table below compares the evolution of cash and assimilates the evolution of cash over assets, cash paid out over equity and leverage (total debts over common equities) ratios per geographical zone, bank type and period. The type of bank corresponds to banks' asset size, whereby small banks are those with total assets below US $50bln, medium-sized banks are those with total assets between US $50bln and US $250bln and large banks are those with total assets equating to greater than US $250bln. The four periods correspond to the Basel regulatory framework deployment: before Basel I (from 1981 to 1988), Basel I (between 1989 and 2007), Basel II (between 2008 and 2010) and Basel III (from 2011 to 2014). In addition to the Basel periods, I have established ten-year periods (1981-1990, 1991-2000, 2001-2010, and 2010-2014). Because the banks are financially constrained and heavily regulated, it intuitively justifies a breakdown of the Basel periods. To control for the potential

[7] The ISDA reported the effects of differences in accounting rules between US GAAP and IFRS based on eight major banks. Based on financial reporting data as of the end of the year 2009, the report indicates that the three major US banks JP Morgan, Citi Bank and Bank of America would have had to gross up, respectively, US $1,485, US $600 and US $1,414 billion of their total assets if they had followed the IFRS accounting netting framework. Source: "Reported gross assets and effects of offsetting derivatives, 2012".

implications of regulatory changes on banks' cash holding decisions, OLS and GMM models are computed on both the Basel and the ten-year periods.

Insert Tables 3 and 4.

Between regions and periods, the cash and leverage ratios show different trends that do not provide strong evidence supporting the substitutability between cash holding and leverage. The medians follow the same trends as the average terms presented below, but they are not reported here for brevity. For small banks (columns 2-13), between 1981 and 2013, the cash ratio increased from 30% to 39% for Asian and Pacific banks, whereas it decreased from 35% to 26% and from 41% to 19% for European and North American banks, respectively. Moreover, the leverage ratio decreased from 115% to 89%, from 1,761% to 343% and from 168% to 85% for Asian and Pacific, European and North American banks, respectively. For medium-sized banks (columns 14-25), the cash ratio remained stable at approximately 38% and 25% for Asian and Pacific and North American banks, respectively, whereas it increased from 26% to 34% for European banks. In addition, the leverage ratio decreased from 1,559% to 160% and from 1,680% to 431% for Asian and Pacific and European banks, while it varied between 119% and 256% for North American banks. For large banks (columns 26-37), the cash ratio remained relatively stable at approximately 39% for Asian and Pacific banks, whereas it varied from 41% to 46% and from 35% to 40% for European and North American banks, respectively. Further, the leverage ratio decreased from 562% to 368%, from 1,093% to 725% and from 327% to 187% for Asian and Pacific, European and North American banks, respectively. The paid out shareholders' equity ratio varied between +0% and +6% for all types of banks, with higher ratios for North American banks.

1.4.2.2 Aggregated cash holdings

This section documents the evolution of cash holding in the amount counter valued in US$ billions based on the IMF foreign exchange rate at the end of each year. Given that the bank size effect relates to several motives, the banks are divided into three types: small, medium and large banks. The type of bank corresponds to the asset size, where small banks are those with total assets below US $50bln, medium banks are those with total assets between US $50bln and US $250bln and large banks are those with total assets greater than US $250blblnn.

Insert Table 5.

The observations demonstrate that the evolution of cash holding is heterogeneous and that European banks tend to stockpile more cash than their peers, confirming the necessity to better understand the motives for banks to hold cash. However, two types of causes for cash holding explain the observed differences: structural and conjectural causes. The conjectural causes can be linked to the conjectural circumstances that oblige banks to increase their cash holdings to cover against the cash flow risk. For instance, in 2005, the European Constitutional Treaty was rejected in France after a referendum. In addition, the oil commodity price rose by 40% for the first nine months of 2015. This generated significant inflation, which in turn obliged the FED to increase its funding rate. Consequently, the foreign exchange rate of €/US$ in Europe changed from 0.73 to 0.84 at the end of 2014 and 2015, respectively. Coupled with a significant variation in the rate €/US$, this referendum rejection obliged French banks to increase substantially their cash holdings

from US $0.7bln to US $1.9bn between 2004 and 2005. The structural causes of this heterogeneity are further discussed in the regression section, which shows the significance of cash holding motives.

For all regions aggregated (columns 26-27), cash holdings increased steadily from US $104bln in 1981 to US $3 304bln in 2002. The amount of cash holdings then increased from US $4 399bln to US $14 071bln between 2003 and 2012, and in 2013, this figure decreased to US $11 255bln. For Asian and Pacific (columns 2-9) small banks, the amount of cash holdings between 1981 and 1998 increased progressively from US $17bln to US $146bln. Then, in 1999, it decreased sharply to US $79bln. Between 2000 and 2013, cash holdings increased steadily from US $191bln to US $442bln, and finally, in 2014, small banks aggregated US $284bln. For medium banks, the amount of cash holdings between 1982 and 1990 increased from US $6bln to US $162bln, and between 1991 and 1993, it decreased from US $135bln to US $68bln. In 1994, the amount of increased to US $229bln, and from 1995 to 2000, it varied between US $158bln and US $ 107bln on the cusp of the Asian crisis. Between 2001 and 2011, the amount of then increased from US $123bln to US $715bln, and it started to decrease sharply between 2012 and 2014 from US $675bln to US $375bln. For large banks, the amount of cash holdings between 1991 and 1993 increased from US $32bln to US $123bln, but it decreased sharply to US $53bln in 1994. Between 1995 and 1998, the amount of cash holdings varied hieratically between US $99bln and US $172bln. In 1999, at the edge of the Asian financial crisis, it fell to less than US $0.1bln. Between 2000 and 2012, the amount of cash holdings then increased from US $113bln to US $2,996bln, and between 2012 and 2013, it decreased from US $2,996bln to US $2,315bln. For all European banks (columns 16-17), between 1981 and 2007, the amount of cash holdings increased from US $59bln to US $9,597bln, and between 2008 and 2014, it decreased from US $8,874bln to US $5,131bln.

For all North American banks (columns 24-25), between 1981 and 2012, the amount of cash holdings increased from US $28bln to US $2,046bln, and between 2012 and 2013, it decreased from US $1,979bln to US $1,901bln. In the next section, which analyses the motives for cash holding by banks, I analyze the structural causes of these differences.

1.5 Methodology and empirical results

This section presents the model specification, the results of the regression model that computes the determinants of bank cash holding and of the GMM estimate that analyses cash holding from a dynamic perspective.

1.5.1 Variable definition and model specification

From the literature review, an exhaustive list of explicative variables was established, in which the cash-to-assets ratio is the variable explained in detail. Different alternatives to the cash ratio, such as cash to assets, cash to net assets (Opler, Pinkowitz, Stulz and Williamson (1999)) or the log of cash to net assets (Fritz Foley, Hartzell, Titman and Twite (2007)), are proposed by the literature. In this sample, one independent variable is used: cash and the assimilated ratio over assets, which comprises treasury securities, trading account securities and cash due from banks. This definition is conceptually similar to that of liquid assets (see Berger and Bouwman (2009)).

The model is constructed as follows. I use the dependent variable cash holding assets, and the explanatory variables are (1) the standard deviation of ROA, a proxy for the bank's precautionary motive (Laeven and Levine (2009)); (2) the loan growth and market-to-

book ratios, proxies for the bank's growth perspectives (Caprio, Laeven and Levine (2007) and Tobin (1969)) ; (3) the legal and institutional environment in which the bank is located, a proxy for regulatory compliance and the capital/liquidity stringency motive (La Porta, Lopez-De-Silanes, Shleifer and Vishny (1997) and Barth, Caprio and Levine (2004); (4) net income over assets, a proxy for the bank's signaling motive (Ohlson (1995)); (5) the leverage ratio, a proxy for the bank's strategic motive (Bates, Kahle and Stulz (2009)); and (6) the dividend paid out over the equity ratio, a proxy for the bank's agency motive (Jensen and Meckling (1976)). Moreover, five additional variables suggested by the literature review are added to the model: The first three are considered independent, as they may substantially affect the dependent variable, while the last three variables are control variables: (i) bank size, as small banks may behave differently from large banks; (ii) the 10-year government bond per country in which the bank is located, a proxy for government monetary policy; (iii) GDP growth in the country in which the bank is located, a proxy for the economic environment (Beck, Demirgüç-Kunt and Levine (2006)); (iv) the TED in which the bank is located, a proxy for interbank liquidity shocks (Cornett, McNutt, Strahan and Tehranian (2011)); (v) Jensen (1968) excess returns, a proxy for the risk profile of the bank; and (vi) nonperforming loans over the total loans ratio, a proxy for the bank's risk management efficiency (Acharya, Hasan and Saunders (2006)). Consequently, the model can be notated as follows:

Equation 1:

$$\begin{aligned} \textit{Cash Holding}_i = {} & \beta 0 + \beta 1\ \textit{Standard deviation of ROA}_i + \beta 2\ \textit{Legal environment}_j + \beta 3 \\ & \textit{Net income over asset ratio}_i + \beta 4\ \textit{Leverage ratio}_i + \beta 5\ \textit{Loan growth}_i \\ & + \beta 6\ \textit{Market-to-book ratio}_i + \beta 7\ \textit{Dividend paid out over equity}_i \\ & + \beta 8\ \textit{Bank size}_i + \beta 9\ \textit{Government 10-year bond rate}_j + \beta 10\ \textit{GDP Growth}_j + \\ & \beta 11\ \textit{Control1\_TED}_j + \beta 12\ \textit{Control2\_Excess return}_{i,j} + \end{aligned}$$

$$\beta 13\ Control3\_Nonperforming\ Loans\ over\ total\ loans\ ratio_{i} + \mu_i$$

Tables 6 and 7 below list the explained explicative and control variables that are used in the regression model.

Insert Tables 6 and 7

This chapter examines banks' cash holding motives based on robust (Massart, Kaufman, Rousseeuw and Leroy (1986)) regression models that control for heteroscedasticity. Based on observations noted in the descriptive statistics, the following combination of test elements were established systematically for each model presented in order to ensure the solidity of the regression models: endogeneity, omitted variables, colinearity and size effect. For endogeneity, the control variables test the nonperforming loans ratio, the excess returns and the TED. By including Jensen (1986) excess returns in the control variables, I avoid endogenous biases linked to strategic effects or unobserved factors. For omitted variables, a time-fixed effect test is computed to check average variances in cash holding across years that would not be taken into account by the former exogenous variables and to lessen threats related to serial correlation. They results show p-values below 0.001, with Eta² or Omega² below 0.3, while the results of Student t-tests show p-values below 0.001.

1.5.2 Regression results

The table below displays the results of the regression model for all banks per geographical zone and period (Basel and ten-year) to control for the effect of the deployment of the Basel regulatory framework on banks' cash holding motives.

Insert Tables 8 to 15.

The findings reveal significant heterogeneity in relation to banks' cash holding motives. This disparate nature of motives suggests that cash holding is sensitive to various parameters that depend on the environment in which a bank is located. Below, the standardized coefficients are presented to scale the cash holding motives and thus enable a comparison between heterogeneous regions.

The following observations can be drawn. Mainly composed of developed countries with lower starting point, on economic point of view, the banks in APAC have enjoyed a stronger economic growth than in Europe or North America over the last decades. Also, the regulatory framework in APAC region has been less constraining as shown by Barth, Caprio Jr and Levine (2001). Over the period studied, the banks in US have taken advantage of a common currency and more homogenous fiscal and regulatory framework than their European peers. In addition, the legal environment in the US favors the business risk takers. Consequently the US banks have benefited of a stable regulatory environment, even if the US has been hurt by different economic downturns. In contrast, the European banks had to face a lower economic growth, fiscal instability, heterogeneous regulatory frameworks and monetary policies. These differences in Europe have started to be reduced, with the implementation of the common euro currency. The necessity for a greater convergence has been largely discussed, in particular since the last 5 years and after the budget crisis of 2010 that was

mainly triggered by Greece. The recent vote for Brexit in UK may accelerate this global convergence, enabling a more stable environment for the banking system in Europe. This difference of environments explains why the motives for holding cash and assimilated liquid assets differ between regions.

For Asian and Pacific banks (table 10, column 4), the GDP growth, interbank liquidity shock, precautionary and signaling motives explain Asian and Pacific banks' cash holding behavior, with standardized coefficients of 0.25***, 0.21***, 0.18*** and 0.16***, respectively. These motives vary over time, as can be observed in columns 5 to 7, which show the unstandardized coefficient per Basel period, or in columns 8 to 11 (table 10), which show the unstandardized coefficient per ten-year period. The leverage ratio, which tests the substitutability between cash holding and external funding, is relatively low and nonsignificant, and the sign changes over the different periods, suggesting that the trade-off theory does not apply for these types of banks.

For European banks (table 12, column 4), the bank size, precautionary motive, interbank liquidity shock and regulatory compliance motives explain European banks' cash holding behavior, with standardized coefficients of 0.40***, 0.27***, 0.16***, and -0.11***, respectively. The negative sign of the regulatory motive is expected. The significance of bank size and interbank liquidity shocks remain relatively stable over the various periods presented (table 12, columns 5 to 11); however, the regulatory compliant motive is less significant after the Basel I period, suggesting that the regulatory and institutional changes marginally affected the cash holding decisions of the banks after the deployment of Basel I.

For North American banks (table 14, column 4), the 10-year bond yield, bank size, strategic and regulatory compliance motives explain North American banks' cash holding behavior, with standardized coefficients of 0.32***, 0.17***, -0.12***, and -0.10***, respectively. The findings indicate that the leverage ratio has a significant predictive value but that this predictive standardized coefficient (not reported in the tables for brevity) tends to decrease over time, with values of -0.18***, -0.09** and -0.07*** for the Basel I, Basel II, and Basel III periods, respectively. The negative sign in table 5 "Summary of variables – part 1" is expected.

Overall, the findings confirm that the leverage ratio does not have a significant predictive value, has a varying sign, or has a predictive value that decreases over time, which does not lend support to the substitutability hypothesis regarding the substitutive relation between cash and debt. Thus, the trade-off hypothesis may not apply in the banking sector. To determine precisely whether the trade-off theory has to be rejected, I have established a dynamic and optimal cash holding model.

1.5.3 Dynamic model estimates with GMM

This section analyses cash holding from a dynamic perspective. If an optimal level of cash holding indeed exists, this level could differ over time and across banks. Therefore, an appropriate estimation technique will enable lags in adjustments, as well as systematic changes in the determinants of optimal cash levels. The GMM[8] estimation, developed by Arellano and Bond (1991), helps to estimate unbiased partial adjustments and makes it possible to control not only for endogeneity in bank-specific variables but also for the dynamic nature of cash holding. To build a model consistent with the trade-off hypothesis, which implies that banks have an optimal level of cash holding, I follow the protocols

[8] Usually attributed to Hansen, Lars Peter, 1982, Large sample properties of generalized method of moments estimators, *Econometrica* 1029-1054., the GMM is the most appropriate tool for controlling unobserved effects. First, the cash holding at time t-1 may have an autoregressive effect. Second, Hansen showed that every instrumental variables estimator, in nonlinear or linear models, with cross-section, panel data or time series, could be conceived as a GMM estimator. Considered as a unifying framework for inference in econometrics, this estimation has the advantage of being robust to the distribution of errors, and it is considered more efficient than 2SLS (Hall, Alastair R, 2005. *Generalized method of moments* (Oxford University Press Oxford).. Most commonly tool used when there is endogeneity threat between the dependent variables, the GMM instruments them with a lagged dependent variable. In this article, the independent variables act as control variables, with regards to liquidity created at t+1. Also, at lag 2, the GMM coefficient measures the degree of mean reversion and thus (1-λ) is interpreted as the coefficient of persistence of the explicative variable Yt-1 for each bank. Refer to proof of evidence in art. 1 "Why do banks hold cash?", equation 4 on how to interpret the lag 2 coefficient 1-λ.

elaborated by Ozkan and Ozkan (2004) and Venkiteshwaran (2011). Because this level might vary over time and between banks, the optimal cash ratio obtained is:

Equation 2

Suppose the unobserved target cash ratio: $Cash^*_{i,t}$

$$Cash^*_{i,t} = \sum_k \beta X_{i,t} + \mu_{i,t}$$

Where

- Cash is the cash ratio (cash over total assets)
- Banks = i:from 1 to n
- Time = t, from 1 to t
- Xi,t is the vector of bank-specific determinants.
- β is the estimated coefficient vector, and it corresponds to the propensity to revert to cash holding.

Banks adjust their current cash ratio to reach the target ratio. It ultimately forces the banks to establish a partial adjustment mechanism. This standard partial adjustment model for cash holding can be written, where cash optimal* – cash (actual) = excess of cash.

Equation 3

$$Cash^*_{i,t} - Cash_{i,t-1} = \lambda (Cash^*_{i,t} - Cash_{i,t-1})$$

where coefficient λ varies between 0 and 1 and captures the fraction of the gap between the target and the actual level of cash, said differently the ability for banks to adjust to their target ratio.

- If λ is close to 1: It implies that the banks are able to adjust immediately and thus there is no adjustment costs, i.e., $Cash^*_{i,t} = Cash_{i,t;}$
- If λ is close to 0: It means that banks are not able to adjust immediately thei cash structure because the adjustment costs are too large, i.e., $Cash_{i,t} = Cash_{i,t-1}$

If Equation 2 is substituted into equation 1 and the terms are rearranged, the following equation is obtained:

Equation 4

$$Cash^*_{i,t} = (\lambda\beta)\, X_{i,t} + (1-\lambda)\, Cash_{i,t-1} + \delta_{i,t}$$

where

- $(\lambda\beta)\, Xi,t$ is the target cash ratio toward which the bank's cash ratio converges.
- $1-\lambda$ is interpreted as the mean reverting property of cash holding for a first order autoregressive model of change in cash position for each bank.

It results that the model that tests for dynamic cash holding becomes:

Equation 5

$$Cash\ ratio_{i,t} = \beta 13\ Cash\ ratio_{i,t-1} +$$

$$\beta 0_t + \beta 1\ Standard\ deviation\ of\ ROA_{i,t} + \beta 2\ Legal\ environment_{j,t} + \beta 3\ Net\ income\ over\ asset\ ratio_{i,t} + \beta 4\ Leverage\ ratio_{i,t} + \beta 5\ Loan\ growth_{i,t}$$

$$+ \beta 6\ Market\text{-}to\text{-}book\ ratio_{i,t} + \beta 7\ Dividend\ paid\ out\ over\ equity_{i,t}$$

$$+ \beta 8\ Bank\ size_{i,t} + \beta 9\ Government\ 10\text{-}year\ bond\ rate_{j,t} + \beta 10\ GDP\ Growth_{j,t}$$

$$+ \beta 11\ Control1\_TED_{t\,j} +$$

$$+ \beta 12\ Control2\_Nonperforming\ Loans\ over\ total\ loans\ ratio_{i,t} + \mu_{i,t}$$

The tables below report the results of the estimation. The results of Sargan & Hansen's J tests indicate that the instruments utilized in the GMM estimation do not correlate with the error terms and that there are no overidentifying restrictions.

Insert Table 16.

Table 16, which reports the coefficient of the propensity to revert to cash holding (1-λ) per geographical zone and bank size, confirms that the dynamic nature of the cash holding model in the banking sector can be rejected. For the Asian and Pacific, European and North American zones, the coefficients are 0.07 (1-0.93***), 0.28 (1-0.716***) and 0.13 (1-0.871***), respectively. For small, medium and large banks, the coefficients are 0.37 (1-0.631***), 0.03 (1-0.968***) and 0.02 (1-0.978***), respectively.

Overall, these findings provide strong evidence that the dynamic nature of the optimal cash model in the banking sector is rejected.

1.6 Conclusions

In this paper, I examined the hypothesis that cash optimality exists in the banking sector. To determine the excess of the cash coefficient, I first identified the determinants of cash holding. In contrast to previous studies, this paper explored the empirical determinants of cash holding for a large sample of listed banks and over a long period of 35 years. I did not find any evidence that might support a substitutive relationship between cash holding and the leverage ratio. Second, I integrated the dynamic nature of cash holding over

time to test whether banks adjust their level of cash to an optimal level. By using the GMM protocol, I could establish this optimal cash level per bank while controlling for endogeneity and measurement errors. Finally, the findings provide evidence that the dynamic nature of the optimal cash model in the banking sector is rejected, in contrast to the nonbanking sector (Ozkan and Ozkan (2004); Venkiteshwaran (2011) Akbari, Rahmani, Ahmadi and Shababi (2014)); Subramaniam, Tang, Yue and Zhou (2011)). This paper yields several important features that provide additional insights into not only what causes a bank to hold significant amounts of cash but also how banks differ from corporations in regard to cash management. Additionally, the Basel III regulatory framework—particularly with respect to liquidity ratios—may oblige banks to adapt their financing models and, by extension, may change the relationship between cash holding and debt levels. Further research on the impact of Basel III on liquidity creation would be useful in this respect.

1.7 Tables

Table 1: Breakdown of the number of banks per geographical zone and country

Table 1 shows the number of banks included in this research, per main geographical zone and per country. The sample includes Thomson Reuter's bank year observations from 1981 to 2013. Banks in Thomson Reuters correspond to listed companies, and they are classified as such by the ICB. The first column indicates the region and then the country, while the second column shows the number of banks per year that belong to these countries. The years 1981, 1985, 1990, 1995 and 2000 and then every year from 2005 to 2014 are displayed.

Region - Country	Year										
	1981	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**
Asia & Pacific	**14**	**34**	**61**	**84**	**108**	**153**	**166**	**166**	**166**	**166**	**157**
Australia	3	3	4	6	7	7	7	7	7	7	6
China	0	0	1	1	2	10	11	11	11	11	7
India	0	0	0	0	10	30	36	36	36	36	36
Japan	11	31	56	73	74	80	84	84	84	84	83
South Korea	0	0	0	0	2	5	7	7	7	7	6
Taiwan	0	0	0	3	12	20	20	20	20	20	18
Turkey	0	0	0	1	1	1	1	1	1	1	1
Europe	**17**	**26**	**69**	**84**	**120**	**134**	**145**	**142**	**141**	**131**	**109**
Austria	0	0	5	6	6	6	6	6	6	6	3
Belgium	1	1	1	1	2	2	2	2	2	2	2
Cyprus	0	0	0	0	0	0	1	1	1	1	1
Czech Republic	0	0	0	0	1	1	1	1	1	1	1
Denmark	1	1	16	18	24	24	24	24	24	19	16
Finland	0	0	2	2	2	2	2	2	2	2	0
France	2	3	5	5	6	6	6	6	6	6	5
Germany	2	3	4	4	6	9	10	10	9	9	6
Greece	0	2	3	5	6	9	9	6	6	6	4
Hungary	0	0	0	0	1	1	1	1	1	1	1
Ireland	1	1	2	2	2	2	2	2	2	2	2
Italy	2	3	7	10	11	13	13	13	13	13	12
Netherlands	0	0	0	0	1	1	1	1	1	1	0
Norway	0	0	2	4	16	16	21	21	21	20	17
Poland	0	0	0	2	7	9	9	9	9	9	8
Slovakia	0	0	0	0	1	3	4	4	4	3	3
Slovenia	0	0	0	0	0	0	2	2	2	0	0
Sweden	3	3	3	4	4	4	4	4	4	4	4
Switzerland	1	5	15	17	20	22	22	22	22	21	19
United Kingdom	4	4	4	4	4	4	5	5	5	5	5
North America	**29**	**37**	**92**	**262**	**459**	**535**	**546**	**540**	**521**	**510**	**438**
Canada	5	5	8	8	9	9	9	9	9	9	9
United States	24	32	84	254	450	526	537	531	512	501	429
Total général	**60**	**97**	**222**	**430**	**687**	**822**	**857**	**848**	**828**	**807**	**704**

Table 2: Fraction of the market covered by the sample

Table 2 compares the total deposits and loans of the sample of banks used in this study vs. the total deposits and loans reported by local regional banker associations and summed per geographical zones. The first column indicates the region. The first and second columns display the number of banks used in this study for 2011 and 2013, respectively. The second and third columns sum the deposits and loans of the banks from the current bank sample. The fifth and sixth columns display the total deposits and loans of all banking sectors. These data were extracted from local or banker associations for the year 2011, except for Canada (year 2013). The last two columns show the percentage of the sample used in this study over the total of deposits and loans aggregated per geographical zone, respectively.

	Thomson Reuters (current sample)				**Data from local bankers association**		**Sample over total per country**	
Region	**Number of banks**		**Deposits**	**Loans**	**Deposits**	**Loans**	**Deposits**	**Loans**
	2011	**2013**	**$ Bln**	**$ Bln**	**$ Bln**	**$ Bln**	**%**	**%**
Asia & Pacific	166	166	13 738	10 818	15 688	19 406	88%	56%
Europe	142	131	9 635	12 960	29 949	26 581	32%	49%
North America	540	510	8 413	6 870	12 258	10 529	69%	65%
Total général	**848**	**807**	**31 785**	**30 649**	**57 895**	**56 516**	**55%**	**54%**

Table 3 : Compared evolution of the cash and paid out over equity and leverage ratios – per geographical zone, type of bank and period – Small and Medium banks

This table shows the evolution of the cash and assimilated, paid out over the equity and leverage (total debt over equity) ratios in average terms. The medians follow the same trend, but they are not reported for the sake of brevity. The first column shows the periods corresponding to the Basel regulatory framework deployment: before Basel I (from 1981 to 1988), Basel I (between 1989 and 2007), Basel II (between 2008 and 2010) and Basel III (from 2011 to date). Columns 2 to 13 display for small banks and per geographical zone (Asia and Pacific, Europe and North America) the following information: the number of observations, the cash ratio, the paid out ratio and the leverage ratio. This order is duplicated for medium banks (columns 14 to 25) and large banks (columns 26 to 37). The type of bank corresponds to the asset size, where small banks are those with total assets below US $50bln, medium banks are those with total assets between US $50bln and US $250bln and large banks are those with total assets greater than US $250bln.

Period	Small banks												Medium banks											
	Asia & Pacific				Europe				North America				Asia & Pacific				Europe				North America			
	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1981-1988	194	30%	2%	115%	156	35%	4%	1761%	270	41%	4%	168%	15	38%	3%	1559%	60	26%	3%	1680%	32	22%	6%	129%
1989-2007	1652	35%	2%	85%	1525	26%	4%	439%	6391	26%	3%	136%	274	35%	3%	793%	267	32%	4%	1163%	192	32%	6%	256%
2008-2010	343	40%	2%	86%	319	23%	3%	423%	1600	18%	3%	151%	119	38%	2%	223%	37	33%	3%	904%	33	22%	4%	204%
2011-to date	418	39%	2%	89%	371	26%	2%	343%	1925	19%	2%	85%	164	39%	2%	160%	56	34%	0%	431%	40	22%	3%	119%

Table 4 : Compared evolution of the cash and paid out over equity and leverage ratios – per geographical zone, type of bank and period – Large banks

This table shows the evolution of the cash and assimilated, paid out over the equity and leverage (total debt over equity) ratios in average terms. The medians follow the same trend, but they are not reported for the sake of brevity. The first column shows the periods corresponding to the Basel regulatory framework deployment: before Basel I (from 1981 to 1988), Basel I (between 1989 and 2007), Basel II (between 2008 and 2010) and Basel III (from 2011 to date). Columns 2 to 13 display for small banks and per geographical zone (Asia and Pacific, Europe and North America) the following information: the number of observations, the cash ratio, the paid out ratio and the leverage ratio. This order is duplicated for medium banks (columns 14 to 25) and large banks (columns 26 to 37). The type of bank corresponds to the asset size, where small banks are those with total assets below US $50bln, medium banks are those with total assets between US $50bln and US $250bln and large banks are those with total assets greater than US $250bln.

Period	Large banks											
	Asia & Pacific				Europe				North America			
	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR	N	Cash ratio	Paid out	LR
1	26	27	28	29	30	31	32	33	34	35	36	37
1981-1988												
1989-2007	49	40%	3%	562%	201	41%	5%	1093%	63	40%	6%	327%
2008-2010	35	38%	4%	417%	79	46%	3%	1075%	33	36%	5%	268%
2011-to date	73	39%	4%	368%	96	44%	2%	725%	44	35%	4%	187%

Table 5 : Evolution of aggregated cash holding – per type of bank

This table shows the evolution of aggregated cash holding. The first column shows the reporting year, the second the number of banks, and the third the sum of cash and assimilated. This order is replicated per geographical zone (i.e., Asia and Pacific, Europe and North America) and type of bank (i.e., small, medium and large bank). The type of bank corresponds to the asset size, where small banks are those with total assets below US $50bln, medium banks are those with total assets between US $50bln and US $250bln and large banks are those with total assets greater than US $250bln. Cash and assimilated are defined in Table 4's "Summary of variables". Amounts are expressed in billions of USD, based on the IMF foreign exchange rate of each end of year.

Year	Asia & Pacific								Europe								North America								All	
	Small banks		Medium banks		Large banks		All		Small banks		Medium banks		Large banks		All		Small banks		Medium banks		Large banks		All			
	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln	N	$ Bln
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1981	14	17	0	0	0	0	14	17	12	28	5	32	0	0	17	59	26	21	3	7	0	0	29	28	60	104
1982	15	18	1	6	0	0	16	24	12	25	6	36	0	0	18	61	28	25	3	4	0	0	31	29	65	114
1983	18	25	1	9	0	0	19	34	14	26	6	36	0	0	20	62	27	25	4	12	0	0	31	37	70	132
1984	22	30	1	8	0	0	23	38	13	21	6	31	0	0	19	52	30	27	4	10	0	0	34	37	76	127
1985	33	37	1	12	0	0	34	50	19	33	7	50	0	0	26	83	33	34	4	12	0	0	37	47	97	180
1986	33	61	1	16	0	0	34	76	24	55	8	63	0	0	32	118	36	45	4	16	0	0	40	61	106	255
1987	31	61	3	40	0	0	34	101	24	58	11	115	0	0	35	173	39	48	5	27	0	0	44	75	113	349
1988	28	55	7	104	0	0	35	160	38	82	11	98	0	0	49	180	51	53	5	33	0	0	56	86	140	425
1989	48	102	7	113	0	0	55	214	50	92	13	141	0	0	63	233	77	49	7	45	0	0	84	95	202	542
1990	51	102	10	162	0	0	61	264	52	59	13	163	4	82	69	304	85	54	7	44	0	0	92	98	222	667
1991	59	113	10	135	1	32	70	279	54	51	13	190	4	83	71	324	87	65	7	78	0	0	94	143	235	747
1992	61	115	10	131	1	38	72	284	57	52	13	145	4	75	74	271	125	57	9	103	0	0	134	160	280	716
1993	64	129	8	68	2	123	74	320	59	58	12	128	5	46	76	231	131	58	10	135	0	0	141	193	291	744
1994	68	145	12	229	1	53	81	427	59	59	12	91	7	123	78	273	222	61	10	167	1	0	233	228	392	929
1995	70	148	12	158	2	172	84	479	64	80	12	104	8	353	84	537	251	68	9	153	2	46	262	267	430	1 283
1996	74	144	10	121	2	146	86	411	65	84	12	97	9	507	86	688	285	64	10	148	2	57	297	269	469	1 368
1997	77	135	10	126	1	99	88	360	79	78	14	110	9	570	102	758	318	70	10	121	3	260	331	452	521	1 569
1998	83	146	10	109	1	104	94	358	86	73	16	209	9	716	111	998	374	72	10	152	3	225	387	449	592	1 805
1999	82	79	13	115	1	0	96	194	91	85	15	148	10	920	116	1 153	421	76	10	175	3	275	434	526	646	1 873
2000	97	191	10	107	1	113	108	411	93	78	16	228	11	1 117	120	1 423	444	63	11	200	4	473	459	737	687	2 570
2001	101	200	11	123	2	101	114	424	100	75	16	223	12	1 297	128	1 595	466	64	12	219	4	446	482	730	724	2 749
2002	117	309	14	140	2	216	133	665	98	65	17	280	13	1 445	128	1 790	494	70	12	222	4	557	510	849	771	3 304
2003	114	333	19	205	5	391	138	929	100	91	14	245	16	2 123	130	2 459	501	68	12	247	5	696	518	1 010	786	4 399
2004	117	386	22	274	6	723	145	1 383	99	91	16	300	16	2 781	131	3 171	513	61	13	204	6	897	532	1 162	808	5 716
2005	123	396	25	339	5	691	153	1 427	101	92	17	394	16	4 878	134	5 364	516	66	11	141	8	1 176	535	1 383	822	8 174
2006	123	371	29	381	7	876	159	1 628	110	104	15	210	21	6 393	146	6 708	532	67	10	90	9	1 460	551	1 617	856	9 953
2007	123	365	32	450	9	894	164	1 709	108	105	11	167	27	9 325	146	9 597	549	57	12	104	9	1 763	570	1 924	880	13 229
2008	119	372	37	603	9	1 136	165	2 112	108	110	10	114	27	8 650	145	8 874	541	53	11	84	11	1 445	563	1 582	873	12 568
2009	118	418	37	607	11	1 397	166	2 422	104	83	14	160	27	7 550	145	7 793	535	62	11	92	11	1 647	557	1 801	868	12 016
2010	106	410	45	630	15	2 239	166	3 279	107	110	13	204	25	7 336	145	7 650	524	60	11	81	11	1 848	546	1 990	857	12 918
2011	103	407	47	715	16	2 782	166	3 904	103	99	15	202	24	7 534	142	7 834	519	59	10	83	11	1 778	540	1 921	848	13 659
2012	102	409	45	675	19	2 996	166	4 081	103	139	12	219	26	7 586	141	7 945	500	67	10	91	11	1 888	521	2 046	828	14 071
2013	107	442	39	554	20	2 794	166	3 790	92	115	15	181	24	5 190	131	5 486	489	72	10	65	11	1 842	510	1 979	807	11 255
2014	106	284	33	375	18	2 315	157	2 974	73	107	14	219	22	4 804	109	5 131	417	75	10	74	11	1 752	438	1 901	704	10 006

Table 6: Summary of variables (part 1)

This table sums up the discussion above and shows the exhaustive list of variables used in this research. The first column indicates the motive, the second the variable name, the third the corresponding code used in the regression models, the fourth whether the variable has been scaled under a Siegel-Tukey test, the fifth the predictive sign and the sixth how the variable has been computed (Thomson Reuters' code).

Motive	Variable name	Variable name in the OLS	Tukey' scale type	Predictive sign	How this variable is computed
1	2	3	4	5	6
Explained variable 1	Cash and assimilated over assets		Y (Sqrt)	NA	Cash and Assimilated over Assets = Treasury Securities (item WC02205) + Trading account Securities (item WC02208) + Cash and due from banks (item WC2004) over Total Assets (item WC02999)
Explained variable 2 (GMM)	Cash and assimilated over assets year +1		NA	NA	Δ cash holding = [Cash holding(y) - Cash holding(y-1) / Cash holding(y-1)]
1. Precautionary	Standard deviation of returns on assets	X1SdRoa	Y (Log)	+	Standard deviation of RoA = Net Income Total (item WC01751) / Total assets (item WC02999). The standard deviation require at least three observations, is rolling and computed every year (step of maximum 5 years). Net Income Total (WC01751) NET INCOME TOTAL represents the net income the company. It is before extraordinary items.
2. Effect of regulatory environment	Liquidity creation may depend on local regulatory constraints.	X2Legal	NA	-	To measure the effect of the legal environment and institutional differences on liquidity creation, an index has been established as follow : (1) before Basel I : I start first from La Porta et al. (1997) who established legal zones to measure the effect of the legal environment on the development of the capital market. To measure the effect of the legal environment on liquidity creation, a similar mapping is utilized in this paper, where a grade is provided to the level of property right protection from 0 to 4 corresponding from not protective to most protective, respectively. (2) from Basel I to II, (3) from Basel II to III, and (4) since Basel III : The regulatory environment mapping of banks is elaborated from Barth et al. (2008); Barth et al. (2001) for the three last periods corresponding respectively to Basel regulatory frameworks deployments. It is a summary that averages the capital stringency as well as capital activity and restrictiveness per periods.
3. Signaling	Net income over assets	X3Incoa	NA	-	IncoA: Net Income Total (item WC01751) / Total Assets (item WC02999) Net Income Total (item WC01751) represents the net income the company uses to calculate its earnings per share. It is before extraordinary items.
4. Strategic - Funding source substitutability	Leverage ratio	X4LR	NA	-	Total Debt / Equity : The ratio is calculated as follow : Total debts (item WC03255) /Common equities (item WC03501)
4. Strategic - Growth opportunities	Loan growth	X5LnGwth	NA	+	Loan growth is a proxy for bank's growth opportunity. It is the variation of total loans over one reporting year LnGwth : (Loans Total Y of bank i- Loans total Y-1 of bank i) / Loans total Y-1 of bank 1 - [Where Loans total is item WC02271]
4. Strategic - Growth opportunities	Market-to-book ratio	X6MktBkR	NA	+	This ratio is calculated as follow in this research: Market value per share (item WC05001) over Book value per share (item WC05476).

Table 7: Summary of variables (part 2)

This table sums up the discussion above and shows the exhaustive list of variables used in this research. The first column indicates the motive, the second the variable name, the third the corresponding code used in the regression models, the fourth whether the variable has been scaled under a Siegel-Tukey test, the fifth the predictive sign and the sixth how the variable has been computed (Thomson Reuters' code).

Motive	Variable name	Variable name in the OLS	Tukey' scale type	Predictive sign	How this variable is computed
1	2	3	4	5	6
5. Agency	Dividend paid out over shareholders' equity ratio	X7PaisShroEq	NA	+	Cash dividends (item WC04551) over Shareholders' equity (item WC03995). Cash dividends (item WC04551) represents the total common and preferred dividends paid to shareholders of the company. It excludes: Dividends paid to minority shareholders Footnotes: A. Included in other sources or uses B. Includes bonuses to directors C. Prior year's proposed dividend Total Shareholder's Equity (item WC03995) represents the sum of Preferred Stock and Common Shareholders' Equity.
Endogenous	Bank size	X8BkSUSD	Log	+	The firm size is measured as follow in this research: Log Total Assets (item WC02999).
Exogeneous	Governement monetary policy. Government 10 years rate : The cash holding creation may depend on the monetary policy of country.	X9Rf	Y (Sqrt)	-	The government bond rate of where is located the head quarter of the bank.
Exogenous	Macroeconomic environment - GDP growth	X10GDPgwth	NA	+	The GDP growth corresponds to the yearly growth of GDP of the country in which the bank is located. Source : International Monetary Fund, World Economic Outlook Database, October 2014.
Control variable 1	Liquidity shock	X11TED	NA	+	Spread between interbank loan 3 months and free risk rate 3 months. For all countries : yearly average of Interbank loan 3 months - T-bills 3 months. Exceptions : For Japan yearly average of interbank 1M - Gensaki T-bills 1 month. For Australia and Chile yearly average of Interbank O/N - T-Bills 3 month
Control variable 2	Excess Return	X12ExccsR	NA	+	Jense's Excess Return (α) = R(a) – R(f) – Beta(a,m) [R(m) - R(f)] ; beta is the commonly indicator [Cov (a, m) / Variance (m)], where R(a) is the return of market share, R(f) is the return of benchmark government bonds, R(m) is the return of market index m where is listed the bank. Var(x) and Cov (x, y) require at least three observations. Covariances and variances are rolling and computed every year (step of maximum 5 years). Market price = Market value per share (item WC05001).
Control variable 3	NPLoLoans	X13NploL	NA	-	Non Performing loans over loans is the control variable that proxies the risk management. NPLoLoans = Non performing loans (item WC02285) / Loans total (item WC02271)
Omitted variables	Set of dummies for all but one year. Per bank and country in which the bank is located.		NA	+ / -	Fixed effects : $Bank_i$ and $country_j$, where the bank is located

Table 8: Regression models per period – All banks (Basel period)

This table presents the results of the regression models for all banks per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Column 3 shows the results for all banks. Columns 4 to 6 show the result per Basel period (Basel I = 1998-2007, Basel II = 2008-2010, and Basel III = 2011-2014).

Motive	Variable name	All	Basel period		
		Unstandardized coefficient	Basel I	Basel II	Basel III
1	2	3	4	5	6
Precautionary	X1SdRoa2	0.00223	0.0134***	-0.0206**	-0.0189***
		(1.04)	(4.51)	(-2.92)	(-3.48)
Effect of regulatory environment	X2Legal	-0.00532***	-0.0134***	-0.0000663	0.00813**
		(-4.94)	(-6.62)	(-0.02)	(2.71)
Signaling	X3Incoa	0.260**	0.551**	-0.0970	-0.244
		(2.58)	(2.97)	(-0.41)	(-0.90)
Strategic	X4LR	-0.000298***	-0.000260	-0.00197	-0.000358
		(-3.53)	(-0.97)	(-1.69)	(-1.48)
Strategic - Growth opportunities	X5LnGwth	0.00206	0.00121	0.00323	-0.0641***
		(0.80)	(0.44)	(0.26)	(-4.20)
Strategic - Growth opportunities	X6MktBkR	0.000294**	0.000214***	0.00286***	0.00143
		(3.17)	(4.32)	(4.23)	(0.93)
Agency	X7PaisShroEq	-0.121***	-0.0627	-0.313*	-0.105
		(-3.45)	(-1.19)	(-2.05)	(-0.88)
Bank Size	X8BkSUSD	0.0585***	0.0465***	0.0808***	0.0693***
		(51.47)	(27.20)	(26.34)	(28.21)
Monetary policy	X9Rf	0.337***	0.0163	0.556***	0.392***
		(16.68)	(0.37)	(6.63)	(6.44)
Macroeconomic environment - GDP growth	X10GDPgwth	0.0119***	0.0156***	0.00725***	0.00963***
		(24.96)	(17.71)	(8.97)	(3.77)
Control variable 1	X11TED	0.0101***	-0.0125*	0.0157***	0.0188*
		(4.07)	(-2.01)	(3.33)	(2.27)
Control variable 2	X12ExccsR	0.00243*	0.00738*	0.00711	0.000843
		(2.35)	(2.29)	(1.17)	(1.36)
Control variable 3	X13NploL	0.00499*	0.00417**	0.0154	0.154**
		(2.49)	(2.71)	(0.26)	(3.19)
Constant	_cons	0.00113	0.169***	-0.200***	-0.171***
		(0.12)	(10.34)	(-7.53)	(-9.67)
	rep dummies				
	N	14537	8841	2399	2898
	R-sq	0.218	0.152	0.378	0.320
	adj. R-sq	0.217	0.151	0.375	0.317

Table 9: Regression models per period – All banks (ten-years period and fixed effect)

This table presents the results of the regression models for all banks per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Column 3 shows the results for all banks. Columns 4 to 6 show the result per Basel period (Basel I = 1998-2007, Basel II = 2008-2010, and Basel III = 2011-2014). Columns 7-10 show the results per ten-year period (1981-1990, 1991-2000, 2001-2010, and 2011-2014). Columns 11 and 12 show the fixed-effects results, where bank and country are the variables that control for unobserved heterogeneity. Robustness tests include endogeneity with instrumented variables and omitted variables with fixed effects. All the results show F values greater than 10, with P(F) less than 0.0001 and P(t) less than 0.0001.

Motive	Variable name	Calendar period				Fixed effects	
		1981-1990	1991-2000	2001-2010	2011-2014	Per bank	Per country
1	2	7	8	9	10	11	12
Precautionary	X1SdRoa2	0.00683	0.00192	0.00848*	-0.0189***	0.00620**	0.0120***
		(0.64)	(0.41)	(2.23)	(-3.48)	(2.83)	(5.56)
Effect of regulatory environment	X2Legal	0.0699***	-0.0171**	0.000300	0.00813**	0.00881***	0.00541**
		(7.26)	(-3.09)	(0.15)	(2.71)	(5.41)	(2.75)
Signaling	X3Incoa	3.707***	2.124***	-0.134	-0.244	0.156	0.425***
		(3.63)	(5.56)	(-0.73)	(-0.90)	(1.92)	(4.51)
Strategic	X4LR	0.000758	-0.0000639	-0.00511***	-0.000358	-0.0000828	-0.000306***
		(1.21)	(-0.46)	(-4.98)	(-1.48)	(-1.31)	(-4.02)
Strategic - Growth opportunities	X5LnGwth	0.0133	0.000158	0.00876	-0.0641***	-0.00287	-0.00378
		(0.51)	(0.05)	(1.15)	(-4.20)	(-1.54)	(-1.66)
Strategic - Growth opportunities	X6MktBkR	-0.0168***	0.0000635	0.00454**	0.00143	-0.0000409	0.000209*
		(-5.86)	(1.50)	(3.19)	(0.93)	(-0.25)	(2.54)
Agency	X7PaisShroEq	-0.679**	-0.0383	-0.143*	-0.105	-0.00442	0.172***
		(-2.95)	(-0.46)	(-2.12)	(-0.88)	(-0.14)	(5.17)
Bank Size	X8BkSUSD	-0.00672	0.0222***	0.0734***	0.0693***	-0.0629***	0.0306***
		(-0.98)	(7.74)	(34.75)	(28.21)	(-12.69)	(21.95)
Monetary policy	X9Rf	0.378***	-0.102	0.240***	0.392***	0.0866**	0.0307
		(4.81)	(-1.78)	(4.42)	(6.44)	(3.18)	(0.92)
Macroeconomic environment - GDP growth	X10GDPgwth	-0.00154	0.000912	0.0110***	0.00963***	0.00714***	0.00634***
		(-0.50)	(0.59)	(17.83)	(3.77)	(11.27)	(7.99)
Control variable 1	X11TED	0.0383***	0.0319**	-0.0178***	0.0188*	0.0405***	0.0433***
		(3.87)	(3.28)	(-5.08)	(2.27)	(13.68)	(11.74)
Control variable 2	X12ExccsR	0.000939	0.00900	0.0137**	0.000843	-0.000410	0.000750
		(0.08)	(1.65)	(3.07)	(1.36)	(-0.53)	(0.80)
Control variable 3	X13NploL	0.118	0.152	0.00392*	0.154**	0.00105	0.00165
		(0.40)	(1.61)	(2.56)	(3.19)	(0.69)	(0.92)
Constant	_cons	0.0649	0.287***	-0.0241	-0.171***	0.394***	0.207***
		(0.88)	(8.77)	(-1.23)	(-9.67)	(20.15)	(9.76)
	rep dummies					Yes	Yes
	N	650	3641	7348	2898	14537	14537
	R-sq	0.358	0.049	0.312	0.320	0.106	0.136
	adj. R-sq	0.344	0.046	0.311	0.317	0.043	0.131

Table 10: Regression models per period – Asian and Pacific banks (Basel period)

This table presents the results of the regression models for Asian and Pacific banks per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Columns 3 and 4 show the unstandardized and standardized beta coefficients, respectively, for Asian and Pacific banks. Columns 5 to 7 show the result per Basel period (Basel I = 1998 -2007, Basel II = 2008-2010, and Basel III = 2011-2014).

Motive	Variable name	Apac		Basel period		
		Unstandardized coefficient	Standardized coefficient	Basel I	Basel II	Basel III
1	2	3	4	5	6	7
Precautionary	X1SdRoa2	0.0365***	0.1805***	0.0235***	0.0221	0.0216
		(8.85)	(8.85)	(4.84)	(1.91)	(1.90)
Effect of regulatory environment	X2Legal	0.00886**	0.0982**	0.00606	-0.0143	-0.0706***
		(3.12)	(3.12)	(1.21)	(-1.33)	(-5.92)
Signaling	X3Incoa	2.500***	0.161***	2.012***	2.089	-1.784
		(5.19)	(5.19)	(3.76)	(1.75)	(-0.87)
Strategic	X4LR	0.000268***	0.0649***	0.000341***	-0.00927***	-0.0116*
		(3.40)	(3.40)	(3.35)	(-3.38)	(-2.31)
Strategic - Growth opportunities	X5LnGwth	0.0408**	0.0735**	0.0368*	-0.0322	0.0653
		(2.58)	(2.58)	(2.31)	(-1.50)	(1.40)
Strategic - Growth opportunities	X6MktBkR	0.0137**	0.0878**	0.0118	0.00660	-0.0260**
		(2.88)	(2.88)	(1.63)	(0.85)	(-2.85)
Agency	X7PaisShroEq	-0.509***	-0.117***	-0.586***	0.0189	0.716**
		(-3.85)	(-3.85)	(-3.33)	(0.07)	(2.80)
Bank Size	X8BkSUSD	0.00690	0.0340	0.00421	0.0155*	0.0145
		(1.70)	(1.70)	(0.75)	(2.04)	(1.51)
Monetary policy	X9Rf	0.0180	0.0118	-0.191**	0.368	1.514***
		(0.34)	(0.34)	(-2.73)	(1.35)	(7.15)
Macroeconomic environment - GDP growth	X10GDPgwth	0.00763***	0.2456***	0.0166***	0.00139	0.00459
		(10.52)	(10.52)	(14.96)	(1.60)	(1.69)
Control variable 1	X11TED	0.0530***	0.20513***	-0.00558	0.0938***	-0.0308
		(10.82)	(10.82)	(-0.35)	(11.24)	(-1.96)
Control variable 2	X12ExccsR	0.00954*	0.0435*	0.0256**	0.0164**	-0.0438***
		(2.06)	(2.06)	(3.05)	(3.26)	(-3.68)
Control variable 3	X13NploL	0.000279	0.002995	-0.0000180	0.0989*	0.0788
		(0.10)	(0.10)	(-0.01)	(2.38)	(0.81)
Constant	_cons	0.361***		0.363***	0.357***	0.543***
		(14.49)		(9.76)	(6.22)	(8.88)
	rep dummies					
	N	2855		1679	446	590
	R-sq	0.350		0.355	0.593	0.459
	adj. R-sq	0.347		0.350	0.581	0.447

Table 11: Regression models per period – Asian and Pacific banks (ten-years period and fixed effect)

This table presents the results of the regression models for Asian and Pacific banks per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Columns 8 to 11 show the results per ten-year period (1981-1990, 1991-2000, 2001-2010, and 2011-2014). Columns 12 and 13 show the fixed-effects results, where bank and country are the variables that control for unobserved heterogeneity. Robustness tests include endogeneity with instrumented variables and omitted variables with fixed effects. They all show F values greater than 10, with P(F) less than 0.0001 and P(t) less than 0.0001.

Motive	Variable name	Calendar period				Fixed effects	
		1981-1990	1991-2000	2001-2010	2011-2014	Per bank	Per country
1	2	8	9	10	11	12	13
Precautionary	X1SdRoa2	0.00514	-0.00465	0.0288***	0.0216	0.000696	0.00293
		(0.42)	(-0.57)	(4.29)	(1.90)	(0.20)	(0.88)
Effect of regulatory environment	X2Legal	0.0915***	-0.172***	-0.0122*	-0.0706***	-0.0262***	-0.0243***
		(5.31)	(-4.21)	(-2.02)	(-5.92)	(-8.09)	(-7.58)
Signaling	X3Incoa	-9.330	0.0234	2.188***	-1.784	-0.352	-0.0788
		(-1.81)	(0.03)	(3.31)	(-0.87)	(-1.55)	(-0.32)
Strategic	X4LR	-0.00299**	0.0000686	-0.0112***	-0.0116*	-0.0000859	-0.0000580
		(-3.24)	(0.39)	(-5.22)	(-2.31)	(-1.36)	(-0.88)
Strategic - Growth opportunities	X5LnGwth	-0.0714	0.0639	0.0491***	0.0653	-0.00525	-0.00836
		(-1.13)	(1.51)	(3.73)	(1.40)	(-0.77)	(-1.13)
Strategic - Growth opportunities	X6MktBkR	0.0317	-0.000550	0.00701	-0.0260**	-0.00778**	-0.00685**
		(1.13)	(-0.03)	(1.17)	(-2.85)	(-3.08)	(-2.84)
Agency	X7PaisShroEq	1.763	-0.108	-0.0940	0.716**	0.208*	0.181*
		(1.94)	(-0.38)	(-0.53)	(2.80)	(2.43)	(2.15)
Bank Size	X8BkSUSD	0.122***	0.0294***	-0.00106	0.0145	0.0353***	0.0256***
		(7.05)	(3.66)	(-0.18)	(1.51)	(3.63)	(9.37)
Monetary policy	X9Rf	0.402	0.300**	0.367*	1.514***	-0.217***	-0.197***
		(1.80)	(2.80)	(2.40)	(7.15)	(-4.43)	(-3.64)
Macroeconomic environment - GDP growth	X10GDPgwth	-0.00866**	0.00688*	0.00677***	0.00459	0.00366***	0.00407***
		(-3.17)	(2.19)	(7.41)	(1.69)	(4.16)	(4.06)
Control variable 1	X11TED		0.0158	0.0566***	-0.0308	-0.0160***	-0.0116*
			(0.33)	(11.17)	(-1.96)	(-3.56)	(-2.39)
Control variable 2	X12ExccsR	0.00516	0.0334	0.0135**	-0.0438***	-0.000143	0.00214
		(0.54)	(1.69)	(3.23)	(-3.68)	(-0.05)	(0.64)
Control variable 3	X13NploL		-0.600**	-0.000713	0.0788	0.000691	0.00103
			(-3.12)	(-0.22)	(0.81)	(0.69)	(0.96)
Constant	_cons	-0.542***	0.740***	0.444***	0.543***	0.342***	0.368***
		(-4.91)	(5.23)	(12.79)	(8.88)	(9.07)	(11.96)
	rep dummies					Yes	Yes
	N	221	753	1291	590	2855	2855
	R-sq	0.473	0.289	0.385	0.459	0.339	0.306
	adj. R-sq	0.446	0.277	0.379	0.447	0.289	0.294

Table 12: Regression models per period –European banks (Basel period)

This table presents the results of the regression models for European per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Columns 3 and 4 show the unstandardized and standardized beta coefficients, respectively, for European banks. Columns 5 to 7 show the result per Basel period (Basel I = 1998 -2007, Basel II = 2008-2010, and Basel III = 2011-2014).

Motive	Variable name	Europe		Basel period		
		Unstandardized coefficient	Standardized coefficient	Basel I	Basel II	Basel III
1	2	3	4	5	6	7
Precautionary	X1SdRoa2	0.0808***	0.268***	0.0640***	0.0989***	0.0638***
		(13.26)	(13.26)	(7.64)	(4.79)	(4.25)
Effect of regulatory environment	X2Legal	-0.0109***	-0.1146***	-0.0102***	0.00102	-0.00671
		(-4.93)	(-4.93)	(-3.57)	(0.16)	(-1.24)
Signaling	X3Incoa	0.588*	0.0447*	1.650**	0.412	0.400
		(2.22)	(2.22)	(3.15)	(0.78)	(0.90)
Strategic	X4LR	-0.000994**	-0.0687**	-0.00159	-0.000140	-0.000513
		(-2.92)	(-2.92)	(-1.80)	(-0.14)	(-1.53)
Strategic - Growth opportunities	X5LnGwth	0.0165**	0.0467**	0.0154**	-0.0281	-0.0247
		(3.29)	(3.29)	(3.02)	(-0.76)	(-0.49)
Strategic - Growth opportunities	X6MktBkR	-0.00236	-0.0285	-0.0100***	-0.00548	0.0000103
		(-1.81)	(-1.81)	(-5.01)	(-0.77)	(0.01)
Agency	X7PaisShroEq	0.193	0.052	0.0172	0.0920	0.411*
		(1.89)	(1.89)	(0.13)	(0.27)	(2.51)
Bank Size	X8BkSUSD	0.0656***	0.40182***	0.0573***	0.0977***	0.0748***
		(19.64)	(19.64)	(11.49)	(11.05)	(9.36)
Monetary policy	X9Rf	0.00295	0.00125	-0.0446	0.826**	0.190
		(0.05)	(0.05)	(-0.49)	(3.17)	(1.42)
Macroeconomic environment - GDP growth	X10GDPgwth	0.00211	0.0317	0.00348	0.00381	-0.0131**
		(1.47)	(1.47)	(1.45)	(1.58)	(-2.78)
Control variable 1	X11TED	0.0543***	0.1569***	0.121***	0.0286*	0.0494***
		(6.97)	(6.97)	(8.55)	(2.12)	(3.78)
Control variable 2	X12ExccsR	0.00222*	0.02562*	0.00181	0.0376	0.00142*
		(2.42)	(2.42)	(0.17)	(1.77)	(2.41)
Control variable 3	X13NploL	0.0749	0.02664	0.215**	-0.289	-0.196
		(1.38)	(1.38)	(2.70)	(-1.72)	(-1.79)
Constant	_cons	0.281***		0.276***	-0.0369	0.169*
		(9.08)		(6.69)	(-0.36)	(2.34)
	rep dummies					
	N	2332		1496	352	434
	R-sq	0.231		0.241	0.428	0.286
	adj. R-sq	0.227		0.235	0.406	0.264

Table 13: Regression models per period –European banks (ten-years period and fixed effect)

This table presents the results of the regression models for European per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Columns 8 to 11 show the results per ten-year period (1981-1990, 1991-2000, 2001-2010, and 2011-2014). Columns 12 and 13 show the fixed-effects results, where bank and country are the variables that control for unobserved heterogeneity. Robustness tests include endogeneity with instrumented variables and omitted variables with fixed effects. They all show F values greater than 10, with P(F) less than 0.0001 and P(t) less than 0.0001.

Motive	Variable name	Calendar period				Fixed effects	
		1981-1990	1991-2000	2001-2010	2011-2014	Per bank	Per country
1	2	8	9	10	11	12	13
Precautionary	X1SdRoa2	0.00921	0.0526***	0.0826***	0.0638***	0.00821	0.0532***
		(0.20)	(4.81)	(7.89)	(4.25)	(1.22)	(8.69)
Effect of regulatory environment	X2Legal	-0.0109	-0.0238*	0.00487	-0.00671	0.00662	0.00372
		(-0.23)	(-2.25)	(1.57)	(-1.24)	(1.71)	(0.89)
Signaling	X3Incoa	7.785*	1.356*	0.290	0.400	-0.525*	-0.277
		(2.03)	(2.09)	(0.59)	(0.90)	(-2.04)	(-1.05)
Strategic	X4LR	-0.00403	-0.00261	-0.00147	-0.000513	-0.000444	-0.000646*
		(-1.70)	(-1.87)	(-1.78)	(-1.53)	(-1.73)	(-2.35)
Strategic - Growth opportunities	X5LnGwth	0.105	0.0130**	0.0135	-0.0247	-0.00513	0.00226
		(1.16)	(2.84)	(1.11)	(-0.49)	(-0.99)	(0.39)
Strategic - Growth opportunities	X6MktBkR	-0.0108	-0.0135***	-0.0102	0.0000103	0.000812	-0.00137
		(-0.42)	(-5.93)	(-1.87)	(0.01)	(0.61)	(-0.95)
Agency	X7PaisShroEq	-0.250	-0.132	0.109	0.411*	0.0881	0.190**
		(-0.48)	(-0.69)	(0.73)	(2.51)	(1.31)	(2.68)
Bank Size	X8BkSUSD	-0.0404	0.0328***	0.0964***	0.0748***	0.0547**	0.0652***
		(-1.75)	(4.73)	(16.58)	(9.36)	(3.25)	(16.55)
Monetary policy	X9Rf	0.00958	-0.340**	1.202***	0.190	-0.380***	-0.384***
		(0.08)	(-2.95)	(7.45)	(1.42)	(-6.00)	(-5.36)
Macroeconomic environment - GDP growth	X10GDPgwth	-0.00244	0.00167	0.00625***	-0.0131**	0.00181	0.000318
		(-0.27)	(0.51)	(3.88)	(-2.78)	(1.07)	(0.17)
Control variable 1	X11TED	0.0629	0.0957***	0.0441***	0.0494***	0.0286***	0.0322***
		(0.95)	(6.04)	(3.64)	(3.78)	(3.92)	(3.86)
Control variable 2	X12ExccsR	0.0104	0.00273	0.00553	0.00142*	0.000432	0.000856
		(0.41)	(0.20)	(0.44)	(2.41)	(0.35)	(0.61)
Control variable 3	X13NploL	0.461	0.499*	0.0129	-0.196	-0.0867	-0.188**
		(0.24)	(2.27)	(0.16)	(-1.79)	(-1.58)	(-3.21)
Constant	_cons	0.587**	0.473***	-0.164**	0.169*	0.0881	0.227***
		(2.77)	(9.02)	(-2.75)	(2.34)	(1.19)	(3.94)
	rep dummies					Yes	Yes
	N	86	737	1075	434	2332	2332
	R-sq	0.360	0.261	0.390	0.286	0.107	0.182
	adj. R-sq	0.245	0.248	0.383	0.264	0.036	0.159

Table 14: Regression models per period –North American banks (Basel period)

This table presents the results of the regression models for North American banks per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Columns 3 and 4 show the unstandardized and standardized beta coefficients, respectively, for North American banks. Columns 5 to 7 show the result per Basel period (Basel I = 1998 -2007, Basel II = 2008-2010, and Basel III = 2011-2014).

Motive	Variable name	North America		Basel period		
		Unstandardized coefficient	Standardized coefficient	Basel I	Basel II	Basel III
1	2	3	4	5	6	7
Precautionary	X1SdRoa2	-0.0104***	-0.04015***	-0.0160***	0.00823	-0.00143
		(-3.51)	(-3.51)	(-3.82)	(1.19)	(-0.25)
Effect of regulatory environment	X2Legal	-0.0271***	-0.10089***	-0.0234***	-0.731***	-0.641***
		(-5.91)	(-5.91)	(-3.37)	(-7.78)	(-7.97)
Signaling	X3Incoa	0.187	0.018	-0.0468	0.0649	0.283*
		(1.60)	(1.60)	(-0.16)	(0.32)	(2.53)
Strategic	X4LR	-0.00640***	-0.1195***	-0.0131***	-0.00412**	-0.00211***
		(-3.34)	(-3.34)	(-3.91)	(-3.21)	(-3.77)
Strategic - Growth opportunities	X5LnGwth	-0.00473	-0.01674	-0.00194	-0.0214**	-0.0337*
		(-1.08)	(-1.08)	(-0.64)	(-2.58)	(-2.17)
Strategic - Growth opportunities	X6MktBkR	0.000263***	0.02968***	0.000292***	0.00166*	-0.000606
		(4.11)	(4.11)	(3.77)	(2.53)	(-0.46)
Agency	X7PaisShroEq	0.103*	0.02465*	0.103	0.301**	0.104
		(2.10)	(2.10)	(1.62)	(2.86)	(0.94)
Bank Size	X8BkSUSD	0.0266***	0.1673***	0.0286***	0.0164***	0.00948*
		(13.40)	(13.40)	(8.02)	(3.90)	(2.31)
Monetary policy	X9Rf	0.919***	0.3187***	1.513***	-0.0272	0.222
		(21.93)	(21.93)	(15.70)	(-0.01)	(0.92)
Macroeconomic environment - GDP growth	X10GDPgwth	0.00488***	0.07190***	0.00358*	-0.000917	0.00669
		(6.09)	(6.09)	(2.22)	(-0.09)	(0.95)
Control variable 1	X11TED	0.00676*	0.02005*	-0.0242***	-0.00748	-0.0468
		(2.17)	(2.17)	(-3.89)	(-0.10)	(-0.71)
Control variable 2	X12ExccsR	0.00460***	0.02789***	0.00365	0.000282	0.00214**
		(3.85)	(3.85)	(1.43)	(0.03)	(2.97)
Control variable 3	X13NploL	0.257***	0.05265***	0.477**	-0.116	0.201**
		(5.03)	(5.03)	(2.82)	(-1.46)	(2.97)
Constant	_cons	0.0375		-0.105*	3.450***	3.000***
		(1.31)		(-2.37)	(7.83)	(7.78)
	rep dummies					
	N	9350		5666	1601	1874
	R-sq	0.230		0.198	0.130	0.082
	adj. R-sq	0.229		0.196	0.123	0.076

Table 15: Regression models per period –North American banks (ten-years period and fixed effect)

This table presents the results of the regression models for North American banks per Basel and calendar period. Column 1 shows the cash holding motives, and column 2 the corresponding independent variables. The next columns show the estimated coefficients with their level of confidence. T-tests are reported in parentheses. The symbols ***, ** and * indicate significance levels at 0.1%, 1% and 5%, respectively. Columns 8 to 11 show the results per ten-year period (1981-1990, 1991-2000, 2001-2010, and 2011-2014). Columns 12 and 13 show the fixed-effects results, where bank and country are the variables that control for unobserved heterogeneity. Robustness tests include endogeneity with instrumented variables and omitted variables with fixed effects. They all show F values greater than 10, with P(F) less than 0.0001 and P(t) less than 0.0001.

Motive	Variable name	Calendar period				Fixed effects	
		1981-1990	1991-2000	2001-2010	2011-2014	Per bank	Per country
1	2	8	9	10	11	12	13
Precautionary	X1SdRoa2	-0.0122	-0.0343***	0.000208	-0.00143	0.00378	-0.00782**
		(-0.64)	(-4.82)	(0.05)	(-0.25)	(1.47)	(-2.91)
Effect of regulatory environment	X2Legal	0.0686***	0.0627***	-0.173***	-0.641***	0.0583***	0.0530***
		(5.23)	(6.29)	(-12.38)	(-7.97)	(6.81)	(4.62)
Signaling	X3Incoa	2.632	0.721	-0.495**	0.283*	0.147	0.152
		(1.71)	(1.82)	(-2.61)	(2.53)	(1.76)	(1.45)
Strategic	X4LR	0.000152	-0.0256***	-0.00831***	-0.00211***	-0.00283***	-0.00567***
		(0.10)	(-13.45)	(-7.07)	(-3.77)	(-7.01)	(-11.83)
Strategic - Growth opportunities	X5LnGwth	-0.00240	-0.00101	-0.0159*	-0.0337*	-0.00446*	-0.00590*
		(-0.09)	(-0.66)	(-1.96)	(-2.17)	(-2.34)	(-2.37)
Strategic - Growth opportunities	X6MktBkR	-0.0170***	0.000293***	0.00209**	-0.000606	-0.0000869	0.000258***
		(-4.77)	(3.77)	(2.96)	(-0.46)	(-0.60)	(3.34)
Agency	X7PaisShroEq	-0.506	-0.0979	0.281***	0.104	-0.0255	0.132**
		(-1.59)	(-1.11)	(4.37)	(0.94)	(-0.63)	(3.25)
Bank Size	X8BkSUSD	-0.00533	0.0405***	0.0288***	0.00948*	-0.0240***	0.0194***
		(-0.56)	(10.68)	(11.89)	(2.31)	(-4.04)	(12.09)
Monetary policy	X9Rf	0.740***	0.254	-1.047***	0.222	1.248***	1.300***
		(9.71)	(1.59)	(-6.44)	(0.92)	(17.36)	(13.64)
Macroeconomic environment - GDP growth	X10GDPgwth	0.00280	-0.00491	-0.00791***	0.00669	0.0355***	0.0378***
		(0.62)	(-1.61)	(-6.78)	(0.95)	(7.07)	(5.56)
Control variable 1	X11TED	0.0437***	-0.163***	-0.0543***	-0.0468	0.230***	0.244***
		(4.15)	(-6.31)	(-9.92)	(-0.71)	(15.02)	(11.94)
Control variable 2	X12ExccsR	-0.0158	-0.00736	0.00703	0.00214**	-0.00178	0.00117
		(-0.77)	(-1.60)	(1.79)	(2.97)	(-1.52)	(0.78)
Control variable 3	X13NploL	0.0152	0.331	-0.127	0.201**	0.203***	0.143**
		(0.04)	(1.04)	(-1.43)	(2.97)	(4.80)	(2.91)
Constant	_cons	-0.111	-0.0341	1.099***	3.000***	-0.357***	-0.470***
		(-1.22)	(-0.60)	(12.19)	(7.78)	(-7.65)	(-7.84)
	rep dummies					Yes	Yes
	N	343	2151	4982	1874	9350	9350
	R-sq	0.376	0.190	0.134	0.082	0.306	0.297
	adj. R-sq	0.351	0.185	0.131	0.076	0.253	0.294

Table 16: GMM estimation of dynamic cash holding – propensity to revert to optimal cash compared per region and bank size

This table reports the results of the GMM estimation (Arellano and Bond (1991)) computed to estimate the coefficients for optimal cash and the assimilated over an asset ratio of t. The dependent variables correspond to those in table 4. The z statistics are presented in parentheses below the coefficient estimates. Sargan J-stats [P(Chi²)] appear in the last lines per model. The symbols ***, ** and * indicate significance levels at 0.1%, 1%, and 5%, respectively. Column 1 displays the motives, column 2 the corresponding variables and column 3 the coefficient name. Column 4 shows the coefficient estimates for all banks. Columns 5 to 6 show the coefficient estimates per geographical zones that correspond to Asia and Pacific, Europe and North America. Columns 8 to 9 show the coefficient estimates for bank size, which corresponds to banks' asset size, where small banks are those with total assets below US $50bln, small banks are those with total assets between US $50bln and US $250bln and large banks are those with total assets greater than US $250bln.

Motive	Variable	Coefficient	All	Region			Bank size		
				Apac	Europe	North America	Small	Medium	Large
1	2	3	4	5	6	7	8	9	10
Cash holding$_{i,t-1}$	YCaaoA previous year	b14	0.915*	0.930***	0.716	0.871	0.631	0.968***	0.978***
		_cons	(2.18)	(5.97)	(1.06)	(1.07)	(1.83)	(4.87)	(7.52)
Precautionary	X1SdRoa	b1	-0.00782	-0.0310	-0.118	0.597**	-0.0701	-0.0364	0.140
		_cons	(-0.08)	(-0.49)	(-1.90)	(3.22)	(-0.43)	(-1.10)	(0.88)
Effect of regulatory environment	X2Legal	b2	-0.0163	0.115	-0.00794	0.438	-0.0189	-0.0143	0.0353
		_cons	(-0.76)	(1.95)	(-0.48)	(1.12)	(-0.50)	(-1.43)	(1.90)
Signaling	X5Incoa	b3	-1.994	-1.764	0.546	3.501	-5.104	-0.965	-11.36*
		_cons	(-0.66)	(-1.77)	(0.14)	(0.36)	(-0.58)	(-0.30)	(-2.15)
Strategic	X6LR	b4	-0.000445	0.000301	0.000875	-0.00786	-0.000926	0.000626	0.0107
		_cons	(-1.19)	(0.50)	(0.18)	(-1.18)	(-0.08)	(1.09)	(1.92)
Strategic - Growth opportunities	X5LnGwth	b5	0.392	0.0634	0.352	-0.0508	1.456	0.371	-0.0379
		_cons	(0.36)	(1.20)	(0.41)	(-0.09)	(1.47)	(1.10)	(-0.16)
Strategic - Growth opportunities	X6MktBkR	b6	0.0223	-0.0632**	0.00469	-0.00233*	0.00631	0.115	-0.0882
		_cons	(0.68)	(-3.05)	(0.08)	(-2.33)	(0.12)	(1.83)	(-1.60)
Agency	X7PaisShroEq	b7	0.232	-0.729	-1.456	5.784	1.352	-1.353	0.283
		_cons	(0.33)	(-0.69)	(-1.77)	(0.95)	(0.99)	(-1.41)	(0.22)
Bank Size	X8BkSUSD	b8	0.0322	0.0309**	0.00130	-0.0129	0.0304	0.00275	0.0515
		_cons	(1.59)	(3.16)	(0.05)	(-0.11)	(1.12)	(0.07)	(1.49)
Monetary policy	X9Rf	b9	-0.0268	-1.137**	0.790	9.115	-0.471	0.440	-0.160
		_cons	(-0.07)	(-2.99)	(1.20)	(0.35)	(-1.29)	(1.88)	(-0.42)
Macroeconomic environment - GDP growth	X10GDPgwth	b10	-0.00225	-0.0209	-0.00344	-0.0423	-0.0175	-0.00723	-0.00499
		_cons	(-0.11)	(-1.21)	(-0.39)	(-0.06)	(-0.83)	(-1.05)	(-0.69)
Macroeconomic environment - Liquidity shock	X11TED	b11	0.0423	0.0922	0.427	-0.287	0.0643	0.109	0.0258
		_cons	(0.86)	(1.15)	(1.65)	(-0.16)	(0.86)	(0.87)	(0.33)
Banks profit performance - Excess Return	X12ExccsR	b12	0.00458	0.00687	0.00210	0.0216	-0.00101	0.00193*	-0.172
		_cons	(0.58)	(0.78)	(0.59)	(0.43)	(-0.03)	(2.06)	(-0.96)
Banks risk performance - NPL	X13NploL	b13	0.795	0.00350	2.823	-2.651	1.385	-0.537	-5.342*
		_cons	(0.53)	(1.65)	(1.71)	(-1.02)	(0.90)	(-0.50)	(-2.31)
Constant		b0	0.0288	-0.160	-0.351	-1.719	-0.107	-0.00567	0.349
		_cons	(0.10)	(-0.46)	(-0.77)	(-0.45)	(-0.21)	(-0.03)	(0.76)
		N	14229	2842	2163	9224	12585	1096	548
		Sargan J P(chi²)	0.6031	0.3063	0.6056	0.6031	0.676	0.3402	0.699

Chapter 2. Does an increase in capital negatively impact banking liquidity creation?

2.1 Abstract, keywords and JEL classification

From a dataset composed of a panel of 940 listed banks based in European, American and Asian countries, this paper documents the evolution of bank liquidity creation over a 35-year period (1981-2014).

The empirical evidence confirms that risk and equity levels play a significant and negative role. Overall, the negative effects of equity increases on bank liquidity creation are more significant than corresponding positive effects on risk management, suggesting that capital requirements imposed to support financial stability negatively affect liquidity creation. These findings have broad implications for policymakers.

Keywords: Liquidity creation, sensitivity analysis, GMM, Cox regression

JEL Classifications: C3 - Econometric Methods: Multiple/Simultaneous Equation Models; C53 -Forecasting and Other Model Applications; G21 - Banks; Other Depository Institutions; Mortgages.

2.2 Introduction

Throughout modern finance theory, and according to Diamond and Dybvig (1983) in particular, there has been a consensus that the primary purpose of banks is to create liquidity. Two main facets of banks represent their inherent characteristics, but these two elements can also be a source of weakness: By transforming liquid liabilities into illiquid assets, banks expose themselves to liquidity mismatching, which in turn results in structural fragility.

Nonetheless, do banks create liquidity and if so, what types of banks achieve this goal? In addition, how has this pattern of liquidity creation evolved over time? Finally, do any increases in equity have a positive effect overall? Although liquidity creation is acknowledged as the primary goal of banks, paradoxically, only a few empirical studies have attempted to address such questions, and these have only focused on limited periods and countries. The first attempt in this respect, by Deep and Schaefer (2004), is based on a panel of 200 US commercial banks over a period of four years (Q2 1997 to Q2 2001). Their work presents clues to the determinants of liquidity creation and concludes that credit risk inhibits the liquidity creation process. The second study, by Berger and Bouwman (2009), which examines a panel of 9,095 US banks over 11 years (1993-2003), shows that bank size plays a positive role in the process. A third work focuses on German banks over a period of 10 years (1999-2009) and attempts to determine the impact of banking regulation on liquidity creation (Berger, Bouwman, Kick and Schaeck (2011)).

Several studies have examined banking liquidity creation in other countries, such as Lei and Song (2013) in reference to China; Pana (2012) in reference to Japan; Lakštutienė and Krušinskas (2010) in reference to Lithuania; Al-Khouri (2012) in reference to Bahrain,

Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates; Hackethal, Rauch, Steffen and Tyrell (2010) in reference to Germany; Fungáčová, Weill and Zhou (2010) and Fungáčová and Well (2012) in reference to Russia; Esterhuysen, Vuuren and Styger (2012) in reference to South Africa; and Horváth, Seidler and Weill (2014) in reference to the Czech Republic. All of these authors measure bank liquidity creation and test the effects of certain factors on it. Capital, risk, and macroeconomic factors are nearly always considered in these studies. Performing the analyses presented in this paper on an international sample of banks is therefore not new.

While these works shed valuable light on banking liquidity creation, they still perform analyses of specific countries and for limited periods (typically over ten years). However, a review of the literature review indicates that no empirical research has undertaken a unified and large cross-country analysis of liquidity creation over a period of more than 10 years. Given the potential effects of exogenous variables – such as economic recession and monetary policy – on bank liquidity creation, an examination of a shorter period of less than 10 years and of only one country may influence a study's determinants substantially.

To address this gap, I examine liquidity creation over a period of 35 years and across the following geographic zones: Asia-Pacific, Europe, and North America. Additionally, I attempt to determine whether capital increases positively affect liquidity creation.

To address this question, this paper is organized as follows. The first section reviews the literature on liquidity creation, and the second section shows how the various methodologies employed to compute liquidity creation levels have been adapted to this dataset. A dataset of 940 listed banks extracted from Thomson Reuters has been established that gathers financial and market data from 29 countries over more than three decades. These

data have been supplemented with macroeconomic data from the Bank of International Settlement and from the International Monetary Fund.

The results demonstrate that the evolution of liquidity creation is somehow heterogeneous across the examined regions. The last section of this paper is composed of three parts as follows. First, a model for identifying determinants and liquidity creation processes is presented. To address issues of endogeneity, I employ a multivariate dynamic panel model using a GMM (Generalized Method of Moment) estimator as established by Arellano and Bover (1995). In addition, OLS with a fixed effects estimator is presented to ensure that it is not affected by omitted variables or other biases that would otherwise weaken it. Second, a Cox regression (Cox (1972)) is used to establish a hazard model, which makes it possible to determine a bank's propensity to create liquidity. This makes it possible to construct a profile of banks that create more liquidity than others based on inherent characteristics such as size, risk level and equity level. Finally, a sensitivity analysis is conducted to extend the core results and to estimate the marginal effect of an equity increase on liquidity creation and risk management performance. General implications are presented for policymakers in the conclusion.

2.3 Literature review on liquidity creation

This section reviews the literature on bank liquidity creation and its determinants.

2.3.1 Litterature review

Although Smith (1776) was the first to emphasize the role of banks in financing the economy, the mainstream literature on bank liquidity creation dates back to the 1980s with the

work of Diamond and Dybvig (1983). Indeed, the model developed by the authors provides the most comprehensive theoretical explanation regarding why it is important for banks to hold a mix of illiquid loans and liquid assets. In addition, it helps practitioners to understand that banks create liquidity by funding illiquid assets, such as loans with liquid liabilities, such as deposits. It also shows that the fragile capital structures of banks are caused precisely by this liquidity mismatch. Moreover, this liquidity creation process cannot be disassociated from the risk transformation process, whereby banks transform risk by issuing riskless deposits to fund risky loans (Ramakrishnan and Thakor (1984); Boyd and Prescott (1986)). By issuing short-term deposits while lending against a medium- or long-term horizon, banks expose themselves to interest rate fluctuations and counterparty defaults on payments. This transformation, coupled with risk management (Diamond and Rajan (2001)), is thus the defining characteristic of banks.

Thus, do equity level increases contribute to the creation or destruction of liquidity? Two opposing views address this subject; the first, “risk absorption hypothesis” (Berger and Bouwman (2009)), contends that equity levels have a moderator or buffer effect on risk. With increases in the probability of defaults arising as loans increase (Allen and Santomero (1997)), increases in equity levels enable banks to absorb risks (Repullo (2005); Coval and Thakor (2005)). In this respect, this risk-buffer effect favors liquidity creation. In other words, an increase in equity levels reduces risk, making it possible to increase bank loan capacities and thus liquidity creation. The second view, “financial fragility-crowding out hypothesis” (Berger and Bouwman (2009)), contends that a bank’s level of equity contributes to the destruction of liquidity, i.e., as deposits are immediately available, they offer more insurance for short-term investors than illiquid equities (Gorton and Winton (2000)). As a result, and because equities are illiquid, capital providers are more reluctant to fund banks (Diamond and

Rajan (2001); Diamond and Rajan (2000)); thus, this view assumes that liquidity is a form of indirect insurance for depositors and that equilibrium is to be found by investors in short-term (deposits) and medium- to long-term (equity) investments. If equities are preferred, it is to the detriment of deposits, which mechanically decreases the capacity of banks to create liquidity. In essence, there is an arbitrage effect between the preference for illiquid liabilities (equities) and liquid liabilities (deposits) within a context of limited resources.

Other factors may contribute to liquidity creation. According to Kashyap, Rajan and Stein (2002), both sides of a bank's assets cannot be dissociated due to their mutual synergies. These synergies between deposits and loan commitments create a form of liquidity provision that contributes to liquidity creation (Kashyap, Rajan and Stein (2002). In addition, supervisory regimes and regulatory stringency may also affect whether banks decide to consider risk (Berger, Bouwman, Kick and Schaeck (2011).

Two approaches to measuring liquidity creation have been identified. The first, proposed by Deep and Schaefer (2004), defines liquidity as a gap between liquid liabilities and liquid assets, i.e., it shows the amount of transformed liquidity over total assets. The second approach, created by Berger and Bouwman (2009), proposes a protocol that makes it possible to construct a comprehensive measure of liquidity. It essentially dissociates liquid assets/liabilities from illiquid assets/liabilities and establishes a three-step protocol for computing liquidity creation, which can be summarized as follows: (1) classify asset liabilities and off-balance sheet items with a certain degree of liquidity based on two types of criteria (category or maturity), (2) assign to them three types of weight (+0.5; 0 or -0.5) and (3) combine these two steps. The use of weights is justified by the "dollar-for-dollar adding up constraints" argument, which is as follows. Assume that a bank holds $1 in liquid liabilities, such as deposit claims, and that it uses this $1 to finance a loan, which is an illiquid

asset. The weighted protocol ensures that liquidity creation is indeed $1, where half of the $1 of liquid liability + half of the $1 of illiquid asset = $1 of created liquidity. In effect, $1 is created when the bank transforms $1 of a deposit into a $1 loan. Similar reasoning is applied to cases of liquidity destruction.

An additional measure presented by Fungáčová, Weill and Zhou (2010) is a gross measure that has the advantage of providing an overall understanding of liquidity creation. By applying assumptions that are less strict than other measures, it does not use detailed categories or maturity classifications of different balance sheets items. On the assets side, total loans are assumed to be illiquid, and current account and securities investments are assumed to be liquid. On the liabilities side, total deposits are treated as liquid liabilities and equity is treated as illiquid liabilities.

Another measure of liquidity exists, that is the Liquidity Mismatch Index (Brunnermeier, Gorton and Krishnamurthy (2014). Because this index measures the difference between the "asset price in times of crisis relative to the maturity structure of the liabilities", it takes into account the fact that liquidity of assets is endogenous: there is indeed an interaction between funding and market liquidity (Brunnermeier and Pedersen (2009)) and also between capital and liquidity problems (Allen and Gale (2004). This interaction can generate a loop effect when the financial sector runs into liquidity problem, leading to further asset price reduction, which in turns worsens the liquidity of the markets. This index thus measures the risk for banks to be short of liquidity in adverse scenario, whereas the liquidity measures of Deep and Schaefer (2004), Berger and Bouwman (2008) and Fungáčová, Weill and Zhou (2010) measure the liquidity created by banks.

2.3.2 Determinants of liquidity creation

Which elements determine liquidity creation? Different variables may interact within liquidity creation processes. Based on the literature review, the effect of bank size and the relationship between a bank's role as a risk transformer and liquidity creator were identified as the elements that are most likely to substantially interfere with liquidity creation. Additional parameters, such as the level of equity, monetary policy and the legal environment, are also explored. The determinants can be categorized into two sets of indicators: specific and environmental bank factors.

2.3.2.1 Specific bank factors include the following.

Four bank specific factors have been identified: (1) bank size, (2) level of risk, (3) level of equity and (4) bank performance.

Bank size: The relation between bank size and liquidity creation is due to several factors. For instance, Houston, James and Marcus (1997) demonstrate that capital market imperfections oblige banking group to put in place internal capital markets. Consequently, bigger banks reduce their transaction cost, which enable them to optimize the allocation of funding sources among their branches and subsidiaries. Given the empirical evidence presented by Kashyap, Rajan and Stein (2002) that highlighted the synergy between deposit taking and lending, as well as the relationship between bank size and transaction deposits, the size of a bank may have a significant effect on liquidity creation. Following Demirgüç-Kunt and Huizinga (2011), the log of total assets is a proxy for the size of a bank.

Level of equity: The role of equity levels in liquidity creation is documented by Gorton and Winton (2000) and Diamond and Rajan (2001), who establish that higher capital levels diminish liquidity creation as they negate deposit collection. Berger and Bouwman

(2009) elaborate two hypotheses to offer explanation for the substitution relationship between liquidity creation and the level of capital. The first posits that given the limited access to resources, if level of equity increases it is at the detriment of liquid assets and thus reduces the liquidity creation. The second posits that increase of capital, reduces the risk, which provides more resources allocated to loans, thus augments the liquidity creation. In this paper, the equity variable is scaled over the assets. I acknowledge that the bank capital structure plays an important role in the risk management (Laeven and Levine (2009)). Also, the bank capital structure reflects not only its own characteristics, but also the environment in which it operates (De Jonghe and Öztekin (2015)). Because bank capital structure is not available in Thomson Reuters database, the level of risk is used to take into consideration the effect of bank capital structure on risk management (see below). In addition, I have also accounted for the exogenous factors that may influence the capital of banks in the section "Environmental factors".

Level of risk: The role of banks as risk transformers is examined widely in the literature. According to Diamond (1984) and Ramakrishnan and Thakor (1984), banks finance risky loans by issuing riskless deposits. However, the strength of the relationship between liquidity creation and risk transformation has not been explored fully, and there is no evidence that they vary in perfect parallel to one another. Reliance on performance indicators such as RoE are a key incentive to excessive risk-taking in banks, as shown by Moussu and Petit-Romec (2014). In this paper, bank risk is measured using approach, namely, the standard deviation of RoE. For robustness and following Imbierowicz and Rauch (2014), I add the credit risk level typically calculated by non-performing loans over loans and bank stability risk or z-scores (as originally proposed by Roy (1952)).

Bank performance: Following Hackethal, Rauch, Steffen and Tyrell (2010), I include a set of similar indicators, such as operating income (before taxes and exceptional profits or losses), but also commonly used indicators to proxy bank performance, such as dividends paid over equity, loan growth, Jensen's excess return (as originally proposed by Jensen (1968)) and the market price of the bank shares.

2.3.2.2 Environmental factors include the following.

Two environmental factors have been identified: (1) institutional regulatory framework and (2) macro-economic factors.

Institutional regulatory framework: As argued by Berger, Bouwman, Kick and Schaeck (2011), the supervisory regime can affect bank risk taking. To control this effect, and because regulations in this regard vary across countries and over time, I have created a supervisory index similar to that used by Shehzad, de Haan and Scholtens (2010). However, the World Bank's 2007 Regulation and Supervisory Database (Barth, Caprio and Levine (2008)) has been maintained over a relatively short period of time. For this reason, the index has been drawn from two sources and calculated for four periods corresponding to the following: (1) before Basel I, (2) from Basel I to II, (3) from Basel II to III and (4) since Basel III. For the before Basel I period, I follow La Porta, Lopez-De-Silanes, Shleifer and Vishny (1997), who established legal zones for measuring the effect of the legal environment on capital market development. To measure the effect of the legal environment on liquidity creation, I use a similar mapping exercise whereby a grade is used to represent the level of property rights protection (0 to 4, corresponding to "not protective" to "most protective"). Second, the regulatory environment mapping of banks is adapted from Barth, Caprio and Levine (2008)); Barth, Caprio Jr and Levine (2001) for the last three periods corresponding to

the Basel regulatory framework deployment (Barth, Caprio and Levine (2008). This summary averages out capital stringency and capital activity and restrictions for each period. When banks are subjected to high levels of scrutiny from regulatory agencies, they tend to lower their risk exposure while managing their liquidity needs more efficiently. The relationship between tight supervisory control and bank risk-taking behavior is expected to be negative. A decrease in risk implies that less liquidity destruction is present, and this in turn contributes to liquidity creation. Thus, a positive regulatory framework coefficient is predicted with regard to liquidity creation.

Macroeconomic factors: Following Imbierowicz and Rauch (2014), Hackethal, Rauch, Steffen and Tyrell (2010) and Lei and Song (2013), I include GDP and the unemployment rate. Government monetary policy effects are also considered in this paper and are supported by two traits. As Bernanke and Gertler (1995) established, a relatively low government-set interest rate encourages credit supply. Furthermore, Hackethal, Rauch, Steffen and Tyrell (2010) established the close relationship between liquidity and risk transformation. A relaxed monetary policy ends by positively increasing bank liquidity and risk transformation capabilities. The relationship between monetary policy and liquidity creation is thus in opposition in that a decrease in the interest rate is expected to increase liquidity creation. Because the money supply is typically ensured by the government interest rate, in this paper, the 10-year government bond rate and the LT-ST spread are used to assess the effect of a country's monetary policy on liquidity creation in the banking sector. The use of this metric is justified by the sensitivity of bank lending/borrowing to this maturity yield and by the effect of the ST-LT spread structure on a bank's profit margin (Bernanke, Gertler and Gilchrist (1999)). In addition, to control for the "interbank liquidity shock effect," I follow Cornett, McNutt, Strahan and Tehranian (2011) and for each country use the TED

spread indicator, which is the spread between interbank loans and government bonds with maturities of 3 months or thereabouts. Other macroeconomic metrics are also utilized: GDP growth and the unemployment rate, which assumes that a positive economic context encourages investment, which in turn triggers loan demand. To control for market competition and following Lei and Song (2013), I include the bank-level Herfindahl market competition index (HHI). Based on the loan market share for each country where bank headquarters are located, this variable proxies for market concentration. As shown by Beck, Demirguc-Kunt and Maksimovic (2004), market concentration impacts the availability of credit and therefore may affect liquidity creation.

The tables below summarize the determinants for estimating liquidity creation and how they have been computed.

Insert Tables 17 and 18.

2.4 Methodology used to estimate liquidity creation

Based on three approaches, this section describes the proxies to estimate liquidity creation and compares the liquidity measures with those utilized by their authors, to check for their correctness.

Note that the dataset is composed of variables extracted from a Thomson Reuters database and they do not correspond fully with those used by the authors. Because Thomson Reuters defines assets and liabilities according to their accounting classification, information on customer types and off balance sheets are non-existent. Thus, I adopted the following three measures:

- Liquidity transformation (LT) gap as established by Deep and Schaefer (2004), calculated as (liquid liabilities minus liquid assets) / total assets. In this article, this measure is abbreviated as "**LTGap**".
- Gross liquidity creation measure (LGM) as established by Fungáčová, Weill and Zhou (2010). A simple measure that classifies all loans as illiquid and all deposits as liquid. In this article, this measure is abbreviated as "**LGM**".
- BB-MatNonFat as established by Berger and Bouwman (2009). This measure calculates liquidity creation using a 3-step procedure: it first classifies bank activities as liquid / semi-liquid / illiquid using information on both product category and maturity of each activity, except that for loans only maturity information is used (due to data limitations); it then applies a weighting scheme to these activities; finally, it calculates the dollar amount of liquidity created by an individual bank by multiplying the dollar amounts in the different buckets by the weights and summing the weighted amounts. In this article, this measure is abbreviated as "**BB-MatNonFat**", where Mat means that the balance sheet items have categorized by maturity and NonFat means that the off balance sheet is excluded because of Thomson Reuter's limitations that do not have these data.

Because of Thomson Reuters' limitations on maturity, I followed Distinguin, Roulet and Tarazi (2013) to compute the liquidity measures. As a result, for US banks, the deposits were weighted at 33%, whereas for other banks, they were weighted at 80%. The net loans are all weighted at 85%. All amounts were deflated by the IMF inflation index (base 2005). The table below shows how these three measures were proxied and presents the Thomson Reuters items that were used to compute them. Notice that the time-series data are inflation adjusted

(base 2005) from the IMF inflation index for each country and are counter evaluated in US$ at the IMF foreign exchange rate for each end of calendar year.

Insert Table 19.

Overall, these liquidity creation measures are consistent with those utilized by the works described above, although the dataset established herein helps to construct metrics for a larger range of countries and for a longer period of time.

Insert Table 20.

For a similar period (1997-2001) and US banks, the LT gap computed with the protocol aforementioned has a mean of 0.17, a median of 0.19 and a standard deviation of 0.08, whereas the same metric computed by the authors Deep and Schaefer (2004) records a mean of 0.20, a median of 0.19 and a standard deviation of 0.16. The difference of the standard is due to the fact that the authors of the LT Gap used quarterly data, whereas I used annual data.

For a similar period (1993-2003) and US banks, the **Mat**NonFat measure computed with the aforementioned protocol has a mean of 0.25 in 1993 and of 0.27 in 2003, whereas the **Cat**NonFat[9] measure computed by the authors Berger and Bouwman (2009) record 0.22 and 0.26 respectively. Note that the authors do show only means of CatNonFat measures, making it difficult to conduct a strict comparison. Median and standard were not indicated in their article.

[9] Where **Mat** means that the balance sheet items have categorized by maturity, whereas **Cat** means that the balance sheet have been categorized by category of products; **Fat** means that the off balance sheet is included, whereas **NonFat** means that the off balance sheet data are excluded.

For a similar period (1997-2006) and for German banks, the **Mat**NonFat and the LT Gap record a mean of 0.29 and 0.14 respectively, whereas **Cat**NonFat and the LTGap computed by the authors Hackethal, Rauch, Steffen and Tyrell (2010) record 0.18 and 0.14 respectively. Median and standard were not indicated in their article.

For a similar period (1988-2008) and for Chinese banks, the **Mat**NonFat measure computed with the aforementioned protocol has a mean of 0.38, whereas the same metric computed by the authors Lei and Song (2013) record a mean of 0.28. Median and standard were not indicated in their article.

The liquidity creation over assets is then computed as follow:

Equation 6

$$LC/A = \frac{\begin{array}{c}[0.5 * \text{illiquid assets} \\ + \\ 0 * \text{semi liquid assets} \\ - \\ 0.5 * \text{liquid assets} \\ + \\ 0.5 * \text{liquid liabilities} \\ + \\ 0 * \text{semi liquid liabilities} \\ - \\ 0.5 * \text{illiquid liabilities }]\end{array}}{\text{Total assets}}$$

2.5 Evolution of liquidity creation over a 34-year period

This section analyses liquidity creation. I first briefly describe the bank sample and the database; the second part analyses bank liquidity creation. To explore differences between the two metrics, I begin by comparing the three liquidity creation measures reported over

assets. The second section presents liquidity creation levels valued in billions of US dollars per year and per geographic zone, and the final section compares the evolution of liquidity creation and risk to the equity level for each period. The following four periods are examined: (1) before Basel I (1981-1988), (2) from Basel I to II (1989-2007), (3) from Basel II to III (2008-2010) and (4) since Basel III (2011 to date). My use of these periods is intuitive and is justified by the effect of the institutional and regulatory framework that surrounds banking activity, thus legitimizing my examination of the evolution of banking liquidity creation based on this timeframe.

2.5.1 Bank sample

This section begins with a short description of the data sources and of the panel representativeness.

Thomson Reuters referential data have the advantage of providing a somehow homogeneous set of information, making it possible to create a database of banks with common items and for a long period of time. To avoid double counting various banks that fall under the same group, I have carefully selected unique bank values and excluded their subsidiaries or branches. As shown by Cetorelli and Goldberg (2012), banking groups tend to establish internal capital markets, and this may skew overall measures of liquidity creation. Banks selected in the Thomson Reuters database correspond to those classified in ICB industry sector 800 as "Banks providing a broad range of financial services, including retail banking, loans and money transmissions," which may aggregate different lines of business corresponding to various banking activities (e.g., M&A, commercial banks) or banks with state involvement (partially state-owned banks, fully private banks). As the aforementioned

breakdown was not provided, I followed Imbierowicz and Rauch (2014) and based the bank typologies on three inherent characteristics: bank size, risk level and the level of capital.

The original number of unique listed banks extracted from Thomson Reuters is 940, with the minimum and maximum numbers of years ranging from five to 35. The table below shows a breakdown of the number of banks per geographic zone, country and year, with the highest number of banks (857) recorded in 2010. North American listed banks include 537 US banks and nine Canadian banks, the latter of which represent a minor portion of this geographic zone. A total of 166 Asia-Pacific banks are listed, with Japan, India, Taiwan and China accounting for 84, 36, 20 and 11 listed banks, respectively. A total of 145 are European banks, with Denmark, Switzerland and Norway accounting for 24, 22 and 21 listed banks, respectively.

Because the panel data set is composed uniquely of listed banks, it is dominated by US banks that represent 60% of the number of banks toward the end of the sample period. However, 95 % of the US banks have a small size of less than $10 bln and represent around 15% of the sum of assets of all US banks (figures not displayed). Besides, the coverage of the initial year is rather limited to 60 banks in 1981. This coverage is much improved in 2000 with 687 banks. The results are thus broken down per geographical zones (Asia & Pacific, Europe and North America) per period and types bank (small, medium and large).

Following Berger and Bouwman (2008), I include data from consolidated financial statement of mother companies, which includes the financial statement of branches and subsidiaries but eliminates intragroup activities. By excluding subsidiaries and branches, I avoid double counting the liquidity created by banks and for banks that belong to the same group, which would have inflated the results otherwise. But this exclusion does not obstruct

the results because the panel is sufficiently representative. As can be observed in the table 21 below, the panel dataset indeed covers a substantial fraction of Asia & Pacific, European and US market.

Table 22 shows a breakdown of the number of banks by geographical zone, country and year.

Insert Table 21.

Accounting and market data were extracted from the Thomson Reuters data source on an annual basis for the last 35 years. Foreign exchange rates, GDP growth and the inflation index have been provided by the IMF at closing end of year since 1981.

Although I acknowledge that this dataset is composed of 940[10] listed banks, excluding small banks, the panel is representative enough as shown in the table below, which presents the fraction of the market covered per geographical zone by this panel dataset.

Insert Table 22.

[10] The number of banks varies per year. This variation is attributable to the fact that newly listed banks appear in the Thomson Reuter's database, while merged, delisted or bankrupt banks are omitted.

2.5.2 Descriptive statistics

The first table shows the evolution of the three liquidity creation metrics scaled to the total asset level for each period and geographic zone, thereby making a comparison between them possible.

Insert Table 23.

Table 23 illustrates the evolution of each period and geographic zone for the three liquidity creation measures "LTGap," "LGM" and "BB-MatNonFat" – such as defined in the section "2.4 Methodology used to estimate liquidity creation" – and scaled over assets. Major disparities between the geographic zones can be observed. The cause of such disparities is also due to different factors that compose the structural environment of the banks. In terms of liquidity creation, the APAC region has created most. Triggered by a strong GDP growth, which itself is linked to the low economic starting point of the different countries in this region, such increase is not surprising. This region has also benefited of less compelling regulatory framework, enabling the banks in this region to allocate their resource on illiquid assets, and hence finance the economic growth. Developed countries have a higher starting point, in terms of economic development. Therefore, the liquidity created in North America and Europe is lower than in APAC region. But US banks have enjoyed a common currency on their market, whereas European banks had to face different monetary policies until the euro currency was implemented in 2000. Additionally, the heterogeneous regulatory framework in Europe has complicated the story for the banks, until the implementation of Basel III. The budget crisis mainly triggered by Greece in 2010 has brought to light the necessity for the European countries to converge their budget, legal and fiscal frameworks. The recent vote for Brexit in UK may accelerate this convergence. The sections below show these differences.

For LTGap (column 4). In the Asia-Pacific region, liquidity creation ratios decreased from 48% to 44% between 1981 and 2014, with a peak of 50% occurring during the period 1991-2000, which corresponds to the economic boom of the APAC zone. For Europe and North America, liquidity creation ratios increased steadily from 16% to 26% and from 14% to 22%, respectively, between 1981 and 2014. Median values follow the same trend.

For LGM (column 7). In the Asia-Pacific region, this measure decreased from 57% to 50%, with a peak of 59% occurring during the period 1991-2000. For Europe, this measure decreased from 45% to 41%, with a peak of 45% occurring during the period 1991-2000. For North America, the measure remained relatively stable at 36%, with a peak of 39% occurring during the period 2001-2010. The median follows the same trend.

For BB-MatNonFat (column 11). In the Asia-Pacific region, this measure decreased from 51% to 46%, with a peak of 53% occurring during the period 1991-2000. In Europe, the measure increased from 33% to 37% between 1981-1990 and 1991-2000 and then steadily decreased to 34% until the period 2011-2014. For North America, the measure remained relatively stable at approximately 29%.

These findings show that liquidity creation varies significantly across countries and over time. The figure below illustrates the evolution of liquidity creation for each year and geographic zone as established by the LGM and BB-MatNonFat measures. Values are expressed in US$ billion, counter valued at the end-of-year IMF foreign exchange rate and deflated based on the IMF inflation index (base 2005).

Insert Figure 1.

For the Asia-Pacific region (data not reported but indicated in Figure 1), liquidity creation steadily increased from $153bln to $1 873bln and from $116 to $1 570bln between 1981 and 1999 for the LGM and BB-MatNonFat measures, respectively. In 2000, with the onset of the Asian Financial crisis, liquidity creation declined and fell to $1 542bln and $1 293bln for the LGM and BB-MatNonFat measures, respectively. Between 2001 and 2012, liquidity creation dramatically increased from $2 345bln and $2 030bln to $7 364bln and $6 411bln for the LGM and BB-MatNonFat measures, respectively. These values started to decline in 2013 and 2014, falling to $6 780bln and $5 728bln for the LGM and BB-MatNonFat measures, respectively. Over this period, liquidity creation levels increased 44- and 49-fold for the LGM and BB-MatNonFat measures, respectively.

In Europe (data not reported but indicated in Figure 1), liquidity creation between 1981 and 2004 increased steadily from $775bln and $632bln to $4 244bln and $2 928bln for the LGM and BB-MatNonFat measures, respectively. However, in 2005-2006, liquidity creation suddenly decreased to $3 143bln and $1 622bln. This diminution occurred as a result of the conjunction of two main factors. First, the EUR/USD rate reached a historical low of 1.16 in December of 2005. The rejection of a referendum on the EC Constitution by France and the Netherlands, the suspension of the UK's entry into the euro zone and the increase of 200 basis points to the FED funds rate may explain this rate variance. Second, French banks hoarded a substantial amount of cash and assimilated in 2005; between 2004 and 2005, cash and assimilated holdings increased from €572bln to €1 610bln (not shown in the tables). This substantial increase in liquid assets on the balance sheets of the French banks caused a sudden upsurge in liquidity destruction, and both the effect of the exchange rate and the relative increase in liquidity destruction largely explain the overall decline in liquidity creation in

Europe in 2005-2006. Between 2007 and 2012, liquidity creation varied from $5 015bln and $2 511bln to $6 243bln and $3 584bln for the LGM and BB-MatNonFat measures, respectively. Between 2013 and 2014, signals of financial recovery appeared to be somehow present with increases to $6 104bln and $3 842bln in 2013, but decreases to $5 162bln and $3 176bln in 2015 for the LGM and BB-MatNonFat measures, respectively. Over this period, liquidity creation multiplied seven- and five-fold for the LGM and BB-MatNonFat measures, respectively.

In North America (data not reported but indicated in Figure 1), between 1981 and 1997, liquidity creation steadily increased from $485bln and $436bln to $1 051bln and $788bln for the LGM and BB-MatNonFat measures, respectively. Between 1998 and 2013, this steady increase accelerated from $1 341bln and $1 010bln to $3 324bln and $2 394bln for the LGM and BB-MatNonFat measures, respectively. In 2014, liquidity creation declined to $3 250bln and $2 329.bln for the LGM and BB-MatNonFat measures, respectively. Over this period, liquidity creation levels multiplied seven- and five-fold for the LGM and BB-MatNonFat measures, respectively.

The next table compares the evolution of liquidity creation to the level of capital and risk over four periods: (1) before Basel I (1981-1988), (2) from Basel I to II (1989-2007), (3) from Basel II to III (2008-2010) and (4) since Basel III (2011-present).

Insert Table 24.

While an increase in equity levels is observable across all regions, this was not followed by a significant decrease in the standard deviation of RoE. In the Asia-Pacific

region, from 1981-1988 to 1989-2007, the std. dev. of RoE increased from 2% to 24%. From 2008-2010 to 2011-2014, this measure sharply decreased from 8% to 6%. In Europe, from 1981-1988 to 2011-2014, the std. dev. of RoE steadily increased from 7% to 14%. In North America, between 1981-1988 and 1989-2007, the std. dev. of RoE remained stable at 5%. From 2008-2010 to 2011-2014, this variable increased from 11 to 13%.

The median values follow the same trends, though these are again not reported for the sake of brevity. It can be concluded that an increase in equity may reduce liquidity creation, but this is not necessarily accompanied by better risk performance.

The following section examines the determinants of liquidity creation and presents a sensitivity analysis of the effect of marginal increases in equity levels on liquidity creation and risk performance.

2.6 Econometric model

This section presents the results of the regression model that computes the determinants of liquidity creation. To establish a profile of banks that generate liquidity following Pagano, Röell and Zechner (2002) approach for predicting the probability of a European company listing abroad, a Cox regression is also used. This section concludes with a sensitivity analysis that compares the marginal effect of an increase in capital levels on both liquidity creation and risk diminution measures.

2.6.1 Determinants of liquidity creation

Following Berger and Bouwman (2009) and Imbierowicz and Rauch (2014), to address endogeneity issues, I have constructed a model for estimating a multivariate dynamic panel model using a GMM[11]estimator ((Arellano and Bover (1995); Berger and Bouwman (2009) and Imbierowicz and Rauch (2014); Distinguin, Roulet and Tarazi (2013)).

This model can be notated as follows:

Equation 7

$$Eq1: \text{Liquidity created over assets}_{i,t} = \beta 0 + \beta 18\ \text{Liquidity created over assets}_{i,t-1} +$$

[11] Usually attributed to Hansen, Lars Peter, 1982, Large sample properties of generalized method of moments estimators, *Econometrica* 1029-1054., the GMM is the most appropriate tool for controlling unobserved effects, with regards to liquidity created by banks. First, the liquidity created at time t-1 may have an autoregressive effect. The autoregressive effect can be intuitively attributed to traditional banking model contributions to the stable structure of commercial banks: When a loan is granted to a customer, it is typically allocated for a number of years. The customer may repatriate extra resources that are deposited and may open a current account, which may in turn be used to finance new loans for the same customer or for other customers. Second, Hansen showed that every instrumental variables estimator, in nonlinear or linear models, with cross-section, panel data or time series, could be conceived as a GMM estimator. Considered as a unifying framework for inference in econometrics, this estimation has the advantage of being robust to the distribution of errors, and it is considered more efficient than 2SLS (Hall, Alastair R, 2005. *Generalized method of moments* (Oxford University Press Oxford). Most commonly tool used when there is endogeneity threat between the dependent variables, the GMM instruments them with a lagged dependent variable. In this article, the independent variables act as control variables, with regards to liquidity created at t+1. Also, at lag 2, the GMM coefficient measures the degree of mean reversion and thus (1-λ) is interpreted as the coefficient of persistence of the explicative variable Yt-1 for each bank. Refer to proof of evidence in article 1 “Why do banks hold cash?”, equation 4 on how to interpret the lag 2 coefficient 1-λ.

$$\beta 1\ Bank\ size_{i,t} + \beta 2\ Std.\ dev.\ RoE_{i,t} + \beta 3\ Equity\ scaled\ over\ asset_{i,t} + \beta 4\ Non\ performing\ loans\ over\ loans_{i,t} + \beta 5\ Z\text{-}score_{i,t} + \beta 6\ cash\ dividend\ paid\ over\ shareholder's\ equity_{i,t} + \beta 7\ Loan\ growth_{i,t} + \beta 8\ Jensen's\ excess\ return_{i,t} + \beta 9\ Operating\ income\ over\ assets_{i,t} + \beta 10\ Market\ value\ per\ share_{i,t} + \beta 11\ 10\text{-}years\ bond\ yield_{j,t} + \beta 12\ Institutional\ regulatory\ framework_{j,t} + \beta 13\ GDP\ growth_{j,t} + \beta 14\ HHI\ market\ concentration\ index_{j,t} + \beta 15\ LT\text{-}ST\ yield\ curve\ spread_{j,t} + \beta 16\ Unemployment\ rate_{j,t} + \beta 17\ Interbank\ liquidity\ shock\ TED_{j,t} + \mu$$

where the variables are those discussed in the first (literature review) section and listed in Table 1.

In addition to the GMM models, OLS regressions were conducted using the standard robust approach and by clustering banks to control for heteroskedasticity. For the omitted variables, a time-fixed effect test was conducted to check for average variances in liquidity creation across years that would not be accounted for by the former exogenous variables and to diminish serial correlation threats. In addition, the regression models were tested to ensure that no collinearity or size effects were present. They show p-values of less than 0.001 with Eta² or Omega² values of less than 0.4. Student tests show p-values of less than 0.001. A correlation matrix is displayed in the table below.

Insert Table 25.

The results of the GMM and OLS regressions are shown in the tables below. Given the correlations with the z-score and the std. dev. of RoE or operating income, the results are first presented without the z-scores but with the std. dev. of RoE or operating income and second with the z-scores but without the std. dev. of RoE or operating income.

Insert Tables 26, 27 and 28.

The results of the GMM estimators for the European banks are remarkably similar to those presented by Hackethal, Rauch, Steffen and Tyrell (2010), although their study focused only on German banks during the period 1997-2006. For instance, they found that the liquidity creation estimator at the 2nd correlation had a coefficient of 0.842*** and of 0.938*** for the LTGap and BB (not indicated whether MatNonFat or CatNonFat), respectively, whereas I found European peers coefficients of 0.910*** and 0.906*** for the LTGap and BBMatNonFat, respectively. The results for other countries are also similar to these coefficients, with 0.864*** and 0.809*** found for LTGap values and with 0.910*** and 0.878*** found for BBMatNonFat values for the Asia-Pacific region and North America, respectively (table 26, columns 6-8). Overall, this indicates that liquidity created at time *t-1* has an autoregressive effect. The autoregressive effect can be intuitively attributed to traditional banking model contributions to the stable structure of commercial banks: When a loan is granted to a customer, it is typically allocated for a number of years. The customer may repatriate extra resources that are deposited and may open a current account, which may in turn be used to finance new loans for the same customer or for other customers. However, this autoregressive effect remains relatively low and below 0.5 for all regions (i.e., 1-0.910 and 1-0.906 for LTGap and BBMatNonFat of European banks, respectively)[12]. It results that this autoregressive effect is not sufficient to harm the OLS specification. Table 28 shows the coefficient of the other variables for the standard OLS. Monetary policy plays a significant role in liquidity creation. The 10-year bond yield significantly affects the LTGap, with expected negative coefficients of -1.256***, -0.619*** and -0.815*** found for the Asia-Pacific region, Europe and North America, respectively (table 28, columns 4, 6 and 8). The

[12] At lag 2, the GMM coefficient measures the degree of mean reversion and thus (1-λ) is interpreted as the coefficient of persistence of the explicative variable Y_{t-1} for each bank.

unemployment rate, always significant, also affects negatively the liquidity creation. This confirms that an increase in economic activity results in investment growth, which in turn triggers loan demand. Bank size and equity levels both play a negative and significant role. These results confirm the views of Gorton and Winton (2000) and Diamond and Rajan (2001), according to which higher capital diminishes liquidity creation, i.e., the larger the size of the bank, the lower the probability of liquidity creation. As larger banks enjoy broader access to national and international markets, they may finance their loans through indebtedness rather than by collecting deposits. Conversely, small banks may tend to prefer collecting deposits in order to fund loans. Finally, the results reported in both the OLS and fixed effects estimator, which tests for variance between countries, show that bank size and equity level coefficients are not affected by fixed effects biases, confirming that the econometric model presented generates accurate estimates. The descriptive statistics and econometric model provide some evidence of a relationship between equity levels and banking liquidity creation. However, to compare the explanatory power of the competing hypotheses and eliminate spurious correlations, I employ a duration analysis to determine which specific bank characteristics predict the variation in liquidity creation.

2.6.2 Bank typologies that generate more liquidity per geographic zone

This section describes the bank profiles that generate more liquidity than others based on the Cox regression. Though typically used for survival analysis, I use the Cox proportional hazard model because it is suited to the prediction of events in a panel setting, hence to the estimation of distances to liquidity creation. This model reports the hazard rate

h(t) (that is, the probability of creating liquidity at time *t* conditional on not creating liquidity) for a set of explicative variables:

Equation 8

$$h(t) = h_0(t) \exp(X'\beta)$$

where $h_0(t)$ is the baseline hazard rate at time t for the covariate vector set at 0 and β is a vector coefficient. The Cox hazard regression is a semi-parametric model, which does not require assumptions about the baseline hazard. The table below presents the exponentiated coefficients *((exp(β1), exp (β2),…)* rather than the coefficients *(β1, β2,…)*. Exponentiated coefficients can be interpreted as the effect of a unit change in the explanatory variable on the hazard ratio $h(t) = h_0(t)$. For instance, a coefficient of 1.098 implies that a unit change in the dependent variable increases the relative hazard by 9.8 percent.

To achieve this goal, I created a survivor function that corresponds with the derivative of the three following liquidity creation measures: LTGap, LGM and BB-MatNonFat. Note that the measures are deflated values drawn from the IMF inflation index (base 2005) for each country. If the function is negative (i.e., if liquidity creation over assets decreases over two reporting years), it is considered a failure. If the function is positive (i.e., if liquidity creation over assets increases over two reporting years), it is considered a success. The table below shows the results and the hazard ratio for specific bank characteristics, bank sizes, risk levels and equity levels. These explicative variables have been layered to satisfy the proportional-hazards assumption. For risk levels, the stratification corresponds to the quintile, where IStratSDRoE_2 corresponds to q1 (less than or equal to 25%); IStratSDRoE_3 corresponds to q2 (less than or equal to 50%) and IStratSDRoE_4 corresponds to q3 (less than or equal to 75%). In regards to bank size, small banks are those with total assets of less than

$US 50bln; medium banks are those with total assets of more than or equal to $US 50bln and of less than $US 250bln; and large banks are those with total assets of more than or equal to $US 250bln. Note that the total asset values have been deflated based on the IMF index inflation rate for each country (base 2005) and then counter revaluated at each end-of-year US$ IMF foreign exchange rate. For level of equity, stratification values vary from 0% ("_IStratEqoA_0") to 17.5% ("_IStratEqoA_5") with a regular increase of 2.5bp with each step. Overall, the Wilcoxon tests for the equality of survivor functions for the three liquidity measures generate a $p(\chi^2)$ of less than 0.000, demonstrating that the hypothesis of survivor function equality is not rejected. As the Wilcoxon test gives more weight to tables at earlier failure times, this test is preferred to the log-rank test when hazard functions are believed to vary in ways other than proportionally; this is a reasonable assumption given that this paper focuses on liquidity creation over a period of 35 years.

Insert Table 29.

Although level of risk, bank size and level of equity have a large impact on banking liquidity creation, the effects vary among the three factors. The results indicate that for the transformation from liquid liabilities to illiquid assets, the liquidity that generates liquidity creation is closely linked to risk. The hazard ratio estimated shows a regular increase when the std. dev. of RoE moves to a higher quintile.

For instance, the estimate decreases but with negative coefficients from -0.249***, -0.406***, .0568*** for the LTGap and LGM, respectively, in the Asia-Pacific region (column 4) when the std. dev. of RoE changes from q1 to q3. However, for Europe, the coefficients are not significant to extrapolate the effects of increase of risk on banking

liquidity creation with regard to the semi parametric regression method. However, in North America, an increase in risk level is followed by a decrease in the estimate. The coefficients steadily decreases with negative coefficients from -0.176 *** to -0.578*** for the LTGap when the std. dev. of RoE changes from q1 to q3. Only the LTGap shows significant coefficients for all regions and for the risk level criteria. The results suggest that Asia-Pacific and North American banks tend to generate liquidity for less risky projects than those of their European counterparts.

Bank size plays a role in the Asia-Pacific region and in Europe but does not significantly affect the liquidity creation process in North America. For the Asia-Pacific region, when the bank size increases, the hazard ratio decreases as well. The estimate decreases from 0.556*** to 0.464** between small and medium banks for the LTGap (column 4). For Europe, the opposite is observed. The estimate increases from 0.313*** to 0.575*** for the LTGap (column 7). A similar comparison for North America is not possible given the absence of highly significant coefficients, and thus, over a long period of time, there is no clear evidence for the real effect of bank size on liquidity creation.

The effect of equity level increases also exhibits heterogeneous evolutions between regions and across liquidity creation measures. For the Asia-Pacific region, between Equity level 1 (5-7.5%) and Equity level 3 (10%-12.5%), the estimates decrease with negative coefficients from -1.357*** to -1.496*** for the LTGap (column 4). The estimates decrease from -1.786*** to -1.818*** between Equity level 1 (5-7.5%) and Equity level 2 (7.5-10%) and increase to -1.416*** at Equity level 3 (10-12.5%) for the BB-MatNonFat (column 6). There is strong evidence that for this region, regular equity increases are accompanied by liquidity creation decline.

For Europe, the LGM (column 8) and BB-MatNonFat (column 9) provide significant coefficients, enabling comparisons with different equity levels. For LGM (column 8), between Equity level 1 (5-7.5%) and Equity level 2 (7.5-10%), estimates decrease from -0.838*** to -0.871*** but increase to -0.592* at Equity level 3 (10-12.5%). For BB-MatNonFat (column 9) between Equity level 1 (5-7.5%) and Equity level 2 (7.5-10%), estimates decrease from -0.566*** to -0.613** but increase to 0.450** at Equity level 3 (10-12.5%).

For North America, the estimates follow very different patterns depending on the liquidity creation measure. Between Equity level 1 (5-7.5%) and Equity level 3 (10-12.5%), this value decreases from 0.212** to -0.31*** and then increases to -0.29*** at Equity level 4 (12.5-15%) and decreases to-0.360** at Equity level 5 (15-17.5%) for the LTGap (column 10). Between Equity level 2 (7.5-10%) and Equity level 4 (12.5-15%), the estimates decrease steadily from -0.351*** to -0.508*** and increase to -0.340** at Equity level 5 (15-17.5%) for the LGM (column 11). Between Equity level 2 (7.5-10%) and Equity level 4 (12.5-15%), the estimates decrease steadily from -0.463*** to -0.612*** and increase to -0.548*** at Equity level 5 (15-17.5%) for the BB-MatNonFat (column 12).

These results may also leave the real effects of equity level increases on liquidity creation measures unclear. However, it can be observed that between Equity level 1 (5-7.5%) and Equity level 2 (7.5-10%), the hazard ratio tends to decrease for all liquidity creation measures and regions, indicating that liquidity creation risks tend to increase in parallel with equity level increases. However, the results strongly suggest that optimality effects are important: Beyond a certain point, the variation in liquidity creation may change, suggesting that liquidity creation is subject to marginal effects. To further this analysis, I have conducted

a sensitivity analysis of the effects of a marginal increase in equity levels on liquidity creation and risk performance for each region.

2.6.3 Sensitivity analysis

This section presents the results of the marginal effect that a change on a regressor has on those quantities computed and after estimation. As a convenient way used in understanding the response of supply and demand in a market, the elasticity analysis enables to observe the effect of changing level of equity on level of risk vs. liquidity creation, hence to determine if the "risk absorption hypothesis prevails to the "crowding out hypothesis". This model reports the marginal effect of an increase of level of equity over the risk (i.e. Std Dev of RoE, z-score) and liquidity creation (i.e. LTGap, LGM, BB-MatNOnFat) measures, hence to compare these effects.

The figure below shows the sensitivity analysis for the LTGap, LGM and BB-MatNonFat measures and for the std dev. of RoE and z-score risk performance measures for a regular increase in equity level from 4% to 16%. The data are presented within the figures. All of the data have p(t) values of less than 0.000 (not reported for purposes of brevity).

Insert Figure 2.

The sensitivity analysis shows that over the study period, an increase in equity levels is accompanied by a decrease in liquidity creation levels. For the Asia-Pacific region and North America, an increase in equity levels is regularly accompanied by higher declines in liquidity creation measures than declines in risk. For Europe, only the LGM is less affected

and shows lower declines than risk. The other liquidity creation measures follow an identical trend to those of the Asia-Pacific region and North America.

Each 2bp increase in the level of equity is followed by a regular decrease in liquidity creation and by a slower decrease in the std dev. of the RoE, z-score and non-performing loan ratio. The diminution of non-performance is not reported, as it has a P(t) of more than 5% and can thus be ignored. Nevertheless, these findings demonstrate that a marginal increase in the level of equity has at best a relatively neutral impact on both liquidity creation and risk reduction. At worst, it reduces liquidity creation more than it reduces risk performance. Strikingly, the decrease of liquidity creation is a curve for Asia & Pacific region, whereas it has a form of a slope or Europe and North America, suggesting that this marginal effect is higher for Asia & Pacific banks. In addition, I have compared the trends of the slopes of liquidity vs. risk. The findings show that for increase of equity over assets from 4% to 16%

- For Asian & Pacific banks, the slopes of LTGap, LGM and BB-MatNonFat measures are of-0.89, -0.49 and -0.63, respectively, whereas the slope of the risk (RoE) is of -0.02 (not reported for purposes of brevity).
- For European banks the slopes of LTGap, LGM and BB-MatNonFat measures are of -0.0003, -0.0414 and -0.0097, respectively, whereas the slope of the risk (RoE) is of -0.0020 (not reported for purposes of brevity).
- NAR the slopes of LTGap, LGM and BB-MatNonFat measures are of -0.06, -0.10 and -0.15, respectively, whereas the slope of the risk (RoE) is of -0.05 (not reported for purposes of brevity).

This sensitivity analysis demonstrates that the liquidity creation decreases more that the risks for Asian & Pacific and North American banks suggesting that over a long period of time, the "financial fragility-crowding out hypothesis" prevails for these banks. However, the liquidity tends to decrease less that the risk for European banks, suggesting that over a long period of time, the "risk absorption" hypothesis prevails for these banks.

To summarize the findings that can be extrapolated from the standard and Cox regressions and from the sensitivity analysis carried out in this section, banks with lower equity and that take more risks, create more liquidity. These outcomes confirm that over a long period of time, the negative effect of high levels of equity that Gorton and Winton (2000) and Diamond and Rajan (2001) indicated for. Within a context of scarce resources, the allocation of liquid liabilities to illiquid liabilities mechanically increases liquidity destruction. These results complement those of Fungáčová, Weill and Zhou (2010); Horváth, Seidler and Weill (2014) and Lei and Song (2013), who show that more stringent bank capital requirements implemented to support financial stability among Russian, Czech and Chinese banks, respectively, have harmed liquidity creation. This effect is however more pronounced for Asian & Pacific and North American banks than their European peers. The heterogeneity of the banking regulation and the implementation of Basel I and II, is a factor explaining potentially this difference.

The finding that bank size plays a significant role in liquidity creation processes also echoes the results of previous studies. Two main factors may oblige larger banks to hold more liquid assets than their smaller counterparts: first, as documented by Allen and Gale (2000), idiosyncratic and systemic risk are closely related. Given the high volumetric nature of payments, the larger the bank, the more likely it is to hold cash to avoid internal cash-in and outflow shocks. Second, larger banks hold cash not only for idiosyncratic constraint reasons

but also to establish an internal market (see Houston, James and Marcus (1997)). Banks may also hold cash for other reasons, as explored in the first article. However, the effect is not necessarily negative; it may also play a positive role, in particular for European banks.

2.7 Conclusions

This study yields results with respect to three factors. First, it is the only cross-national, empirical study that documents bank liquidity creation over a period of 35 years. Second, over this period, bank liquidity creation has increased from $1 413bln and $1 185bln to $15 194bln and $11 234bln for the LGM and BB-MatNonFat measures, respectively. This pattern may vary across regions; for example, liquidity creation increases in Asia and Europe have multiplied 44- and 49-fold for the LGM and BB-MatNonFat measures, respectively, although those measures for Europe and North America have increased seven- and five-fold for the LGM and BB-MatNonFat measures, respectively. Third, this study shows that liquidity creation is not only determined by monetary policy, macro-economic environment, but also by endogenous factors of banks such as bank size, equity levels and risk performances.

The results may have implications in regards to policy issues, particularly pertaining to banking regulations and transmission of monetary policy. The results of this study highlight that an increase in equity levels has two consequences. The first is positive, i.e., risk reduction, and the second is negative and involves a decline in liquidity creation. The results indicate that at best, the positive effects are equal to the negative effects; at worst, risk reduction is lower than the decline in liquidity creation. This overall negative effect of an increase in the level of equity may present medium- and long-term consequences for banking

industry of Asia & Pacific and North America. This sensitivity analysis demonstrates that the liquidity creation decreases more that the risks for Asian & Pacific and North American banks suggesting that over a long period of time, the "financial fragility-crowding out hypothesis" prevails for these banks. However, the liquidity tends to decrease less that the risk for European banks, suggesting that over a long period of time, the "risk absorption" hypothesis prevails for these banks. This finding ultimately poses the question the effect of inappropriate regulations (Morris and Shin (2004)). In a context of homogenization of the banking regulation, in particular with Basel III deployment, further study on the effect of this new regulatory framework on banking liquidity creation could be useful. Finally, the results suggest that to reduce inefficiencies of monetary policy transmission, the conventional "bank lending channel" needs to be completed with a model that would include bank specific factors such as bank size, capital structure (Van den Heuvel (2002); (Shehzad, de Haan and Scholtens (2010))) and risk performances.

2.8 Tables and figures

Table 17: Summary of variables (part 1)

The table below lists the explained and explicative variables, including the control variables used for the robustness tests in the regression model established herein. The first column lists the typology of the variable; the second lists the variable name; the third lists the shorthand variable name used in the GMM, OLS and Cox regressions; the fourth indicates whether a variable was scaled; the fifth lists the expected relationship to liquidity creation and the last column shows how the variable was computed.

Variable typology	Variable name	Variable name in the OLS	Tukey' scale type	Predictive sign	How this variable is computed and Thomson Reuters definitions
Liquidity creation variable 1	LTGap	Y1LTGap at t and t+1 (for GMM)	NA		LT gap as proposed by Deep and Schaefer (2004). Deflated based on the IMF inflation index (2005=100)
Liquidity creation variable 2	LGM	Y2GLC at t and t+1 (for GMM)	Squaled over assets		Gross Liquidity creation as measured by Fungáčová, Weill and Zhou (2010). Deflated based on the IMF inflation index (2005=100).
Liquidity creation variable 3	BB-MatNonFat	Y3NLC at t and t+1 (for GMM)	Squaled over assets		Liquidity created as measured by the BB-measure, which proxies the "MatNonFat". Deflated based on the IMF inflation index (2005=100)
Bank characteristics	Bank size	X1BkSizeUSD	Log	+	The firm size is measured as follow in this research: Log Total Assets (item WC02999).
Bank risk typology	Standard deviation of returns on assets	X2SdRoe1	Log	+	RoE1 = Operating income (item WC01250) / Shareholder's equities [Total Shareholder's Equity (item WC03995)] If Equity is empty, then calculated as follow : Total Liabilities & Shareholder's Equities (WC03999) - Total Liabilities (WC03351)], Operating income (WC01250) OPERATING INCOME represents the difference between sales and total operating expenses Footnotes: Net of income taxes Shareholder's equities (WC03995) TOTAL SHAREHOLDERS' EQUITY represents the sum of Preferred Stock and Common Shareholders' Equity.
Bank characteristics	Level of equity	X3EQoA	NA	-	Common equities (item WC03501) / Total assets (item WC02999)
Bank risk typology	Credit risk : NPL over Loans	X4NPLoLoans	NA	-	Non Performing loans over loans is the control variable that proxies the risk management. NPLoLoans = Non performing loans (item WC02285) / Loans total (item WC02271).
Bank risk typology	Bank stability risk : z-score	X5Z	Log	+	The z-score as proposed originally by Roy (1952): RoA+ Equity over Asset divided by standard deviation of RoA. This bank risk indicator measures the bank's distance to insolvency. Inversely related to the probability of default, the sign is expected to be positive. - Standard deviation of RoA = Net Income Total (item WC01751) / Total assets (item WC02999). Tthe standard deviation requires at least three observations, is rolling and is computed every year (step of maximum 5 years).
Bank characteristics	Agency : Dividend paid out over shareholders' equity ratio	X6PayShldrsoEq	NA	+	Cash dividends (item WC04551) over Shareholders' equity (item WC03995). Cash dividends (item WC04551) represents the total common and preferred dividends paid to shareholders of the company. It excludes: Dividends paid to minority shareholders Footnotes: A. Included in other sources or uses B. Includes bonuses to directors C. Prior year's proposed dividend Total Shareholder's Equity (item WC03995) represents the sum of Preferred Stock and Common Shareholders' Equity.
Bank performance	Loan growth	X7LnGwth	NA	+	Loan growth is a proxy for bank's growth opportunity. It is the variation of total loans over one reporting year LnGwth : (Loans Total Y of bank i- Loans total Y-1 of bank i) / Loans total Y-1 of bank 1 - [Where Loans total is item WC02271]
Bank performance	Excess Return	X8ExcssR	NA	+	Jense's Excess Return (α) = R(a) – R(f) – Beta(a,m) [R(m) - R(f)] ; beta is the commonly indicator [Cov (a, m) / Variance (m)], where R(a) is the return of market share, R(f) is the return of benchmark government bonds, R(m) is the return of market index m where is listed the bank. Var(x) and Cov (x, y) require at least three observations. Covariances and variances are rolling and computed every year (step of maximum 5 years). Market price = Market value per share (item WC05001).

Table 18: Summary of variables (part 2)

The table below lists the explained and explicative variables, including the control variables used for the robustness tests in the regression model established herein. The first column shows the typology of the variable; the second lists the variable name; the third lists the shorthand variable name used in the GMM, OLS and Cox regressions; the fourth indicates whether a variable was scaled; the fifth lists the expected relationship to liquidity creation and the last column shows how the variable was computed.

Variable typology	Variable name	Variable name in the OLS	Tukey' scale type	Predictive sign	How this variable is computed and Thomson Reuters definitions
Bank performance	Operating income over assets	X9OpIncoA	NA	-	Operating Income (item WC01250) / Total Assets (item WC02999) OPERATING INCOME represents the difference between sales and total operating expenses. It is before extraordinary and tax items.
Bank performance	Market share value	X10MktPrice			Market value per share (item WC05001).
Macro environment	Governement monetary policy. Government 10 years rate : The cash holding creation may depend on the monetary policy of country.	X11Rf	Sqrt	-	The government bond rate of where is located the head quarter of the bank.
Macro environment	Institutional regulatory framework	X12Legal	NA	-	To measure the effect of the legal environment and institutional differences on liquidity creation, an index has been established as follow : (1) before Basel I : I start first from La Porta et al. (1997) who established legal zones to measure the effect of the legal environment on the development of the capital market. To measure the effect of the legal environment on liquidity creation, a similar mapping is utilized in this paper, where a grade is provided to the level of property right protection from 0 to 4 corresponding from not protective to most protective, respectively. (2) from Basel I to II, (3) from Basel II to III, and (4) since Basel III : The regulatory environment mapping of banks is elaborated from Barth et al. (2008); Barth et al. (2001) for the three last periods corresponding respectively to Basel regulatory frameworks deployments. It is a summary that averages the capital stringency as well as capital activity and restrictiveness per periods.
Macro environment	GDP growth per country	X13GDPgwth	NA	+	The GDP growth corresponds to the yearly growth of GDP of the country in which the bank is located. Source : International Monetary Fund, World Economic Outlook Database, October 2014.
Macro environment	Hirshman-Herfindhal Index of market concentration	X14HHI	NA	+	Computed as follow : HHI = Squared [Loan market share = Total (item WC02271) countervalued in KUSD / Total loan (BIS data) in KUSD per country where the bank is located]. Yearly Foreign exchange rate is that of IMF, closing end of year.
Macro environment	Yield curve spread	X15YieldSpread	NA	+	Interest rate spread between 3-months and 10 year government bond. Source : Thomson Reuters.
Macro environment	Unemployment	X16UnmpRate	Sqrt	+	Unemployment rate per country of where the bank is located. Source : IMF.
Interbank liquidity shock	Interbank liquidity shock	X17TED	NA	+	Spread between interbank loan 3 months and free risk rate 3 months. For all countries : yearly average of Interbank loan 3 months - T-bills 3 months. Exceptions : For Japan yearly average of interbank 1M - Gensaki T-bills 1 month. For Australia, yearly average of Interbank O/N - T-Bills 3 month.
Omitted variables	Set of dummies for all but one year. Per bank and country in which the bank is located.	NA	NA	+ / -	Fixed effects : $country_j$, where the bank is located.

Table 19: Items for computing the three liquidity creation measures

The table below identifies the Thomson Reuters items used to proxy the three liquidity creation measures: The liquidity creation measures are the "LTGap" as established by Deep and Schaefer (2004); the liquidity gross creation measure – "LGM" as established by Fungáčová, Weill and Zhou (2010) and the "B-B MatNonFat" measure as established by Berger and Bouwman (2009). The first column displays the liquidity level: liquid, semi-liquid and illiquid. Column 2 displays the asset items, column 3 presents the asset weights, column 4 presents the liability items, and column 5 presents the liability weights for the LTGap. This order is used for the LGM and BB MatNonFat measures. Note that for US banks, deposits were weighted at 33%, whereas for other banks, they were weighted at 80%. The loan net values are weighted at 85%. All amounts were deflated from the IMF inflation index (base 2005).

Liquidity level	LTGap				Liquidity Creation- Gross measure : "LGM"				BB MatNonFat			
	Asset		Liabilities		Asset		Liabilities		Asset		Liabilities	
	Item	Weight	Item	Weight	Item	Weight	Item	Weight	Item	Weight	Item	Weight
1	2	3	4	5	6	7	8	9	10	11	12	13
Liquid	WC02205 - Treasury Securities	-1	WC03019 - Cust Dep	1	WC02205 - Treasury Securities	-0.5	WC03019 - Cust Dep	0.5	WC02205 - Treasury Securities	-0.5	WC03019 - Cust Dep	0.5
	WC02208 - Trading account Securities				WC02208 - Trading account Securities				WC02208 - Trading account Securities			
	WC02004 - Cash and Due from Banks				WC02004 - Cash and Due from Banks				WC02004 - Cash and Due from Banks			
	WC02055 - Interbank Loans				WC02055 - Interbank Loans				WC02055 - Interbank Loans			
Semi liquid	NA	NA	NA	NA	NA	NA	NA	NA	WC02055 - Interbank Loans	0	WC03051 - Total ST debts	0
Illiquid	NA	NA	NA	NA	WC02271 - Loans	0.5	WC03995 - Total Shareholder's Equity	-0.5	WC02271 - Loans	0.5	WC03251 - LT Debts	-0.5
	NA	NA	NA	NA							WC03995 - Total Shareholder's Equity	
Scaled over asset	WC02999 - Total Assets											

Table 20: Liquidity creation measure results compared with those of other articles

The table below compares LTGap and B-B CatNonFat liquidity creation measures for US, German and Chinese banks. Note that I only present the MatNonFat measure, whereas other researchers show only CatNonFat measures, making it difficult to conduct a strict comparison. The differences found are in line with the results of Berger and Bouwman (2009), wherein CatNonFat values are generally lower than MatNonFat values.

	Deep and Schaefer (2004)		Berger and Bouwman (2009)				Hackethal et al. (2010)				Lei and Song (2013)	
	US banks 1997-2001		US banks 1993 - 2003				German banks 1997 - 2006				Chinese banks 1988 - 2008	
	Their article	This article	Their article		This article		Their article		This article		Their article	This article
	Quarter - all periods	Annual - all periods	1993	2003	1993	2003	BB - CatNonFat	LT Gap	BB- MatNonFat	LT Gap	BB - CatNonFat	BB- MatNonFat
1	2	3	4	5	6	7	8	9	10	11	12	13
Mean	0.20	0.17	0.22	0.26	0.25	0.28	0.18	0.14	0.29	0.11	0.28	0.37
Median	0.21	0.18	NA	NA	0.27	0.30	0.18	0.13	0.28	0.11	NA	0.37
Standard deviation	0.16	0.08	NA	NA	0.09	0.10	0.09	0.02	0.22	0.24	NA	0.05

Table 21: List of banks

The table below lists the number of banks. The first column denotes the geographic zone and country. The second column shows the number of banks per year. Data for the following years are displayed: 1981, 1990, 2000, 2010 and 2014.

Region - Country	1981	1990	2000	2010	2014
Asia & Pacific	**14**	**61**	**108**	**166**	**157**
Australia	3	4	7	7	6
China		1	2	11	7
India			10	36	36
Japan	11	56	74	84	83
South Korea			2	7	6
Taiwan			12	20	18
Turkey			1	1	1
Europe	**17**	**69**	**120**	**145**	**109**
Austria		5	6	6	3
Belgium	1	1	2	2	2
Cyprus				1	1
Czech Republic			1	1	1
Denmark	1	16	24	24	16
Finland		2	2	2	
France	2	5	6	6	5
Germany	2	4	6	10	6
Greece		3	6	9	4
Hungary			1	1	1
Ireland	1	2	2	2	2
Italy	2	7	11	13	12
Netherlands			1	1	
Norway		2	16	21	17
Poland			7	9	8
Slovakia			1	4	3
Slovenia				2	
Sweden	3	3	4	4	4
Switzerland	1	15	20	22	19
United Kingdom	4	4	4	5	5
North America	**29**	**92**	**459**	**546**	**438**
Canada	5	8	9	9	9
United States	24	84	450	537	429
Total	**60**	**222**	**687**	**857**	**704**

Table 22: Fraction of the market covered by the sample

This table compares total deposits and loans for the banks examined in this study vs. total deposits and loans reported by local and regional banking associations summed for each geographic zone. The first column lists the region. Columns 2 and 3 show the number of banks examined in this study for 2011 and 2013, respectively. Columns 4 and 5 sum the bank deposits and loans for the current bank sample, respectively. Columns 6 and 7 display the total deposit and loan values for all of the banking sectors, respectively. These data were extracted from local banking associations for the year 2011, with the exception of data for Canada (year 2013). Columns 8 and 9 show percentages of the sample used in this study over the total deposits and loans aggregated for each geographic zone, respectively.

	Thomson Reuters (current sample)				**Data from local bankers association**		**Sample over total per country**	
Region	**Number of banks**		**Deposits**	**Loans**	**Deposits**	**Loans**	**Deposits**	**Loans**
	2011	**2013**	**$ Bln**	**$ Bln**	**$ Bln**	**$ Bln**	**%**	**%**
1	2	3	4	5	6	7	8	9
Asia & Pacific	166	166	13 738	10 818	15 688	19 406	88%	56%
Europe	142	131	9 635	12 960	29 949	26 581	32%	49%
North America	540	510	8 413	6 870	12 258	10 529	69%	65%
Total	**848**	**807**	**31 785**	**30 649**	**57 895**	**56 516**	**55%**	**54%**

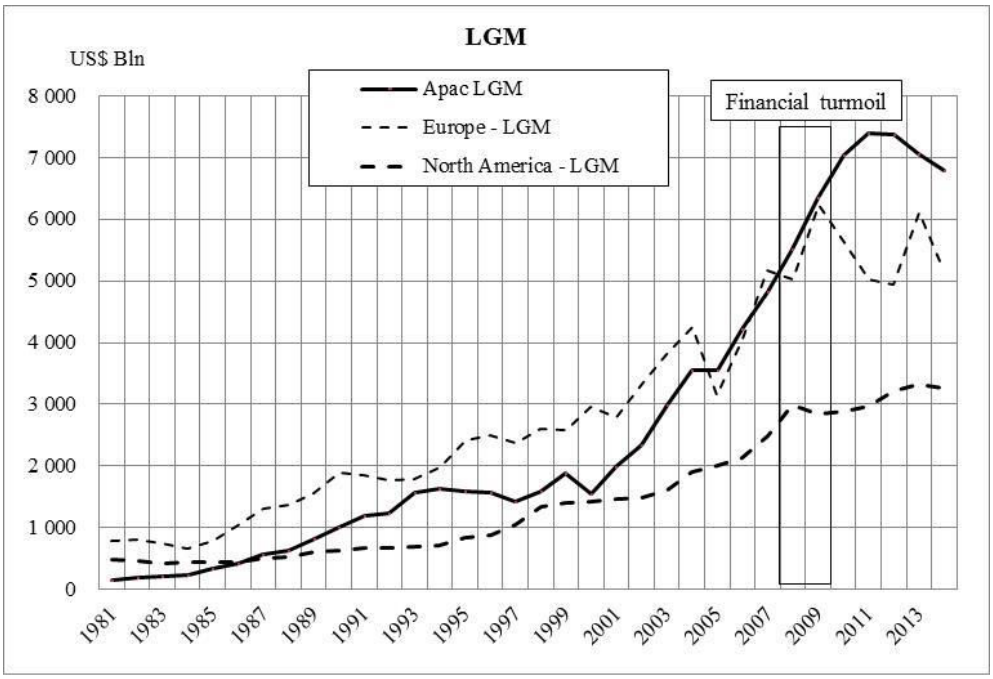
Table 23: Liquidity created over asset measures per period and geographic zone.

The table below displays the three measures "LTGap," "LGM" and "BB-MatNonFat" of liquidity creation per year by geographic zone. Column 1 displays the region (Asia-Pacific region, Europe and North America, respectively), column 2 lists the ten-year periods, and column 3 lists the number of observations reported. Columns 4 to 6 display the average, median and standard deviation of the LTGap, respectively. This order is used for the LGM (columns 7 to 9) and BB MatNonFat (columns 11 to 12) liquidity creation measures.

Region	Period	N	LT Gap			LGM			BB - MatNonFat		
			Av.	Med.	Std Dev.	Av.	Med.	Std Dev.	Av.	Med.	Std Dev.
1	2	3	4	5	6	7	8	9	10	11	12
Asia & Pacific	1981-1990	325	0.48	0.51	0.12	0.57	0.60	0.09	0.51	0.55	0.11
	1991-2000	853	0.50	0.54	0.14	0.59	0.62	0.13	0.53	0.57	0.14
	2001-2010	1503	0.44	0.49	0.15	0.51	0.54	0.13	0.47	0.50	0.13
	2011-2014	655	0.44	0.45	0.14	0.50	0.52	0.12	0.46	0.47	0.11
	Total	**3336**	**0.46**	**0.50**	**0.14**	**0.54**	**0.57**	**0.12**	**0.49**	**0.52**	**0.12**
Europe	1981-1990	348	0.16	0.16	0.23	0.45	0.48	0.16	0.33	0.37	0.18
	1991-2000	918	0.21	0.20	0.22	0.45	0.48	0.16	0.37	0.40	0.15
	2001-2010	1378	0.22	0.28	0.23	0.41	0.45	0.20	0.36	0.39	0.17
	2011-2014	523	0.27	0.33	0.22	0.41	0.46	0.20	0.34	0.39	0.18
	Total	**3167**	**0.21**	**0.24**	**0.22**	**0.43**	**0.47**	**0.18**	**0.35**	**0.39**	**0.17**
North America	1981-1990	478	0.14	0.10	0.16	0.35	0.32	0.15	0.29	0.27	0.15
	1991-2000	2772	0.16	0.17	0.10	0.35	0.36	0.11	0.28	0.29	0.11
	2001-2010	5364	0.20	0.21	0.07	0.39	0.40	0.10	0.30	0.31	0.10
	2011-2014	2009	0.22	0.23	0.07	0.36	0.39	0.12	0.30	0.31	0.09
	Total	**10623**	**0.18**	**0.18**	**0.10**	**0.36**	**0.37**	**0.12**	**0.29**	**0.30**	**0.11**
All	**Total**	**17126**	**0.29**	**0.31**	**0.15**	**0.44**	**0.47**	**0.14**	**0.38**	**0.40**	**0.14**

Figure 1: Liquidity created per measure, year and geographic zone

The figure below displays liquidity levels generated for each year and geographic zone. The first graph shows LGM values, and the second graph shows the BB-MatNonFat measures. Amounts were deflated from the IMF index inflation rate for each country (base 2005) and were counter revaluated at the US$ IMF foreign exchange rate for each end-of-year period. They are expressed in billions of US$.



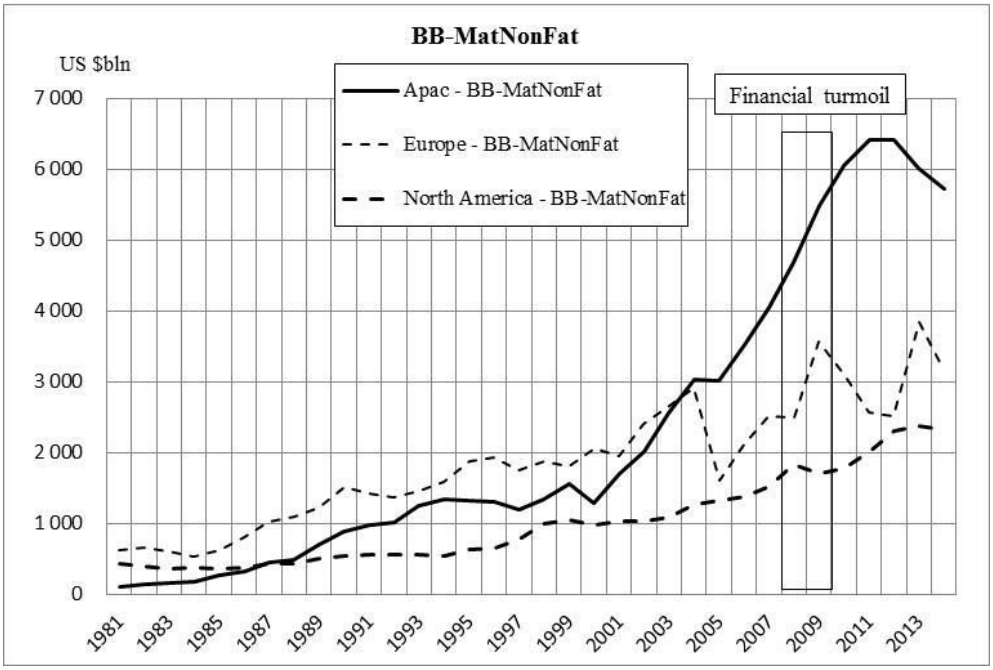


Table 24: Comparative evolution of equity level, risk performance, and liquidity creation measures

The table below displays per Basel periods for the evolution of equity over assets; the standard deviation of RoE; and LTGap, LGM and BB-MatNonFat liquidity creation measures per geographic zone (Asia-Pacific region, Europe, North America). Column 1 shows the four periods: (1) before Basel I (1981-1988), (2) from Basel I to II (1989-2007), (3) from Basel II to III (2008-2010) and (4) since Basel III (2011-present). Columns 2 to 7 show the number of observations; the average equity over assets ratio; the average standard deviation of ROA and the LTGap, LGM and BB-MatNonFat liquidity creation measures scaled over assets for Asia-Pacific banks, respectively. This order is used for the European (columns 8-13) and North American banks (columns 14-19). Though not displayed for purposes of brevity, median values follow the same trends.

Basel Period	Asia & Pacific						Europe						North America					
	N	EqoA	SD. RoE	LTGap	LGM	BB-MatNonFat	N	EqoA	SD. RoE	LTGap	LGM	BB-MatNonFat	N	EqoA	SD. RoE	LTGap	LGM	BB-MatNonFat
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Before Basel I (1988)	209	4%	2%	48%	58%	51%	216	5%	7%	14%	45%	34%	302	6%	5%	14%	35%	29%
Basel I (1989-2007)	1975	5%	24%	46%	54%	50%	1993	7%	7%	21%	43%	36%	6646	10%	5%	18%	37%	28%
Basel II (2008-2010)	497	5%	8%	44%	51%	48%	435	7%	11%	23%	41%	35%	1666	9%	11%	22%	40%	30%
Basel III(2011-2014)	655	6%	6%	44%	50%	46%	523	7%	14%	27%	41%	34%	2009	10%	13%	22%	36%	30%

Table 25: Correlation matrix

The table below displays the correlation matrix of the explicative variables. The results indicate that only a combination of 2 sets of variables has a correlation superior to the commonly accepted threshold of 0.5 (in bold): The variables X2SdRoe1 and X9OpIncoA record a correlation with the variable X5Z of -0.77 and 0.5, respectively. It results that that the regression models are broken down by two set of variables: Model 1 that excludes the X5Z variable and model 2 that excludes the X2SdRoe1 and X9OpIncoA variables. The first column displays the variables as they appear in the table "Summary of variables (part 1 and 2). The next columns display these variables: X1BkSizeUSD, X2SdRoe1, X3EQoA, X4NPLoLoans, X5Z, X6PayShldrsoEq, X7LnGwth, X8ExcssR, Variable name in the OLS, X9OpIncoA, X10MktPrice, X11Rf, X12Legal, X13GDPgwth, X14HHI, X15YieldSpread, X16UnmpRate and X17TED.

	X1BkSize USD	**X2SdRo e1**	X3EQoA	X4NPLo Loans	**X5Z**	X6PaySh ldrsoEq	X7LnGwt h	X8Excss R	X9OpInc oA	X10MktP rice	X11Rf	X12Legal	X13GDP gwth	X14HHI	X15Yield Spread	X16Unm pRate	X17TED
X1BkSizeUSD	1																
X2SdRoe1	0.17	1															
X3EQoA	-0.36	-0.21	1														
X4NPLoLoans	0.02	0.10	-0.03	1													
X5Z	-0.10	**-0.77**	0.23	-0.07	1												
X6PayShldrsoEq	0.19	-0.25	-0.05	-0.04	0.25	1											
X7LnGwth	-0.01	-0.06	0.00	-0.03	0.05	0.00	1										
X8ExcssR	-0.01	-0.01	0.01	-0.01	0.02	0.00	0.01	1									
X9OpIncoA	-0.05	-0.41	0.22	-0.07	**0.50**	0.36	0.13	0.05	1								
X10MktPrice	0.04	0.07	-0.03	0.01	-0.05	-0.03	0.00	0.00	-0.03	1							
X11Rf	-0.19	-0.21	0.05	-0.02	0.22	0.18	0.15	-0.01	0.27	0.01	1						
X12Legal	0.25	0.15	-0.10	0.04	-0.14	-0.03	-0.10	0.04	-0.19	-0.03	-0.37	1					
X13GDPgwth	-0.10	-0.17	0.03	-0.03	0.19	0.13	0.13	0.01	0.32	0.02	0.31	-0.32	1				
X14HHI	0.25	0.01	-0.09	0.00	-0.01	0.11	0.01	0.00	0.02	0.04	0.09	0.16	0.04	1			
X15YieldSpread	-0.02	0.09	0.00	0.04	-0.10	-0.09	-0.10	0.04	-0.23	-0.01	0.08	0.08	-0.35	-0.05	1		
X16UnmpRate	0.04	0.21	0.08	0.04	-0.25	-0.14	-0.09	0.00	-0.22	-0.01	-0.17	0.07	-0.33	0.01	0.26	1	
X17TED	-0.26	-0.11	0.14	-0.05	0.08	0.05	0.06	0.00	0.04	-0.02	0.04	-0.16	-0.11	-0.14	-0.06	-0.18	1

Table 26: GMM estimators per liquidity creation measure and geographic zone – Without z-scores

The table below shows the results of the GMM estimators with heteroskedasticity robust standard errors. The explained variables are the LTGap, LGM and BB-MatNonFat measures scaled over assets. Columns 1 to 3 list the typology, the comprehensive names and the names of the explicative variables, respectively. Columns 5 to 8 show the LTGap measure results for all regions, for the Asia-Pacific region, for Europe and for North America, respectively. This order is replicated for the LGM (columns 9-12) and BB-MatNonFat (columns 13-16) measures. T-stats are shown in brackets underneath the estimated coefficients, and the number of asterisks denotes the level of significance, where * denotes p<0.05, ** denotes p<0.01 and *** denotes p<0.001. The Sargan J-stat [p(chi²)] is reported at the bottom.

Explicative variable			LTGap				LGM over assets				B-B MatNonFat over assets			
Typology	Comprehensive name	Name	All	Asia & Pacific	Europe	North America	All	Asia & Pacific	Europe	North America	All	Asia & Pacific	Europe	North America
1	2	3	5	6	7	8	9	10	11	12	13	14	15	16
Liquidity creation	Variable at t0		0.903***	0.864***	0.910***	0.809***	0.930***	0.905***	0.934***	0.895***	0.911***	0.910***	0.906***	0.878***
			(133.38)	(29.81)	(69.05)	(70.80)	(183.75)	(37.21)	(73.69)	(126.67)	(148.98)	(28.36)	(61.48)	(96.19)
Bank characteristics	Bank size	X1BkSizeUSD	-0.00434***	0.00251	-0.0144***	-0.00427***	-0.00382***	-0.00498	-0.0107***	-0.00493***	-0.00509***	-0.00613	-0.0131***	-0.00525***
			(-5.94)	(0.32)	(-4.47)	(-5.66)	(-6.74)	(-1.39)	(-4.51)	(-6.90)	(-7.90)	(-1.02)	(-5.25)	(-6.86)
Bank risk typology	Std. dev. of RoE	X2SdRoe1	-0.000553	-0.00924	0.000256	-0.000289	-0.00180	0.00589	-0.000458	0.00322	-0.00139	0.00409		-0.00180
			(-0.38)	(-1.09)	(0.06)	(-0.20)	(-1.38)	(1.53)	(-0.14)	(1.43)	(-0.90)	(0.99)		(-1.02)
Bank characteristics	Level of equity	X3EQoA	-0.0631*	-0.198	-0.146*	-0.0652**	-0.0563*	-0.141	-0.127**	-0.0810**	-0.0790**	-0.116	-0.121**	-0.0959**
			(-2.39)	(-1.24)	(-2.21)	(-2.63)	(-2.26)	(-1.27)	(-3.01)	(-2.61)	(-3.17)	(-0.96)	(-3.18)	(-3.09)
Bank risk typology	NPL over Loans	X4NPLoLoans	0.00128	0.0873	0.0847	-0.129*	-0.00105	-0.00186	0.0801*	-0.180**	-0.00110	-0.00118	0.0861**	-0.177*
			(0.41)	(1.08)	(1.37)	(-2.05)	(-0.47)	(-0.97)	(2.40)	(-2.99)	(-0.41)	(-0.51)	(2.58)	(-2.52)
Bank characteristics	Dividend paid out	X6PayShldrsoEq	0.000668	0.322	0.00667	0.0269	0.0501**	0.110	0.0207	0.102***	0.0368	0.146	0.0245	0.0896***
			(0.03)	(1.86)	(0.12)	(1.08)	(2.74)	(1.69)	(0.56)	(4.67)	(1.67)	(1.90)	(0.52)	(3.57)
Bank performance	Loan growth	X7LnGwth	-0.00153	-0.0362	-0.00873	0.00808**	0.0415***	0.0618***	0.0159	0.0566***	0.0298**	0.0518**		0.0464***
			(-0.50)	(-1.33)	(-1.26)	(2.74)	(3.30)	(4.03)	(1.59)	(10.88)	(2.85)	(2.95)		(9.15)
Bank performance	Excess Return	X8ExcssR	-0.000939***	0.0446*	-0.000908***	-0.000157	-0.000410	0.00285	-0.0000294	-0.000875	-0.000936**	0.00181	-0.000587	-0.000820
			(-3.37)	(2.21)	(-4.15)	(-0.37)	(-1.80)	(0.77)	(-0.08)	(-1.11)	(-3.26)	(0.47)	(-1.56)	(-1.05)
Bank performance	Operating income	X9OpIncoA	-0.00182	-0.147	-0.0602	-0.195	-0.209**	-0.436	0.0828	-0.233*	-0.110	-0.361	0.186	-0.284*
			(-0.02)	(-0.35)	(-0.22)	(-1.91)	(-2.60)	(-1.79)	(0.43)	(-1.98)	(-1.35)	(-1.49)	(0.88)	(-2.56)
Bank performance	Market share value	X10MktPrice	4.08e-08	0.000000167	-1.53e-08	-0.00000134*	0.000000105*	-0.000000316	6.71e-08	-0.00000118**	7.16e-08	-0.000000400	4.27e-08	-0.00000124**
			(1.21)	(0.37)	(-0.47)	(-2.50)	(2.02)	(-1.49)	(1.41)	(-3.11)	(0.84)	(-1.64)	(0.45)	(-2.73)
Macro environment	10 years bond yield	X11Rf	-0.107***	-0.303	-0.246***	-0.0680*	-0.0407**	0.0648	-0.111**	0.0511*	-0.0863***	-0.00215	-0.132**	0.0797**
			(-5.88)	(-1.61)	(-4.20)	(-2.44)	(-2.76)	(0.92)	(-2.83)	(2.11)	(-5.60)	(-0.03)	(-3.24)	(3.06)
Macro environment	Institutional regulatory framework	X12Legal	0.000360	0.00512	-0.000315	-0.00185	0.00117*	-0.000458	-0.000771	0.0169***	0.000430	0.000802	-0.00105	0.0163***
			(0.41)	(1.42)	(-0.22)	(-0.58)	(2.02)	(-0.20)	(-0.87)	(6.12)	(0.64)	(0.29)	(-0.99)	(5.68)
Macro environment	GDP per country	X13GDPgwth	-0.000469	0.000324	-0.0000968	-0.000606	0.000531	0.000447	0.000190	0.00212***	0.000391	0.000736	-0.000263	0.00215***
			(-1.36)	(0.24)	(-0.13)	(-1.32)	(1.83)	(0.64)	(0.36)	(5.49)	(1.08)	(1.00)	(-0.39)	(4.99)
Macro environment	Market concentration	X14HHI	5.19e-10	-6.25e-10	1.90e-10	3.42e-09	2.52e-10	-1.79e-10	9.95e-10	1.15e-08***	2.34e-10	-3.01e-10	8.40e-10	1.09e-08**
			(1.49)	(-1.32)	(0.10)	(0.80)	(1.06)	(-0.52)	(0.88)	(3.39)	(0.89)	(-0.91)	(0.75)	(2.99)
Macro environment	Yield curve spread	X15YieldSpread	0.00100*	0.00141	0.00289*	0.000581	0.000742	0.000167	0.00307***	0.000388	0.000582	0.000606	0.00215*	-0.000474
			(2.25)	(1.10)	(2.23)	(1.22)	(1.01)	(0.10)	(3.30)	(0.97)	(0.76)	(0.31)	(2.50)	(-1.09)
Macro environment	Unemployment	X16UnmpRate	-0.0248***	0.0603	0.00244	0.0218*	-0.0300***	-0.0150	-0.0118	-0.0133	-0.0199***	-0.00293	-0.00877	0.0253**
			(-5.25)	(0.87)	(0.24)	(2.52)	(-7.61)	(-0.48)	(-1.64)	(-1.76)	(-4.93)	(-0.08)	(-1.13)	(2.83)
Interbank liquidity shock	Interbank liquidity shock	X17TED	-0.00536**	0.0602**	-0.00742	0.00114		0.0418***	0.000881	0.00776***	-0.00527***	0.0565***	-0.00335	0.00468*
			(-3.08)	(2.72)	(-1.18)	(0.64)		(3.37)	(0.23)	(4.73)	(-3.56)	(3.36)	(-0.79)	(2.51)
		Constant	0.0954***	0.00852	0.176***	0.0788***	0.0758***	0.0998**	0.136***	0.00293	0.0928***	0.0895	0.161***	-0.0341
			(8.54)	(0.10)	(5.56)	(3.82)	(10.03)	(2.75)	(5.29)	(0.17)	(10.05)	(1.70)	(6.24)	(-1.86)
		N	10229	683	1642	7904	10229	683	1642	7904	10229	683	1743	7904
		Sargan J P(chi²)	0.7675	0.0963	0.2187	0.3571	0.2847	0.0722	0.3265	0.5843	0.4051	0.0732	0.1116	0.1144

Table 27: GMM estimators per liquidity creation measure and geographic zone - with z-scores but without the std. dev. of RoE and op. income over assets

The table below shows the results of the GMM estimators with heteroskedasticity robust standard errors. The explained variables are the LTGap, LGM and BB-MatNonFat measures scaled over assets, respectively. Columns 1 to 3 show the typologies, the comprehensive names and the names of the explicative variables, respectively. Columns 5 to 8 show the results of the LTGap measure for all regions, for the Asia-Pacific region, for Europe and for North America, respectively. This order is used for the LGM (columns 9-12) and BB-MatNonFat (columns 13-16) measures. T-statistics are reported in brackets below the estimated coefficients, and the number of asterisks denotes the level of significance, where * denotes p<0.05, ** denotes p<0.01 and *** denotes p<0.001. The Sargan J-stat [p(chi²)] is reported at the bottom.

Explicative variable			LTGap				LGM over assets				B-B MatNonFat over assets			
Typology	**Comprehensive name**	**Name**	**All**	**Asia & Pacific**	**Europe**	**North America**	**All**	**Asia & Pacific**	**Europe**	**North America**	**All**	**Asia & Pacific**	**Europe**	**North America**
1	**2**	**3**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Liquidity creation	Variable at t0		0.904***	0.876***	0.909***	0.811***	0.915***	0.918***	0.933***	0.882***	0.909***	0.905***	0.915***	0.865***
			(133.14)	(34.64)	(70.68)	(66.60)	(162.70)	(29.70)	(75.31)	(134.68)	(149.95)	(28.71)	(69.25)	(100.07)
Bank characteristics	Bank size	X1BkSizeUSD	-0.00436***	-0.00802	-0.0143***	-0.00416***	-0.00470***	-0.00303	-0.0107***	-0.00581***	-0.00519***	-0.00739	-0.00938***	-0.00660***
			(-6.22)	(-1.79)	(-4.45)	(-5.13)	(-8.63)	(-0.60)	(-4.59)	(-9.67)	(-8.12)	(-1.28)	(-4.46)	(-9.56)
Bank characteristics	Level of equity	X3EQoA	-0.0655**	-0.203	-0.149*		-0.0719***	-0.00184	-0.124**	-0.0880***	-0.0737***	-0.151		-0.0951***
			(-3.11)	(-1.46)	(-2.44)		(-3.43)	(-0.01)	(-2.99)	(-3.49)	(-3.31)	(-1.24)		(-3.47)
Bank risk typology	Credit risk : NPL over Loans	X4NPLoLoans	0.00129	-0.0000879	0.106	0.399*	-0.000628	0.0000659	0.0806*	-0.157**	-0.000550	-0.00120	0.0785*	-0.177**
			(0.41)	(-0.03)	(1.75)	(2.28)	(-0.28)	(0.03)	(2.55)	(-2.76)	(-0.21)	(-0.50)	(2.37)	(-2.68)
Bank risk typology	Bank stability risk : z-score	X5Z	0.000791	0.00564	0.00464	0.00337	-0.00174	-0.0385*	0.00209	-0.00354**	-0.000764	-0.00368	0.00287	-0.00263*
			(0.70)	(1.26)	(1.32)	(1.29)	(-1.66)	(-2.30)	(0.78)	(-3.00)	(-0.70)	(-0.99)	(0.92)	(-1.96)
Bank characteristics	Dividend paid out	X6PayShldrsoEq	-0.000616	0.112	0.00101	-0.0119	0.0393*	0.209*	0.0227	0.0783***	0.0323	0.134	0.0256	0.0734***
			(-0.03)	(1.14)	(0.02)	(-0.33)	(2.38)	(2.38)	(0.62)	(4.44)	(1.62)	(1.77)	(0.54)	(3.83)
Bank performance	Loan growth	X7LnGwth	-0.00160	-0.0424	-0.00930	0.0139***	0.0414***	0.0655***	0.0162	0.0521***	0.0271**	0.0494**	0.0108	0.0442***
			(-0.53)	(-1.47)	(-1.30)	(3.55)	(4.52)	(3.66)	(1.62)	(9.74)	(2.89)	(2.95)	(1.41)	(9.36)
Bank performance	Excess Return	X8ExcssR	-0.000943***	0.00658	-0.000936***	-0.00000679	-0.000509	0.00516	-0.0000444	-0.00106	-0.000909**	0.00124	-0.000596	-0.00106
			(-3.41)	(1.34)	(-4.38)	(-0.01)	(-1.86)	(1.18)	(-0.12)	(-1.31)	(-3.25)	(0.32)	(-1.54)	(-1.25)
Bank performance	Market share value	X10MktPrice	4.08e-08	-0.000000378	-1.53e-09	-0.00000161*	0.000000107*	-0.000000654**	6.90e-08	-0.00000131***	6.65e-08	-0.000000498*	4.81e-08	-0.00000132**
			(1.22)	(-1.59)	(-0.05)	(-2.43)	(2.22)	(-2.86)	(1.49)	(-3.30)	(0.78)	(-1.99)	(0.51)	(-2.85)
Macro environment	10 years bond yield	X11Rf	-0.107***	0.00469	-0.235***	-0.0772**	-0.0702***	-0.0584	-0.102**	0.0547*	-0.0882***	-0.00361	-0.130***	0.0783**
			(-5.96)	(0.06)	(-4.26)	(-2.65)	(-5.38)	(-0.86)	(-2.66)	(2.28)	(-5.82)	(-0.04)	(-3.40)	(3.00)
Macro environment	Institutional regulatory framework	X12Legal	0.000381	0.00108	-0.000215	-0.00376	0.0000231	0.00112	-0.000576	0.0176***	0.000398	0.00128		0.0157***
			(0.44)	(0.41)	(-0.16)	(-1.14)	(0.04)	(0.49)	(-0.65)	(6.39)	(0.59)	(0.46)		(5.44)
Macro environment	GDP per country	X13GDPgwth	-0.000459	0.00124	-0.000121	-0.00114*	-0.000363	-0.00224*	0.000224	0.00194***	0.000307	0.000625	0.000438	0.00193***
			(-1.34)	(1.25)	(-0.17)	(-2.56)	(-1.23)	(-2.06)	(0.43)	(5.40)	(0.85)	(0.83)	(0.67)	(4.89)
Macro environment	Market concentration	X14HHI	5.20e-10	-6.03e-10	1.45e-10	1.41e-08**	4.48e-10	6.76e-10	1.01e-09	1.52e-08***	2.61e-10	-3.90e-10	8.60e-10	1.48e-08***
			(1.50)	(-1.38)	(0.08)	(2.82)	(1.81)	(1.58)	(0.89)	(4.58)	(1.00)	(-1.19)	(0.70)	(4.16)
Macro environment	Yield curve spread	X15YieldSpread	0.00101*	0.000419	0.00288*	0.000293	0.0000159	-0.000202	0.00298***	-0.00000575	0.000475	0.00136	0.00269*	-0.000471
			(2.27)	(0.53)	(2.33)	(1.04)	(0.03)	(-0.15)	(3.36)	(-0.02)	(0.63)	(0.69)	(2.57)	(-1.78)
Macro environment	Unemployment	X16UnmpRate	-0.0241***	-0.0205	0.00213	-0.0144	-0.0398***	-0.128***	-0.0117	-0.0137	-0.0207***	-0.000726	-0.0128	0.0258**
			(-5.07)	(-0.52)	(0.21)	(-1.09)	(-9.34)	(-3.49)	(-1.64)	(-1.90)	(-5.12)	(-0.02)	(-1.64)	(3.08)
Interbank liquidity shock	Interbank liquidity shock	X17TED	-0.00523**	0.0344*	-0.00621	-0.00178	-0.00246*	0.0317*	0.00119	0.00902***	-0.00541***	0.0596***	-0.00350	0.00609***
			(-3.02)	(2.22)	(-0.97)	(-0.91)	(-2.01)	(2.15)	(0.31)	(6.10)	(-3.69)	(3.54)	(-0.80)	(3.57)
		Constant	0.0945***	0.123**	0.165***	0.0979***	0.115***	0.206***	0.131***	0.0103	0.0977***	0.0978	0.114***	-0.0150
			(8.56)	(2.76)	(5.17)	(4.55)	(13.06)	(5.28)	(4.98)	(0.59)	(10.75)	(1.90)	(5.41)	(-0.80)
		N	10229	683	1642	8721	11265	801	1642	8721	10229	683	1642	8721
		Sargan J P(chi²)	0.9394	0.1013	0.6102	0.0615	0.1766	0.2726	0.5466	0.1007	0.3217	0.0986	0.1069	0.1504

Table 28: Determinants of liquidity creation OLS and fixed effects estimators per country

The table below shows the results of the robust regression. The explained variables are the LTGap, LGM and BB-MatNonFat measures scaled over assets. Columns 1 to 3 denote the typologies, the comprehensive names and the names of the explicative variables, respectively. Columns 1 to 3 display the typologies, the comprehensive names and OLS names of the explicative variables, respectively. Columns 4 to 9 display the coefficients without z-scores. Columns 4 to 5 display the results of the robust regressions that control for heteroskedasticity and fixed effects estimators per country, respectively. This order is used for the LGM (columns6-7) and BB MatNonFat (columns 8-9). Columns 10 to 15 display the z-score results. This order is used in table with z-scores. T-statistics are reported in brackets underneath the estimated coefficients, and the number of asterisks denotes the level of significance, where * denotes p<0.05, ** denotes p<0.01 and *** denotes p<0.001.

Explicative variable			Without Z-score						With z-score but without SD Roa and operating income					
			LTGap		LGM over assets		BB-MatNonFat over assets		LTGap		LGM over assets		BB-MatNonFat over assets	
Typology	Comprehensive name	Name	OLS	Fe, country	OLS	Fe, country	OLS	Fe, country	OLS	Fe, country	OLS	Fe, country	OLS	Fe, country
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bank characteristics	Bank size	X1BkSizeUSD	-0.0366***	-0.0473***	-0.0264***	-0.0492***	-0.0305***	-0.0527***	-0.0373***	-0.0469***	-0.0274***	-0.0477***	-0.0316***	-0.0507***
			(-18.49)	(-33.25)	(-15.74)	(-35.91)	(-19.03)	(-38.26)	(-20.68)	(-35.20)	(-17.70)	(-36.94)	(-21.37)	(-38.92)
Bank risk typology	Standard dev. of RoE	X2SdRoe1	-0.0116**	-0.0206***	0.00153	-0.00458	-0.000811	-0.00725**						
			(-2.83)	(-8.10)	(0.46)	(-1.87)	(-0.23)	(-2.94)						
Bank characteristics	Level of equity	X3EQoA	-0.625***	-0.542***	-0.890***	-0.786***	-0.819***	-0.745***	-0.671***	-0.572***	-0.961***	-0.830***	-0.864***	-0.764***
			(-9.44)	(-22.10)	(-23.44)	(-33.26)	(-21.34)	(-31.34)	(-12.14)	(-24.61)	(-35.00)	(-36.80)	(-30.73)	(-33.62)
Bank risk typology	Credit risk : NPL over Loans	X4NPLoLoans	0.0374***	0.0171**	0.0136**	-0.000461	0.0138**	0.00259	0.0391***	0.0154*	0.0168**	-0.00242	0.0159**	0.000112
			(4.30)	(2.68)	(3.05)	(-0.08)	(2.82)	(0.42)	(4.24)	(2.46)	(3.11)	(-0.40)	(3.27)	(0.02)
Bank risk typology	Bank stability risk : z-score	X5Z							0.00894**	0.0238***	-0.00223	0.00917***	-0.0000190	0.0122***
									(3.13)	(12.65)	(-0.95)	(5.02)	(-0.01)	(6.63)
Bank characteristics	Dividend paid out	X6PayShldrsoEq	-0.291***	-0.206***	-0.121*	-0.137***	-0.149*	-0.148***	-0.260***	-0.173***	-0.141**	-0.117***	-0.126*	-0.0921**
			(-3.68)	(-6.08)	(-1.97)	(-4.19)	(-2.41)	(-4.52)	(-4.33)	(-5.41)	(-2.68)	(-3.76)	(-2.17)	(-2.94)
Bank performance	Loan growth	X7LnGwth	-0.0118	-0.00402	0.0148	0.0142***	0.0142	0.0179***	-0.00780	0.000406	0.00761	0.00918**	0.00934	0.0142***
			(-1.85)	(-1.09)	(1.61)	(3.99)	(1.71)	(5.01)	(-1.56)	(0.14)	(1.41)	(3.24)	(1.80)	(4.96)
Bank performance	Excess Return	X8ExcssR	-0.00303*	-0.000643	-0.00223*	-0.000561	-0.00279**	-0.000976	-0.00280	-0.000342	-0.00219*	-0.000241	-0.00252**	-0.000455
			(-2.05)	(-0.76)	(-2.01)	(-0.69)	(-3.11)	(-1.20)	(-1.91)	(-0.41)	(-1.99)	(-0.30)	(-3.23)	(-0.56)
Bank performance	Operating income over assets	X9OpIncoA	0.149	0.676***	-0.319*	0.518***	0.0990	0.936***						
			(0.73)	(6.43)	(-2.40)	(5.11)	(0.76)	(9.18)						
Bank performance	Market share value	X10MktPrice	0.000000806***	0.000000304**	0.000000673***	0.000000164	0.000000497***	9.11e-08	0.000000864***	0.000000279*	0.000000747***	0.000000192	0.000000558***	0.000000118
			(6.03)	(2.95)	(8.49)	(1.65)	(7.69)	(0.91)	(4.62)	(2.48)	(8.18)	(1.76)	(9.83)	(1.07)
Macro environment	10 years bond yield	X11Rf	-1.256***	-0.325***	-0.619***	0.0197	-0.815***	-0.0833	-1.314***	-0.133	-0.615***	0.258**	-0.813***	0.117
			(-28.86)	(-3.86)	(-17.98)	(0.24)	(-23.40)	(-1.02)	(-32.80)	(-1.62)	(-18.92)	(3.23)	(-24.49)	(1.45)
Macro environment	Institutional regulatory framework	X12Legal	-0.0146***	0.00558*	-0.000321	-0.00553*	-0.0129***	-0.00156	-0.0164***	0.00543*	-0.0000733	-0.00626**	-0.0134***	-0.00310
			(-5.31)	(2.24)	(-0.15)	(-2.30)	(-6.15)	(-0.64)	(-6.29)	(2.27)	(-0.04)	(-2.70)	(-6.70)	(-1.33)
Macro environment	GDP growth per country	X13GDPgwth	-0.00608***	-0.0000558	-0.00736***	-0.00416***	-0.00558***	-0.000977	-0.00717***	-0.000560	-0.00800***	-0.00453***	-0.00595***	-0.000985
			(-6.41)	(-0.05)	(-9.52)	(-3.94)	(-6.93)	(-0.92)	(-7.73)	(-0.51)	(-10.55)	(-4.29)	(-7.72)	(-0.93)
Macro environment	Market concentration	X14HHI	8.98e-09***	-5.46e-09***	5.50e-09***	-3.38e-09***	5.77e-09***	-4.07e-09***	9.21e-09***	-5.24e-09***	5.55e-09***	-3.49e-09***	5.82e-09***	-4.07e-09***
			(7.08)	(-7.01)	(6.68)	(-4.50)	(7.10)	(-5.39)	(7.29)	(-6.94)	(6.75)	(-4.75)	(7.22)	(-5.50)
Macro environment	Yield curve spread	X15YieldSpread	0.00635***	0.00352***	0.00454***	0.00220**	0.00384***	0.00204*	0.00443***	0.00166*	0.00407***	0.000892	0.00303***	0.000597
			(6.12)	(4.02)	(5.14)	(2.61)	(4.24)	(2.40)	(4.44)	(2.37)	(5.88)	(1.31)	(4.18)	(0.87)
Macro environment	Unemployment	X16UnmpRate	-0.247***	0.0792***	-0.260***	0.100***	-0.229***	0.100***	-0.259***	0.0875***	-0.255***	0.109***	-0.231***	0.0979***
			(-18.12)	(3.85)	(-24.42)	(5.06)	(-21.99)	(5.02)	(-19.45)	(4.51)	(-24.90)	(5.79)	(-23.05)	(5.15)
Interbank liquidity shock	Interbank liquidity shock	X17TED	-0.0800***	-0.0140*	-0.0724***	0.00174	-0.0732***	-0.00605	-0.0830***	-0.0166**	-0.0728***	-0.00341	-0.0735***	-0.0112
			(-22.11)	(-2.35)	(-21.55)	(0.30)	(-24.46)	(-1.05)	(-23.48)	(-2.79)	(-21.03)	(-0.59)	(-24.40)	(-1.93)
		_cons	1.015***	0.482***	1.015***	0.698***	1.001***	0.638***	1.062***	0.421***	1.024***	0.621***	1.020***	0.581***
			(36.06)	(13.21)	(47.10)	(19.88)	(46.90)	(18.06)	(42.01)	(12.30)	(51.79)	(18.67)	(52.68)	(17.33)
		rep dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
		N	10439	10439	10439	10439	10439	10439	11382	11382	11382	11382	11382	11382
		R-sq	0.257	0.173	0.274	0.201	0.240	0.192	0.288	0.180	0.285	0.202	0.257	0.188
		adj. R-sq	0.256	0.168	0.273	0.196	0.239	0.188	0.287	0.176	0.284	0.198	0.256	0.184

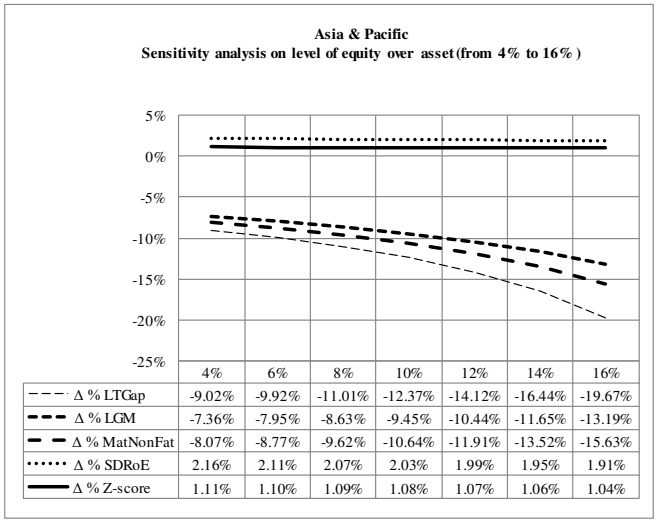
Table 29: Cox regression (survival analysis)

This table displays the Cox estimation hazard ratio of the LTGap, LGM and BBMatNonFat measures. The survivor function corresponds to the derivative of liquidity creation: It is the variance between the y and y-1 of liquidity creation. If negative, it takes a value of 1, i.e., failure, and it takes a value of zero otherwise. The explanatory variables have been layered. For levels of risk, stratification levels correspond to the quintile, where IStratSDRoE_2 corresponds to q1 (less than or equal to 25%); where IStratSDRoE_3 corresponds to q2 (less than or equal to 50%) and where IStratSDRoE_4 corresponds to q3 (less than or equal to 75%). For bank size, small banks are those with total assets of less than $US 50bln; medium banks are those with total assets of more than or equal to $US 50bln and of less than $US 250bln; and large banks are those with total assets of more than or equal to $US 250bln. Total assets were deflated based on the IMF index inflation rate for each country (base 2005) and were counter revaluated at the US$ IMF foreign exchange rate for each end-of-year period. For equity levels, stratification levels vary from 0% ("_IStratEqoA_0") to 17.5% ("_IStratEqoA_5"), with a regular increase of 2.5bp at each step. Columns 1 to 3 denote the variable type, the variable name used in the model, and the value corresponding to the variable, respectively. Columns 4 to 6 display the hazard ratio of the LTGap, LGM and BBMatNonFat measures for the Asia-Pacific region, respectively. This order is used for Europe (columns 7-9) and North America (columns 10-12). Z-statistics are reported in brackets underneath the estimated coefficients, and the number of asterisks denotes the level of significance, where * denotes p(z) <0.05, ** denotes p(z)<0.01 and *** denotes p(z)<0.001. Absent values exist due to a lack of observations and are not reported.

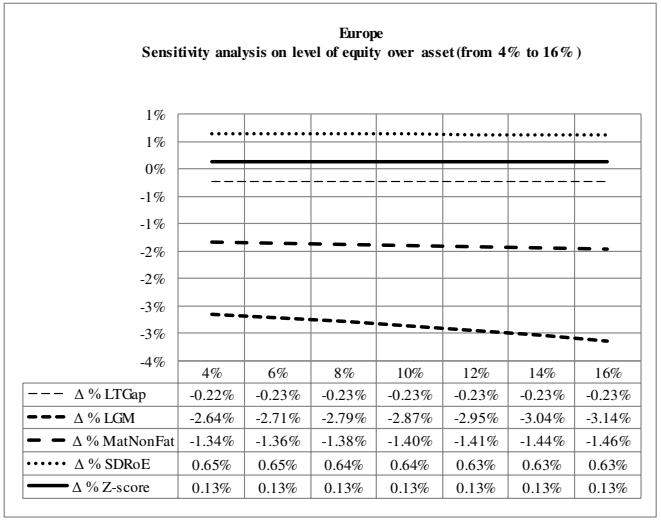
Variable			Asia & Pacific			Europe			North America		
Bank specific characteristic	Variable name	Value	LTGap Log likhd: -11772 LRχ^2 (11) : 206.56 Prob > χ^2 : 0.0000	LGM / assets Log likhd: -6434 LRχ^2 (11) : 116.33 Prob > χ^2 :0.0000	BB-MatNonFat / assets Log likhd: -6641 LRχ^2 (11) : 137.65 Prob > χ^2 : 0.0000	LTGap Log likhd: -11546 LRχ^2 (11) : 70.44 Prob > χ^2 : 0.0000	LGM / assets Log likhd: -7625 LRχ^2 (11) : 72.29 Prob > χ^2 :0.0000	BB-MatNonFat / assets Log likhd: -8117 LRχ^2 (11) : 55.16 Prob > χ^2 : 0.0000	LTGap Log likhd: -40706 LRχ^2 (12) : 383.85 Prob > χ^2 : 0.0000	LGM / assets Log likhd: -27033 LRχ^2 (12) : 231.87 Prob > χ^2 :0.0000	BB-MatNonFat / assets Log likhd: -29218 LRχ^2 (12) : 229.99 Prob > χ^2 : 0.0000
1	2	3	4	5	6	7	8	9	10	11	12
Level of risk	IStratSDRo_2	Quintile1	-0.249**	0.185	0.122	-0.0773	0.152	0.0764	-0.176***	-0.123*	-0.0914
			(-2.92)	(1.39)	(0.96)	(-0.87)	(1.24)	(0.67)	(-4.17)	(-2.11)	(-1.69)
	IStratSDRo_3	Quintile2	-0.406***	-0.0738	-0.231	-0.0105	0.246*	0.147	-0.340***	-0.0302	-0.107
			(-4.91)	(-0.56)	(-1.82)	(-0.13)	(2.13)	(1.38)	(-7.60)	(-0.52)	(-1.95)
	IStratSDRo_4	Quintile3	-0.568***	-0.0349	-0.151	-0.115	0.381***	0.181	-0.578***	-0.165**	-0.234***
			(-7.43)	(-0.29)	(-1.30)	(-1.48)	(3.56)	(1.83)	(-14.14)	(-3.20)	(-4.78)
Bank size	_IBkSize012_1	Small (GTA < $50bn)	0.556***	0.456**	0.429**	0.313***	-0.0639	0.0443	0.119	-0.277	-0.352
			(4.50)	(2.79)	(2.72)	(3.82)	(-0.67)	(0.49)	(0.17)	(-0.55)	(-0.70)
	_IBkSize012_2	Medium(GTA < $250bn)	0.464***	0.273	0.211	0.575***	0.340**	0.420***	0.672	0.377	0.312
			(3.48)	(1.52)	(1.21)	(5.98)	(3.07)	(3.93)	(0.94)	(0.74)	(0.61)
	_IBkSize012_3	Large (GTA ≥ $250bn)							-0.204	-0.839	-0.693
									(-0.28)	(-1.60)	(-1.33)
Level of equity	IStratEqoA_0	0% ≤ 5%	-0.766*	-0.522	-1.076**	0.0738	-0.649***	-0.273	0.159	0.348***	0.130
			(-2.15)	(-1.04)	(-2.81)	(0.39)	(-3.41)	(-1.33)	(1.74)	(3.54)	(1.41)
	IStratEqoA_1	5% ≤ 7,5%	-1.357***	-1.196*	-1.786***	-0.200	-0.838***	-0.566**	0.212**	-0.101	-0.202*
			(-3.79)	(-2.36)	(-4.63)	(-1.04)	(-4.37)	(-2.74)	(2.78)	(-1.12)	(-2.46)
	IStratEqoA_2	7,5% ≤ 10%	-1.468***	-1.237*	-1.818***	-0.373	-0.871***	-0.613**	-0.0731	-0.351***	-0.463***
			(-3.96)	(-2.37)	(-4.47)	(-1.87)	(-4.37)	(-2.87)	(-1.00)	(-4.08)	(-5.94)
	IStratEqoA_3	10% ≤ 12,5%	-1.496***	-0.768	-1.416**	-0.137	-0.592**	-0.450*	-0.314***	-0.417***	-0.577***
			(-3.56)	(-1.39)	(-3.15)	(-0.67)	(-2.90)	(-2.04)	(-4.12)	(-4.70)	(-7.13)
	IStratEqoA_4	12,5% ≤ 15%	-0.874	-0.609	-1.194*	-0.301	-0.402	-0.493*	-0.290***	-0.508***	-0.612***
			(-1.84)	(-0.94)	(-2.13)	(-1.36)	(-1.87)	(-2.07)	(-3.36)	(-4.99)	(-6.50)
	IStratEqoA_5	15% ≤ 17,5%	-0.801	-0.0593	-1.085	-0.221	-0.394	-0.413	-0.360**	-0.340**	-0.548***
			(-1.18)	(-0.08)	(-1.35)	(-0.97)	(-1.74)	(-1.67)	(-3.29)	(-2.75)	(-4.60)
		N° of subjects	3335			3167			10623		
		N° of observations	3335			3167			10623		
		N° of failures	1646	894	925	1610	1089	1153	4882	3316	3544

Figure 2: Sensitivity analysis comparison for the effect of a marginal increase in the level of equity on liquidity creation and risk performance

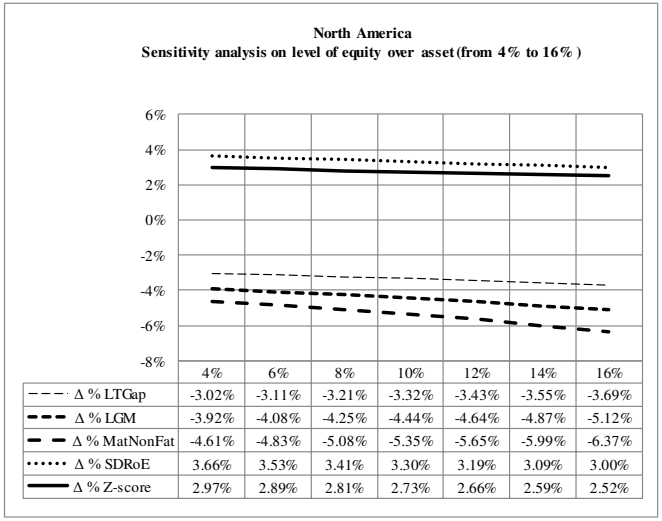
The figure below shows the marginal effect of a regular increase in equity levels from 4% to 16% on LTGap, LGM and BBMatNonFat measures. Values are below the graphs as % values, and they all show p(t) less than 0.000, although they are not reported in the interest of brevity.



	4%	6%	8%	10%	12%	14%	16%
Δ % LTGap	-9.02%	-9.92%	-11.01%	-12.37%	-14.12%	-16.44%	-19.67%
Δ % LGM	-7.36%	-7.95%	-8.63%	-9.45%	-10.44%	-11.65%	-13.19%
Δ % MatNonFat	-8.07%	-8.77%	-9.62%	-10.64%	-11.91%	-13.52%	-15.63%
Δ % SDRoE	2.16%	2.11%	2.07%	2.03%	1.99%	1.95%	1.91%
Δ % Z-score	1.11%	1.10%	1.09%	1.08%	1.07%	1.06%	1.04%



	4%	6%	8%	10%	12%	14%	16%
Δ % LTGap	-0.22%	-0.23%	-0.23%	-0.23%	-0.23%	-0.23%	-0.23%
Δ % LGM	-2.64%	-2.71%	-2.79%	-2.87%	-2.95%	-3.04%	-3.14%
Δ % MatNonFat	-1.34%	-1.36%	-1.38%	-1.40%	-1.41%	-1.44%	-1.46%
Δ % SDRoE	0.65%	0.65%	0.64%	0.64%	0.63%	0.63%	0.63%
Δ % Z-score	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%



	4%	6%	8%	10%	12%	14%	16%
Δ % LTGap	-3.02%	-3.11%	-3.21%	-3.32%	-3.43%	-3.55%	-3.69%
Δ % LGM	-3.92%	-4.08%	-4.25%	-4.44%	-4.64%	-4.87%	-5.12%
Δ % MatNonFat	-4.61%	-4.83%	-5.08%	-5.35%	-5.65%	-5.99%	-6.37%
Δ % SDRoE	3.66%	3.53%	3.41%	3.30%	3.19%	3.09%	3.00%
Δ % Z-score	2.97%	2.89%	2.81%	2.73%	2.66%	2.59%	2.52%

Chapter 3. Positive effects of Basel III on banking liquidity creation

3.1 Abstract, keywords and JEL classification

This paper estimates the effect of the Basel III regulatory framework on banking liquidity creation. The results are based on a panel data set of U.S. banks that represent approximately 60% of U.S. loans and deposits over a 7-year period (from 2009 to 2015) in addition to difference-in-difference and standard survival methods. All components of Basel III taken together, there is empirical evidence that Basel III has a positive effect on banking liquidity creation in the US market in particular for major banks. These findings have broad implications for policy makers.

Key words: Difference-in-difference, Cox, Survival, GMM, Basel III, Banking liquidity.

JEL Classifications: C3 - Econometric Methods: Multiple/Simultaneous Equation Models; C53 -Forecasting and Other Model Applications; G21 - Banks; Other Depository Institutions; Mortgages.

3.2 Introduction

This paper estimates the effect of the new banking regulatory framework – commonly referred to as Basel III – on banks' liquidity creation. Because the liquidity crisis of the banking sector was the cause of the 2007/2008 financial crisis, regulators have tightened banking liquidity ratios. Indeed, under the BIS (Bank of International Settlement) requirement and, in particular, Basel III, the LCR (liquidity coverage ratio) and NSFR (net stable funding ratio) have been created. The former underpins the short-term resilience of a

bank's liquidity risk profile, whereas the latter covers medium- and long-term liquidity capabilities. The LCR regulatory framework has been prioritized and will be deployed in an orderly fashion within a common timeframe among a significant majority of countries[13]. Although the deployment of the LCR will begin in 2015 and be completed in 2019, it will be subject to a transitional arrangement before reaching full implementation on 1 January 2019. In addition, certain requirements, such as the increase in tier 1 and core tier 1 capital, started in 2013.

In January 2014, the Basel Committee issued the final requirement for bank LCR-related disclosures; the regulatory and supervisory agencies required the banks belonging to their jurisdictions to disclose the LCR on 1 January 2014. For instance, calculation and reporting requirements have been applicable since 1 January 2014 in the EU[14]. In Switzerland, all banks reported the Basel III leverage ratio for Q3 2014. In the US, the leverage ratio included in the final Basel III rule was approved in July 2013 and has been in effect since 1st January 2014. To comply with this regulatory framework and as a potential signal addressed to the market, banks have started to anticipate these liquidity constraints.

What will the effects of such regulation be? Will the treatment (the Basel III regulatory framework) be positive, or will it ultimately weaken the banking sector? Overall, there is no consensus within the academic community on whether the effects will be positive or negative (Bancel and Salé (2016)). On one hand, by providing a cushion layer of extra

[13] An exhaustive list of countries that have signed the Basel III regulatory framework is available on the BIS web site. This list includes not only the G20 and EU countries but also Chile, Norway, the Republic of Korea, the Republic of China (Taiwan), and Switzerland. Additional information is available at : "http://www.bis.org/fsi/fsipapers.htm".

[14] Articles 451 and 521 of Regulation (EU) N° 575/2013.

liquidity, many experts estimate that this regulation will strengthen the banking sector against a liquidity crisis without additional social costs and will have overall positive effects. On the other hand, other authors wish to highlight the risk that inappropriate regulation can generate for liquidity creation; by obliging banks to allocate fewer available resources to fund their activity, the regulation reduces liquidity creation. From this perspective, the regulation ultimately weakens the macroeconomic environment, encourages shadow banking, and weakens the banking system.

Because banks began progressively implementing the required liquidity constraint before the official deadline of 1 January 2015, this paper proposes estimating the effect of this treatment on banking liquidity creation. To achieve this objective, two sets of methods have been used. The first, is Card and Krueger (1994), who use the difference-in-difference (D-in-D) method to estimate the effect of a wage increase policy on the fast food industry. Since their publication, this method has been broadly used by most econometricians to estimate a policy's effect. For robustness, the effect by using other methods, in particular, life table and Cox regression methods were analyzed. These methods offer additional insights into the policy effects and complete the analysis of the D-in-D estimation.

This paper is organized as follows: Section 1 reviews the literature on the effects of banking regulation on liquidity creation. It also provides a brief summary of the components of the Basel III regulatory framework. Section 2 describes the bank sample and the methodology and models applied to estimate the effects of Basel III. Section 3 estimates the effects of Basel III, using a set of methods that includes the D-in-D and additional methods

for robustness. Concluding remarks are drawn from these empirical findings and directed toward policy makers.

3.3 Literature review on the effects of the banking regulation on bank's liquidity creation and brief presentation of Basel III

The first part of this section reviews the literature on the effects of the banking regulation on the liquidity creation by banks. The second and last part presents the components of the Basel III regulatory framework.

3.3.1 Literature review on the effects of banking regulation on liquidity creation by banks

The effect of regulation on the banking sector has been the subject of debate for decades, and there is an extensive strand of the literature that addresses these effects (Admati, DeMarzo, Hellwig and Pfleiderer (2010)), in particular since the financial crisis. This literature first poses questions regarding the proper objective of financial regulation and sufficient measures to achieve the goal (Morris and Shin (2008)). For instance, Repullo (2005) shows that the existence of the lender-of-last-resort mechanism has both positive and negative effects: although it improves the safety of the financial system, it reduces the incentive for banks to self-insure against payment shocks. As a result, a liquidity buffer is necessary and must be supported by a regulatory framework. However, it is difficult to anticipate the effects of a regulation. Indeed, Morris and Shin (2004) suggest that inappropriate regulations can be the source of liquidity shortages, and Wagner (2007) shows

that an augmentation of liquid assets unexpectedly increases the instability of banks and the probability of failure. It is the inherent fragility of banks – that is, liquidity creation and the risk transformation process (Diamond and Rajan (1999)); Diamond and Rajan (2001)) – that motivates policy makers to establish regulatory constraints as a means to protect against banking fragility and to limit the spillover effects when a bank defaults. Ultimately, regulatory constraints may in turn reduce banking liquidity creation (Berger, Bouwman, Kick and Schaeck (2011).

Finally, at least one consensus can be reached. Given the complexity of the interconnection between the banking sector and the macroeconomic environment, it is necessary to measure the amplitude of the effect of Basel III on banking liquidity creation.

How can the effect of the regulation be measured? Several surveys have attempted to study the effect of banking regulation on liquidity. From a liquidity perspective, Berger, Bouwman, Kick and Schaeck (2011) assess the impact of regulatory interventions and capital support banking regulation in Germany on a panel of 2789 banks between 1999 and 2009; Horváth, Seidler and Weill (2014) examine the effect of Basel III on 31 Slovakian banks between 2000 and 2010, and Lei and Song (2013) study its effect on the capital structure of 135 Chinese banks between 1998 and 2009; Lakštutienė, Krušinskas and Rumšaitė (2011) explore the effect of deposit insurance systems on 8 Lithuanian banks between 1995 and 2008; and Fungáčová, Weill and Zhou (2010) study the implementation of deposit insurance by Russian banks between 1999 and 2007. Therefore, evaluating a regulatory framework's effects on banking activity is not new. However, based on the literature review, there is no study that estimates the effects of all component taken together of the Basel III regulatory framework on banking liquidity creation based on a broad set of methods.

By analyzing the impact of Basel III on a panel of US listed banks between 2009 and 2015 and by using a set of various methods to estimate the effect of a policy or a treatment, this paper addresses this gap. The set of methods used is detailed in the next section.

3.3.2 Summary of Basel III

This section discusses summarizes the Basel III regulatory framework. The first part summarizes the historical background of Basel III, the second and last part presents the components of Basel III.

3.3.2.1 From Basel I to Basel III, a brief history

At the onset of the 1980s, many American Latin countries were not able to pay their foreign debt. This "Latin American debt crisis" deteriorated the capital and generated systemic risk for the US banks, which triggered the regulators of the central banks to establish common standards in all important financial marketplaces. As a result, the G10 countries signed the 1988 accord that called for a minimum capital ratio of capital to risk-weighted assets of 8%. This accord evolved over time to entail precise definitions such as general provisions or general loan-loss reserves included in the capital adequacy calculation or rules on netting in derivative products. Finally, this framework was extended to all other countries with active international banks (Basel I). Despite these attempts to improve this regulatory framework, Basel I had a structural weakness. It did not provide the appropriate method to accurately compute the underlying risks. For this reason, the revised capital framework of

Basel II was released in June 2004; it had three objectives, also named the “three pillars”: (1) developing and expanding the standardized rules established in Basel I by imposing minimum capital requirements on all; (2) establishing a common supervisory review framework on institutions’ capital adequacy and internal assessment process; and (3) strengthening market discipline and encouraging sound practices by enforcing higher disclosure standards for the banking sector. However, the collapse of Lehman Brothers in September 2008 demonstrated that the combination of poor governance and risk management with excessively leveraged activities and insufficient liquidity buffers were the basements for misprices of credit and liquidity risk. To respond to these risks, in November 2010, the G20 Summit in Seoul established the new capital and liquidity standards, referred as Basel III.

3.3.2.2 Brief presentation of the Components of Basel III

This section presents briefly the main components of the new Basel III regulatory framework.

The Basel III regulatory framework has several facets, i.e., increasing tier 1 and core tier 1 capital, in terms of both quality and amount; imposing limits on leveraged activities; obliging banks to create cushions against liquidity risk; and promoting the development of organized markets for derivatives. The table below summarizes these components.

Insert Table 30.

From a broad liquidity perspective, the objective of this new regulatory framework is to ensure that banks hold sufficient liquid assets to protect against unpredictable payment

shocks (Ashcraft, McAndrews and Skeie (2011)), the contagious effects of which may lead to a global financial crisis. Thus, the principle is straightforward: banks must hold a certain amount of high-quality liquid assets (HQLA) to be able to potentially cover their liquidity needs for a certain number of days. Therefore, the liquidity risk is expected to decrease among the banks. The number of days depends mainly on the bank size in order to mitigate systemic risk. The table below summarizes the types of banks that are subject to the liquidity requirements of the new banking regulation. I acknowledge that there are multiple size thresholds in Basel III, and their application is not a simple function of bank size [15]. However, the observation indicates that 95% of US banks have a size of less than $10 bln (see section "3.4.1 Bank sample and the fraction of the market covered"). Consequently, it can be estimated that the population identified as untreated is virtually not concerned by the liquidity ratios. It enables to break down two types of population, i.e., untreated vs. treated, hence to tests the effects of the treatment i.e. the Basel III regulatory framework.

[15] With respect to the liquidity coverage ratio (LCR), here is a summary of the thresholds from the Federal Register (source: Federal reserve System, 12 CFR Part 249, Regulation WW; Docket No. 1525) "The final rule applies to large and internationally active banking organizations, generally, bank holding companies, certain savings and loan holding companies, and depository institutions with $250 billion or more in total assets or $10 billion or more in on-balance sheet foreign exposure and to their consolidated subsidiaries that are depository institutions with $10 billion or more in total consolidated assets. The final rule focuses on these financial institutions because of their complexity, funding profiles, and potential risk to the financial system. Therefore, the agencies do not intend to apply the final rule to community banks. In addition, the Board is separately adopting a modified minimum liquidity coverage ratio requirement for bank holding companies and savings and loan holding companies without significant insurance or commercial operations that, in each case, have **$50 billion** or more in total consolidated assets but that are not internationally active. The final rule is effective January 1, 2015, with transition periods for compliance with the requirements of the rule."

Insert Table 31.

By obliging banks to hold a certain amount of cash as insurance against liquidity shocks, it forces banks to internalize the cost of a financial crisis. Because the consequences of financial crises generate social costs, by internalizing this social cost within the banking sector, the liquidity ratios can finally be viewed as Pigouvian taxes.

However, does this new banking regulation affect the banking sector on a global basis and are the effects equally distributed? In the desire to ensure that all of the main players follow the same rules and to avoid distortions between competitors, the G20 countries (including all EU member states) and Chile, Norway, the Republic of Korea, the Republic of China (Taiwan), and Switzerland have agreed to adopt Basel III[16]. Equality of treatment is also ensured by the progressive deployment schedule of the Basel III LCR requirements, as shown in the table below.

Insert Table 32.

3.4 Bank sample, methodology and econometric model

This section begins with a short description of the data sources and of the panel representativeness. The second part presents the methodology used to estimate the effect of

[16] The BIS regularly edits a progress report on the adoption of the Basel regulatory framework. See the BIS website for the Basel committee publication : "http://www.bis.org/bcbs/publications.htm".

Basel III on bank liquidity creation. The third and last part is a descriptive statistics of the liquidity creation of the listed banks in the US market from 2009 to 2015.

3.4.1 Bank sample and the fraction of the market covered

This section shows the fraction of the market covered by the sample used in this research. The data were extracted from Thomson Reuters. Based on the original number of listed bank identifiers available in Thomson Reuters, 555[17] listed banks have been selected. From 2009 to 2014, the table below shows the number of banks per year.

Insert Table 33.

Because the panel data set is uniquely composed of listed banks, it is dominated by small banks. However, 95% of US banks have a small size of less than $10 bln and represent approximately 15% of the sum of assets of all US banks (figures not displayed), neutralizing the effect size of the number of small banks.

Following Berger and Bouwman (2008), I include data from the consolidated financial statements of mother companies, which include the financial statements of branches and subsidiaries but eliminate intragroup activities. I have carefully selected unique values for each bank and excluded their subsidiaries or branches. As shown by Cetorelli and Goldberg (2012) and Houston, James and Marcus (1997), banking groups tend to establish internal capital markets. Thus, if the liquidity creation of each bank belonging to the same group is summed, the total liquidity created is inflated. Therefore, to avoid double counting liquidity

[17] The number of banks varies per year because, every year, newcomers are in and closed banks are out.

creation, the banks selected exclude subsidiaries and branches. Additionally, foreign banks and their branches and subsidiaries are excluded. Therefore, each selected bank is a unique unit that corresponds to the mother company of a banking group. I acknowledge that these data are composed of 555 listed banks, excluding small banks. However, this exclusion does not obstruct the results because the panel is sufficiently representative. As shown in the table below, the panel data set indeed covers a substantial fraction of the US market.

Insert Table 34.

The banks selected in Thomson Reuters correspond to those classified in ICB industry sector 800 as "banks providing a broad range of financial services, including retail banking, loans and money transmissions," which may aggregate different business lines that correspond to various banking activities (e.g., M&A, commercial banks) or banks with state involvement (partially state-owned banks, fully private banks). Observe that the sample covers 61% and 60% of the deposits and loans, respectively, of the US market. Thus, the panel elaborated can be considered representative of the US market.

3.4.2 Methodology and econometric model

This section presents the results of the econometrics used to estimate the effect of Basel III on banking liquidity creation.

3.4.2.1 Measuring banking liquidity creation

This section describes the main measures used to estimate the banking liquidity creation and justifies why these measures were used.

To determine the impact on banking liquidity creation, I have first calculated liquidity creation based on the most common measures established: the LTGap and the BB-MatNonFat[18] established by Deep and Schaefer (2004) and by Berger and Bouwman (2009), respectively. Given that Thomson Reuters does not provide off-balance sheet data or offer the category of loans, only the BB-MatNonFat could be calculated. The table below shows how these two measures have been proxied and also details which Thomson Reuters items were used to compute them.

Because of Thomson Reuters' limitations on maturity, I followed Distinguin, Roulet and Tarazi (2013) to compute the liquidity measures. As a result, for US banks, the deposits were weighted at 33%, whereas for other banks, they were weighted at 80%. The net loans are all weighted at 85%. All amounts were deflated by the IMF inflation index (base 2005).

Insert Table 35.

[18] As per as defined in Chapter 2 (Article 2) p.83 : the Liquidity transformation (LT) is calculated as (liquid liabilities minus liquid assets) / total assets. In this article, this measure is abbreviated as "LTGap" The BB-MatNonFat", calculates liquidity creation using a 3-step procedure: it first classifies bank activities as liquid / semi-liquid / illiquid using information on both product category and maturity of each activity, except that for loans only maturity information is used (due to data limitations); it then applies a weighting scheme to these activities; finally, it calculates the dollar amount of liquidity created by an individual bank by multiplying the dollar amounts in the different buckets by the weights and summing the weighted amounts. Where Mat means that the balance sheet items have categorized by maturity and NonFat means that the off balance sheet is excluded because of Thomson Reuter's limitations that do not have these data. In this article, this measure is abbreviated as "BB-MatNonFat",

To check for correctness, I have compared the results of the measures computed in this research with those from the aforementioned authors and for similar periods. The table below demonstrates that, overall, these liquidity creation measures are consistent with those utilized by several authors.

Insert Table 36.

3.4.2.2 Measuring the effects of a policy

This section explains the models used to estimate the effect of Basel III on liquidity creation of banks: D-in-D and additional models used for robustness, i.e actuarial and Cox regression.

The main principle of the D-in-D method to assess the impact of a regulatory change on banks is similar to the survival models used in medical science to estimate the effects of a medical treatment on a population: it compares 2 populations – one is subject to the treatment, and the other is not –in two periods – before the treatment and after. In this paper, Basel III is considered to be the treatment, and the banking population is divided into 2 types of banks: those subject to Basel III ("treated") and those that are not ("untreated"). Following section 3.4, which summarizes the Basel III regulatory framework, the treated vs. untreated populations are divided based on their asset size ($50 billion).

The time series are between 2009 and 2015, where 2013 is the starting year of the implementation of the liquidity constraints. The organizational challenges implied by such a deployment for banks and the time given by regulators to banks to adjust to new capital requirements (Kashyap, Stein and Hanson (2010)) indicate that the banks started to prepare some years in advance to satisfy the first deadline requirements. In addition, two major

components of Basel III were implemented in 2013 : (1) the Leverage ratio disclosure and (2) the Minimum common equity capital ratio (3.5%). Thus, it is reasonable to assume that the effects of Basel III on liquidity creation started before the official deployment of liquidity ratios. I acknowledge that this estimation could be re-assessed at various stages in the future. However, this paper presents estimations that provide the first insights into the effects of Basel III on banking liquidity creation. For purposes of robustness and to complete the D-in-D estimation[19], a set of additional tools have been used to estimate the effects of the policy. Data before 2013 are considered as being before the deployment of the Basel III liquidity constraints, whereas data from 2013 are considered as being after this deployment. Given the potential interactions of the different components of Basel III on liquidity creation, this article estimates the effect of all components taken together, rather than estimating the effects of a particular component.

[19] However, the D-in-D method is concerned with analyzing the time to occurrence of an event, and though this method is robust, it also relies on key assumptions. The problem with using a linear regression to analyze liquidity creation lies with the assumption that a common trend affects equally both treated and untreated population. This assumption is weakened in particular when the treatment is spread out over time, as is the case for the Basel III deployment for which the time duration turns out to be long. In particular, the underlying causes of changes that do not relate to policy modification have evolved in the same way among the treated and untreated population. As a result, the D-in-D estimation is potentially challenged by the duration of the Basel III deployment, which occurs over several years. Because the key assumption of the D-in-D is weakened over a long period, additional methods have been established that address non-normal distribution of time to pre-estimate the effects of Basel III on banking liquidity creation. These methods also provide complementary perspectives. Additionally, and for robustness, the bank characteristics, bank risk typology, bank performance and macro environmental variables where used in the D-in-D as control variables, as shown in the columns 5 and 9 of Table 40.

The table below shows how the two population types – treated and untreated – have been elaborated.

Insert Table 37.

Categorization as treated vs. untreated is a function of bank size, where untreated banks are banks for which total assets are below 50 bln. A large strand of the literature shows that small and large banks behave differently. Although, from a theoretical perspective, the fundamental function of liquidity creation does not depend on the bank size, Berger and Bouwman (2009) document that large and small banks create liquidity in different ways when using a measure that includes the off-balance sheet balances. Thus, I have compared the averages, medians and standard deviations of liquidity creation per population and do not find large differences. For the untreated population, the average, median and standard deviation are 0.22, 0.23 and 0.06 for LT Gap and 0.30, 0.32 and 0.09 for MatNonFat scaled over assets, respectively. For the treated population, the average, median and standard deviation are 0.16, 0.19 and 0.10 for LT Gap and 0.23, 0.26 and 0.12 for MatNonFat scaled over assets, respectively (these figures are displayed in the table 38 and are shown in Figure 3). In addition, to estimate the degree of heterogeneity between the untreated and treated populations, I have computed the propensity score matching (Rosenbaum and Rubin (1983)). The PSM (Propensity Score Matching) is an estimate of the likelihood that any given individual would be in a treatment group, given a set of measures characteristics. Ranging from 0 to 1, the PSM is commonly notated as follow:

Equation 9

$$\Pr (Tr = 1 \mid x_1, x_2, \ldots x_n)$$

Where:

Pr indicates the likelihood that any given individual would be a treatment group

X_i, represent the set of variables or characteristics used to compare both population

To compute the distance between the two populations, the following bank-specific characteristics were aggregated:earnings per share, leverage ratio , standard deviation of RoE, equity over asset ratio; non-performing loans, z-score, paid shareholders over equity, loan growth, net income over assets and market price per bank. Windsorized at 5%, the rate of on support over total number of observations equals 96.55% (2971 over 3077; not displayed in the tables for brevity) for both LTGap and BB- BB-MatNonFat, providing strong evidence that, on liquidity creation perspective, both treated and untreated populations are nearly perfectly comparable, given the aforementioned set of inherent characteristics of banks.

Additional methods that estimate the Basel III effect on banking liquidity creation have been used for robustness. The first method is actuarial and the second method is the Cox regression method. For both the actuarial and the semi-parametric regression, the derivative of liquidity creation was used: it is the variance between y and y-1 of the liquidity creation from the LTGap and BB-MatNonFat. If the function is negative – liquidity creation over assets decreases between 2 reporting years – then it is considered to be a failure. If the function is positive – liquidity creation over assets increases between 2 reporting years – then it is considered to be a success. In addition, the log-rank tests for equality of derivative functions have been used to determine whether the differences in the functions differ significantly between treated and untreated samples and for both the LTGap and the BB-MatNonFat measures.

3.5 Descriptive statistics

The table below describes the liquidity creation indicators for the treated and untreated banks. The first indicator is LTGap, and the second is BB-MatNonFat scaled over assets and in US$ billions. Figure 3 shows the data displayed in Table 39 and depicts the evolution of the banking liquidity creation measures.

Insert Figure 3 and Table 38.

Two main observations can be drawn, as discussed below.

First, the 15 treated banks, which represent 3% of the total banks, amount to 70% of the liquidity created in the US, implying that Basel III affects a small number of banks but a significant portion of the liquidity created.

For liquidity creation measures scaled over assets:

- Average LTGap of untreated banks is stable at 0.22 between 2009 and 2015. For treated banks, the LTGap increased from 0.14 to 0.17 between 2009 and 2012, but decreased from 0.16 to 0.15 between 2013 and 2014 and then increased to 0.16 in 2015(columns 3 and 11). The medians follow the same trends.

- Average BB-MatNonFat over asset of untreated banks is stable at 0.30 between 2009 and 2014. For treated banks, BB-MatNonFat over asset increased from 0.20 to 0.24 between 2009 and 2013, but decreased to 0.22 in 2015 (columns 6 and 14). The medians follow the same trends.

For the liquidity creation measures in US$ billions (BB-MatNonFat, columns 9 and 17): liquidity creation by untreated banks steadily increased from US$342 bln to US$412 bln between 2009 and 2014 but decreased to US$410 bln in 2015. These figures are to be reconciled with the sharp decrease of small US banks as observed in table 4. For treated banks, liquidity creation increased from US$621 bln to US$899 bln between 2009 and 2013, then decreased to US$810 bln in 2014. It has sharply increased to US$923 bln in 2015, whereas the number of treated banks has remained stable to 15 banks (table 38).

Second, the observed negative evolution of banking liquidity creation among treated banks in 2014 is very small and is contradicted by an increase of liquidity creation in 2015. Based on the trends displayed in Figure 3, extrapolating the effects of Basel III on banking liquidity creation is difficult. Hence, the next section estimates the effects of Basel III with more sophisticated approaches.

3.6 Estimation of the effects of Basel III on banking liquidity creation

This section presents the results of the models that estimate the effect of Basel III on bank liquidity creation.

3.6.1 Estimation by D-in-D

This section shows the results of the D-in-D estimator. To estimate the policy effect, I have specified the model as follows:

Equation 10

$$\Delta \textit{ Liquidity created over assets }_{i,tn} = \beta 0 + \beta 1 G1 + \beta 2 R2 + \beta 3 (G \cdot R) + \varepsilon.$$

Where:

G equals 1 if the bank is treated; otherwise, 0.

R equals 1 if the subject was observed in the second period, otherwise 0.

$G \cdot R$ is the interaction term between G and R.

To control for endogeneity, I established a multivariate dynamic panel model GMM[20] estimator ((Arellano and Bover (1995); Berger and Bouwman (2009) and Imbierowicz and Rauch (2014); Distinguin, Roulet and Tarazi (2013)).

This GMM is itself based on an OLS model that is based on the determinants of liquidity creation from the literature review. Several studies have examined banking liquidity creation in other countries, such as Lei and Song (2013) in reference to China; Pana (2012) in reference to Japan; Lakštutienė and Krušinskas (2010) in reference to Lithuania; Al-Khouri (2012) in reference to Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates; Hackethal, Rauch, Steffen and Tyrell (2010) in reference to Germany; Fungáčová, Weill and Zhou (2010) and Fungáčová and Well (2012) in reference to Russia; Esterhuysen, Vuuren and Styger (2012) in reference to South Africa; and Horváth, Seidler and Weill (2014) in reference to the Czech Republic. All of these authors measure banking liquidity creation and test the effects of specific factors on it. Capital, risk, and macroeconomic factors are nearly always considered in these studies.

[20] Please refer to the note # 11 p.94 chapter 2 (article2) of the present thesis.

Based on the literature review, the model is constructed as follows. I use the dependent variable of liquidity creation (the LTGap and BB-MatNonFat scaled over assets), and the explanatory variables are (1) bank size, given that small banks may behave differently from large banks; (2) equity over assets, which is a proxy that measures the risk absorption effect (Repullo (2005); Coval and Thakor (2005)); (3) nonperforming loans over the total loans ratio, which is a proxy for the bank's risk management efficiency and credit risk profile (Acharya, Hasan and Saunders (2006)); (4) z-score, which is a proxy for bank strength originally proposed by Roy (1952); (5) the dividend paid out over the equity ratio, (6) loan growth, (7) Jensen (1968)'s alpha for excess returns, and (8) the market share value, which all proxy for bank performance (Hackethal, Rauch, Steffen and Tyrell (2010)); (9) the LT-ST spread, which is used to assess the effect of a country's monetary policy on liquidity creation in the banking sector; the use of this metric is justified by the sensitivity of bank lending/borrowing to the LT maturity yield and by the effect of the ST-LT spread structure on a bank's profit margin (Bernanke, Gertler and Gilchrist (1999)); (10) GDP growth and (11) the unemployment rate, which are proxies for the economic environment (Beck, Demirgüç-Kunt and Levine (2006), Imbierowicz and Rauch (2014), Hackethal, Rauch, Steffen and Tyrell (2010) and Lei and Song (2013)); and (12) the bank-level Herfindahl market competition index (HHI), which controls for market competition (Lei and Song (2013)). This variable is a proxy for market concentration; as shown by Beck, Demirguc-Kunt and Maksimovic (2004), market concentration impacts the availability of credit and, therefore, may affect liquidity creation.

Consequently, the model can be notated as follows:

Equation 11

$$\textit{Liquidity created over assets}_{i,t} = \beta 0 + \beta 18\ \textit{Liquidity created over assets}_{i,t-1} +$$

$\beta 1$ *Bank size* $_{i,t}$ + $\beta 2$ *Equity scaled over asset* $_{i,t}$ + $\beta 3$ *cash dividend paid over shareholder's equity*$_{i,t}$ + $\beta 4$ *Non performing loans over loans* $_{i,t}$ + $\beta 5$ *Z-score* $_{i,t}$ + $\beta 6$ *Loan growth*$_{i,t}$ + $\beta 7$ *Jensen's excess return* $_{i,t}$ + $\beta 8$ *Market value per share* $_{i,t}$ + $\beta 9$ *LT-ST yield curve spread* $_{j,t}$ + $\beta 10$ *GDP growth* $_{j,t}$ + $\beta 11$ *Unemployment rate* $_{j,t}$ + $\beta 12$ *HHI market concentration index* $_{j,t}$ + ε

The table below shows the items selected to compute the aforementioned determinants.

Insert table 39.

OLS regressions were conducted by using the standard robust approach and by clustering banks to control for heteroskedasticity. For the omitted variables, a time fixed-effect test was conducted to check for average variances in liquidity creation across years that would not be accounted for by the former exogenous variables and to diminish the risk of serial correlation. In addition, the regression models were tested to ensure that no collinearity or size effects were present. They show p-values of less than 0.001 with Eta² or Omega² values of less than 0.4. Student tests show p-values of less than 0.001.

The table below displays the results of the aforementioned econometric model and they indicate that the model is robust to endogeneity and fixed effects. The table below shows also the results of the D-in-D estimator for both the LTGap and BB-MatNonFat measures.

Insert Table 40

For the LTGap, the results show that the interaction term is 0.28** (columns 4). This interaction term, controlled by the determinants of liquidity creation, remains very significant

at 0.24** (column 5). For BB-MatNonFat, the interaction term has a coefficient of 0.28** (column 8). Controlled by the determinants of banking liquidity creation, the interaction term remains significant at 0.25*.

Based on the findings of the D-in-D analysis, it can be concluded that Basel III has a positive effects on banking liquidity creation, for both LTGap and BB-MatNonFat scaled over asset measures.

3.6.2 Robustness tests and estimation with additional methods

This section presents the results of additional models used to estimate the effects of Basel III on bank liquidity creation, for robustness: actuarial model and semi parametric regression.

For both the actuarial and the semi-parametric regression, I use the derivative of liquidity creation: it is the variance between y and y-1 of the liquidity creation from the LTGap and BB-MatNonFat. If the function is negative – liquidity creation over assets decreases between 2 reporting years – then it is considered to be a failure. If the function is positive – liquidity creation over assets increases between 2 reporting years – then it is considered to be a success. In addition, the log-rank tests for equality of derivative functions have been used to determine whether the differences in the functions differ significantly between treated and untreated samples and for both the LTGap and the BB-MatNonFat measures.

3.6.2.1 Actuarial

The results of the actuarial method are displayed in the graph below and demonstrate that Basel III has little effect on banking liquidity creation. The data are sourced from the actuarial life table that has been calculated.

Insert Figure 4 and Table 41

The evolution of the curves of the untreated and treated banks shows that there are no substantial differences between these two types of bank. From the actuarial perspective, between 2008 and 2013, the results indicate that the new banking regulation did not affect substantially the liquidity creation of the banking sector. The curve, however, indicates that the survival function, which was lower for untreated banks, crosses the curve of treated banks in 2011 and is higher in 2015 for both measures. The life table below shows the results of this actuarial estimation and indicates that the liquidity creation for treated population becomes higher than untreated population. It suggests that the cure enables the treated banks to create more liquidity than their untreated peers, which is consistent with the D-in-D.

3.6.2.2 Cox regression and comparison of banks' propensity to create liquidity

The Cox regression provides additional clues on the propensity of banks to create liquidity. This model reports the hazard rate *h(t)* (that is, the probability of creating liquidity at time t conditional on not creating liquidity) for a set of explicative variables:

Equation 12

$$h(t) = h0(t) \exp(X'\beta)$$

where *h0(t)* is the baseline hazard rate at time t for the covariate vector set at 0, and β is a vector coefficient. The Cox hazard regression is a semi-parametric model that does not require assumptions about the baseline hazard. The table below presents the exponentiated coefficients ((*exp(β1)*, *exp (β2)*,…) rather than the coefficients (*β1, β2*,…) and also shows the results and the hazard ratio for specific bank characteristics, including bank size, risk level and equity level. These explicative variables have been layered to satisfy the proportional-hazards assumption. For the risk levels, the stratification corresponds to the quintile, where level of risk_2 corresponds to quintile 1 of the std. dev. of RoE less than or equal to 25%, level of risk _3 corresponds to quintile 2 of the std. dev. of RoE less than or equal to 50%, and level of risk_4 corresponds to quintile 3 of the std. dev. of RoE less than or equal to 75%. With regard to bank size, small banks are those with total assets of less than $US50 bln, medium banks are those with total assets of between $US50 bln and $US250 bln, and large banks are those with total assets of $US250 bln or more.

Insert Table 42.

The results indicate that liquidity creation is closely linked to risk. The estimated hazard ratio exhibits a regular increase when the standard deviation of RoE moves to a higher

quintile. For instance, between quintile 2 and 4 the estimates increase from 1.313*** and 1.282*** to 1.625*** and 2.510*** for the LTGap and BB-MatNonFat, respectively. The coefficients of bank size are not significant, which makes it difficult to extrapolate the effects by the bank size category. It also indicates that on liquidity perspective, the bank size does not make the difference, which is consistent with the PSM tests.

The hazard ratio estimates tend to decrease when the level of equity is augmented. For instance, at the lower level of equity over assets of less than or equal to5% (IStratEqoA0), the coefficient is 1.155 and 1.516** for the LTGap and BB-MatNonFat, respectively. At the level of equity less than 5% to 7.5% (IStratEqoA1), the coefficient is 1.271 and 1.097 for the LTGap and BB-MatNonFat, respectively. At the level of equity less than 7.5 % to 10% (IStratEqoA2), the coefficient is 0.937and 0.762* for the LTGap and BB-MatNonFat, respectively. At the level of equity less than 10 % to 12.5% (IStratEqoA3), the coefficient is 0.865 and 0.748* for the LTGap and BB-MatNonFat, respectively. At the level of equity less than 12.5 % to 15% (IStratEqoA3), the coefficient is 0.845and 0.740* for the LTGap and BB-MatNonFat, respectively.

This finding is evidence that as the risk profile of the bank increases, the probability of failure with regard to liquidity creation for both the LTGap and the BB-MatNonFat measures increases. The results also confirm that, increase of capital contributes to increase the probability of liquidity creation.

However, unlike the LTGap measure, the BB-MatNonFat measure is observably sensitive to changes in the funding structure. Berger and Bouwman (2009) highlight this

endogeneity issue and view it as a correlation matter instead of a causal relationship. As pointed out by (Distinguin, Roulet and Tarazi (2013)), they address this endogeneity using instrumental variable regressions.

3.7 Conclusions

Although the primary focus of this paper has been to determine the effects of Basel III on banking liquidity creation, the results presented herein have broader applicability for policy makers. First, the choice of the measure is not neutral either. Because the BB-MatNonFat measure is constructed with funding structure data, it is more sensitive to the effects of Basel III. It can be concluded that the LTGap measure is more appropriate for measuring the effects of Basel III on liquidity creation, although the BB-MatNonFat measure and its variants offer considerable advantages when estimating liquidity creation in terms of volume.

Though the deployment of the Basel III will be fully in place in 2019, the results are significant and robust. The empirical results of this research indicate that, all components of Basel III taken together, the positive effects are higher than the negative effects. It implies that the synergies of the different component create an overall positive effect (for instance risk reduction and stabilization of the financial sector) that is superior to the negative effects that some components taken individually may have on liquidity creation. These findings have broad implications for policy makers.

3.8 Tables and figures

Table 30: Key aspects of Basel III

This table summarizes the Basel III key components (source: the Bank for International Settlements (BIS) and the US Federal Reserve). Column 1 displays the key components of Pillar1 –Capital, column 2 for pillar 1 – risk coverage, the column 3 for pillar 1- Containing leverage; column 4 pillar 2 -Risk management and supervision, column 5 pillar 3 – market discipline and column 6 – liquidity. The row at the bottom makes a special note for systemically important financial institutions (SIFIs).

	Capital					Liquidity
	Pillar 1			Pillar 2	Pillar 3	
	Capital	**Risk coverage**	**Containing leverage**	**Risk management and supervision**	**Market discipline**	**Global liquidity standard and supervisory monitoring**
All banks	**Quality and level of capital** - Greater focus on common equity. - The minimum will be raised to 4.5% of riskweighted assets, after deductions. **Capital loss absorption at the point of non-viability** - Contractual terms of capital instruments will include a clause that allows – at the discretion of the relevant authority – write-off or conversion to common shares if the bank is judged to be non-viable. - This principle increases the contribution of the private sector to resolving future banking crises and thereby reduces moral hazard. **Capital conservation buffer** Comprising common equity of 2.5% of risk-weighted assets, bringing the total common equity standard to 7%. Constraint on a bank's discretionary distributions will be imposed when banks fall into the buffer range. **Countercyclical buffer** Imposed within a range of 0-2.5% comprising common equity, when authorities judge credit growth is resulting in an unacceptable build up of systematic risk.	**Securitisations** - Strengthens the capital treatment for certain complex securitisations. - Requires banks to conduct more rigorous credit analyses of externally rated securitisation exposures. **Trading book** - Significantly higher capital for trading and derivatives activities, as well as complex securitisations held in the trading book. - Introduction of a stressed value-at-risk framework to help mitigate procyclicality. - A capital charge for incremental risk that estimates the default and migration risks of unsecuritised credit products and takes liquidity into account. **Counterparty credit risk** Substantial strengthening of the counterparty credit risk framework. Includes: more stringent requirements for measuring exposure; capital incentives for banks to use central counterparties for derivatives; and higher capital for inter-financial sector exposures. **Bank exposures to central counterparties (CCPs)** The Committee has proposed that trade exposures to a qualifying CCP will receive a 2% risk weight and default fund exposures to a qualifying CCP will be capitalised according to a risk-based method that consistently and simply estimates risk arising from such default fund.	**Leverage ratio** A non-risk-based leverage ratio that includes off-balance sheet exposures will serve as a backstop to the risk-based capital requirement. Also helps contain system wide build up of leverage.	**Supplemental Pillar 2 requirements.** Address firm-wide governance and risk management; capturing the risk of off-balance sheet exposures and securitisation activities; managing risk concentrations; providing incentives for banks to better manage risk and returns over the long term; sound compensation practices; valuation practices; stress testing; accounting standards for financial instruments; corporate governance; and supervisory colleges.	**Revised Pillar 3 disclosures requirements** The requirements introduced relate to securitisation exposures and sponsorship of off-balance sheet vehicles. Enhanced disclosures on the detail of the components of regulatory capital and their reconciliation to the reported accounts will be required, including a comprehensive explanation of how a bank calculates its regulatory capital ratios	**Liquidity coverage ratio** The liquidity coverage ratio (LCR) will require banks to have sufficient highquality liquid assets to withstand a 30-day stressed funding scenario that is specified by supervisors. The Liquidity Coverage Ratio applies to U.S. banks as follow: 1- Large Bank Holding Companies (BHC) – those with over $250 billion in consolidated assets, or more in on-balance sheet foreign exposure, and to SiFis : 30 days, 2 - Regional banks, whose gross total asset is between $50 and $250 billion : 21 days 3 - Small banks, whoc gross total asset is lower than $50 billion : reprieve **Net stable funding ratio** The net stable funding ratio (NSFR) is a longer-term structural ratio designed to address liquidity mismatches. It covers the entire balance sheet and provides incentives for banks to use stable sources of funding. **Principles for Sound Liquidity Risk Management and Supervision** The Committee's 2008 guidance Principles for Sound Liquidity Risk Management and Supervision takes account of lessons learned during the crisis and is based on a fundamental review of sound practices for managing liquidity risk in banking organisations. **Supervisory monitoring** The liquidity framework includes a common set of monitoring metrics to assist supervisors in identifying and analysing liquidity risk trends at both the bank and system-wide level
SiFis	In addition to meeting the Basel III requirements, global systemically important financial institutions (SIFIs) must have higher loss absorbency capacity to reflect the greater risks that they pose to the financial system. The Committee has developed a methodology that includes both quantitative indicators and qualitative elements to identify global systemically important banks (SIBs). The additional loss absorbency requirements are to be met with a progressive Common Equity Tier 1 (CET1) capital requirement ranging from 1% to 2.5%, depending on a bank's systemic importance. For banks facing the highest SIB surcharge, an additional loss absorbency of 1% could be applied as a disincentive to increase materially their global systemic importance in the future. A consultative document was published in cooperation with the Financial Stability Board, which is coordinating the overall set of measures to reduce the moral hazard posed by global SIFIs.					

Table 31: Summary of the types of banks potentially affected by the new liquidity ratio requirements.

This table summarizes the Basel III major high-quality liquid assets (HQLA) required for the liquidity coverage ratio (LCR). The first column displays the bank size in US$ billions and its equivalent. The second column shows the number of days required by the LCR. Source: BIS.

Bank size (in $ Bn or equivalent)	LCR ratio requirements
Less than 50 and shadow banks	Reprieve
Between 50 and 250	21 days
More than 250	30 days

Table 32: Summary of the LCR implementation schedule.

The table below shows the main schedule of the LCR deployment. The first column displays the minimum LCR requirement; the next columns display this minimum in % per year: 2015, 2016, 2017, 2018, and 2019. Source: BIS.

Year	2015	2016	2017	2018	2019
Minimum LCR requirement	60%	70%	80%	90%	100%

Table 33: Data set – number of banks per geographical zone and year

The table below shows the number of untreated and treated banks per year. The first column indicates the year, and the second column indicates the number of listed banks. The banks selected in Thomson Reuters correspond to those classified in ICB industry sector 800 as "banks providing a broad range of financial services, including retail banking, loans and money transmissions." To avoid double counting from the same group of banks, the banks selected exclude subsidiaries and branches. Foreign banks and their branches and subsidiaries are also excluded. Thus, each bank is a unique US bank unit.

Year	Number of banks		
	Untreated	Treated	Total
2009	532	16	548
2010	521	16	537
2011	516	15	531
2012	497	15	512
2013	486	15	501
2014	414	15	429
2015	362	15	377

Table 34: Fraction of the market covered by the sample

The table below shows the fraction of the market covered by the sample based on 2011 figures. The first column indicates the country, for instance, the United States. Columns 2 and 3 display the number of US banks, the total deposits and total loans in US$ billions from the current sample of Thomson Reuters. Columns 6 and 7 display the total deposits and total loans in the U.S., as recorded by the DIC and the American Bankers Association, respectively. Columns 8 and 9 display the % of total deposits and total loans covered by the current sample over the total recorded by the American Bankers Association.

Country	Thomson Reuters (current sample)			Data from local bankers association		Sample over total per country	
	Number of banks	Deposits	Loans	Deposits	Loans	Deposits	Loans
	2011	$ Bln	$ Bln	$ Bln	$ Bln	%	%
1	2	4	5	6	7	8	9
United States	531	6 165	4 977	10 183	8 249	61%	60%

Table 35: Items for computing the liquidity creation measures

The table below identifies the Thomson Reuters items used to proxy the liquidity creation measures: the "LTGap" measure, as established by Deep and Schaefer (2004), and the "B-B MatNonFat" measure, as established by Berger and Bouwman (2009). The first column displays the level of liquidity: liquid, semi-liquid and illiquid. Column 2 displays the asset items; column 3, the asset weight; column 4, the liabilities item; and column 5, the liabilities weight for the LTGap measure. This order is replicated for the BB MatNonFat measures. Observe that, for US banks, the deposits were weighted at 33%, whereas for other banks, they were weighted at 80%. The net loans are all weighted at 85%. All amounts were deflated by the IMF inflation index (base 2005).

Liquidity level	LTGap				BB MatNonFat			
	Asset		Liabilities		Asset		Liabilities	
	Item	Weight	Item	Weight	Item	Weight	Item	Weight
1	2	3	4	5	6	7	8	9
Liquid	WC02205 - Treasury Securities	-1	WC03019 - Cust Dep	1	WC02205 - Treasury Securities	-0.5	WC03019 - Cust Dep	0.5
	WC02208 - Trading account Securities				WC02208 - Trading account Securities			
	WC02004 - Cash and Due from Banks				WC02004 - Cash and Due from Banks			
	WC02055 - Interbank Loans				WC02055 - Interbank Loans			
Semi liquid	NA	NA	NA	NA	WC02055 - Interbank Loans	0	WC03051 - Total ST debts	0
Illiquid	NA	NA	NA	NA	WC02271 - Loans	0.5	WC03251 - LT Debts	-0.5
	NA	NA	NA	NA			WC03995 - Total Shareholder's Equity	
Scaled over asset	WC02999 - Total Assets							

Table 36: The results of the liquidity creation measures compared with other articles

The table below compares the LTGap and BB-CatNonFat liquidity creation measures for US, German and Chinese banks. Note that I only present the MatNonFat measure, whereas other researchers show only the CatNonFat measures, which makes it difficult to conduct a strict comparison. The differences found are in line with the results of Berger and Bouwman (2009), who find that CatNonFat values are generally lower than MatNonFat values

	Deep and Schaefer (2004)		Berger and Bouwman (2009)				Hackethal et al. (2010)				Lei and Song (2013)	
	US banks 1997-2001		US banks 1993 - 2003				German banks 1997 - 2006				Chinese banks 1988 - 2008	
	Their article	This article	Their article		This article		Their article		This article		Their article	This article
	Quarter - all periods	Annual - all periods	1993	2003	1993	2003	BB - CatNonFat	LT Gap	BB- MatNonFat	LT Gap	BB - CatNonFat	BB- MatNonFat
1	2	3	4	5	6	7	8	9	10	11	12	13
Mean	0.20	0.17	0.22	0.26	0.25	0.28	0.18	0.14	0.29	0.11	0.28	0.37
Median	0.21	0.18	NA	NA	0.27	0.30	0.18	0.13	0.28	0.11	NA	0.37
Standard deviation	0.16	0.08	NA	NA	0.09	0.10	0.09	0.02	0.22	0.24	NA	0.05

Table 37: Definition of population treated vs. population untreated

The table below identifies the types of banks that are affected by Basel III LCR requirements ("treated") and those that are not ("untreated"). The first column indicates the bank size in US$ billions or equivalent, the second column indicates whether the bank is subject to Basel III, and the last column indicates whether the bank is considered to be "treated" or "untreated."

Bank size (in $ Bn or equivalent)	Banking regulation	Treated / Untreated
Less than 50 and shadow banks	Reprieve	Untreated
More than 50	Impacted	Treated

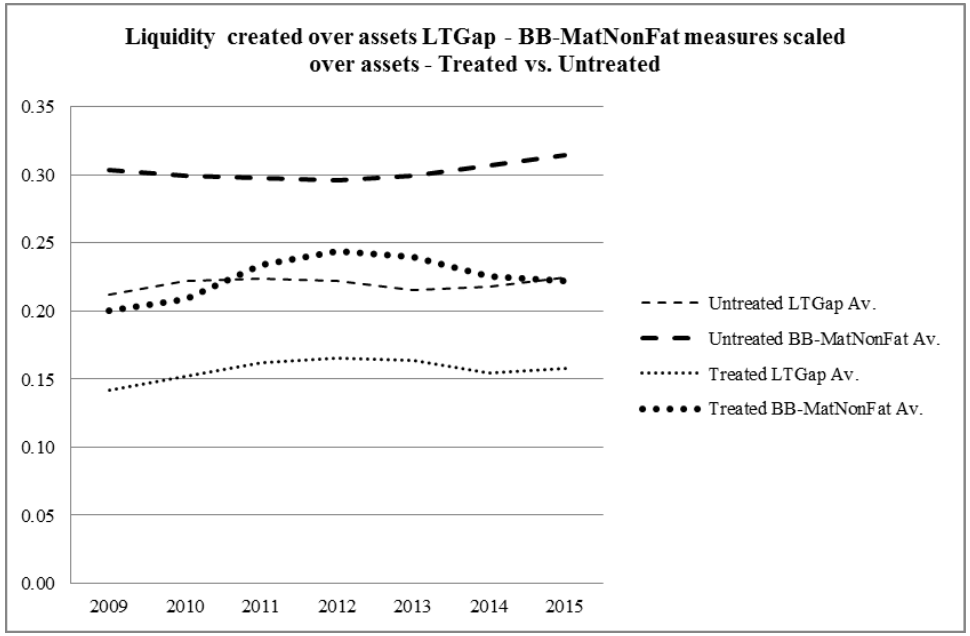
Table 38: Comparative evolution of liquidity creation indicators: Untreated, treated and all banks

The table below shows the evolution of the main liquidity creation indicators of both the treated and the untreated banks from 2008 to 2015. The LT gap corresponds to the liquidity creation measure established by Deep and Schaefer (2004). The second metric corresponds to the liquidity creation measure established by Berger and Bouwman (2009). The latter is shown scaled over assets. Column 1 displays the year. For untreated banks (columns 2 to 9), columns 2 to 5 display the number of observations and the mean, median, and standard deviation of the LTGap measure, respectively. Columns 6 to 9 display the number of observations and the mean, median, and standard deviation of BB-MatNonFat measure scaled over assets and the BB-MatNonFat in US$ billions, respectively. This order is replicated for treated banks (columns 10 to 17) and for all banks (columns 18 to 25).

RepY	Untreated								Treated								All							
	LTGap				BB-MatNonFat o. Assets				LTGap				BB-MatNonFat o. Assets				LTGap				BB-MatNonFat o. Assets			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	N	Av.	Med.	Std Dev	Av.	Med.	Std Dev	Bn $	N	Av.	Med.	Std Dev	Av.	Med.	Std Dev	Bn $	N	Av.	Med.	Std Dev	Av.	Med.	Std Dev	Bn $
2009	532	0.21	0.23	0.06	0.30	0.32	0.09	342	16	0.14	0.18	0.10	0.20	0.24	0.13	621	548	0.18	0.20	0.08	0.25	0.28	0.11	962
2010	521	0.22	0.23	0.05	0.30	0.31	0.11	340	16	0.15	0.19	0.11	0.21	0.25	0.13	626	537	0.19	0.21	0.08	0.25	0.28	0.12	966
2011	516	0.22	0.24	0.05	0.30	0.31	0.09	352	15	0.16	0.19	0.10	0.23	0.26	0.11	804	531	0.19	0.21	0.08	0.27	0.29	0.10	1157
2012	497	0.22	0.24	0.06	0.30	0.31	0.09	372	15	0.17	0.20	0.11	0.24	0.28	0.12	853	512	0.19	0.22	0.08	0.27	0.29	0.10	1224
2013	486	0.22	0.23	0.06	0.30	0.32	0.10	391	15	0.16	0.19	0.09	0.24	0.29	0.11	899	501	0.19	0.21	0.08	0.27	0.30	0.10	1290
2014	414	0.22	0.23	0.06	0.31	0.32	0.10	412	15	0.15	0.19	0.10	0.23	0.26	0.11	810	429	0.19	0.21	0.08	0.27	0.29	0.10	1222
2015	362	0.22	0.24	0.05	0.31	0.33	0.10	410	15	0.16	0.19	0.09	0.22	0.25	0.10	923	377	0.19	0.21	0.07	0.27	0.29	0.10	1333
Total / av.	3328	0.22	0.23	0.06	0.30	0.32	0.10	2 617	107	0.16	0.19	0.10	0.22	0.26	0.12	5 535	3435	0.19	0.21	0.08	0.26	0.29	0.11	8 153

Figure 3: Evolution of liquidity creation– treated vs. untreated

The graphs below show the evolution of liquidity creation from two perspectives. The figure on the left side displays the evolution of the LTGap measure and BB-MatNonFat measure scaled over assets. It displays the results from 2009 to 2015 for both the treated and the untreated bank populations. The figure on the right side displays the evolution of the BB-MatNonFat measure from 2009 to 2015 in US$ billions for both the treated and the untreated populations. Data correspond to the averages displayed in Table 38.



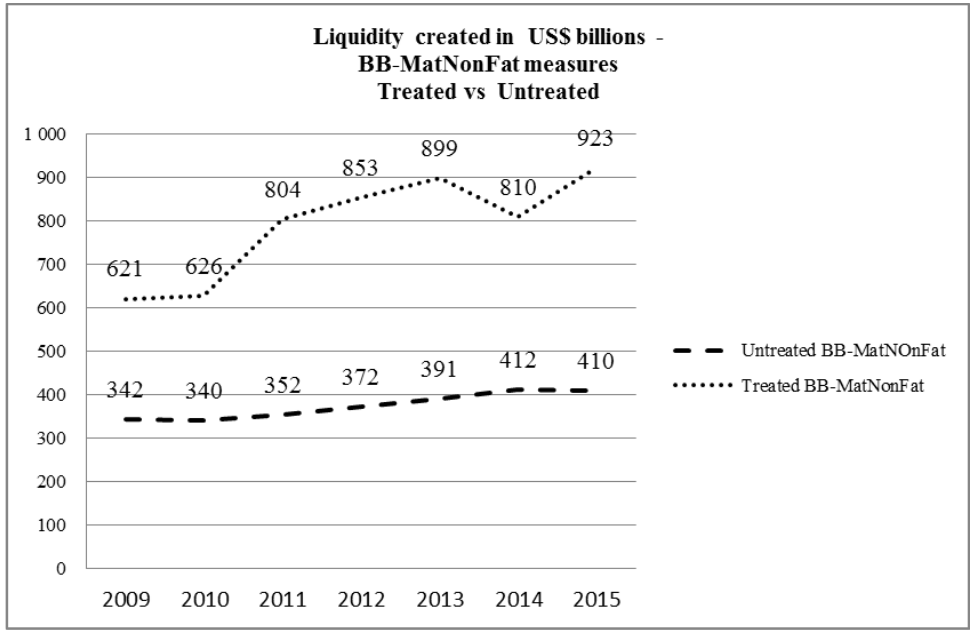


Table 39: List of variables that affect liquidity creation

The table below lists the explained and explicative variables, including the control variables used for the robustness tests in the regression model established herein. The first column shows the typology of the variable; the second lists the variable name; the third lists the shorthand variable name used in the GMM, OLS and Cox regressions; the fourth indicates whether a variable was scaled; the fifth lists the expected relationship with liquidity creation; and the last column shows how the variable was calculated.

Variable typology	Variable name	Variable name in the OLS	Tukey' scale type	Predictive sign	How this variable is computed and Thomson Reuters definitions
1	2	3	4	5	6
Liquidity creation variable 1	LTGap	Y1LTGap at t and t+1 (for GMM)	NA		LT gap as proposed by Deep and Schaefer (2004). Deflated based on the IMF inflation index (2005=100)
Liquidity creation variable 3	BB-MatNonFat	Y2NLC at t and t+1 (for GMM)	Scaled over assets		Liquidity created as measured by the BB-measure, which proxies the "MatNonFat". Deflated based on the IMF inflation index (2005=100)
Bank characteristics	Bank size	X1BkSizeUSD	Log	+	Firm size is measured as follows in this research: Log Total Assets (item WC02999).
	Level of equity	X2EQoA	NA	-	Common equities (item WC03501) / Total assets (item WC02999)
	Agency : Dividend paid out over shareholders' equity ratio	X3PayShldrsoEq	NA	+	Cash dividends (item WC04551) over Shareholders' equity (item WC03995). Cash dividends (item WC04551) represents the total common and preferred dividends paid to shareholders of the company. Total Shareholder's Equity (item WC03995) represents the sum of Preferred Stock and Common Shareholders' Equity.
Bank risk typology	Credit risk : NPL over Loans	X4NPLoLoans	NA	-	Non Performing loans over loans is the control variable that proxies the risk management. NPLoLoans = Non performing loans (item WC02285) / Loans total (item WC02271).
	Bank stability risk : z-score	X5Z	Log	+	The z-score as proposed originally by Roy (1952): RoA+ Equity over Asset divided by standard deviation of RoA. This bank risk indicator measures the bank's distance to insolvency. Inversely related to the probability of default, the sign is expected to be positive. - Standard deviation of RoA = Net Income Total (item WC01751) / Total assets (item WC02999). Tthe standard deviation requires at least three observations, is rolling and is computed every year (step of maximum 5 years). - Net Income Total (WC01751) , represents the net income of the company, before extraordinary items.
Bank performance	Loan growth	X6LnGwth	NA	+	Loan growth is a proxy for bank's growth opportunity. It is the variation of total loans over one reporting year LnGwth : (Loans Total Y of bank i- Loans total Y-1 of bank i) / Loans total Y-1 of bank 1 - [Where Loans total is item WC02271]
	Excess Return	X7ExcssR	NA	+	Jense's Excess Return (α) = R(a) – R(f) – Beta(a,m) [R(m) - R(f)] ; beta is the common indicator [Cov (a, m) / Variance (m)], where R(a) is the return of market share, R(f) is the return of benchmark government bonds, R(m) is the return of the market index for the market where the bank is listed. Var(x) and Cov (x, y) require at least three observations. Covariances and variances are rolling and computed every year (step of maximum 5 years). Market price = Market value per share (item WC05001).
	Market share value	X8MktPrice			Market value per share (item WC05001).
Monetary policy	Yield curve spread	X9YieldSpread	NA	+	Interest rate spread between 3-months and 10 year government bond. Source : Thomson Reuters.
Macro environment	GDP growth per country	X10GDPgwth	NA	+	The GDP growth corresponds to the yearly growth of GDP of the country in which the bank is located. Source : International Monetary Fund, World Economic Outlook Database, October 2014.
	Unemployment	X11UnmpRate	Sqrt	+	Unemployment rate for the country where the bank is located. Source : IMF.
	Hirshman-Herfindhal Index of market concentration	X12HHI	NA	+	Computed as follows : HHI = Squared [Loan market share = Total (item WC02271) countervalued in KUSD / Total loan (BIS data) in KUSD per country where the bank is located]. Yearly Foreign exchange rate is that of IMF, closing end of year.
Omitted variables	Set of dummies for all but one year. Per bank.	NA	NA	+ / -	Fixed effects : $country_j$, where the bank is located.

Table 40: D-in-D, robust regressions with fixed effects and GMM estimators

The table below shows the results of the D-in-D robustness regression with fixed effect and GMM estimators. The explained variables are the LTGap and BB-MatNonFat measures scaled over assets. Columns 1 to 3 indicate the typology, the comprehensive name and the name of the explicative variables, respectively. Columns 4 to 7 display the results for the LTGap measure. Column 4 displays the results for the D-in-D estimated with only the interaction term. Column 5 displays the results of the D-in-D but with the explicative variables, which in this case act as control variables. Columns 6 and 7 display the results of the robustness regression that controls for heteroskedasticity and the fixed effects estimators per bank, respectively. The LTGap (columns 4-7) order is replicated for BB MatNonFat measure (columns 8-10), respectively. Columns 10 to 15 display the results of the GMM estimators with heteroskedastic robust standard errors for the LTGap and BB MatNonFat measures. T-statistics are reported in brackets below the estimated coefficients, and the number of asterisks indicates the level of significance, with * for p<0.05, ** for p<0.01 and *** for p<0.001. The Sargan J p(chi²) is reported at the bottom.

Typology	Comprehensive name	Name (if GMM correspondent coefficients)	LTGap				BB-MatNonFat				GMM	
			D-in-D		Std. Regression		D-in-D		Std. Regression		LTgap	BB-MatNonFat
					Robust	fixed effect (bank level)			Robust	fixed effect (bank level)		
			LTGapCrtdY0	LTGapCrtdY0	Y1LTGapt0	Y1LTGapt0	BBCrtdY0	BBCrtdY0	Y3NLCt0	Y3NLCt0	Y1LTGapt1	Y3NLCt1
1	2	3	4	5	6	7	8	9	10	11	13	14
DID	Dummy before (0) / After (1)	BefAft	0.0524**	0.317***			-0.201***	0.130**				
			(2.94)	(6.07)			(-11.91)	(2.84)				
DID	Dummy Untreated (0) / Treated (1)	Treated_0N_1Y	-0.131*	-0.219***			-0.0606	-0.0681				
			(-2.24)	(-3.31)			(-0.95)	(-0.93)				
DID	Interaction term	interactionLiqCrtdPop	0.279**	0.252**			0.277**	0.256*				
			(2.97)	(2.74)			(2.80)	(2.56)				
Liquidity creation	Variable at t0	Y1LTGapt0 / Y3NLCt0									0.785***	0.861***
											(25.39)	(40.27)
Bank characteristics	Bank size	X1BkSizeUSD		0.0109	-0.00936***	0.0105		-0.0141	-0.0198***	0.0246*	-0.00198	-0.00138
				(0.64)	(-5.98)	(0.96)		(-0.93)	(-8.64)	(2.07)	(-1.07)	(-0.74)
Bank characteristics	Level of equity	X2EQoA		0.242	-0.366***	-0.237***		0.158	-0.715***	-0.593***	0.408***	0.181*
				(1.02)	(-9.70)	(-5.43)		(0.47)	(-10.72)	(-12.52)	(5.32)	(2.51)
Bank characteristics	Dividend paid out	X3PayShldrsoEq		-0.481	-0.192**	-0.140**		-1.551*	-0.295*	-0.183***	-0.0382	-0.374
				(-1.20)	(-2.78)	(-2.89)		(-2.57)	(-2.43)	(-3.47)	(-0.12)	(-1.18)
Bank risk typology	Credit risk	X4NPLoLoans		0.627*	-0.222***	-0.0440		0.989	-0.371***	-0.0866*	-0.139	-0.222
				(2.45)	(-3.58)	(-1.39)		(1.81)	(-3.94)	(-2.51)	(-1.54)	(-1.91)
Bank risk typology	Bank stability risk : z-score	X5Z		0.00783	0.000267	0.00184		-0.0715***	-0.00735	0.00447	-0.0126*	-0.00511
				(0.41)	(0.10)	(0.65)		(-3.58)	(-1.69)	(1.45)	(-2.12)	(-0.91)
Bank performance	Loan growth	X6LnGwth		-0.112	0.0212**	0.00354		-1.129***	0.0451***	0.0154**	0.0114	0.0605***
				(-1.93)	(2.82)	(0.70)		(-9.72)	(3.52)	(2.81)	(1.45)	(5.79)
Bank performance	Excess Return	X7ExcssR		0.0167	-0.00487	-0.00324		-0.0257	-0.00543	-0.00743**	-0.000312	-0.00485
				(0.71)	(-1.66)	(-1.56)		(-1.18)	(-1.29)	(-3.29)	(-0.11)	(-1.63)
Bank performance	Market share value	X8MktPrice		0.00000219	-0.000000778	0.0000534		0.000000758	-0.00000127	0.0000941*	-0.00000108	-4.78e-09
				(0.14)	(-0.85)	(1.33)		(0.07)	(-1.08)	(2.16)	(-1.24)	(-0.01)
Macro environment	Yield curve spread	X9YieldSpread		-0.143***	-0.00394*	0.0101		-0.0678***	0.00209	0.0109	-0.00652***	-0.00125
				(-6.62)	(-2.49)	(1.83)		(-3.69)	(0.98)	(1.81)	(-3.58)	(-0.72)
Macro environment	GDP per country	X10GDPgwth		-0.0147*	0.000880	-0.000101		0.0228***	0.000776	-0.000996	-0.00565***	-0.00203*
				(-2.03)	(1.31)	(-0.13)		(3.51)	(0.79)	(-1.15)	(-5.06)	(-1.97)
Macro environment	Unemployment	X11UnmpRate		1.563***	0.0194	-0.0951*		1.524***	-0.0760***	-0.161***	0.0163	-0.000821
				(5.03)	(1.28)	(-2.51)		(6.10)	(-3.60)	(-3.90)	(1.57)	(-0.07)
Macro environment	Market concentration	X12HHI		0.00000455**	-0.00000268***	0.000000175		0.00000122	-0.00000265***	0.000000162	-0.000000495*	-0.000000442*
				(2.61)	(-7.11)	(0.31)		(0.56)	(-6.77)	(0.26)	(-2.26)	(-2.04)
		Constant	0.422***	-0.789**	0.314***	0.225**	0.496***	-0.624**	0.584***	0.313***	0.0566*	0.0511*
			(38.76)	(-2.70)	(15.38)	(2.85)	(45.08)	(-2.61)	(20.70)	(3.64)	(2.25)	(2.37)
		rep dummies	No	No	No	Yes	No	No	No	Yes	N/A	N/A
		N	3427	3077	3077	3077	3435	3077	3077	3077	3077	3077
Regressions : R-Sq - GMM : J-stat [P(chi²)]			0.006	0.032	0.191	0.034	0.038	0.259	0.248	0.117	0.4427	0.0577

Figure 4: Actuarial method – Estimated effects of the new banking regulation on liquidity creation: Untreated vs. treated banks for the LTGap and BB-MatNonFat measures

The graphs below show the results of the actuarial method utilized to pre-estimate the effects of the new banking regulation on liquidity creation between untreated banks and treated banks. The Y-axis corresponds to the survival function, and the X-axis corresponds to the time (year). Data are established from the life table actuarial method, where the survival function is the derivative of the LTGap measure and the BB-MatNonFat measure scaled over assets; the untreated population corresponds to banks that are not subject to Basel III, and the treated population corresponds to banks that are subject to Basel III. Observe that the interval is one year and that the last interval, 2015/2016, corresponds to the end of the year 2015.

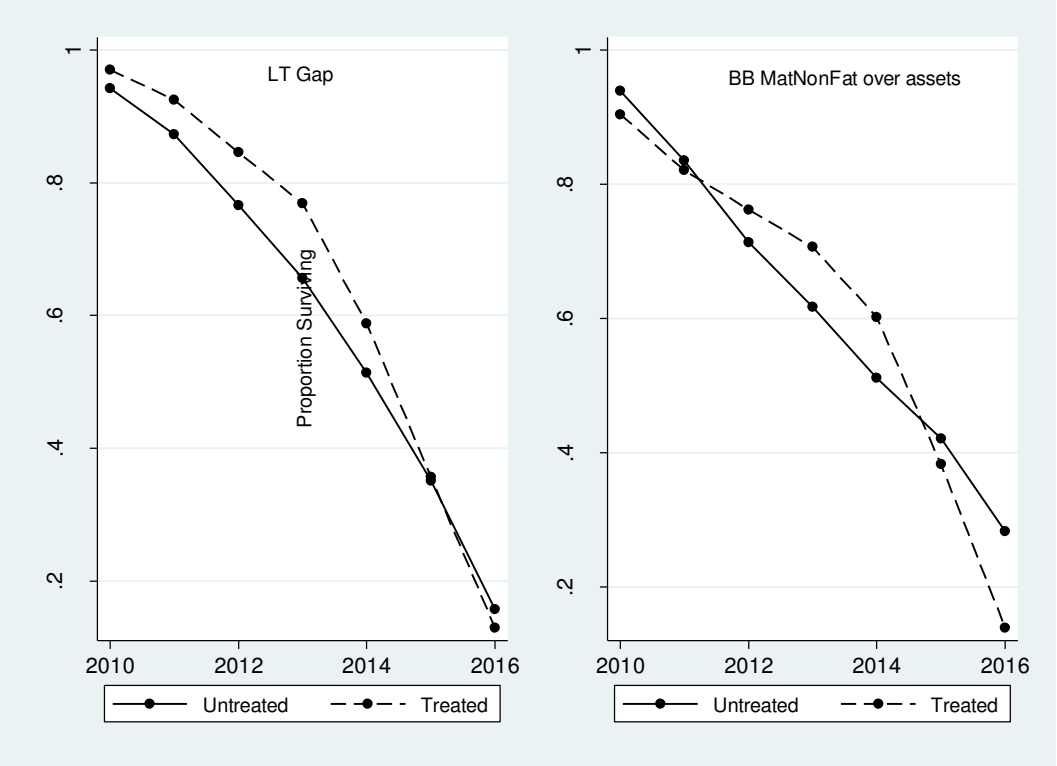


Table 41: Actuarial method – Estimated effects of the new banking regulation on liquidity creation: Untreated vs. treated banks for the LTGap and BB-MatNonFat measures

This table displays the results of the Life table estimation of the LTGap and BB-MatNonFat measures. The derivative function corresponds to the derivative of liquidity creation: it is the variance between y and y-1 of liquidity creation. If negative, then it takes the value of 1, i.e., failure; otherwise, zero. Column 1 indicates the type of population, i.e., untreated or treated. Columns 2 to 10 show the results for the LTGap measure : Columns 2-3 indicate the time interval, columns 4 displays the number of subject that were present at the beginning, column 6 the number of subject who "died" during this interval, and column 6 the number of subject that were lost. Column 7-10 provide the estimates of the survival rate, the standard error, the lower level and upper level of the confidence interval, respectively. This order is duplicated for columns 11 to 19 which show the results for the BB-MatNonFat measure.

Population	LTGap									BB-MatNonFat o. Assets								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Interval		Total	Deaths	Lost	Survival	Error	Conf. Int. (95%)		Interval		Total	Deaths	Lost	Survival	Error	Conf. Int. (95%)	
Untreated	2009	2010	3320	181	351	0.9424	0.0042	0.9337	0.95	2009	2010	3328	193	339	0.9389	0.0043	0.93	0.9467
	2010	2011	2788	195	325	0.8724	0.0062	0.8598	0.884	2010	2011	2796	297	224	0.835	0.0068	0.8211	0.8479
	2011	2012	2268	262	253	0.7657	0.0082	0.7491	0.7813	2011	2012	2275	317	199	0.7133	0.0086	0.6961	0.7298
	2012	2013	1753	232	264	0.6561	0.0097	0.6367	0.6747	2012	2013	1759	218	279	0.6173	0.0096	0.5982	0.6358
	2013	2014	1257	247	238	0.5137	0.011	0.4919	0.5351	2013	2014	1262	191	295	0.5115	0.0106	0.4906	0.532
	2014	2015	772	212	200	0.3516	0.0119	0.3283	0.375	2014	2015	776	110	304	0.4213	0.0117	0.3983	0.4441
	2015	2016	360	137	223	0.1578	0.0123	0.1345	0.18	2015	2016	362	71	291	0.2832	0.0156	0.253	0.314
	Interval		Total	Deaths	Lost	Survival	Error	Conf. Int. (95%)		Interval		Total	Deaths	Lost	Survival	Error	Conf. Int. (95%)	
Treated	2009	2010	107	3	13	0.9701	0.017	0.9103	0.9903	2009	2010	107	10	6	0.9038	0.0289	0.8287	0.9471
	2010	2011	91	4	12	0.9245	0.0275	0.8478	0.9634	2010	2011	91	8	8	0.8207	0.0384	0.7304	0.8832
	2011	2012	75	6	9	0.8458	0.0397	0.7481	0.9079	2011	2012	75	5	10	0.7621	0.0437	0.6631	0.8356
	2012	2013	60	5	10	0.7689	0.0488	0.6559	0.849	2012	2013	60	4	11	0.7062	0.0486	0.5989	0.7897
	2013	2014	45	10	5	0.588	0.0624	0.4558	0.6984	2013	2014	45	6	9	0.6016	0.0572	0.4804	0.7031
	2014	2015	30	11	4	0.357	0.0662	0.2309	0.4849	2014	2015	30	10	5	0.3828	0.0661	0.2551	0.5092
	2015	2016	15	7	8	0.1298	0.0571	0.0444	0.2623	2015	2016	15	7	8	0.1392	0.0605	0.048	0.278

Table 42: Cox regression for the LTGap and BB-MatNonFat measures

This table displays the hazard ratio of the Cox estimation of the LTGap and BB-MatNonFat measures. The derivative function corresponds to the derivative of liquidity creation: it is the variance between y and y-1 of liquidity creation. If negative, then it takes the value of 1, i.e., failure; otherwise, zero. The explanatory variables have been layered. For the level of risk, the stratification corresponds to the quintile, where IStratSDRo_2 corresponds to q1 (less than or equal to 25%), IStratSDRo_3 corresponds to q2 (less than or equal to 50%), and IStratSDRo_4 corresponds to q3 (less than or equal to 75%). For bank size, small banks are those with total assets below $US50 bln; medium banks are those with between $US50 bln and less than $US250 bln; and large banks are those with $US250 bln or more. For the level of equity, the stratification varies from 0% ("_IStratEqoA_0") to 17.5% ("_IStratEqoA_5"), with a regular increase of 2.5 bp at each step. Columns 1 to 3 indicate the type of variable, the variable name used in the model, and the value corresponding to the variable, respectively. Columns 4 to 5 display the hazard ratio of the LTGap and BB-MatNonFat measures, respectively. Z-statistics are reported in brackets below the estimated coefficients, and the number of asterisks indicates the level of significance, where * for p(z) <0.05, ** for p(z)<0.01 and *** for p(z)<0.001.

Bank specific characteristic	Variable Variable name	Value	LTGap Haz. Ratio	BB-MatNonFat Haz. Ratio
			Log likhd: -11083 LRχ^2 (12) : 101.2 Prob > χ^2 : 0.0000	Log likhd: -10760 LRχ^2 (12) : 337.17 Prob > χ^2 : 0.0000
1	2	3	4	5
Level of risk	IStratSDRo_2	Quintile1	1.313*** (0.104)	1.282*** (0.122)
	IStratSDRo_3	Quintile2	1.547*** (0.122)	1.882*** (0.168)
	IStratSDRo_4	Quintile3	1.625*** (0.121)	2.510*** (0.205)
Bank size	_IBkSize012_1	Small (GTA < $50bn)	1.002 (1.006)	0.682 (0.396)
	_IBkSize012_2	Medium(GTA < $250bn)	0.715 (0.739)	0.845 (0.520)
	_IBkSize012_3	Large (GTA ≥ $250bn)	1.314 (1.349)	0.980 (0.612)
Level of equity	IStratEqoA_0	0% ≤ 5%	1.155 (0.213)	1.516** (0.255)
	IStratEqoA_1	5% ≤ 7,5%	1.271 (0.209)	1.097 (0.178)
	IStratEqoA_2	7,5% ≤ 10%	0.937 (0.146)	0.762* (0.119)
	IStratEqoA_3	10% ≤ 12,5%	0.865 (0.136)	0.748* (0.117)
	IStratEqoA_4	12,5% ≤ 15%	0.845 (0.142)	0.740* (0.125)
	IStratEqoA_5	15% ≤ 17,5%	1.077 (0.215)	0.930 (0.192)
		Observations	3,435	3,435
		No. of subjects	3435	3435
		No. of failures	1512	1447
		Time at risk	18920	18920

Conclusion

This thesis has focused on liquidity in the banking sector. As one of the cornerstones of banking, liquidity is a concept that can be viewed from two primary, related angles. The first refers to the cash or assimilated resources that banks hold to meet immediate or short-term needs. They provide security in the face of unforeseen risks and have proven essential to banks' survival under conditions of stress. The second refers to the classical maturity process, through which resources undergo a transformation that ranges from short-term to long-term and contributes to financing the economy.

The first article, "*Why do banks hold cash?*", examined the hypothesis that cash optimality exists in the banking sector. To reach this goal, I first explored the empirical determinants of cash-holding for a large sample of listed banks over a period of 35 years. Using the GMM-system estimation method, this study provides evidence that, in contrast to the nonbanking sector, there is no support for the dynamic optimal cash model in the banking industry. It confirms that agents in the banking sector face difficulties in determining their preferences and optimizing their utility. These results provide new insights into cash management in the banking sector and how it fundamentally differs from that of non-financial industries, offering additional clues as to how banks differ from non-banks.

The next articles focus on liquidity-creation by banks. The article, "*Does an increase in capital negatively impact banking liquidity-creation?*", isolates the effect of increasing levels of capital to determine which of the "risk absorption" or "crowding out" hypotheses

(Berger and Bouwman (2009)) prevails. The next and final article, "*Positive effects of Basel III on banking liquidity creation*", discusses the overall effects of Basel III on liquidity-creation.

The article, "*Does an increase in capital negatively impact banking liquidity-creation?*" yields several results. First, it is the only cross-national, empirical study documenting bank liquidity-creation over a period of 35 years and providing a unified view of banking liquidity-creation. Second, it confirms results presented in previous studies, which show that liquidity-creation is determined not only by exogenous factors, such as monetary policy, but also by endogenous factors, such as bank size, equity levels and risk performance. These findings have broad applications for policy, particularly for reducing inefficiencies in monetary policy transmission. Third, it confirms that an increase in equity levels has two consequences. The first is positive: risk reduction. The second is negative, involving a decline in liquidity-creation. However, taken alone, there is an overall negative effect from an increase in the level of equity.

The primary focus of the last article, "*Positive effects of Basel III on banking liquidity creation*" was to estimate the overall effects of Basel III, considering all components together. The primary method used to estimate the effects of Basel III is the "D-in-D" method, which, for robustness, has been complemented by additional analyses. The results indicate that during the period studied, all things being equal, the Basel III regulatory framework has not negatively impacted banking liquidity-creation in the U.S.

Overall, this thesis highlights the following key points:

The Basel III regulatory framework can be assimilated to a Pigouvian tax because it internalizes the social costs of financial instability to banks.

Liquidity in the banking sector can be defined as a function for optimal asset structure when bank managers face the dilemma of having to choose between allocating resources to liquid assets to reduce the costs of illiquidity or allocating resources to illiquid assets to finance projects and generate income. Given the market and regulatory constraints that banks face, this arbitrage on the asset side is a complex process that is not yet fully understood. Likely caused by the complexity and interdependence of constraints, the absence of a dynamic optimal cash model may indicate that bank managers use models that are similar to a "pecking order" approach, that is, by order of preference. This process echoes the "*pecking order hypothesis*" of Myers and Majluf (1984), though the latter focuses on the liability side of corporations. For the sake of future financial stability, further studies on this issue should be conducted.

Finally, cash-holding and liquidity-creation by banks are affected by endogenous factors of banks, such as bank size, level of equity or risk performance. In this regard, this project has demonstrated that specific bank factors play a significant role in the transmission of monetary policy. How could a monetary policy account for these factors appropriately? This question lies ahead to be addressed by future studies.

But exogenous variables such as regulatory frameworks affect the motives for banks to hold liquid assets or to create liquidity. A balkanized legal and fiscal environment may lead the banks to arbitrate their decisions, based on these differences and ultimately select countries which legal and fiscal frameworks is less compelling. In that sense, the results

presented in the articles in this thesis argue in favor of more integrated legal and fiscal frameworks in Europe to mitigating these tradeoff effects.

Looking ahead to the next years, it is likely that the current liquidity ratios will be amended to include the endogeneity property and the stochastic movements of the market as proposed by the Liquidity Mismatch Measurement of Brunnermeier, Gorton and Krishnamurthy (2014).

Tables des graphes, des tables, des équations et références bibliographiques

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