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The impact of Liquidity Risk on Stock Returns of European and American banks in the context of the Subprime Crisis

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ESCP Europe – Paris and Universidade Católica Portuguesa – CLSBE

The impact of Liquidity Risk on Stock Returns of European and American banks in the context of the Subprime Crisis

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ABSTRACT:

Literature shows that liquidity risk is an important determinant of stock performance, particularly during times of stress in the financial system. The following paper studies the relationship between liquidity risk and stock returns, using a data set of 87 banks, European and American, over the period of 2004-2011. Liquidity risk is measured by the bid-ask spread on stocks and the empirical study is performed with three types of analyses – a cross-sectional and a panel on the overall sample and four cross-sectional studies on individual banks.

The results show that not only liquidity risk became more important to explain bank stock returns, but also that investors changed their attitude towards liquidity risk, after the turmoil of 2007. That may be the result of a "flight to liquidity" behavior during that time.

KEY WORDS: liquidity risk; banks; stock returns; subprime crisis

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Paris, 9th May 2011.

RESUME:

La littérature montre que le risque de liquidité est une caractéristique très importante pour comprendre la performance des actions, en particulier dans les périodes de stress du système financier. Ce document étudie la relation entre le risque de liquidité et la performance des actions, en utilisant un échantillon de 87 banques, européennes et américaines, au cours de la période de 2004-2011. Le risque de liquidité est mesuré par le bid-ask spread sur les actions, et l'analyse empirique est réalisée avec trois types d'études - une étude cross-sectional, une étude panel sur l'échantillon global, et quatre études cross-sectional sur les banques individuelles.

Les résultats montrent que non seulement le risque de liquidité est devenu plus important pour expliquer la performance des actions des banques, mais aussi que les investisseurs ont changé leur attitude face au risque de liquidité, après la crise financière de 2007. Cela peut-être le résultat d'un comportement de "fuite vers la liquidité" durant cette période.

MOTS CLES: le risque de liquidité, les banques, la performance des actions; la crise des subprime

RESUMO:

A literatura mostra que o risco de liquidez tem um papel preponderante na explicação da performance das ações, especialmente durante épocas de stresse no sistema financeiro. O artigo que se segue estuda a relação entre risco de liquidez e retorno das ações, recorrendo a uma amostra de 87 bancos europeus e americanos, durante o período de 2004-2011. O risco de liquidez é medido pelo bid-ask spread nas ações dos bancos estudados e a análise empírica é feita com base em três tipos de estudo - um cross-seccional e um panel, ambos na amostra global, e quatro estudos "cross-seccionais" em bancos individuais.

Os resultados mostram que o risco de liquidez não só se tornou mais importante para explicar os retornos de ações dos bancos, mas também que os investidores mudaram a sua atitude perante o risco de liquidez, após a crise financeira de 2007. Tal pode dever-se a um comportamento de "fuga para a liquidez" durante este período.

PALAVRAS-CHAVE: risco de liquidez, bancos, retornos de ação; crise do subprime

This work is dedicated to my mother Maria de Jesus, brother João and aunt Alice. It is thanks to their love and support that I achieved everything I did until today.
I would also like to thank my friend Catarina Pais, with whom I had very useful discussions, and Francisco Góis, who provided me the information I used in this study.

Ce travail est dédié à ma mère Maria de Jesus, mon frère João et ma tante Alice. C'est grâce à leur amour et leur soutien que j'ai réalisé tout ce que j'ai entrepris jusqu'à aujourd'hui.
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Este trabalho é dedicado à minha mãe Maria de Jesus, irmão João e tia Alice. É ao amor e apoio que sempre me deram que devo todos os sucessos que até hoje atingi.
Gostaria ainda de agradecer à Catarina Pais, com quem tive discussões muito úteis, e ao Francisco de Góis, que me facultou os dados que utilizei neste estudo.

DECLARATION SUR L'HONNEUR

Je, soussignée, Joana Reis Lopes, certifie sur l'honneur que je n'ai rien plagié dans le travail ci-joint, ce qui signifie que je suis le seul auteur de toutes les phrases dont le texte est composé. Toute phrase ayant un autre auteur que moi a été mise entre guillemets, avec indication explicite de sa source. Je suis consciente qu'en contrevenant à la présente règle je transgresse les principes académiques reconnus et m'expose aux sanctions qui seront prononcées par le conseil de discipline.

J'atteste également que ce travail n'a jamais été présenté dans le cadre d'études antérieures à ESCP EUROPE. S'il s'agit d'un travail réalisé dans le cadre d'études effectuées en parallèle, je dois le préciser.

Les propos tenus dans ce mémoire n'engagent que moi-même.

Fait à Paris, le 9 mai 2011.

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1. MOTIVATION

According to Ernst et al. (2009), times of crisis change the environment under which assets are traded. The past financial crisis, started in August 2007, was peculiar because of the role played by liquidity – some authors even describe it as a liquidity crisis. Therefore, studying the relationship between liquidity risk and performance in the context of that crisis seems to be interesting as a research topic.

The next step was to find a pertinent sample in which perform the study. The banking sector seemed to be the most appropriate in the context of this study. Well, besides the fact that

liquidity has always been an important issue for financial institutions, it is relatively consensual that the past financial crisis started with the problems faced by financial institutions. Hence, it seemed very pertinent to analyze the impact of the financial crisis on the relationship between liquidity risk and performance in the financial sector.

Another argument that contributed for the choice of this thesis' topic was the fact that literature is relatively scarce when it comes to explain this subject. Even though there are many studies investigating the relationship between liquidity and stock returns in general, there is clearly a gap in literature exploring the impact of the last financial crisis, which was peculiar because of the role played by liquidity, on the relationship between liquidity risk and performance. Furthermore, there is lack of literature in what concerns the study of this relationship in the banking sector, which again seems pertinent, given that it is a sector particularly sensitive to such type of risk. Indeed, most of the studies that study liquidity risk and stock returns excluded both the banking sector and periods of crisis in their analyses. It is in this context that the present paper aims at contributing to literature, providing it with an empirical study on the impact of liquidity risk for bank stock returns in the context of the subprime crisis.

It is a relatively basic concept in economics that "there are no free lunches", or if we want to see it from a financial point of view "there is no return without risk". Taking a look at different investment strategies and trying to find out which are the most profitable ones, we will understand that the ones that invest in less liquid assets, such as private equities, low capitalizing stocks or even emerging markets are the ones that generate more returns. Indeed, we confirm that there is no return without risk. That relationship should hold in normal periods, where prices of assets reflect the fundamentals of the economy. But what about situations of turbulence, in which investors are anxious and many times end up not being rational? How do they react to risk under this environment? Is the relationship between risk and return questioned during these times? What about market imperfections, which are assumed not to exit in most asset pricing models? Do they become more relevant during periods of crisis? Do they have an impact in the way investors evaluate assets? Those are the questions to be discussed in this paper, next to an empirical analysis on liquidity risk and stock returns of banks over a period of six years that embodies the financial crisis of 2007.
Situations of crisis are definitely very critical for the financial system, especially when it

comes to explain liquidity. When the market faces situations of stress, illiquid assets can hardly be traded, or can only be traded at very expensive costs. Therefore, their prices move to levels very far from their fundamental values. That happens because liquidity is very scarce in the market, which is a result of the conjoint behavior of all participants in the market, either by trying to sell riskier assets or by buying the ones that offer them more security. As a consequence, the prices of assets may not reflect their fundamental value, and be a result of the impatient behavior of investors during periods of stress.

Literature has shown that liquidity is very important in the financial system, in particular in the stock market. Indeed, liquidity influences the economic activity through the stock markets. In other words, the creation of liquidity in stock markets is fundamental to empower economic dynamism. Levine and Zervos (1998), with a cross-country study on 47 countries, proved that stock market liquidity contributed significantly to GDP growth in the period of 1976-93. That is relatively easy to understand if we look at the behavior of investors in the market. Most profitable and value creating investments need long term commitments of capital to be realized. However, investors usually do not have the money available for long periods of time, or are not willing to sacrifice money for long periods, given the high opportunity cost they would have to bear. That is the reason why they would not be willing to accept many value-creating investments if they could not obtain the money from other sources. That is where liquid equity markets play a role. These markets enable investors to buy assets and sell them very quickly and at low cost if they need the money back for any reason. As a result, liquid markets reduce the cost of investments and make the ones that rally add value more attractive to investors, contributing to augment the value creation in the economy and therefore boosting economic growth. Liquidity influence on stock returns is therefore a key topic in finance.

Liquidity risk is indeed an extremely important risk in the financial system and plays a crucial role in economic dynamism and growth. However, it is not yet sufficiently considered in the risk management policies of institutions and regulators. Literature has offered many models to assess liquidity risk, however, there is still a few empirical studies that are able to actually assess the impact of this risk in the financial system. The importance of these types of studies increased especially after the last financial crisis, which was peculiar because of the role played by liquidity. The financial crisis of 2007 was characterized by the well-known Bailouts

from governments. They were forced to intervene and save some banks from default, in order to avoid contagion effects across the economy, which would have had dramatic consequences in the system, given the degree of dependency among participants. Governments bailed out their bankrupted banks either by injecting cash directly on their balance sheets or by buying shares or bonds from these institutions. Securitization processes also played an important role for the emergence of this crisis. They enabled financial institutions to take toxic products out of their balance sheets, which "artificially" allowed them to decrease the levels of liquidity required by law and, therefore, increase the return on existing assets. However, the complexity of these out of balance sheet products, whose risk was hardly assessed, gave birth to more vulnerable institutions and less capable to face times of crisis. That was corroborated when some banks went bankrupt and a terrible financial crisis started emerged in August of 2007.

There are various types of liquidity risk – funding and market liquidity risk are the most popular. This paper considers market liquidity risk to explore the relationship between liquidity and stock returns of banks. Market liquidity risk represents the less an investor may incur in as a result of costs from the difficulty of trading an asset. Market liquidity is measured in this paper through the bid-ask spread on banks stock prices. The contribution of this paper to literature also lies on the fact that is considers market liquidity risk when exploring the liquidity risk and its impact on performance. In fact, there are many studies in literature investigating liquidity risk, but the majority of them examine the importance of funding liquidity risk to explain performance. The present paper provides an empirical study on the relationship between market liquidity risk and performance of banks, assessing the impact of the last financial crisis on this relationship.

To perform such a study, data from the biggest banks in the USA and Europe (France, Germany and UK) was collected, over the past six years – three years before the financial crisis and another three years after the crisis of 2007. Subsequently, three types of statistical studies were performed – a cross-sectional study on the overall sample, a panel study considering on all the banks an finally four individual cross-sectional studies in one bank from each country considered in the sample. Three regressions were run in each study to assess the impact of the financial crisis for the relationships between liquidity risk and stock returns of banks. Liquidity risk is measured using monthly bid-ask spreads on banks share

prices and it is crossed with share price returns (also monthly), measuring bank performance. Succinctly, this paper investigates if liquidity risk is a relevant variable for bank performance and thus for shareholder value creation and if the financial crisis, started in August 2007, also know as the liquidity crisis, somehow changed the circumstances under which financial institutions react to liquidity risk.

After the empirical analysis, the importance of liquidity risk is discussed. The discussion touches the importance of this risk for crises in general and for the particular case of the financial crisis of 2007, which was peculiar because of the role played by liquidity. Besides that the importance if liquidity risk in asset pricing theories is discussed and finally investments policies are explored in the grounds of liquidity risk.

The relevance of this study can therefore be understood from the point of view of regulation, for posterior adjustments in policies, in particular for the banking system. But it could also be understood from an investment point of view, given that it highlights the importance of other variables on bank's performance, which are important variables for investment decisions. Overall, this paper helps filling a gap in literature on the topic of liquidity and performance, considering a sector, a period, and a measure of liquidity barely explored in literature

The paper is composed by five sections for this point on: a literature review, a presentation of the hypothesis on the study, an empirical analysis, a discussion on the topic under the results obtained in the empirical study and finally a section with conclusions and remarks on the study and the results found.

2. LITERATURE REVIEW

Literature review in this paper is organized as follows:

2.1. THE SUBPRIME – A LIQUIDITY CRISIS

Some authors labeled the financial crisis started in August 2007 as the Liquidity Crisis. They defend that liquidity risk played a very important role in this crisis and that it was one of the factors that distinguished this crisis from others that occurred in the past. This section focuses on the importance of liquidity risk for the origin and subsequent development of the financial crisis of 2007.

The subprime crisis harshly affected the world economy, having started by the financial system. The Basel Committee on Banking Supervision understood that one of the most important elements that were at the core of the emergence of this crisis was absolutely the liquidity risk – a very important risk that had been, nevertheless, neglected until then. The banks more affected by the crisis were the ones that relied more on short-term financing. Northern Rock, for instance, one of the biggest British mortgage lenders, could not finance itself in the market because it had relied on the money market during the previous years, when it should have relied more on deposits from customers. Because of that, this bank faced huge liquidity squeezes and ended up being bailed out by the Bank of England, in 2008 (Shen et al., 2009).

During the period before the financial crisis, the world economy observed an enormous growth in asset prices (Acharya and Matthew, 2009). At the same time, the levels of leverage, both in corporations and financial institutions increased substantially. In the USA, for instance, the ratio of debt to income increased from 3.75 to 4.75 in the five years prior to the financial crisis (Acharya and Naqvi, 2010). The abundance of liquidity in the financial system was one of the elements that enabled all that growth. It did play a crucial role enabling banks to amplify their balance sheets over this period.

During several years the prices of assets grew until the day in which the "bubble burst". A lot of concerns that had been ignored for years were finally unhidden. The enormous bonuses received by financial managers, for instance, at the cost of strategies that had short run horizons in mind, rather than long run sustainable investment perspectives, were disclosed and started to be discussed, giving birth to the emergence of many scandals.

The financial crisis of 2007 refreshed the importance of liquidity risk in the economy and, in particularly, in the financial system (Matz and Neu, 2007). Market liquidity becomes scarcer in times of crisis, as a consequence of problems of confidence in the system, according to many authors. But why does that happen? To protect against credit risk, banks reduce their willingness to lend, increasing interest rates. Additionally, banks face stricter requirements on their balance sheets, in times of more stress, which limits even more their ability to lend. This inefficiency in the provisioning of liquidity in financial markets can cause some "cash-in-the-market pricing effects". The situation worsens even more when even the prices of safe assets fall below their fundamental value. That can lead to problematic situations of "financial fragility" (Allen and Carletti, August 2008).

The process of financial innovation and the securitization of assets enabled banks to move many risky assets out of their balance sheets and supported the enormous growth in volume of financial assets. That also intensified risks faced by financial institutions and made it more and more difficult to measure and manage risk. The securitization process was concluded with the creation of credit risk transfer products, namely Asset Backed Securities, Collateralized Debt Obligations and Collateralized Loan Obligations and others. These products, by hiding some of the risks face by banks, allowed them to sell much more loans than they should sell and thus enabled them to increase profits. However, it did not guarantee liquidity in the secondary markets. That started to be obvious with the decline in the prices of assets, reflecting the uncertainty about future performance of companies underlying these products and anticipating market illiquidity (Bank of England, April 2008). The securitization procedures also allowed banks to reduce the relative weight on customers' loans and, as a result, allowed them to invest their assets into other products, enabling them to generate even more profits. However, this weakened the stability of the system and the ability of institutions to handle unexpected liquidity situations, which gave birth to more vulnerable institutions.

Also the level of leverage hold by banks increased tremendously before the turmoil. They became more and more dependent on the bond market and, later, on the money market[1]. Mostly, financial institutions started to borrow money from other financial institutions. These were extremely similar to each other, having the same business models and portfolios of assets and consequently the correlations between these assets were very similar. The risk of collapse also increased as a result of such behaviors, given the possibility of contagion effects.

Contagion risk was another critical problem in this crisis, especially because of the characteristics of the economic world at that time and nowadays, namely the huge dependencies between participants. During the past crisis, the possibility of contagion was the reason to save, for instance, Bear Stearns and merge it with J. P. Morgan, by using of public funds. "If Bear Stearns had been allowed to fail, its extensive involvement as counterparty in many derivatives markets might have caused a string of defaults." (Allen and Carletti, August 2008). However, some academics believe that contagion in banking is unlikely (Federal Reserve Bank, 2008a, 2008b; Bank of England, 2008; European Central Bank, June 2008). The uncertainties in the banking system started to originate difficulties in obtaining financing, either through commercial paper or bond issues, in order to refinance loans. Furthermore, because investors were afraid of the default of some companies they were invested in, they started to enter into "flight to quality" behaviors, running away from risky assets. Additionally, rating companies started downgrading companies, which increased loss of confidence and anxiety in the system. Such a sentiment in the financial system led to the widening of spreads, collateralized loan obligations and credit default swaps[2] (which were signals of higher credit risk). The reduction of Federal fund rates and Treasury bill yields was another consequence of such an environment, as a result of the increased demand for safe assets – "flight to quality" behavior. The decrease in debt issuances and leverages lending and the increase of LIBOR spreads, due to the unwillingness of financial institutions to provide credit to each other, were events that characterized the financial system by that time.

This unwillingness to provide liquidity into the financial system, either because banks wanted to protect themselves against liquidity needs or because there was a huge uncertainty on default of counterparties, was definitely one of the main issues in the emergence of the

[1] The money market is part of the financial markets for assets in short-term borrowing or lending, with original maturities of one year or less. Treasury bills, commercial paper, bankers' acceptances, certificates of deposit, federal funds, and short-lived mortgage- and asset-backed securities compose it.
[2] Measure cost of insurance against the default of large complex financial institutions and increases in counterparty risk.

financial crisis. The situation worsened in March 2008, with the enforcement of mark-to-market accounting. That generated further losses and boosted concerns on creditworthiness and loss of confidence in the system.

Liquidity risk played indeed a very important role in this crisis, which was the result of pressures in interbank market and money market funding, fear of contagion from potential failure of big institutions and unwillingness of lending between financial institutions, which made liquidity a scarce resource in the financial system.

The interactions between market and funding illiquidity increased substantially during this period (Frank et al., 2008), and the degree of sophistication of the financial system, as a result of the development it had been facing over the last years played a crucial role strengthening the interactions between funding and market liquidity risk, which had a crucial role in the emergence of the crisis. The poor liquidity of credit risk transfer instruments increased the importance of other type of risk in the financial system - the market liquidity risk. The relationship between all these risk in an environment of dependency between instruments and participants that led to the emergence of the past crisis.

Figure 1 in appendix, shows the evolution of the Liquidity Index over the past years. This is the Bank of England Financial Market Liquidity Index and it is a measure of liquidity risk considers the bid-ask spread on bonds, on currencies and stocks, as well as the ratio of returns to volumes on these assets and finally the spread in the credit market. The graph was adapted with the inclusion of other past crisis to show how liquidity risk has reacted to situations of turbulence in the economy. From the analysis of the graph we can conclude that since 1992, investors never observed such low levels of liquidity in the financial system as during the financial crisis of 2007. We can see that the liquidity index usually decreases during times of crisis, as the Speculative attack on currencies, the Asian financial crisis or the crisis in Russia in 1998, which is means that during times of crisis market liquidity risk increases considerably. Nonetheless, the level of liquidity risk in the market by the time of the subprime crisis is substantially higher that in any other period of turbulence seen in history since 92.

Liquidity risk is indeed one of the elements that distinguish the last financial crisis from the others that occurred in the past. That helps us understand why this crisis was designated as the

liquidity crisis. It is a crisis that started from credit issues but that ended up transformed into a liquidity crisis.

2.2. LIQUIDITY

2.2.1. DEFINITION

"Liquidity is easier to recognize than to define" (Crockett, 2008).

"When you buy a stock, bond, real asset or a business, you sometimes face buyer's remorse, where you want to reverse your decision and sell what you just bought. The cost of illiquidity is the cost of this remorse" (Damodaran, 2005).

Even though there are various definitions for the word liquidity, according to the specific context in which it is used, illiquidity of an asset is always seen as risk.

Keynes (1930) defines a liquid asset as an asset that is realisable at short notice without loss. Keynes also states that liquid assets function as buffers for contingencies and for unforeseen opportunities of advantageous purchases (Keynes, 1936) and that the greater the uncertainty, the more the value of a liquid asset.

But there are other authors that share the same opinion, defending that liquid securities are the ones that can be traded in large quantities quickly, at low cost and without major movements in their price. Additionally, these securities can be converted easily into cash during times of market stress, in order to satisfy heavy redemption requests and to take advantage of investment opportunities, without having to sell the less liquid assets (Huang, June 2008).

Agarwal (2009) considers that Liquidity is the easiness how assets or claims on assets can be transacted and converted into cash or other mediums of exchange. Figure 4, in appendix, distinguished assets, according to their level of liquidity. We can see that US Treasury Bills are considered to be the most liquid securities, followed by highly rated corporate bonds, and then stocks. Minority stakes in private companies are considered to be the less liquid assets.

Cash is in the limit the most liquid asset we can have. The difference between cash land the most liquid assets, as Treasury Bills, for instance, lies on transaction costs. Even to transact the most liquid asset we have to bear some transaction costs, which does not happen with cash.

It is interesting to know that the concept of Liquidity has changed over time as a result of the development of the financial markets and the impact of some periods of turbulence it faced. The evolution of secondary markets, for instance, has widened the portfolio of assets considered as liquid assets (Gualandri et al., 2009). The Financial crises in the United States (1987), the U.S./Iraq war (1990), the South East Asia (1997) problem, the crisis in Russia (1997), the LTCM collapse[3], the bond market crisis (1998), and finally the subprime crisis (2007) show that credit and market conditions can tighten suddenly, leading to a large decline in market wide liquidity (Agarwal, 2009). Some securities that used to be considered liquid can no more be as a result of harsher market conditions.

At the individual security level, liquidity is associated to the cost of trading (MSCI Barra, July 2009). Figure 5, in appendix, adapted from Damodaran (2009), provides an overview on the levels of liquidity of different classes of stocks. We can see that heavily traded stocks in widely held companies, in developed markets are the most liquid ones, whereas thinly traded stocks, or OTC[4] stocks, or stocks traded in emerging markets are the less liquid ones. Investors may require higher returns on less liquid stocks to compensate for the liquidity costs they have to bear.

Market returns can also impact the liquidity of an asset. In particular, negative market returns reduce liquidity. Furthermore, the impact of negative market returns on liquidity is stronger when financial intermediaries are more likely to face funding constraints. In other words, negative market returns reduce liquidity even more when there are also large declines in the aggregate balance sheets of financial intermediaries or in the market value of the investment banking sector. Summarizing, changes in the balance sheets of financial institutions are related to funding liquidity through the *risk appetite* in the market. Once again we conclude

[3] Long-Term Capital Management L.P was a hedge fund management firm based in Greenwich that used absolute-return trading strategies (such as fixed-income arbitrage, statistical arbitrage, and pairs trading) and high leverage. The most important hedge fund was Long-Term Capital Portfolio L.P., failed in the 1990s and led to the bailout of other financial institutions.

[4] OTC stocks are stocks that are traded over-the-counter, as opposed to stocks that are traded in Exchange markets.

that the various types of liquidity risk are dependent and influence each other. In particular, there is a string connection between funding liquidity and market liquidity.

Seen from a macro-economical point of view, liquidity can be endogenously determined and it is linked with the macro-economic cycle. If seen from this perspective, liquidity is pro-cyclical. That is to say that assets are less liquid in times of downturn, and the reverse. Furthermore, negative market returns decrease liquidity much more than positive returns increase it, with the effect being strongest for high volatility firms and during times when the funding sector is likely to face capital tightness (Eisfeldt, 2004). Also, the cost of providing liquidity is higher in periods with large market declines. Market liquidity falls after large negative market returns because aggregate collateral of financial intermediaries fall and many asset holders are forced to liquidate, making it difficult to provide liquidity precisely when the market demands it - collateral view of market liquidity.

"Liquidity is a slippery and elusive concept" (Kyle, 1985).

Defining liquidity involves considering a huge number of transactional properties of markets, such as costs associated with searching for counterparties, risk of adverse selection when trading with counterparties, inventory risks due to delays incurred in transactions, and other costs due to imperfect competition in the market. That way, it is a complex and extremely difficult concept to define. However, understanding the concept and clearly defining the perspective from which it will be seen is fundamental before any study. Therefore, the different types of liquid will first be described and then the one to be considered for the purpose of this study will be specified.

2.2.2. TYPES

According to Gehrig (2010), there are various types of liquidity. The first is macroeconomic liquidity, which is the availability of cash in an economy. It is often used as a synonym for the monetary base and is influenced by the policy of the central banks. It is a function of interest rates, credit conditions, money supply, credit aggregates and others. Funding liquidity is another type of liquidity. It is linked to the capacity of obtaining funding for investments. It

can also be seen as companies' ability to meet their obligation when they are due. A company is in danger of insolvency in case of incapacity to meet its obligations on time. Finally, there is market liquidity, the one to be considered in this empirical study. It represents the easiness how an asset can be traded immediately within the market hours, without causing major movements in its price and with minimum loss of value.

Market liquidity is "the ability to settle transactions at current prices and at all times with no transaction costs" (Bervas, 2006). It is, however, almost never achieved, even though investors are many times eluded about it. Literature says that investors overestimate their ability to finish transactions smoothly and quickly, being able to overcome unforeseen events. That is what makes them incur in excessive risks. The assessment of market liquidity is based on certain characteristics, according to Bervas (2006). The tightness of the bid-ask spread is the first. It measures the costs one has to incur in to revert a position immediately, in other words, the transaction costs. It does not include brokerage commissions, clearing and settlement fees. The market depth ids the second and it "reflects the volume of transactions that can be immediately executed without slippage of best limit prices major changes in price". Finally, the market resilience "reflects the speed with which prices revert to their equilibrium levels, after a shock in their transaction flow". Market depth and resilience indicate the ability of a market to absorb significant volumes without substantial effects on prices, whereas the bid-ask spread measures the cost a participant has to incur in if he wants to revert a certain position. In this paper bid-ask spread will be considered as measures of liquidity risk, but that will be clarified later. According to this description of Bervas (2006), fully market liquidity can only be achieved in organized markets, where trades of standardized products are large enough to make it worth to work to develop and make information on the transactions available.

As already seen liquidity played indeed a very important role in the emergence and development of past financial crisis. Banks were dependent on markets' ability to raise funds at required conditions, which was a result of the functioning of markets. Problems with credit risk generated changes in cash flows, which impacted confidence and stability in the system and made refinancing in the market even more difficult for all participants, individuals, corporations or even financial institutions. That generated not only funding liquidity risk, which is balance sheet liquidity, in other words, the inability to obtain funds, either by selling

assets or by borrowing, but also market liquidity risk.

The different types of liquidity are, however, closely interconnected. Macroeconomic liquidity, as a synonym for the monetary base, and funding liquidity are both critical factors in what concerns market liquidity, evidence that is provided by Brunnermeier and Pedersen (2008).

Additionally, liquidity can see from another perspective, according to Bauwens and Goit (2001), which are in line with the definitions above presented. The descriptions above underscore two distinct dimensions in liquidity, namely a time dimension (related to the quickness assets can be traded) and a price dimension (considering that they should be realized without loss). The time dimension of liquidity indicates how long it takes until an investor is able to realize an intended investment. It describes the period of time between the point in which the investor emits his unlimited market order and the point in which the order is realized. It is especially important if an investor wants to realize his transaction quickly. He might need to do that, for instance, if he faces a funding shortage that makes him have to sell his assets immediately against cash. The risk associated with the time dimension of liquidity is comprehended as the waiting cost or the opportunity cost an investor suffers because there is no demand for his asset, which means that there is a lack of liquidity. The price dimension of liquidity illustrates the change that a market order causes in the price of an asset, as soon as the order is realized. In other words, it indicates the level of discount an investor has to accept when he is forced to sell an asset quickly. This risk is expressed by the discount in the price of the asset and must be understood as additional transaction cost for the selling investor.

Regarding the different types of liquidity, it is also important to understand some expressions that are often times used in literature to distinguish between different types of liquidity. These are the terms: depth, breadth and resiliency. They are frequently used to describe the liquidity level of a certain market, as opposed to the time and price dimensions (Garbade, 1982). A market has depth if there are buying and selling orders that have not yet been realized and are close to the reservation price, a market has breadth if there are many buying and selling orders that have not yet been realized and are close to the reservation price. Finally, market resilience is used to describe a situation in which the underling prices of an asset are restored fast after a certain disturbance. Even if some authors prefer the later dimensions to

characterize liquidity, they are still compatible with the previously mentioned dimensions of liquidity. Nevertheless, it is interesting to notice that depth, breadth and resiliency are more aligned with price dimension of liquidity. That is not be a problem if assets are traded in highly organized markets, where orders can be obtained almost instantaneously and thus, time is not a big issue. Moreover, it is very seldom that there is no demand for an asset on a market at any price. Investors may have to bear some discount for immediate realization of the order, but they will be able to realize it. That is rather reflected on the price dimension than on the time dimension. Therefore, depth, breadth and resiliency could be seen as specifications of the price dimension and therefore be used to measure liquidity.

It seems pertinent at this stage, after having presented the different types of liquidity considered in literature, to define the one that will be considered for the purpose o this empirical study. The term liquidity as used in this paper largely fits the definition of market liquidity. An asset is considered to be liquid if it can be bought or sold immediately and without major changes in its price. "Market liquidity is the product of externalities generated by all market participants, which agree to act as counterparties in buying or selling transactions and by so doing perform a market making function" (Bervas, 2006). That will be measure by the bid-ask spread, which will be further discussed in this literature review.

2.2.3. LIQUIDITY RISK

"Investors want three things from the markets: liquidity, liquidity, liquidity." (Handa and Schwarz, 1996)

Investors like liquidity and therefore they will only be willing in illiquid assets if they are compensated with some extra return. Accordingly, investors accept to pay a higher price for an asset that it is liquid (Gehrig, August 2010). As a result, lack of liquidity of an asset can be seen as an additional risk, which is liquidity risk. In other words, liquidity risk can be defined as the potential loss an investor may face as a result of liquidity costs.

Liquidity is different from Liquidity risk, but the two concepts are intimately related. Liquidity should be negatively correlated with liquidity risk. That is because normally

increases in liquidity reduce transaction costs, which affects positively the process of trading. As changes in portfolios become less costly, diversification become more attractive, which contributes positively for the sharing of financial risks (Domowitz et al., 2005; Harford and Kaul, 2005). That is if we consider liquidity risk from a market perspective. However, liquidity risk can also come from other sources. For instance, the dependency on external funding, or the reliance on supervisory and regulatory factors may impact the risk of illiquidity. The greater the restrictiveness of the supervision and regulatory system, the lower the liquidity risk. But liquidity risk can also result from macroeconomic factors – periods of economic expansion make banks decrease their liquidity buffers, which may lower their profitability, as a consequence of higher cost of funds (Shen et al., 2009).

According to Shamroukh (2000), liquidity risk from a market point of view represents the costs of liquidation of a position for a particular asset. It can be seen as the difference between sell (ask) price and buy (bid) prices and that is the exogenous liquidity risk. But it can also be seen as the costs associated with the impact of the number of transactions on prices and that is the endogenous liquidity risk. Bangia et al. (1999) defend that the price of an asset is a function of not only the risk from fluctuations in its price, interest rates and exchange rates, but also of liquidity risk.

Literature offers various interpretations for the concept. Liquidity risk has been associated with transaction costs and movements in price. That may happen because market participants engage in panic selling, which is a demand effect, or because financial intermediaries renounce to provide liquidity, and that is a supply effect, or even as a result of the two effects (Hameed et al., February 2007).

According to Bervas (2006), liquidation costs are relatively predictable during calm periods and therefore it is fairly easy to manage liquidity risk during these times. However, these periods may be very dangerous for the financial system, given that it during these times that vulnerabilities of institutions are developed, even though they are not noticeable. Liquidity costs are far less predictable during times of stress than periods of stability and therefore liquidity risk should increase during turmoil periods. The cost of liquidating or hedging a position in calm periods is normal liquidity risk, whereas during periods of crisis markets are

less capable to absorb order flows without violent price adjustments and therefore liquidity risk increases.

Market liquidity risk is extremely difficult to be captured and therefore there are not many tools that are able to measure it, which result in a deficient management of this type of risk. The more liquid an asset is, the easier it is to exchange it for money, at low cost, rapidly and without significant changes in price. A perfectly liquid market is a market with "a single bid-ask price at all times and irrespective of the quantities being traded" (Bervas, 2006). However, that is extremely difficult to be found, even in the most liquid markets. That is because it is a fundamental condition of market efficiency, even though it is not assured in markets. The main danger behind that is the possibility of systemic crisis to occur. Literature shows that liquidity shortage is an element that has been part of the last major crises. As a result, central banks, regulators and even managers have paid more attention to this type of risk during the recent times.

2.2.4. MEASURES

Liquidity measurement is a very sensitive topic. Mankower and Marschak (1938) say that it is impossible to measure liquidity. Baker (1996) defends that all liquidity measures suffer from one or more limitations and therefore none of the measures is totally comprehensive. Literature suggests, nevertheless, various methods to assess liquidity risk.

Regarding funding liquidity, literature shows that it has been mainly assessed by liquidity ratios. Figure 2, in appendix, presents some of the measures of funding liquidity that have been used by academics in their studies. It is mainly in liquidity ratios that these authors have based their analysis. However, opinions about these measures vary among authors. According to Poorman and Blake (2005), liquidity ratios are not sufficient to assess banks' liquidity risk. To support that they took the example of Southeast Bank in the US that had a liquidity ratio of more than 30 and ended up failing, as a result of liquidity risk. Matz and Neu (2007) suggested balance sheet analysis as a method to assess liquidity risk, using measures as cash capital positions and maturity mismatches, for instance. Shen et al. (2009) measured liquidity risk through the use of the financing gap, which is the difference between bank's average

loans and core deposits. Saunders and Cornett (2006) preferred to use exposure peer group ratio comparisons, liquidity index, financing gap and the financing requirements, and liquidity planning to measure liquidity risk. The previous are quantitative measures of liquidity risk, however qualitative measures have also been suggested in literature. Matz and Neu (2007) support that the former are at least as important as the quantitative ones.

However, as already mentioned, what is measured in this paper is market liquidity, therefore it makes sense to look at what literature has to say about measuring this type of risk. The typical measures of market liquidity risk are the bid-ask spread (Amihud and Mendelson, 1986), the dollar volume (Brennan et al., 1998), the price impact of a unit trade size (used by Brennan and Subrahmanyam, 1996) and the turnover, as the reciprocal of the average holding period of stocks (Datar et al., 1998).

Literature shows, through numerous empirical studies, that the measurement of liquidity is important. Indeed, investor need to be compensated with excess on returns to be willing to invest in less liquid assets. Furthermore, models of asset pricing are in line with the result. That is demonstrated with LAPM[5]. The Standard CAPM assumes frictionless markets and does not reflect the risk due to illiquidity. Acharya und Pedersen (2005) proposed a liquidity adjusted CAPM for returns net of illiquidity cost, which actually has a higher R^2 than the standard CAPM.

Baker (1996) presented some studies about the quality of liquidity measures. According to them, the time dimension of assets alone is not enough and can even be misleading under certain conditions. Methods to measure liquidity risk should focus on the price dimension of assets or at least in one of the three components – market depth, breadth and resiliency – in line with the price dimension of liquidity, to attain a proper assessment of liquidity risk. Ernst et al. (2009) defended that bid-ask spread measures consistently outperformed all other non-limit order data models.

Bangia et al. (1999) consider two different components in liquidity risk: an exogenous dimension, which is the average of transaction costs set by the market, and the endogenous dimension, which is the impact on prices that results from the liquidation of a position in an

[5] LAPM is a liquidity-adjusted version of the CAPM, Capital Asset Pricing Model, considering the effect of liquidity in asset pricing.

excessively tight market. The last dimension applies to orders that are sufficiently large to be able to move market prices. The exogenous component can be measured by the bid-ask spread, whereas the endogenous one has to be assessed recurring to the use of measures of elasticity of prices to volumes, also designated by impact measures.

Spread measure will be use in this empirical study of this paper, to assess liquidity risk. That is because spread measures are easier to calculate and they are sufficiently reliable if we consider small investors, which is assumed in this study. The difference between these two types of measures is relevant when considering big investors, who trade big amounts of assets, and influence the price of assets, which is assumed not to happen in this study. If that were the case, impact measures would be of importance to assess market liquidity risk. However, impact measures usually can only be calculated a posteriori and depend on information that is hard to obtain, which makes many authors to prefer using spread measures, hence considering the exogenous component of liquidity risk (Gaspar and Sousa, 2010).

Gaspar and Sousa (2010) present some of the most used spread measures. The first is the bid-ask spread, which is the difference between ask and bid prices. Then, the Qspread, which is the percentage quoted spread, in other words, the difference between ask and bid price to the midpoint price. The Espread is another spread measure, which is the effective percentage half-spread, calculated as the ratio of the absolute difference between the transaction price and the bid/ask price midpoint of the asset to the bid/ask price midpoint. The effective spreadTAQ, which is calculated by the New York Stock Exchange Trades and Automated Quotes Database and computed as the bid/ask spread as twice the absolute difference between the transaction price and the midpoint of the bid/ask spread. The c-Roll indicator measures the effective bid/ask spread in terms of covariance of changes in price. The effective tick is the ratio of a probability-weighted average of effective spreads to the average price in a time interval. The H-spread is the weighted average of the possible spreads and finally the LOT measure is the difference between the percentage of transaction costs from a sell and the percentage of transaction costs associated with a buy and the zero indicators and measure the proportion of days with zero returns and/or nil volume in a month.

The most popular measures are, according to Gaspar and Sousa (2010), are the quote size, which is the quantity supplied and the quantity ordered using realized sell and buy prices; the

trade size, which represents the quantities traded; the trading volume, which represents the volume traded; the trading frequency, which represents the number of transactions within a certain price range and finally the illiquidity and extended illiquidity, which represent the relationship between the volume and returns of an asset and the relationship between the bid/ask spread and volume.

Given that this study uses the bid-ask spread to measure liquidity risk, it is pertinent at this stage to define this measure of market liquidity risk. The bid-ask spread is the difference between the ask price and the bid price of a security, being that the bid price is the highest price an investor is willing to pay at a given time to purchase the asset, and the ask price is the lowest price an investor accepts to receive to be willing to sell the asset. The bid-ask spread can also be seen as the compensation for the market maker from providing the immediate execution of the transaction. Likewise, the bid-ask spread measures the cost of buying or selling a position. It is important to notice that it is composed by the cost born by the two parties, when they incur into a transaction. Therefore, only half of it should be attributed to each part, considering that mid price is the resulting price in a perfectly liquid market. The bid-ask spread represents the liquidity available in the market at a given point in time.

2.3. RELATIONSHIP BETWEEN LIQUIDITY RISK AND STOCK RETURNS

Literature is rich when it comes to explain stock returns and liquidity is considered as a fundamental element to understand them. Some authors even say that liquidity risk has first order effects on stock returns (Vo and Batten, 2010). Liquidity is indeed an important feature of assets and therefore has a considerable impact in investment decisions.

Many studies on the impact of liquidity risk on stock performance show that there is a positive relationship between the two variables. That means that returns increase with illiquidity. In order words, the more illiquid a stock is the lower its price is after controlling for risk and therefore the higher will be the it offers to its investors, *coeteris paribus*. Literature says that risk-averse investors price illiquidity risk and therefore they need to be compensated with excess returns to be willing to invest in less liquid stocks. Indeed, investors expect more returns from more illiquid stocks. That is relatively easy to understand if we

consider rational and risk-averse investors. Given that less liquid stocks are more costly that liquid ones, an investors will only willing to invest in illiquid assets if they generate, on average, higher returns. That is the reasoning provided by literature to justify what most papers have proven - a positive relationship between illiquidity and stock returns, or, seen from the other perspective, the negative correlation between liquidity of an asset and its performance.

Many authors have studied the relationship between liquidity and stock performance, using different measures to assess liquidity risk.

Amihud and Mendelson (1986), in a cross-sectional study on US stock returns, proved that liquidity, measured by the bid-ask spread on stocks, influences negatively risk-adjusted returns. Loderer and Roth (2005) studied the effect of stock illiquidity in the Swiss market. Both bid-ask spreads and volume traded were used to measure liquidity risk, and the Price-Earnings ratio was considered to assess stock performance. The two studies (one considering the bid-ask spread and the other on volume traded) provided the same result – the more illiquid and asset is, which is the higher its bid-ask spread is or the lower the volumes traded are, the lower the ratio of Price-to-Earnings. That is consistent with theory, since stocks with lower Price-to-Earnings rations are expected to generate higher returns. Hence, positive relationship between liquidity risk and returns is confirmed by this study.

Datar et al. (1998) and Brennan et al. (1998) measured liquidity risk with the stock turnover, which is the ratio of trading volume to shares outstanding. In the two studies the results were in the same direction – the higher the illiquidity of stocks the higher the return they generate, after controlling for risk. The relationships on the two studies were robust. Other studies that used turnover rate as a measure for liquidity. For instance, Haugen and Baker (1996), studying Russell 3000 stock index, found a significant negative relationship between the turnover and the return of stocks, corroborating once again the negative relationship between the liquidity and stock returns.

Amihud and Mendelson (2006) performed a cross-sectional study having has dependent variable the average return of portfolios and as dependent variables the bid-ask spreads, the firm size and the unsystematic volatility. The result, once again, was that stocks with higher

illiquidity showed, on average, higher returns. An interesting conclusion of the study was that the relationship between stock illiquidity and returns was positive, but concave. That means that the marginal increases in returns were decreasing with illiquidity. In Figure 6, in appendix, we can observe the shape of the relationship found by Amihud and Mendelson (2006) with more detail.

Literature also mentions that liquidity becomes more important in riskier investments and that the impact of liquidity on asset prices varies among countries, securities and periods of time. Pastor and Stambaugh (2003) find that stocks that are more sensitive to illiquidity have, in general, higher average stock returns. Also, Acharya and Pedersen (2005) use liquidity betas to measure systematic liquidity risk and demonstrate that the market prices those betas, i.e., investors incorporated them in prices. Once again, the study shows that stocks that are more sensitive to market illiquidity have, on average, higher returns. Both theory and empirical studies show that market prices liquidity and that less liquid securities have, on average, lower prices, enjoying higher expected returns. Risk lowers securities' prices and therefore boosts expected returns.

Many authors, who studied the influence of trading costs on stock returns, have proved that transactions costs do influence investment decisions. Indeed, investors need to be compensated for them to be willing to invest in illiquid assets. Therefore, most of the cross sectional studies show that there is a negative relationship between liquidity and stock returns. This result has been confirmed studies developed and mature markets. However, conclusions seem to be different when it comes to studies on non-developed and emerging markets. Another variable questioning the relationship between liquidity risk and stocks performance is the investment horizon of investors. Amihud and Mendelson (1980), using bid-ask spreads to measure liquidity, proved that, in equilibrium, only investors with long-term investment horizons would hold illiquid assets.

2.4. EXPLANATIONS FOR THE RELATIONSHIP

More than providing us with the results of the relationships between liquidity and stock performance, literature has also offers some explanations on the reasons why liquidity affects

stock returns in a certain way.

One of the reasons why investors discount stocks that have higher transactions costs is that they imagine that they will also face these transaction costs in the future, by the time they will want to sell these assets. Hence, they are only willing to invest in these stocks if they are compensated with higher returns. In other words, they accept to buy them only if at discount (Amihud and Mendelson, 1986; Vayanos, 1998). The return of an asset varies, indeed, positively with their transaction costs. Nevertheless, the relationship is concave, as already mentioned. That means that the marginal increase in stock returns is decreasing with illiquidity. Some authors explain the previous with the following argument: that less liquid stocks are usually held by long-term investors, the only ones who are willing to bear these costs, according to Amihud and Mendelson (1980), hence they can spread transaction costs over the period of the investment and do not require such large returns to be willing to invest in less liquid assets. Furthermore, the impact of illiquidity is higher in liquid stocks. Those are traded more frequently and therefore would bear liquidity costs more often than the illiquid ones, which are seldom traded and whose trading costs can be spread over the holding period.

Other authors defend that stocks in which private information plays an important role from the point of view of trading will have higher returns, (Easley and O'Hara, 2004; Easley et al., 2002). Glosten and Harris (1988) consider that adverse selection costs play an important role generating illiquidity in the market and therefore contribute for the negative relationship between liquidity and stock returns. Another reason that explains the relationship between liquidity and returns is the level of market integration. In low integrated markets, the relationship between the two variables is positive. The reason is that in less integrated markets, liquidity is not a risk factor and therefore there is not necessarily a negative relationship between liquidity and stock returns.

As it was already mentioned, investors like liquidity. But why do they have such preference for liquid assets? Some studies on the topic show that liquidity influences positively the corporate governance of companies, which is reflected on their stock performance (Fang et al., 2009). In other studies the argument is that liquidity facilitates the information of a toehold stake (Kyle and Vila, 1991), promoting more management compensation (Holmstrom and Tirole, 1993). Other studies prove that liquidity reduces managerial opportunism (Admati and

Pfleiderer, 2009; Edmans, 2009; Palmiter, 2002), which may encourage trading by informed investors and therefore improve investment decisions by providing investors better information on share prices (Khanna and Sonti, 2004; Subrahmanyam, 2001).

Even though most of the studies in literature support a positive relationship between illiquidity and stock returns, the relationship is not vigorous. It was already proved that there are effects contradicting the findings, as the one that investor have different investment horizons, and many variables have not been tested yet. For instance, most of these studies have not distinguished between different sectors when assessing the relationship between liquidity and performance, and it is true that some sector are more sensitive than others to this topic. Moreover, times of turbulence are usually not considered in the samples, and the argument is that they may "mess up" the results. The following empirical study intents to fill this gap in literature by including some new variables in the study of the relationship between liquidity and performance, trying to clarify a little more literature.

3. HYPOTHESIS PRESENTATION

"Investors will come if they can leave" (Levine, 1996).

Literature proves that liquidity is an important characteristic of assets and therefore investors consider it when evaluating financial assets. In other words, before investing in a certain asset, investors will consider it they will be able to trade it whenever they want and without major changes in price, which is to say without having to bear significant costs.

Theories of asset pricing defend a positive relationship between risk and expected return. That is because investors are assumed to be risk-averse and therefore they are only willing to incur into more risks if they are compensated with higher returns. The cost of illiquidity represents a risk for investors and hence they are also averse to it. Consequently, an investor will only be willing to incur into liquidity costs of he is compensated with higher future returns. Expected returns and liquidity risk should therefore be positively correlated. And, indeed, most of the empirical studies presented in literature prove that – investors do require a premium on returns of less liquid stocks or, reversely, a discount when buying illiquid assets. However,

during periods of crisis this relationship may be questioned, due to changes in fundamentals of the economy and alterations in the behavior of investors, as a result.

The main hypothesis of the following empirical study is that the importance of liquidity risk to explain stock returns of banks increased after the turmoil of 2007. In addition, the sign of the relationship between liquidity risk and stock return of banks will be tested. A second hypothesis in this study is that the way investors react to liquidity risk also changed after the financial crisis of 2007, potentially as a result of "flight to quality/liquidity" behaviors, very common during times of stress in the financial system.

Succinctly, the main question that this paper tries to answer is whether the financial crisis started in August 2007 impacted the relationship between liquidity and banks stock performance, as a result of changes in economic fundamentals and subsequent alterations in the attitude of investors towards this type of risk. Answers to these questions will be looked through the analysis of a data set of 87 European and American banks over the period of 2004-2011. Liquidity risk will be measured by the bid-ask spread on bank stocks and regression analysis will find evidence on whether or not liquidity became more importance to explain banks stock returns after the turmoil od 2007 and if investors' attitude towards this risk did change.

4. EMPIRICAL ANALYSIS

As already mentioned, the purpose of this study is to assess the impact of the financial crisis of 2007 on the relationship between liquidity and stocks performance of banks. With that intention in mind, the empirical analysis is organized as follows:

4.1. DATA DESCRIPTION

4.1.1. SAMPLE SELECTION

To analyze the impact of the financial crisis of 2007 on the relationship between market liquidity risk and stock return of banks, we collected data from a Bloomberg terminal. All data in the sample covers the period of August of 2004 to August of 2011 and is monthly. Trying o obtain a representative sample of the worldwide financial system, a Bloomberg screening was performed. The criteria included the following restrictions: only financial institutions, from USA and Europe, being that in Europe only the UK, France and Germany were considered. Additionally, financial institutions had to show a market capitalization higher than 1 billion monetary units by the beginning of the period of analysis. After performing the screening, a sample of 98 banks, from USA and Europe was obtained. However, 11 banks had to be taken out of the sample due to lack of information available to perform the desired study. Finally, we got a sample of 87 banks, being that 77% was the USA and the remaining from Europe. Inside Europe, the sample was well distributed, with 40% of the banks from the UK, 30% from France and other 30% from Germany. There is indeed an overweight of American banks in the sample, which is the result of the criteria considered in the screening. Definitely, the size criterion excluded many European institutions that have smaller market capitalizations than their American counterparties. The description of the overall sample used for the purpose of this study can be seen in more detail in Figure 7, in appendix.

What follows are the reasons behind the choice of this sample and period of analysis. It is important to understand them before actually describing them.

Well, this study aims at understanding the influence of the past financial crisis in the relationship between liquidity risk and stock performance of banks, especially because liquidity risk played a crucial role in that turmoil, which is designated by many authors as a liquidity crisis. Therefore, the period of analysis had to include the time in which the crisis affected more strongly the financial system. That is the reason the period of the financial crisis were considered. However, in order to obtain a more representative sample, not capturing solely the event of the crisis, some more years before and after the event were included. A period of 3 years before and 3 after the turmoil seemed to be enough. The period was not wider so that other events that may have harmed the financial system before 2007 were also considered, which could bring some unrelated effects to the analysis and thus increase the noise. Figure 1, in appendix, shows the evolution of the liquidity index (by bank of England and adapted in this paper) over the past years. It highlights the level of the index during the period considered in this empirical study (red box).

What this study tries to assess is if this crisis somehow changed the fundamentals of the financial system in such a way that it impacted the relationship between liquidity and stock performance of banks. But why the banks and not another sector? And why market liquidity risk and not another? Well, it is relatively consensual that banks were at the core of the past financial crisis and indeed the turmoil of 2007 started by the financial sector. Furthermore, literature is extremely scarce in what concerns the analysis of the relationship between market liquidity risk and the banks performance. Most of the papers explore the role of funding liquidity risk faced by financial institutions, leaving the market one, increasingly important during the past years, apart. Moreover, what exists in literature covering market liquidity risk is related to stocks in general, almost never focusing on the financial sector. Many author justify the exclusion the financial sector from their samples arguing that arguing that it may "mess up" the results, as happens to periods of crisis in the financial system, also taken out of the analysis, often times. This paper tries to fill this gap in literature, choosing a sample hat enables the inclusion of variables that although important have not sufficiently explored by literature.

Regarding the choice of countries, the USA had to be included, given that it was at the core of financial crisis. Moreover, liquidity risk is plays a fundamental role in this financial system,

given that it is much more market-based, when compared to others. So that Europe was also represented in the sample, the most relevant financial systems in that continent were considered, namely the UK, France and Germany. The choice of the sample was also based on the study of Haugen and Baker (1996), which showed that liquidity is an important factor to explain stock returns, especially in developed markets.

It is also important to mention that banks included are all listed and monthly periodicity of data had to be considered to permit a wider coverage of time, since there were considerable lacks of information on daily and weekly data. Furthermore, monthly data removed some noise from the study. These arguments were supported by benchmarking the former analysis with papers that performed a similar study and also considered monthly data the better approach for this type of analysis.

A summary of the composition of sample is presented in Figure 7, in appendix, as well as some graphs on the evolution of the main variables, namely the bid-ask spread and stock returns of banks, during the period analyzed, which confirm the importance of liquidity risk after the financial crisis of 2007. The graphs consider the overall sample (with the 87 banks, from the USA and Europe) and show that while before the crisis the bid-ask spreads and stock returns of banks fluctuated in a similarly fashion, in the period after the turmoil the relationship becomes more difficult to be understood. The purpose of this study is to clarify and potentially answer that question.

4.1.2. VARIABLES DESCRIPTION

In what concerns the measurement of performance, banks have often used ROE[6] as one of the most important measures of performance. It is true that it provides investors with a simple and complete picture of how banks are delivering value to their shareholders. However, the last financial crisis proved that ROE failed to distinguish the best performing banks from the remaining ones in what concerns the sustainability of their results (European Central Bank, 2010). In this paper performance of banks is assessed by the return on their stock price. It is the dependent variable in this analysis and is assessed by the logarithm of monthly returns on

[6] Stands for Return on Equity

banks stock prices. The price considered is the one from the last day of each month and the logarithm was used to compute returns, assuming that stock returns follow a log normal distribution, which has already been provided by other studies in the topic.

Regarding the measurement of liquidity risk, the bid-ask spread was the variables chosen. That is because spread measures are usually easier to calculate and they are reliable when we consider that most of the investors in the market are small, which is assumed this study. When that is not the case, meaning that there is a considerable number of big investors trading huge amounts of assets, impact measures should also be considered to measure market liquidity risk. That is, however, not the case in this study. Additionally, the use of bid-ask spread measures seemed to be make sense in this study, given that the sample is composed by stocks that belong to exchanges that use the bid-ask spread system for trading. Therefore, data on this measure was easy to obtain from the Bloomberg terminal.

The effect of liquidity risk on banks stock returns before the crisis of 2007 is expected to be positive, according to most of the studies that belong to literature. That is because investors are only willing to invest in less liquid assets if they are compensated with a premium on returns. Therefore it is expected that the relationship between bid-ask spread and stock returns of banks is positive, at least before the financial crisis of 2007. However, after this turmoil the relationship becomes ambiguous. If on the one hand, investors should be averse to illiquidity and therefore require a premium for holding less liquid stocks, on the other hand, the "flight to quality/liquidity" behavior, which is characteristic of times of stress in the financial system, may contradict the fist effect, particularly in less liquid stocks.

The bid-ask spread is the ratio of the difference between the ask price and the bid price over the bid price on bank stocks. The bid-ask spread is considered to be enough to take some conclusions on the relationship between liquidity risk and stock returns, given that many papers have proved that liquidity risk is already a very important component of risk, even if only the costs resulting from the bid-ask spread are considered. Amihud and Mendelson (1986) defend that an investor that is willing to transact can either wait to transact at a desirable price or, if he does not want to wait, he may buy or sell the asset immediately and face the costs of it – the bid-ask spread. Indeed, the ask price (usually higher) includes a premium for immediate purchase, whereas the bid may incorporate a discount for immediate

sale of the asset. The bid-ask spread is therefore a pertinent measure of liquidity, given that it represents both the buying premium and the selling discount that enable an asset to be transacted immediately. Illiquidity is seen, according to this approach, as the cost that results from the execution of immediate transactions in capital markets.

Control variables had to be included in the regressions to guarantee the robustness of the conclusions. The systematic risk of banks, assessed by their betas, is the first control variable. It was chosen following Fama and French (1992) approach, which has been used in many other papers studying the variables that explain stock returns. As the systematic risk of a stock, the beta represents an important measure of risk.

The book-to-market ratio, which is the ratio of book value over market value of the bank at the end of each period, was considered as another control variable in the study. Literature says that companies with lower ratios of book to market are expected to have higher returns, whereas the stocks of companies with higher book-to-market rations are expected to perform worse in the future. Indeed, investors require premiums to be willing to invest in stocks with high book-to-market ratios in order to compensate for the additional risk they incur in, because these companies are considered to be weaker. On the other hand, investors accept a discount for holding stocks whose book-to-market ratio is lower (Fama and French, 1993). Hence, the relationship between book-to-market ratio and stock returns is expected to be positive. The logarithm of this variable was considered in the former analysis, once again assuming that it follows a lognormal distribution, which was also considered in several previous studies.

Size is the last control variable in this study. Its use seemed to be pertinent for control purposes, given that it is related to the liquidity of a stock. According to literature, larger stocks are usually more liquid than the smaller ones. Size was also computed using logarithm terms, under the assumption that it follows a lognormal distribution. Literature says that size is negatively related with stock returns, since investors require a premium of return in order to compensate for the risk incurred when they hold stocks of smaller firms, which are usually riskier that the bigger ones. On the other hand, they accept a discount for holding stocks of larger firms, which are less risky (Fama and French, 1993).

Also Aitken and Comerton-Forde (2003), Beaver and Ryan (2000) and Datar et al. (1998) used betas, book to market ratios and firm size as control variables in their studies of stock returns. Fama and French (1992) defended that size and book-to-market ratio should be used to explain expected returns, claiming that the systematic risk, assumed by CAPM as the main explanatory variable of returns, was not enough.

In Figure 8, in appendix, we can find a description of the variables used in this empirical study.

4.2. METHODOLOGY

Multivariate linear regression analysis is used in this paper to explore the relationship between liquidity risk and performance of banks and all regressions are run on STATA econometric software.

Three types of studies are performed to increase the robustness of the study. First, a cross-sectional study was performed with the overall sample. Cross-sectional regression analyses have been used in literature to assess the relationship between liquidity risk and stock price returns. These types of studies control the heterogeneity of the observations by assuming a certain specific effect, or by assuming non-observable specific effects. The regressions on the cross-sectional studies were run as follows:

$$\mathbf{P_i = c + \beta_1 bidaskspread_i + \beta_2 beta_i + \beta_3 bookratio_{it} + \beta_4 size_i + \varepsilon_i}$$

$P_{i,t}$ denotes the average of stock returns of bank i during the period studied; liquidity risk is represented by the average of $bidaskspread_i$ during that time and finally control variables are $beta_i$ $bookratio_i$ and $size_i$. ε_{it} is the error term in the regressions.

Three regressions were run to assess the importance of the financial crisis for the relationship between liquidity risk and performance: one for the period before the crisis, another for the period after the turmoil and a final regression on the overall period.

Secondly, a panel study was performed, on the following regression:

$$\mathbf{P_{it} = c + \beta_1 bidaskspread_{it} + \beta_2 beta_{it} + \beta_3 bookratio_{it} + \beta_4 size_{it} + \varepsilon_{it,}}$$

Variables are the same as in the cross-sectional study, with the inclusion of an additional

dimension – time.

Panel studies are one of the most advanced econometric tools, since they consider both cross-sectional and time series data, meaning that they measure the levels of the variable overtime and across groups. Indeed, a panel data regression has two indexes in its variables – the i, which denotes the particular group, in the case of the former study the particular bank studied, and t for time. In other words, the i index denotes the cross-sectional dimension, whereas t represents the time-series one. The advantages of using this type of study are that it controls for individual heterogeneity, mitigating the risk of obtaining biased results and also it allows a more complete study, including more information and enhancing the quality of the conclusions, potentially. Panel studies have also been used in literature to explore the relationship between liquidity risk and stock return, given that they are advantageous reducing collinearity as well as estimation biases in variables. Shams et al. (2011) used a panel study to evaluate the relationship between liquidity risk and stock prices in the Tehran stock exchange, also using monthly data. The cross-sectional study has the disadvantage of not enabling the inclusion of time in the regression, which is overcome with the inclusion of a panel study to enhance the analysis. Also for this panel study three regressions were run, once again, for the periods before the crisis, after the financial crisis and before and after the turmoil (the overall period).

Finally, a cross-sectional study was performed for one bank from each country studied, following the same cross-sectional methodology:

$$\mathbf{P_i = c + \beta_1 bidaskspread_i + \beta_2 beta_i + \beta_3 bookratio_{it} + \beta_4 size_i + \varepsilon_i.}$$

For this last analysis, banks considered were ZION (USA), STAN (UK), BNP Paribas (France) and DBK (Germany).

Summarizing, three studies are performed to assess the impact of the financial crisis in the relationship between liquidity risk and performance of banks: a cross-sectional study in the overall sample (89 European and America banks, over the period of 2004 to 2011); a panel study in the overall sample as well, and finally four cross-sectional studies but for individual banks. The use of different types of studies contributes for the enhancement of the analysis.

4.3. RESULTS

The tables with the results interpreted in this section can be seen in appendix. In particular, the statistics of the variable can be found in Figure 9, the matrix of correlations is in Figure 10 and Figure 11 shows the regression results.

4.3.1. CROSS-SECTIONAL STUDY ON OVERALL SAMPLE

The impact of liquidity risk in the cross-section of bank stock returns, on the overall sample (European and American banks) in the context of the financial crisis of 2007 will first be presented.

Regarding the statistics of the variables, we can see that in the period before the financial crisis of 2007, the monthly price return of banks included in the sample had a positive mean (0.27%), with a relatively low standard deviation (0.92%), which means that observations in the sample were not considerably different. In the period after the financial crisis, the average of price returns was negative (-1.96%), as expected, and the standard deviation increased a slightly, showing that observations in the sample become relatively more heterogeneous when compared to the previous period of analyzed. If we look at the statistics of price return during the whole period (before and after the crisis), we can see that the average of monthly price returns of banks was negative (-0.85%), which shows that the financial crisis had a substantial impact in the performance of banks during the period of analyzed. The standard deviation in this period was also higher than during the two other periods, which shows that when considering the whole period there are higher differences among observations than if we considers each period individually, which makes sense.

Regarding the measure of liquidity (bid-ask spread), we can see that its mean is positive in the three periods, which was expected, given that the ask price should always be higher that the bid price. Also intuitively the bid-ask spread is the cost of transacting a security immediately at the amount desirable, which should be positive. However, it is interesting to note that the bid-ask spread average in this sample is smaller in the period after the crisis. That can be a result of the evolution of trading systems over time. The standard deviation of this variable,

opposite to what happened to price returns, is higher during the first period (before the crisis), which shows that observations were more heterogeneous in the period before the financial crisis.

Regarding the control variables, the first considered – systematic risk on banks (beta) – is positive and higher than 1 in the three periods analyzed, with means that the return on banks stocks included in the sample varied according to the index used as their benchmark (usually Bloomberg uses the index of the index in which these banks were listed). Furthermore, the means of this variable do not vary much among periods. The beta average is slightly higher in the period after the crisis, which is understandable given that as overall risk usually increases during periods of crisis, also systematic risk does. Standard deviations of beta are not substantially different among periods. The book-ratio, which is the logarithm of the ratio of book-to-market value of banks included in the sample, has a negative average. That happens not because the ratio of book to market is negative itself, but because we considered the logarithm of this variable in this study, following the approach of many papers exploring the same topic. Its average, however, increases in the period after the crisis. Finally, the last control variable – size (the logarithm of market capitalization of banks) – had a positive average in the three periods, although smaller after the crisis, which makes sense given that banks were negatively affected by the turmoil, which reduced their market capitalization. The standard deviation is not significantly different in the three periods, which shows that the heterogeneity of the sample is similar among the periods studied.

Before running the regressions, it the analysis of the matrix of correlations of variables seemed to be important. From that we can see that price returns are positively correlated with bid-ask spread (the measure of liquidity) before the crisis, which is perfectly in line with what we expected – a positive relationship between illiquidity and stock price before the turmoil (31.52%). Also, it is in line with what many papers already proved – investors are only willing to invest in less liquid assets if they are compensated with higher returns, which results in a positive relationship between the bid-ask spread (which represents illiquidity) and price returns. Even though being in line with what most paper proved, the results still bring some "new information to literature", given that most papers studied the relationship between stocks in general and price returns, whereas this study explores the relationship for a particular segment - banks, being innovative in the sense that it shows that also the particular

segment of banks showed a positive reaction of stock price to illiquidity, before the financial crisis of 2007. The period after the crisis shows, on contrary, a negative correlation between price returns and illiquidity (-1.95%), which is another "new" in literature. That gives some hints to answer the main hypothesis of this paper, which is that the financial crisis of 2007 changed the relationship between liquidity and performance of banks. That makes us anticipate that that the reaction of banks to liquidity risk may have changed after the financial crisis, becoming negative. That may be a result of some flight to liquidity behaviors during times of crisis. However, we should not take conclusions already, since we are only analyzing the correlations between variables. Conclusions on results will only be possible when we look at the significance of the regressions. If we consider the whole period (before and after the crisis), we can see that the correlation is still positive (21.93%), but lower, which in understandable given that there are two opposite results in the separate periods.

Regarding the control variables, we can see a negative relationship between price returns and systematic risk during the three periods, a positive correlation between book-to-market ratio and price return before the crisis, but negative in the other two periods analyzed and finally a positive correlation between price returns and size of the banks in the three periods analyzed. Also, bid-ask spread is negatively correlated with beta in the three periods and positively correlated with the book-to-market ratio. The systematic risk (beta) of banks in the sample varies negatively with the size of the same banks, also in the three periods analyzed, which is consistent with literature, showing that larger firms (usually less risky) have lower systematic risks. Finally, book-ratio and size are negatively correlated in the three periods, which shows that bigger banks have lower book-to-market ratios, or, in other words, less opportunities of growth, which is also consistent with some papers in literature.

After interpreting the statistics of the variables used in this study and the correlations between them we are ready to run regressions.

First of all it is important to notice that the liquidity measure is highly significant in the three periods. The three stars of the coefficient of bid-ask spread in the periods before and after the crisis show that this variable is significant at 1% or, in other words, it is significant in a 99% confidence interval. In the period before the crisis the coefficient of the bid-ask spread is significant at 5% (two stars). Regarding the level and signal of this coefficient, we can see

that it is positive but small in the period before the crisis (0.768%), which means that during this period liquidity risk contributed positively to explain the stock returns of banks in the sample stock returns, but had a small impact on them of approximately 0.8%. But still, as the signal of the coefficient is positive, investor were compensated with a return premium for investing in less liquid stocks. This result is in line with expectations that assets that are more expensive to trade, meaning less liquid, have to provide higher returns so that investors are willing to invest in them. Also, that indicates that investors evaluate stock illiquidity, and they are averse to it. Hence, they require a liquidity premium to compensate for additional risk from holding illiquid stocks.

However, if we look at the second regression (for the period after the financial crisis), we can see that not only the absolute value of the coefficient increases, which means that this variable (liquidity risk) becomes more important to explain the stock returns of banks, but also its signal changes. Indeed, the coefficient of bid-ask spread becomes negative after the financial crisis (-8.47%), being that this result extremely significant (three stars, meaning that it is significant at 1%, with a t-statistic of -5.82, as it can be see in the regressions taken from the statistics program used, in Figure 13.

An explanation for this change is that during periods of crisis investors are no more willing to invest in less liquid stocks (with higher bid-ask spreads) and therefore, we start observing certain movements in the market, which are called by many authors as “flight to quality/liquidity” movements. In this context, the effect of such movements in less liquid assets is clear. As long as investors divest from their illiquid stocks, supply on this type of assets decreases and therefore their price decreases. On the other hand, demand for more liquid stocks increases, as a result of this “flight to liquidity behavior”, therefore the price of more liquid assets increases. Indeed, the effect of “flight to quality” movements during periods of crisis can be ambiguous for liquid stocks, given that they suffer the two contradictory effects. What we conclude from the sample used in this analysis (that included the biggest banks in the world) is that overall the relationship between illiquidity (measured by bid-ask spread) and banks stock returns became negative in the 3 years after the financial crisis of 2007, which, in line with the flight to quality behavior, means that the stock of these institutions were not considered to be liquid by investors, *coeteris paribus*. Considering the whole period (before and after the crisis) we can observe a positive and significant

relationship (t- statistic of 3.86) between illiquidity and bank stock returns, however with an higher coefficient than in the period before the crisis (1.35%), which shows that the period after the crisis increased the importance of liquidity risk to explain banks stock returns. In other words, the financial crisis of 2007 increased the importance of this variable, in particular for financial institutions.

Regarding the control variables considered in the regressions, we can see that the systematic risk of banks (beta) is significant at 1% in the three periods and influences negatively price returns, which means that investors reacted negatively to the systematic risk of the institutions considered in the sample, during the three periods analyzed. Moreover, the absolute value of the coefficient of beta increased after the financial crisis, which shows that the influence of systematic risk explaining stock returns of banks increases after the turmoil. The book-ratio is not significant to explain stock returns in the period preceding the crisis; therefore we cannot conclude anything from that. However, it is significant and its coefficient is negative in the two subsequent regressions, which shows that, in this sample, banks with higher book rations generated lower returns. Still, the absolute value of the coefficients is small in the three periods, which shows that this variable had a small impact explaining the stock price returns of these banks. Finally, the last control variable – size – is significant at 5% in the period before the crisis and has a positive impact on stock returns of banks, meaning that bigger banks generated higher returns overall, during this period. That is, however, inconsistent with literature that says that investors require a premium in to compensate for the additional risk they incur in when they hold stocks of smaller firms (Fama and French, 1993). Regarding the two following periods, we cannot conclude anything, since the coefficients are not sufficiently significant.

To improve the robustness of the study, the same regressions were run on the sample of banks from the USA and Europe, separately. The conclusions of these analyses are similar for the USA, with the exception that in the second regression (analyzing the 3 years after the crisis) the coefficient of bid-ask spread is not sufficiently significant to enable us to take conclusions (t-statistic of -1.22 and a p-value of 22%). In Europe, the results are similar to the ones on the overall sample, which is to say that the relationship between illiquidity and stock returns of banks is significant in the three periods, being positive before the financial crisis and negative after the event. However, in Europe, the absolute value of the coefficient is substantially

higher in the period before the financial crisis, when compared to the same period on the overall sample, showing that, in Europe, liquidity risk was already considerably important to explain stock returns of banks in the 3 years before the financial crisis.

What is important to notice from this study is that overall liquidity is significant to explain stock return of banks, and the results of both the intensity and the signal of the relationship are coincident in all the cross-sectional analysis at this stage, even after considering the control variables.

4.3.2. PANEL STUDY ON OVERALL SAMPLE

In this section, the results of the panel study on the impact of liquidity risk for banks stock returns are presented.

Concerning the statistics of variables, we can see that before the financial crisis, the average of price returns of banks was positive (0.26%) and the standard deviation was relatively low (4.78%), whereas after the turmoil, the average of price returns was negative (-1.96%), as expected, and the standard deviation increased slightly, as happened in the cross-sectional study. Also, in the overall period, the average of monthly price returns of banks was negative (-0.85%), showing that the financial crisis affected significantly the performance of banks during the whole period, as in the previous analysis.

About the bid-ask spread, we can see that it had a positive mean during the three periods, which was expected, being smaller in the period after the crisis, as in the cross-sectional study. This variable showed a high standard deviation in the period before the crisis, reducing substantially after that, showing that observations were more heterogeneous before the turmoil.

Regarding the control variables, the beta is lower than 1 before the crisis (0.978), but higher than the unity in the other two periods. The increase in systematic risk after the turmoil is understandable, given that overall risk augmented at that time. The average of the book-ratio increased after the crisis, showing that the market value of financial institutions when

compared to their book value decreased after the turmoil. Size, as the logarithm of market capitalization, was not very different average among the three periods, although it reduced after the crisis. Also its standard deviation did not vary significantly among the three periods.

About the matrix of correlations of variables, we can see that price return is positively correlated with bid-ask spread before the crisis (0.44%), which in line with literature. However, the correlation of price return with bid-ask spread became negative after the turmoil (-0.89%), as happens in the cross-sectional study. That supports the hypothesis on the impact of bid-ask spread on stock returns after the crisis, showing that the correlation between the two variables changed after the event. Considering the whole period (before and after the crisis), we can see that the correlation is still positive (0.25%), but lower than before the turmoil, which highlights the effect of the event changing the relationship between these two variables. Price returns were negatively correlated with systematic risk before the crisis and in the whole period, but positively after the turmoil. Book-to-market ratio varied negatively with price returns in the 3 periods, whereas size showed a positive correlation with price returns. Bid-ask spread was positively correlated with beta before the crisis, but negatively related after that, while it varied negatively with book-to-market ratio during the 3 periods. Beta varied negatively with size in the three periods, which shows that larger firms had lower systematic risks. Book-ratio and size were negatively correlated in the three periods of analysis, which is in line with the sample on the cross sectional study.

Regarding the regression results, we can see that the liquidity measure is highly significant in the three periods, in line with the cross-sectional study. The coefficient of the bid-ask spread is positive but very small in the period before the crisis, which means that during this period the relationship between liquidity risk and banks stock returns was positive, although bid-ask spread had a very small impact on stock returns. Still, it is a very significant variable in the regression. This result is in line with expectations and with the cross-sectional results, showing that investors are only willing to invest less liquid stocks if they provided them with higher returns. In the period after the financial crisis we can see that the absolute value of the coefficient increases, meaning that the impact of liquidity risk explaining stock performance increases, meaning that liquidity risk becomes more important to explain returns on bank stocks. Moreover, the signal of the coefficient becomes negative in this period (-31.6%), in a 95% confidence interval or with a p-value of 5%. This change is in line with what happened

in the cross-sectional study and whose reasoning was already provided – a "flight to quality/liquidity" movement. For the whole period we can see that the relationship between liquidity risk and stock returns is still positive, but small, again in line with the cross-sectional study.

It is interesting to note that all control variables in the regression are extremely significant. The systematic risk of banks (beta) influences negatively price returns, being significant at 1% in the three periods. Indeed, investors reacted negatively to the systematic risk of the institutions considered in the sample, during the three periods analyzed. Furthermore, the absolute value of the coefficient of beta increased after the financial crisis, showing that the turmoil enhanced the impact of systematic risk on banks stock returns. The book-ratio is also significant and affects negatively stock returns in the three periods, showing that banks with higher book-ratios generated lower returns, in the sample analyzed. However, the coefficient of this variable is extremely small, showing that it has a small relevance to explain stock returns of banks. Size is significant and positive in the three regressions, showing that bigger banks generated higher returns in the three periods, which is inconsistent with literature that says that investors require a premium for the additional risk they incur in by holding stocks of small firms (Fama and French, 1993).

In the regression of only American banks the conclusions are similar, with the exception that the coefficient of bid-ask spread after the crisis is not significant and therefore we cannot conclude about it if we only consider the American banks. However, the coefficient of this variable is positive in the other two periods, which is in line with the results of the cross-sectional study. In Europe the results are similar to the ones obtained on the cross-sectional study. The relationship between illiquidity and stock returns of banks is significant in the three periods, being positive before the financial crisis and negative after the event. In Europe, however, the coefficient of bid-ask spread in the whole period is also negative (and significant at 1%), which shows that the relationship between these two variables changed considerably with the inclusion of the financial crisis. Also interesting to notice is that in Europe, the coefficient of liquidity was already high in the period before the crisis (2.596), having this variable an important contribution to explain price returns of banks, with a positive impact in them, as mentioned by literature.

The results of the panel study are in line with the ones from the cross-sectional analysis, which enhances the robustness of this empirical study. Once again, we should notice that the results are significant, even with the inclusion of control variables.

4.3.3. INDIVIDUAL CROSS-SECTIONAL STUDIES

The results of the individual analysis on the relationship between liquidity risk and performance of banks are shown in this section. ZION, from the USA; STAN, from the UK; BNP Paribas, from France and DBK, from Germany are the banks considered in the analysis. The statistics of the variable can be seen in Figure 8, the matrix of correlations is in Figure 10 and the regression results are presented in Figure 11, in appendix. Furthermore, information on each of the banks analyzed that was taken from Bloomberg website can be seen in Figure 12, in appendix.

4.3.3.1. ZIONS BANCORPORATION

In line with the previous results, we can see that Zions Bancorporation (ZION:US), listed in NASDAQ, showed an average positive return (0.56%) before the financial crisis and negative (-3.78% and -1.61%) in the two subsequently analyzed periods. That shows that the financial crisis also affected significantly the performance this bank American bank, in particular. The bid-ask spread had a positive mean during the three periods, as happens in the previous studies. Concerning the control variables, beta was lower than 1 before the turmoil but higher than unity in the two subsequent periods, again in line with the other two studies. The book-ratio increased after the crisis, on opposite of what happened to size, as the logarithm of market capitalization.

The matrix of correlations between variables shows that price returns were positively correlated with bid-ask spread before the crisis (1.10%), becoming negative after the that (-39.83%), as in the two other analyses - the cross-sectional and panel studies, which shows once again the impact of the crisis in the relationship between illiquidity and banks returns. Price returns were positively correlated with systematic risk in the three periods for Zions

Bancorporation, as opposed to the previous two studies, in which the correlation between these two variables was negative. Book-to-market ratio varied negatively with price returns, whereas size had a positive correlation with returns before the crisis and negative in the other two periods. Bid-ask spread varied negatively with beta in the three periods whereas it was positively related with the book-ratio.

Regression results show that the liquidity measure is highly significant in the three periods analyzed, for ZION, as it was for the whole sample in he two previous studies. The bid-ask spread affected positively and significantly the stock returns of this bank before the crisis (14.61), which means that during this period the relationship between liquidity risk and this stock returns was positive. Once again, this result is in line with expectations as well as in accordance with the two other studies. In the period after the financial crisis as well as during the whole period, the coefficient of bid-ask spread became negative and its absolute value increased (-27.65 and -20.26, respectively). That means that the impact of liquidity risk on the stock performance of Zion increased, after the turmoil and, furthermore, the relationship between the two variables became negative. These results strengthen the hypothesis of "flight to quality/liquidity" behavior. It is important to notice that the coefficient of bid-ask spread is extremely significant (at 1%) after the crisis and during the whole period.

Regarding the control variables, we can see that book-ratio is significant in the 3 regressions and affects negatively the stock returns of this bank. Moreover, the impact of liquidity risk on stock returns is substantially higher in this bank than it is in both the cross-sectional and panel studies. That may result from removing some noisy effects with the separation of the financial institutions. Succinctly, we can say that the analysis Zions Bancorporation, overall, leads to the same conclusions as the other studies.

4.3.3.2. STANDARD CHARTERED PLC

In line with the previous results, we can see that Standard Chartered PLC (STAN:LN), commercial bank listed in London, showed an average positive return (0.74%) before the crisis and negative (-0.72%) in after the turmoil. That confirms the negative effect of the financial crisis for this English bank as well. The mean of the bid-ask spread was positive and

not very different in the three periods. Beta was higher than 1 in the three periods, the book ratio increased as well as the size of the bank did after the turmoil, on opposite of what happened in the previous studies.

The matrix of correlations of variables shows that price returns were positively correlated with the bid-ask spread before the crisis (19.38%) and negatively after that (-7.41%), in line with the cross-sectional and panel studies, confirming again the impact of the financial crisis in the relationship between the two variables. Book-to-market ratio varied negatively with price returns, whereas size showed a negative correlation with price returns before the turmoil, but positive after that. Bid-ask spread was positively related with beta but negatively correlated with size in the three periods.

Regression results show that the liquidity measure is significant only in the two periods – after the crisis and during the whole period, for STAN, on contrary to what happened in all other studies until now, in which bid-ask spread was extremely significant in all the regression. However, by looking at the regressions in which the variable is significant we arrive to the same conclusions, overall. The negative relationship between price returns and liquidity risk after the financial crisis (-6.913) is in line with the remaining studies. Regarding the regression considering the whole period, we can see that the coefficient of the bid-ask spread is negative, even though its absolute value is slightly lower than in the regression on the period after the turmoil, showing that the period before the crisis might have had a positive effect in the relationship analyzed, although we can not take conclusions directly from the regression before the crisis, given that the t-statistic of the bid-ask spread is not conclusive.

Generally, this analysis shows that the impact of liquidity risk in this particular British bank is in line with the remaining studies, supporting the initial hypothesis.

4.3.3.3. BNP PARIBAS

BNP Paribas (BNP:FP), a French bank listed in CAC 40, shows an average positive monthly return (1.44%) before the crisis and negative (-1.29%) in after the turmoil, which corroborates

the negative effect of the financial crisis on stock returns, through the analysis of a French bank. The average of the bid-ask spread is positive during the three periods and slightly lower in the period after the turmoil. Beta is higher than 1 in the three regressions, having increased slightly after the turmoil. The book-ratio increased after the crisis, showing that the financial crisis affected negatively the growth opportunities of BNP Paribas. In line with the previous studies, the size of BNP Paribas also decreased after the turbulence of 2007.

Observing the matrix of correlations we can conclude that price returns were positively correlated with the bid-ask spread before the crisis (8.66%) and negatively correlate after that (-29.33%), in line with the cross-sectional and panel studies, sustaining again the hypothesis on the impact of the crisis in the relationship between liquidity risk and banks stock returns. The book-to-market ratio varies negatively with price returns, whereas size had a negative correlation with price returns before the turmoil, although positive after that. Bid-ask spread is negatively related with beta and with size in the three periods, in the sample of BNP Paribas.

Regression results from this bank show that liquidity risk had a substantial impact on stock returns in the period after the financial crisis, being negative (-42.64) and extremely significant (at 1%). What is differentiating in the analysis of this bank is that it is the one in which the absolute value of the coefficient of the bid-ask spread is higher after the financial crisis, being very significant at the same time. The second bank with highest absolute value of the coefficient of liquidity risk after the turmoil was ZION (-27.65), being significant at 5%. However, we could not obtain sufficiently significant coefficients for the liquidity measure in the other two periods analyzed (before the crisis and during the whole period), which does not allow extracting conclusions from the regressions. Still, the hypothesis that after the turmoil of 2007 liquidity risk had a negative impact on the stock return of banks is corroborated by the analysis of BNP Paribas.

4.3.3.4. DEUTSCHE BANK

Deutsche Bank (DBK:GR), a German bank listed in DAX, showed an average positive monthly return (1.53%) before the crisis and negative (-1.92%) in after that, supporting, once again, the negative effect of the turbulence of 2007 on a Germany institution this time. The

bid-ask spread averages were positive during the three periods analyzed, being that it increased in the period after the crisis, as opposed to what happened in the previous studies. Beta was higher than 1 in the three regressions, increasing slightly after the turmoil, as expected. The book-ratio increased after the crisis, in accordance with the previous studies, as well. The market capitalization of this bank flows the pattern of the remaining studies, decreasing in the period after the turmoil.

The matrix of correlations demonstrates that price returns were negatively correlated with the bid-ask spread in the three periods studied, different from what happened in all the other studies in which we could see a positive relationship between bid-ask spread and stock returns before the crisis and a negative correlation after that. However, the absolute value of the coefficient of correlation is higher in the period after the turmoil, with is in line with our hypothesis that the financial crisis affected the relationship between liquidity risk and stock returns of banks, being in line with the cross-sectional and panel studies. Price returns vary negatively with the book-to market ratio, whereas the size of the bank showed a positive correlation with its stock price returns, during the three periods analyzed.

Looking at the regression we can see that the liquidity measure (bid-ask spread) is extremely significant in the periods after the crisis and in the whole period (at 1%). Furthermore, we observe that the liquidity measure was negatively related with stock returns after the turmoil, once again supporting the hypothesis that after the subprime crisis stock returns of banks reacted negatively to liquidity risk. However, we cannot conclude about the relationship between the two variables in the period before the turmoil, given that the coefficient of the bid-ask spread is not significant. Nevertheless, if we look at the coefficient of correlation between price returns and bid-ask spread in the period after the crisis (negative) and complement this analysis by looking at the coefficient of the bid-ask spread in the regression of the whole period (whose absolute value is higher than the one from the regression covering the period after the turmoil, and is still negative), we can guess that the impact of liquidity risk on price returns of Deutsche Bank was already negative before the financial crisis of 2007. However, this conclusion is not strong, given that the bid-ask spread does not show a sufficiently significant coefficient before the crisis to allow the extraction of sound deductions.

What should be noticed after all the analyses is that all of them support the hypothesis that liquidity risk had a negative impact on the stock returns of banks in the period after the financial crisis, contradicting studies that have been performed until now showing that stock prices are positively related with liquidity risk and that investors were compensated with a premium in return when they invest in less liquid stocks.

5. DISCUSSION ON LIQUIDITY RISK

5.1. LIQUIDITY RISK AND ASSET PRICING MODELS

Literature defines liquidity risk as the possibility of an investor incur into losses as a result of liquidity costs, showing that transaction costs, which result from the illiquidity of assets, influence investment decisions. Well, financial theory defends that, because investors are risk-averse, they will only be willing to hold less liquid assets if they are compensated with higher returns on them. Asset-pricing models, which underlie these theories, assume perfect competition and no frictions in markets. The CAPM, for instance, assumes that systematic risk is the only risk that matters to explain expected returns. Many empirical studies already confirmed that, showing that most of the investment strategies that generated high returns also showed high levels of systematic risk (beta). However, illiquidity is clearly a friction in the market and therefore generates imperfections, which may have undesirable effects in the value of assets. One of the questions that this papers raises is how adequate are these models when describing the reality, if some of their assumptions are not met, in particular during periods of turbulence in the system – periods when the fundamentals of the economy are questioned.

Pastor and Stambaugh (2003) mentioned that in times of economic downturn, if investors' wealth decreases significantly, they may have to liquidate some assets in order to meet other obligations. That may be very costly if liquidity in the market is low, in particular when decreases in wealth are such that the marginal utility of liquidity increases enormously. Some authors argue that it is especially during times, in which liquidity risk increases, that investors will require higher extra expected returns to be willing to invest in less liquid assets, which generates a positive correlation between illiquidity and expected returns. They also say that

such relationship is stronger for more sensitive to liquidity assets, which is to say, assets in which liquidity risk is higher. Vayanos and Wang (2009), on the other hand, studying the relationship between liquidity and asset prices, showed that market imperfections, such as asymmetric information, transactions costs, leverage constrains and others, do not always increase expected returns. Others even say that these types of imperfections can even impact liquidity measures in different directions (Omri et al., 2010).

Lack of liquidity raises some questions concerning the validity of pricing models, which assume no imperfections in the market. Asset pricing models assume that assets can be transacted quickly and without major changes in their price, which is not true for illiquid assets. Moreover, the assumption that all investors have the same investment horizon is again questioned with the presence of liquidity. In fact, investors do not have all the same horizon of investment, as assumed, for instance, by CAPM. Amihud and Mendelson (1986) defended that short-term investors prefer to invest in liquid stocks, whereas the long-term ones choose to invest more in less liquid stocks. As a result, the liquidity of a stock depends on the investors' preferences about investment horizon.

The results of this empirical study shed light on the above questions, showing that during times of crisis the non-compliance with some of the assumptions that underlie these models may lead to contradictory results. The sample considered in this study proves that during normal times in the financial system (namely the 3 years before the subprime crisis, used as a proxy for those periods), the existence of transaction costs (as a synonym of market frictions) do not generate considerable changes in the relationships between variables. However, during times of turmoil, that may happen, which was proved with the financial crisis of 2007.

5.2. LIQUIDITY RISK AND CRISES

"A liquid asset can be traded at the prevailing market price quickly and at low cost" (Amihud and Mendelson, 2006). Nevertheless, market liquidity depends on the level of risk aversion of investors, on their expectations regarding price and on the information available in the market. Indeed, investors will only be willing to trade if they have positive expectations regarding the price evolution of an asset. Also, the existence of a sufficient number of counterparties willing

to trade is an important determinant of market liquidity. Keynes (1936) mentioned the paradoxical nature of liquidity, by explaining that liquidity is not a characteristic of a financial asset *per se*. A financial asset only remains liquid while investors are willing to trade it. As soon as, by any reason, investors are not willing to trade it anymore the asset loses its liquidity attribute.

Literature mentions that investors' perceptions about guaranteed liquidity may make them incur into excessive risk taking. Borio (2004) shows that most of the past financial crises were preceded by phases of excessive confidence in the system and excessive risk taking. The sensitivity of this issue is due to the fact that it is only needed a simple "hint of doubt creeping into market operators' minds" to change the market shape and prompt a liquidity crisis (Bervas, 2006).

Berger and Bouwman (2008b) investigated the relationship between liquidity and crises, considering the period of 1984-2007[7] and concluded that the two banking crises that happened during this time were preceded by abnormal positive liquidity creation. According to Bervas (2006), "liquidity crisis emerge when illiquidity risk reaches its paroxysm". During those times, the market is unable to "absorb order flows without provoking violent price adjustments that are unrelated to fundamental value". Besides that, liquidity crisis often enjoy "a sudden widening of the bid-ask spreads, or even the total disappearance of buy or sell flows and the inability to trade".

A liquidity dry up happens when all participants in the market want to unwind their positions in the market at the same time. The problem is that this type of event is very difficult to be predicted. That is why liquidity crisis are so threatening and difficult to avoid. An originator of such events could be a simple swing in participants' opinion, which happened in 1987, with the disappearance of perpetual floating-rate notes (Bervas, 2006). The main problem with liquidity dry ups is that they usually induce participants to behave in such a way that worsens even more the situation. That is why they usually lead to systemic crises. Basically, liquidity collapses originate a negative chain of events that leads the financial system to collapse. The stock market crash of 19th October 1987 in the US resulted, according to Amihud et al. (1990), from the decline in investors' perception about market liquidity. As a

[7] During this period there were two banking crises: the credit crunch of the early 1990's and the subprime crisis.

result, investors started to price securities far below their fundamental values, which led to the crash of the economy[8]. And the contagion effects that may result from the integration of markets are another threat. Because markets were integrated, the crash of 19th October 1987 in the US was spread to London, where the bid-as spread of the most liquid stocks increased significantly for a couple of months. Also interesting to notice in this crash is that the stocks with higher declines were the ones with highest deteriorations in liquidity, whereas the ones that recovered faster were the ones that whose liquidity improved quicker, as well. That shows the importance of liquidity to generate and exit periods of crisis.

Also Martinez et al. (2005) defend that periods of recession are particular for the relationship between liquidity and stocks performance. During these times, liquidity is scarce and stocks have worse performances, which makes investors to react more strongly liquidity issues. Martinez et al. (2005) concluded that stock returns are more sensitive to liquidity shocks, during periods of turbulence, but the relationship between the two variables is still positive. Well, the former empirical study partially contradicts this study, with its analysis of the banking industry. Even though this study corroborates the fact that times of turbulence in the financial system increase the sensitivity of stock returns of banks to liquidity risk, the sample used shows that bank stock returns reacted negatively to liquidity risk after the financial crisis of 2007. That confirms the fact that this crisis was definitely particular because of the role played by liquidity. Indeed, Figure 1, in appendix, shows that the level of liquidity index was never as low as by the time of the turmoil of 2007. Supporting that, Amihud (2002) argued that when market liquidity is expected to decrease (in particular during periods of crisis), two effects may occur: either stock prices decrease and therefore expected returns increase, and that is common to all classes of stocks; or there is a substitution effect from less liquid stocks to more liquid ones – the so called "flight to liquidity" effect. As a result of this last effect, investors leave illiquid positions and go for more liquid ones, which makes the price of liquid assets to increase. The effects on illiquid stocks are in the same direction, meaning that the flight to quality behavior has a negative impact on the performance of illiquid stocks. However, the effect on liquid stocks is ambiguous. On the one hand, the rise in illiquidity has a negative effect on stock price, but, on the other hand, the substitution effect on liquidity increases demand for liquid assets, which increases the price of liquid stocks, contradicting the decline in its price.

[8] The market saw the dollar bid-ask spreads increasing by more than 63% and the quote size decreased tremendously, both signals of low liquidity.

5.3. LIQUIDITY RISK AND THE FINANCIAL CRISIS OF 2007

Liquidity risk is a peculiarity of "liberalized financial systems where phases of excessive optimism alternate with sharp market decline" (Bervas, 2006).

The key lesson learnt from the past financial crisis was that liquidity is undeniably an important element for financial stability, in particular after the later transformations in the function of the financial system.

Financial innovation allowed risk to be transferred to different participants through the financial market and intensified the degree of interrelation and dependency between participants, enhancing the links between risks and "opening the doors" for eventual systemic effects.

One of the main problems concerning the financial innovation was that participants were eluded about the easiness of trading in the market, which made them think that they could do whatever they wanted at a very low cost. That is, however, wrong. Financial markets can certainly satisfy investors' preferences, but only as long as they are supported by confidence, which is very easily questioned, in particular during times of stress. The liquidity on the market strongly depends on the trust and confidence of investors. The main question is if such trust can actually be attained in such a highly securitized market, as the one we face nowadays.

Allen and Carletti (August, 2008) defend the importance of liquidity in the past financial crisis and argue that the "cash-in-the-market" pricing led to a decrease in market prices of many instruments, leading them to levels far below their fundamentals. That generated changes in the functioning of the market. Investors are more and more demanding marketability and liquidity in the market, which makes sense in such a "new financial environment", given that it facilitates efficiency in the market and eases the customization of products according to investors' needs.

The positive aspect of crises is that they always transmit some learning and the financial crisis of 2007 was not an exception. After this turbulence, the financial community understood that "market liquidity can never be taken for granted" (Gaspar and Sousa, 2010).

5.4. LIQUIDITY RISK AND POLICY IMPLICATIONS

The development of financial markets is a critical and an inseparable part of growth. They facilitate the trading of assets and help sharing and diversifying risk, which is fundamental for growth (Levine, 1997). There are, nonetheless, undesirable consequences resulting from the all this development. Hence, regulation and supervision play a fundamental role ensuring the well functioning of the financial system.

Bervas (2006) defends that the excessively optimistic assessment of market liquidity, in other words, the belief that transactions can be set at current prices without major changes in prices or transactions costs, is a threat for the stability of the financial system. Indeed, declines in market liquidity occur, usually, after periods of high liquidity.

Even though nowadays, especially after the crisis of 2007, participants in the financial system, have a better idea of the risks that may arise from lack of liquidity, management tools used do not take this risk into consideration is a sufficient manner. Traditionally, liquidity risk has been assessed through banks' balance sheets, but that only captures funding liquidity risk. How to consider market liquidity risk as well? That is particularly important in the modern financial system, where financial innovation eased the creation of new capital and risk transfer instruments, but is not easy. Financial innovation has made banks rely more and more on the functioning of the market, which has increased their vulnerability as institutions. In other words, they have become victims of themselves. The increased complexity of the financial system has made the management of liquidity risk more and more difficult but also increasingly important.

The subprime crisis showed, however, that regulatory and supervision frameworks were inadequate to handle situations of stress, by questioning some critical issues in the financial system. It did prove that Basel II is not capable to mitigate liquidity risk (Gualandri et al., 2009). As a result the reform of Basel II started to be considered, searching a better alignment with liquidity and solvency risks.

The Basel agreements have been important policies to achieve stability in the European financial system. Banks were guided to define and adjust the levels of capital to maintain in

their balance sheets, according to the riskiness of their assets. But besides that, these agreements also aimed at improving transparency in the financial system, providing investors with a more realistic picture of the products in which they invest and adjusting them to their needs and preferences. The Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) recognized, in March 2010, the importance of the quantitative evaluation of liquidity risk for banks under Pillar I (Gaspar and Sousa, 2010). Before that, liquidity risk was only considered under Pillar II and the approach was more qualitative than quantitative. Whether liquidity risk should be evaluated on quantitative or qualitative way is not yet defined. But what has been proved by literature (and corroborated with this study) is that this is a very important source of market risk and therefore should be taken into consideration both in management and regulatory policies. Also Bervas (2006) defends that communication between markets and authorities is crucial to prevent liquidity risk. But for that to be possible, transparency has to be ensured in the market place. Only under these grounds the development of proper liquidity risk management tools would be possible. Therefore, rethinking financial institutions' management models and supervision frameworks and adjust them to the "new reality" is fundamental. Banks should strengthen their internal risk management policies, with internal systems for management, control, monitoring and reporting of liquidity positions and identify specific measurements of liquidity risks, to be periodically validated by supervisors, (Panetta and Porretta, 2008; Tarantola, 2008).

In a globalized world in which interdependencies between parties are rising, the field of vision should be broader (European Central Bank, 2008a). As a result, both regulation and supervision policies should be reconsidered.

6. CONCLUSIONS

The growth of the economy before the crisis of 2007 allowed financial institutions to increase the level of their assets with more and more innovative products, under the perception that the level of liquidity of these products was also higher. As opposed to perceptions, the financial system became more and more vulnerable, ending up in the turmoil of August 2007. According to many authors this crisis was different from the others that occurred in the past because of the role played by liquidity. Many designate that as a Liquidity Crisis.

"Liquidity is the capacity of stocks trades without high price spread and in a minimum time" (Omri et al., 2010). Lack of liquidity brings liquidity risk. Liquidity risk is the possibility of facing losses as a result of costs coming from the illiquidity of assets. Therefore, liquidity risk can affect negatively investors' wealth. Because investors are averse to risk they consider liquidity as an important issue when they make investment decisions. Usually, investors who are rational are only willing to invest in illiquid assets if they are compensated with higher expected returns. That is why more liquid assets should generate lower returns than the less liquid ones. Liquidity can be seen from two perspectives. The first is a liquidity feature that is associated with the level of liquidity of an asset. That is present in the idiosyncratic level of risk of the asset. The second dimension is its market one, which represents a non-diversifiable risk factor (Sadka, 2009). While many studies have explored the idiosyncratic component of liquidity – the liquidity level, and its impact on performance, a few studies have explored the systematic component of liquidity – the one that cannot be diversified away, in other words, the market liquidity risk. Indeed, most of the articles in literature covering this topic, approach it from the corporate finance point of view. That is the reason why this paper studies the liquidity from its systematic component.

Literature shows that illiquidity affects stock returns. Brennan and Subrahmanyam (1996) show that there is a positive relationship between expected stock returns and illiquidity, even after controlling for Fama-French risk factors. However, Subrahmanyam (2001) found a negative and strong relation between illiquidity risk (measured by liquidity volatility) and expected stock returns, contradicting the hypothesis that investors are averse to the risk of fluctuations in liquidity. Indeed, effects are not clear in literature and it is the aim of this paper to further explore them.

Most of the studies in literature do not consider the financial sector when analyzing the relationship between liquidity risk and stock performance and do not include periods of crisis in the samples. This is another gap in literature that this paper tries to fill. Some authors argue that there is a risk that the inclusion of periods of crises in the analyses will mess up the results. In this paper, data on the biggest listed banks in America and Europe is used to further explore the relationship between liquidity risk and stock returns. By using a new industry and period of time (peculiar because of the presence of the financial crisis, particular itself

because of the role played by liquidity risk in it), this paper tries to complement literature, investigating the impact of liquidity risk in the stock returns of banks in the context financial crisis of 2007.

Three types of studies are performed to increase the robustness of the analysis – first, a cross-sectional study was performed, then a panel study (both on the overall sample) and finally four individual studies on one banks from each country considered. The bid-ask spread was used as a proxy to liquidity risk.

Ernst et al., (2009) defends that available data is the main driver of the preciseness of risk forecasts. That is why we chose monthly data on variables. Restrictions in availability of data for shorter periodicities were obvious. The robustness of the study was improved by considering control variables, namely beta, book-ratio and bank size, following Fama and French (1993) approach.

The main findings of this paper are that liquidity risk, as measured by the bid-ask spread on banks stocks, is significant to explain banks stock returns in the three periods studied – before, after and before and after the turmoil of 2007. However, both the intensity and the signal of the relationship changed among periods. In the period before the turbulence of 2007, we can see a positive relationship between illiquidity and stock returns of banks. This relationship is significant in the majority of the analyses performed and is robust to the control variables introduced. Furthermore, it is consistent with most studies in literature that also defend a positive relationship between the two variables. That is explained by investors' risk-aversion. Indeed, they will only be willing to invest in less liquid assets if they are compensated with higher returns, which explains the positive correlation between stock returns and risk in general. As illiquidity is seen as a risk – the potential loss resulting from costs of illiquidity, investors are also averse to it and therefore they require excess returns to be willing to invest in assets that are less liquid. However, this paper also finds that overall the impact of this type of risk to explain banks stock returns was relatively low before the crisis of 2007, which validates that lower importance of liquidity risk during this period.

This study also finds is that liquidity risk became more important to explain banks returns after the crisis. That is to say that the absolute value of the coefficient associated with the bid-

ask spread in the regressions increases in almost all analyses. That means that the turmoil of 2007 "brought liquidity risk to the game", making it a much more important variable to understand the stock returns of the financial institutions considered in the sample. However, what is astonishing, or, in other words, contradicts most of the studies in literature, is that the relationship between the two variables became negative in the period after the turbulence of 2007. That finding is robust to almost all studies performed in this paper, even considering the control variables. Moreover, the significance of this result is considerably high to enable extracting conclusions. The explanation relies on the fact that during periods of crisis investors are no more willing to invest in less liquid stocks (with higher bid-ask spreads) and therefore, we start observing certain movements of "flight to quality/liquidity" in the market. The effect of such movements in less liquid assets is clear. As long as investors divest from their illiquid stocks, supply on this type of assets decreases as does their prices. On the other hand, demand for more liquid stocks increases, as a result of the "flight to liquidity" behaviours, therefore the prices of more liquid assets increase. Indeed, the effect of "flight to quality" movements during periods of crisis can be ambiguous for liquid stocks, given that they suffer the two contradictory effects. What we conclude from the sample used in this analysis is that overall the relationship between illiquidity and banks stock returns became negative in the 3 years after the financial crisis of 2007, which, under the flight to quality behaviour, may mean that the stock of these institutions were not considered to be liquid by investors, *coeteris paribus*. During the whole period (before and after the crisis) we still observe a positive and significant relationship between illiquidity and bank stock returns in most of the studies performed. However with a higher coefficient than in the period before the crisis, which shows the crisis increased the importance of liquidity risk to explain banks stock returns.

Succinctly, our hypothesis that the financial crisis of 2007 increased the importance of liquidity risk for financial institutions and that it even changed the signal of the relationship between the two variables is corroborated by this sample.

This study has several implications. First of all, it is important to understand the importance of liquidity to price assets. Liquidity is an important factor and thus it should be facilitated in the market, with higher transparency and disclosure requirements. That brings more confidence to the market and lowers transaction costs, increasing liquidity. Also important is

to understand that liquidity risk is particularly important during times of crisis. Literature shows that lack of liquidity in banks produces vulnerabilities in the financial system and generate lack of confidence, which may lead to crises as the last one – the subprime. Market liquidity risk is another type of risk that generated the lack of confidence in the system and therefore it should be taken into account.

Literature shows that stocks whose returns are more sensitive to aggregate liquidity have higher average returns (Franzoni, et al., June 2010). From an investment point of view, it is important to understand that the management of illiquidity is not easy. That is because the cost that investors have to incur in if they invest in illiquid assets cannot be diversified away. To mitigate that, what managers can do is to include in their portfolios different types of securities, from the point of view of liquidity. It is an alternative way of diversifying this risk. Having different types of assets with various liquidity levels, or reducing the frequency of trading of the more illiquid one, trying to benefit from the returns without bearing the costs of illiquidity, investors mitigate the risk of illiquidity. Clearly the continuous management of the trade-off between liquidity and returns is more and more important for managers.

For further research it would be interesting to analyze the impact of the financial crisis of 2007 on the relationship between liquidity risk and performance under other variables, to see if these results found in this paper are corroborated or not. Other measures of liquidity risk could be used, with different periodicities, if availability of information allows that. Moreover, other sectors could be analyzed, besides the financial one. It is true that banks were at the core of the turbulence of 2007 and that liquidity risk affected the attitude of the market towards them in a strong way. However, it would still be interesting to see how other sectors reacted to the turmoil from a "liquidity risk point of view".

Regarding the limitations of this study, we should be aware that only listed banks were considered in the analyses and the sample is comprised by the biggest banks in the world, which is an outcome of the criteria used in the screening. As a result, liquidity risk can be underestimated.

Nevertheless this study has some limitations, as any other, the findings show that liquidity risk became more important to explain performance of banks after the crisis. The turmoil of

2007 represented indeed an important event in what concerns liquidity risk and this paper shows that it changed both the intensity and the signal of the relationship between liquidity risk and stock returns, in the sample considered. Not only liquidity risk became more important to explain bank stock returns, but also investors changed their attitude towards liquidity, which may be explained by a flight to quality/liquidity behaviour during times of crisis. Indeed "cash-in-the-market" pricing decreased the price of assets to levels far below their fundamentals, which generated changes in the functioning of the market. Investors are more and more demanding marketability and liquidity in the market, which makes sense in a "new financial environment", given that it facilitates efficiency and eases the customization of products according to investors' needs.

What is good about crisis is that we always learn something with them. The turmoil of 2007 made the financial community understand that "market liquidity can never be taken for granted" (Gaspar and Sousa, 2010).

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APPENDIX

FIGURE 1: LIQUIDITY AND THE FINANCIAL CRISIS

Source: Bloomberg, by Mark Gilbert - October 28, adapted.

FIGURE 2: FUNDING LIQUIDITY MEASURES

Measuring Funding Liquidity	Studies
Ratio of liquid assets to total assets	Bourke (1989); Barth, Nolle, Phumiwasana and Yago (2003); Demirgu_c_-Kunt, Laeven and Levine (2003)
Ratio of loans to total assets	Demirgu_c_-Kunt and Huizinga (1999); Athanasoglou, Delis and Staikouras (2006)
Ratio of liquid assets to deposits	Shen, Kuo and Chen (2001)
Ratio of liquid assets to customer and short term funding	Kosmidou, Tanna and Pasiouras (2005)
Ratio of net loans to customer and short term funding	Pasiouras and Kosmidou (2007); Kosmidou (2008); Naceur and Kandil (2009)

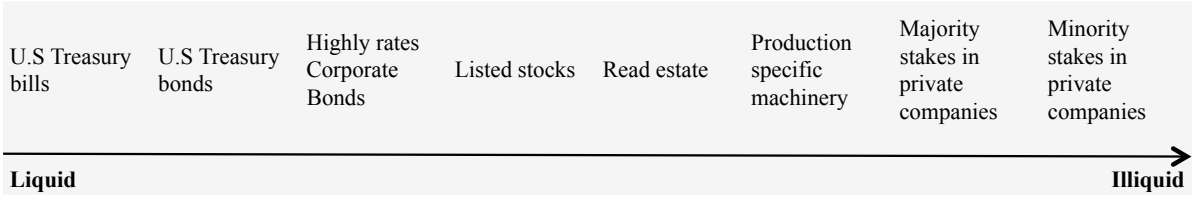
Source: Shen et al. (2009), adapted.

FIGURE 3: BANK PERFORMANCE MEASURES

Performance Measures	Studies
ROA (Return on Assets)	Bourke (1989); Demirgu_c_-Kunt and Huizinga (1999); Barth, Nolle, Phumiwasana and Yago (2003); Athanasoglou, Delis and Staikouras (2006); Naceur and Kandil (2009)
ROE (Return on Equity)	Athanasoglou, Delis and Staikouras (2006); Naceur and Kandil (2009)
ROAA (Return on Average Assets)	Kosmidou, Tanna and Pasiouras (2005); Pasiouras and Kosmidou (2007); Kosmidou (2008)
NIM (Net Interest Margin)	Demirgu_c_-Kunt and Huizinga (1999); Shen, Kuo and Chen (2001); Demirgu_c_-Kunt, Laeven and Levine (2003); Kosmidou, Tanna and Pasiouras (2005); Naceur and Kandil (2009)

Source: Shen et al. (2009), adapted.

FIGURE 4: LIQUIDITY OF DIFFERENT ASSET CLASSES



Source: Damodaran (2005), adapted.

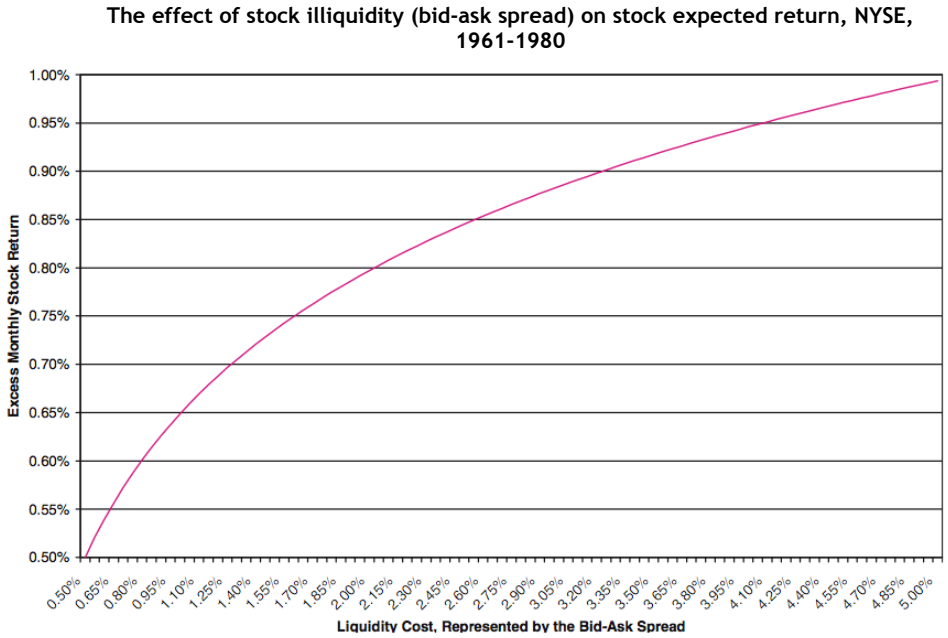
FIGURE 5: LIQUIDITY OF STOCKS

Heavily traded stocks in widely held companies in developed markets	Traded stocks in small companies in developed markets	Traded stocks in companies with a small float	Thinly traded stocks, OTC stocks or stocks traded in emerging markets

Liquid → **Illiquid**

Source: Damodaran (2005), adapted.

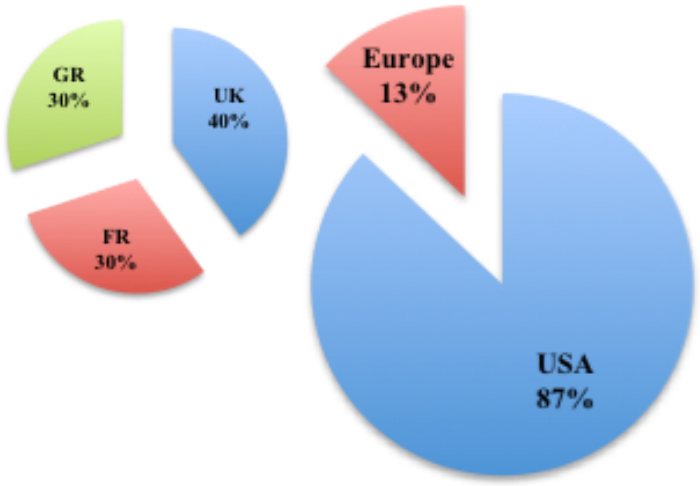
FIGURE 6: RETURNS AND ILLIQUIDITY – A CONCAVE RELATIONSHIP



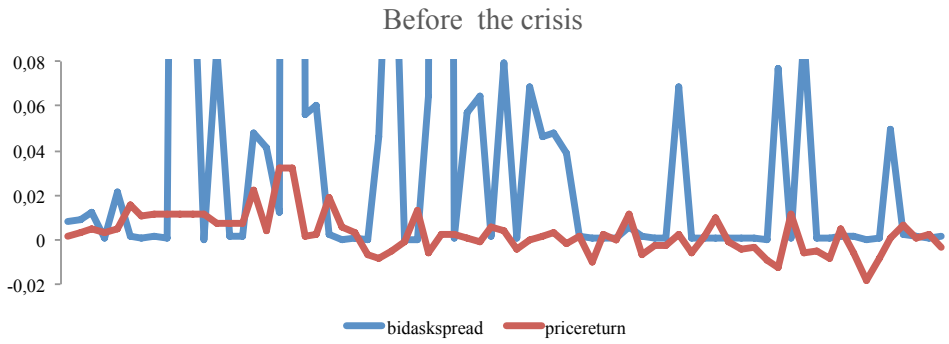
Source: Amihud and Mendelson (2006)

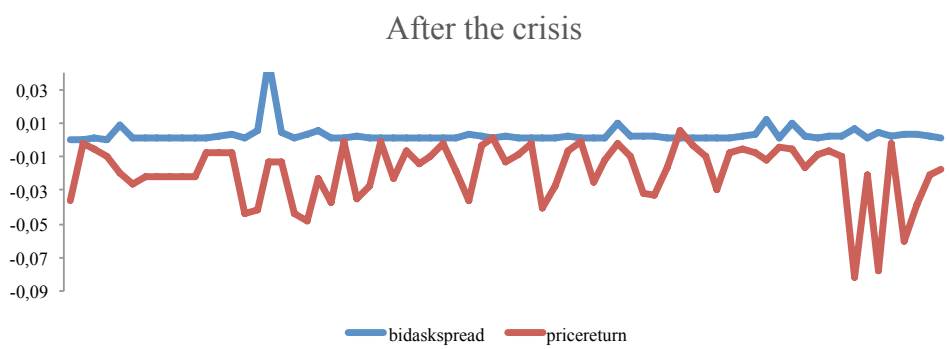
FIGURE 7: SAMPLE DESCRIPTION

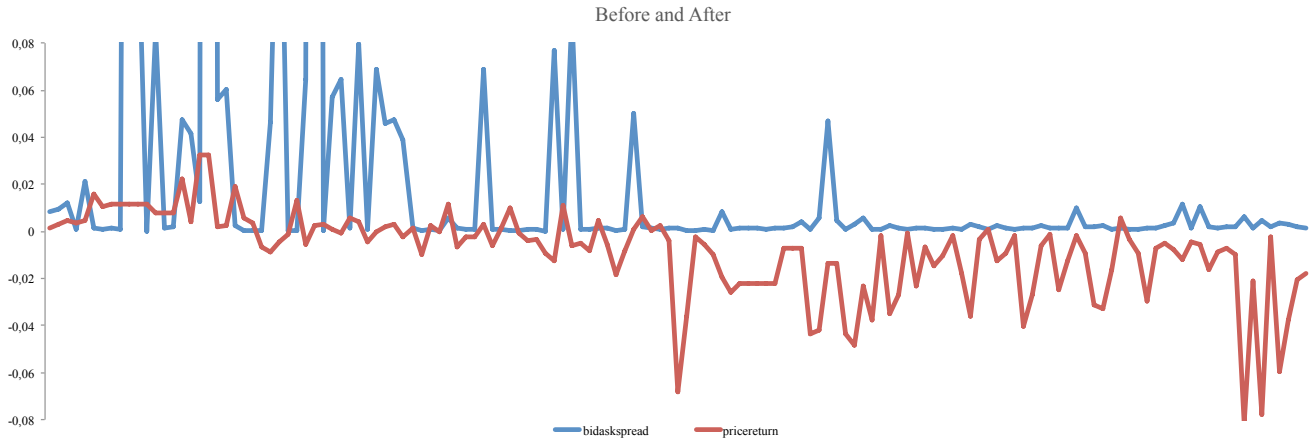
Country		Banks	
USA		67	77%
Europe		10	11%
	UK	4	5%
	FR	3	3%
	GR	3	3%
Total		87	100%



Note: Graphs of bid-ask spread and price return in the cross-section study of the whole sample, during the period of analysis.







Note: Graphs on the bid-ask spread and price return of the overall sample, over the period analyzed.

FIGURE 8: DESCRIPTION OF VARIABLES

Variable	Symbol	Description
Dependent Variable:		
Price Return	**pricereturn**	Logarithm of monthly stock returns [ln(P1/P0)] Reference day for the cross-sectional analysis was 30 August 2004
Independent Variables:		
Bid-Ask Spread	**bidaskspread**	The liquidity measure. Computed as the difference between ask ans bid prices, divided by bid price. Computed as: [(Ask price-Bid price)/Bid price]
Beta	**beta**	The systematic risk on the stock. Taken from bloomberg terminal.
Book to Market Ratio	**bookratio**	Logarithm of book to market ratio at the end of the year
Size	**size**	Logarithm of Market Capitalization at the end of the month

FIGURE 9: VARIABLES STATISTICS

Cross-Sectional: USA & Europe					
before crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	.0026571	.0804893	1.156781	-.8063913	8.53259
p50	.0019546	.0013087	1.1383	-.7278512	7.973052
sd	.0091513	.3144289	.2447722	1.465687	1.465055
min	-.0185552	0	.3736833	-6.491682	6.790709
max	.0323097	2.231279	1.834	7.56328	12.40238
p1	-.0185552	0	.3736833	-6.491682	6.790709
p99	.0323097	2.231279	1.834	7.56328	12.40238
Nr observations	75	75	75	75	75
after crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0196259	.0028462	1.253834	-.185073	8.112828
p50	-.0135469	.0015225	1.236062	-.0709817	7.693095
sd	.017848	.0055644	.2223355	1.473165	1.532432
min	-.0818184	.0000949	.5441108	-5.900556	5.143047
max	.0057748	.046829	1.834	8.21529	11.75422
p1	-.0818184	.0000949	.5441108	-5.900556	5.143047
p99	.0057748	.046829	1.834	8.21529	11.75422
Nr observations	75	75	75	75	75
before & after	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0084844	.0416677	1.205308	-.4957322	8.322709
p50	-.0056403	.001433	1.1923	-.5019234	7.874811
sd	.0180216	.2250378	.2380692	1.497416	1.508979
min	-.0818184	0	.3736833	-6.491682	5.143047
max	.0323097	2.231279	1.834	8.21529	12.40238
p1	-.0780703	0	.5441108	-5.900556	5.631183
p99	.0323097	1.541152	1.834	7.56328	12.22471
Nr observations	150	150	150	150	150
Pr(Skewness)	.003	.000	.538	.000	.001
Pr(Kurtosis)	.024	.000	.138	.000	.916

Panel: USA & Europe

before crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	.0025853	3.637549	.9781101	-.8074014	8.528025
p50	.0013934	.0014997	.9526	-.7515066	7.978392
sd	.0478269	189.9609	.2172411	1.46388	1.462189
min	-.2579009	-.0104364	.105	-6.645532	6.077773
max	.2784422	10139	1.5909	7.900969	12.51976
p1	-.1290852	-.0025021	.4102	-6.404924	6.804726
p99	.1192043	.2518689	1.5137	7.433767	12.37048
Nr observations	2849	2849	2849	2849	2849

after crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0196319	.0028472	1.239224	-.185138	8.112828
p50	-.0136331	.0011036	1.2249	-.1546386	7.710625
sd	.1624732	.0161482	.2440965	1.507641	1.585794
min	-1.192907	-.0314136	.414	-6.393004	2.474753
max	1.537429	.5483871	2.0279	8.763842	12.35968
p1	-.5543156	-.0015175	.5879	-5.844752	4.548575
p99	.3988591	.0309598	1.8397	8.08793	11.98456
Nr observations	2848	2848	2848	2848	2848

before & after	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0085213	1.820517	1.108644	-.4963243	8.320427
p50	0	.001226	1.0917	-.5205513	7.860793
sd	.120255	134.3349	.265379	1.518019	1.539177
min	-1.192907	-.0314136	.105	-6.645532	2.474753
max	1.537429	10139	2.0279	8.763842	12.51976
p1	-.4445524	-.0021962	.448	-5.975732	5.470047
p99	.2982135	.1712563	1.8187	7.520426	12.27472
Nr observations	5697	5697	5697	5697	5697
Pr(Skewness)	.365	.000	.001	.000	.000
Pr(Kurtosis)	.000	.000	.000	.000	.184

ZION | USA

before crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	.005644	.0003767	.9450622	-.6944758	8.900655
p50	.0054282	.0001636	.9461	-.7031743	8.994084
sd	.0307616	.0004123	.0214756	.0910506	.1789756
min	-.0451243	0	.9008	-.8203167	8.599698
max	.0802443	.0016513	.9843	-.4797876	9.136082
p1	-.0451243	0	.9008	-.8203167	8.599698
p99	.0802443	.0016513	.9843	-.4797876	9.136082
Nr observations	37	37	37	37	37

after crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0377847	.0007916	1.35453	.3952825	8.02661
p50	-.0544399	.0008507	1.3955	.3684174	8.097053
sd	.2007665	.0028449	.2433422	.4691218	.5371087
min	-.4963786	-.0147783	.9008	-.4253477	6.985377
max	.3910726	.0056782	1.6543	1.515596	8.935247
p1	-.4963786	-.0147783	.9008	-.4253477	6.985377
p99	.3910726	.0056782	1.6543	1.515596	8.935247
Nr observations	37	37	37	37	37

before & after	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0160704	.0005842	1.149796	-.1495966	8.463632
p50	-.0066077	.0005536	.9666	-.4525677	8.682036
sd	.1442988	.0020295	.2681784	.643101	.5930168
min	-.4963786	-.0147783	.9008	-.8203167	6.985377
max	.3910726	.0056782	1.6543	1.515596	9.136082
p1	-.4963786	-.0147783	.9008	-.8203167	6.985377
p99	.3910726	.0056782	1.6543	1.515596	9.136082
Nr observations	74	74	74	74	74
Pr(Skewness)	.451	.002	.614	.211	.564
Pr(Kurtosis)	.437	.075	.798	.350	.000

STAN | UK

before crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	.007446	.001232	1.019619	-2.094945	9.691072
p50	.00798	.0007698	1.1535	-2.123908	9.767927
sd	.0367328	.0008009	.2378468	.1101475	.2435215
min	-.0713607	.0004973	.6589	-2.23946	9.268298
max	.0812517	.003288	1.2185	-1.762042	10.08448
p1	-.0713607	.0004973	.6589	-2.23946	9.268298
p99	.0812517	.003288	1.2185	-1.762042	10.08448
Nr observations	37	37	37	37	37

after crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0072385	.0017911	1.335646	-1.50599	10.10478
p50	.0071773	.0007085	1.3741	-1.523829	10.13911
sd	.1348814	.0032263	.0895535	.2456489	.2860699
min	-.409965	.0002706	1.2056	-1.855919	9.440722
max	.304105	.0174405	1.4349	-.8879916	10.54981
p1	-.409965	.0002706	1.2056	-1.855919	9.440722
p99	.304105	.0174405	1.4349	-.8879916	10.54981
Nr observations	37	37	37	37	37

before & after	pricereturn	bidaskspread	beta	bookratio	size
mean	.0001038	.0015116	1.177632	-1.800467	9.897925
p50	.0075787	.0007545	1.2185	-1.837438	9.91356
sd	.0984477	.0023513	.2390886	.3516341	.33612
min	-.409965	.0002706	.6589	-2.23946	9.268298
max	.304105	.0174405	1.4349	-.8879916	10.54981
p1	-.409965	.0002706	.6589	-2.23946	9.268298
p99	.304105	.0174405	1.4349	-.8879916	10.54981
Nr observations	74	74	74	74	74
Pr(Skewness)	.651	.006	.027	.005	.445
Pr(Kurtosis)	.433	.558	.004	.122	.003

BNP | FRANCE

before crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	.0143818	.001076	1.06593	-.40654	11.0162
p50	.0178759	.0006809	1.1006	-.4104555	11.02887
sd	.0436218	.0009467	.0759392	.0585757	.222483
min	-.0804126	.0001165	.9054	-.5400372	10.66434
max	.091127	.0037204	1.1417	-.2775094	11.34008
p1	-.0804126	.0001165	.9054	-.5400372	10.66434
p99	.091127	.0037204	1.1417	-.2775094	11.34008
Nr observations	37	37	37	37	37

after crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0128533	.0006045	1.191589	-.0011813	10.89414
p50	-.0088222	.0002592	1.213	-.0359401	10.9953
sd	.1231021	.0009146	.0504262	.2329135	.2864478
min	-.3592356	0	1.1035	-.3466862	10.07346
max	.2572591	.0046474	1.2644	.5930517	11.19161
p1	-.3592356	0	1.1035	-.3466862	10.07346
p99	.2572591	.0046474	1.2644	.5930517	11.19161
Nr observations	37	37	37	37	37

before & after	pricereturn	bidaskspread	beta	bookratio	size
mean	.0007642	.0008402	1.128759	-.2038606	10.95517
p50	.006997	.0006099	1.1256	-.3023626	10.9994
sd	.0927343	.0009544	.0899973	.2647385	.2620121
min	-.3592356	0	.9054	-.5400372	10.07346
max	.2572591	.0046474	1.2644	.5930517	11.34008
p1	-.3592356	0	.9054	-.5400372	10.07346
p99	.2572591	.0046474	1.2644	.5930517	11.34008
Nr observations	74	74	74	74	74
Pr(Skewness)	.247	.000	.001	.776	.828
Pr(Kurtosis)	.975	.022	.239	.768	.000

DBK | GERMANY

before crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	.0153491	.0011946	1.014643	-.3063709	10.67891
p50	.0152247	.0013863	.9838	-.2954038	10.73442
sd	.0480609	.000472	.1384662	.1145436	.1984874
min	-.0864413	0	.8501	-.5020702	10.32225
max	.1181721	.0020189	1.2992	-.0823376	10.99527
p1	-.0864413	0	.8501	-.5020702	10.32225
p99	.1181721	.0020189	1.2992	-.0823376	10.99527
Nr observations	37	37	37	37	37

after crisis	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0192445	.0083615	1.175986	.2032058	10.2939
p50	-.0213905	.0020882	1.1836	.1639189	10.32088
sd	.1564811	.0289433	.1447061	.311201	.358435
min	-.5180591	.0001908	.9854	-.229002	9.367567
max	.3988591	.1702187	1.3383	.964536	10.79647
p1	-.5180591	.0001908	.9854	-.229002	9.367567
p99	.3988591	.1702187	1.3383	.964536	10.79647
Nr observations	37	37	37	37	37

before & after	pricereturn	bidaskspread	beta	bookratio	size
mean	-.0019477	.0047781	1.095315	-.0515826	10.48641
p50	-.0007877	.0015119	1.0573	-.1801037	10.48449
sd	.1162663	.0206458	.1624152	.3464626	.3469165
min	-.5180591	0	.8501	-.5020702	9.367567
max	.3988591	.1702187	1.3383	.964536	10.99527
p1	-.5180591	0	.8501	-.5020702	9.367567
p99	.3988591	.1702187	1.3383	.964536	10.99527
Nr observations	74	74	74	74	74
Pr(Skewness)	1.000	.005	.042	.820	.501
Pr(Kurtosis)	.886	.096	.608	.159	.007

FIGURE 10: CORRELATION MATRIX

Cross-Sectional: USA & Europe

before crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.3152	1.0000			
beta	-0.6075	-0.0906	1.0000		
bookratio	0.0097	0.1742	-0.0425	1.0000	
size	0.4741	0.0737	-0.4637	-0.0021	1.0000

after crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.0195	1.0000			
beta	-0.6693	-0.3524	1.0000		
bookratio	-0.1401	0.0980	-0.0210	1.0000	
size	0.1456	-0.1083	-0.0635	-0.0332	1.0000

before & after	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.2193	1.0000			
beta	-0.5935	-0.1040	1.0000		
bookratio	-0.1924	0.0840	0.0112	1.0000	
size	0.2727	0.0712	-0.2871	-0.0449	1.0000

Panel: USA & Europe

before crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.0044	1.0000			
beta	-0.0889	0.0435	1.0000		
bookratio	-0.0234	-0.0012	-0.0856	1.0000	
size	0.0948	-0.0163	-0.1677	-0.0013	1.0000

after crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.0089	1.0000			
beta	0.0172	-0.0833	1.0000		
bookratio	-0.0736	0.0369	-0.0048	1.0000	
size	0.0578	-0.0443	-0.0646	-0.0800	1.0000

before & after	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.0025	1.0000			
beta	-0.0492	0.0185	1.0000		
bookratio	-0.0728	-0.0036	0.0649	1.0000	
size	0.0706	-0.0091	-0.1620	-0.0690	1.0000

ZION | USA

before crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.0110	1.0000			
beta	0.3465	-0.1362	1.0000		
bookratio	-0.4597	0.2879	-0.0902	1.0000	
size	-0.1459	0.1803	0.1423	0.7041	1.0000

after crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.3983	1.0000			
beta	0.3015	-0.1639	1.0000		
bookratio	-0.1984	0.1591	0.4105	1.0000	
size	0.0967	-0.1698	-0.4878	-0.9812	1.0000

before & after	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.3985	1.0000			
beta	0.0742	-0.0248	1.0000		
bookratio	-0.2354	0.1721	0.7892	1.0000	
size	0.1679	-0.1773	-0.7663	-0.9378	1.0000

STAN | UK

before crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.1938	1.0000			
beta	-0.0188	0.0829	1.0000		
bookratio	-0.4048	0.0805	0.5051	1.0000	
size	-0.1195	-0.1325	0.8968	0.5585	1.0000

after crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.0741	1.0000			
beta	0.0383	0.0425	1.0000		
bookratio	-0.2817	-0.0226	0.6640	1.0000	
size	0.3289	-0.2452	0.4235	-0.1859	1.0000

before & after	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.0656	1.0000			
beta	-0.0437	0.1043	1.0000		
bookratio	-0.2196	0.0945	0.7244	1.0000	
size	0.1267	-0.0832	0.7976	0.5304	1.0000

BNP | FRANCE

before crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	0.0866	1.0000			
beta	0.0354	-0.3816	1.0000		
bookratio	-0.2631	0.0046	-0.0133	1.0000	
size	-0.0426	-0.4813	0.6549	-0.3879	1.0000

after crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.2933	1.0000			
beta	-0.0513	-0.2487	1.0000		
bookratio	-0.2098	0.1778	-0.1550	1.0000	
size	0.2062	-0.2430	0.5604	-0.8512	1.0000

before & after	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.1273	1.0000			
beta	-0.1158	-0.3982	1.0000		
bookratio	-0.2483	-0.1173	0.5029	1.0000	
size	0.1739	-0.2671	0.2358	-0.6205	1.0000

DBK | GERMANY

before crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.0846	1.0000			
beta	-0.0590	0.2435	1.0000		
bookratio	-0.1192	0.1299	0.2758	1.0000	
size	0.0538	-0.1932	-0.6287	-0.7785	1.0000

after crisis	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.1780	1.0000			
beta	0.2542	-0.1189	1.0000		
bookratio	-0.1999	0.0106	0.4001	1.0000	
size	0.1667	-0.0108	-0.3402	-0.9797	1.0000

before & after	pricereturn	bidaskspread	beta	bookratio	size
pricereturn	1.0000				
bidaskspread	-0.1922	1.0000			
beta	0.0651	0.0165	1.0000		
bookratio	-0.2381	0.1365	0.5665	1.0000	
size	0.2043	-0.1066	-0.5851	-0.9346	1.0000

FIGURE 11: REGRESSION RESULTS[10]

Cross-Sectional Model: pricereturn i = constant + β1bisaskspread i + β2 beta i + β3 bookratio i + β4 size i + εi

Panel Model: pricereturn it = constant + β1bisaskspread it + β2 beta it + β3 bookratio it + β4 size it + εi

Cross-Sectional: USA & Europe			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**0.00768****	**-0.847*****	**0.0135*****
	(0.00375)	(0.146)	(0.00351)
beta	-0.0181***	-0.0609***	-0.0412***
	(0.00505)	(0.00794)	(0.00680)
bookratio	-0.000350	-0.00152*	-0.00233***
	(0.000438)	(0.000777)	(0.000745)
size	0.00145**	0.000730	0.00112
	(0.000703)	(0.00131)	(0.00101)
Constant	0.0103	0.0532***	0.0303**
	(0.0108)	(0.0154)	(0.0134)
Observations	75	75	150
R-squared	0.484	0.543	0.426

Panel: USA & Europe			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**2.33e-06*****	**-0.316****	**3.09e-06*****
	(2.83e-07)	(0.141)	(4.39e-07)
beta	-0.0173***	-0.0733***	-0.0160**
	(0.00472)	(0.0130)	(0.00736)
bookratio	-0.00102*	-0.0133***	-0.00525***
	(0.000574)	(0.00244)	(0.00112)
size	0.00269***	0.0141***	0.00472***
	(0.000601)	(0.00271)	(0.00129)
Constant	-0.00421	-0.113***	-0.0327**
	(0.00748)	(0.0277)	(0.0133)
Observations	2,849	2,009	5,697
Number of banks	77	77	77

[10] **Significance levels: *** p<0.01, ** p<0.05, * p<0.1**
Robust standard errors between brackets

Cross-Sectional: USA			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**0.00792****	**-0.844**	**0.0170****
	(0.00352)	(0.692)	(0.00656)
beta	-0.0141***	-0.0582***	-0.0364***
	(0.00391)	(0.00765)	(0.00681)
bookratio	0.000612	-0.00442**	-0.00711***
	(0.00140)	(0.00199)	(0.00198)
size	0.00127*	0.000884	0.000630
	(0.000654)	(0.00173)	(0.00119)
Constant	0.00718	0.0484***	0.0261*
	(0.00817)	(0.0172)	(0.0145)
Observations	65	65	130
R-squared	0.433	0.580	0.472

Panel: USA			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**2.18e-06*****	**-0.545**	**1.80e-06*****
	(2.79e-07)	(0.641)	(4.78e-07)
beta	-0.0147***	-0.0359**	0.000288
	(0.00455)	(0.0145)	(0.00822)
bookratio	-0.00170	-0.0487***	-0.0185***
	(0.00179)	(0.00648)	(0.00313)
size	0.00221***	0.0102***	0.00349**
	(0.000697)	(0.00332)	(0.00158)
Constant	-0.00414	-0.117***	-0.0468***
	(0.00763)	(0.0324)	(0.0163)
Observations	2,479	1,916	4,957
Number of banks	67	67	67

Cross-Sectional: Europe			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**4.791*****	**-0.111**	**-0.998*****
	(0.911)	(0.572)	(0.110)
beta	0.0343*	0.00377	-0.0773***
	(0.0139)	(0.0358)	(0.0111)
bookratio	-0.000401	0.00146	-0.00162**
	(0.000408)	(0.00110)	(0.000725)
size	0.00539*	-0.00450	0.00288
	(0.00221)	(0.00583)	(0.00352)
Constant	-0.0850**	0.0260	0.0526*
	(0.0294)	(0.0737)	(0.0285)
Observations	10	10	20
R-squared	0.911	0.239	0.679

Panel: Europe			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**2.596***	**-0.250*****	**-0.349*****
	(1.396)	(0.0906)	(0.101)
beta	-0.0138	-0.00720	-0.0452**
	(0.0131)	(0.0363)	(0.0188)
bookratio	-0.00106	-0.000740	-0.00187
	(0.000667)	(0.00283)	(0.00115)
size	0.00340	0.00981	0.00931
	(0.00402)	(0.0110)	(0.00573)
Constant	-0.0122	-0.106	-0.0494
	(0.0440)	(0.0891)	(0.0503)
Observations	358	370	740
Number of banks	10	10	10

ZION | USA			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**14.61***	**-27.65*****	**-20.26*****
	(8.263)	(5.465)	(4.696)
beta	0.398*	0.0734	0.292**
	(0.234)	(0.115)	(0.139)
bookratio	-0.225***	-1.156***	-0.213***
	(0.0545)	(0.303)	(0.0563)
size	0.0426	-0.963***	-0.0872*
	(0.0364)	(0.281)	(0.0519)
Constant	-0.911***	8.070***	0.366
	(0.317)	(2.441)	(0.523)
Observations	37	37	74
R-squared	0.368	0.470	0.317

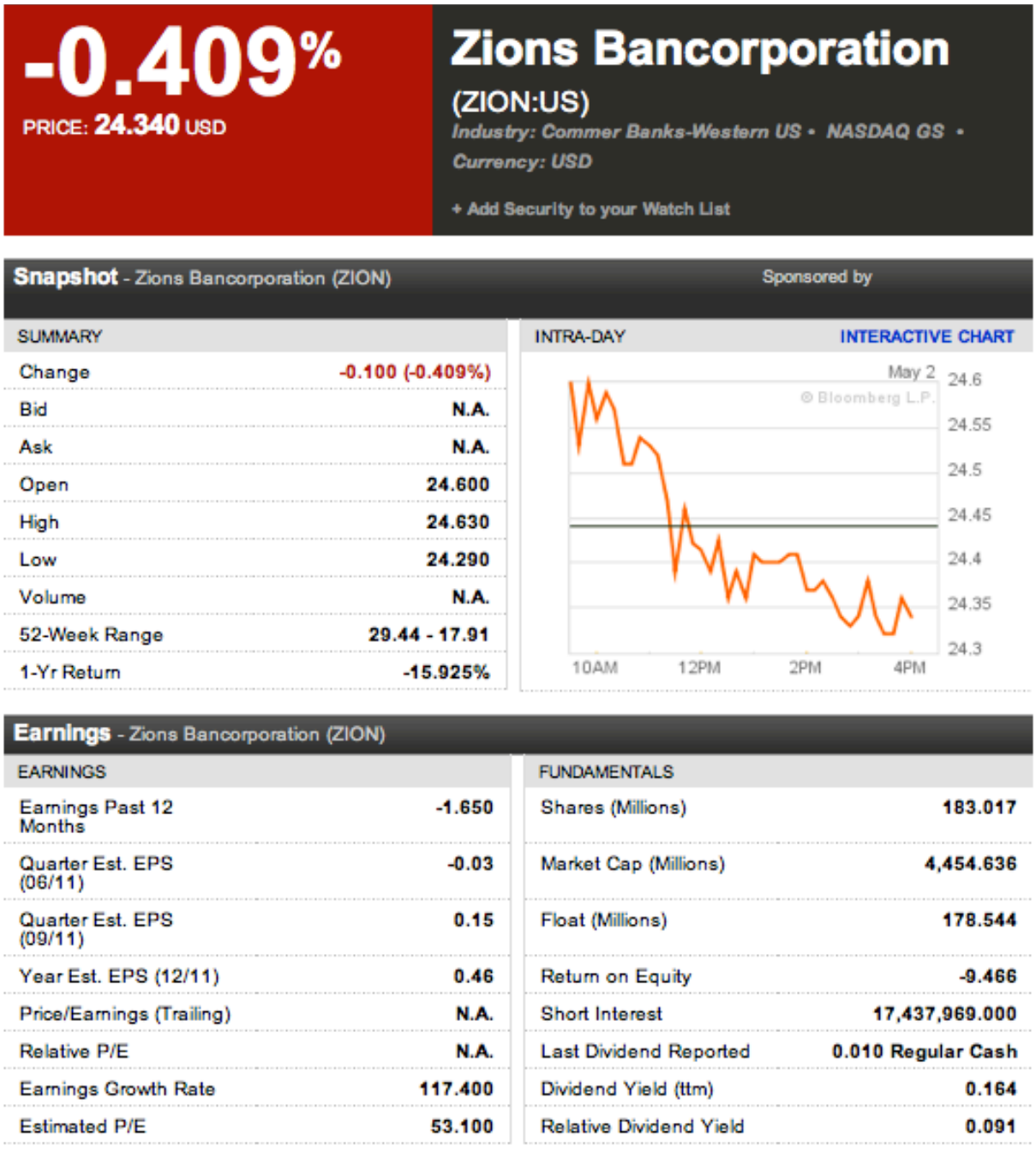
STAN | UK			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**9.968**	**-6.913***	**-6.505****
	(6.858)	(3.857)	(2.475)
beta	0.0369	0.514	0.0439
	(0.0546)	(0.371)	(0.0626)
bookratio	-0.181***	-0.257	-0.0131
	(0.0632)	(0.156)	(0.0390)
size	-0.000349	0.0109	-0.000442
	(0.0524)	(0.108)	(0.0569)
Constant	-0.418	-1.180	-0.0487
	(0.534)	(0.767)	(0.545)
Observations	37	35	68
R-squared	0.257	0.227	0.065

BNP | FRANCE			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**1.533**	**-42.64*** **	**-17.58**
	(6.307)	(14.32)	(14.20)
beta	0.158	-0.165	0.163
	(0.126)	(0.517)	(0.161)
bookratio	-0.250*	0.0126	-0.231***
	(0.141)	(0.166)	(0.0710)
size	-0.0715	0.186	-0.0402
	(0.0452)	(0.163)	(0.0544)
Constant	0.530	-1.859	0.209
	(0.414)	(1.341)	(0.481)
Observations	35	31	70
R-squared	0.120	0.470	0.335

DBK | GERMANY			
	before	**after**	**before & after**
	pricereturn	pricereturn	pricereturn
bidaskspread	**13.40**	**-0.646*** **	**-0.819*** **
	(11.17)	(0.224)	(0.254)
beta	0.0579	0.499**	0.202*
	(0.0870)	(0.187)	(0.103)
bookratio	0.0692	-0.843*	-0.126
	(0.118)	(0.432)	(0.0804)
size	0.136	-0.576*	0.00107
	(0.105)	(0.336)	(0.0812)
Constant	-1.476	5.502	-0.237
	(1.167)	(3.434)	(0.920)
Observations	33	37	74
R-squared	0.147	0.254	0.136

FIGURE 12: INFORMATION ON BANKS INDIVIADUALLY ANALIZED

Source: Bloomberg website, 3rd May 2011.



-0.271%

PRICE: **1,654.500** GBp

Standard Chartered PLC

(STAN:LN)

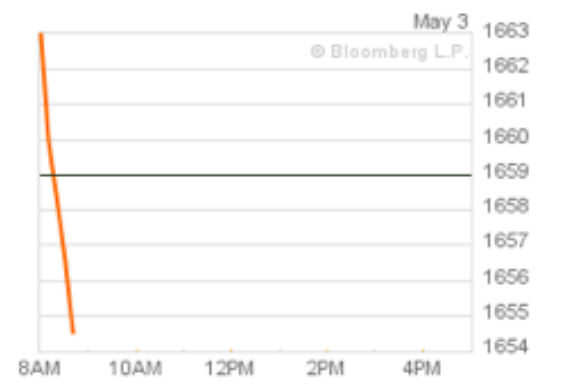
Industry: Commer Banks Non-US • London • Currency: GBp

+ Add Security to your Watch List

Snapshot - Standard Chartered PLC (STAN)

SUMMARY	
Change	-4.500 (-0.271%)
Bid	1,654.500
Ask	1,655.000
Open	1,663.000
High	1,667.000
Low	1,653.000
52-Week Range	1,975.00 - 1,483.65
Volume	592,750
1-Yr Return	0.404%

INTRA-DAY INTERACTIVE CHART



Earnings - Standard Chartered PLC (STAN)

EARNINGS	
Earnings	2.010
Price/Earnings (Trailing)	13.936
Relative P/E	0.957

FUNDAMENTALS	
Shares (Millions)	2,352.714
Market Cap (GBP) (Millions)	38,960.950
ROE	13.217
Last Dividend Reported	0.466 Final
Dividend Yield (ttm)	2.890
Relative Dividend Yield	0.926
90-Day Volatility	20.206
Beta vs. UKX	1.237

-0.094%

PRICE: **53.340** EUR

BNP Paribas (BNP:FP)

Industry: Diversified Banking Inst • EN Paris • Currency: EUR

+ Add Security to your Watch List

Snapshot - BNP Paribas (BNP)

SUMMARY	
Change	-0.050 (-0.094%)
Bid	53.320
Ask	53.350
Open	53.800
High	53.800
Low	53.070
52-Week Range	59.93 - 40.81
Volume	724,086
1-Yr Return	5.293%

INTRA-DAY INTERACTIVE CHART

Earnings - BNP Paribas (BNP)

EARNINGS	
Earnings	6.330
Price/Earnings (Trailing)	8.241
Relative P/E	0.654

FUNDAMENTALS	
Shares (Millions)	1,198.828
Market Cap (Millions)	63,921.530
ROE	12.249
Last Dividend Reported	2.100 Regular Cash
Dividend Yield (ttm)	2.783
Relative Dividend Yield	0.745
90-Day Volatility	26.967
Beta vs. CAC	1.297

-0.250%

PRICE: **43.835** EUR

Deutsche Bank AG

(DBK:GR)

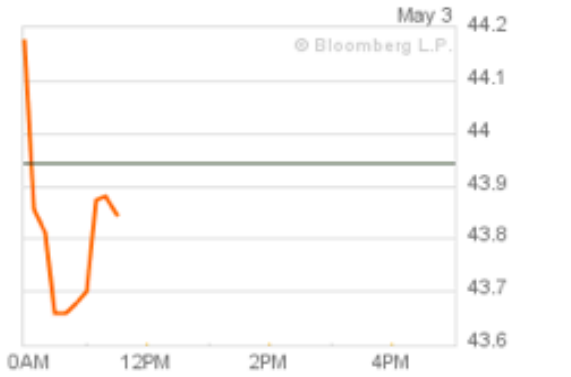
Industry: Diversified Banking Inst • Xetra • Currency: EUR

+ Add Security to your Watch List

Snapshot - Deutsche Bank AG (DBK)

SUMMARY	
Change	-0.110 (-0.250%)
Bid	43.830
Ask	43.840
Open	43.850
High	44.175
Low	43.550
52-Week Range	51.61 - 35.92
Volume	1,330,321
1-Yr Return	-7.748%

INTRA-DAY INTERACTIVE CHART



Earnings - Deutsche Bank AG (DBK)

EARNINGS	
Earnings	3.070
Price/Earnings (Trailing)	15.072
Relative P/E	1.120

FUNDAMENTALS	
Shares (Millions)	929.500
Market Cap (Millions)	40,777.150
ROE	5.404
Last Dividend Reported	0.750 Regular Cash
Dividend Yield (ttm)	1.568
Relative Dividend Yield	0.558
90-Day Volatility	24.805
Beta vs. DAX	1.195

FIGURE 13: STATA REGRESSIONS

Cross-Sectional: USA & Europe

Before Crisis

Linear regression — Number of obs = 75; F(4, 70) = 15.62; Prob > F = 0.0000; R-squared = 0.4836; Root MSE = .00684

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	.0076795	.0037451	2.05	0.044	.00021	.0151489
beta	-.0180647	.0050477	-3.58	0.001	-.0281321	-.0079973
bookratio	-.0003503	.0004384	-0.80	0.427	-.0012246	.0005241
size	.0014542	.0007031	2.07	0.042	.0000519	.0028565
_cons	.0103336	.0107582	0.96	0.340	-.0111229	.03179

After Crisis

Linear regression — Number of obs = 75; F(4, 70) = 15.40; Prob > F = 0.0000; R-squared = 0.5428; Root MSE = .01234

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-.8467902	.1455684	-5.82	0.000	-1.137117	-.5564631
beta	-.0608988	.0079384	-7.67	0.000	-.0767314	-.0450662
bookratio	-.0015194	.0007772	-1.95	0.055	-.0030696	.0000307
size	.0007297	.0013148	0.55	0.581	-.0018926	.0033521
_cons	.053211	.0153743	3.46	0.001	.0225479	.0838741

Before & After

Linear regression — Number of obs = 150; F(4, 145) = 18.05; Prob > F = 0.0000; R-squared = 0.4256; Root MSE = .01378

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	.0135497	.0035103	3.86	0.000	.0066116	.0204877
beta	-.0411553	.0067999	-6.05	0.000	-.054595	-.0277156
bookratio	-.0023267	.000745	-3.12	0.002	-.0037992	-.0008542
size	.0011154	.0010059	1.11	0.269	-.0008728	.0031035
_cons	.0302727	.0133983	2.26	0.025	.0037914	.056754

Cross-Sectional: USA

Before Crisis

```
Linear regression                               Number of obs =        65
                                                F(  4,    60) =      9.74
                                                Prob > F      =    0.0000
                                                R-squared     =    0.4330
                                                Root MSE      =    .00651

------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   .0079247   .0035175     2.25   0.028     .0008886    .0149608
        beta |  -.0140612   .0039051    -3.60   0.001    -.0218725   -.0062498
   bookratio |   .0006125   .0013954     0.44   0.662    -.0021787    .0034036
        size |   .0012666   .0006544     1.94   0.058    -.0000424    .0025756
       _cons |   .0071764   .0081713     0.88   0.383    -.0091686    .0235214
------------------------------------------------------------------------------
```

After Crisis

```
Linear regression                               Number of obs =        65
                                                F(  4,    60) =     15.99
                                                Prob > F      =    0.0000
                                                R-squared     =    0.5804
                                                Root MSE      =    .01258

------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |  -.8438187   .6920811    -1.22   0.228    -2.228187    .5405496
        beta |  -.0581769   .0076536    -7.60   0.000    -.0734865   -.0428674
   bookratio |  -.0044231     .00199    -2.22   0.030    -.0084037   -.0004425
        size |   .0008843   .0017278     0.51   0.611    -.0025719    .0043404
       _cons |   .0483838   .0171508     2.82   0.006     .0140771    .0826905
------------------------------------------------------------------------------
```

Before & After

```
Linear regression                               Number of obs =       130
                                                F(  4,   125) =     15.34
                                                Prob > F      =    0.0000
                                                R-squared     =    0.4722
                                                Root MSE      =    .01321

------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   .0170037   .0065583     2.59   0.011      .004024    .0299834
        beta |  -.0364215   .0068126    -5.35   0.000    -.0499045   -.0229384
   bookratio |  -.0071086   .0019807    -3.59   0.000    -.0110288   -.0031885
        size |    .00063   .0011861     0.53   0.596    -.0017174    .0029773
       _cons |   .0261355   .0145336     1.80   0.075    -.0026284    .0548994
------------------------------------------------------------------------------
```

Cross-Sectional: Europe

Before Crisis

Linear regression

Number of obs	= 10
F(4, 5)	= 98.03
Prob > F	= 0.0001
R-squared	= 0.9109
Root MSE	= .00316

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	4.790743	.910502	5.26	0.003	2.450223	7.131263
beta	.0342779	.0139232	2.46	0.057	-.0015129	.0700686
bookratio	-.0004006	.000408	-0.98	0.371	-.0014493	.0006481
size	.005392	.0022066	2.44	0.058	-.0002803	.0110642
_cons	-.0850426	.0293857	-2.89	0.034	-.160581	-.0095041

After Crisis

Linear regression

Number of obs	= 10
F(4, 5)	= 2.47
Prob > F	= 0.1745
R-squared	= 0.2388
Root MSE	= .00955

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-.1107148	.5717088	-0.19	0.854	-1.580339	1.358909
beta	.0037747	.0358045	0.11	0.920	-.0882636	.095813
bookratio	.0014618	.0010966	1.33	0.240	-.0013572	.0042808
size	-.0045007	.0058278	-0.77	0.475	-.0194816	.0104802
_cons	.0259874	.0737103	0.35	0.739	-.163491	.2154658

Before & After

Linear regression

Number of obs	= 20
F(4, 15)	= 56.19
Prob > F	= 0.0000
R-squared	= 0.6790
Root MSE	= .01092

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-.9975517	.1098768	-9.08	0.000	-1.231748	-.7633549
beta	-.0772785	.0110768	-6.98	0.000	-.1008881	-.053669
bookratio	-.0016156	.0007245	-2.23	0.041	-.0031599	-.0000713
size	.0028848	.0035182	0.82	0.425	-.0046141	.0103837
_cons	.0525714	.0284603	1.85	0.085	-.0080902	.113233

Panel: USA & Europe

Before Crisis

```
Random-effects GLS regression                   Number of obs      =      2849
Group variable: bancs                           Number of groups   =        77

R-sq:  within  = 0.0101                         Obs per group: min =        37
       between = 0.2527                                        avg =      37.0
       overall = 0.0155                                        max =        37

Random effects u_i ~ Gaussian                   Wald chi2(5)       =    173.98
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   2.33e-06   2.83e-07     8.25   0.000     1.78e-06    2.89e-06
        beta |  -.0173476   .0047185    -3.68   0.000    -.0265957   -.0080995
   bookratio |  -.0010212   .0005739    -1.78   0.075    -.0021461    .0001037
        size |   .0026884   .0006013     4.47   0.000     .0015097     .003867
       _cons |  -.0042064   .0074766    -0.56   0.574    -.0188603    .0104475
-------------+----------------------------------------------------------------
     sigma_u |   .0017009
     sigma_e |   .04610764
         rho |    .001359   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

After Crisis

```
Random-effects GLS regression                   Number of obs      =      2009
Group variable: bancs                           Number of groups   =        77

R-sq:  within  = 0.0761                         Obs per group: min =        21
       between = 0.1709                                        avg =      26.1
       overall = 0.0600                                        max =        33

Random effects u_i ~ Gaussian                   Wald chi2(4)       =     74.17
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |  -.3158208   .1414757    -2.23   0.026    -.5931081   -.0385335
        beta |  -.0732867   .0130276    -5.63   0.000    -.0988203   -.0477531
   bookratio |  -.0132934   .0024407    -5.45   0.000     -.018077   -.0085098
        size |   .0141302   .0027073     5.22   0.000     .0088241    .0194364
       _cons |  -.1129401   .0276976    -4.08   0.000    -.1672264   -.0586538
-------------+----------------------------------------------------------------
     sigma_u |   .01837196
     sigma_e |   .10712292
         rho |   .02857303   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Before & After

```
Random-effects GLS regression                   Number of obs      =      5697
Group variable: bancs                           Number of groups   =        77

R-sq:  within  = 0.0222                         Obs per group: min =        73
       between = 0.1216                                        avg =      74.0
       overall = 0.0108                                        max =        74

Random effects u_i ~ Gaussian                   Wald chi2(4)       =    133.00
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                    (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   3.09e-06   4.39e-07     7.04   0.000     2.23e-06    3.95e-06
        beta |  -.0159671   .0073633    -2.17   0.030    -.0303989   -.0015352
   bookratio |  -.0052518   .0011208    -4.69   0.000    -.0074486   -.003055
        size |   .0047166   .0012921     3.65   0.000     .0021842    .007249
       _cons |  -.0326808   .0132847    -2.46   0.014    -.0587183   -.0066434
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |   .11621439
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Panel: USA

Before Crisis

```
Random-effects GLS regression                   Number of obs      =      2479
Group variable: bancs                           Number of groups   =        67

R-sq:  within  = 0.0156                         Obs per group: min =        37
       between = 0.1355                                        avg =      37.0
       overall = 0.0112                                        max =        37

Random effects u_i ~ Gaussian                   Wald chi2(5)       =    166.21
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   2.18e-06   2.79e-07     7.84   0.000     1.64e-06    2.73e-06
        beta |  -.0146751   .0045476    -3.23   0.001    -.0235882   -.0057619
   bookratio |   -.001702   .0017921    -0.95   0.342    -.0052145    .0018105
        size |   .0022117   .0006966     3.17   0.001     .0008463     .003577
       _cons |  -.0041436   .0076338    -0.54   0.587    -.0191057    .0108184
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .04539126
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

After Crisis

```
Random-effects GLS regression                   Number of obs      =      1916
Group variable: bancs                           Number of groups   =        67

R-sq:  within  = 0.1526                         Obs per group: min =        24
       between = 0.1921                                        avg =      28.6
       overall = 0.0905                                        max =        35

Random effects u_i ~ Gaussian                   Wald chi2(4)       =    100.16
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |  -.5447609   .6408573    -0.85   0.395    -1.800818    .7112963
        beta |  -.0359352   .0145322    -2.47   0.013    -.0644178   -.0074525
   bookratio |  -.0486579   .0064781    -7.51   0.000    -.0613548    -.035961
        size |   .0102286   .0033224     3.08   0.002     .0037169    .0167403
       _cons |  -.1170232   .0323606    -3.62   0.000    -.1804487   -.0535976
-------------+----------------------------------------------------------------
     sigma_u |  .01944575
     sigma_e |  .11159241
         rho |  .02947059   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Before & After

```
Random-effects GLS regression                   Number of obs      =      4957
Group variable: bancs                           Number of groups   =        67

R-sq:  within  = 0.0538                         Obs per group: min =        73
       between = 0.0562                                        avg =      74.0
       overall = 0.0210                                        max =        74

Random effects u_i ~ Gaussian                   Wald chi2(4)       =    119.12
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

                                (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   1.80e-06   4.78e-07     3.76   0.000     8.61e-07    2.73e-06
        beta |   .0002881   .0082174     0.04   0.972    -.0158176    .0163939
   bookratio |  -.0184986   .003131     -5.91   0.000    -.0246353   -.0123619
        size |   .0034852   .0015823     2.20   0.028      .000384    .0065864
       _cons |  -.0467686    .016251    -2.88   0.004    -.0786199   -.0149173
-------------+----------------------------------------------------------------
     sigma_u |          0
     sigma_e |  .11723701
         rho |          0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Panel: Europe

Before Crisis

```
Random-effects GLS regression                   Number of obs      =       358
Group variable: bancs                           Number of groups   =        10

R-sq:  within  = 0.0036                         Obs per group: min =        32
       between = 0.8531                                        avg =      35.8
       overall = 0.0529                                        max =        37

Random effects u_i ~ Gaussian                   Wald chi2(4)       =      7.65
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.1052

                                    (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   2.595844   1.395965     1.86   0.063    -.1401969    5.331885
        beta |  -.0137506   .0130546    -1.05   0.292    -.0393372    .0118359
   bookratio |  -.0010622   .0006674    -1.59   0.111    -.0023703    .0002458
        size |   .0033952   .0040168     0.85   0.398    -.0044776     .011268
       _cons |  -.0122059    .043952    -0.28   0.781    -.0983502    .0739384
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |   .04455344
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

After Crisis

```
Random-effects GLS regression                   Number of obs      =       370
Group variable: bancs                           Number of groups   =        10

R-sq:  within  = 0.0197                         Obs per group: min =        37
       between = 0.0215                                        avg =      37.0
       overall = 0.0075                                        max =        37

Random effects u_i ~ Gaussian                   Wald chi2(5)       =     27.01
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0001

                                    (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |   -.250282   .0906231    -2.76   0.006      -.4279   -.0726639
        beta |  -.0071982    .036324    -0.20   0.843    -.0783919    .0639955
   bookratio |  -.0007402    .002828    -0.26   0.794    -.0062831    .0048026
        size |   .0098142   .0109744     0.89   0.371    -.0116952    .0313237
       _cons |  -.1058773   .0890947    -1.19   0.235    -.2804998    .0687451
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |   .14454346
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Before & After

```
Random-effects GLS regression                   Number of obs      =       740
Group variable: bancs                           Number of groups   =        10

R-sq:  within  = 0.0184                         Obs per group: min =        74
       between = 0.1498                                        avg =      74.0
       overall = 0.0144                                        max =        74

Random effects u_i ~ Gaussian                   Wald chi2(5)       =     24.08
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0002

                                    (Std. Err. adjusted for clustering on bancs)
------------------------------------------------------------------------------
             |               Robust
 pricereturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
bidaskspread |  -.3491697   .1012944    -3.45   0.001    -.5477032   -.1506363
        beta |  -.0451788    .018845    -2.40   0.017    -.0821142   -.0082434
   bookratio |  -.0018664   .0011513    -1.62   0.105    -.0041229    .0003901
        size |   .0093094   .0057273     1.63   0.104    -.0019158    .0205347
       _cons |  -.0494407   .0502772    -0.98   0.325    -.1479822    .0491008
-------------+----------------------------------------------------------------
     sigma_u |           0
     sigma_e |   .10837934
         rho |           0   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

ZION | USA

Before Crisis

Linear regression — Number of obs = 37; F(4, 32) = 9.31; Prob > F = 0.0000; R-squared = 0.3683; Root MSE = .02593

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	14.61117	8.263471	1.77	0.087	-2.220965	31.44331
betal	.3978989	.2343057	1.70	0.099	-.0793662	.875164
bookratio	-.2249039	.0545297	-4.12	0.000	-.3359774	-.1138305
size	.0426209	.0364288	1.17	0.251	-.0315821	.1168238
_cons	-.9114434	.3173164	-2.87	0.007	-1.557796	-.2650911

After Crisis

Linear regression — Number of obs = 37; F(4, 32) = 13.40; Prob > F = 0.0000; R-squared = 0.4695; Root MSE = .15509

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-27.64687	5.465278	-5.06	0.000	-38.77927	-16.51446
beta	.0734149	.1151463	0.64	0.528	-.1611304	.3079603
bookratio	-1.155634	.3025191	-3.82	0.001	-1.771845	-.5394227
size	-.9629145	.2809689	-3.43	0.002	-1.535229	-.3905996
_cons	8.070399	2.440786	3.31	0.002	3.09868	13.04212

Before & After

Linear regression — Number of obs = 74; F(4, 69) = 17.92; Prob > F = 0.0000; R-squared = 0.3174; Root MSE = .12262

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-20.25529	4.696394	-4.31	0.000	-29.62434	-10.88624
beta	.2920829	.1392151	2.10	0.040	.0143565	.5698094
bookratio	-.2133092	.0562599	-3.79	0.000	-.3255447	-.1010738
size	-.087158	.0518901	-1.68	0.098	-.1906758	.0163598
_cons	.3656894	.5226135	0.70	0.486	-.676896	1.408275

Before Crisis

Linear regression

Number of obs	= 37
F(4, 32)	= 4.38
Prob > F	= 0.0061
R-squared	= 0.2572
Root MSE	= .03358

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	9.968428	6.858114	1.45	0.156	-4.001093	23.93795
beta	.0368948	.0546253	0.68	0.504	-.0743732	.1481629
bookratio	-.1806566	.0632004	-2.86	0.007	-.3093916	-.0519216
size	-.0003489	.0524131	-0.01	0.995	-.107111	.1064131
_cons	-.4175374	.5335087	-0.78	0.440	-1.504259	.6691843

After Crisis

Linear regression

Number of obs	= 35
F(4, 30)	= 3.01
Prob > F	= 0.0335
R-squared	= 0.2266
Root MSE	= .10099

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-6.912684	3.85709	-1.79	0.083	-14.78991	.9645442
beta	.5139054	.3706405	1.39	0.176	-.2430435	1.270854
bookratio	-.2572073	.1557997	-1.65	0.109	-.5753926	.0609781
size	.0108501	.1081292	0.10	0.921	-.2099793	.2316794
_cons	-1.179907	.7671949	-1.54	0.135	-2.746728	.3869137

Before & After

Linear regression

Number of obs	= 68
F(4, 63)	= 3.46
Prob > F	= 0.0129
R-squared	= 0.0646
Root MSE	= .06708

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-6.504578	2.475243	-2.63	0.011	-11.45096	-1.558199
beta	.0438709	.0625534	0.70	0.486	-.0811321	.1688738
bookratio	-.0131276	.0389825	-0.34	0.737	-.0910279	.0647728
size	-.0004423	.0568501	-0.01	0.994	-.1140481	.1131635
_cons	-.0487262	.5454982	-0.09	0.929	-1.138817	1.041365

BNP | FRANCE

Before Crisis

Linear regression — Number of obs = 31; F(4, 26) = 11.58; Prob > F = 0.0000; R-squared = 0.4699; Root MSE = .07808

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-42.63963	14.31877	-2.98	0.006	-72.07229	-13.20697
beta	-.1654424	.5166029	-0.32	0.751	-1.227335	.8964501
bookratio	.0126391	.1660604	0.08	0.940	-.328703	.3539812
size	.1862739	.1628328	1.14	0.263	-.1484337	.5209816
_cons	-1.858947	1.340932	-1.39	0.177	-4.615273	.897378

After Crisis

Linear regression — Number of obs = 31; F(4, 26) = 11.58; Prob > F = 0.0000; R-squared = 0.4699; Root MSE = .07808

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-42.63963	14.31877	-2.98	0.006	-72.07229	-13.20697
beta	-.1654424	.5166029	-0.32	0.751	-1.227335	.8964501
bookratio	.0126391	.1660604	0.08	0.940	-.328703	.3539812
size	.1862739	.1628328	1.14	0.263	-.1484337	.5209816
_cons	-1.858947	1.340932	-1.39	0.177	-4.615273	.897378

Before & After

Linear regression — Number of obs = 70; F(4, 65) = 4.70; Prob > F = 0.0021; R-squared = 0.3353; Root MSE = .06844

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-17.57722	14.19829	-1.24	0.220	-45.93317	10.77873
beta	.1629922	.1605353	1.02	0.314	-.157619	.4836034
bookratio	-.2314003	.0709802	-3.26	0.002	-.3731575	-.089643
size	-.0401596	.0544363	-0.74	0.463	-.1488763	.0685571
_cons	.2088803	.481272	0.43	0.666	-.7522861	1.170047

DBK | GERMANY

Before Crisis

Linear regression — Number of obs = 33; F(4, 28) = 1.25; Prob > F = 0.3120; R-squared = 0.1473; Root MSE = .03929

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	13.40253	11.17002	1.20	0.240	-9.478227	36.28329
beta	.0578593	.0869995	0.67	0.511	-.120351	.2360697
bookratio	.0691838	.1179843	0.59	0.562	-.172496	.3108636
size	.1358957	.105324	1.29	0.208	-.0798507	.3516421
_cons	-1.476365	1.166912	-1.27	0.216	-3.866676	.9139464

After Crisis

Linear regression — Number of obs = 37; F(4, 32) = 10.39; Prob > F = 0.0000; R-squared = 0.2538; Root MSE = .14337

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-.64621	.2243357	-2.88	0.007	-1.103167	-.1892531
beta	.4992828	.1867957	2.67	0.012	.1187923	.8797732
bookratio	-.8429842	.4324095	-1.95	0.060	-1.723774	.0378052
size	-.5762401	.3357235	-1.72	0.096	-1.260087	.1076064
_cons	5.502068	3.433642	1.60	0.119	-1.492031	12.49617

Before & After

Linear regression — Number of obs = 74; F(4, 69) = 17.25; Prob > F = 0.0000; R-squared = 0.1362; Root MSE = .11114

pricereturn	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
bidaskspread	-.8186322	.2537352	-3.23	0.002	-1.32482	-.3124443
beta	.2017591	.1034004	1.95	0.055	-.0045192	.4080373
bookratio	-.125837	.0803647	-1.57	0.122	-.2861602	.0344861
size	.0010652	.0811938	0.01	0.990	-.160912	.1630424
_cons	-.236687	.9200675	-0.26	0.798	-2.072172	1.598797