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Understanding Society

Corporate derivative use

The influence of hedging on different performance measures relative to the financial crisis

Master Thesis

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1 Introduction

Risk management is taking an increasingly important role in corporate financial management decisions. Especially in recent years fuelled by the financial crisis that started in August 2007[2] and which clearly exposed the magnitude and the vulnerability to various types of risks corporations are facing. Therefore, financial executives have become more concerned and are putting more focus on their risk management strategies. At the same time financial developments in this field, like the growing complexity and variety of derivative instruments, are indicated by some academics as one of the causes and contributor to the current crisis.

Derivatives generated significant publicity recent years through the dubious role some of the instruments played in the origin and further development of the financial crisis. In combination with the exponential growth of the market as shown in Appendix A, it reflects the actuality and relevance of derivatives. This paper focuses on a different role of derivatives related to the crisis, namely hedging risks and adding value to the company through corporate risk management. Although there is an increasing amount of empirical research about corporate derivative use, the evidence of the effects on the risk and value of the firm is still mixed. One of the interesting features of the financial crisis that started in 2007, is the rare severity of the credit crunch and liquidity crisis. Suddenly corporations faced a shortage of external financing due to financial institutions who lowered their capacity to lend or were not capable to. Together with their declined willingness to take on risk, the liquidity market quickly dried up and the required conditions to obtain a loan tightened. This can also be derived from the loan spreads shown in Appendix B, which clearly and sharply react at the beginning of the financial crisis in August 2007. To summarize, the capital markets stopped to function as they always did almost overnight and this led to a substantial reduction in lending activity. The uncertainty in the market causes the money market to dry up and finding funds, even for valuable projects, proved to be extremely difficult.

These characteristics are at the basis of the main hypothesis of this paper. Theoretically corporations should be able to create value through reducing the volatility of earnings and cash flows by hedging certain market risks with derivative contracts. One of the effects would be a lower probability of default, which entails that the firm could take into account lower distress costs and that in turn results in a higher firm value compared to not using derivatives. Furthermore, lower volatility of cash flows creates a more stable and constant internal capital market. This is valuable because the firm would be able to keep on investing in attractive business opportunities by using internal funds, even when they are facing adverse market conditions. Based on these theoretical effects the main

[2] This point in time is commonly indicated as a starting point of the active phase of the financial crisis, which subsequently resulted in economic turmoil and its effects are still noticeable today.

hypothesis of this research is that corporations that use derivatives to hedge certain market risks show better performance measures over both periods relative to the start of the financial crisis and that this differences increased as of 2008. To study this hypothesis the research is examining various measures, such as cash flow and stock return volatility, which are both expected to be lower in case a firm uses derivatives. Moreover, the capital expenditures in the sample period are studied, to show whether there is a link between derivative use and a higher level of investments. This could not only suggest an underinvestment problem for non-hedging firms, but it could also show whether the financial crisis magnified this problem. The final supporting measure relates to the market value of a firm and it is expected that derivative users have a higher firm value than non-derivative users. This difference is also expected to increase as of 2008, which would entail that hedging with derivatives generated value during the financial crisis.

The empirical results of this paper are obtained by studying data of 1,114 non-financial US firms who are constituents of the Wilshire 5000 index and are analysed over the sample period January 2004 till December 2012. Based on the initially performed univariate tests there appears to be significant differences between derivative users and non-users, which emphasized the importance of the multivariate analysis. Therefore, multiple OLS regressions are conducted with various control variables included, such that the effects are controlled for differences in firm characteristics and differences in exposures that firms have to the potentially hedged risk factors. This lowers the probability that spurious relationships are found when running the regressions. The subsequently performed hypothesis tests show that their results are partly in line with the expectations derived from the theory discussed in the literature review. This suggests that there are some significant differences found between the four tested derivative groups, called derivative users, non-users, new-users and changing users. However, the p-values of the following difference in differences hypothesis tests indicate that the hypothesized increases in differences as of 2008, can be mostly rejected or in a few cases there even seems to be a moderate significant opposite effect. The only differences that significantly increased after the start of the crisis are between changing users and the other three derivative groups.

The remainder of this paper is structured as follows. In Section 2 a review of the existing literature is presented, which is the theoretical framework for this research. In this part various papers are discussed and based on their main conclusions and views the hypotheses of this study are derived. The data collection and the methodology are described and motivated in Section 3. Based on the resulting uniquely obtained sample, the hypotheses stated in Section 2 are empirically tested by making use of multivariate and hypothesis testing and the results are shown in Section 4. This is followed by the conclusion in Section 5.

2 Literature review

In this section the existing literature related to corporate derivative use is reviewed. First, based on a few papers a brief overview is given of derivatives and their use related to the financial crisis. This is followed by an elaboration of the discussion whether corporate hedging is useful and valuable for a firm. The elaboration is based on the irrelevance theorem of Modigliani and Miller (1958) and thereafter is expanded by introducing different market imperfections, which attempt to justify corporate derivative use for hedging certain market risks. Then, specific literature with regard to the effect of hedging with derivatives on the market value of corporations and on firm risk is discussed. At last the hypotheses are presented, who are based on the reviewed literature.

2.1 The financial crisis and derivative use

Carmassi, Gros and Micossi (2009) indicate an important link between changing legislation and the growing complexity and variety of derivative instruments, which allegedly contributed to the collapse of the financial system. They mention the explosive growth of derivative contracts that originated at the end of the twentieth century and illustrate that some of the financial innovations in this field were introduced to amplify the increase in leverage by offloading risks of the balance sheet by using structured products. The resulting innovative instruments and the increasing interconnectivity of financing, hedging and investment operations between firms made it almost impossible to independently assess the attendant risks (Carmassi et al., 2009). Acharya, Philippon, Richardson and Roubini (2009) are pointing out the same phenomenon of exponential growth in the development of financial instruments. According to them the resulting effects on the market were the ever more complex derivative instruments, which some of them were so exotic and illiquid that it was difficult to value and price them. Besides that many of them were traded over-the-counter (OTC), thus directly between two parties, instead of on an exchange were there is supervision and the trading is visible and controllable. Little disclosure about the holding of these instruments further enlarged this lack of transparency and some innovations, such as for off-balance sheet financing, even enabled corporations to circumvent regulations.

The characteristics mentioned in the studies above contributed to severe effects on financial sectors and economies worldwide. Consumers in the United States who started to default on their subprime mortgages triggered a string of events which led to the beginning of the financial crisis in August 2007. The crisis revealed and emphasized huge underlying issues, which rearranged the financial landscape and the resulting effects still has an impact on the global economy today. In the beginning the impact in the US was marginal with several failures of regional banks and mortgage

lenders. One of the first notable events occurred in March 2008 when the global investment bank Bear Stearns threatened to collapse and was bought by JP Morgan through a fire sale. However, the peak of the crisis for the US financial institutions was in September and October 2008. Major companies such as Lehman Brothers, AIG, Washington Mutual, Citigroup, Merrill Lynch, Wachovia, Fannie Mae and Freddie Mac failed and went bankrupt, were supported or taking over by the government or were acquired under duress. Other key players in the financial sector did not get untouched and encountered major setbacks as well. One important reason for this consecutive failure can be related to the profound interconnectivity due to new increasingly complex derivative instruments, which led to a situation where at a certain point there was a general lack of understanding and insight who was bearing what risks.

As a result, the financial crisis instantly made clear the actuality and relevance of derivatives to the general public and it quickly got associated with negativity. Nevertheless, for corporations the crisis was an extra reason and motivation to increase the focus on their risk management strategy. Currently financial executives perceive risk management as one of their main objectives and derivative securities are an important tool to implement their strategies. These instruments used by corporations have a primary purpose to hedge certain market risks such that they are fully or partly protected against adverse market movements. Therefore, correctly implemented hedges will ensure the firms future cash flows and profitability for the hedged part of the risk, even when the underlying asset is showing successive adverse shocks. This does not entail that through risk management the ultimate goal of a firm should be to minimize volatility, but it is rather to maximize value from the volatility that is inherent to the business environment of the firm. Thus, partly hedging risky exposures can be optimal for a firm due to the conception that risk is the uncertainty of the future market conditions, which includes both the downward and the upward risk. Hedging can theoretically create value in multiple ways, as further elaborated in the following paragraphs. The most commonly used types of derivative contracts are forwards, futures, options and swaps. These instruments can be used to hedge market risks such as price risk, which includes exchange rate risk, interest rate risk and commodity price risk.

2.2 The value of corporate hedging

2.2.1 Irrelevance theorem

In a Modigliani and Miller (1958) world with perfect capital markets, there would be no need for corporations to engage in hedging or to use derivatives. Hedging would not have an effect on firm value, since perfect markets are characterised by the absence of market imperfections. Therefore,

individual shareholders are equally able to adjust their portfolios to obtain their individually desired risk exposure and accomplish the same effect as a firm who hedges certain market risks. This is called the irrelevance theorem of Modigliani and Miller (1958) and it states that whether to engage in corporate risk management is irrelevant for a firm. However, there are several hypotheses that are discussed in existing literature, which are suggesting that corporate hedging can be rational and value increasing when taking into account market frictions or agency problems. The main focus of these theories is that market imperfections can make volatility costly and therefore hedging justifiable for corporate risk management (Guay & Kothari, 2003).

In general, the imperfections are broadly categorized into financial distress costs, tax motivations, costs associated with managerial risk aversion and costly external financing. To find empirical evidence whether hedging with derivatives creates value for a firm, each study typically looks at different imperfections. Changes in regulation, with regard to derivative disclosure, initiated by the Financial Accounting Standards Board (FASB) contributed substantially to the amount and quality of derivative research. For example, the Statement of Financial Accounting Standards (SFAS) No. 105 requires firms to disclose information about the use of financial instruments with off-balance sheet risk of accounting loss, especially the notional principal amount of these instruments.[3] SFAS 105 became effective for the fiscal years that end after June 1990, which entails that as of that date a firm's position in derivative securities can be determined (Guay, 1999). Prior to that year the studies related to derivatives were mainly theoretical or they used surveys to support the theory with empirical evidence. However, surveys were relatively scarce and potentially caused severe data problems, such as an extensive data gathering process. A more fundamental problem of relying on surveys is the high probability of a sampling error, which implies that the sample is not representative and this undermines the results and credibility of the research. Relative to the topic of this paper, especially corporations are known of being not eager to voluntarily disclose private and potentially sensitive information. Therefore, one could argue that the results of these kind of studies are at least questionable or in some way biased.

SFAS No. 119, effective as of December 1994, is another statement that contributed to further important research to the effects of corporate derivative use. Besides information about notional values, this statement requires firms to disclose the direction and purpose of their derivative holdings, including a separation across different categories.[4] In essence, due to this legislation there came an insight in the use of different types of derivative contracts and it requires an explicit statement whether they speculate or use the derivatives for risk management purposes. Additional successive regulation,

[3] http://www.fasb.org/summary/stsum105.shtml
[4] http://www.fasb.org/summary/stsum119.shtml

such as SFAS 133[5], enhanced this insight and resulted in an increasingly better and more transparent view on corporate derivative use.

Although these legislations led to extensive new research and to a state in which the market imperfections are thoroughly studied, the empirical evidence of the effects of corporate derivative use is still mixed and inconclusive. The next paragraph continues by relaxing the assumptions that Modigliani and Miller (1958) needed to derive the propositions that led to their irrelevance theorem and therefore it is going to discuss various studies that address these simplifications.

2.2.2 Market imperfections

Smith and Stulz (1985) point out that financial distress costs are an example where hedging can increase the value of a firm. A levered company faces expected costs of financial distress, which can decrease the firm value. By hedging certain market risks with derivatives, the company can reduce the variability of their cash flows, hence the uncertainty of their profitability. Narrowing the distribution of performance outcomes results in a lower probability that the firm has to default on their liabilities, such as interest payments, wages or even principal payments. Therefore, due to risk management the expected costs of financial distress can be reduced, which has a positive effect on the value of the firm since these costs are reflected in the current market value. Another study that discuss the same effect of hedging on financial distress costs is Stulz (1996) and also Shapiro and Titman (1986) underline this line of argument.

Furthermore, financial distress can cause agency problems with regard to accepting positive net present value (NPV) opportunities. Myers (1977) shows that financial distress can create incentives to equity holders to reject positive NPV projects if primarily fixed claimholders benefit from the gains. This implies that financial distress can result in forgoing valuable projects as a manager, because that is in the best interest of your shareholders. For this reason, hedging can increase firm value by reducing the probability of distress, which makes it less likely that valuable projects are rejected.

Tax motivations is another market imperfection and it is somewhat related to financial distress costs. Leland (1998) demonstrates that hedging can increase firm value because of the principal that less volatility generally allows the firm to be more leveraged. This potentially results in lower expected distress costs, due to partly leaving the increased debt capacity unused. However, Leland argues that the main gain comes from the higher tax benefits, because the increased leverage allows the firm to make more use of the tax deductions or tax shield. Another tax motivation that attempt to

[5] http://www.fasb.org/summary/stsum133.shtml

justify corporate hedging with derivatives is discussed by Smith and Stulz (1985). They show that hedging can lower expected taxes if a company reduces the volatility of their taxable income and at the same time faces a convex effective tax function. Therefore, a more stable taxable income results in lower expected taxes and an increase in firm value.

Graham and Rogers (2002) are mentioning the same tax incentives to hedge and attempt to support these theories with empirical evidence. Using a sample of 442 non-financial US corporations, they find no significant evidence that tax convexity is an important factor for firms regarding the decision to use derivatives. Nevertheless, the study does indicate that an increased debt capacity is an important determinant, which according to Graham and Rogers leads to an increased tax benefit of on average 1.1% of firm value.

The third market imperfection relates to the compensation packages of managers and their affiliated managerial behaviour, which can be approached by two different aspects. Managerial risk aversion is the first one, and its associated costs are discussed by reviewing Stulz (1984) and Smith and Stulz (1985). Their theories are based on the fact that managers determine the firms' hedging policy and that shareholders can influence the compensation contracts of those managers. Because managers are typically risk averse and their compensation and financial position strongly related to the firm, hence rather undiversified, they likely want to be compensated to bear this risk. At the same time, these characteristics are an incentive for managers to reduce the risk of the firm by using derivatives to hedge. This can in turn lead to a lower required risk premium and therefore Stulz and Smith and Stulz argue that hedging increases firm value.

The second aspect that is affiliated with issues regarding the third market imperfection are agency problems, which can also affect the decision to hedge and therefore the theoretically related value of a firm. Derivatives are not solely used by corporations as a hedging mechanism, but can also be implemented for speculation reasons. Speculating on the value of the underlying assets offers the managers a tempting opportunity to generate additional profits next to their core business. However, it generally entails increasing the risk the company is exposed to and it can create ambiguity about the fundamental results of the firm. Hentschel and Kothari (2001) are pointing out that there are theories that suggest that firms might use derivatives to increase their volatility, which would be beneficial for the equity holders of the company at the expense of the debt holders (Black & Scholes, 1973). This is in line with Jensen and Meckling (1976) who demonstrate that equity holders of a levered firm have incentives to increase the risk of the firm to initiate a wealth transfer from bond to stock holders. Based on this theory, managers with substantial out-of-the-money stock option compensation may have incentives to take on more firm risk through derivative speculation (Bartram, Brown, & Conrad, 2011). The increasing volatility creates a higher probability that their options end up in-the-money and

therefore adding risk to the firm may be lucrative for these managers. This can result in managers who are reluctant to use derivatives to hedge firm risk or they use them for speculative purposes, which both have a negative impact on firm value according to the already discussed literature.

The final market imperfection that is discussed here is costly external financing and the somewhat related underinvestment problem. Froot, Scharfstein and Stein (1993) suggest that hedging can increase the value of a firm by lowering the volatility of earnings and thereby of cash flows. As a result, the firm is able to match their inflows and outflows of funds more closely and therefore it lowers the probability to have to access the capital markets. Besides the increased independence of the capital market, it is perceived that internal financing is less costly than external financing, which makes the better matching value increasing and it potentially increase the number of projects that are valuable to invest in. Moreover, Froot et al. (1993) argue that smoothing the cash flow volatility can increase the probability that the firm can keep on financing valuable projects, despite of the state of the capital markets. It would be able to lower the probability to have to forgo these value increasing projects due to a lack of funding, which is called the underinvestment problem. Geczy, Minton and Schrand (1997) show that this problem is perceived to be more severe for firms that face a combination of high growth opportunities and a low availability of internal and a low accessibility of external funds. Bessembinder (1991) and the already discussed study of Myers (1977) are also indicating that reducing firm risk through the use of derivatives has the effect of increasing firm value, due to a lower incentive to underinvest.

In conclusion, the theories in this paragraph give compelling theoretical arguments that suggest that hedging market risks can lead to an increase in firm value.

2.3 Firm risk and firm value

2.3.1 Empirical evidence

Although numerous studies are theoretically rationalising that hedging with derivatives does have an effect on firm risk and firm value, the empirical evidence is still inconclusive and mixed. For instance, Hentschel and Kothari (2001) investigate whether corporate derivative use results in a systematic reduction or increase in their riskiness. Based on data of 425 large US firms over the period 1991 to 1993, they find no statistically significant difference in the risk characteristics between firms that have and do not have a derivative position. Moreover, they find no significant association between derivative use and the stock price volatility of the firm. Another study that does not find an effect of

derivative use on systematic risk is Guay (1999). However, his results does show a risk reduction related to a reduced stock-return volatility, exchange rate and interest rate exposure of new derivative users, which is statistically and economically significant. Allayannis and Ofek (2001) examine a sample of 378 nonfinancial US firms and find also a significant reduction of the exposure to exchange rate risk, because of the use of derivatives. In addition, the results of Bartram et al. (2011) show that using derivatives can lead to lower cash flow and idiosyncratic volatility and it can reduce systematic risk.

Furthermore, related to firm value Bartram et al. (2011) find a positive effect of derivative use, but the evidence is weak and the tested differences not always statistically significant. A more significant result is shown by Allayannis and Weston (2001) who investigate a sample of 720 large nonfinancial US firms for the use of foreign currency derivatives. Between the years 1990 and 1995 they find a hedging premium of on average 4.87% of firm value. On the contrary, Guay and Kothari (2003) argue that the potential benefit and impact on firm value is relatively small and economically not significant compared to benchmarks such as the size of the firm or the operating cash flows. This is also the result of Jin and Jorion (2006) who indicate that hedging has not a statistically significant effect on firm value, based on their study of 119 US producers of oil and gas. Nevertheless, the already discussed study of Graham and Rogers (2002) does find empirical evidence that hedging increases the value of a firm by on average 1.1% due to increased tax benefits and also the study of Carter, Rogers and Simkins (2006) document a substantial increase of firm value. Their empirical tests, related to fuel hedging of the US airline industry, are showing statistically and economically significant hedging premiums, which they argue are mainly due to the reduction of the underinvestment problem.

2.3.2 Hypotheses

Besides the actuality and relevance of derivatives, the main reason why it is interesting to study the effect of corporate derivative use with respect to the financial crisis that started in August 2007, is the combination between the increased probability of default and the rare severity of the credit crunch. Therefore, together with the discussed theory, the main hypothesis of this paper is:

Main hypothesis: *Corporations that use derivatives to hedge certain market risks show better performance measures, as indicated by the supporting hypotheses, over both periods relative to the start of the financial crisis and these differences increased as of 2008.*

To find empirical evidence for this hypothesis, this paper is studying three supporting hypotheses which are based on four different groups of firms. These groups are distinguished by their derivative use relative to the beginning of the financial crisis and are explained in more detail in section 3. For now the groups are indicated by derivative users, non-derivative users, new derivative users and a residual group called changing derivative users.

Hypothesis 1: *Firms belonging to a group that use derivatives have lower cash flow and stock return volatility than firms belonging to a group that do not use derivatives and these differences increased as of 2008.*

Hypothesis 2: *Firms belonging to a group that use derivatives show higher capital expenditures than firms that do not use derivatives and the crisis amplified these differences.*

Hypothesis 3: *Firms belonging to a group that use derivatives have a higher market value than firms that do not use derivatives and these differences increased as of 2008, suggesting that there is value in hedging with derivatives.*

The following sections further elaborate on how these hypotheses are tested.

3 Data and methodology

This section provides information about the data collection, the characteristics of the obtained data and about the methodology that is used to conduct the research.

3.1 Data

3.1.1 Derivatives

The core or fundamental data of this research are the variables that determine to which group each firm belongs. This data is obtained from the annual fundamentals of the North America Compustat database. The two interesting variables for this study are called AOCIDERGL and CIDERGL by Compustat and they are both reported as a comprehensive income. Respectively they represent the unrealized derivative gain or loss and the derivative gains or losses. The data availability of these items is an important aspect in determining the sample period; January 2004 till December 2012. The first variable is annually available from 2001 onwards, but the second variable appeared to be annually available only from around 2004. When constructing the variable 'Derivgroup', that indicates to which of the four groups a firm belongs, both of the discussed variables are taking into account as of 2004. A deviation from zero, of both or one of them, results in a note that the company used derivatives in that particular year. After determining for each firm year in the sample whether the company used derivatives, the groups can be constructed.

The original amount of 4,111 constituents on the Wilshire 5000 is dropped to the final studied 1,114 firms due to three requirements. First missing observations of all variables discussed in Table 1 are deleted. Secondly, firms belonging to the financial sector (SIC codes 6000-6999) are excluded. At last, the final sample size is determined by requiring that only firms with data available over the entire nine years of the sample period are included. From these 1,114 firms, 402 (36%) are classified as derivative users, who essentially used derivatives throughout the whole sample period and therefore did not change their policy of derivative use in this period wherein the crisis initiated. The second group contains 407 (37%) firms and is characterized by not using derivatives over all the years in the sample period; hence non-derivative users. Within the third group there are companies that did not use derivatives prior to the crisis, but initiated the use as of 2008 after the financial crisis began. This group of firms is called new derivative users and turns out to contain 126 (11%) companies. As a result of the definition of each of the prior groups, there is a remaining group of firms. These last 179 (16%) companies form their own group and are characterized by their alternating use of derivatives over the studied period; hence they are called changing derivative users.

Based on the extensive explanation of the two key variables above in the data guide of Compustat, these variables should be able to properly indicate whether a company used derivatives in a particular year. Although this method appears not to be flawless, it is believed to be the most suitable method for a study of this size and objective. Moreover, even the traditional alternative of a time consuming analysis of each annual report does not lead to a 100% reliability of correctly categorize each firm, even when performing a well thought out automated keyword search (Bartram et al., 2011). To test the reliability of the method used by this research, a sample of 100 ($\pm$ 1%) randomly selected firm years of different companies are thoroughly studied. This is achieved by conducting a keyword search on the retrieved annual reports or 10-K filings from the SEC's EDGAR database. The outcome is that in 91% of the cases a firm is correctly indicated as derivative user or non-user for that year. This appears to be a slightly lower reliability percentage compared to some other studies who performed solely a keyword search on all the annual reports of their studied companies. Due to a systematic approach in categorizing each firm, potential misclassifications are probably random and in combination with the relatively large sample size, the effect on the end results should be marginal. Therefore, together with the advantage of a less time consuming method and the ability for this research to study a larger sample, it is decided to use the discussed method to categorize the companies.

3.1.2 General characteristics

To study the hypotheses, data is obtained from various databases, which leads to a unique sample. The general characteristics of the companies that are included in this research are non-financial US firms, who are a component of the Wilshire 5000 index in June 2013. Firms belonging to the financial sector (SIC codes 6000-6999) are excluded for two main reasons, because of their dual role in the derivatives market and their partly speculative reasons to trade in derivatives. Having a dual role refers to the situation that financial institutions are often both traders in derivatives and acting as intermediaries in the derivative market. Furthermore, the motivations for financial corporations to engage in derivative trading are perceived to be not only for hedging market risks, but also for speculative reasons which increases the risk rather than reducing it. Together these characteristics cause financial companies to significantly differ compared to other companies, especially related to the main interest of this paper; the potential effects of derivative use.

The reason this research focuses on US firms is mainly because of the combination of data availability and the clear and leading disclosure regulation regarding derivative use. The regularly updated and improved SFAS legislation, initiated by the FASB, has contributed a lot to the enhanced

insight and transparency of corporate derivative use. These disclosure requirements for all publicly traded corporations has led to extensive and leading US databases. In addition, the main interest of this research is in several performance measures relative to the beginning of the financial crisis in August 2007. This crisis originated in the US and had a severe effect on their economy. Therefore, together with the already mentioned reasons, it is interesting to study US firms.

The Wilshire 5000 is also referred to as the Wilshire 5000 Total Market Index and it includes almost all publicly traded firms, with exceptions as penny stocks or extremely small companies[6]. For this reason, it is perceived as one of the best measure of the entire US stock market. At the time the index was created it contained nearly 5,000 stocks, hence the Wilshire 5000, but the number of stocks included fluctuates accordingly to the economic conditions. Based on the complete list of all Wilshire 5000 companies in June 2013, the index contains 4,111 firms. This research aims to perform a broad market study and therefore the Wilshire 5000 is a suitable starting point, because it includes large market capitalization (large-cap), mid-cap and small-cap companies. Consequently, this entails that there has to be a sufficient amount of control variables, because the characteristics of the included companies will be substantially diversified as further explained in the paragraph methodology. The relative large amount of studied companies allows the implementation of an adequate number of control variables, when also taking into account the degrees of freedom. Moreover, the broad approach with the Wilshire 5000 is convenient for the further requirements of the data. For example, the combination of using a substantial amount of variables and the requirement of no missing data points for all those variables within the sample period, results in excluding a fairly amount of companies. The last consideration for using the Wilshire 5000 as basis, is the need for a sufficient spread of the firms between the four different groups, especially between derivative users and non-users.

June 2013 as point in time to retrieve the constituents of the Wilshire 5000 is chosen partly arbitrarily. The requirement of no missing data points within the sample period, January 2004 till December 2012, entails that firms who were added to the index within this period, will be excluded from the research. Companies who dropped from the index before June 2013 only have a small probability to meet the mentioned requirement, which partially justifies June 2013 as retrieval point. There are a few reasons that determined the indicated sample period. For instance, January 2004 is chosen because this study does not want to include the biggest impact of the aftermath of the burst of the dot-com bubble; mainly from 2000 to 2002. As mentioned before, data availability is another important reason to have January 2004 as starting point. The variables this research use to determine whether a company uses derivatives in a certain year are annually broadly available in the Compustat database of Wharton Research Data Services (WRDS) from 2004 onwards. Furthermore, December

[6] http://web.wilshire.com/Indexes/Broad/

2012 is chosen to ensure that there are a sufficient amount of years to perform the research, both for the entire sample period and prior and after the beginning of the financial crisis. Another reason for performing the research till December 2012 is the attempt to capture a possible value increasing effect on the longer term from the hypothetical ability of derivative users to engage in more profitable and optimal investment strategies after the start of the crisis. Compared to the existing literature it seems to be a relatively longer sample period, which is exactly the aim of this research and one of the reasons that it can contribute to this existing literature.

3.1.3 Risk measures and control variables

In order to answer the research questions, the data will be obtained from various databases of WRDS and particularly from various components of the Compustat database. The majority of the variables are retrieved from the annual fundamentals of North America within Compustat. A few exceptions are variables that were needed for determining whether a firm had foreign sales during a year, whether the executives of the firm owned shares or where compensated with stock options or were needed for calculating the standard deviation (SD) of the stock return (Table 1). For these variables other databases were used, respectively the North America Segments database, the Compustat Execucomp database and the North America Security Daily database. Besides using other databases, some variables are obtained from the same main database, but due to individual deviations they are first retrieved separately and after adjustments merged with the final data file. These variables are related to the calculation of the SD of the operating cash flow and to calculate the change in leverage (Table 1). After adjusting and preparing the other exceptions they are also merged to come to the complete dataset from where further research and calculations will be done. The statistical software package that is used to process and analyse the data is Stata, which is used by many businesses and academics around the world and is fitted and capable to work with large datasets.

Before generating the variables that will be used in the regressions, all observations of non-dummy variables are winsorized to eliminate outliers. Although winsorizing is not a perfect solution for every situation to deal with outliers in the data, it has also characteristics that determined the choice for this approach. Winsorizing the data entails that extreme values are replaced by the value of a pre-specified percentile, which results in putting more weight on the edges of the distribution relative to trimming the data. This alternative to trim the data implies simply to discard the extreme values and in case of this research it can result in dropping a company as a whole due to missing one year out of the required nine years of data points in the sample period. Therefore is chosen for winsorization to prevent loosing valuable data. Based on detailed summary statistics the observations are winsorized in the bottom and top 0.1 percentile, with two exceptions due to individual extreme distributions. These

variables are winsorized at 1 percentile, which notably improved their characteristics. Together this mitigates the problem of data errors due to for example reporting a variable in a different magnitude. An overview of all the generated and related retrieved variables, which are at the basis of the remaining study, can be found in Table 1 below.

Table 1: Variable definitions

Contains and explains the variables which are used in the regression models. The first time a retrieved item is mentioned in this table, its annual Compustat data item number is in parentheses.

Variable	Definition
Altman Z-score	1.2 * (working capital (4-5) / total assets (6)) + 1.4 * (retained earnings (36) / total assets) + 3.3 * (EBIT (117-131-132-133) / total assets) + 0.6 * (market value of equity (25*199) / total liabilities (181)) + 0.999 * (sales (12) / total assets).
Size (log)	Natural logarithm of the total of the market value of equity plus total debt (142+34) plus preferred stock (130).
Leverage	Total debt / size.
Change in leverage	The change in leverage from year *t – 1* to year *t*.
Tangible assets	Tangible common equity (11) / total assets.
Sales (log)	Natural logarithm of net sales (12).
ROA	Return on assets (18 / 6).
Quick ratio	Cash and short-term investments (1) / total current liabilities (5).
Interest coverage	Earnings before interest and taxes (EBIT) / interest expense (15).
SG&A	Selling, general and administrative expense (132) / size.
Operating cash flow	Operating income before depreciation (13) / sales.
Capex / size	Capital expenditures (128) / size.
R&D / size	Research and development expense (46) / size (missing set to 0).
Dividend	Dummy variable with value 1 if the firm engaged in dividends, and 0 otherwise (Based on items DVT and 201).
Stock ownership	Dummy variable with value 1 if the executives of the firm own shares of the firm, and 0 otherwise (Based on item SHROWN_EXCL_OPTS in the ExecuComp database).
Stock options	Dummy variable with value 1 if the executives are compensated with stock options, and 0 otherwise (Based on item OPTION_AWARDS_NUM in the ExecuComp database).
Foreign sales	Dummy variable with value 1 if the firm reported non-domestic sales in the Compustat geographic segment file, and 0 otherwise.
Foreign income	Dummy variable with value 1 if the firm had foreign income, and 0 otherwise (Based on 273 and 64).
Cash flow volatility	The standard deviation of the above mentioned ‘Operating cash flow’, over the last 8 quarterly data points.
Stock return volatility	The standard deviation of the daily stock returns (annualized).
Expend	Capital expenditures / sales.
Tobin’s Q	Size / (book value of equity plus total debt plus preferred stock).

By looking at other papers, such as Bartram et al. (2011), and by analysing the summary statistics of some of the generated variables, the distribution of Size and Sales appeared to be very positively skewed. As can be seen in Table 1 this resulted in transforming those variables into their natural logarithm, which is a commonly used approach. Taking a natural logarithm affects the distribution of the variable, turning a positively skewed variable into a more normal distribution and it can create a better fit of the variable into the model. In this case the skewness drops to respectively 0.06 and 0.08, which is far less than that of their original variables, respectively 14.14 and 15.17. In addition, besides the improved distribution only the interpretation of their coefficients related to the dependent variable changes.

Furthermore, after analysing the detailed distribution of the generated dependent variables[7], there were still a few extreme values that did not make sense. Therefore, winsorizing is used again to deal with the spurious outliers of these variables. This time the observations are winsorized only in the top 0.5 percentile, which after looking at the detailed summary statistics, notably improved the characteristics of the dependent variables.

Since the paragraph methodology will elaborate on the choice of control variables for each individual OLS regression, here only the dependent variables are going to be discussed. The first measure is the risk measure operating cash flow volatility. As described in Table 1 this variable is defined as the SD of the operating margin and is calculated following a similar approach as Bartram et al. (2011). The expectation is that derivative users will have a smaller impact on this dependent variable than non-derivative users. Although cash flow volatility is an appropriate measure that can and is expected to differ between the four groups, there are some reasons to believe that the second risk measure captures different, more complete and accurate information. Stock prices should be an aggregate indication of asset and liability risk and should further include the effects that come from financial risk management (Bartram et al., 2011). Therefore, studying the SD of the stock returns, as shown in Table 1, is thought to be an informative and relevant risk measure. Consistent with the first risk measure, the effect of derivative users on this dependent variable is also expected to be smaller than that of non-users.

The third dependent variable that is studied is Expend and is included to find empirical evidence whether the severe credit crunch affected the capital expenditures of firms. The hypothesis implies that firms that use derivatives to hedge certain market risks show more resilient investment levels relative to non-users. Consequently, it is expected that especially after the beginning of the crisis derivative users have a larger impact on this dependent variable than non-derivative users. The last dependent

[7] The variables explained below the double line in Table 1.

variable is a proxy of the Tobin's Q, which is a widely used measure to study the effect of derivative use on firm value. However, there is some variation in the way the Tobin's Q is calculated and this can substantially impact the results. The common definition is the ratio of the market value of a company divided by the replacement value of the same assets. This study follows Bartram et al. (2011) who define the Tobin's Q as the size of the firm divided by the book value of equity, total debt and preferred stock. Here the size is calculated as the market capitalization of equity plus the book value of total debt and preferred stock. This simple method is an advantage compared to other ways of calculating the Tobin's Q, because it results in the possibility to generate a value for almost all companies which is beneficial when the aim is to study a broad sample. Similar to the third dependent variable, the effect of derivative users on the Tobin's Q is also expected to be larger than that of non-users.

3.2 Methodology

The methodology that is used is a combination of OLS regressions and hypotheses testing. Prior to running the regressions, an univariate analysis is performed for each individual variable. Therefore, this study will show the results of two different tests between derivative users and non-users, where the characteristics of each variable are divided into a period before 2008 and 2008 onwards. The first test is a common t-test to find out whether there is a significant difference between the means of each group in the sample period. Although testing the mean can entail some disadvantages, like robustness in case of skewed distributions, it does take all observations into the calculation and gives a first indication whether there is a possible difference between those two groups. To further study the distributions, a Wilcoxon rank sum test is performed, which tests the hypothesis whether the two samples are from populations that have the same distribution.

3.2.1 Multivariate analysis

For the multivariate analysis multiple OLS regressions are performed, but the main structure of each regression is the same to all. When studying the effect of corporate derivative use, ideally one would prefer to observe the same company, under similar economic conditions and one time with derivatives in place and the other time without (Bartram et al., 2011). However, in practice this is impossible and therefore studies attempt to include suitable control variables into their regressions, which supposed to partly explain variations in the dependent variable. By adding other variables, the resulting hypothesized effect of the main interesting variable on the dependent variable becomes more accurate and informative. On the contrary, there is a limit on adding more and more control variables,

because it can raise issues on its own, such as appropriate degrees of freedom. The decision to add a control variable is mainly guided and influenced by the theoretical foundation whether it could explain variations in the dependent variable.

A general control used for all the regressions is based on a potential industry effect, which is often controlled for by other studies and moreover is thoroughly examined by Nain (2004). Differences across industries are controlled for with the Compustat variable SPCSECCD. This variable is the S&P economic sector code and identifies each company within one of the eleven defined broad economic industry groups. Furthermore, the main arguments for including control variables are based on the market imperfections described in the literature review section and on existing theory. To give more insight in these decisions, some control variables will be discussed. For instance, Purnanandam (2008) discussed that holding more liquid assets can reduce the underinvestment problem and that is one reason for this study to include the quick ratio as this variable probably affect the dependent variables. Another example is using stock option compensation as a control variable. As discussed in Section 2 this can affect the perceived managerial risk aversion and in turn can influence the hedging decision or the risk and value of the firm. Size is another commonly used control variable for which the dependent variables are expected to directly differ or indirectly through the effect on the hedging decision. For example, Allayannis and Weston (2001) among many others are pointing out that small firms are less likely to use derivatives than large firms. Combined with the already discussed literature, this potentially affects the dependent variables. The arguments for the remaining control variables used for this research are already implied by the literature review or have the same line of reasoning as the ones discussed above. An example of a performed regression is:

$$\begin{aligned} SDOCF_{i,t} = {} & \alpha + \beta_1 AltZscore_{i,t} + \beta_2 LogSize_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROA_{i,t} + \beta_5 Quickratio_{i,t} \\ & + \beta_6 Intcov_{i,t} + \beta_7 ExeStockown_{i,t} + \beta_8 StockOptionComp_{i,t} + \beta_9 Forsales_{i,t} \\ & + \beta_{10} Forinc_{i,t} + \beta_{11} Users_i + \beta_{12} NewUsers_i + \beta_{13} ChangingUsers_i \\ & + \sum IndSec^{8} + \varepsilon_{i,t} \qquad (if\ fyear < 2008)^{9} \end{aligned}$$

An overview of the abbreviations of all the variables discussed in Table 1, can be found in Appendix C. As can be noticed the same regression is performed twice, because both periods relative to the beginning of the crisis are tested separately. Due to the fact that these regressions are performed

[8] This represents the summation of the included industry sector dummies which control for potential industry effects.
[9] Due to collinearity the group of non-derivative users is omitted for the initial regressions and it therefore act as a base level and is the benchmark for the interpretation of the coefficients of the remaining derivative groups.

over panel data, the cluster option in Stata is used to indicate that many individual firms are studied. The risk measure SDStockreturn is tested with exactly the same control variables. In case of the dependent variable Expend some control variables are added to the displayed items above, namely CHG_Lev, Tang, LogSales, SGA and OCF. To regress the last dependent variable TobinsQ, the following control variables are added compared to the items mentioned in the SDOCF regression; Tang, LogSales, OCF, Capex, RD and Div.

The methodology used to provide empirical evidence for the research questions is hypothesis testing. Subsequent to running the regressions, the coefficients of the various independent variables can be tested to study their impact on that particular dependent variable. The key interest of this research is in the coefficients of the different groups related to derivative use. These coefficients are tested relative to each other to find out whether they have a significantly different impact on the dependent variable. In addition, not only the difference is tested, but also the 'larger than' or 'smaller than' hypothesis. For example, in case of the two risk measures the hypothesis is tested whether the coefficient of the derivative users is significantly smaller than the coefficient of non-derivative users. This would imply that if the company is using derivatives they have a lower volatility or risk, as is the expectation of this study. For the other two dependent variables the coefficient of derivative users is tested to be larger than that of non-derivative users, suggesting that derivative users have higher capital expenditures and a higher Tobin's Q. These tests are conducted separately on the regression prior to 2008 and that of 2008 onwards. To provide additional information, a significant change of a particular derivative group relative to the crisis can also be tested by comparing its coefficient of the prior period to the period after the beginning of the financial crisis.

The last tests are designed to find out whether an initial difference between two derivative groups has significantly increased after the start of the crisis. An example of an alternative hypothesis is:

$$H_a: \quad \beta_{UsersPrior2008} - \beta_{NonUsersPrior2008} < \beta_{UsersAsOf2008} - \beta_{NonUsersAsOf2008}$$

This test is an illustration of one of the various tests that are performed after the regressions of the Tobin's Q. Based on the discussed literature this study expects that the differences between the groups are increased, especially between derivative users and non-users.

In addition to the indicated regressions, along with the accompanied conducted hypothesis tests and the discussion of their results, finally the following interaction terms are added to each regression.

$$\beta_{14}Users * AltZscore + \beta_{15}NewUsers * AltZscore + \beta_{16}ChangingUsers * AltZscore + \beta_{17}Users * Lev + \beta_{18}NewUsers * Lev + \beta_{19}ChangingUsers * Lev + \beta_{20}Users * ROA + \beta_{21}NewUsers * ROA + \beta_{22}ChangingUsers * ROA + \beta_{23}Users * StockOptionComp + \beta_{24}NewUsers * StockOptionComp + \beta_{25}ChangingUsers * StockOptionComp$$[10]

The choice of which variables to interact with each group within Derivgroup is based on the four somewhat related market imperfections. These terms are added due to an expected interaction between these variables and the main variable of interest Derivgroup, which means that the effect of those other independent variables may depend on the level of Derivgroup. Besides this theoretical justification, the advantage of adding the interaction terms is that it can strengthen the results of the regressions and it can improve its explanatory ability.

[10] Due to collinearity the interaction terms of the group non-derivative users with each indicated independent variable are omitted.

4 Empirical results

In this section the obtained data is empirically analysed by using the described methodology of Section 3. At first the results from the univariate analysis are presented and discussed. Furthermore, the regression results of the multivariate analysis are displayed, followed by an overview of the outcomes of the various performed hypothesis tests. At last this overview is discussed to empirically support or reject the hypotheses stated in the literature review.

4.1 Univariate analysis

To begin, the variables from Table 1 are individually studied to obtain a first indication whether their characteristics show a difference between derivative users and non-derivative users. This univariate analysis consists of both a common t-test and a nonparametric Wilcoxon rank sum test and is performed over two separate periods relative to the beginning of the financial crisis. The results are presented in Table 2.

Table 2: Univariate tests

Presents the mean, median and difference in means of each independent and dependent variable used in the OLS regressions. These characteristics are only mentioned for derivative users and non-derivative users, whereby the number of observations per group remains constant for each included variable. For derivative users there are 1608 observations before 2008 and 2010 observations as of 2008, which relates to 402 companies studied times the respective years within the sample. The group of non-derivative users consists of respectively 1628 and 2035 observations for the 407 companies included. The second to last column presents the p-values of the t-test between the means of the derivative users and the non-users. The last column contains the p-values of the Wilcoxon rank sum tests between the two groups. All variables are defined in Table 1.

	User		Non-user				
Variable	Mean	Median	Mean	Median	Difference in Means	T-test p-value	Wilcoxon p-value
Panel A. Before 2008							
AltZscore	3.768	3.321	4.218	3.645	-0.450	0.034	0.004
LogSize	8.246	8.176	5.984	6.056	2.262	< 0.001	< 0.001
Lev	0.209	0.176	0.159	0.110	0.050	< 0.001	< 0.001
CHG_Lev	-0.005	-0.007	-0.005	0.000	0.001	0.861	0.047
Tang	0.207	0.226	0.301	0.375	-0.094	< 0.001	< 0.001
LogSales	7.861	7.836	5.581	5.586	2.279	< 0.001	< 0.001
ROA	0.063	0.060	-0.018	0.043	0.081	< 0.001	< 0.001
Quickratio	0.460	0.259	1.121	0.457	-0.661	< 0.001	< 0.001
Intcov	17.193	7.297	28.123	5.471	-10.930	< 0.001	< 0.001
SGA	0.159	0.113	0.228	0.164	-0.069	< 0.001	< 0.001

OCF	0.183	0.145	0.043	0.093	0.140	< 0.001	< 0.001
Capex	0.045	0.030	0.039	0.022	0.006	0.002	< 0.001
RD	0.011	0.001	0.023	0.000	-0.011	< 0.001	0.028
Div	0.699	1.000	0.356	0.000	0.343	< 0.001	< 0.001
ExeStockown	0.843	1.000	0.474	0.000	0.369	< 0.001	< 0.001
StockOptionComp	0.688	1.000	0.358	0.000	0.330	< 0.001	< 0.001
Forsales	0.808	1.000	0.585	1.000	0.224	< 0.001	< 0.001
Forinc	0.773	1.000	0.488	0.000	0.285	< 0.001	< 0.001
SDOCF	0.030	0.020	0.105	0.035	-0.075	< 0.001	< 0.001
SDStockreturn	0.373	0.303	0.633	0.451	-0.260	< 0.001	< 0.001
Expend	0.088	0.039	0.071	0.031	0.018	0.003	< 0.001
TobinsQ	2.407	1.983	2.489	1.962	-0.082	0.323	0.514
Panel B. As of 2008							
AltZscore	3.205	2.970	2.173	3.082	1.032	< 0.001	0.803
LogSize	8.288	8.292	5.851	5.924	2.437	< 0.001	< 0.001
Lev	0.271	0.230	0.210	0.144	0.061	< 0.001	< 0.001
CHG_Lev	0.007	-0.001	0.007	0.000	0.000	0.904	0.655
Tang	0.173	0.196	0.239	0.382	-0.066	0.003	< 0.001
LogSales	8.083	8.053	5.843	5.824	2.240	< 0.001	< 0.001
ROA	0.042	0.052	-0.028	0.033	0.070	< 0.001	< 0.001
Quickratio	0.544	0.362	0.966	0.507	-0.422	< 0.001	< 0.001
Intcov	15.845	6.680	29.702	5.634	-13.858	< 0.001	< 0.001
SGA	0.203	0.135	0.369	0.228	-0.166	< 0.001	< 0.001
OCF	0.171	0.152	0.067	0.094	0.105	< 0.001	< 0.001
Capex	0.051	0.030	0.049	0.028	0.003	0.233	< 0.001
RD	0.015	0.002	0.038	0.000	-0.023	< 0.001	< 0.001
Div	0.685	1.000	0.359	0.000	0.326	< 0.001	< 0.001
ExeStockown	0.852	1.000	0.478	0.000	0.374	< 0.001	< 0.001
StockOptionComp	0.639	1.000	0.317	0.000	0.322	< 0.001	< 0.001
Forsales	0.814	1.000	0.582	1.000	0.232	< 0.001	< 0.001
Forinc	0.813	1.000	0.552	1.000	0.261	< 0.001	< 0.001
SDOCF	0.050	0.023	0.093	0.038	-0.043	< 0.001	< 0.001
SDStockreturn	0.514	0.425	0.760	0.574	-0.247	< 0.001	< 0.001
Expend	0.083	0.034	0.059	0.025	0.024	< 0.001	< 0.001
TobinsQ	1.861	1.608	1.259	1.423	0.602	0.039	< 0.001

Table 2 shows that nearly every variable has a highly statistical significant different mean between the two indicated groups. In addition, most variables appears to have significantly different distributions for users and non-users as shown by the results of the Wilcoxon rank sum tests. These last tests are believed to be more robust in the presence of outliers and more efficient for non-normal distributions. At a univariate level the key variables SDOCF, SDStockreturn and Expend are highly significantly different between the two groups. Moreover, the difference in means appears to be in the expected direction. Based on these univariate results the means of the two risk measures of derivative users are significantly smaller in both periods compared to non-derivative users. The variable Expend

presents higher means for derivative users in both periods, as especially from 2008 is in line with the expectations. An exception is the last key variable TobinsQ which shows an insignificant difference in means prior to 2008, indicating that at a univariate level the value of companies that use derivatives does not significantly differ from the value of companies of non-users. This result is supported by the Wilcoxon test that also reports an insignificant difference in distributions between the two groups. As of 2008 both the t-test and the Wilcoxon test show significant differences for the TobinsQ. The mean of derivative users is as expected larger than that of non-derivative users, indicating a possible increased difference between these two groups. However, this is thoroughly tested further on and is merely a preliminary result at a univariate level.

As mentioned, most of the other variables are significantly different between the two groups and are therefore potentially important and suitable control variables that contribute to more accurate and informative regression results. Some variables show partly insignificant differences, such as the Wilcoxon test of AltZscore as of 2008 or the t-test result of Capex as of 2008, while only CHG_Lev appears to be insignificantly different between users and non-users for both periods. Although these variables do not always report a difference between these two groups, they are included in the regressions of the multivariate analysis due to the theoretical foundation and explanation that they can add explanatory value to the regression results.

The difference in means of the control variables are showing a similar pattern as found by other papers, such as Bartram et al. (2011), Bartram, Brown and Fehle (2009) and Graham and Rogers (2000). For example, firms that use derivatives are more likely to pay dividends or to have foreign sales or foreign income, their executives are more likely to own shares of the firm or being compensated with stock options. Furthermore, consistent with the argument that substantial fixed costs are a barrier for smaller firms to engage in derivatives, users are significantly larger than non-users. The average derivative user also appears to be more profitable, keep less liquid assets as shown by the Quickratio, tends to have less tangible assets and a higher leverage. Besides other papers that found similar results for their univariate analysis, some of these characteristics are also consistent with the discussed literature, such as the financial distress hypothesis. Overall, the univariate analysis show the need for controlling the substantial differences in the characteristics between the two groups and it suggest that firms have hedging motives to use derivatives.

4.2 Multivariate analysis

The effects resulting from the univariate analysis are more carefully studied with multivariate models. Therefore, various OLS regressions are performed before conducting the hypothesis tests. The possibility to include control variables is an important advantage of performing multiple regression

models, because they can deal with spurious relationships and can improve the quality of the regression results. The paragraph methodology in Section 3 already discussed the detailed design of the regressions and the results are presented in Table 3 below.

Based on the general statistics each regression is highly statistically significant, which entails that for each regression the joint coefficients are different than zero. To be able to properly conduct the hypothesis tests further on, these regressions are first performed without interaction terms. By including them the interpretation of the effect of a single derivative group on the dependent variable changes, such that testing the effect would be more sophisticated and challenging. The adjusted R-squared differs substantially between the various regressions, but broadly they are in line with comparative papers, such as Guay (1999), Allayannis and Weston (2001) and other already mentioned papers. It is a statistic that indicates the goodness of fit of the model and it provides information about how much of the variance of the dependent variable is explained by the independent variables included in the model. For example, the variables included in the SDOCF as of 2008 model are explaining 24% of the variation in SDOCF. Besides the significance of the entire model, the adjusted R-squared provides additional information about the performed regressions, but the main valuable information is reflected by the significant coefficients.

Whether a variable is significant can be interpreted in both a statistically and an economically point of view. Table 3 indicates the statistical significance and it shows that the vast majority of the variables are individually significant for both or at least one of the periods at the mentioned significance levels. The key interesting variables are the derivative group dummies for which one group is omitted due to collinearity. Therefore, the interpretation of these coefficients are relative to the omitted group, non-derivative users. Based on Table 3 and additional tests, the coefficients for these dummies are individually and/or jointly statistically significant for each regression, with an exception for both periods for the dependent variable TobinsQ. This entails that the level of SDOCF, SDStockreturn and Expend statistically differs between the various derivative groups, while controlling for multiple other firm characteristics which show an effect on these dependent variables.

Furthermore, the signs of the coefficients of these dummy variables are largely as expected, with again a deviation in case of the TobinsQ. For example, when a firm is a derivative user the cash flow volatility measured by SDOCF turns out to be 2.74% lower relative to a non-derivative user for the period prior to 2008 and keeping all other variables equal; ceteris paribus. Related to the characteristics of SDOCF this suggests that this difference is also economically significant. However, this economic significant difference appears to decay together with its statistical significance for the period from 2008 onwards, with only a 0.15% lower SDOCF for users relative to non-users ceteris

Table 3: Regression results

*This table presents the results of the OLS regressions for the four dependent variables, SDOCF, SDStockreturn, Expend and TobinsQ, for the period before 2008 and from 2008 onwards. The accompanied number of observations and the adjusted R-squared are also provided at the end of the table. Furthermore, besides the reported coefficients in this table, each regression also included the explained industry sector dummies (coefficients are suppressed). The key coefficients which are tested further on, are between the two double lines. Due to collinearity the group of non-derivative users is omitted for these regressions. ***,**,* respectively denote the significance at the 1%, 5% and 10% levels and the accompanied t-statistics can be found in Appendix D. All variables are defined in Table 1.*

	SDOCF				SDStockreturn				Expend				TobinsQ			
Variable	Prior 2008		As of 2008		Prior 2008		As of 2008		Prior 2008		As of 2008		Prior 2008		As of 2008	
AltZscore	-0.0043	***	-0.0086	***	-0.0086	***	-0.0361	***	-0.0034	***	-0.0036	***	0.1189	***	0.3904	***
LogSize	0.0074	***	0.0014		-0.0680	***	-0.0831	***	0.0991	***	0.0921	***	0.9304	***	0.1486	
Lev	-0.0918	***	-0.0584	***	0.2569	***	0.3894	***	0.1190	***	0.0942	***	-2.9870	***	-0.0521	
CHG_Lev									0.1547	***	0.1417	***				
Tang									0.0804	***	0.0746	***	-0.8108	***	-1.3209	***
LogSales									-0.1015	***	-0.0986	***	-0.7710	***	-0.1399	
ROA	-0.3875	***	-0.2645	***	-0.1121		-0.0254		0.0305	*	0.0567	***	0.5754	***	3.2904	***
Quickratio	0.0288	***	0.0298	***	0.0357	***	0.0175	**	-0.0066	***	-0.0134	***	-0.1588	***	0.0549	
Intcov	-0.0002	***	-0.0002	***	-0.0001		0.0003	*	-0.0002	***	-0.0002	***	0.0009		-0.0050	**
SGA									0.0746	***	0.0409	***				
OCF									0.0303	**	-0.0803	***	-1.3512	***	1.9088	***
Capex													0.0258		-0.0871	
RD													1.4589	*	6.7327	***
Div													-0.2416	***	0.0210	
ExeStockown	-0.0288	***	-0.0090		-0.0560		0.0126		0.0122		0.0099		-0.1775	*	-0.2071	
StockOptionComp	0.0157	*	-0.0026		0.0312		0.0328		-0.0341	***	-0.0138	**	0.0437		0.0691	
Forsales	-0.0002		-0.0189	**	0.0155		0.1339	***	-0.0369	***	-0.0460	***	0.0423		-0.6078	*
Forinc	-0.0431	***	-0.0188	**	-0.0585	*	-0.0664	**	-0.0217	***	0.0023		-0.1142		0.4401	
Users	-0.0274	***	-0.0015		-0.0610	**	-0.0381		0.0206	***	0.0204	***	-0.0910		-0.1780	
NewUsers	-0.0198	*	-0.0097		-0.0445		-0.0877	***	0.0274	***	0.0204	***	-0.0683		-0.1715	
ChangingUsers	0.0171	*	0.0329	***	-0.0771	**	-0.0024		0.0375	***	0.0589	***	-0.0083		0.0001	
Number of observations	4,380		5,475		4,380		5,475		4,380		5,475		4,380		5,475	
Adjusted R-squared	0.20		0.24		0.08		0.19		0.46		0.48		0.31		0.06	

paribus. Another strong example is that for all three derivative groups included in the regressions, the variable Expend is statistically and economically significantly higher relative to non-derivative users, when holding all other variables constant. In case of changing derivative users this economically significant difference relative to non-users seems to increase after the beginning of the crisis. Furthermore, next to the statistically insignificance of the key dummy variables' coefficients for both regressions of the TobinsQ, when more closely examined the relative difference is also economically insignificant.

The effect of the control variables on a dependent variable is not interpreted relative to a reference group, with an exception for the included dummy variables. An example is the effect of leverage on SDOCF prior to 2008, which entails that if the variable Lev increases by one unit, it is expected that SDOCF decreases by 0.0918, holding all other variables constant. Based on the regression output and the characteristics of SDOCF this effect turns out to be statistically and economically significant. Another variable that is interesting to discuss is Intcov, which appears to be statistically significant for most of the regressions. However, the actual effect of this variable is extremely small and therefore economically insignificant. Due to the main focus of this study on the coefficients of the various derivative groups, the interpretation of the remaining coefficients is in line with the discussed example. A few exception are the dummy variables that are interpreted relative to their base level and the effect of Size and Sales, because these variables are included as a natural logarithm which slightly changes their interpretation.

At last, there are some control variables that are statistically insignificant for both periods of a particular dependent variable. These variables remain incorporated in the models for various reasons, but the main argument is that they can still represent valuable information. One of the reasons is that they are initially included based on valid theoretical arguments and by keeping them in the model it shows that they are controlled for. Besides even if a variable turns out to be statistically insignificant, it can still have economic significance.

4.2.1 Hypothesis tests

The results of Table 3 only indicate whether a specific derivative group is significantly different from the reference group non-derivative users, but it mentions nothing about whether the effect of one group is significantly larger or smaller than another. Therefore, the coefficients of the groups can be directly compared to each other, because for a given regression they have the same reference group, like non-derivative users in Table 3. To be able to test all the relative effects of the different groups on the dependent variables, various other regressions are performed with alternating omitted derivative groups. All of this leads to initial empirical results that can support or reject the first part of the three

supporting hypotheses. An overview of the setup and outcomes of the conducted hypothesis tests can be found in Table 4 below.

Table 4: Hypothesis tests; differences

Presents the p-values of various hypothesis tests indicated in the first column. Panel A shows the results for the two risk measures, where the hypotheses are mainly based on the expectation that derivative use relates to lower volatility. Panel B reports the results for the dependent variables Expend and TobinsQ and these hypotheses are mainly based on the expectation that the coefficients of derivative users are larger than that of non-users. Each hypothesis is tested for the period before 2008 and from 2008 onwards. Although from the results of the regressions in Table 3 can be derived whether a coefficient of one of the derivative groups significantly differs from the omitted group, a 'larger than' or 'smaller than' test cannot be conducted. Therefore, in order to test the hypotheses related to non-derivative users, similar regressions are performed with varying omitted derivative groups. The bold p-values indicate a significance level of at least 10%.

Panel A.			SDOCF		SDStockreturn	
Hypothesis test			Prior 2008	As of 2008	Prior 2008	As of 2008
β_{Users}	<	$\beta_{NonUsers}$	**0.009**	0.448	**0.025**	**0.066**
$\beta_{NewUsers}$	<	$\beta_{NonUsers}$	**0.029**	0.214	0.192	< **0.001**
$\beta_{ChangingUsers}$	<	$\beta_{NonUsers}$	0.802	0.929	**0.003**	0.472
β_{Users}	<	$\beta_{NewUsers}$	0.150	0.790	0.345	0.963
$\beta_{ChangingUsers}$	<	β_{Users}	0.993	0.963	0.300	0.856
$\beta_{ChangingUsers}$	<	$\beta_{NewUsers}$	0.982	0.980	0.256	0.991
Panel B.			Expend		TobinsQ	
Hypothesis test			Prior 2008	As of 2008	Prior 2008	As of 2008
β_{Users}	>	$\beta_{NonUsers}$	**0.009**	**0.012**	0.843	0.940
$\beta_{NewUsers}$	>	$\beta_{NonUsers}$	**0.010**	**0.049**	0.750	0.925
$\beta_{ChangingUsers}$	>	$\beta_{NonUsers}$	**0.008**	< **0.001**	0.530	0.500
β_{Users}	>	$\beta_{NewUsers}$	0.729	0.498	0.579	0.520
$\beta_{ChangingUsers}$	>	β_{Users}	0.115	**0.009**	0.253	**0.099**
$\beta_{ChangingUsers}$	>	$\beta_{NewUsers}$	0.272	**0.021**	0.318	0.122

The most interesting hypotheses for each dependent variable are the three tests above the dotted line, which are relating non-derivative users to the other three groups. Panel A presents the p-values of the hypotheses in case of the two risk measures and therefore it is tested whether for example derivative users have a significantly smaller coefficient than non-derivative users. This would entail

that firms that do use derivatives have a lower cash flow or stock return volatility than non-users, which is perceived to be one of the effects of corporate derivative use and the expectation of this study. The empirical evidence is rather mixed for both variables, but it seems that there is slightly stronger evidence that non-users have a higher stock return volatility. A striking example is that prior to 2008 there is no significant evidence that new-users have a lower stock return volatility than non-users, but as of 2008 this expected effect is highly significant with a significance level of at least 1%. This is consistent with the changed policy regarding derivative use of the group new-users after the beginning of the crisis. When testing users with non-users the stock return volatility turns out to be lower for derivative users in both periods, despite the slightly weaker significance as of 2008. Other interesting results are that in three different cases it appears to be that there is a significant lower volatility for the three distinct user groups relative to the non-users prior to 2008, which is no longer the case in the period after the beginning of the crisis with p-values of 0.45, 0.21 and 0.47. This suggests that, at least based on these results, the financial crisis decreased the difference between the groups instead of the expected increase in differences, but this is thoroughly tested further on. Furthermore, the remaining tests show no significant lower volatility for the groups in the indicated hypothesis. Based on additional tests users and new-users even turn out to have significantly lower cash flow volatility than changing users for both periods.

The results for Expend are relatively more straightforward and clearer to interpret. It turns out to be that non-derivative users have highly significant lower capital expenditures than the other groups for both periods. This is derived from the test results that indicated that the coefficients of all three groups are significantly larger than that of non-users. Moreover, the firms in the group changing users show significantly larger capital expenditures as of 2008, where this was not significant prior to 2008 compared to users and new-users.

Besides the mentioned statistical and economical insignificance of the coefficients of the various derivative groups of the TobinsQ regressions, the hypothesis tests conducted in Table 4 also indicate insignificance for each test. One exception is that as of 2008 the firms that are changing users of derivatives appears to have a significantly higher TobinsQ as the group derivative users. Additional tests even suggest that if there is any significant difference at all, non-users would show an economically insignificant higher TobinsQ compared to users and new-users as of 2008. Overall, despite of other significant results the empirical evidence of this study does not indicate that the market value of firms significantly differs between the four groups.

Based on the final hypothesis tests shown in Table 5, the remaining parts of the three supporting hypotheses are provided with empirical results. In addition to the tests performed in Table 4 this study is interested whether the differences increased after the beginning of the financial crisis. Although the

results in Table 4 suggest certain changes as of 2008 relative to the period prior to 2008, the difference in difference is tested to significantly support these assumptions. The hypotheses are constructed such that the expectations are tested that the difference is larger for the period as of 2008. Table 5 presents the results.

Table 5: Hypothesis tests; difference in difference

This table presents the p-values of various hypothesis tests indicated in the first two columns. The tests are based on the expectation that the difference, tested in Table 4, between two groups prior to 2008, increased after the beginning of the financial crisis. Similar as for Table 4, additional regressions are performed to be able to conduct each hypothesis test. The bold p-values indicate a significance level of at least 10%.

Hypothesis test						SDOCF	SDStockreturn
Prior 2008				As of 2008			
$\beta_{NonUsers}$	− β_{Users}	<	$\beta_{NonUsers}$	− β_{Users}		0.968	0.725
$\beta_{NonUsers}$	− $\beta_{NewUsers}$	<	$\beta_{NonUsers}$	− $\beta_{NewUsers}$		0.785	0.217
$\beta_{NonUsers}$	− $\beta_{ChangingUsers}$	<	$\beta_{NonUsers}$	− $\beta_{ChangingUsers}$		0.771	0.964
$\beta_{NewUsers}$	− β_{Users}	<	$\beta_{NewUsers}$	− β_{Users}		0.950	0.921
β_{Users}	− $\beta_{ChangingUsers}$	<	β_{Users}	− $\beta_{ChangingUsers}$		0.300	0.889
$\beta_{NewUsers}$	− $\beta_{ChangingUsers}$	<	$\beta_{NewUsers}$	− $\beta_{ChangingUsers}$		0.623	0.979
Hypothesis test						Expend	TobinsQ
Prior 2008				As of 2008			
β_{Users}	− $\beta_{NonUsers}$	<	β_{Users}	− $\beta_{NonUsers}$		0.508	0.765
$\beta_{NewUsers}$	− $\beta_{NonUsers}$	<	$\beta_{NewUsers}$	− $\beta_{NonUsers}$		0.810	0.776
$\beta_{ChangingUsers}$	− $\beta_{NonUsers}$	<	$\beta_{ChangingUsers}$	− $\beta_{NonUsers}$		**0.054**	0.478
β_{Users}	− $\beta_{NewUsers}$	<	β_{Users}	− $\beta_{NewUsers}$		0.161	0.456
$\beta_{ChangingUsers}$	− β_{Users}	<	$\beta_{ChangingUsers}$	− β_{Users}		**0.025**	0.240
$\beta_{ChangingUsers}$	− $\beta_{NewUsers}$	<	$\beta_{ChangingUsers}$	− $\beta_{NewUsers}$		**0.010**	0.243

The most obvious result is that the majority of the differences are not significantly increased. The only significant effect between the two periods is related to the variable Expend and particularly the differences between changing users and the other three derivative groups are significantly increased. This entails that especially changing derivative users have relatively increased capital expenditures as of 2008, which could already be suggested based on the coefficients of the regression output in Table 3. Furthermore, the p-values related to the TobinsQ provides empirical evidence that at these significance levels the differences between the groups did not increase, but additional analysis indicates that they also have not been decreased. The other two variables show somewhat similar p-values as those of the TobinsQ. However, when more closely examined there are several differences that significantly decreased as of 2008 instead of increased. Relative to non-users this is the case for

cash flow volatility when compared to derivative users and for stock return volatility when compared to changing derivative users. This effect was already indicated when the results of Table 4 were discussed. In conclusion, these parts of the main supporting hypotheses can be mostly rejected or in a few cases there is even a moderate significant opposite effect.

Regarding the various results in this paragraph multivariate analysis, the interpreted and discussed effects can be sensitive to endogeneity problems. Some examples of endogeneity occurring in multiple regression models are omitting a key explaining variable, measurement errors especially in the independent variables or simultaneity. In case of correlation between a variable and the error term, the variable is alleged to be endogenous. Endogeneity can be a serious problem due to a main general interest in a causal relationship between an independent and a dependent variable within the model. Although this is a real and substantial problem which in existing literature is addressed to with several different methods, there is no single method that can perfectly address and overcome this problem. An example of a method is a propensity score matching technique used by Bartram et al. (2011), which allows them to match firms in their multivariate tests on the basis of the estimated likelihood that a firm is using derivatives instead of matching on individual firm characteristics. Guay (1999) deals with endogeneity by merely studying firms that start to use derivatives and use as a control the same firm prior to the derivative use. Another example is to reduce the selection bias, by only examining firms which belong to a single industry as Jin and Jorion (2006).

An alternative method to deal with endogeneity problems is by using instrumental variables, which are characterized by expecting to have an effect on certain independent variables but not on the dependent variable. However, in practice these instruments are hard to find and often leads to a switch in the discussion from the potential endogeneity of the independent variables to the validity of the incorporated instrumental variable. Moreover, frequently the assumptions of this method have to be considerably weakened to be able to implement the technique and all combined this approach can become somewhat questionable.

Based on existing theory and the varying significant effect of all the independent variables on the dependent variables in Table 3, it is doubtful to be able to come up with a suitable and valid instrumental variable for this research. Nonetheless, the results of Table 3 can be sensitive to endogeneity and by comparing the differences between the coefficients and afterwards the difference in differences this study at least partly attempt to mitigate potential endogeneity problems. Studying the difference in differences, the same companies are taking into account prior to and from 2008 onwards, which is somewhat in line with the method of Guay (1999) and it entails that the business operations of the companies are assumed to be largely the same in both periods.

At last, this research includes some interaction terms in the regressions of Table 3, according to the already discussed methodology. The regression results are presented in Appendix E and due to the substantially increased complexity which arises from the changing interpretation of the effect of a single derivative group, the hypothesis tests are not conducted. Changes that can be derived from Appendix E are a slightly higher adjusted R-squared for some regressions. However, overall the results suggest that the interactive models do not substantially explain more variation on the dependent variables compared to the regressions presented in Table 3. Due to the various interactions of each derivative group, the effect of a single group is not as straightforward as before. The interpretation of one group is now dependent on multiple coefficients and different levels of the variables they interact with. Therefore, together with the hardly changed R-squared and the minimal effect on the significance of most of the control variables, this research is not going to perform additional hypothesis tests to study the differences between derivative groups when interaction terms are included.

5 Conclusion

This paper studies the effect of corporate derivative use on certain performance measures relative to a recent crucial event, called the financial crisis. Initiated in August 2007 the crisis revealed substantial systematic problems and the impact of its effects are still noticeable today. The main interesting characteristic that led to the hypotheses of this research is the resulting credit crunch. The rare severity of this credit crunch, together with the increased probability of default are features that are at the basis of forming the research questions. Translated to hypotheses it entails that derivative users are expected to show lower cash flow and stock return volatilities and higher capital expenditures and Tobin's Q and particularly that these potential differences increased after the beginning of the crisis. To answer these hypotheses the sample is divided into four different groups, which are called derivative users, non-users, new-users and changing users.

Based on empirical evidence of data of 1,114 non-financial US firms belonging to the Wilshire 5000 index within the sample period January 2004 till December 2012, the results of this paper suggest that there are several significant differences between the four groups both prior to and as of 2008. The most compelling effect comes from significantly lower capital expenditures for non-derivative users compared to the other three groups for both periods relative to the beginning of the crisis. In case for the stock return volatility the various derivative user groups mostly report significantly lower volatilities than non-users, as is in line with the hypothesis and expectations. Moreover, the p-values of the group new-users suggest an expected switch as of 2008 when they starting to use derivatives. The significant effects for cash flow volatility are weaker, where only prior to 2008 the volatility of users and new-users are significantly lower compared to non-users. The tests related to the Tobin's Q indicate that there are virtually no significant differences between the groups for both indicated periods, which supports and strengthen the statistical and economical insignificance of the coefficients found in Table 3. Thus although the empirical results of this study suggest that non-users have significantly and economically lower capital expenditures both before and after the start of the financial crisis, this does not translate into a relatively higher Tobin's Q or market value for the other three groups.

The difference in differences hypothesis tests show only significantly increased differences in case of the capital expenditures and particularly that the difference between changing users and the other three derivative groups is significantly increased. Based on the remaining tests the empirical evidence indicate that despite a potentially significant difference prior to and/or as of 2008, the differences did not significantly increase and largely not decrease after the beginning of the financial crisis. Therefore, overall the crisis seems to have an effect on the various performance measures of a firm, but it appears to affect more or less equally across all firms despite of their derivative use.

Although this research incorporates a substantial amount of control variables, a factor that can also be of influence to the results is the changed ability or willingness of financial institutions to engage in derivative contracts as of 2008. The vast majority of the contracts are traded on the OTC market and therefore this is potentially an interesting variable to take into account for future research.

In conclusion, the results suggest that the supporting hypotheses are partly in line with the expectations derived from the theory, which entails that there are some significant differences between the four derivative groups. However, the subsequent part of the supporting hypotheses that relates to the main hypothesis and is testing whether the expected differences increased as of 2008, can be mostly rejected or in a few cases there even appears to be a moderate significant opposite effect.

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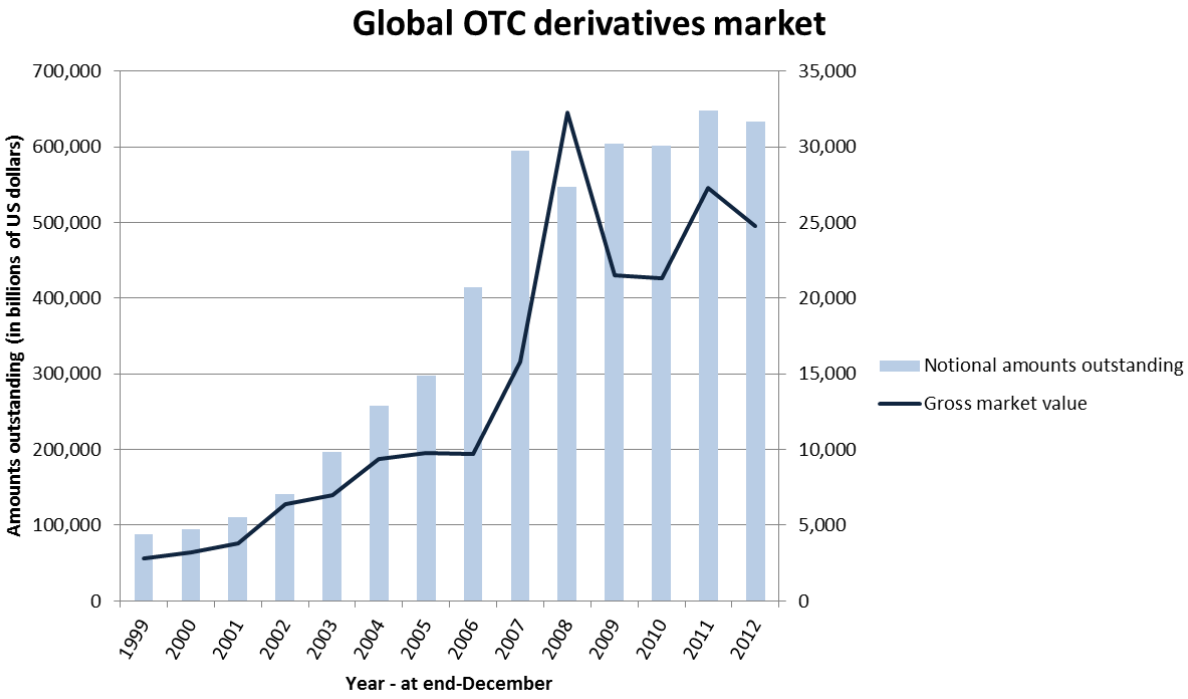
Appendices

Appendix A

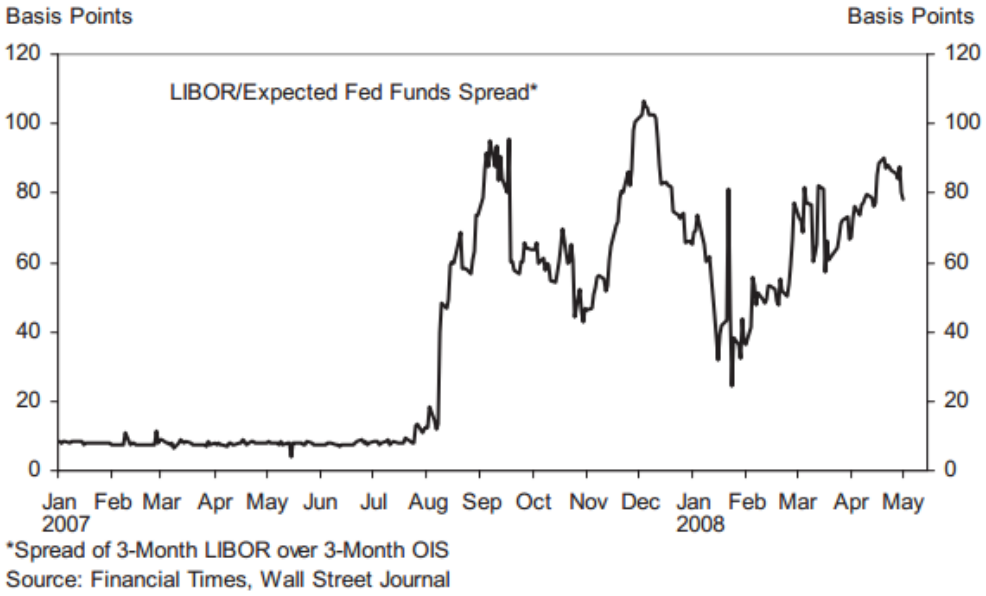
The figure below shows the development of the notional amounts outstanding and the gross market value of the global over-the-counter (OTC) derivatives market, based on the semi-annual statistical release reports of the Bank for International Settlements (BIS)[11]. It is an indication of the rapid growth of the total derivatives market, especially leading up to the beginning of the financial crisis in August 2007.



[11] Retrieved from http://www.bis.org/list/statistics/index.htm

Appendix B

This figure presents the spread between the 3-month LIBOR[12] and the 3-month overnight indexed swap rate (OIS), which gives an indication of the interbank funding pressures. It is retrieved and copied from Greenlaw, Hatzius, Kashyap and Shin (2008) of their report of the proceedings of the US monetary policy forum 2008. The figure is incorporated to show and support the statements related to the market conditions and the credit crunch.



[12] London Interbank Offered Rate (LIBOR).

Appendix C

Overview of abbreviations of the variables explained in Table 1.

Variable	Abbreviation
Altman Z-score	AltZscore
Size (log)	LogSize
Leverage	Lev
Change in leverage	CHG_Lev
Tangible assets	Tang
Sales (log)	LogSales
ROA	ROA
Quick ratio	Quickratio
Interest coverage	Intcov
SG&A	SGA
Operating cash flow	OCF
Capex / size	Capex
R&D / size	RD
Dividend	Div
Stock ownership	ExeStockown
Stock options	StockOptionComp
Foreign sales	Forsales
Foreign income	Forinc
Cash flow volatility	SDOCF
Stock return volatility	SDStockreturn
Expend	Expend
Tobin's Q	TobinsQ

Appendix D

T-statistics of the coefficients of the regressions performed in Table 3, to give more insight in the statistical significance.

	SDOCF		SDStockreturn		Expend		TobinsQ	
Variable	Prior 2008	As of 2008	Prior 2008	As of 2008	Prior 2008	As of 2008	Prior 2008	As of 2008
AltZscore	-6.52	-13.84	-3.65	-18.01	-6.73	-4.99	18.28	10.10
LogSize	3.30	0.72	-8.50	-13.58	28.79	27.80	23.74	1.00
Lev	-4.53	-3.99	3.54	8.28	7.10	7.45	-14.20	-0.08
CHG_Lev					6.78	7.98		
Tang					10.28	13.16	-8.11	-4.32
LogSales					-30.72	-30.17	-19.90	-0.91
ROA	-19.36	-13.92	-1.56	-0.42	1.76	3.48	2.57	3.91
Quickratio	15.98	11.84	5.52	2.17	-4.56	-6.44	-8.59	0.50
Intcov	-2.78	-2.76	-0.37	1.68	-4.12	-3.82	1.56	-2.21
SGA					8.48	5.63		
OCF					2.32	-6.07	-7.93	2.77
Capex							0.10	-0.05
RD							1.71	3.37
Div							-3.73	0.08
ExeStockown	-2.82	-1.03	-1.53	0.45	1.62	1.47	-1.84	-0.59
StockOptionComp	1.79	-0.37	0.99	1.43	-5.33	-2.53	0.53	0.24
Forsales	-0.02	-2.14	0.46	4.73	-5.37	-6.84	0.48	-1.72
Forinc	-4.61	-2.08	-1.75	-2.30	-3.20	0.33	-1.30	1.23
Users	-3.24	-0.20	-2.02	-1.57	3.35	3.56	-1.15	-0.59
NewUsers	-1.88	-1.03	-1.18	-2.90	3.59	2.84	-0.69	-0.46
ChangingUsers	1.81	3.93	-2.29	-0.09	5.50	9.24	-0.09	0.00

Appendix E

*This table presents the results of the OLS regressions for the four dependent variables, SDOCF, SDStockreturn, Expend and TobinsQ, including the interaction terms discussed in the paragraph methodology. The regressions are performed for the period before 2008 and from 2008 onwards and the accompanied number of observations and the adjusted R-squared are provided at the end of the table. Furthermore, next to the reported coefficients each regression also included the explained industry sector dummies (coefficients are suppressed). The key coefficients are between the two double lines. ***,**,* respectively denote the significance at the 1%, 5% and 10% levels. All variables are defined in Table 1.*

	SDOCF				SDStockreturn				Expend				TobinsQ			
Variable	Prior 2008		As of 2008		Prior 2008		As of 2008		Prior 2008		As of 2008		Prior 2008		As of 2008	
AltZscore	-0.0033	***	-0.0094	***	-0.0033		-0.0372	***	-0.0027	***	-0.0037	***	0.1060	***	0.3820	***
LogSize	0.0070	***	0.0026		-0.0688	***	-0.0811	***	0.0984	***	0.0916	***	0.9237	***	0.1615	
Lev	-0.0706	**	-0.0992	***	0.0299		0.4452	***	0.1779	***	0.0934	***	0.0000	***	0.2387	
CHG_Lev									0.1484	***	0.1489	***				
Tang									0.0776	***	0.0722	***	-0.7819	***	-1.3547	***
LogSales									-0.1014	***	-0.0982	***	-0.7761	***	-0.1368	
ROA	-0.5486	***	-0.1962	***	-0.9907	***	0.0302		0.0528	**	0.0895	***	0.2299		4.4405	***
Quickratio	0.0287	***	0.0286	***	0.0348	***	0.0167	**	-0.0056	***	-0.0137	***	-0.1779	***	0.0486	
Intcov	-0.0002	**	-0.0001	***	0.0001		0.0002		-0.0001	***	-0.0002	***	-0.0002		-0.0044	*
SGA									0.0756	***	0.0409	***				
OCF									0.0195		-0.0773	***	-1.2515	***	2.2264	***
Capex													0.1624		-0.5124	
RD													1.0379		6.9810	***
Div													-0.2727	***	0.0446	
ExeStockown	-0.0255	**	-0.0126		-0.0035		0.0162		0.0103		0.0060		-0.0702		-0.2295	
StockOptionComp	0.0392	***	0.0079		-0.0329		-0.0330		-0.0141		0.0122		-0.0093		-0.0035	
Forsales	0.0016		-0.0127		0.0072		0.1340	***	-0.0351	***	-0.0419	***	0.0365		-0.5078	
Forinc	-0.0400	***	-0.0228	**	-0.0277		-0.0675	**	-0.0232	***	-0.0009		-0.0732		0.3292	
Users	-0.0393	*	-0.0135		-0.2955	***	-0.2044	***	0.0610	***	0.0628	***	-1.2249	***	-0.4557	
NewUsers	-0.0002		0.0357		-0.4981	***	-0.2724	***	0.1044	***	0.0465	**	-1.6526	***	0.7909	
ChangingUsers	0.0120		0.0542	***	-0.2679	***	0.0231		0.1354	***	0.1145	***	-0.6234	***	1.4802	*

Users*AltZscore	0.0010		0.0022		-0.0194	**	0.0366	***	-0.0043	**	-0.0050	*	0.0998	***	0.1036	
NewUsers*AltZscore	-0.0001		-0.0034		0.0279	*	0.0327	**	-0.0052		0.0020		0.2065	***	-0.1280	
ChangingUsers*AltZscore	-0.0012		-0.0053		-0.0143		-0.0115		-0.0081	***	-0.0067	**	0.1528	***	-0.2261	
Users*Lev	0.0368		0.0459		0.5540	***	0.0918		-0.0949	***	-0.0473		1.6416	***	-0.3876	
NewUsers*Lev	-0.0112		-0.0747		1.4864	***	0.0653		-0.1684	***	-0.0520		3.3302	***	-2.0118	
ChangingUsers*Lev	0.0429		0.0177		0.6731	***	-0.2059		-0.1834	***	-0.0602	**	0.8253		-3.0431	*
Users*ROA	0.4182	***	-0.2241	***	3.6865	***	-0.1581		-0.1103		-0.1210	***	5.0776	***	-4.8549	**
NewUsers*ROA	0.3157	**	-0.1111		1.8821	***	-0.5862	**	-0.0969		-0.1294	**	1.7754		-4.2319	
ChangingUsers*ROA	0.4895	***	-0.4204	***	2.5779	***	-0.1032		-0.0458		-0.1668	***	-0.0566		-6.9555	***
Users*StockOptionComp	-0.0330	**	-0.0085		0.0648		0.0572		-0.0051		-0.0282	***	0.1452		0.1817	
NewUsers*StockOptionComp	-0.0530	**	-0.0293		0.0225		0.1612	***	-0.0402	***	-0.0422	***	-0.0558		0.0659	
ChangingUsers*StockOptionComp	-0.0324	*	-0.0156		0.1028		0.1448	***	-0.0634	***	-0.0494	***	-0.2465		0.0228	
Number of observations	4,380		5,475		4,380		5,475		4,380		5,475		4,380		5,475	
Adjusted R-squared	0.22		0.25		0.16		0.19		0.46		0.48		0.33		0.06	