Bank lines of credit during macroeconomic contraction
- An empirical analysis of credit line usage and availability

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ABSTRACT

This thesis set out to investigate the usage and availability of bank lines of credit in corporate liquidity management for large public firms during macroeconomic contraction. Corporate liquidity management and especially bank lines of credit are receiving increasing attention, both in the literature and in the marketplace. To investigate this, I employ a random sample of 95 public US non-bank firms, which is analyzed in the 2007-2011 timeframe that entails the recent financial crisis and the negative effects on the general economic context this brought about. In recent theory, bank lines of credit are believed to be held primarily for liquidity reason and for future capital to engage in investments, but also questioned for their non-contingent characteristics. By applying a combination of Compustat data coupled with analysis of annual financial reports, I set up a series of 16 variables from which the data is correspondingly tested. This approach was pioneered by Sufi (Sufi, 2005 & 2009). My findings indicate that bank lines of credit during stressed scenarios are not used extensively to support either of the two variables liquidity and capital to engage in investments, as otherwise suggested by theory. Credit lines are found to be held in abundance to their need, but that this might be due to firm specific factors affecting the credit deciding decision. In terms of availability during macroeconomic contraction, credit lines are found to be reduced for 20% of the firms in the sample, with 10% experiencing a reduction material enough to affect operations. Holding relative to the total number of firm-years analyzed in the sample however, material reductions are only found to be taking place in 2.1% of the observations.
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This section will present background information regarding the motivation, limitations, goals and objectives of the thesis in regards to the analysis of bank lines of credit usage and availability during stressed economic scenarios.

During the past 10 years, the field of financial literature has seen a substantial increase in studies revolving around bank lines of credit. But while the topic has received increased attention, it is only in recent years that credit lines began being investigated empirically, instead of via models and theories. Driving this increase towards more empirical testing has been an increase in the importance of credit lines as a financing tool. Corporate decision makers are putting more and more attention into how credit lines can be used as the marginal source of financing or liquidity, primarily due to the inherent flexibility that characterizes them. As such, credit lines are often held in comparison to cash-holdings, and much has been theorized about their relative usage and application.

Before the focus on empirical testing, behind which the author Amir Sufi is a main contributor, earlier studies focused on modeling and scenario construction to determine the role of credit lines in corporate capital structures. Overarchingly, this research has revolved around two types of usage for credit lines: Short term liquidity and the ability to supply future capital to engage in investments. Today, these two aspects are still assumed to be at the core of credit line obtainment.

As research pioneered by Sufi in 2005 (Sufi, 2005) began investigating more empirically how credit lines were actually used, these two aspects lacked focus. Firms showed, and still show, a tendency to be greatly increasing their obtainment of credit lines, and correspondingly their dependence upon them. Essentially, credit lines for some firms outcompete cash holdings and
other financing tools. But distinctive empirical evidence of how they are applied in different economic contexts is still limited. This thesis will try to fill that gap.

Along with the increasing interest and dependency on credit lines in the markets however, also came important questions of how ‘safe’ these credit lines are. Credit lines are not uncontingent loans, but in many cases dependant on the firms ability to comply with a often long series of covenants. Many of which are linked to firm financial performance, primarily profitability and cash flow. Based on this fact, a current discussion in the field of study is how credit lines behave when the firm holding it experience a negative performance and might be needing the credit line more than ever. With the economic paradigm many firms are facing ex-post the recent financial crisis - funding and capital resources are pushed to be even more important parts of the business landscape than previously seen, especially in terms of liquidity. Having the best liquidity possible becomes paramount for firms in stressed and volatile economic environments, and I find my study to be a mediator in this field by trying to provide new information and insights to the case.

This thesis is thus set to evaluate and test the use and availability of bank lines of credit for a sample of 95 public non-bank US firms. More specifically, the thesis will investigate to what level bank lines of credit are employed, what they are used to finance and how they behave during stressed economic scenarios.

Several research papers revolve around investigating this relation (Sufi 2005 & 2009, Campello et al. 2009) but the current body of literature could benefit from further empirical testing. In the 2005 study by Sufi, it is concluded that the field of study could benefit from research that set out to explore credit lines on a time series basis, in order to examine how corporate liquidity supplied by credit lines varies through business cycles and a stressed economic environment.

Supplied with such a scenario in the recent financial crisis, I try to bridge this gap by performing an empirical study of how bank lines of credit are used and perform under negative economic shocks that stresses firms’ ability to comply with contingent loan covenants. I do this by extracting and analyzing empirical data for a sample of 95 public non-bank US firms, spanning the recent global financial downturn from 2007 to 2011. The majority of earlier
research is based on similar firms, and the selection of these here will help comparability of the results going forward. To collect the empirical data, I source all new primary data from the COMPUSTAT financial database, as well as from 475 manually collected and analyzed financial reportings (Form 10-K’s).

The overarching goal of the thesis is to empirically test bank line of credit usage, and whether or not bank lines of credit can be used as dependable liquidity tools, for example as substituted to cash holdings. In doing so, the thesis will investigate the degree of obtainment and dependability of credit lines, the actual usage of credit lines, incl. motives behind, and finally investigate how the stressed economic scenario of the 2007-2011 time period affected the access and availability of pre-existing credit lines with firms. Specifically focusing on covenant violations as a source of this.

To narrow the scope of the analysis, two limitations are set up. (1) Credit line usage will only be investigated in relation to short term liquidity and future capital to engage in investments. (2) Covenant violations will only be investigated in regards to the two main measures: Cash-flow and profitability.

The thesis will incorporate both data analysis, literary analysis and will also link and draw on previous research and conclusions.

The following parts in this section will cover, research questions and delimitation, while the last part presents the structure of the thesis.

1.2 RESEARCH QUESTION

As made clear in the introduction there are large amount of literature which investigate bank line of credit usage and dependancy. While some studies also investigate availability, most point to this segment as being lacking research. This indication is mainly based on the lack of empirical data to thoroughly investigate the relation in a stressed economic scenario. In this thesis I am
primarily inspired by the work done by Sufi (2005 & 2009), in terms of the general set up of the analysis, including data collection processes, variables and analysis techniques. I do however also rely greatly on own observations and methods developed during the process of constructing the analysis / thesis.

Due to the limited number of studies and the interesting characteristics of credit line behavior in stressed economic scenarios, I find it very interesting to do a study of such on the basis of the recent financial crisis.

Thus, the purpose of this thesis is to investigate statistical and empirical evidence of the usage and availability of credit lines in regards to short term liquidity and future capital to engage in investments by using new primary data, and a comprehensive set of well tested predicting variables.

This leads to the following key research question, with additional sub questions:

*Are bank lines of credit durable liquidity tools that can be used to fund short term liquidity and investments, even during negative economic shocks?*

- What is the position and dependability of bank lines of credit for public non-bank US firm?
- How do bank lines of credit usage behave under a negative economic shock for these firms?
- How contingent are bank lines of credit availability on firm performance for these firms?

### 1.4 Delimitation

Certain limitations are made in this thesis. Please read and note the following:

Given the relatively short timeframe of roughly 6 months to complete the thesis, a substantial limitations is the ability to obtain extensive depth and scope in the data, specifically in terms of sample size. The sample size of 95 firms selected for this study represents a statistically significant level, but as with any analysis, it could always gain from a larger sample size.
A large part of the analysis performed in this thesis is based on data retrieved from the Annual Reports of firms in the sample (Form 10-K’s). There is, to my knowledge, only one country who demands the explicit discussion and transparency towards debt and in particular bank lines of credit that is needed to perform such an analysis, which is the US. Due to this, I am only using US data for this thesis. Correspondingly, this limitation limits the application of the findings to the US, as well as to firms matching the firms in the sample pool. Please see the section ‘Data’ for details. All of these reporting are collected on a yearly basis which affects the quality of the data. By collecting yearly data, a limitation of the thesis is the failure to capture effects happening in between the yearly screenshots taken and displayed in the annual reports. A way to mitigate this would be to investigate quarterly filings for example – but taken this approach would also quadruple the workload.

I search the annual reports via a search algorithm. A limitation of this approach is the possibility for data to not be captured. As detailed in the Data section later however – a series of precautions are taken to minimize the risk of this happening. Nonetheless – the limitation of using the search algorithm results in focus only being put on the specific key area’s selected, which does not directly promote the finding of new information along the way.

Based on extensive literature review, I use a selection of 6 variables from the COMPUSTAT data source, which should provide the necessary theoretical and practical data characteristics that have previously showed good empirical results. The selection of these variables will likely be subject to scrutiny, but even though I cannot rule out that other variables may also have been suited for this empirical testing, or even potentially having an effect on the results, I believe the selected variables are valid, applicable and fit the scope of the thesis. These are detailed more specifically under the upcoming ‘Data’ section.

The data in the thesis only covers the time period of 2007-2011. The time period is chosen as the period frames the recent financial / economic crisis. It was not possible to retrieve data more recent than 2011.
1.5 Structure

To answer the research questions outlined above, this thesis is organized into three parts.

The first part gives an introduction to the methodology, as well as a thorough description of the data and data collecting process used. Part 1 also supplies a walkthrough and review of the existing literature to get a general understanding of bank lines of credit from the thesis’ perspective, and outline the theoretical framework and findings that sets the basis for the empirical testing.

The second part introduces the analysis of the firms in the sample and their usage of and dependability on credit lines. Six firm and credit related measures are derived and correspondingly analyzed in a time series analysis. Focus in terms of usage is two folded, with one section focusing on usage for short term liquidity, and the other section focusing on the usage to provide capital to engage in investments. Based on the findings, a discussion of the average level of credit lines held by companies relative to their usage is conducted.

Part three investigates the availability of credit lines during stressed scenarios, focusing of how contingent they are on firm performance. First, two variables of firm performance, profitability and cash-flow are determined to be integral in the obtainment and maintaining of credit lines. Next, the development in these two variables is investigated in a time series analysis to indicate to what extent the sample should show a propensity for reductions in credit lines. Finally, covenant violations are tracked and measured to see how much the stressed scenario during the sample period affected credit line availability.
2. Research Methodology

2.1 Search Methods and Research Streams

The literature and theoretical framework used for this thesis was obtained by a structured research strategy that focused on extracting all relevant literature associated with the topic. The sampling and collection of literature was one of the first tasks done on the project, and was conducted in the period after defining the initial scope and research question of the thesis. The reason and goal behind this process was for me as a researcher, to obtain vast information about the topic I have selected. And furthermore look at previously used methods, research areas, methodology, results, conclusions and recommendations, in order to create inspiration for my paper, but also to help define its limitations and scope.

To successfully navigate the scientific field of study in my search, I primarily used two sources of information. Search engines, and citation tracking. To first get a more holistic overview of the literature available relating to the topic, I conducted a search engine search on the CBS Libsearch. Libsearch searches and compiles results from a broad specter of the CBS available databases. Given the schools requirements to supply information useful at graduate level, I readily assume that a search done on this search engine is sufficient to cover the scientific level demanded for a thesis and at this level of education. However, I also add to this primary search tool, by exploring other search engines and avenues of collecting literature.

These avenues are other databases, other key search words (developed as new information and topics comes to surface) and citation tracking, where I follow citations from articles and books to gain deeper insight into the field of theory. The citation tracking method is especially useful, and is often used backwards, i.e. using the capabilities of the search engine to locate which newer articles have quoted an older article. By applying this method, the most recent literature is able to be identified. This helps alleviate the problem of blindly using old literature with conclusions that has since been reviewed, challenged or discussed.
To ensure that I was kept updated on the field of theory through the months it took to write this thesis, I regularly checked back on these research streams to identify if new research have come up. In addition to this, the process of collection research over a longer period forced me as a researcher to take a critical standpoint towards every theory or result. Since I kept learning more and more about the topic, this was an iterative process of constantly challenging earlier research and theories based on newly obtained knowledge. I find such a process very important, especially with a relatively new topic with relatively few scientific studies targeting it.

Based on the above mentioned arguments, I believe my extensive literature search and analysis both at the outset of the process, as well as during the writing and construction, provides a validated, solid and robust foundation to build my thesis on.

2.2 Research Paradigm and Philosophy

After establishing the research streams, determining the thesis’ research paradigm and philosophy plays an important part in the research methodology. Knowledge about the research paradigm is imperative in deciding how to collect data in effective and fitting manner. By processing which type of research paradigm is applied, I benefit from the knowledge and insight of how to effectively perform research and data collection. More specifically, exploring the research paradigm forces a deeper investigation of the research topic and the research method, which helps understand and manage the aspect of time constraints, objectivity and data types etc.

From a research method standpoint, the study I am doing is an empirical investigation of credit line usage, as well as the cause and effect relationship between liquidity during negative economic shocks and bank lines of credit as a source of such. The research philosophy chosen to best fit the research question is Positivism (Saunders 2003). As positivism regards “reality” as objective and general, it is rightly aligned with the investigating driven research question. The reality is objective and given largely by external factors. Conversely, it is not subjective or driven
by personal opinions or beliefs, although subjectivity in large parts come into play when performing analysis of the data.

Positivism is based upon research methods that are highly structured with quantifiable observations that allow for the results to be obtained via statistical tools and methods, thus being able to lead to generalization. Obtaining insight, about which research paradigm is essentially used, has proven valuable in constructing the research design and making sure it holds all the characteristics needed to support the study.

The study is constructed to be highly structured, use quantifiable observations, collect facts from general sources and have a high level of objectivity and criticalness in both the data collection, design and result analysis phase. Especially when constructing the research method and data segments, recognizing positivism as the research paradigm helped influence and validate the design related decision. In positivism, the researcher is needed to be objective and excluded from having an influencing role on the results, besides the one of being the constructing partner and analysing party. On a more detailed level, all aspects of me as a researcher or how I perceive the world may not influence the results, and it is critical that I fully take on the role of being objective throughout the research and collection of data. Something I find to have successfully managed.

The strengths of applying the positivism paradigm as done here, is the ability to form a general reality based on objectively gathered and quantifiable data from a sample. By adhering to the requirements of data collection, and building my analysis primarily on statistical tools and data analysis methods, both these aspects are found to be satisfied. Adherence to these criteria is critical for the findings to be credibly expanded to a general population matching the characteristics of the sample.

Among the weaknesses of using the positivism paradigm is the extensive need for resources in terms of time and effort in creating a data sample with the right characteristic to be viewed as representative enough to say something about the full population. Comparing to interviews, or more social paradigms, it also does not promote a deeper understanding of the drivers behind the results, which often must be inferred and argued from tendencies and variations in the data.
2.3 Methodological approach

Scientifically speaking, I am using a primarily inductive methodology approach in this thesis, since I am trying to use specific observations to create findings that can be applied to a general context, as described above. The methodology applied is to begin with a randomly selected sample from which findings are presented, analyzed and interpreted. After the primary task of selecting the random sample, my research continues with a set of pre-determined measures and variables for analysis. From these, I will try to detect patterns and regularities in the data in order to form a ‘hypothesis’ from which I can derive a general conclusion that answers the research questions.

This form of inductive reasoning forces me as a researcher to take a critical standpoint towards the findings. A critical standpoint is imperative, since it is cannot readily be assumed with 100 percent certainty that the data and conclusion can be scaled correctly up to a broader general principle or theory. In relation to that, I find it important to note, that any findings may benefit from be exposed to more deductive testing afterwards to prove validity. This is especially true for small data sets, like the one I am dealing with.

A key aspect in securing this causality is the selection of the variables that are used for the analysis. Relating again to the research paradigm, I must be certain that the particular data set in the study can be objectively used to derive the conclusions it is set to find. There must be a strong cause and effect (causality) relationship between the data variables sourced and analyzed, and the conclusion they are used to form. In short, the variables must measure what they supposed to measure. For example – if you want to measure the development in sales, you have to use the variable which rightly depicts set sales. This relation sounds simple, but becomes more complicated as the subject and things we seek to measure becomes more diffuse and complex. In this thesis, several steps are taken to ensure this causality, which will be explained in greater detail in the upcoming Data section.
From a data standpoint, the thesis will use primarily quantitative and empirical data sourced from two databases; COMPUSTAT and EDGAR. Secondary data will be sourced from the current body of literature related to the thesis topic. My data format consists primarily of numbers and statistics from the Compustat database, but will also be based on text analysis of the FORM-10K’s. There can be made a discussion about the distinction of Form 10-K data as quantitative or qualitative data, but the reasoning behind treating it as quantitative data is due to it primarily supplying raw data in the form of numbers (quantitative), more so than in the form of anecdotal evidence (qualitative).

3. DATA

In this section, I will thoroughly define and go through the selecting and production of the unique dataset used for performing my analysis. All data that is used in this thesis is gathered on a yearly basis. As I look from a US perspective, all data are denominated and measured in US dollar. The section is divided into 5 parts: Type of firms used in the sample, the timeframe selected, the variables and measures selected, the sampling process and the Form 10-K variables / sampling process.

3.1 SAMPLE

As noted, the selection of firms incorporated in this thesis are public, US based non-bank firms. These types of firms are chosen since they are used in the majority of the existing literature, and since they provide the optimal dataset in terms of availability and structure necessary to conduct the analysis. The general company data for the sample firms are collected after gaining access to the COMPUSTAT database via the Wharton Research Data Services (WRDS). COMPUSTAT allows for access to a long list of company financial, not readily available for many other types of firms. The list of every firm employed in the sample can be found in the appendix.
What drives the uniqueness of the dataset is the annual reportings data, henceforth the Form 10-K data. The data collected from these reportings is data on bank lines of credit levels and their usage in nominal terms. To be able to collect this data which is not normally data that is publically available, the distinction of only using public firms in the sample again comes in to play. For public US firms, the financial regulation S-K of the Securities and Exchange Commission (SEC) requires all firms who publish under these rules, to reveal and discuss all aspects regarding the use of bank lines of credit in their FORM 10-K’s.

In addition, the collection of Form 10-K data is, also uniquely for US firms, readily available through the SEC’s EDGAR database.

Combined, this makes the US public firms an optimal choice in terms of data availability, structure and validity. The only limitation made, is the elimination of banks from the sample. The reason for this is due to their size and composition of debt, which skew the data if included. A process that has been undertaken in previous studies as well.

Construction of the sample start with a Compustat search based on all the variables outlined (see section 3.3 below). This produces a sample of 7965 firms. An initial concern regarding the rather large data universe was how to select a sample that was representative, but also manageable from a more pragmatic viewpoint of manually collecting, organizing and analyzing the sample. Ideally, every firm observation is included in the sample in order to get the most representative results. Taking into consideration the time aspect however, such an approach is not sustainable. Conversely, selecting only a handful of observations greatly reduces the restrictions of a time constraint, but is likely to not be very representative from a statistical standpoint.

The trade-off faced is how to leverage each aspect in order to get a sample size that fits both the validity criteria, as well as the time criteria. Figuring out the optimal solution to this trade-off issue have been struggled heavily with, and several avenues has been investigated. One of these avenues explored was whether or not to limit to the observation universe, which is quite large. For example only looking at S&P 500 firms. I find however, that reducing the data universe will not only be oppose to acknowledged practice from previous studies, but also ultimately reduce
the broader usage of the results. Based on this, and after conferring with a professional\textsuperscript{1}, it was decided to maintain the full data universe in line with previous studies and use confidence levels as a mean of balancing each side of the equation.

To obtain a sample size smaller but comparable to current studies, it was decided to collect a sample with a 95% confidence level and a 10% confidence interval. Applying these measures to a 7965 firm sample, yields a sample result of 95 firms, equaling 475 firm year observations.

To achieve full randomness in the selection of observations, the 95 firms are selected using a random number generator that randomly selects numbers between 0 and 7965 \([0;7965]\). Having selected the sample based on the Compustat data, the primary process of selecting a timeframe and collecting variables and Form 10-K data is undertaken.

\section*{3.2 Timeframe}

Focus is put on the 2007-2011 timeframe as it incorporates an economic climate not yet considered in the field of study. Existing research focuses on earlier periods, mainly from the late 1990's to the earlier 2000’s, but common for these results is their inability to capture how bank lines of credit behave under periods of economic downturn or stress. The 2007-2011 timeframe display such a scenario due to the financial crisis experienced in this period, and should effectively capture the effects on bank lines of credit.

2007 is assumed the beginning of the crisis, and 2011 is the latest data available through the Compustat and Form 10-K data. The data is selected to be based on fiscal year reporting, rather than the calendar year reporting. This ensures complete year end data for all companies.

\section*{3.3 Compustat Variables & measures}

In order to provide validity of the gathered data in saying something about the usage of bank lines of credit, there is a need to ensure data measures, what ‘it is supposed’ to measure. To

\textsuperscript{1} Interview with thesis counselor about the pros and cons about pursuing the full data universe.
secure that, I here outline which parameters I will look at, and how I will use them in my analysis to derive reliable results. These variables are inspired by earlier studies, primarily Sufi (Sufi 2005 & 2009)

The dataset will consist of firms with 5 years of data on the following variables:

- **Total assets** - This item represents the total assets/liabilities of a company at the end of the fiscal year.

- **Short term debt** - This item is the sum of 3 parameters
  - Accounts payable (including income taxes payable)
  - Current liabilities
  - Debt in current liabilities

- **Long term debt** - Include debt with a maturity of longer than one year, such as bonds, mortgages, long term lease obligations (capitalized lease obligations) and similar debt. Using Compustat data on long term debt does not determine the underlying source of the debt obligations, e.g. whether it be from bank notes, private placements, public issues or, important to the study, bank lines credit. There is no record defining these characteristics in the Compustat data universe, which is one of the main drivers for using Form 10-K analysis to source this data.

- **Cash holdings / balance sheet cash** – is defined to represent any immediately negotiable asset or any instruments such as cash, checks, letters of credit, money orders, among others.

- **Operating income EBITDA** - this item is the \textit{sum} of Sales - Net (SALE) \textit{minus} Cost of Goods Sold (COGS) \textit{minus} Selling, General & Administrative Expense (XSGA). Is selected instead of total revenue, as EBITDA is the primary cash-flow denominator used in supporting bank lines of credit agreements (Sufi, 2005).

- **Cash flow** - The primary measure of cash flow is EBITDA divided by non-cash total assets.

These variables data will be used to form 5 key measures which serve as parameters for the analysis. These parameters will (1) measure the development of the companies in terms of performance, (2) segment the companies in relation to their use of bank lines of credit and (3) in
relation with the Form 10-K data show how firm performance is connected to credit line availability. An oversight of these and every other variables/measures used, including how they are calculated, can be found in the appendix.

The 5 key measures are:

- Company size (total assets)
- Different types of debt and their ratio’s (Short term vs. Long term)
- Profitability
- Cash holdings over time
- Cash flow

### 3.4 FORM 10-K VARIABLES

As noted, the Form 10-K variables focuses specifically on credit lines.

The Form 10-K variables are defined as:

- The amount of credit line employed
- Total line
- Used line (draw downs)
- Unused line
- Covenant violations
- Investment driven draw downs

In this study, I categorize bank line of credit in the Form 10-K data as defined and limited to bank debt due to draw down on a credit facility. Term bank debt, as well as debt to non-financial companies is excluded.
To account for the two variables, having a line of credit or not, the results is structured as either a 1 or a 0 \(\{0, 1\}\), where 1 is representing the firm having (access to) a bank line of credit, and 0 is representing the firm not having a bank line of credit.

To account for the variables of how big the used on unused parts of each bank line of credit is, financial numbers from the Form 10-K is structured into individual formats, as well as a total sample format and tracked during the entire 5 year period. To ensure no bias is giving to larger firms affecting the results more than smaller firms (if measured in nominal terms, five 100 \% increases for 3 million credit lines, could easily be offset by a 15 percent decrease in a 100 million credit line), the nominal development between periods will be converted to percentages.

For covenant observations, focus will only be on financial covenants to the extent this is possible. Covenant violations due to change in ownership or the likes are excluded on the basis that only the financial covenants reflect the firm specific development occurring during stressed environments.

A failure to comply with a loan covenant manifest in the Form 10-K as firms are required by the SEC to report covenant violations. “companies that are, or are reasonably likely to be, in breach of such covenants must disclose material information about that breach and analyze the impact on the company if material” (SEC, 2003). Similar to measuring the credit line, if no covenant violation is reported, the observations are given a 0. If a covenant violation is reported, the observation is given a 1. This method is also applied to measure if a draw down is associated with an investment. This will be explained in greater detail under the ‘Investment driven draw down’ section of the thesis.

What makes the Form 10-K data unique is that it is based on manual collection and a new timeframe. In total for the 95 firms in the sample, there exists 475 Form 10-K’s. The process of collecting the data is the following: First, the reportings for the 95 randomly selected firms are collected through manually searching the Securities and Exchange Commissioners EDGAR database by using CIK-identification codes obtained from COMPUSTAT. Next, each individual Form 10-K for each of the years in the 5 year timeframe (2007-2011) is searched up, extracted and filed.
Finally, to extract the specific data about credit lines, each Form 10-K is searched through. Given that a Form 10-K is on average approximately 90-100 pages long, it is an insurmountable task to read all 475 reports from end to end. Instead, a search algorithm is developed and manually applied in an iterative process – inspired by the study of Sufi (2005 & 2009). Still, it must be noted that this is no easy feat, and that it is a very time consuming task since everything is done manually by one person.

The application of a search algorithm benefits from the structure of a Form 10-K. Data about bank lines of credit (used/unused) and debt structure will primarily be located two places in the Form 10-K. Either under the section called “Liquidity and Capital Resources” (Management Discussion), or in the financial notes related to debt and capital structure. This mitigates potentially missing out on information. The algorithm is set up to search 13 key terms, also attached in the appendix; “Credit lines”, “Credit facility”, “Working capital facility”, “Revolving credit agreement”, “Bank credit line”, “Lines of credit”, “Line of credit”, “Covenant violation”, “Covenant breach”, “Violation of covenant”, “Breach of covenant”, “Failure to comply with covenant” and “Non-compliance to covenant”. Employing the same type of algorithm, Sufi (Sufi, 2005) verifies the statistical robustness of this method in accurately portraying the use of bank lines of credit for the full sample. I personally add the covenant search words, and I believe these to capture any covenant violation as well.

For each result / observation, the corresponding paragraph of text is read. As a minimum, this includes 5 lines of text before and after each search result. In the following is presented a random example of what an observation might return. It displays how detailed and precise results the algorithm is able to produce. From the 2007 Form 10-K of Tiffany & Co:

“In July 2005, the Company entered into a new $300,000,000 revolving credit facility (“Credit Facility”) and, in October 2006, exercised its option to increase the Credit Facility by $150,000,000 to $450,000,000 [...] The Credit Facility is available for working capital and other corporate purposes and contains covenants that require maintenance of certain debt/equity and interest-coverage ratios, in addition to other requirements customary to loan facilities of this nature.” –Tiffany & Co. Form 10-K (2007)
From a table summary of credit facilities found immediately below this paragraph, it is furthermore described that Tiffany & Co. had borrowings outstanding (e.g. used portion) of USD 106,608,000.

Reading a minimum of 5 lines before and after each search result also ensures the search algorithm will not have a bias to produce errors where the search result is taken out of context, or not giving a correct image of what is actually written in the Form 10-K. To further test for errors, a selection and full read through of three Form 10-K’s is undertaken to investigate if relevant information is left out. The result of this process was that in none of the selected Form 10-K were there information located that would have been directly relevant but not found by the search algorithm. In short, the search algorithm is found to be effective in extracting the relevant information. I attribute this characteristic primarily to the fact that Form 10-K’s are highly standardized documents that used the same formatting, language and phrases. Being enforced by law only emphasizes this aspect. Firms do not use various words or terms to describe their operations, but rather stick to a common terminology, which allow for the use of specific phrases in the search to be so successful.

The best example of information missed by the algorithm is where information behind the numbers was found. A case is reproduced from the 2008 Form 10-K for the firm Ashland, in which the following was stated:

“Cash flows generated from operating activities from continuing operations, a major source of Ashland’s liquidity, amounted to $478 million in 2008, $189 million in 2007 and $145 million in 2006. The increased cash generated during 2008 primarily reflects a $311 million and $302 million cash improvement in operating assets and liabilities as compared to 2007 and 2006, respectively.

- Ashland Form 10-K (2008)

While not specifying or revolving around something that would affect the numbers of the credit lines, the paragraph open the curtains on why this particular firm has a relatively small bank line of credit in place, compared to its size. Namely, that it instead has been working on increasing cash flow through internal processes and optimization.
As described, finding clear cut errors was not accomplished. The immediately best example found is the one above, and however descriptive the information is, excluding it is clearly not causing a distortion of the data or results. It should be noted however that some small degree of error must be expected. Most likely in the process of manually extracting the correct numbers from the search results.

4. LITERATURE REVIEW

The following literature review will revolve around discussing the existing literature, findings and opinions regarding the subject of the thesis.

4.1 BANK LINES OF CREDIT

For companies operating in today’s capital markets, it does not come by surprise that bank lines of credit are a common phenomenon in a firm’s capital structure. From small family business, to multi-billion dollar corporations, they are a part of largely all firm structures, and often play a vital role. The first mentioning and use of bank lines of credit is unknown to this author, but it is know that the market for credit facilities that includes this instrument, experienced a dramatic growth during the 1980-1990, growing from approximately 50 % of all commercial lending in the 80’, to around 75 percent in 1990, according to a study performed by Donald P. Morgan (Morgan, 1994). A later study by Shockley & Thakor (Shockley & Thakor, 1997) backs that notion and development, by estimating that by 1997, over 80 percent of the commercial bank lending to corporations in the United states were attributable to credit facilities that also allowed for incorporation of credit lines. In his study, Mr. Morgan defines what I have found to be the best description of credit lines. Namely that bank lines of credit can be defined as a ‘promise’ from the bank to the commitment holder. Notably, that it is not an un-contingent loan most commonly known as an ordinary debt contract, but a rather contingent loan that does not entail any contractually obligation for the lender to fulfill the loan requests of the borrower.
What more specifically defines and makes this different from ordinary debt contracts, is the specification of a loan limit, and the possibility for a borrower to borrow according to need, up to that certain limit which is either pre-determined or revolving. The loan operates with a used and unused portion of credit for which the lender ultimately has control. Furthermore, a substantial characteristically aspect of bank lines of credit is that a lines of credit distinguishes itself from an ordinary debt contract, by often being heavily linked to the financial health of the borrower. These links, often called financial covenants, are at the heart of the foundation for my thesis given their key in determining the amount committed (available) to a borrower in a loan agreement.

4.2 Credit line usage

Even though loan commitments, (Henceforth; bank lines of credit, or simply, lines of credit) increased in the 80’ and 90’, I identify a small gap between the early investigations on bank lines of credit and up until the recent years of the millennium. The scientific body regarding lines of credit received little attention, and resulted in a low number of studies revolving around the usage of lines of credit. Although limited, the vast majority of these studies focuses on two applications of credit lines. For future investment need, and for short term liquidity need. I will highlight some of the few I find to be relevant in building the foundation for my thesis.

4.2.1 Future investment need

One of the earliest studies regarding credit line usage for investment purposes, is the study in 1987 by Boot et al. (Boot et al. 1987) (See also Kanatas 1987, Houston & Venkataraman, 1990, Maksimovic, 1990.) The study by Boot et al. initially focuses on transaction costs being a motivating factor for bank lines of credit use, but also takes a another perspective on the topic and use game theory to point out that “loan commitments”, reduces moral hazard, align incentives between parties and help obtain a better equilibriums in the markets. The conclusion being that lines of credit are used, primarily since they mitigate agency cost between the borrower and the lender in an investment scenario.
Another perspective was put forward a few years later by Berkovitch and Greenbaum (Berkovitch & Greenbaum, 1991) who acknowledges the findings of Boot et al., but build upon this early foundation by applying a two stage investment scenario and studying the effect of lines of credit on the ex-post investment decision of firms. Their findings show that using lines of credit can resolve underinvestment problems arising from ordinary debt funding. They do this by decreasing information asymmetry and providing flexibility at the later stages of an investment. Consequently, they view this effect, the investment effect, to be one of the main drivers of bank lines of credit. A view which is later on in 1993, followed up upon by Duan & Suk (Duan & Suk, 1993).

In their study of bank lines of credit, Duan and Suk also focuses on how bank lines of credit as a capital tool is used to fund future investment opportunities. The paper uses a model that endogenizes the firm's investment decisions, while analyzing the implications of using loan commitments in how firms take investment decisions in competitive capital markets. The principal hypothesis investigates if a firm with a future investment project is motivated to use lines of credit as a “blank check” to fund a future investment project, rather than wait until a future point in time to borrow at the then prevailing spot rate. Taking out a bank line of credit will allow borrowing up to a pre-determined amount at a pre-determined rate in the future. Constructing this model yields result that show firms overinvesting when having a line of credit, and that a line of credit to a significant degree can be viewed as a hedging tool which hedges towards future fluctuations in spot rates or access to credit markets that may otherwise defer or prohibit investing.

The rationale theorized is that with a bank line of credit, the firm will be more incentivized to invest when the line of credit rate is lower than the current spot rate (assuming market imperfections), since investing can be done cheaper and potentially create more profitable projects. Tying these different aspects together, the Duan and Suk study views bank lines of credit as a tool linked heavily to, and motivated by, the investment decision of firms.

Adding to this, Martin and Santomero (Martin & Santomero, 1997) models the demand for credit lines, and find that credit lines permit firms to move quickly to take advantage of investment
opportunities. They attribute this to the relative speed and flexibility in debt obtainment, presented by credit lines.

What I learn is that the use of a bank line of credit is initially founded in theory, as being able to fund investments cheaper and more flexible in the future, driven by a disconnection from the capital markets. Furthermore, credit lines are suggested to be switching over to more individual firm control over its investment decision. The interesting aspect will be to investigate how these theories translates into reality, which is part of what will be answered in the thesis’ analysis section by analyzing the empirical data gathered.

4.2.2 Liquidity

Turning the emphasis over to the aspect of liquidity, and looking at the empirical data on how firms use bank lines of credit in liquidity management, an influential article is made by Amir Sufi (Sufi, 2005). Sufi was one of the first to use Form 10-K data as a source of data for the corporate use of bank lines of credit while systematically analyzing it. Analyzing the then largest sample in the literature, Sufi investigates a sample consisting of 1,916 firm year observations from 1996-2003. The approach taken is to look at which firms use bank lines of credit, and how they use them. Similar to the approach taken in this thesis. Taking note from the more theoretical approaches by previous studies – reviewed in the next section in regards to cash - it is acknowledged that there is a need for empirical testing of the different hypothesis previously put forward – primarily the liquidity aspect. His study is boiled down to be focusing on answering the main hypothesis; that bank lines of credit provide a unique source of financial flexibility to firms that obtain them.

By doing a cross sectional analysis, he suggest that firms use credit lines to fund short term liquidity, but the results are not significant. He also finds that firms who primarily use bank lines of credit, are firms with a higher than average profit ratio. This relation is found to hold for both the used and the unused portion, indicating that more profitable firms not only use more line of credit – they are also given a larger total line of credit to draw from. Looking at the statistics, he finds that firms with profitability levels one standard deviation above the mean, has a 25 percent higher unused bank line of credit to total asset ratio. Consistent with results from Agarwal et. Al
(Agarwal et al, 2004) who, from reviewing 712 loan obtaining firms, finds that firms with higher profitability obtain larger credit lines. What we can understand from this is that profitability plays a huge role in how much line of credit can be obtained by a firm. Relating it to how banks manage their credit lines, it becomes evident that profitability is a primary tool in estimating the line of credit availability to a firm. Conversely, this financial ratio must then be important to look at. The aspect of this thesis is to test these findings during a stressed scenario, to investigate if more significant results can be found for liquidity usage, and if the relation for profitability and credit line obtainment holds.

Sufi takes the small initial step and partially tries to investigate this relation in a later, 2009 article (Sufi, 2009), where he uses the same dataset of 1,916 observations from 1996-2003 as previously to investigate how bank lines of credit correlates with cash holdings. Despite the significance of bank lines of credit in corporate liquidity management, this study is one of the first to use empirical data (not game theory) to analyze how lines of credit fit into the liquidity needs of public corporations.

By applying the same analytical tools as in the 2005 study, he now focuses on the different factors that lead firms to utilize bank lines of credit instead of cash in corporate liquidity management (Sufi, 2009). By doing so, his main finding of the study is that firm cash flow may have a large predictive effect in whether a firm uses bank lines of credit or cash in their liquidity management. Firms with low or below average cash flow, or with more cash flow volatility, may rely more heavily on cash as oppose to bank lines of credit for firms with high or above average cash flow, or with low cash flow volatility. Relating to the previous studies analyzed, cash flow joins profitability in being a key determinant in how and which firms use either tool. Specifically, he finds;

“The positive correlation between lagged cash flow and the use of lines of credit is robust to both the extensive margin of use (whether a firm obtains a line of credit) and the intensive margin (conditional on having a line of credit, how large a fraction the credit line is of firm liquidity). Finally, the positive correlation exists only among firms with a high probability of
financial distress; in other words, if a firm has high distress likelihood, then high cash flow is critical to obtaining a line of credit.” (Sufi, 2009)

To further distinction my study from earlier studies, I also incorporate the aspect of cash-flow to capture the effect of internal liquidity (cash generation). Even with the Sufi article, extant research does not empirically investigate or discuss why some firms utilize lines of credit while others rely on cash for liquidity, especially not during stressed scenarios. Being heavily contingent on bank lines of credit, makes, in theory, firms hold low cash reserves. Combined, it then makes it very interesting to investigate more in depth, as I am here, how bank lines of credit behave when there are shocks to these key measures (profitability and cash flow). A consequence could be for firms to be financially distressed due to liquidity setbacks (reductions/cancellations of the credit line) or in a worst case scenario lead to bankruptcy.

The Sufi article further builds upon this argument, by documenting that the important correlation between bank lines of credit, and profitability and cash flow, is heavily driven by financial covenants put down by banks who supply the credit. This is supported by Chava and Roberts (Chava and Roberts, 2008). Chava and Roberts finds that covenants, and the potential for violation, are embedded in mostly all loan contracts, and therefore a risk for largely all firms. They also document that in general, declining financial performance of firms is likely to trigger covenant violations leading to amendments of the loan contracts.

From measuring this effects, I attempt to show how much a financially based covenant violation decrease the bank line of credit capacity. Doing so will shed light on bank lines of credits ability to be a sustainable liquidity substitute for cash, when firms experience drops in financial performance.

4.2.3 Bank lines of credit versus cash holdings

In analyzing how bank lines of credit fit into corporate liquidity management, I find it relevant to compare credit lines in regards to cash as their role in hedging against future income shortfalls. Articles by Almeida, Campello and Weisbach (Almeida et al, 2004), as well as Acharya, Almeida and Campello (Acharya et al, 2007) concentrates on the cash aspect of this relation, and provide
evidence on how cash relates to debt in terms of their liquidity hedging aspects and holding preference. They find that (1) constrained firms prefer higher cash and lower debt, and conversely (high debt, low cash) if their hedging needs against income shortfalls are low (high). (2) That while cash allow firms who are financially constrained to hedge against income shortfalls, it actually is more effective to reduce the current debt.

I find this to relate well to bank lines of credit, where it is theorized that the outstanding debt is reduced by the cash, and instead, unused portions of line of credit constitutes the debt or hedging tool for income shortfalls. It is argued that firms have incentives to hold lines of credit, with the unused portion functioning as the hedging regulator. In the analysis section, I investigate this theory based on the empirical data I collect.

Cash is such an evident factor in the relation to bank lines of credit since both hold liquidity measures, and both come at a price. The opportunity cost of capital for cash, and the interest rates for credit lines. The aspect of cash generation becomes a critical measure in this thesis, as several of the key financial ratios and comparisons are made based on cash-related ratios levels and development over time.

Cash has readily been accepted as the tool most used to handle net working capital from day to day operations, some forms of investments and provide liquidity. However, certain disliked features are also associated with high cash-levels. Including entrenching motives (from an investor's viewpoint) and holding costs.

Much more theoretical material has been composed about the presence, usage and cost of cash in corporate finance liquidity management (Faulkender and Wang (2006), Haushalter et al (2007) and Bates et al, (2009)). As seen, the cash relation has primarily been investigated within the recent decade. This section will review a selected few that relates to the topic of the thesis.

In the 2006 study by Faulkender and Wang, they investigate the trade-off relationship between cash and external liquidity. They find a relation between the debt levels of firms and the amount of cash they hold, namely that highly levered firms (including credit lines) also hold more cash than lightly levered firms. They also find that the marginal value of cash decreases as the amount
of cash increases. In short, the results point towards the market perceiving internal liquidity as more valuable, but only to a certain degree or upper bound. The timing aspect of this relation is modeled by Thakor (Thakor, 2005) who based on his results theorize that firms uses credit lines to secure liquidity during contractions, and rely more on internal cash during macroeconomic expansion. He proposes that during aggregate credit contractions, firms will exercise the liquidity option embedded in their credit lines, and use them to secure against potential shortfalls in liquidity. As such, he theorizes the usage of credit lines to be strongest during negative macroeconomic scenarios, i.e. macroeconomic contractions.

Lins et al. (Lins et al., 2010) however, supports the opposite relation. Building on the conclusion by Holmstrom & Tirole (Holmstrom & Tirole, 1998) that firms view liquidity as being an insurance against future periods of lower cash flow, or constrained financing opportunities, Lins et. Al. performs an extensive qualitative survey. By surveying a large number of Chief Financial Officers about their usage of credit lines, incl. motives behind holding them etc., Lins et al. finds that the two liquidity sources cash and credit lines differ in usage depending on the macroeconomic outset. Operational cash is found to guard against cash-flow shocks and declining liquidity in bad times. Lines of credit on the other hand is predominately used to exploit future business opportunities available in good times.

Again, it becomes interesting to then look at how these credit lines actually behave during economic contraction. A goal of this thesis is to try to back up these findings with empirical data and potentially shed more light on the relation by looking specifically at how each liquidity tool is applied during a stressed scenario.

With these opposing views on the usage of credit lines during either ‘good’ or ‘bad’ economic times, it is clear that the body of literature could benefit from such a study.

As noted earlier in the section regarding how the search for studies used in this thesis was conducted, an important aspect is to critically asses every theory and study used. A process followed in this thesis, which is also why only a selected number of studies and theories are used. These are used as they relate to the topic and have been validated by other studies since their
inception. A limitation however is the relatively small number of studies performed. Arguably, a more intensively studied field of theory ensures more credibility and better discussion of findings.

4.3 Literary conclusion

To provide a summary conclusion to the literature surrounding this topic, it becomes evident that there are many different theories, models and hypothesis that could benefit from empirical backing. The papers considering corporate liquidity and which revolves around cash and credit lines, points to a interesting and largely unexplored line of research: How lines of credit behaves under stressed conditions, and what is the overall effect of macroeconomic conditions on firms liquidity management choices – more specifically their use of cash and lines of credit. Providing empirical data to this research can potentially affect future real corporate decisions regarding finance and liquidity choices. Something which makes it a very interesting case. This thesis uses the unique macroeconomic development from the past half decade to provide new information on the dynamic relation, which hopefully can helps corporate managers take well calculated and well informed financing decisions in the future.
PART 2

5. SUMMARY ANALYSIS

5.1 SUMMARY STATISTICS

To initiate the analysis section of this thesis, I start with a summary analysis of the data collected. In order to investigate the type of firms in the sample, their overall usage of credit lines and their propensity to be affected by negative changes in economy, the sample is analyzed based on a set of key measures, as described earlier under ‘Data’. The analysis of the measures serves to set the average levels for all the involved variables that will undergo time series analysis. It furthermore helps define each measures corresponding effect in relation to the firm and either is dependency towards or usage of credit lines. The findings are reported as summary statistics in Table 1.

5.1.1. FIRM CHARACTERISTICS

The first half of table 1 represents the summary statistics based on firm characteristics formed from the Compustat data. For the first three measures of cash, assets and debt ratio, I notice the large variation indicated by the standard deviation. It is estimated that the wide array of different firms in terms of size and debt composition leads to extreme outliers, in which case the median, for these three variables might be viewed as the more stable and accurate statistical parameter. For the remaining of the data, I use the mean (average).

For the random sample, the median cash level is $32.8 million and the median size of the companies (measured in assets) is $1.243 million. On average, cash, a primary source of liquidity, only represents 2.6% of the total assets of the firm if measured at the media - but there is a large amount of variation included in both these measures. Holding relative to other studies using Compustat data – Lins et al. (Lins et al. 2010) employs a bigger more statistically valid sample, and find a cash/asset ratio of 2 %, and a Bank line of credit / asset ratio of 15 % (18.2 % for my sample), which indicate that my sample correctly depicts the characteristics of the full sample universe, and that variations are common.
The debt ratio median is 0.67 or 67%. Total debt is an average of 0.529 or 52.9% of assets, where the long term debt portion of this is 0.29 or 29% of assets and the short term portion is

Table 1
Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assets - Cash</td>
<td>407.3</td>
<td>32.792</td>
<td>1132.2</td>
<td></td>
</tr>
<tr>
<td>Assets - Total</td>
<td>10063.2</td>
<td>1243.086</td>
<td>28143.4</td>
<td></td>
</tr>
<tr>
<td>Debt ratio (short term debt/long term debt)</td>
<td>57.42</td>
<td>0.67</td>
<td>443.93</td>
<td></td>
</tr>
<tr>
<td>Cash / short term debt ratio</td>
<td>0.5972</td>
<td>0.2907</td>
<td>1.1199</td>
<td></td>
</tr>
<tr>
<td>Long term Debt/Assets</td>
<td>0.2997</td>
<td>0.2051</td>
<td>0.5443</td>
<td></td>
</tr>
<tr>
<td>Short term Debt/Assets</td>
<td>0.2296</td>
<td>0.1937</td>
<td>0.1728</td>
<td></td>
</tr>
<tr>
<td>Total debt/Assets</td>
<td>0.5293</td>
<td>0.4548</td>
<td>0.5538</td>
<td></td>
</tr>
<tr>
<td>Profitability (EBITDA/Assets)</td>
<td>0.1039</td>
<td>0.1070</td>
<td>0.1926</td>
<td></td>
</tr>
<tr>
<td>Cash Flow (EBITDA/(Assets-Cash))</td>
<td>0.1055</td>
<td>0.1132</td>
<td>0.3018</td>
<td></td>
</tr>
<tr>
<td><strong>Line of credit variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has a line of credit {0,1}</td>
<td>0.87368421</td>
<td>0.81473684</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- No variation over observation period</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of credit line</td>
<td>484.1533</td>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unused line of credit</td>
<td>295.4715</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total line of credit/assets</td>
<td>0.1821</td>
<td>0.1181</td>
<td>0.2285</td>
<td></td>
</tr>
<tr>
<td>Used line of credit/assets</td>
<td>0.0575</td>
<td>0.0022</td>
<td>0.1107</td>
<td></td>
</tr>
<tr>
<td>Unused line of credit/assets</td>
<td>0.1246</td>
<td>0.0728</td>
<td>0.1649</td>
<td></td>
</tr>
<tr>
<td>Cash holdings/assets</td>
<td>0.0998</td>
<td>0.0575</td>
<td>0.1255</td>
<td></td>
</tr>
<tr>
<td>Bank liquidity ratio: Total line/(Total line+cash)</td>
<td>0.5617</td>
<td>0.6262</td>
<td>0.3588</td>
<td></td>
</tr>
<tr>
<td>Bank liquidity ratio: Unused line/(Unused line+cash)</td>
<td>0.4988</td>
<td>0.5412</td>
<td>0.3632</td>
<td></td>
</tr>
</tbody>
</table>

This table presents summary statistics for the sample of 95 non-bank firms in the period from 2007 to 2011. The sample is based on 475 firm year observations and divided into Firm characteristics and Line of credit variables.
0.22 or 22% of assets. Firms with high levels of short term debt will have greater incentives to draw down on their lines of credit in adverse situations to pay off set short term debt. As a result, these companies are also more exposed to reductions and cancellations of their credit lines.

Profitability and cash flow are both approximately at 10% on average, with profitability averaging 0.1038 or 10.38%, and cash flow averaging 0.1055 or 10.55%. At first this strikes as a substantial average cash-flow and profitability. The numbers however, also show that the average firm can be exposed to low or even negative profitability, within a small margin. The data shows standard deviations of .192 and .301 respectively. In both cases a one standard deviation drop from the mean would result in a level so low, it would be assumed a potential covenant breaching level. For cash-flow, the average cash-flow can drop to 0 with a drop from the mean of just 1/3 of standard deviation. Potentially, this low level could also result in a covenant violation.

In sum, the firms in the sample are suggested to be having the right characteristics present to objectively display any effect on liquidity and performance that could arise from reductions or cancellations of their credit lines.

5.1.2. Application of Credit Lines
Focus is now put on the line of credit variables, specifically to what extent lines of credit are employed by firms.

The statistics inform that in the random sample selected, a total of 87.3% of the firms have had a line of credit at some point in the 2007-2011 observation period. A very substantial percentage which suggests that firms obtain credit lines to great extents – even during stressed scenarios. Again, the finding are very similar to that of another study, in this case Sufi (Sufi, 2009), who from the larger 300 firms sample (representing 6.5% of the total sample at the time), finds a line of credit with 85% of the firms in the sample. The similarity in this key statistic confirms the findings of Sufi, but also provides validation to the results of the dataset employed here, even though it is based on a smaller sample. The fact that the sample show similar statistics to a sample that is statistically significant (over 5%) helps argue it is an accurate representation of the total dataset and corresponding to previous studies. Obtaining results similar to those of Sufi who undertook his investigation in a non-stressed environment is interesting. It advocates that
credit line obtainment is stagnant and at this first finding – does not seem to be affected by the stressed environment.

Deriving the same statistical measure, but now based on firm-year observations, i.e. including years where a firm does not have a line of credit, contingent on that firm having a line of credit at some other point in the time-period, a total of 81.4% of firm-years have a line of credit registered.

The difference between these two measures captures the variation parameter of firms fluctuating between having a line of credit, and not having a line of credit which is important in regards to how firm view credit lines that might not be used (drawn down)

Amounting to approximately 6 percent, the difference in the two results tells that firms largely either hold a line of credit – or don’t. Very few firms in the sample fluctuate between having a line of credit one year, and not having a line of credit the next. What this statistical result implies is that firms keep rolling over their credit lines on a continuing basis, despite the fact that some of these credit lines are not used (drawn down) at all during the sample period. From a logical standpoint, credit lines that are not used should not be maintained if the economic outset allows for a stop. However, these findings provides support for the case and argument that firms, if they have a line of credit, have great incentives to keep it and likely will be negatively affected if the line of credit is not prolonged, gets revoked or gets substantially reduced – for example as a result of a covenant violation.

A possible way to try to explain this relation by other means is by arguing the bank lines of credit contracts do not allow for the flexibility of changing from year to year, whether or not to hold a bank line of credit or not. And that this is the reason for the lack of variety. While this argument is reasonable, firms in the sample entered into new contracts during the observed period and still showed the tendency to continue having a bank line of credit – even those who were not drawn down. These observations effectively rules out contract formats as the cause of lacking variation in year to year credit line agreements.
The next three measures show the relation between average size of the total credit line, used amount and unused amount, all related to the size of the firm denoted by assets. These ratios take into consideration the individual size of the bank line of credit relative to the size of the firm. Doing so allows for a more accurate representation of the data, not skewed by potentially large numbers of large firms or small numbers of small firms.

On average, total line of credit to assets (the amount of total credit line obtained by the firm), henceforth TLC/A, is found to represent 0.182 or 18.2% of assets. Representing 18.2% of the firms’ assets, firms are found to have a substantial amount of liquidity tied to their revolving credit facilities. Almost double the fraction of cash holdings.

Used line of credit, henceforth ULC/A is 0.0575 or 5.75 percent of assets and unused line of credit, henceforth UNULC/A, is found to represent 0.124 or 12.4% of assets. Combining these first three measures, it shows that firms only use approximately a third (31.5%) of their available credit lines on average, with almost 2/3 standing undrawn. In total, the actual average amount of credit line being used is only 5.75 percent of assets as shown by the ULC/A ratio. Initially these findings suggest that firms obtain quite substantial credit lines when compared to firm size, but that the actual implementation of these credit lines via draw downs is limited. Again a very interesting finding since the maintenance of credit lines is associated with certain costs.

As the focus of this thesis investigates credit lines as a source of short term liquidity, the results for these findings need to be held up against the results for the other main short term liquidity tool, cash.

The average cash/asset ratio for the sample is found to be just shy of 10%, at 0.09975 or 9.975% of assets (All cash are assumed readily available to provide liquidity). Compared not to total line, but only to the draw downs on credit lines, cash seem to be the larger held liquidity tool by firms. But the cash-ratio also have a lower standard deviation of only .125 compared to .228 for TLC/A. The difference in these two standart deviations suggests that there is more variation in the amount of liquidity provided from bank lines of credit than for cash. The larger standard
deviation for the credit line ratios indicate that firms view on how much liquidity should be supported by a credit line, differ quite substantially when compared to how much should be supported by holding cash. (Cash holdings are assumed to be held for the purpose of short term liquidity. This is the reason it is compared to the draw down aspect of the credit lines.) The difference in standard deviation, and the fact that the standard deviation for credit lines is relatively large, point towards large variations from firm to firm of how much the credit line is drawn. As such, while the average usage of credit lines are low, individual firms in the sample may use credit lines to a great extent. In return, these will also be more vulnerable to changes in their credit lines.

To further investigate the degree of credit line implementation, credit line debt is compared to total debt\(^2\). Credit line debt is defined as the amount of debt supplied by the credit line.

As previously noted, total debt is found to be an average of 0.529 or 52.9 \% of assets. By comparing total debt to credit line debt, I get a measure that indicates to what extent firms employ credit lines relative to other forms of debt.

Given total debt is 52.9 percent of total asset, bank line of credit usage is found to account for an average of 10.8 \% of outstanding debt (the amount drawn), and approximately 25 \% of marginal debt availability (the amount available). A significant portion.

Comparing to total debt then, I find credit lines to be a substantial and important part of the average firms’ debt composition, especially in terms of available debt. Correspondingly, any reductions a firm might face in its credit line could substantially impact the debt composition and the way the firm funds its operations.

Finally, in order to isolate the pure liquidity aspects of credit lines, and assess the magnitude and importance of their existence in corporate liquidity management, I look to two measures that designate bank liquidity to total liquidity: (1) Total line ratio and (2) Unused line ratio. Similar to some of the other measures employed – these two measures were pioneered by Sufi (Sufi, 2005).

\(^2\) Total debt is used since bank lines of credit hold varying terms on their outstanding amount. They cannot be specifically classified as neither short term debt, nor long term debt.
(1) Total line ratio is a measure that measures the amount of bank lines of credit liquidity engaged in the firm, scaled by total liquidity (cash and bank lines of credit). It takes into consideration the concern that some firms consistently draw down heavily on their bank lines of credit which can skew the data for the next measure; Unused line ratio.

(2) Unused line ratio measures the amount of available liquidity to a firm in the form of lines of credit, by scaling the unused amount available in the firm's line of credit by the sum of unused line of credit and cash. Similar to total line ratio, the unused line ratio captures how dependent the firm is of its bank lines of credit to provide liquidity.

In short, the two ratios isolate what can be defined as liquidity for the firm, and calculate how much of this liquidity is attributable to credit lines.

The results for the total line ratio show bank lines of credit representing 0.5617 or 56.17% of total liquidity, while the second measure, unused line ratio, show bank lines of credit provide 0.4988 or 49.88% of available liquidity. Together, these two measures show that bank lines of credit provide, on average, over 50% of firms total liquidity, making them very important to the firms who obtain them. Which is likely why so many firms have them as part of their debt structure. For 120 firm-year observations in the sample, the ratios are even found to be over 90%. That means that for almost a quarter of the sample, bank lines of credit is essentially the main and only liquidity tool engaged. Consequently, maintaining access to bank lines of credit is especially essential for firms in this upper decile, and they can be categorized as extremely exposed to changes in line of credit availability.

5.2 Partial Conclusion
From the statistical analysis performed on the sample of 475 firm-year observations, an understanding of the key characteristics of the firms in the sample is obtained. These initial results show that on average, firm year observations have short/long term debt ratio's of 67%, making them vulnerable to money market squeezes or negative changes in their liquidity sources.

Almost a quarter of average firm debt is found to be short term debt which further solidifies this vulnerability.
For the main firm performance related measures, profitability and cashflow, I find the average levels to be at a fairly stable level on average, but only 1 and 1/3 of a standard deviation away from 0 (negative).

87.3 percent of firm-year observations included a line of credit that shows that credit lines are an important part of firms debt structure. Along with other firm characteristic data, this result is very similar to previous datasets with much larger sample sizes (Lins et. al (2010), Sufi (2009)). From I similar measure, I also find that firms holds and prolongs bank lines of credit, even if they do not draw down on them at all.

Digging deeper, my analysis finds that bank lines of credit amounts to 18.2 % of assets, 10.8 % of outstanding debt, approximately 25 % of marginal debt availability and over 50 % of liquidity, even though that these measures varies. All together, they all point to one conclusion: That firms are very dependant of bank lines of credit. Isolating the fact that 50 % is the fraction of firm liquidity provided by bank lines of credit just solidifies all these results and emphasizes the importance of bank lines of credit in corporate liquidity management.

Combined, I find the statistical analysis to have successfully shown that bank lines of credit are extremely important tools in corporate liquidity management, and how firms are exposed to negative changes in their credit facilities. However, the findings also indicate that firms do not actually use credit lines to a great extent. Performing a time series analysis next, should help shed light on these findings.

6. TIME SERIES ANALYSIS OF LINES OF CREDIT USAGE FOR LIQUIDITY

The main goals of this thesis is to analyze how bank lines of credit behave during a stressed economic scenario. This is done to test if their usage and importance increase/decrease, as well as if their availability is contingent on firm performance, and if so – to what extent.

To do so, I perform a time series to look at how firms use specific measures of liquidity and bank lines of credit during the sample period. As the overarching argument for using the sample period is the general macroeconomic downturn that occurred between 2007-2011, the time
series analysis should present any changes in these measures, caused by the negative shock to the world economy spilling over on firms. Accordingly, it should showcase any tendencies credit lines have to get reduced during declining firm and economic performance.

To capture this effect, 2007 is denoted as the “normal” state from which the development for the next four years is benchmarked against.

I analyze a total of six measures: total line of credit/assets, Used line of credit/assets, unused line of credit/assets, Cash holdings/assets and the two bank liquidity ratios defined in the previous section. To construct the data for the time series analysis, I used the existing data, but segmented this data into each of the five years from 2007 through 2011. Based on this segmentation, I then performed the same statistical analysis as performed earlier. Combined, this analysis allows for the development in each of the measures to be tracked for the entire length of the sample period. My results are presented in Table 2 and in Figure 1 through 6.

6.1 Total line of credit/assets

*Figure 1*
The table presents summary statistics for each of the consecutive years 2007-2011 for the sample of 55 non-financial firms.

<table>
<thead>
<tr>
<th>Variable</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unversal line/Total line</td>
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<td>0.5946</td>
<td>0.3400</td>
<td>0.2777</td>
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<td>0.4900</td>
<td>0.3600</td>
<td>0.3400</td>
<td>0.3000</td>
</tr>
<tr>
<td>Cash holdings/Assets</td>
<td>0.1800</td>
<td>0.1905</td>
<td>0.1800</td>
<td>0.1800</td>
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</tr>
<tr>
<td>Unversal line of credit/assets</td>
<td>0.2400</td>
<td>0.2400</td>
<td>0.2400</td>
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<tr>
<td>Total line of credit/assets</td>
<td>0.2700</td>
<td>0.2700</td>
<td>0.2700</td>
<td>0.2700</td>
<td>0.2700</td>
</tr>
</tbody>
</table>

**Table 2**

Time Series Analysis
In 2007, the “normal state” year, the Total Line of Credit/Assets ratio was an average of 17.35 % aggregated for the sample. This number translates into every firm having $173.5 million in line of credit for every $1.000 million in assets. Looking at the first half of the time period, this ratio peaked in 2009 at 19.27 % showing an increase of 11.02 % or $19.2 million in the average amount of credit line held. For the second half going from 2009-2011, the ratio drops back and returns to slightly below the initial level at 17.21 %. This development implies that from 2007 to 2009 firms increased their credit lines quite substantially. Considering the general assumption that the crisis topped in 2009, and that banks as well as the general market for debt and credit was also stressed during this period of time, an increase in the credit lines to firms might seem peculiar. However, as suggested by Thakor (Thakor, 2005), firms are theorized to increase their credit lines via contract options when facing negative economic outlooks. Investigating this scenario based on my data finds support hereof. The further investigation resulted in the following findings: While some of the increase is due to firms simply increasing the limit of the credit line as contracts gets renewed, a major driver is the increase in already existing credit lines. What is found is that in many of the credit line contracts investigated, the firm has an embedded option to increase the upper limit of the credit. For example a $100 million revolving credit line – with a $20 million option embedded to it, which can be exercised by or when the firm chooses. While it is not disclosed implicitly in every Form 10-K’s, I argue based on the findings that the increase seen from 2007-2009, is primarily driven by firms bolstering their financial position by increasing the upper limit of their credit lines. A very interesting finding as it show firms looking to bank lines of credit as a marginal source of liquidity.

The drop from 2009-2011 on the other hand might be due to two factors. (1) Firms that initially increased their liquidity position by increasing their credit line leading up to 2009, may after 2009 be reducing these again. (2) The lagging characteristics of credit lines combined with the escalating crisis makes the effects on availability to first kick in from 2009 and onwards. I find both to be equally likely, but as the data does not go beyond 2011, the trend for the lagging characteristic cannot be verified or credibly determined.
In sum, Figure 1 showcase that on average, firms actually increased their credit lines during the first years of the crisis from 2007-2009, but that there since 2009 has been an equal drop in credit lines, potentially caused by the stressed scenario affecting credit line availability. It can be concluded however that firms view credit lines as an important tool in managing their marginal liquidity. As the economic outlook starts to deteriorate, credit lines are found to be used to flexibly increase or decrease short term liquidity access.

To investigate how firms then used these obtained credit lines during the stressed scenario, I have also collected and time series analyzed data on the credit line usage. (used and unused) The results are depicted in Figure 2 & 3

6.2 Used line of credit/assets

*Figure 2*

Analyzing the actual usage of lines of credit to assets does not indicate to the same extent, that firms collectively drew down their credit lines during the period as a whole, or in the peak year of 2009. The increase in credit line usage went from 4.33 percent in 2007 to 6.67 percent in 2009, suggesting that even though firms secured their liquidity by increasing their max limit
availability under their credit lines – they did not draw down on these as extensively to fund set short term liquidity. In percentage terms, the draw downs increased 54 %, but compared to asset size, the increase is not substantial at only 2.34 percent.

Looking more nuanced at this, I include the standard deviation to look for changes that is not captured by the average nature of the mean measure. During the sample period the standard deviation increases about 30 %, from 0.0917 in 2007 to 0.1232 in 2011. What spurred this increase in standard deviation is a greater variety in the numbers, meaning that some firms are drawing down more heavily on their credit lines, i.e. exhibiting more reliability on these for liquidity, than others. Still, on an overarching level, the data does not indicate a substantial increase in the usage of credit lines during the stressed scenario.

Looking towards the unused portion of credit (which depicts credit line availability), the trend is the same (but inverse):

6.3 Unused Line of Credit/Assets

The relation between Figure 1 & 2 is shown in Figure 3 which displays the unused line of credit as a fraction of assets. Translated, Figure 3 effectively shows the amount of line of credit available on average to each firm in the sample during the sample period, taking into regard both the development in total line of credit and used line of credit. Measuring this ratio measures how firm used their credit lines, relative to how they increased them.

In 2007, the level of line of credit available (total line of credit, reduced by the amount drawn) amounted to 13.02 % of assets. During 2008 this amount dropped to 11.83 %, signaling a small drop in liquidity availability, but grew again through 2009 to a period high of 13.59 % in 2010, before dropping to 11.37 % in 2011. The tendency show that despite firms increasing their total line of credit from 2007-2009, the unused line of credit available dropped, indicating that usage for this period was higher. Still however, the trend is not significant enough to classify credit lines as being heavily used by firms in corporate liquidity management. The drop from 2010 to 2011 is unaccounted for, but is likely due to firm specific variations or a result of declining use + declining maintenance of credit lines as the stressed scenario ebbes out.
All in all it’s an important finding, especially compared to the general level as well as increase seen for the total line. It raises the question if firms actually obtain and hold significantly larger credit lines than is in reality needed for usage, even during stressed scenarios where the need to draw liquidity from these credit lines should become apparent. Based on the general data, one could argue that firms hold any given (high) level of credit line to protect against scenarios where liquidity becomes scarce. But when such a scenario is tested as it is here and it still do not motivate credit line usage, the general level of credit line held becomes subject to scrutiny.

To hold the development in the credit line usage relative and to try to answer this question, I look to the time series analysis performed on cash holdings, as well as the two bank liquidity ratios to see if these exhibit the same tendencies, and to see if there is a distinct variation in how firms use these cash holdings in contrast to credit lines. The analysis of the two bank liquidity ratios should also project the first indication whether or not firms experienced a drop in credit line availability. The analysis for cash holdings is presented in Figure 4.

Since the bank line of credit data did not show a significant increase in accumulated draw downs, I look to the data for company cash holdings as a fraction of assets. This ratio measures the

![Figure 3](image-url)
proportional development of cash holdings relative to firm size, adjusted for cash itself in the assets compilation.

6.4 Cash holdings/assets

**Figure 4**

![Cash holdings/assets graph](image)

Again assuming the 2007 data as the ‘normal’, cash levels dropped from the normal level of 10.89% of assets in 2007 to 9.95% in 2009 and finally to 9.49% in 2011. Not a significant drop that could indicate a substitution to cash reserves instead of credit lines as the main liquidity funding tool. The standard deviation stayed consistent, meaning that there are no large outliers that skew the data or can be ruled as firm specific exemptions from the general trend.

If firm cash holdings had dropped more significantly during the period, it could be indicating either an increased use of cash, or a reduced degree of cash retention as the source of low credit line usage. No such trend was convincingly proved.

Based on the findings so far, the indication is that firms did not use neither bank lines of credit of cash holdings to support any substantial liquidity needs. Assuming that firms must have had some form of liquidity need, the cause of this lack of development is argued to likely be due to the
usage of operating cash flow to support the short term liquidity, or the usage of other financial
debt/liquidity tools, not measured in this thesis. Further cause could be the type of firms
investigated. Campello et. al, (Campello et al., 2009) finds that limited use of credit is more likely
for public investment grade firms. Smaller, more constrained firms, will use credit lines more
intensively. My findings here support this notion, and find this to be true also during a
macroeconomic contraction.

6.5 **Bank Liquidity Measures**

The numbers and graphs of figure 1-4 are all ratios related to firm size/assets in order to get the
most representative results across the varying sample in terms of credit line usage. To isolate the
development in bank lines of credit, specifically in terms of availability, firm size (assets) should
remain constant and not fluctuate. When firm size fluctuate, as they are identified to be doing in
this analysis, it can create a distortion of the results which needs to be accounted for when
drawing conclusion based on the finding. To counter this potential distortion, two bank liquidity
ratios are employed to see how firms overall liquidity supply from bank lines of credit were
affected during the stressed scenario. These two ratios are displayed in Figure 5 and 6.

*Figure 5*

Bank liquidity ratio: Total line/(Total line+cash)
From figure 5 it can be seen that liquidity provided by bank lines of credit totaled 59.2% of total firm liquidity in 2008, which is the peak in the sample period. From 2008 to 2011, the ratio dropped 6.5 percent to reach 52.7% in 2011. Although the ratio dropped approximately 6.5 percent, the development still only represents a small to moderate change, and show the same tendency as the previous findings, albeit more distinctive than the development of cash holdings and used line of credit. A limitation is presented again, as the data does not go beyond 2011 to potentially confirm the reduction in bank liquidity that is ongoing up until 2011. While there seem to be a trend of reduction on the credit line availability – it is not possible to convincingly say how big or what effect the reduction in bank lines of credit may have on driving this downward trend, or if it continues.

The development in the data depicted in Figure 5 indicates that one of two things happened during the time period. Bank lines of credit were reduced, or cash holdings were reduced. When holding in comparison to the drops in both total lines of credit and cash individually from figure 2 and 3, the development in the ratio confirms that bank line of credit usage by firms lessened in comparison to cash. This assumption is found to be confirmed by Figure 6.

**Figure 6**

Bank liquidity ratio: Unused line/(Unused line+cash)
In Figure 6 the ratio displayed is the unused line of credit liquidity ratio.

Overall the availability ratio in figure 6 is fairly stable, but drop from 0.5166 in 2007 to 0.4785 in 2009. The drop off in 2009 as seen on the figure indicate that at this specific year, firms did have a reduction in bank lines of credit compared to cash. In general over the sample period though, there is only a slight tendency present indicating that some reduction in credit line availability was taking place, but no substantial overall reduction in credit line availability happened. Isolating the level the unused line of credit operates at, it indicates that even though credit lines are seen to be reduced, the usage of the credit line was also reduced.

Looking for the cause of this limited use of credit lines, I returned and investigated the Form 10-K’s. My finding were that several companies specifically refer in their Form 10-K to cash flow from operations as a tool used heavily to secure liquidity. Altra Inc. supply anecdotal evidence in their 2011 Form 10-K:

"We finance our capital and working capital requirements through a combination of cash flows from operating activities and borrowings under our senior secured revolving credit facility ("Revolving Credit Agreement"). We expect that our primary ongoing requirements for cash will be for working capital, debt service, capital expenditures [and - edited] acquisitions."

- Altra Inc. 2011 Form 10-K

Given that operating cash flow is the ‘third’ and final liquidity tool, the lack of development in cash holdings and credit lines suggest that firms were able to depend on their operating cash flow during the stressed economic period.

These findings shed some light on the relation between what type of liquidity tool are primarily used by firms during stressed economic scenarios. Thakor (Thakor, 2004) argues bank lines of credit are primarily used, while Lins e. al. (Lins et al., 2010) argue firms primarily use cash during stressed scenarios. Based on my findings, cash, in the form of operating cash flow, is indicated to be the primary tool for firms to use during stressed scenarios to provide liquidity. However, to the extent that operating cash flow cannot provide all the liquidity needed – firms are found to be employing bank lines of credit to a slightly bigger degree that cash-holdings.
It's a very interesting finding since it suggest bank lines of credit along with cash-holdings are not used extensively to supply short term liquidity, but mainly held as liquidity buffers. A finding that goes against the initial theories put forward in the beginning of the thesis. With 85 percent of firms having a line of credit at some point in the sample period, combined with total bank lines of credit amounting to approximately 18 percent of firm assets, firms employ a large portion of liquidity relative to assets into credit lines. The data show that firms increase their credit lines during the sample period. However, the data also show that even under extreme\textsuperscript{3} economic stress, firms do not actively apply these bank lines of credit as a short term liquidity tool, or at least only to a limited extent. Instead it is found that operating cash flow might cover most of the liquidity need. As the bank lines of credit are not being applied in stressed scenarios, for which instead operating cash flow fund short term liquidity, the credit lines as well as the cash holdings can essentially be viewed as liquidity buffers.

To try to investigate if there were any findings like this in the literature, I found several articles that can be related to the results. (see: Boot et al. (1987), Berkovitch & Greenbaum (1991), Holmstrom & Tirole (1998) and Demiroglu & James (2011)). These studies focus on bank lines of credit, not as a source of short term liquidity, but rather as a tool to secure future liquidity. My initial results are in line with these theories and findings, and back the notion that bank lines of credit, even when firms are enduring extreme economic stress, are not used for short term liquidity. Rather they are used as liquidity/capital buffers. Generally in these studies, it is suggested that bank lines of credit are not obtained for the purpose of short term liquidity as much as for the purpose of providing future liquidity. Firms are proposed to employ credit lines with the purpose of providing a funding capability to fund future investments in times where the access to credit markets might be constrained. By obtaining credit lines, it is suggested that firms bypass the potential of capital market constrains, prohibiting them in funding a future investment. In these earlier studies, the results were based on scenario modeling. For example where a firm was given two investment periods, and introduced with a credit line in the later scenario to see how this affected the degree of investment. Findings in general supported that

\textsuperscript{3} I define the world economic crisis as an "extreme" situation
introducing credit lines increased investment in the stressed scenario. This is the investment relation described in the beginning of the thesis.

To see if these modeled results also comply with the empirical data, I re-analyzed the Form 10-K’s for a second time in the upcoming section. This time, the method applied was to search and isolate the draw downs on credit lines, to see if there was any material investment made which driven by the particular draw down. Incorporating this empirical data from Compustat and Form 10-K’s distinguish my analysis from the more theoretical and modeling nature of these earlier studies.

6.6 PARTIAL CONCLUSION

The purpose of the time series analysis in this section is to see how bank lines of credit variables (coupled to firm size) behaved during the sample period. The goal is to identify if, on a general basis, the economic distress affected the way firm used bank lines of credit as a liquidity tool. The analysis focuses on the average or collective development for all 95 firms in the sample. To a large extent, this was also examined in relation to cash in order to see if firms distinctively used one or the other in the stressed scenario. The findings show that firms on average increased their line of credit by 19.2 million from 2007 to the peak in 2009, and reduced it back to 2007 numbers by 2011. Neither the used amount of credit lines or cash holdings showed any imperative reduction in their fraction of assets, suggesting that firms in the sample did not apply heavy support from either cash or bank lines of credit to provide liquidity. Rather, and to a larger extent, firms are suggested to be funding short term liquidity with the operating cash flow generated from operations.

The findings based on my empirical data also6 supports earlier theories from studies which suggest that bank lines of credit are used by firms to fund future investments. To be able to shed more light on the relation, I perform more specific in-depth analysis of this to back up the findings so far, and investigate if the investment incentive holds.
7. INVESTMENT DRIVEN DRAW DOWNS

7.1 USAGE OF CREDIT LINES FOR INVESTMENTS

After having analyzing the use of credit lines for short term liquidity in the previous section, I now turn attention towards the second part of the analysis. The analysis of bank lines of credit usage to fund future investments.

The argument for bank lines of credit driving future investment is logical, and is based on restrictions in the capital markets. When the economy contracts and firms access to capital resources can get restricted, it is argued that the nature of the pre-mandated bank line of credit serves as a key source of capital. Capital than can be used to fund investments not else able to find funding for.

The information asymmetry between companies and banks are seen as one of the major drivers behind this firm-specific reduction in credit availability, as supported by Demiroglu & James (Demiroglu & James, 2011).

Essentially, banks cannot know which firms are seeking loans for survival, and which are seeking loans for other purposes such as investments. Coupled with the increase in transaction costs (incl. higher rates) due to banks being financially stressed, and the increased risk and volatility in the markets, these restriction can be severe enough to the point where firms will either not be able to obtain new loans for investments or will be forced to pay a very high interest rate. This difficulty to fund new investment naturally increases if the investment or the firm itself has a high risk profile.

Embedded in this relation we thus find a driver for firms, during negative macroeconomic scenarios, to not only have a push by the markets for engaging in fewer investments, but also for engaging in less risky investment, i.e. investments with a low risk profile or low price/cost.

So what about other means of financing than the immediate? Well, trying to fund the ability to invest by issuing new debt or equity also becomes more difficult in times of economic stress. First
off, issuing new debt or equity (for example bond/stocks) will only be attractive for large investments due to the transaction costs related. To issue shares as the marginal flexible source of capital for smaller to mid-sized investments would also be very cost inefficient.

Secondly, in a negative economic environment, issuing new debt/equity may entail signaling problems. Even though the firm may try to communicate it is only sourcing capital for making new investments, perception may be different. The market may perceive the new issue as the firm being in financial trouble and cause the bond/stock to drop. The presence of information asymmetry between the firm and the market is a major driver of this signaling problem, as well as a driver for the other mentioned aspects.

Finally, the adverse effect from a stressed economy on firm outlook and valuation will also negatively affect the potential for sourcing new capital via new debt or equity. Even though the firm may be in good financial shape, it will very likely to be experiencing a drop in valuation and share price driven by the systematic exogenous risk. Issuing debt in times where this relations hold will force managers to issue ‘cheap’ debt/equity, which is generally avoided.

What are left for firms to apply are the two measures investigate so far: cash and bank lines of credit. For the aspect of cash, the data from the sample suggest that cash, primarily in the form of operating cash flow, is used to fund the short term liquidity of day-to-day operations. In times of economic distress, the full liquidity of cash makes it a valuable tool for exactly this purpose. However, the relation between cash and investment for public firms have been studied before (see Campello et. Al, 2009). Campello et. Al. performs a regression from which they find that in the complete absence of external funds, including bank lines of credit, cash savings and investment compete for funds and have an inverse relationship. Firms that save most also invest less. But by introducing bank lines of credit, this relation is reversed which supports the argument that bank lines of credit are held as a mean to fund investment.

By combining the arguments and information above, I find that relative to the access to other forms of funding which contract during a negative trending economy, bank lines of credit should in theory be a superior tool to fund investments in times of constrained capital markets. The following empirical testing of this will provide further information to the topic.
In order to empirically investigate bank lines of credit as a mean to fund future investments, and how effectively bank lines of credit provide future liquidity to do so, I identify investment timing and covenant violations as two key measures.

Specifically linking investments to bank lines of credit has previously been done by modeling a scenario driven ‘playing field’. Firm behavior was modeled in a series of steps in which investment opportunities was then introduced in one of the stages (Berkovitch & Greenbaum, 1991). Another attempt has been made by interviewing CFO’s from a variety of firms (Lins, et. al, 2010) for a more qualitative result. Instead of these approaches, I manually analyze the sample of 475 firm year observations I extracted. To my knowledge this is the first attempt at using direct empirical data to investigate the relation between the credit lines and their propensity to fund investments.

My method is to search each individual Form 10-K and register in a matrix if a draw down on a line of credit is associated with an investment at the corresponding point time. Such a situation is registered when the firm inform in the Form 10-K that the draw down is due to an investment. I denote the data as [1, 0], where 1 represents a credit line draw down caused by an investment, and 0 represent a draw down with no associated investment. An example of a draw down driven by an investment is anecdotally described in the 2007 Form 10-K of Macquarie Infrastructure Co:

“We have entered into a revolving credit facility at the MIC Inc. level, that provides for borrowings up to $300.0 million primarily to finance acquisitions and capital expenditures pending refinancing through equity offerings at an appropriate time. Currently we have drawn $56.0 million to fund the acquisition of Seven Bar FBOs. [...] The total purchase price is approximately $40.1 million (subject to working capital adjustments) and a further $1.7 million is expected to be incurred to cover transaction and integration costs. The purchase will be financed using part of the $56.0 million drawdown on our MIC Inc. revolving acquisition credit facility.”

- Macquarie Infrastructure Co. Form 10-K (2007)

To more specifically measure the degree to which firms draw down on their credit lines to fund investments, I adjust the data to only incorporate firm specific years where there was a draw
down present. The reason for this process is to eliminate firm year observations with no drawdown observed. The inclusion of these observations will negatively affect the total fraction of years where draw downs are driven by an investment. Firms which have no line of credit in place must be taken out of the equation if not to skew the data by artificially inflating the total draw down coefficient which investment driven draw downs are measured against. If there is no draw down in the current year, it is obvious that there will not be a draw down due to investment. I further constrict the adjustment factor by setting a lower argument of a minimum of 5 million in year-to-year drawdown for a firm year to quality as material. This arbitrary boundary is set because I find no draw down less than 5 million to have potential to be due to an investment that could not also be financed with either cash holdings, cash from operations or even in constrained capital markets.

Securing adherence to this boundary, the data on the size of the draw down is thus also considered. This data is collected via the Form 10-K’s. I calculate and note the size of each individual draw down in USD millions. By plotting the difference in the drawdowns between year $n$ and year $n+1$ – results that does not comply with the relation $\text{Investment} > 5.000.000$ is excluded.

A decisive factor for performing this data collection is that firms note in their Form 10-K if a draw down is associated with funding an investment. While I cannot eliminate the potential for errors in the data due to missing information, I accept the method as valid based on the legal requirement and general propensity for firms to discuss in their Form 10-K any investments that substantially affects, add to or alters their business.

The findings are presented in Figure 7 below:

As displayed in Figure 7 - the total dataset resulted in findings which show that 7 % of the draw downs made during the 2007-2011 sample period were directly related to a firm specific investment at the corresponding point in time as the draw down. Based on only draw down years, this is found to be a small fraction. The findings suggest that presence of external flexible funds in the form of bank lines of credit, do
fund corporate investment – but they do not seem to be a driver for such investments to the extent previously argued in the literature (Berkovitch & Greenbaum, Lins et al.). Similar to the findings about bank lines of credit supplying liquidity, the empirical data does not support the aspect of credit lines being a driver of investments in a constrained capital market. While I have no proxy for the ‘average’ level of investment in normal times to hold relative to the number of investments made in the sample pool, I also find it irrelevant for the case in point. The data is only tested to identify the degree to which bank lines of credit is a driver for investment during stressed scenarios.

*Figure 7*

**Investment driven draw downs**

From analyzing the data in Figure 7, it is not found reasonable for firms to hold credit lines to the extent they currently do at on average 87.3 % of the firm-years and at 18.2 % of total assets. My findings do support that bank lines of credit is used to fund some future investments, but also
provide evidence that too many firms on average maintain credit lines in abundance to their investment needs.

To further back up this statement, I isolate the draw downs associated with investments, and calculate the size of the draw down compared to the size of the credit line in total (available amount). This procedure captures how big the draw down is, as a percentage of the total credit line available. Compiling each observation, I obtain results which show the draw downs associated with investments on average comprised of 37.6 percent of the total credit line held. Isolating the investment need – this finding show that firms could on average have sufficed with holding slightly under two thirds of the size in credit lines currently held.

Combined with all the other results, the tendency seem to be clear. Firm do not use credit lines for liquidity or investment to an extent that can support the holding of the current level of credit lines. The finding here supports the earlier results, and back the argument that credit lines are held in abundance to their use and need.

7.2 Partial Conclusion

In the concluded analysis I use an empirical data based approach to investigate bank lines of credit and their corresponding draw downs driven by a need to fund investments. Earlier studies suggest the obtainment of credit lines to be motivated by a fear for future capital market constraints. From a theoretical standpoint, this hypothesis seems logic, as the nature of credit lines are viewed to be a superior funding tool during negative economic periods – such as the period investigated here. However, the empirical results find that in total, only 7 % of the firm year observations were there occurred a draw down, was this draw down due to a firm specific investment.

Not isolating observations with draw downs only, this number falls to 2.6 %. Breaking the numbers down to the fraction of total credit line size, this fraction amounted to 37.6 %, suggesting that even for those credit lines that were used to fund an investment, the drawdown only amounted to slightly over one third of the total sum available. Furthermore – no firms were observed allocating draw downs to an investment more than one time in the sample period. My
findings from the empirical data indicate that firms only apply credit lines to fund investments to a small degree. This results in firms on average holding too many credit lines, and to large credit lines. While individual differences from firm to firm may be present (For example I cannot fully demote the use of a bank line of credit as critical for one particular firm in securing short term liquidity or funds for a future investment) I find that the empirical data in general does not support the ‘investment motivation’ as a critical motivation factor for obtaining a bank line of credit.

8. Firm Specific Factor

To get a better grasp of the results and to investigate and discuss why the result show firm holding significantly higher credit lines than their use should imply, I look to investigate the potential for firm specific factors affecting the average level credit line obtainment. I look at this from both the liquidity and capital to engage in investment perspective.

8.1 Liquidity

While the data suggests firms do not significantly drawing down on their credit lines during the stressed scenario period, the data does not illustrate perfectly the firm specific cases where there actually was a drawdown associated with a liquidity problem. Analyzing the Form 10-K data again, I find several observations were this is the case. An example is the 2008 Form 10-K of Supermedia Inc.

In the phrase presented, Supermedia Inc. addresses their all out draw down on their credit line, which went from $0 drawn in 2007 to fully drawn in 2008 with $247 million. A draw down that differs radically from the general findings.

“On October 24, 2008, we initiated borrowings of $247 million under our existing $250 million revolving credit facility, leaving available funds at December 31, 2008 of approximately $0.3 million ($250 million revolving credit facility less $247 million in initiated borrowings less $2.7 million in
letters of credit outstanding). We made this borrowing under our revolving credit facility to increase our cash position to preserve our financial flexibility in light of the current uncertainty in the credit markets. In accordance with the terms of the senior secured credit facility, we intend to use the proceeds from the borrowing for general corporate purposes."

- Supermedia Inc. 2008 Form 10-K

Despite the fact that there is no specific measure or number for this firm specific factor, it becomes evident from the anecdotal evidence from Supermedia Inc. and the other findings, that a portion of the firms in the sample were very much dependant on their credit line to supply short term liquidity and flexibility. Even though the general tendency points to the opposite. While the example of Supermedia is not the norm, it pinpoints the firm specific factor not fully captured in an empirical sample and analysis as the one done in this thesis.

The notion of a firm specific factor is defined as the individual firms’ characteristic and correlation with economic context which can be viewed as part of the explanation to why firms hold so high levels of bank line of credit. While companies in the sample generally do not go bankrupt or draw down heavily on their credit lines because they are lacking liquidity, it is seen that some companies do, for example as with Supermedia Inc.

Based on these findings it is not compulsory to assume that the firm specific aspect, i.e. that a squeeze in liquidity can potentially happen, is a driver of firms ‘overcapitalizing’ on credit lines. And that the maintaining of large credit lines not in use is based on risk aversion. Risk aversion towards the risk of potentially being in a short term liquidity squeeze, and not having any buffers or other means of funding the firm through a stressed period.

This put the findings of the thesis in a dilemma. While the general findings argue for firm to potentially bring down their bank line of credit size as they are not used, the aspect of the firm specific factor must be taken into account. This factor or risk aversion, is very hard to value since again, it is firm specific. What the value/cost of having X-% chance of going bankrupt because of a lack of liquidity is, is hard to define. One way to do it is to ask the question of how much security on the basis of a bank line of credit is enough. At what level does the cost of the insurance a bank
line of credit provide, forego the risk-weighted cost of what the credit line is suppose to mitigate, fx potentially going bankrupt.

The answer to these questions, firms should approach their credit deciding policy with a clear view on its risk profile, based on its individual approach to risk and firm specific economic outlook. The findings of this thesis may help on that account. The findings prove that even under extreme conditions, companies on a statistical average does not use bank lines of credit to the extent which match the levels they are obtained and held at. Since these findings are based on statistics, a relevant measure within risk management, the results of the data are seen as both convincing and applicable to use in estimating future bank line of credit levels for firms similar to those in the sample. The information and findings derived in this thesis thus provide the corporate decision makers who obtain credit lines with new insight. Specifically about how the segment (in terms of public, US firms) is found to hold too large credit lines. As a results, the information contained in this thesis about liquidity application of credit lines can add practical value to the corporate decision making process about whether or not to obtain a bank line of credit, and to what amount of credit as a fraction of assets is potentially considered necessary.

8.2 Capital to Engage in Investments

As described just above, firm specific factors regarding liquidity needs is established as being a potential cause of firms holding credit lines above the levels to which they are found to be applied in practice. While liquidity is only one of the two drivers of credit lines investigated in this thesis, I also consider the firm specific need for capital to engage in investments as a cause. To do so, I set up a relation to capture the underlying drivers that are at the core of the issue.

To the point of firms holding credit lines to fund future investments, I recognize the need to discuss firms individual investment opportunities and the derived effect on the levels of credit obtained. While firms on a general basis show a tendency to hold too high bank lines of credit levels and only use them to fund investment to a very slight degree, they also hold very different invest opportunities. The propensity for a firm to hold a bank line of credit with the purpose of using it to fund investments, must be driven by the extent to which this firms is exposed to
investment possibilities. Profitable ones in particular. As well as its general access to capital markets. This is the firm specific factor. Putting this into a relation, I find that the calculation of how much credit line to hold – isolating only the investment aspect – should be based on the price of credit line, and the price of not being able to engage in a otherwise profitable investment. One side of the equation becomes the price of obtaining and maintaining a credit line (Ex: $8.5 Million over 5 years), with the other side becoming the price of potentially not being able to enter into an investment due to not having a bank line of credit. The relation for how much credit line to obtain can be put as so:

\[ \text{Cost of maintaining credit line} \leq \text{Cost of missing investment opportunity} \]

Isolating the investment argument as done here, firms should enter into credit lines as long as this relation holds. From a economical standpoint, divvying from this method will not be advantageous.

While the cost of maintaining the line of credit is readily available as the holding costs incl. the cost of borrowing, the cost of missing an investment opportunity is trickier to estimate due to the uncertainty related with future estimations. Intuitively, it should be estimated by performing valuations on the potential investments (if known). In doing this, firms should then incorporate the cost of maintaining the credit line in their analysis. Using NPV calculations as an example; firms would need the investment to return an NPV above the costs it has incurred in the period leading up to the investment in which the credit line has been maintained for the purpose to invest in set investments. This is assuming all other relevant costs are incorporated, incl. the cost of borrowing, time value of money etc. The greater this NPV is becomes a measuring stick for how much credit line can be held, assuming at least a break-even result.

Accordingly, firms with more and more valuable investment prospects will have a greater incentive to hold bank lines of credit, readily available to fund these investments. For a firm with particular good investment prospects, a large credit line might be economically advantageous. Generally for firms with many high yielding investment prospects, it will be coherent to obtain greater levels of credit lines in comparison to companies with lesser high yielding investment opportunities. In the same context, the timing aspect of the investment also becomes an
influential factor. The timing aspect enters the equation as the closer to the obtainment of the credit line the investments is, the less cost is associated with maintaining it before engaging it. Firms with investment opportunities in the near future should be more incentivized to secure a line of credit, or increasing their credit levels. Holding relative to the findings in Figure 1 supports this. Figure 1 showed an increase in total credit lines in the years leading up to the peak 2009, beginning in the start of the crisis in 2007. Assuming firms up to that current point in time had adjusted their credit lines to the future, the sudden crisis may have motivated an increase in credit lines as future access to credit markets were now dimmer. Correspondingly, the risk and likely cost of not being able to invest in future investment opportunities goes up. As this happens, the right hand side of equation 1 increases. In return, firms might have incentives to also increase the left hand side of the equation. From the development in Figure 1, this arguably seems to be the case.

Whether or not there is a direct correlation between how many positive investment opportunities are firm is exposed to, and the level of bank line credit it obtains is not 100 percent clear. However, based on the data showing only a small percentage of firms using bank lines of credit for investment, the above arguments can be seen as one of the potential reason for firms continuing to hold the large credit lines. The firm specific factor of future investment opportunities might produce a substantially larger right hand side of the equation, compared to the left hand side. As there is no measure of investment opportunities for firms, it cannot be credibly estimated if, when accounting for firm specific factors, firms hold too high credit lines. Again, it can only be concluded that the general trend form the sample suggests too high credit lines are in fact the case, but the arguments presented here may be among the reasons here for.
PART 3

9. PROFITABILITY & CASH-FLOW RATIOS RELATION ON BANK LINES OF CREDIT AVAILABILITY

What has been a main factor missing in the research field done on bank lines of credit thus far, has been to investigate the effect of bank lines of credit not being unconditional obligations to firms. Specifically the effect of covenant violations and the associated reductions in borrowing capacity during a stressed scenario. Whereas it in this thesis has so far been concluded that firms do not use bank lines of credit to the extent theoretically argued or held, it has become evident that bank lines of credit are highly valued assets for firms – potentially given firm specific factors. Correspondingly, the analysis of credit lines in terms of how they behave during stressed scenarios has great value.

In existing research, credit line availability have been investigated in normal or expanding macroeconomic times, and not with the specific dynamics between bank line of credit availability and covenant related measures in focus. The contributions of my analysis, is to investigate exactly this dynamic by analyzing my sample during a time period with a worldwide financial crisis and the worst macroeconomic environment in recent memory. By analyzing the data during the financial crisis, I use one of the best possible scenario to stress test bank lines of credit in regards to how affected their availability and size is under stressed economic circumstances. Any trend or predisposition the credit lines would have to be reduced or cancelled due to their non-contingent attributes, will be provided with the best conditions to come to light. I then measure this predisposition via covenant violations and the corresponding reductions in total credit lines.

So far in this thesis I have been building up the arguments for why this analysis is important. Namely that companies greatly value bank lines of credit and why a bank lines of credit
potentially could be reduced due to drop in certain key financial ratio's such as cash-flow and profitability which are the focus here. The reason for these two measures being focused upon, is due to their directly related effect on covenants as suggested by earlier studies (Sufi, 2005, 2009).

To provide further backing to these results and validate the measures for being used in the covenant analysis later, I also perform an analysis of their correlation to covenants and variation in credit line availability. To do so, I first calculate and display both for profitability and cash-flow, the fraction of firm year observations with a bank line of credit, segmented into deciles. As the development over time is the primary concern, the top 5 and bottom 5 percentile observations from the Compustat data are eliminated as not to have outliers skew the data. The data is then averaged out for each firm to produce one single measure, which is sorted into deciles depending on the level for the ratios.

For each of these deciles, I then note the corresponding fraction of firm year observations with a credit line. Combined, this process effectively captures the effect of profitability and cash flow on bank line of credit obtainment. The results are presented in figure 8 and 9 for profitability and cash flow respectively. The general trend displayed in Figure 8 is consistent with the assumption and previous arguments. Namely that profitability has a significant impact on the availability of bank lines of credit due to its covenant based attribute. Many banks are found to apply profitability based covenants in their loan agreements, and the findings in Figure 9 confirm the important role profitability play.

In the 1st decile, the fraction of firm year observations in this lower decile range is measured at 0.44, of 44 %. Showing that at the lowest level of profitability, the fraction of firm year observations with a credit line is half of the sample average. Increasing the profitability level just two deciles to the 3rd decile, the fraction of firm year observations with a bank line of credit is increased to 0.88 or 88 %. About the average of 87.3 % found earlier in the study, and corresponding to a doubling in the number of firm year observations with a credit line in place. Looking further along the line, credit line fraction peaks in the 7th decile with a fraction percentage of 0.96 or 96 %. The fraction drops slightly to 0.88 and 0.90 in the 8th and 9th decile respectively.
Looking at figure 8 overall, the tendency and interdependency between profitability levels and obtainment of bank lines of credit becomes evident. The lowest fraction of firm year observations with credit lines corresponds with the deciles with the lowest profitability. Increasing profitability levels also increases the fraction of bank lines of credit observations. These findings are in line with the findings of Sufi (2005) and Campello et. Al (2009) who theorizes that profitability positively affects credit line obtainment. The empirical data presented here provides support for such a relation.

A correlation coefficient is calculated based on the data. The result is a correlation coefficient of 0.688, which confirm the quite substantial correlation effect in place between profitability and the fraction of firm year observations with a credit line in place.

Two things are noted in that regard. One, measuring correlation as a done here can indicate a relationship between the two variables. In this case a positive relationship between profitability and bank lines of credit obtainment. Measuring causality under the same measures is not as
strong a method. While it is argued why profitability linked covenants are at the basis for this relation, the correlation measure cannot necessarily ensure confinement to one source of causality. Other aspects not uncovered may also have a stake which must be taken into consideration. Analyzing figure 8 more in depth however, supports the causality measure. Looking at Figure 8, the relation smooths out after the 3rd decile and fluctuates slightly around the 0.90 mark indicating that the relation is strongest in the lower deciles, and might even be fading towards the higher deciles (8th & 9th). This finding supports the causality of profitability and covenants towards credit line obtainment. If viewed as a “yes or no” type of ratio, i.e. that companies either qualify to this credit line sat level for profitability/cash flow or not, the fraction of firm year observations should follow a steep path initially and then blend out. Exactly what the data show. Once the firms obtain the credit line due to qualifying to the profitability measure, it is measured as a firm year observation with a credit line. As the average profitability level goes over an arbitrary threshold where (mostly) all firms qualify, the increase in the credit line fraction flattens and only varies with individual firm deviations (assuming firms who obtain a credit lines also maintains it, as suggested by earlier findings).

Which relates to note number two; That the correlation coefficient might by negatively affected by this flattening for the main part of the dataset, thus underestimating the actual correlation which might be higher than the current correlation measure indicate. The reason for this is due to the variables only being able to vary within a spectrum of [0;1] = credit line ; no credit line. As such, once the firm obtain the credit line, the correlation measure ‘stops’ and cannot measure any more increase in credit line relative to the increase in profitability (higher decile). So while the correlation measure as a stand alone measure cannot verify causality between the profitability and credit line obtainment – the support of earlier findings together with the characteristic of the variables strongly indicate causality to be established. These same characteristics are in place for the cash-flow measure as well. Cash-flow is presented in figure 9
For the cash-flow measure, the same pattern arises as for the profitability measure in figure 8. Going from the 1st decile to the 3rd decile, the fraction of firm year observations with a line of credit increased 81% from 0.54 or 54% to 0.98 or 98%. After reaching above what I define as the cutoff-level, i.e. the arbitrary level of cash-flow needed to meet most covenant requirements, the fraction starts a slight downward trend down to 0.78 in the 7th decile, before increasing again to a higher level in the 8th and 9th decile. This slight trend is most likely due to the increase in cash flow providing some firms with enough cash flow to shy away from obtaining a line of credit. The high level of cash flow is assumed to eliminate some of the firms who would obtain credit lines for the liquidity capacity, but who already enjoy this liquidity due to their and recurring high cash-flow. The increase for the 8th and 9th decile is likely due to firms at the higher end of the cash-flow range wanting to use this high cash-flow to obtain high credit lines. Hence, the increase in cash flow allows firm who are incentivized or motivated to increase and draw down on their line of credit, do to so due to their high level of cash flow. Conversely, firms who do not have these incentives or motivation will refrain from even obtaining the line of credit – due to their
high level of cash flow. Measuring the correlation, similar to the process done for profitability, yields a result of 0.629 – also very similar to profitability. As with profitability, the support of earlier findings together with the characteristic of the variables proves causality can be established. So like profitability, cash flow is found to also have a strong effect on the ability to obtain credit lines.

The result shown in Figure 8 & 9 combined find that a positive increase in the level of profitability and cash flow ratios, has significant correlation with the firms’ access and ability to obtain lines of credit. The results show that a positive increase in these ratios results in a positive increase in the likelihood of a credit line being obtained by the firm. This correlation is however reduced at higher levels of the ratios due to a maxing out of non-credit line observations.

The findings suggest the presence of an arbitrary cut-off level to these ratio’s in terms of their ability to satisfy credit covenants. The data and analysis also imply that some firms find credit lines less valuable, as they likely rely on internal funding instead. These are specifically firms with high profitability and cash-flow ratios. While these firms should find access and obtainment of credit lines easier, their own ability to supply liquidity via high profitability and cash-flow makes the extra credit capabilities of a credit line irrelevant.

In sum, the results support the conclusions of earlier studies, and show that given the two ratios correlation with bank line of credit availability, these are also relevant to measure in terms of determining the degree of covenant violations. I could have chosen to add a selection of other variables to measure, for example tangible net worth, book leverage ratio or interest coverage ratio, but found profitability and cash-flow to be at the core measures affecting bank line of credit availability. Critically, they are also among the measures of financial data that best and most quickly represent and show the effect of the macroeconomic environment on firms’ financials.

As an important part of this thesis is to investigate how bank lines of credit perform during stressed scenarios, I find it important to show how this stressed scenario comes into play. Based on the analysis above, profitability and cash-flow are found to be two of the main criteria for
credit line obtainment. Correspondingly, I find it central to investigate how these two measures behaved during the sample period to prove that a stressed scenario was in fact in play. And To build up the argument for why the sample should showcase any predisposition for reductions in credit lines. As such, I end this section with a time series analysis of both ratios with respect to the 2007-2011 time period. The goal is to use the development in these ratios to derive the effect the negative shock of the macro economy during this period had on the sample population of firms. Based on these findings, I argue that the derived effect from the financial crisis did in fact affect firm related covenant measures, and thus provide the optimal setting for testing covenant violations in estimating the ability for credit lines to be maintained during stressed scenarios.

9.1 DEVELOPMENT IN PROFITABILITY AND CASH-FLOW

Undertaking the same methodological process as the earlier time series analysis of segmenting the data into year 2007 through 2011, the results for the development in the profitability and cash flow measure are presented in figure 10:

Figure 10)
Overall from Figure 10 it becomes evident that the macroeconomic development had a substantial impact on the firms in the sample. Both the profitability and cash-flow measure show this. From the start of 2007 to 2008, the measures drop 17.2 % and 23.5 % respectively. In 2009, the measures have dropped respectively 65.4 % and 76.7 % from the 2007 level. Going forward through 2010 and 2011, both measures recoup, but are still down 17.8 % and 26.9 % from the normal level of 2007.

The tendency showed in figure 10 clearly indicates 2009 as the most substantial year in terms of the effect on firm financials. Something that is evident in many of the earlier figures as well. The effects captured show how a recession in the macro economy halts growth, cut down consuming and as a result reduces sales and deteriorates profits and cash-flow. Corresponding to the time series analysis on credit line variables, 2009 was also the year with the largest and clearest divergence from the 2007 value assumed as the ‘normal state’.

The empirical data in Figure 10 matches what was assumed in the initial of the thesis, namely that the development in the macro economy have a substantial effect on covenant related financial measures of the firms. Based on this finding and confirmation, it is now possible to investigate if the drops in these measures in fact have an effect of firms violating their covenants, and subsequently to what extent these violations potentially result in cancellations or reductions in the firms’ access to credit.

### 10. Covenant Violations

#### 10.1 Covenant Violations Defined

Financial covenants are appropriately defined as a controlling tool used by lenders, primarily banks, to control and risk manage the exposure they undertake in providing loans or credits to borrowers. Measuring the financial strength and performance of the borrower via a predetermined set of measures, covenants allow the lender to ensure the borrower is in compliance
with the terms of the loan. The measurement of financial covenants is usually performed each year, on a quarterly basis or in severe conditions where there is significant risk, monthly. In the sample for this thesis, yearly and quarterly measurements are predominantly used. As this is also the general norm, I do not adjust my data or results in any way for this potential variety in measurement frequency.

A firm can be either in compliance with its financial covenants, or in violation with one or multiple of these, depending of the situation. Events of default may include but is not limited to (1) a material-adverse event occurring in the borrower's financial condition, (2) the bank believes the borrower will not be financially able to repay the loan or (3) if the bank has material reason to believe its borrowed assets are insecure (Mccrae 2004). Profitability and cash-flow measures are found to be covering all these three events.

For the sample in this thesis, violations from all these three events are accepted as a covenant violation. There is however, no direct measure of the distribution between these three events is in the sample. The reason is that firms are not required by the SEC to disclose why the firm experienced a covenant violation, and in many of the observations of covenant violations, the cause behind was not disclosed. Earlier studies show that between 25-50 % of firms do not report or disclose why the violation occurs (Beneish & Press (1993), Chen & Wei (1993)).

A violation to a financial ratio gives the lender the right to take a number of actions to protect itself. Most severely, the credit line is accelerated and demanded repaid in full. Essentially a cancellation. However, my data show a large portion of covenant violations resulting in renegotiations of the contract terms and that these negotiations lead to either decreases in the credit amount, increased rates or shortened maturities. All changes that significantly alters the credit line availability and its value to the firm, but which not necessarily manifest as a reduction in credit line. The result must thus be considered with this in mind, and that the actual severity of the covenant violation for the firms may be more substantial than indicated by the results.
10.2 Effect of violations

I perform my collection of credit covenant violations via the methodology described in the data section in the beginning of the paper. For quick refreshing: A search algorithm based on a series of key terms. In order to measure the drop in credit line which is not always explicitly stated in the Form 10-K, I use a proxy that estimates the corresponding drop in credit line availability after a covenant violation. For each time the search algorithm returns a positive observation (a violation of a covenant) the size of that firm's credit line is noted on two points in time (1) the year before the observation denoted \( n-1 \), and (2) the year of the observation denoted \( n \). This proxy is specified to capture the effect of the change in credit line availability due to the violation. When applicable, the proxy results are confirmed by reading the related paragraphs in the form 10-K's of the firms at the time of the observation.

As noted, the data does not capture other changes to the credit line such as reduced maturities or increased rates, although these might be material. The focus is solely on the direct drop in availability of the credit line.

An example of a covenant violation and the subsequent change in credit line availability is given by the 2008 and 2009 form 10-K's of Patrick Industries:

“We have a significant amount of debt outstanding that contains financial and non-financial covenants with which we must comply that place restrictions on our subsidiaries and us. At March 1, 2009 (February month end), the Company was in violation of its Consolidated earnings before interest, taxes, depreciation and amortization (“EBITDA”) financial covenant under the terms of the credit agreement that was amended in December 2008 […]

Without improvements from the conditions in the current Economic Crisis in 2009 there can be no assurance that we will maintain compliance with our 2009 financial covenants, which were modified in December 2008 and again in April 2009. These covenants are measured on a monthly basis and require that we attain minimum levels of Consolidated EBITDA as defined by our Credit Agreement. If we fail to comply with our covenants under the Third Amendment, the lenders could
cause our debt to become due and payable prior to maturity or it could result in our having to refinance the related indebtedness under unfavorable terms. If our debt were accelerated, our assets might not be sufficient to repay our debt in full. If current unfavorable credit market conditions were to persist throughout 2009, there can be no assurance that we will be able to refinance any or all of this indebtedness. “

- Patrick industries 2008 Form 10-K

This resulted in the amendment of the credit agreement, which is described in 2009 Form 10-K:

“...the Third Amendmend amended and/or added certain definitions, terms and reporting requirements including a modification of the one-month and two-month consolidated EBITDA covenants to be more reflective of current economic conditions. Borrowing under the revolving credit line is subject to a borrowing base, up to a borrowing limit. The maximum borrowing limit amount was reduced from $33.0 million to $29 million in accordance with The Company's cash flow forecast. “

- Patrick Industries 2009 Form 10-K

In the anecdotal evidence above, the importance of cash flow and profitability is explicitly showed to be having a substantial effect on credit line availability. First off, a covenant violation related to the EBITDA (profitability) took place. Secondly, a failure to comply with covenants related to cash-flow resulted in a reduction in the credit line of $4 million, corresponding to a 12.1 % drop.

10.3 Covenant Violations in Sample

In total, the analysis of all 95 Form 10-K’s concludes that 19 out of the 95 firms in the sample experienced a covenant violation, corresponding to a violation among 20 % of the firms in the sample. As one firm experienced two violations, a total of 20 violations is found. Holding relative to the number of total firm year observations (475), there is found to be a covenant violation in 4.12 % of the total firm year observations in the sample. While I account for potential errors in
the sampling, these fractions is assumed to objectively and correctly depicting the fraction of covenant violations made during the sample period.

The result show that a sizeable number of firms experienced covenant violation during the stressed scenario. With 20% of the firms being assumed as a large number, the results clearly indicate that bank lines of credit are not unconditional loans, and that a portion of firms had trouble complying with the terms that secures their credit line. To be able to fully look grasp the effect of these violations however, the impact on credit line availability is what is most important. For the fraction of firm year observations with a covenant violation, the corresponding drop in credit line availability is noted via the proxy explained. The data is segmented into quartiles in order to get a segmented drop-ratio that also indicates what the drop distribution looks like. In addition, the average drop in credit line availability is calculated. Both of these results are presented in Figure 11.

**Figure 11**

![Figure 11](image-url)
On average, breaching a covenant related to a bank line of credit is found to result in an average drop in the firm credit line of 35.06%. The drop in availability increases exponentially as it moves away from 0, suggesting that the distribution of enforced violations show a propensity for reductions in availability to be substantial, but also very varying and depending on the individual case.

Comparing these results to the results of Sufi (Sufi, 2009) indicate that credit lines on average are reduced more during stressed economic scenarios than normal economic states. For his sample, measuring a more stable, non-stressed scenario, Sufi finds that credit lines are reduced by 15-30 percent. In my sample, firms are found to on average be reduced by ca. 35 %, and having more substantial reductions along the distribution on violations.

Covenant violations in the lower 1st quartile results in an average drop in availability of 0 %. The reason for this zero percent drop for the 1st quartile is due to the fraction of violations that do not directly result in a availability drop, but rather a drop in maturity, a increase in rates/charges or other more business-operating oriented restrictions as previously explained. Usually, these violations results in amendments of the loan contract and terms, but not a direct drop in availability. While it may not results in a direct reduction of the credit line – these violations still have a material effect/cost on the firm due the restrictions they entail.

Going to the 2nd quartile, the drop in availability moves away from zero and into double digits with an average drop in credit line availability of 12 %. At this level, the effect on firm liquidity is substantial, but still estimated to be manageable depending on the amount of liquidity held in cash, and the total size of the credit line compared to total assets (the size of the firm).

For the 3rd and 4th quartile, drops in availability due to a covenant violation are 40 % and 89 % respectively, indicating more significant violation and more significant sanctions. Especially compared to the normal state, depicted by Sufi. In the top quartile with the 89 % average reduction in credit line, 3 firms experienced their credit line being reduced 100 % (cancelled).
The larger reductions in credit line availability in both of these upper quartiles are estimated to have had an extensive effect on firm liquidity and ability to continue operations. Looking at the violations for the sample as a total, this means that for 10 of the 19 companies, the covenant violation resulted in a reduction in the credit line estimated material enough to affect the continuing operation of the firm.

In total, the 20 covenant violations in the sample clearly showcases the contingent characteristics of bank lines of credit, and the inherent risk associated with being dependant on a such. 50 % of these violations are estimated to result in material enough sanctions to substantially affect the firms’ ability to continue operations. Looking at the grander spectrum however, these covenant violations only represent 4.12 percent of the total firm years in the sample. A much lesser fraction. As so, the risk of being exposed to a covenant violation is not statistically significant. Isolating only the reductions assumed to result in materially adverse conditions for the firm experiencing the covenant, the results show that the chance of such a violation being made is 2.1 percent per year.

The sample period should provide exceptional conditions for covenant violations - due to drops in firms financial performance denoted by profitability and cash - and should expose any propensity bank lines of credit has of being contingent on the firm’s ability to be profitable. Although these conditions holds, and that the reductions are more severe than in normal states, the findings of my analysis show that the fraction of firm year observations with substantial reductions in availability are quite low, at 4.12 % for violations in total, and only 2.1 % for violations that leads to a material cancellation of the credit line.

This is a very interesting finding. It displays that even during severe economic distress, assumed to be the worst case scenario, bank lines of credit for public firms are albeit fairly stable credit tools, and still hold very similar characteristics to that of a non-contingent loan in terms of availability. The actual drop in availability of credit lines over time, based not on modeling, but on

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4 Number of violations / 475 (total firm-year observations in the sample)
tangible empirical data, is very low as well as statistically unlikely across the population of firms\(^5\). As a result, credit lines might indeed be a valuable and safe tool for firms to use as part of their debt composition, with the specific focus of managing liquidity for operations and future investments. The added benefit of bank lines of credit are their ability to only be drawn according to the marginal need of the firm holding the line. As such, it provides companies with unique flexibility in regards to liquidity, and allows firms to hold potentially lower cash levels/balances, or to employ these cash amounts in other aspects of the firms operations. What has been a concern about credit lines and what has been the focus of this paper, is how contingent these facilities were on the performance of the firm. Specifically if the access to the credit lines was reduced or cut at the point in time when the firm needed it the most. Based on all the data of this thesis and the results and findings presented - this concern does not prove to find support in the empirical data.

Discussing the reasons behind these results, I come up with two factors that could potentially affect or drive the findings. Arbitrarily enough, the reason behind low covenant violations may actually be the economic climate. When firms in grand scale experience drops in profitability and cash-flow, and the economy plus the banks are also greatly pressured, there might occur a general situation where cancellations and reductions in credit lines might lead to even worse conditions. As a result, the incentives towards cancellation of credit lines is reduced and it is potentially not in the best interest of the bank (borrower) to cancel the credit line. Potentially it can lead to a bankruptcy or a failure for the firm to compete in the marketplace. It must be noted that credit lines often are part of larger credit facilities issued by the same bank to the same firm. Exactly this factor is important as I suggest that the larger the general commitment of the bank is in the firm, the more this commitment mitigates the otherwise non-contingent nature of bank lines of credit. Simply, the bank would not benefit from worsening the conditions for the firm in which it has a stake. While not captured explicitly, such a mismatch in incentives depending on how big the

\(^5\) ‘Firms’ equals the firms employed in the sample, e.g. U.S. public firms.
relationship is between the bank and the firm, could be a reason for the low ‘failure rate’ of firms in regards to their credit lines.

Another aspect considered was the economic high which was present leading up the sample period. Leading up to 2007, the world economy was expanding rapidly and lending activities was going up. 

As seen from the data in Figure 11, the time-frame of which firm financial was extremely affected and below normal was primarily in 2009. Considering how well the economy was going leading up to 2007 and how much lending was booming, many banks might have employed very few and/or very slight covenant restrictions in their credit line contracts in this period. Taking into regard that the general timeframe for a credit line is between 3-5 years, the covenant ratio’s for many of the firms in the sample where likely set after the more positive and expanding economy that was predominant in 2007. As a result, only the companies with severe drops in their financial might have triggered the low covenant violation measures.

While the above arguments are open for discussion, the empirical data and results stay the same. Bank lines of credit does not display significant probability of either a reduction in the available loan amount or a cancellation of the credit line altogether.
11. Conclusion

This thesis sets out to test the important tool of bank lines of credit, used vastly in today’s capital structures of firms. During the last two decades, bank lines of credit have become an increasingly large part of how firm finance themselves. Accordingly, the body of scientific literature surrounding the topic have also increased. Still however, there is much to be investigated. Based on a disconnect from the current studies towards the use of empirical material, I form a sample of 95 public US based non-bank firms from which I source empirical data to test some of the theories and estimations made about bank lines of credit. I do so in a stressed economic scenario that should highlight the characteristics of credit lines and their usage plus availability. Specifically, I test two main opinions in the literature concerning the usage of credit lines. Focusing on the usage of credit lines in regards to cash usage, liquidity usage and future investment use, I try to bridge the gap of missing empirical data, and provide new insight to these topics. Furthermore I investigate the concern about how contingent credit lines are on firm performance, by investigating profitability and cash-flow in regards to covenant violations and associated reductions in credit line availability.

In explaining why firms hold bank lines of credit, a main belief is that they are used for either capital to engage in future investments, or liquidity purposes during economic contractions. For the liquidity aspect, it is debated in the literature whether firms draw on their credit lines opposed to cash, when managing their short term liquidity needs during a stressed scenario. The other main belief is that this relation is reversed, and that during economic contractions, cash is primarily used to provide liquidity.

Based on my empirical data, I find cash, in the form of operating cash flow, as being the primary tool employed by firms to cope with the adverse effects of a negative economy. While my findings indicate firms are increasing their bank lines of credit levels in preparation to the stressed scenario, the measurement of usage of bank lines of credit show only slight actual usage. Credit line usage is found to increase from 4.3 percent of assets to 6.6 percent of assets at most during the sample period. However, to the extent that operating cash flow cannot provide all the
liquidity needed – firms are found to be employing bank lines of credit to a slightly bigger degree that cash-holdings.

In terms of liquidity provided by the credit lines, this is also found to be reduced during the stressed scenario, despite the increase found to be taking place in the beginning of the period driven by the exercise of options to increase the available amount under the credit lines.

In challenging why firms then hold so high credit lines, which they do not use, I find evidence that indicate the firm specific factor, i.e. individual firm variations, is the main reason behind credit line obtainment. And that driving this firm specific factor is primarily the need for liquidity, more than the need for investment. While I find evidence for firm specific credit line need in relation to liquidity, I do not find substantial evidence that the investment incentives are a main driver of credit line obtainment. In the sample, only 7 % of draw downs, was directly related to a major investment.

In investigating the innovative aspect of how credit line availability during stressed scenarios is linked to firm performance, I first find that both profitability and cash are strongly correlated with credit line obtainment and maintenance. The fraction of firm year observations for credit lines increase from 44 % for the lowest decile of profitability to 90 % for the highest decile. For cash flow, the increase is from 54 % to also 90 %. These findings support those of Sufi (Sufi, 2009). But despite a substantial drop in both of these measures during the sample period, covenant violations are found to be scarce. For the sample combined, I only find covenant violations that lead to material reduction in the credit line in 2.1 % of the firm year observations. Based on this, I argue that credit lines for public US based firms are fairly stable and reliable credit tools, even during a worst case scenario analysis.
12. SUGGESTIONS FOR FURTHER RESEARCH

I find several new avenues that could be explored in future research, three of which I highlight here: First, the limitations of the sample naturally highlights future research that breaks down these limitations. For this thesis, a future research could be to apply the testing to another sample group – for example a mixed group of big and small, private and public firms to see if different effects may arise for certain types of firms. Such future research could also enjoy from a collection of quarterly data instead of yearly data. As evident from the theory and the results presented here, there are interesting questions regarding credit line usage and reliability/availability still needed to be answered. Second, investigate how factors such as the overall commitment from the borrower (bank) to the lender (firm) may affect violation sanctions and covenant setting. Third, investigate if based on the findings of this thesis and in combination with other findings, it is possible to set up a model that estimates the ‘optimal’ level of credit line, incorporating factors like pricing, the firm specific factor and worst case availability drop statistics. Such a study might have great influence on how firms in the future approach their credit deciding policy and capital structure setup.

I look forward to future research addressing these and other related questions.
13. REFERENCES


14. APPENDIX

14.1 OVERVIEW OF KEY SEARCH WORDS FOR SEARCH ALGORITHM:

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<thead>
<tr>
<th>Number</th>
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<td>Non-compliance to covenant</td>
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14.2 OVERVIEW OF FIRMS EMPLOYED IN THE RANDOM SAMPLE:

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14.3 **Overview of Key Variables Used and Calculation Information:**

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<td>Unused amount of BLC</td>
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