Bank Opacity
Empirical evidence from the CDS and equity market

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Abstract

This paper examines to what extent the 2011 EU-wide bank stress test provided the market with new information. The intention is to conclude whether the European banking sector should be considered opaque or not. This is done by studying the credit default swap market and the equity market using event-study methodologies. Three different groups will be observed: i) the stress tested banks ii) a sample consisting of small banks and iii) a sample consisting of large banks. The empirical evidence suggests that the stress test was fairly informative to the market generally.. However, the results are much more distinct in the CDS market than in the equity market. These findings support the fact that the degree of bank opacity in the European region should be considered at least intermediate.

Keywords: bank opacity, event-study, bank stress testing, credit default swap

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1. Introduction

Regulators all around the world are stepping up their efforts to restrain the unbridled and complex financial sector. With the 2008 economic crisis close in memory and the current sovereign debt crisis rapidly deteriorating, many investors and market participants are calling for increased transparency across the whole financial sector. Regulators have become increasingly aware of the crucial role banks and financial institutions plays in the global economy. As we have seen lately, the market disruptions from a bank failure can be tremendous and the impact is likely to affect the vast economy. In order to make sure the vital banking sector will not go down that path again, regulators have a set of monitoring tools at their disposal. One of those tools are bank stress testing

This summer, the European Banking Authority (EBA) published the results from the 2011 EU-wide bank stress test. The aim was to assess the resilience of European banks against deliberately severe hypothetical scenarios with the intention to provide unprecedented transparency and disclosure for the market (EBA, 2011a).

This would suggest that some kind of information asymmetry is evident, i.e. investors are not able to accurately measure the value or risk of financial institutions and banks. Instead, regulators and governments have to support the market in this matter. This hypothesis leads us to the core of this thesis which is the degree of bank opacity. By measuring the impact from the 2011 bank stress test conducted by EBA, limited conclusions regarding bank opacity might be drawn.

There are two earlier empirical studies in this field. Peristian et al. (2010) investigated whether the 2009 US bank stress test helped the market develop a more informed view and quell uncertainty by studying both abnormal stock returns and abnormal CDS spread changes. Their conclusion is that the stress test was successful in this matter. Cardinali and Nordmark (2011) used the same event-study methodology but focused on the result of the EU-wide stress test launched in 2010 as well as the methodology and clarification announcements of the 2011 stress test. They conclude that the 2010 stress test result was not very informative to the financial markets. However, they prove that the methodology announcement in the 2011 stress test showed significant abnormal equity returns, suggesting that new information were provided to the market.

With that in mind several interesting questions could be raised concerning the 2011 stress test. How did the credit default swap market react to the stress test? Was that reaction different compared to the equity market?

There has been, to my knowledge, no earlier research in trying to conclude whether the 2011 bank stress test revealed new information to the market using a CDS reaction approach. For more robust results, I will also conduct the same event-study methodology on the equity market around the stress test event. Consequently, I hope this study will bring some light to this question as well as provide further insights concerning the degree of bank transparency in the European banking sector.

1.1 Purpose

The purpose of this thesis is to answer whether the 2011 European bank stress test provided the markets with new information. Whilst the main focus will be the credit default swap market approach, the reaction in the equity market will be studied as well. My intention is to use this information to examine bank opaqueness.

1.2 Research questions

First of all, the main question intended to be answered is if the stress test made any new information available to the market? Was there any specific announcement that seemed to be more informative than the others?

Did the credit default swap market react in the same way as the equity market for these events? If there was a difference, what could be the reason for that?

Finally, using the results from this study; to which extent are banks opaque? Is there any difference in terms of opaqueness between large and small banks?

1.3 Delimitations

I will limit this thesis to the 2011 EU-wide stress test. I have identified three central events surrounding this stress test where I might be able to find abnormal movements in the markets. These are: i) the announcement of the stress test methodology ii) the clarification on the methodology iii) the announcement of the results.

1.4 Method

I will examine the information delivered to the market from the stress test by conducting event-study methodologies. This will capture any potential abnormal movements. The method used will be similar for the two markets.

1.5 Disposition

I will start off by introducing capital ratios and its use in bank regulation in the second section. I will then continue with an overview of bank stress testing in the third section before presenting the main theories upon which I base my subsequent analysis in the fourth section. Prior to presenting the methodology that I have used I will also explain the characteristic of a credit default swap. Finally, the results will be displayed with a coherent analysis followed by concluding remarks.

2. Capital adequacy and bank regulation

-- This section aims to provide an introduction to capital ratios and how these metrics are implemented in the current regulatory framework. I will also present an overview of bank regulation --

Before digging deeper into the current regulatory framework for financial institutions, it is crucial for the reader to understand a few key-concepts concerning capital ratios.

The basic capital-ratio metric expresses capital relative to assets. In the case of financial institutions one could simply argue that this metric measures to what extent the risk (assets = bank lending etc.) is covered by own capital.

$$Capital\ Ratio = \frac{Bank\ Capital}{Assets_{(Risk\ weighted)}}$$

$$Bank\ Capital = Total\ Assets - Total\ Liabilities = Shareholders'\ equity$$

Banks need to make decisions about the capital they need to hold for three reasons. First of all, adequate bank capital levels helps prevent bank failures, a situation where a bank cannot satisfy its obligations and goes bankrupt. Second, the amount of capital affects the return for shareholders. Third, a minimum amount of capital is required by different regulatory authorities (Mishkin, 2006).

Bank capital can basically be divided into two groups which sums up to total capital. Tier 1 "core" capital consists of shareholder equity (common equity) plus disclosed reserves (retained earnings) whilst Tier 2 "supplemental" capital comprises undisclosed reserves, subordinated debt and hybrid capital instruments (FED Kansas City, 2010).

As part of the capital adequacy assessment, regulators convert banks' assets to risk-weighted equivalents. The rationale for this is to quantify the relative risk and hence determine the minimum capital necessary to compensate for this risk. Assets that pose little risk are weighted with a low percentage whilst assets considered more risky will be given a higher percentage (FED Kansas City, 2010).

2.1 Bank regulation

The global capital standards are set by the Basel Committee on Banking Supervision. The committee was formed in 1974 by a group of eleven countries following the liquidation of the German bank Herstatt. Their goal was to harmonize banking standards and regulations amongst its members (Balin, 2008).

2.1.1 Basel I

In 1988 the committee published its first set of minimum capital requirements, called the Basel Capital Accord or more commonly Basel I. The accord focused solely on credit risk and was based on four pillars: (Balin, 2008)

- Pillar 1 (the constituents of capital) defined tier 1 and tier 2 capital and decided on the relative amount of each type a bank was supposed to hold.

- Pillar 2 (risk weighting) introduced the guidelines for risk-weighting of the banks' assets. The weightings were divided into 5 levels: 0, 10, 20, 50 or 100% of the original asset value depending on its risk-level.

- Pillar 3 (target standard ratio) combines the first and second pillar. It sets a universal minimum capital ratio which states that 8% of a bank's risk-weighted assets should be covered by tier 1 and tier 2 capital in total. In addition, it sets 4% as the minimum requirement for tier 1 capital.

- Pillar 4 (implementation) sets the stage of implementation required by the members of the Basel committee.

2.1.2 Basel II

As a consequence of the first accord, financial institutions began what is referred to as "regulatory arbitrage". By selling off their least risky portion of the loan book and keep the most profitable ones they were able to dodge the capital requirement. Furthermore, the risk weighting mechanism in the first accord was poorly applied since it weighted long-term debt at 100% whilst short-term debt at only 20%. By swapping long-term debt to a stream of short-term contracts, banks were able to lower their risk exposure whereas the risk level remained the same. This made the system less trustworthy. (Balin 2008)

As a response to the abovementioned critics, the Basel committee enacted a further comprehensive and updated capital sufficiency accord, informally known as Basel II. The new framework was based upon three pillars:

- Pillar 1 (minimum capital requirements) created a more sensitive measure of bank's risk-weighted assets and attempted to close the loopholes which were present in the first accord. The first pillar also introduced new methods to quantify risk.

- Pillar 2 (regulatory issues) extended the level of interaction allowed by regulatory authorities.

- Pillar 3 (market discipline) recommended banks to regularly disclose crucial capital metrics and risk-taking positions to the public.

2.1.3 Basel III

The third accord, known as Basel III, was endorsed in September 2010 and is estimated to be fully implemented by 2019. The intention with this new directive is to address many of the flaws in present regulation that became visible during the financial crisis. Basel III's focus is to develop a further comprehensive and wide-ranging regulatory framework, mainly targeting capital and funding issues. This will be done by completing the pillars from Basel II as well as adding new focus on liquidity management and systematically important financial institutions (Härle et al. 2010).

On capital target ratios, the Tier 1 requirement will be raised to a minimum of 7.0% (consisting of 4.5% core Tier 1 Capital and 2.5% conservation buffer. On liquidity management, the release of new standards and supervisory tools are intended to simplify the assessment of liquidity risks in the banking sector.

In addition to the abovementioned capital ratios, special rules will apply for global systematically and important financial institutions (SIFIs). Depending on a bank's global importance, the additional core Tier 1 capital required will range from 1% to 2,5%.The rationale for this is that SIFIs pose a larger threat to the financial system in the case of bankruptcy and hence demands tighter regulation (The Basel Committee, 2010).

3. Stress testing

-- This section describes stress testing of financial systems in general as well as provides a broad overview of the key-events for the 2011 EU-wide stress test --

3.1 Background to stress testing

An aggregate stress test of financial institutions intends to measure the risk exposure of a certain group using specified hypothetical stress scenarios. The objective of an aggregate stress test is to help regulators identify structural vulnerabilities in the financial system which eventually could lead to disruptions in the markets. Stress testing techniques began to be applied widely by the largest active banks in the early 1990s as a tool for risk management (Blaschke et al. 2001).

Blaschke et al. (2001) presents a framework for stress testing on the financial system. First of all, to conduct an aggregated stress test, the scope of the stress test has to be decided upon, i.e. which financial institutions should be included in the test. Next step is to decide how the results should be aggregated i.e. how should the results from the individual banks be compiled.

For the actual stress test methodology, the sequence looks something like this: For each type of risk (interest rate risk, market risk, exchange rate risk, liquidity risk etcetera) it is important to decide which type of stress test to perform (sensitivity, scenario, maximum loss etcetera), the type of shock to apply (individual or multiple markets etcetera), the type of scenario to consider (hypothetical, historical) and also which assets are to be shocked, by how much, and during which time frame (Blaschke et al. 2001).

3.2 The 2011 EU-wide stress test

The 2011 EU-wide stress test was conducted by the European Banking Authority (EBA). EBA acts as a hub for financial regulators across EU and national bodies with the intention to safeguard public interests such as stability in the financial sector, transparency in the markets and the protection of depositors and investors. The EU-wide stress test is a supervisory tool designed to assess the resilience of European banks against deliberately severe hypothetical shocks (EBA, 2011a).

Event 1: Methodology
On 18 March 2011, EBA announced in-depth details of the methodology to be used in the upcoming stress test. The testing should be carried out between March and June 2011. The capital threshold for the banks will be focused on Core Tier 1 capital.

EBA in conjunction with the European Systematic Risk Board and the European Central Bank, decided upon two different macroeconomic-scenarios to assess the banks; a baseline scenario and a plausible adverse scenario. These scenarios will cover alterations in key-macroeconomic variables such as GDP growth, unemployment rates, property prices and interest rates during 2011 and 2012. In the baseline scenario, interest rates are expected to gradually rise whilst the economic recovery in the European region is expected to continue, resulting in 1,8% GDP growth in 2011 and 2% in 2012. The adverse scenario on the other hand is composed by three elements: i) a set of EU shocks tied to the persistence of the

sovereign default crisis ii) a global negative demand shock originating in the US iii) a USD depreciation. The result from this scenario will be a decline in GDP growth by 0,4% whilst it is assumed that stock prices will deteriorate by 15%. However, the adverse scenario will not take into account haircuts on sovereign debt (EBA, 2011a).

Event 2: Clarification
On 8 April 2011, EBA announced the benchmark of Core Tier 1 capital to be used as well as a definitive sample of banks included in the stress test. The capital requirement will be set to 5% of risk-weighted assets, which is lower than the proposed capital requirement under Basel III. The reason for this is that Basel III will not be fully implemented during the time frame for the stress test. The sample of banks included in total will be 90 banks which represent more than 65% of total banking assets in the EU and more than 50% of banking assets in all individual EU countries. (EBA, 2011b)

Event 3: Results
On 15 July 2011, EBA published the results from the stress test as well as recommendations for national supervisory authorities to tackle possible shortfalls.

The result shows that:

- As of 31 December 2010, twenty banks would fall below the 5% Core Tier 1 Capital Ratio threshold over the two-year horizon with a capital shortfall estimated to total EUR 26,8 billion.

- In the first four months in 2011, a net amount of EUR 50 billion of capital was raised.

- When the capital raising is taken into account the final results show that eight banks in total fall below the capital threshold of 5% Core Tier 1 capital over the two-year horizon with an estimated shortfall of EUR 2,5 billion.

- In addition, the final result indicates that sixteen banks merely managed to stay above the 5% requirement, i.e. with a ratio between 5% and 6%.

On the basis of these results, EBA issued a formal recommendation stating that national supervisory authorities immediately should demand required banks to remedy their capital shortfall. EBA also recommended the national authorities to request that banks that merely surpassed the 5% threshold should take specific steps to strengthen their capital position. The recommendations will be monitored by EBA and progress reports will be published in February and July 2012. (EBA, 2011c)

4. Theoretical Framework

-- In this section I will provide a comprehensive overview of the main theories upon which I use as the basis for my subsequent analysis as well as a review of the empirical literature in this field --

4.1 Information asymmetry and efficient markets

Information asymmetry is based upon the fact that one part in a transaction or deal has more or better information than the other part. This asymmetry translates into power imbalances between these two parts. Almost all firms suffer from some degree of information asymmetry and in most industries this problem is solved by market-based mechanisms (Kwan et al. 2002).

Fama (1970) states that a market should be considered efficient if security prices always fully reflect all available information. He determines three sufficient conditions for an efficient market; i) no transaction costs ii) all information is costlessly available iii) all participants agree on the implications of current information. Fama argues that these conditions don't need to be met as long as there are a sufficient amount of investors who takes transaction costs into account and also have access to accurate information.

4.1.1 Bank Opacity

The basic concept of a bank is that most of their investments are risky lending and that the lion's part of their liabilities is accounts of depositors (Bodie et al, 2011). Intuitively, from the information asymmetry theory, this transformation could be a basis for opacity. Greenspan (1996) states that bank loans are customized and privately negotiated agreements which lacks transparency for outside investors. This tends to make the risk-level of loans hard to quantify which he argues would be a source for bank opacity.

Despite two decades of bank regulation, banks remain subject to a complex and comprehensive regulatory scheme, making it one of the most controlled sectors (Van Der Weide, 2000). The reason for this intrusive regulation is the perception of banking as a relatively opaque industry, i.e. the market is not able to accurately assess the true value of financial institutions without additional regulatory support (Haggard and Howe, 2007).

Peristian et al (2009) identifies two opposite hypothesis concerning bank opacity. The first states that banks are completely transparent, i.e. the market is able to accurately assess their value. The second hypothesis is the opposite; banks are opaque, i.e. the market is not able to assess their true value at all.

4.2 Empirical Studies

The existing empirical studies on bank opacity are mixed. Previous studies in this field have been undertaken by studying i) split ratings ii) the market microstructure iii) analysts' ability to accurately forecast earnings iiii) bank stress-tests.

Split ratings

This method tackles bank opacity by investigating whether rating-agencies disagree more frequently on banks bond issues compared to other sectors. A significant higher

disagreement on banks' issues compared to other firms would indicate that banks are opaque.

Morgan (2000) examines split ratings between Moody's and S&P in the U.S. and proves that banks are more likely to receive split ratings than industrial firms. This would suggest that banks are opaque.

Iannotta (2006) undertakes a similar approach on European banks and concludes that banks seem to be more opaque that other firms. However, his result shows that a few other industrial sub-industries seem to be even more opaque than banks, suggesting that the conclusions from split rating might not be completely reliable.

Market microstructure
The market microstructure method suggests that certain trading properties of a firm should reflect the information available to market participants. The bid-ask spread, the traded volume and the return volatility seem to be the most common studied variables.

Kwan et al. (2010) uses this approach and compares the trading characteristic between large banks and large non-financial firms as well as between smaller banks and smaller non-financial firms by using recent data from the financial crisis. They conclude that bank opacity seem to vary substantially through time which indicates that the sampling period has to be taken into careful account when conducting empirical studies on bank opacity. Moreover, their study suggests that large banks do not seem to be harder to value in 'normal times' compared to their non-financial counterparties, however this seemed to have changed temporarily during the financial crisis.

Flannery et al (2002) conduct the same type of methodology using data from 1990 to 1997. They conclude that larger banks seem to have the same properties as their non-financial counterparties whilst the smaller banks seem to differ substantially from their control sample. This would suggest that smaller banks are more opaque than larger banks.

Analysts' ability to accurately forecast earnings
 The idea here is that if analysts disagree more frequently on bank forecasts compared to non-financial firms, they should be considered opaque.

Flannery et al (2002) also pursues this approach in their study and their conclusion is that analysts seem to be more accurate in forecasting earnings on smaller banks compared to their control sample. The accuracy seems to be about the same for large banks compared to their control sample. This would suggest that larger banks are more opaque than smaller banks. Their overall conclusion, taking the result from the microstructure study into account, is that banks have about the same opaqueness as other firms.

Bank stress testing
Two studies have examined bank opacity from a bank stress test angle. Peristani et al (2010) investigates the impact from the U.S. 2009 stress test (SCAP) examining the equity and the credit default swap market. They arrive at the conclusion that the stress test produced new

information to the market and that banks should not be considered opaque or transparent. Banks should instead be considered opaque to an intermediate degree.

Cardinali and Nordmark (2011) measured the impact from the 2010 European stress test result as well as from the methodology and clarification announcement for the 2011 European stress test. They focused on abnormal equity returns and tried to distinguish the results between PIIGS and non-PIIGS banks. They draw the conclusion that the 2010 result announcement was not very informative to the market, neither was the 2011 clarification event. However, the impact from the 2011 methodology announcement was significantly abnormal, suggesting that new information was produced from the stress test. No substantial difference between PIIGS and non-PIIGS banks could be determined. Overall, their results indicated that banks are opaque to an intermediate degree.

Hypothesis
With this information in mind I can outline the following hypothesis: If banks are opaque in reality I would expect to see very significant movements in the CDS market over all event windows. On the other hand, if banks are considered to be fully transparent none of the events would impact CDS spreads. The same goes for the reaction in the equity market.

5. The Credit Default Swap and its characteristic

-- This section explains the basic characteristic of a credit default swap and explains its reaction to certain events in the market –

A Credit Default Swap (CDS) is an over-the-counter (OTC) credit derivative which, in brief, is a contractual agreement to transfer the default risk of one or more reference entities from one party to the other. The parties involved in this agreement are the protection buyer and the protection seller. The protection buyer pays a periodic fee to the protection seller, called the CDS premium. If the reference entity defaults or another credit event occurs, the protection seller is forced to compensate the protection buyer for the loss. Settlement can then be made physically or in cash (Mengle, 2007).

This figure illustrates the plain "vanilla" credit default swap.
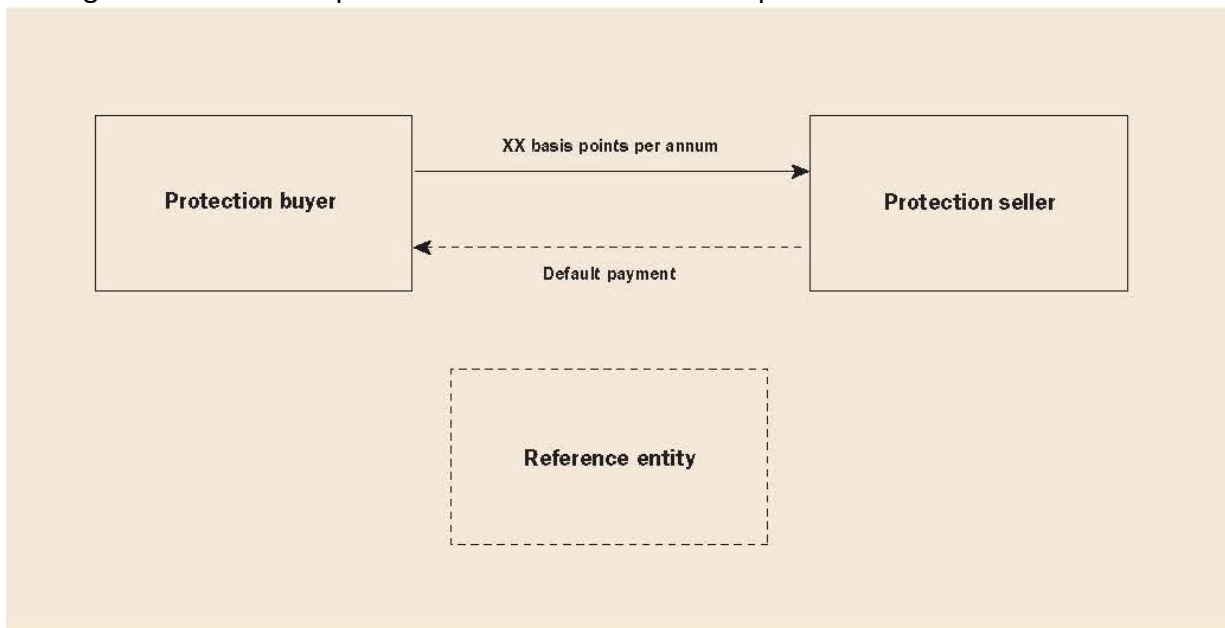
The major source of credit derivatives growth since 2004 has been the development of Index CDSs. A CDS index consists of as many as 125 corporate entities. A holder of this index security is protected against defaults on all entities in the index, where each entity has an equal share of the notional amount. The main index for European corporates is the iTraxx index which tracks the 125 most liquid CDS referencing securities, mainly investment grade (Mengle, 2007).

The maturity of a CDS-contract ranges from a couple of months up to 30 years or more. However, the most common maturity is 5-year and these are also considered most liquid (Blanco et al. 2004).

5.1 CDS spread determinants

The most important determinant of the CDS price is the likelihood that a credit event involving the underlining reference entity occurs (Byström, 2009). In addition, CDS spreads have a strong tendency to widen when stock prices fall and vice versa (Byström, 2009). This suggests a negative relationship between CDS spreads and equity prices. Moreover, Peristian

et al. (2009) study also suggests that CDS spreads reacted similar to the stress test event as equity prices (though with the opposite sign).

Assuming that this negative relationship exists, it is crucial for future comparisons to conclude if any of the instruments lead in price discovery. I.e. does the price impact from the events influence CDS and equity prices at the same time? The research in this field is quite extensive and Buus et al (2009) concludes that there is no unambiguous answer. However, the CDS market seems to be particularly sensitive when credit quality deteriorates (Peristian et al. 2009).

5.2 CDS spreads or secondary market bond spreads?

Blanco, Brennan and Marsh (2004) proves that CDS prices lead in price discovery relative to secondary market corporate bond spreads and therefore are cleaner indicators of credit risk. Forte et al (2009) confirm this finding using a sample with both European and U.S. companies.

6. Methodology

-- This section presents the research methodology that I have used and possible biases related to it --

In this thesis, I will follow a modified event-methodology outlined in Campbell et al (2009) as well as in MacKinlay (1997). These methodologies are widely used when measuring security price reactions to certain events in the market. According to the efficient market hypothesis, security prices reflect all available information, and then price reactions should reflect new information. This is underlying theory for event-studies in the financial markets (Bodie et al. 2011).

I will conduct the following steps to measure this reaction: *event definition*, *selection criteria, normal and abnormal returns*, *estimation procedure, aggregation, testing procedure, empirical results, interpretation and conclusions*.

6.1 Event definition

The first task is to define the actual event of interest. This is done in order to find the exact dates where the security price reactions will be examined. For the European bank stress test 2011 there are three main sub-events to study:

1. **Methodology (18 March 2011)**
2. **Clarification (8 April 2011)**
3. **Results (15 July 2011)**

The next task is to define the event windows for these events. I follow Peristian et al. (2009) and use a three-day window. In practice, I will use the trading day before the actual event took place as well as the subsequent trading day. This event-window expansion is done in order to capture delayed price reactions as well as premature reactions due to news leakages.

6.2 Selection Criteria

Obviously, only banks in the 2011 stress test will be included. In addition, only banks with traded credit default swaps available in DataStream during the estimation period and event-window will be included. This screening resulted in 36 banks.

Since the reaction on CDS contracts will be the base for this thesis, the selection criteria for the chosen stocks will be done from the already chosen 36 banks. Hence only banks with liquid stocks and CDS contracts will be selected. This second screening resulted in 33 banks.

6.3 Normal and abnormal returns

In order to conclude whether the event had any impact on the security, one has to measure the normal performance of the security during the estimation window, i.e. model the expected return of the security as if the event did not take place.

For the debt market the first step is to calculate the return of the CDS:

$$R_{it} = \frac{S_{t,i} * RPV_{i,t}}{S_{(t-1),i} * RPV_{i,(t-1)}} - 1$$

R_{it} = Return for protection buyer at t

S_{ti} = CDS spread for issuer i on day t

RPV_{it} = Present value on day t of 1 basis point stream of premia which terminates at maturity

or default

As the observant reader might already have noticed, the return depends on the unknown present value of RPV whose calculation requires a CDS pricing model. However, Micu et al. (2006) argue that given the relative short holding period (single day), it is reasonable to assume that $RPV_{i,t} = RPV_{i,(t-t)}$. This simplifies our equation and we can write:

$$R_{it} = \frac{S_{t,i}}{S_{(t-1)}} - 1$$

This methodology differs from the one used by Peristian et al (2009). They focus on absolute daily changes in CDS spreads, i.e. $S_{t,i} - S_{(t-1),i}$. Micu et al. (2006) argues that this methodology does not adjust for differences in the level of spreads across issuers nor facilitate a comparison of returns across markets. See Micu et al (2006) for an in-depth explanation on this topic. In order to get robust and valid results, I have chosen to conduct the method used by Peristian et al (2010) as well.

Next step is to measure the abnormal CDS spread returns. MacKinlay (1997) presents several approaches to measure this abnormal security price reaction. If we assume that security returns are jointly multivariate normal and independently distributed through time, we can specify the two most common used methods; the Constant Mean Return Model and the Market Model. The former assumes that the mean return of a given security is constant through time, whilst the latter assumes a linear relation between the market return and the security return. In line with Peristian et al. (2009), I choose the market-model to estimate the abnormal returns.

On the contrary to Peristian et al's study, I regress the return on the CDS spread for bank (i) at (t), R_{it}, on the return of the overall CDS index at (t), R_{mt}. The formula can be expressed as follows:

$$R_{it} = \alpha_i + \beta_i * R_{mt} + \varepsilon_{it}$$

Once this is done I may calculate the abnormal return AR_{it} which is defined as the ex post return minus the normal return over the event window. The formula can be expressed as follows:

$$AR_{it} = R_{it} - \alpha_{i'} - \beta_i * R_{mt}$$
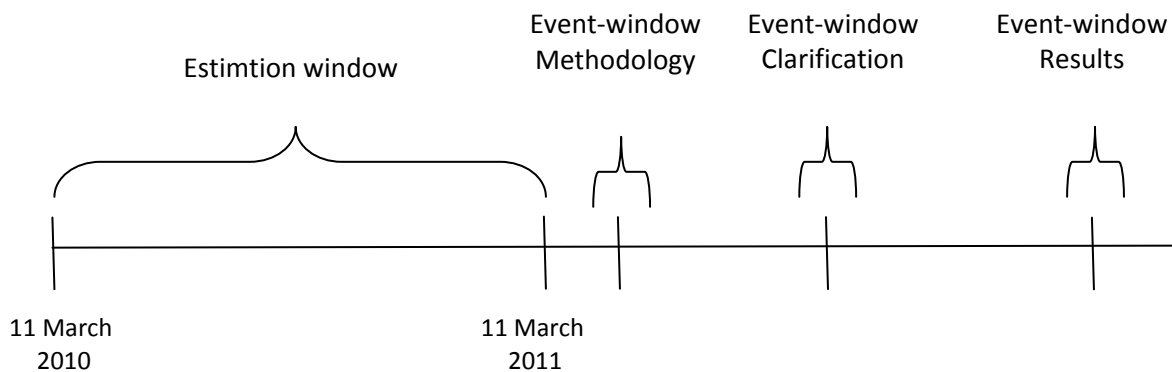
Equity

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The same approach applies for the equity market, however with one vital modification. I will instead use the logarithm of the return on the stocks, i.e. using continuously compounded returns. This is done in order to avoid issues with non-stationarity. There is widespread empirical evidence that stock returns become stationary when they are integrated of the first order. Apart from this modification, the calculations are the same.

6.4 Estimation procedure

In order to estimate the normal returns, the parameters of the market-model have to be projected for each security in both markets over the estimation window. There is not really a consensus regarding the length of this estimation window however I will follow Peristian et al. (2010) and Cardinali & Nordmark (2011) who use an estimation window of one year.

In general, the estimation window should end prior to the event-window which means that the event itself is excluded from projection of the parameters. This seems obvious since the impact from the event otherwise would affect the estimation. Consequently, I will estimate the parameters in the market-model from daily data using OLS from 11 March 2010 to 11 March 2011.

Event Overview

Estimtion window	Event-window Methodology	Event-window Clarification	Event-window Results

11 March 2010   11 March 2011

6.5 Aggregation and averaging

Once the abnormal returns have been computed for each security in their respective event-window, these returns have to be aggregated. Each firm's returns could be analyzed independently, however de Jong (2007) argue that averaging over a number of firms will enhance the analysis.

I will be using two different methods to aggregate these abnormal returns as proposed by de Jong (2007);

- The unweighted cross-sectional average of abnormal returns, **AAR**, on day t. Useful when examining the impact on one particular day in the event-window.

  Calculated by using: $AAR_{(t)} = \dfrac{1}{N} \sum AR_{it}$

- The cumulative average abnormal return, **CAAR**, in period $t_1 - t_2$. Useful when examining the impact of the whole event-window.

  Define $CAR_i(t_1,t_2)$ as the cumulative abnormal return for security i from t_1 to t_2.

$$CAR_{i(t1,t2)} = \sum AR_{it}$$

  Once the CAR for each security has been calculated, CAAR can be computed as follows:

$$CAAR_{(t1,t2)} = \frac{1}{N} \sum CAR_{i(t1,t2)}$$

  Note that CAAR can also be obtained by aggregating the AARs over time.

6.6 Testing procedure

To conclude whether the events had any impact, simple statistical tests will be used. These tests are designed to answer the question whether the calculated abnormal returns are significantly different from zero at a certain significance level. The null-hypothesis to be tested can be expressed as:

$$H_0 : E(AAR_{(t)}) = 0$$

and respectively:

$$H_0 : CAAR_{(t1,t2)} = 0$$

To test the first null hypothesis of no abnormal returns I will use a simple t-test. The AARs are supposed to be independently and identically distributed and assumed to follow a normal distribution with mean zero and variance V^2. An estimator of V can be obtained from the cross-sectional variance of abnormal returns on day t (de Jong, 2007):

$$S_t = \sqrt{\frac{1}{N-1} \sum (AR_{it} - AAR_t)^2}$$

This yield the follow test-statistic for AAR:

$$G_1 = \sqrt{N} \frac{AAR_t}{S_t} \approx t_{n-1}$$

To test the second null hypothesis the approach is similar. The standard deviation is calculated as:

$$S = \sqrt{\frac{1}{N-1} \sum (CAR_i - CAAR)^2}$$

This yields the follow test statistic:

$$G_2 = \sqrt{N}\,\frac{CAAR}{S_t} \approx t_{n-1}$$

6.7 Possible Biases

Event studies are subject to a number of possible biases. The most relevant issues for this paper will be covered in the following paragraphs.

First of all, non-synchronous trading or non-trading, i.e. not enough actively traded securities can bias the results and create inaccurate results. The effect from these issues might cause biased moments of the security returns and affect their coefficient, means and variances etcetera. In general the overall effect from this issue will be minimal (Campbell et al. 2009). It is widely known that the CDS market is not as liquid as the equity market for example. I have tried to eliminate these issues by only using actively traded CDS contracts.

Secondly, the statistical assumptions used in event-studies are based upon the fact that returns are multivariate normal and independently and identically distributed. Departures from this assumption can lead to biases. The normality assumption is important for finite sample results. However, adjustments for these issues are not generally needed since the test statistics automatically converge to their asymptotic distribution rather quickly (Campbell et al. 2009).

7. Data

-- This section presents the data used for the analysis and the selection criteria applied when deciding upon which banks to be included in the sample –

7.1 Selection criteria

The banks included in this study have been selected from the following requirements:

- The first criteria state that only stress-tested banks understandably will be included in the sample.

- The second criteria state that the sampled banks are required to have actively traded credit default swaps between 11 March 2010 and 22 July 2011, i.e. from the start of the estimation window until the last day of the last event-window. The maturity of the credit default swaps in this study is 5-year due to superior liquidity as stated earlier. In addition, I have used swaps on subordinated debt with "Modified-Modified" (MM) restructuring since it was the most frequently used swaps in DataStream for European banks. This selection narrowed down my sample to 36 banks. This number could have been slightly higher if I would have access to CDS prices from Markit, who recently ended their cooperation with DataStream.

- Since the study on CDS price reactions was the main purpose with this thesis, the selection criteria for the banks included in the equity sample takes its start from the prior sample. I.e. only banks with both actively traded credit default swaps and stocks between 11 March 2010 and 22 July 2011 will be included in this sample. This resulted in 31 banks. The rationale for only including banks that have liquid securities in both markets is that I subsequently want to pursue an accurate comparison.

See the appendix for a complete list of all banks included in my sample.

7.2 Portfolio Separation

Since I also intend to study whether the effect was different for large versus small financial institutions, the final sample is divided into two groups. Sorted by market capitalization, the "large" financials institutions group comprises banks in the 50th to 100th percentile from my sample whilst the "small" group comprises banks in the first to the 50th percentile. The outcome of this separation is presented in the appendix.

7.3 Market proxy

As a proxy for the CDS market return I use the iTraxx CDS index. This index tracks the 125 most liquid CDS contracts in Europe and should be a good substitution for the CDS market. As a proxy for the equity market return I use the STOXX Europe 600 which is composed by small, mid and large capitalisation companies in 18 countries across the European region. This index should also be a good proxy for the equity market.

All data were obtained through DataStream.

8. Empirical results

-- This section presents the results from my analysis for both the CDS and the equity market. It also presents the results from the large versus small bank comparison.

Table 1 – 2 displays the average abnormal returns (AAR), the cumulative average abnormal return (CAAR) and their assigned t-statistics (G1, G2) for the stress tested banks. Day 0 is the event day, -1 is the day before the event day and +1 is the day subsequent to the event day.

** = Significant at the 1 percent level
* = Significant at the 5 percent level

Table 1. Abnormal equity returns for the three events-studies of the stress tested banks

Equity results – Stress tested banks

Day	Methodology		Clarification		Result	
	AAR	G1	AAR	G1	AAR	G1
-1	-0,00451	-4,6**	0,004575	2,73*	0,00057	0,27
0	0,001312	1,5	-0,00046	0,64	-0,002799	-2,84**
1	-0,003989	-5**	0,001421	1,17	-0,0003592	-1,74
	CAAR	G2	CAAR	G2	CAAR	G2
	-0,007187	**-5,6**	0,005537	**2,41***	-0,0006021	**-2,04**

Table 2. Abnormal CDS returns for the three event-studies of the stress tested banks

CDS results - Stress tested banks

Day	Methodology		Clarification		Result	
	AAR	G1	AAR	G1	AAR	G1
-1	-0,008832	-3,9**	-0,009662	-2,26*	-0,007224	-1,69
0	-0,006756	-2	-0,007093	-2,41*	0,029839	4,97**
1	-0,039349	-10,5**	-0,013799	-9**	0,01064	4,55**
	CAAR	G2	CAAR	G2	CAAR	G2
	-0,054938	**-10,1**	-0,03055	**-6,5**	0,041679	**4,82**

Table 3 –6 displays the results from the large banks and the non-large banks for the respective market.

Table 3. Abnormal equity returns for the three event-studies of the large bank group

Large banks - Equity Results

Day	Methodology AAR	G1	Clarification AAR	G1	Result AAR	G1
-1	-0,003705	-2.14**	0,004202	3,9**	0,001498	0,86
0	0,001333	1,34	-0,001727	-1,78	-0,002948	-2,66
1	-0,003344	-3,02**	0,003327	-3**	-0,002903	-1,13
	CAAR	G2	CAAR	G2	CAAR	G2
	-0,005716	**-3,04****	0,009256	**6,9***	-0,004352	**-1,2**

Table 4. Abnormal equity returns for the three event-studies of the small bank group

Small banks - Equity Results

Day	Methodology AAR	G1	Clarification AAR	G1	Result AAR	G1
-1	-0,005625	-6,54**	0,005091	1,34	-0,001192	0,86
0	0,001282	0,8	-0,003486	-2,19*	-0,002948	-0,18
1	-0,004881	-3,02**	-0,001218	-0,53	-0,004547	-0,2188
	CAAR	G2	CAAR	G2	CAAR	G2
	-0,009225	**-6,23****	-0,000387	**0,08**	-0,008331	**-1,65**

Table 5. Abnormal CDS returns for the three event studies of the large bank group

Large banks - CDS Results

Day	Methodology AAR	G1	Clarification AAR	G1	Result AAR	G1
-1	-0,00532	-1,89	0,002242	0,54	-0,016478	-3,2*
0	-0,007489	-2,25*	-0,008285	-1,66	0,03503	3,47**
1	-0,043521	-8,64**	-0,01453	-7,7**	0,018474	3,27**
	CAAR	G2	CAAR	G2	CAAR	G2
	-0,056331	**-10,18****	0,020573	**-4,85****	0,037026	**3,48****

Table 6. Abnormal CDS returns for the three event-studies of the small bank group

Small banks - CDS Results

Day	Methodology		Clarification		Result	
	AAR	G1	AAR	G1	AAR	G1
-1	-0,012345	-3,65**	-0,021567	-3,37**	0,002031	0,32
0	-0,006023	-1,02	-0,005901	-1,79	0,024649	3,77**
1	-0,035177	-6,38**	-0,013069	-5,35**	0,019653	3,09**
	CAAR	G2	CAAR	G2	CAAR	G2
	-0,053544	**-5,67****	-0,040537	**-5,18****	0,04633	**3,35***

9. Discussion and analysis

-- This section includes an interpretation and a discussion of the empirical findings. Each sub-event and the small versus large banks comparison will be given its own headline and analysis --

Methodology event

The empirical results from the methodology event, i.e. when the method of the stress test was published, suggests that this this event was informative to the markets. The equity market performed significantly negative over the three-day event period with significant negative movements both the day prior to the event-day and the day after the event-day. CDS spreads tightened significantly over the same time frame and the negative movements can be tracked down to the same days. These findings are significant at the 1% level.

This is actually a quite surprising conclusion since the equity market and the CDS market in theory are supposed to have a negative relationship. The empirical evidence from the methodology event contradicts this theory.

Before analyzing this peculiar situation, I will outline the key-differences between credit default swaps and stocks. A credit default swap is what a layman would call a pure play on the company's credit risk (Lehman Brothers, 2004). If credit risk decreases we would expect to see tightening CDS spreads and vice versa if credit risk increases.
On the other hand, the stockholder's intention is to maximize the return on his investment. So if expected return on the investment increases, the stock price would rise and vice versa if expected return declines.

The findings from the methodology event thus indicate that credit risk decreased whilst the expected return on equity decreased. My theory to this peculiar finding is that the actual announcement of the stress test methodology was anticipated by the market as a mitigating factor for credit risk leading to declining CDS prices. Since the methodology announcement made clear that focus will be on the new tighter Core Tier 1 Capital Ratio this implicates that banks, in order not to fail the stress test, need more bank capital relative to RWA-assets than earlier which will be a negative factor for banks' bottom line profitability and hence return to shareholders.

The results from the equity market reaction are in line with Cardinali and Nordmark's (2011) findings.

Clarification event

The empirical results from the clarification event, i.e. when EBA announced the core capital ratio requirement and the sample of banks to be included in the stress test, suggests that this event was to some extent informative to the markets. The equity market performed significant positive over the event-window, however only the day prior to the event-day displayed significant movements. These findings are significant at the 5%-level, however the CAAR is very close to be insignificant which makes the result somewhat unreliable. The CDS market performed significantly negative at the 1%-level, i.e. spreads tightened. Especially the day subsequent to the event-day showed a negative reaction.

My hypothesis for this reaction is that the revelation of banks included helped mitigate uncertainty, especially in the CDS market.

The results from the equity market reaction are roughly in line with Cardinali and Nordmark's (2011) findings.

Result event
The empirical evidence from the result event, i.e. when the results from the stress test were published, shows mixed outcomes. The equity market showed negative abnormal returns for the whole event however this was not significant on the 5%-level. CDS spread reactions were significantly positive at the 1%-level during this event. Both the event-day and the subsequent day showed widening spreads.

This CDS reaction could be a result of the fact that the capital shortfall were higher than the market had expected and hence the overall credit risk increased.

The insignificant equity reaction can be tracked down to the fact that either i) the market had to some extent anticipated the amount of capital shortfall and that was not enough to drive future expected returns or/and ii) since the sovereign debt crisis was deteriorating rapidly at this time the reaction could be a response to the fact that the stress test did not take into account haircuts on sovereign debt.

Moody's (2011) presents their CDS market findings from the announcement of the stress test results and concludes that the event only had a little influence on CDS prices. However they practice a completely different technique and use a longer post event-window compared to this study. However, they conclude that CDS prices initially rose (in line with this study) before subsequently starting to fall. They also point out that one should be cautious in interpreting abnormal movements due to very turbulent markets and relatively low liquidity at the time.

To be able draw scientifically sound conclusions, the reactions should be studied over a longer period. Due to time constraints I have not been able to pursue this approach, however it is an adequate idea for future studies.

The reactions have been particularly strong in the CDS market overall, suggesting that when credit quality changes, the CDS market will react in a more powerful way than the equity market.

Small versus large banks
Recall from the paragraph on earlier studies in this field that Flannery et al. (2002) came to no distinct conclusion regarding the level of opacity for small versus large banks. One of their studies pointed towards a higher level of opacity for large banks whilst the other study indicated the opposite.

The analysis in this study will be done by comparing small banks versus large banks in their respective market. If the results would differ for the respective group, this could indicate different levels of opacity.

Starting with the equity market, both large and small banks displayed significant negative returns during the methodology event. For the clarification event, the CAAR for large banks was significantly positive on the 5%-level whilst the CAAR for small banks showed insignificant movements. Both groups displayed insignificant negative CAARs during the result event.

Continuing with the CDS market, both groups performed significantly negative CAARs during the methodology event. Both groups did also display significant negative CAARs during the clarification event. In addition, both groups showed positive CAARs during the result event where the large banks group's CAAR was significant at the 1%-level and the small banks group's CAAR only significant at the 5%-level.

The conclusion from this comparison is that no distinct difference in terms of bank opacity can be drawn. Although the results from the clarification event in the equity market differ between the two groups this single deviation is solely no support for different opacity levels between large and small banks.

10. Concluding remarks

By conducting event study methodologies, this paper has studied the market reactions from the EU-wide 2011 bank stress test. The markets in focus have been the credit default swap market and the equity market. The following events have been examined: i) the announcement of the methodology for the stress test ii) the clarification on the methodology announcement iii) the publishing of the final results from the stress test. In addition to the general sample of stress tested banks the study has also examined reactions from large banks versus small banks.

The empirical results shows that the stress test produced new information, however the results were somewhat disparate for the two markets. All CAARs for each event were significant in the CDS study whilst only the methodology event CAAR and possibly the clarification event CAAR showed signs of significance in the equity market.

A general conclusion is therefore that the CDS market seems to be more sensitive to credit quality movements than the equity market. On the other hand, possible liquidity issues might make this conclusion somewhat unreliable

Are banks opaque?
Recall the earlier stated hypothesis that if all events were informative, banks should be considered opaque. On the other hand, if none of the events were informative, they should be considered transparent.

Given my findings in the previous paragraphs, I draw the conclusion that banks are opaque to at least an intermediate degree. This is based on the fact that most of the events showed significant abnormal returns which indicates that the events were informative. However the evidence is much stronger in the CDS market.

The comparison between small financial institutions and large financial institutions did not produce any new evidence concerning opacity levels. Thus, no distinction between large banks and small banks concerning bank opacity can be made.

10.1 Suggestions for future research

This paper has examined the 2011 EU-wide stress test from a CDS and equity market perspective. Since I was not able to acquire access to Markit's financial information systems, the sample of banks had to be reduced.

If access to Markit had been obtained, a number of new possible subjects could be explored. For example, how did banks that failed the stress test exercise perform compared to banks that passed? Did banks in different regions in the European Union react in the same way to the events?

Moreover, EBA recently announced the results and issued recommendations from its capital exercise. This event could be a possible event for future studies regarding bank opacity in Europe.

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12. Appendix

12.1 List of banks

Bank Name	Country Code	CDS Data Available	Equity Data Available	Large
Erste Bank Group (EBG)	AT	x	x	X
Raiffeisen Bank International (RBI)	AT	x	x	
DEXIA	BE	x	x	
KBC BANK	BE	x	x	
DEUTSCHE BANK AG	DE	x	x	X
COMMERZBANK AG	DE	x	x	
Bayerische Landesbank	DE	x		
WestLB AG, Düsseldorf	DE	x		
HSH Nordbank AG, Hamburg	DE	x		
DANSKE BANK	DK	x	x	X
BANCO SANTANDER S.A.	ES	x	x	X
BANCO POPULAR ESPAÑOL, S.A.	ES	x	x	
BANCO DE SABADELL, S.A.	ES	x	x	
BNP PARIBAS	FR	x	x	X
CREDIT AGRICOLE	FR	x	x	X
SOCIETE GENERALE	FR	x	x	x
ROYAL BANK OF SCOTLAND GROUP plc	GB	x	x	x
HSBC HOLDINGS plc	GB	x	x	x
BARCLAYS plc	GB	x	x	x
LLOYDS BANKING GROUP plc	GB	x	x	x
NATIONAL BANK OF GREECE	GR	x	x	
ALPHA BANK	GR	x	x	
INTESA SANPAOLO S.p.A	IT	x	x	x
BANCA MONTE DEI PASCHI DI SIENA	IT	x		
BANCO POPOLARE - S.C.	IT	x	x	
UNIONE DI BANCHE ITALIANE SCPA (UBI)	IT	x	x	
ING BANK NV	NL	x	x	x
SNS BANK NV	NL	x	x	
DnB NOR Bank ASA	NO	x	x	x
CAIXA GERAL DE DEPÓSITOS	PT	x		
BANCO COMERCIAL PORTUGUÊS (BCP)	PT	x	x	
ESPÍRITO SANTO FINANCIAL GROUP (ESFG)	PT	x	x	
Nordea Bank AB	SE	x	x	x
Skandinaviska Enskilda Banken AB (SEB)	SE	x	x	x
Svenska Handelsbanken AB	SE	x	x	x
Swedbank AB	SE	x	x	x

*Blue = Bank is close to fall below the threshold of 5% Core Tier 1 Capital according to the results from the

stress test. None of the banks that failed the stress test was included in this sample.