

MODELING METHODOLOGY

Usage and Exposures at Default of Corporate Credit Lines – An Empirical Study

Author

Janet Yinqing Zhao
Douglas Dwyer
Jing Zhang

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Contact Us

Americas
+1.212.553.1653
clientservices@moodys.com

Europe
+44.20.7772.5454
clientservices.emea@moodys.com

Asia-Pacific (Excluding Japan)
+85 2 3551 3077
clientservices.asia@moodys.com

Japan
+81 3 5408 4100
clientservices.japan@moodys.com

Abstract

Using a unique data set pooled from multiple US financial institutions, we empirically study the credit line usage of middle-market corporate borrowers. We find that defaulted borrowers draw down more of their lines than non-defaulted borrowers. They also increase their usage when approaching default. Riskier borrowers tend to utilize a higher percentage of their credit lines. We find that firms rated as "pass" grade by the lender draw down the credit lines more than those rated below "pass" grade. Usage ratios also vary by collateral type, commitment size, loan purpose type, and prior quarter's usage. Further, we find evidence that usage ratios are higher during economic downturns. The evidence is stronger for non-defaulted firms than for defaulted firms. Taken together, these results suggest that credit line usage is a function of both borrowers' characteristics and banks' monitoring and control of these lines.

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1. Overview

A major source of firm funding and liquidity, credit lines can pose significant credit risk to the underwriting banks. By the end of 2010, the unused credit line commitment across all depository institutions in the US was US\$5.7 trillion, almost half the aggregate assets (US\$13 trillion) of these institutions.¹

Understanding credit line usage patterns is important to banks, for many reasons and different applications. Exposure at default (EAD), the usage estimation conditional upon default, enters into the regulatory capital calculation under Basel II, together with probability of default (PD) and loss given default (LGD). Economic capital calculations require the assessment of the loss risk associated with credit line drawdown. Credit line usage also factors into banks' liquidity management, as simultaneous drawdown on the credit lines by different borrowers can significantly affect both the asset side and the liability side of the balance sheet. Basel III's liquidity coverage ratio, intended to ensure that banks have adequate funding sources relative to the total demand of cash outflows, includes credit line drawdown. In addition, usage patterns are an important component in pricing these lines, as the credit line valuation requires the estimation of the expected drawdown. Further, credit line usage behavior can potentially provide additional information about borrowers' financial distress and defaults.

Our study yields a number of interesting findings, with significant, practical implications. The sample covers approximately 7,600 defaulters and 134,000 non-defaulters with valid usage information from 2001–2010. We pool the data set from multiple US financial institutions. We study the extent to which borrowers draw down their credit lines and link usage to line-level and firm-level variables.

We find that defaulted firms draw down credit lines heavily when approaching default. The mean usage and median usage ratios for defaulted firms are 80% and 96%, respectively, which suggests the risky nature of these facilities. A large portion of the firms draw down almost the full amount of their credit lines. Results suggest that troubled firms draw down credit lines long before default; the mean (median) usage ratio two years prior to default is 74% (87%). In comparison, non-defaulted firms, on average, show lower usage levels than defaulted firms. The mean and median usage ratios for non-defaulted firms are 49% and 52%, respectively. After controlling for other factors such as default probability, the difference in usage between defaulted and non-defaulted firms becomes smaller, suggesting that it can be explained by the two groups' different risk profiles.

Our results show that usage increases with default probability. Risky borrowers tend to draw down lines more. At the same time, firms with an internal "non-pass" grade one year prior to default tend to make fewer additional drawdowns, suggesting banks' monitoring of credit lines reduces line usage. We further find that line usage is related to loan purpose type, collateral type, commitment size and usage one quarter prior. For non-defaulted firms, usage ratios are higher during times of recession. For defaulted firms, the cyclical pattern in usage ratios is not as obvious.

The rest of the paper is organized as follows. Section 2 reviews the existing studies on credit line usage. Section 3 describes the data. Section 4 discusses usage measurements. Section 5 presents our results. Section 6 concludes. Section 7 presents a recent data update.

2. Literature Review

Credit line usage literature generally falls into two main categories. The first studies usage measurement from a bank-risk management perspective. This literature provides statistics on usage measurements and findings on how usage varies with line-level, borrower-level or macro-level variables. The results are useful to banks for their capital calculation and risk management practices. Asarnow and Marker (1995) study a sample of syndicated loans in the Citibank Bank Loan Index and find that average line usage is higher for better rated firms. Araten and Jacobs (2001) is one of the most cited papers. They examine a sample of 399 defaulted borrowers using Chase Bank's internal data and report an average loan equivalent exposure (LEQ) of 32%. They also find that LEQ is higher for better rated firms. They do not observe a relationship between LEQ and either commitment size or maturity. Jiménez *et al.* (2009a,b) look at the EAD and usage for a large sample of Spanish firms. They report an average one-year LEQ of 48%. Defaulted firms have higher usage than non-defaulted firms. Lines with smaller commitment, shorter maturity or with collateral have higher LEQ. Jacobs (2010) examines line usage data on 720 defaulted borrowers with Moody's or Standard & Poor's ratings and reports a one-year LEQ of 38%. He also finds that the EAD is lower for adversely rated firms. Emery *et al.* (2008) study the debt structure evolution during the three years prior to default for 291 defaulted firms. They find that revolver drawdowns increase as firms approach default. The average usage rate at default is approximately 70%. Moral (2006) and Taplin *et al.* (2007) discuss the empirical challenges in EAD measurements.

¹ FDIC Statistics on Banking: <http://www2.fdic.gov/SDI/SOB/>.

The second group of papers examines credit line usage from a corporate finance perspective. The central question they address is the extent to which credit lines provide liquidity and financial flexibility to firms. Sufi (2009) finds that only firms with high profitability have access to lines of credit; when they experience a negative profitability shock, firms often lose access. Acharya *et al.* (2013) find that firms, especially financially constrained firms, with higher aggregate risk rely more upon cash than lines of credit. Lins *et al.* (2010) surveyed chief financial officers (CFOs) from twenty-nine countries. They report that cash and lines of credit are held for different purposes. Lines of credit relate strongly to the external financing needs for funding future investment opportunities, whereas cash is held as a buffer against future cash shortfalls. Two papers study credit line usage during the recent recession: Huang (2009) documents that during the subprime mortgage crisis banks that were more distressed extended less funds via credit lines to existing commercial borrowers, and they charged higher credit spreads on newly negotiated loans. Gao and Yun (2009) find that after the collapse of Lehman Brothers, commercial-paper-rated firms with high default risk reduced their commercial paper greatly and drew heavily from existing lines of credit. Ivashina and Scharfstein (2010) also look at the Lehman Brothers event. They compile evidence showing a run by borrowers drawing down credit lines after the Lehman Brothers failure, leading to a spike in commercial and industrial loans reported on bank balance sheets. Campello *et al.* (2011) surveyed 800 CFOs globally to study the role of credit lines during the recent financial crisis. They find a substitution effect between credit lines and internal sources of liquidity (cash holdings and cashflows) during the crisis.

In general, our study falls into the first category above.

3. Data Description

In this study, we focus on the credit line usage of unlisted, middle-market firms. We gather credit line data from eight US financial institutions. All participate in Moody's Credit Research Database (CRD), a consortium that collects credit risk data. These institutions range from US\$10 billion to US\$2 trillion in total asset size. The quarterly line information spans 2001–10. The data set covers revolving lines of credit; term loans are excluded from the data set.²

Our data set is unlike those used in other studies. First, it is large and derived from multiple institutions. As of the end of 2010, the unused commitment of the credit lines used in the final data set totaled about US\$100 billion. Even though the data set may represent a small portion of all the credit lines extended by financial institutions in the US,³ its broad coverage across industries and size cuts and over time makes it a database well-suited to studying credit line utilization behavior for middle-market borrowers. Second, it contains information on both defaulted and non-defaulted firms; most existing studies rely only upon defaulted names. Third, our data set contains line information linked to borrower characteristics. Fourth, the data set covers both economic downturns and expansion times, which allows us to better understand credit line usage behavior during cycles. Utilizing this unique data set, we examine the extent to which borrowers draw down their credit lines and the characteristics of those firms with high usage. We study how line usage changes with banks' internal ratings, collateral, loan purpose, commitment size and through economic cycles.

The data set is not dominated by a single financial institution. The largest share of any financial institution in the data set is about 30% in terms of the number of facilities. The private firm sample consists of 1.26 million quarterly observations on 7,653 defaulted firms and 134,994 non-defaulted firms from April 2001 through June 2010. Line records with a negative balance amount or those with a commitment amount less than US\$10,000 are deleted. We exclude lines that have never been utilized, because they could be inactive lines that were kept in the loan accounting system. Including inactive lines may introduce downward bias in usage estimates. Our approach of excluding them leads to a more conservative estimate of the usage measurements.

We merge the line usage data with the default and financial statement information housed in the CRD. When there is more than one line for a borrower, we aggregate the lines. In this study we present the results based on the borrower-level information, except when the information is only available at the line level.⁴

We seek to include all defaults consistent with Basel definitions, if the information is available. Once all defaults are detected, we aggregate the data to create a single default for each borrower posting a default event of 90 days past due (90DPD) or more severe. We then assign the defaulter a date of the earliest default event and the most severe default type detected over time. Table 1 presents the default types, ordered by default severity. Note, only 90DPD with a "non-pass" rating is included as a default

² We work with the banks to separate revolving credit lines from term loans. The identifiers provided by banks include "revolver" "line of credit," and "line."

³ The closest measurement of aggregate unused commitment amount on the national level is the "other unused commitments" reported by FDIC Statistics on Depository Institutions (see <http://www2.fdic.gov/SDI/SOB/>). As of the end of 2010, the total amount under "other unused commitments" is US\$1.9 trillion, which includes commitments to extend credit through overdraft facilities or commercial lines of credit and retail check, credit, and related plans. Our data set represents about 5% (US\$100 billion divided by US\$1.9 trillion) of all the credit lines outstanding in the US. Nevertheless, our data set includes overdraft facilities and commercial lines of credit, but does not include retail check, credit and related plans. Therefore, the actual estimate should be higher than 5%.

⁴ The line-level information includes loan purpose (Table 3) and collateral type (Table 7). Table 9 also uses line-level information with collateral type as an input.

event. 90DPD defaults with a pass rating are likely technical defaults that do not progress to economic loss. We therefore exclude these as default events. We also exclude "substandard" as a default event unless the credit is also 90DPD.⁵ US regulatory bodies exclude the "substandard" classification in their definition of "unlikely to pay."⁶ Dwyer and Eggleton (2009) discuss the default definitions applied in the CRD in more detail.

Table 1 DEFAULT TYPES

DEFAULT SEVERITY	DEFAULT TYPE
1	90 DPD w/ "non-pass" rating
2	Non-Accrual
3	Doubtful
4	Loss
5	Charge-off

Figure 1 presents the distribution of the commitment size.⁷ Most of the sample firms are small-and medium-sized enterprises (SMEs).⁸ The median commitment amount is US\$350,000; the 75th percentile of commitment size is at US\$2 million. Approximately 13% of the sample firms have a commitment amount greater than US\$5 million. The large firms pull up the average commitment size to approximately US\$3.8 million.

Figure 1 Sample Distribution by Commitment Size

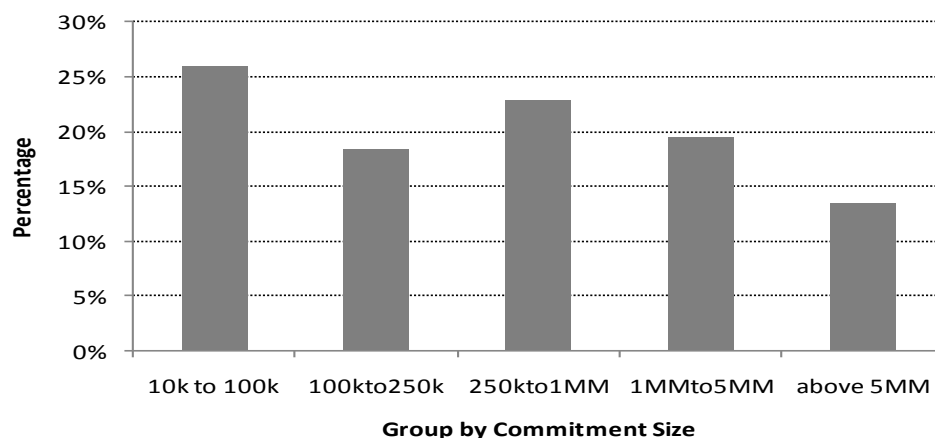


Figure 2 illustrates the sample distribution by sector. The sample contains firms from different industries. The services industry accounts for the largest percentage of the sample (35%), followed by trade, real estate and construction. Note that we break down the manufacturing firms into consumer products and business products. The consumer products sector includes firms that manufacture products for consumer needs such as clothes or wines. The business products sector includes firms that manufacture products for business needs such as machines and equipment.

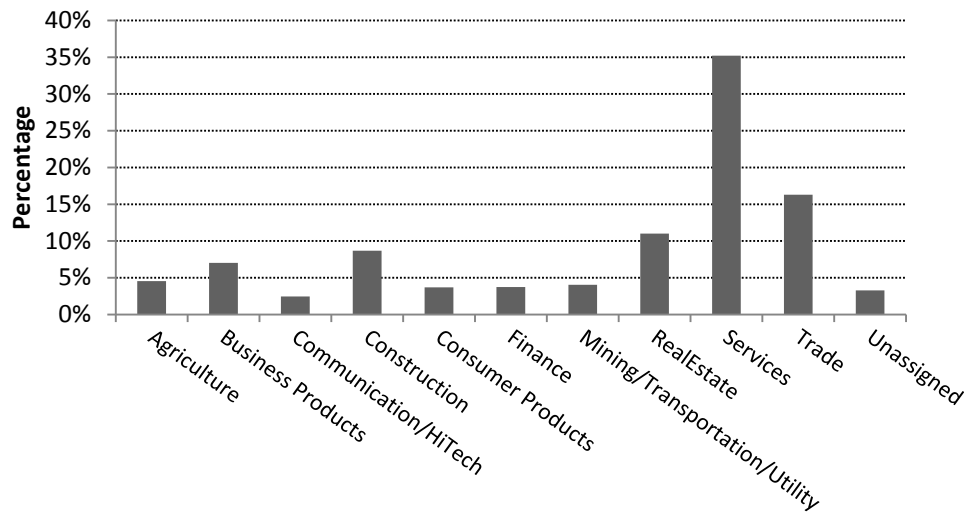
5 A "substandard" asset is defined as "inadequately protected by the current sound worthiness and paying capacity of the obligor or by the collateral pledged, if any. Assets so classified must have a well-defined weakness or weaknesses that jeopardize the liquidation of the debt. They are characterized by the distinct possibility that the institution will sustain some loss if the deficiencies are not corrected." This definition contrasts with an asset classified as "doubtful" that "has all the weaknesses inherent in one classified substandard with the added characteristic that the weaknesses make collection or liquidation in full, on the basis of currently known facts, conditions, and values, highly questionable, and improbable." Please see FDIC (2012) for more details.

6 "Risk-Based Capital Standards: Advanced Capital Adequacy Framework," Basel II; Final Rule.

7 We present the aggregate amount at the borrower level if the borrower has more than one line from a bank.

8 Discussions with CRD participant banks reveal that the definition of SMEs may vary with bank size. Basel II characterizes an SME as a corporate with less than €50 million in turnover (see Annex 3 of "International Convergence of Capital Measurement and Capital Standards: A Revised Framework," June 2004).

Figure 2 Sample Distribution by Sector



4. Usage Measurements

For defaulters, we measure EAD using two variables: usage is the percentage of the exposure expected to be drawn down in the event of default; LEQ is the percentage of additional drawdown over the remaining commitment amount in the event of default:

$$\text{usage} = \text{balance at default} / \text{commitment}_{\text{Year-1}}$$

$$\text{LEQ} = (\text{balance at default} - \text{balance}_{\text{Year-1}}) / (\text{commitment}_{\text{Year-1}} - \text{balance}_{\text{Year-1}})$$

LEQ is commonly used to estimate EAD.⁹ The LEQ measurement is a useful concept in portfolio modeling. It allows us to model the undrawn portion of a credit line separately from the drawn portion. Common practice assumes 100% usage on the drawn portion of the line (between now and the default horizon) and LEQ for the undrawn portion, should the exposure default.

Nevertheless, the LEQ has limitations. For lines with a total commitment almost fully drawn down (small, unused commitment), LEQ may not be meaningful. For example, a line with an unused commitment of US\$1 and an additional drawdown of US\$3 will have an LEQ of 300%. In addition, LEQ can be negative. Negative LEQs may result from the decrease in balance amount or from an overdraw in year -1. We follow previous studies to exclude observations with extreme LEQs (less than zero or greater than 120%).¹⁰ Finally, the LEQ is not independent of current usage. A line almost fully drawn may have a lower LEQ than a line that has a large unused commitment, simply because there is little the borrower can draw down from the former. The usage measurement captures the total usage at default, rather than the additional drawdown. Both measurements are useful.

The usage measurements for non-defaulters are defined similarly. Usage refers to the percentage of the total commitment amount expected to be drawn. LEQ refers to percentage of additional drawdown over the undrawn amount:

$$\text{usage} = \text{balance at default} / \text{commitment}_{\text{Year-1}}$$

$$\text{LEQ} = (\text{balance} - \text{balance}_{\text{Year-1}}) / (\text{commitment}_{\text{Year-1}} - \text{balance}_{\text{Year-1}})$$

To avoid the impact of extreme values, we exclude observations less than zero or greater than 120% when reporting results on usage ratio, and observations less than zero or greater than 120% when reporting results on LEQ ratio. An alternative approach is to set the usage or LEQ ratio to zero when it is less than zero, and set it to 120% when it exceeds 120%. Our treatment has little impact on usage ratio, as most lines have a usage ratio between 0% and 120%. The treatment leads to a more conservative estimate of LEQ than the alternative approach because there are more lines with negative LEQ.

⁹ EAD = (commitment_{year-1} - balance_{year-1}) × LEQ + balance_{year-1}.

¹⁰ We set the upper limit to 120% to allow for overdraw of the lines. Setting the upper limit to 110% or 130% yields similar results.

Note, in this study, we focus on the one-year horizon. In other words, we measure the current drawn amount relative to the commitment or drawn amount one year prior. Discussions with bank practitioners reveal that usage measurements at the one-year horizon are most relevant to them.

5. Results

5.1 Usage Statistics

First we study usage statistics. Table 2 presents summary statistics. Part (a) reports the usage and LEQ for defaulted firms, and part (b) reports the usage and LEQ for non-defaulted firms. When computing the usage and LEQ measurements on defaulted firms, we look for the usage information for the quarters falling into the [-93; -93]-day window, with day 0 being the default date. We then select the quarter with the largest balance amount within this six-month window. This method builds some conservatism into the usage measurement.

Columns 2–5 report the mean, 25th percentile, median and 75th percentile of the usage measurements. Defaulted firms utilize credit lines heavily when they default; non-defaulted firms show lower usage than defaulters. The average usage for defaulters is 80% (part (a) of Table 2). The median is higher, at 96%. In other words, half of the sample firms have almost fully drawn down their credit lines at default. The mean (median) LEQ is 49% (52%), similar to previous findings (see, for example, Araten and Jacobs 2001). We also observe a clustering of LEQs around 0% and 100%. Part (b) of Table 2 presents the usage statistics for non-defaulted firms. The usage level of non-defaulters is lower than that of defaulters: the mean (median) usage is 49% (53%) and the average LEQ is 25%.

Table 2 USAGE AND LEQ STATISTICS: UNLISTED FIRMS FROM THE CRD

	MEAN	25 TH PERCENTILE	MEDIAN	75 TH PERCENTILE
PANEL A: DEFAULTED FIRMS AT DEFAULT QUARTER				
Usage	80%	76%	96%	100%
LEQ	49%	0%	52%	94%
PANEL B: NON-DEFAULTED FIRMS				
Usage	49%	0%	53%	88%
LEQ	25%	0%	3%	45%

We look further into how usage evolves when firms approach default. Figure 3 shows usage behavior before default, and reveals that defaulted firms reach a high usage level eight quarters before default, with quarter 0 being the quarter in which the default event occurs. Figure 3 also plots the mean and median usage levels for non-defaulted firms. Defaulted firms' average usage is 74% two years prior to default, much higher than the average usage of non-defaulted firm (49%). The results imply that monitoring credit line usage may help to predict default events. In unreported results, we examine whether the increase in usage before default is due to commitment decrease or balance increase. We find that the increase in the usage ratio comes primarily from an increase in the balance amount. Even though the commitment amount, on average, does decrease beginning in the fourth quarter prior to default, the impact on the usage ratio is secondary.

Figure 3 Usage Before Defaults

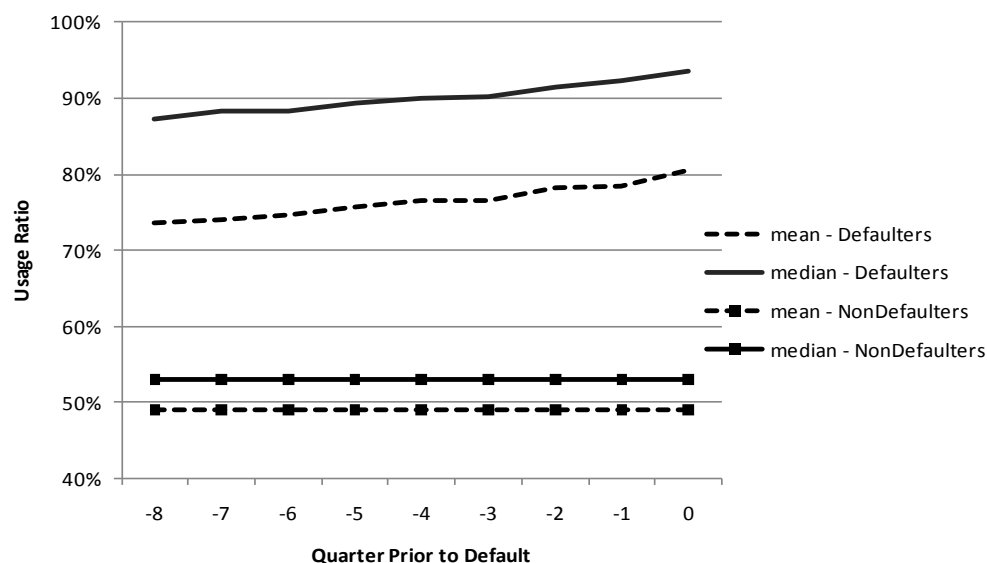


Table 3 presents average usage by loan purpose. We receive loan purpose codes from six out of the eight financial institutions. We classify the loan purpose codes into four major categories as listed in the table. Lines for working capital purposes account for almost half the sample. The second most frequent loan purpose is for real estate. This category includes construction lines and lines for property/land improvement or purchase. For defaulters, the usage and LEQ are high for all purposes. For non-defaulters, usage and LEQ measurements are highest when the loan purpose is real estate.

Table 3 AVERAGE USAGE AND LEQ BY LOAN PURPOSE

GROUP BY LOAN PURPOSE	DEFAULTERS		NON-DEFAULTERS	
	USAGE	LEQ	USAGE	LEQ
Business Expansion	86%	42%	57%	36%
Equipment	76%	56%	60%	41%
Real Estate	83%	52%	70%	49%
Working Capital	89%	56%	47%	35%

Usage measurements may vary with existing usage. In Table 4, we divide the sample into buckets by their usage one year prior and report the average usage ratio. Higher usage one year prior implies higher usage later. The LEQ measures the additional drawdown amount out of the remaining commitment amount. The LEQ measurements increase with usage one year prior when the latter is less than 90%. When the usage one year prior is more than 90%, the LEQ becomes smaller. The results in Table 4 have two implications. First, the additional drawdown and the existing usage may have similar drivers. Firms with lower existing usage seem to take less additional drawdown. Second, the inverse-U-shaped relationship confirms our prior that LEQ becomes smaller when a line already has high usage.

Table 4 AVERAGE USAGE AND LEQ BY USAGE RATIO ONE YEAR PRIOR

CURRENT USAGE	[0, 10%)	[10%, 30%)	[30%, 50%)	[50%, 70%)	[70%, 90%)	[90%, 99%)	>=99%
PANEL A: DEFAULTED FIRMS							
Usage	28%	47%	62%	72%	84%	92%	94%
LEQ	29%	51%	59%	59%	66%	59%	38%
PANEL B: NON-DEFAULTED FIRMS							
Usage	9%	30%	43%	57%	71%	84%	86%
LEQ	9%	35%	32%	44%	55%	46%	26%

5.2 Characteristics of Firms with High Usage

We next examine a set of variables that may further help explain the usage pattern of credit lines. These variables include a firm-level probability of default measure, risk grade assigned by lenders, collateral type, and total commitment size. We also look at how usage ratios change across economic cycles.

FIRMS WITH HIGHER DEFAULT RISK HAVE HIGHER USAGE

Firms with higher default risk are likely to draw down credit lines more. Such firms may have liquidity issues, and high leverage or bad financial performance may make it difficult for them to acquire additional funding other than drawing down their credit lines. Higher risk may also stem from aggressive expansion, which, in turn, implies higher credit line usage. We examine how usage relates to a firms' default risk as measured by Moody's Analytics RiskCalc expected default frequency (EDF) credit measures.¹¹ The EDF credit measure is a probability of default measurement based upon financial statement ratios as well as equity market information. The RiskCalc EDF considers financial ratios that measure the profitability, leverage, liquidity, debt coverage, growth, operating efficiency and size of a firm.¹² Note, only 40% of the firms in the sample have EDF measures; the rest cannot be matched to a financial statement in order to calculate EDF measures.

In Table 5, we divide the sample firms into ten buckets, grouped by RiskCalc EDF credit measures, with an equal number of firms in each bucket. EDF measures are calculated with information available one year prior to the current quarter. Group 1 has the lowest default risk as measured by the RiskCalc EDF measure, and Group 10 has the highest default risk. We compute the mean usage and LEQ for defaulted firms and non-defaulted firms separately for each bucket. We also report the EDF measure range. As expected, EDF measures for defaulters are, in general, higher than those of non-defaulters. Results show that, for defaulted firms, higher EDF measures are related to higher usage. The average usage for Group 1 is 54%, whereas the average usage for Group 10 is 77%. We also see an increase in usage and LEQ for non-defaulted firms as the EDF measure increases. The exception is the defaulters' LEQ measurements. We do not observe a monotonic relationship between LEQ and the EDF level. LEQ increases from 41% for Group 1 to 52% for Group 6 and becomes lower for firms with even higher EDF measures, likely because high-risk firms already have high usage prior to default.

Table 5 USAGE AND LEQ BY PROBABILITY OF DEFAULT MEASUREMENT

GROUP BY EDF	DEFAULTERS			NON-DEFAULTERS		
	EDF RANGE (%)	USAGE	LEQ	EDF RANGE (%)	USAGE	LEQ
Group 1	0.13-0.35	54%	41%	0.13-0.19	24%	10%
Group 2	0.35-0.70	62%	45%	0.19-0.26	32%	14%
Group 3	0.70-1.05	70%	45%	0.26-0.35	37%	17%
Group 4	1.05-1.53	66%	48%	0.35-0.52	40%	20%
Group 5	1.53-2.17	71%	46%	0.52-0.76	43%	22%
Group 6	2.17-3.19	76%	52%	0.76-1.03	46%	25%
Group 7	3.19-4.79	77%	50%	1.03-1.46	49%	26%
Group 8	4.82-6.82	78%	44%	1.46-2.41	51%	27%
Group 9	6.83-10.52	80%	47%	2.41-4.79	54%	28%
Group 10	10.52-35	77%	46%	4.79-35	57%	30%
Difference		23%***	5%		33%***	20%***

*** denotes significance at the 1% level. "Difference" denotes the difference between Group 1 and Group 10.

FIRMS WITH PASS GRADE HAVE HIGHER USAGE

A bank's internal rating captures the bank's own assessment of the borrower's creditworthiness. Such ratings are used in credit approval, portfolio monitoring, provision and allowance calculation and capital allocation. A bank's internal rating process is subject to regulatory oversight. Therefore, most banks have internal rating systems that parallel the credit risk rating scale used by

¹¹ RiskCalc is the Moody's Analytics private firm probability of default model.

¹² For more information on the RiskCalc model, please refer to Korablev, *et al.* (2012).

bank regulators.¹³ Table 6 assigns firms to two groups by their internal rating one year prior: "pass" grade and "non-pass" grade. We observe that defaulted firms with "non-pass" ratings have lower usage and LEQs than those with pass ratings. However, for non-defaulted firms we do not observe a similar pattern.

Results suggest that banks use internal ratings to monitor credit line usage, especially for firms that eventually default on their loans. Firms with a pass rating before defaults are likely not on the radar of credit reviewers and are able to draw down the lines more when approaching default. In the regression analysis, we further examine whether having a pass rating is associated with higher usage ratios, after controlling for other variables. We discuss the multivariate regression results in the next section.

Table 6 USAGE AND LEQ BY INTERNAL RATING

	USAGE	LEQ
PANEL A: DEFAULTED FIRMS		
Pass Rating	81%	51%
Non-Pass Rating	75%	39%
Difference	6%***	12%***
PANEL B: NON-DEFAULTED FIRMS		
Pass Rating	48%	25%
Non-Pass Rating	54%	26%
Difference	-6%	-1%

*** denotes significance at the 1% level

UNSECURED LINES HAVE LOWER USAGE

Collateral posting is another variable that may affect credit line usage. If a firm has both secured and unsecured lines, it has incentives to draw down the unsecured line more. At the same time, banks may monitor line usage of unsecured lines more closely because the LGD would be higher. Alternatively, banks may grant unsecured lines to borrowers with lower risk or longer lending relationships. Table 7 shows that unsecured lines or second lien lines have lower usage than lines with collateral. Results hold for both defaulted firms and non-defaulted firms. In the regression analysis, we further examine whether or not the relationship between collateral posting and usage measurements holds, after controlling for other variables.

We also test how the usage ratio changes with collateral type when there is a collateral posting (see rows 2–6, Table 7). Collateral types include equipment and machinery, all assets, real estate, inventory and accounts receivables, and cash and securities. For defaulters, usage and LEQ are high for all collateral types. For non-defaulters, usage and LEQ are highest when the collateral type is real estate, and lowest when the collateral type is cash and securities.

Table 7 USAGE AND LEQ BY COLLATERAL TYPE

GROUP BY COLLATERAL	DEFAULTERS		NON-DEFAULTERS	
	USAGE	LEQ	USAGE	LEQ
Unsecured / Second Lien	67%	42%	29%	14%
Equipment & Machinery	81%	52%	59%	30%
All Assets	85%	57%	43%	26%
Real Estate	86%	52%	61%	33%
Inventory & A/R	87%	55%	51%	28%
Cash & Securities	87%	58%	39%	17%

¹³ See FDIC (2012) for the definitions of the regulatory ratings.

LINES WITH LARGER COMMITMENT SIZE HAVE LOWER USAGE

The fourth variable we look at is the total commitment size. Large firms typically are able to secure higher commitment amounts from lenders. Therefore, commitment size can be a proxy for the size of the borrower. In Table 8, we divide the sample into five groups based on the size of the commitment. Larger lines are drawn down less, for both defaulted firms and non-defaulted firms. And the differences between Group 1 (the group with the smallest commitment size) and Group 5 (the group with the largest commitment size) are statistically significant. One explanation for this finding is that larger firms have more financing channels, while small firms usually rely on their banks for funding. Therefore, smaller firms draw down more from the credit lines. The other explanation is that banks may monitor lines with larger commitment size more closely.

Table 8 USAGE AND LEQ BY COMMITMENT SIZE

TOTAL COMMITMENT	DEFAULTERS		NON-DEFAULTERS	
	USAGE	LEQ	USAGE	LEQ
Group 1: 10k to 100k	85%	51%	54%	28%
Group 2: 100k to 250k	80%	48%	48%	26%
Group 3: 250k to 1MM	78%	50%	49%	24%
Group 4: 1MM to 5MM	75%	49%	50%	24%
Group 5: Above 5MM	71%	44%	42%	20%
Difference Group 1 vs. 5	14%***	7%***	12%***	8%***

*** denotes significance at the 1% level.

PRO-CYCLICAL NATURE OF LINE USAGE

We further look at how line usage changes through economic cycles. Previous studies showed mixed results on usage cyclicity. Firms tend to draw down credit lines to help weather economic downturns. At the same time, banks typically tighten credit during recessions. Fewer growth opportunities, or firm downsizing, may also lead to lower credit line usage during recessions. Evidence on line usage cyclicity has implications for a bank's liquidity and capital management. Particularly, in recent stress-testing exercises, the EAD estimation is one of the key components of expected loss and capital ratio calculation. A usage ratio or LEQ ratio is typically applied to the total or remaining commitments of credit lines to forecast EAD. Therefore, whether and how these two ratios change over economic cycles are central to bank stress-testing exercises.

Figure 4 plots the mean usage ratio by quarter for defaulted and non-defaulted firms separately. The mean usage ratio for non-defaulted firms is high around March 2001 and around June 2009, suggesting higher credit line utilization during economic downturns. The usage ratio for defaulted firms over time does not show a clear cyclical pattern. The ratio is particularly low in 2004 Q2 due to the low number of observations in that quarter.

Note, for non-defaulters there seems to be a downward trend in usage ratio. The data from before 2005 comes from three financial institutions, and the data after 2005 comes from eight institutions. Therefore, the trend in usage ratio may reflect differences across institutions. In the regression analysis detailed in the next section, we add a fixed bank effect control to account for such differences.

Figure 4 Mean Usage Ratio Over Time, Defaulted and Non-defaulted Firms

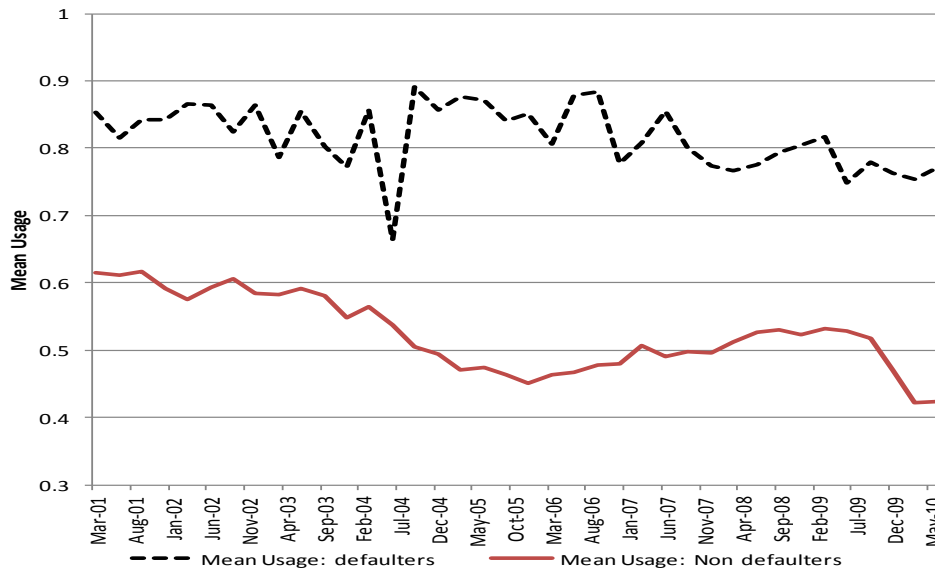
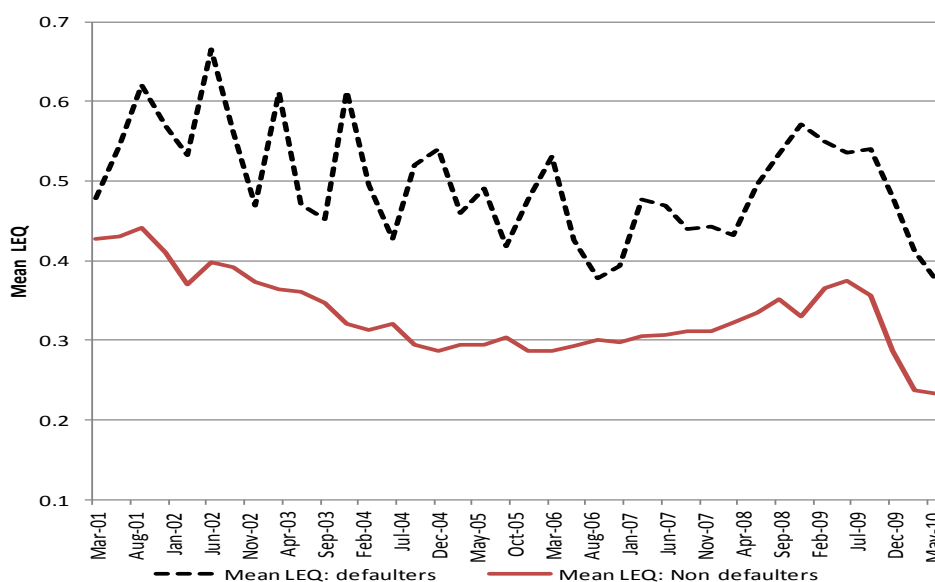


Figure 5 plots the mean LEQ ratio by quarter for defaulted and non-defaulted firms separately. The mean LEQ ratio for non-defaulted firms is high around March 2001 and around June 2009, suggesting more credit line drawdown during economic downturns. The LEQ ratio for defaulted firms over time does not show a clear cyclical pattern.

In the next section, we further examine the relationship between usage or LEQ ratio and an indicator of recession in a multivariate regression setting.

A closer look at the balance amount and commitment amount around the end of 2008 reveals that the increases in usage and LEQ ratios mostly come from additional drawdown rather than a cut in a commitment amount. The results suggest that banks were one of the liquidity providers for private firms at the peak of the recession.

Figure 5 Mean LEQ Ratio Over Time, Defaulted and Non-defaulted Firms



5.3 Regression Analysis

The previous sections analyze each of the factors that may explain credit line usage patterns. In this section, we conduct regression analysis to understand how these factors are associated with the usage measurements in a multivariate scenario.

We pool together both defaulters and non-defaulters into one sample. The dependent variable is either usage or LEQ. The first independent variable is a dummy variable equal to 1 for a defaulted firm-quarter and equal to 0 otherwise. The second independent variable is the EDF measure, in deciles. We place firms into ten equally sized groups ranked by EDF measure. The variable equals 1 if the EDF measure falls into the first group (lowest EDF/lowest risk) and 10 if the EDF measure falls into the last group (highest EDF/highest risk). The third variable is a dummy variable equal to 1 if the line is unsecured and equal to 0 otherwise. The fourth variable measures whether or not the internal rating one year prior is a pass grade. In the univariate analysis, we observe that defaulted firms with a “pass” grade one year prior have higher usage than those with a “non-pass” grade. This finding holds only for defaulters, not for the non-defaulters. Therefore, we add an interaction variable between the pass dummy and the default dummy. The last variable is the commitment size measured on a scale of 1 to 5, with 1 referring to the group with smallest commitment size. We also add the usage one year prior and the squared term of the usage one year prior as independent variables.

We add fixed-effect variables in the regression models. The fixed effect specification is intended to control for unobservable factors such as bank policies or industry practice that may have an impact on usage or LEQ. Such factors can be specific to a particular quarter, to the financial institutions that contribute the data or to the industry sectors to which the borrowers belong. The fixed effect model is often known as “within” regression. In other words, it measures the variation of the dependent variable within a group. We run two sets of regression models for usage and LEQ ratios, respectively. The first includes fixed bank, sector and quarter effect. The second omits the quarter effect, and adds a dummy variable to indicate recession quarters and an interaction term between the recession dummy and the default dummy. The coefficient on the recession dummy measures whether the usage ratio or LEQ ratio becomes higher or lower during times of recession. The coefficient on the interaction term further measures the difference in the cyclical behavior of the usage or LEQ ratio between defaulted and non-defaulted firms.

Note, we did not add a fixed-firm effect into the regression models because our primary interest in this study is the cross-firm variation of line usage.

Finally, we adjust the standard error to allow for clustering at the borrower firm level, as firms may have similar credit line contracts rolling over multiple times. The standard errors and the p-values in Table 9 are reported after the correction.

Table 9 presents regression results. The first two columns present the results with fixed bank, sector and time effects. Such specification controls for the difference in usage or LEQ level across banks and sectors and over time. More specifically, we have the following observations.

- » The coefficient on the default dummy is 5.9% for the usage regression and 4.6% for the LEQ regression. After controlling for other variables, the usage difference between defaulted firms and non-defaulted firms becomes smaller than that observed in Table 2 and Figure 3. It implies that such a difference can be explained by the other variables in the regression.
- » Firm risk as measured by EDF measure has a significant impact on usage and LEQ. Firms in decile 10 have 9% more usage and 7% more LEQ than those in decile 1. Therefore, firms with higher default risk tend to draw down more from credit lines. The coefficient on the pass grade dummy is positive. In other words, pass grade firms have higher usage. And the coefficient on the interaction term between pass and default is positive. Defaulted firms have even higher usage if their internal rating one year prior is a pass grade.
- » The coefficient on the collateral dummy is negative. All else being equal, firms with unsecured lines have lower usage and LEQ than those with secured lines.
- » The coefficient on the commitment size is negative, consistent with the finding that lines with larger commitment get drawn down less.
- » The coefficient on the current usage is positive and highly significant, and the coefficient on the squared term of current usage is negative. Usage increases with usage one year prior within the specified interval [0%, 120%]. Firms with high usage levels tend to maintain the high level. LEQ increases (decreases) with usage one year prior when the latter is smaller (larger) than 97% ($0.66/(0.34^2)$). The additional drawdown as measured by LEQ tends to be larger where usage is already high, except for those firms that have almost maximized their credit line capacity.

The last two columns of Table 9 present the results with fixed bank and sector effects and the recession indicator. The results on the default dummy, EDF measure, pass rating indicator and other control variables are very similar to those in the first two columns. The coefficient on the recession dummy is positive and statistically significant, suggesting that usage or LEQ ratio is

higher during the recession quarters. The coefficient on the interaction term between recession and default dummy is small and not statistically different from zero. The results suggest that the cyclical behavior of defaulted firms' usage ratio or LEQ ratio is not different from that of non-defaulted firms', even though Figure 4 and Figure 5 show that the cyclical behavior is more pronounced for non-defaulted firms.

Table 9 REGRESSION ANALYSIS¹⁴

	USAGE	LEQ	USAGE	LEQ
Default Dummy (=1 if default)	0.059*** (0.00)	0.046*** (0.00)	0.058*** (0.00)	0.042*** (0.00)
EDF Measure in Deciles	0.009*** (0.00)	0.007*** (0.00)	0.007*** (0.00)	0.006*** (0.00)
Collateral Dummy(=1 if Unsecured)	-0.010*** (0.00)	-0.002 (0.62)	-0.013*** (0.00)	-0.003 (0.13)
Internal rating Dummy (=1 if Pass Rating)	0.004** (0.01)	0.023*** (0.00)	0.001 (0.42)	0.022*** (0.00)
Pass * Default	0.035*** (0.00)	0.046*** (0.00)	0.036*** (0.00)	0.047*** (0.00)
Commitment Size (Group 1 to 5)	-0.001** (0.04)	-0.019*** (0.00)	-0.002*** (0.00)	-0.020*** (0.00)
Usage (year-1)	0.769*** (0.00)	0.658*** (0.00)	0.776*** (0.00)	0.668*** (0.00)
Usage (year-1) Squared	-0.129*** (0.00)	-0.343*** (0.00)	-0.131*** (0.00)	-0.348*** (0.00)
Loan Purpose: Working Capital	0.006*** (0.00)	-0.008*** (0.00)	0.016*** (0.00)	0.009*** (0.00)
Loan Purpose: Real Estate	0.081*** (0.00)	0.080*** (0.00)	0.089*** (0.00)	0.095*** (0.00)
Loan Purpose: Business Develp.	0.028*** (0.00)	-0.014 (0.30)	0.035*** (0.00)	-0.003 (0.73)
Recession			0.025*** (0.00)	0.037*** (0.00)
Default Dummy * Recession			-0.003 (0.63)	0.009 (0.54)
Fixed Bank Effect	Yes	Yes	Yes	Yes
Fixed Sector Effect	Yes	Yes	Yes	Yes
Fixed Quarter Effect	Yes	Yes		
Adjusted R ²	49%	18%	49%	17%
N	537,543	253,287	537,543	253,287

¹⁴ *** Denotes statistical significance at the 1% level, ** denotes statistical significance at the 5 % level.

6. Conclusion

This study is the first to provide large sample evidence on the credit usage for US middle-market borrowers. Previous studies generally focused on a small sample from one institution, collected data on publicly listed firms or utilized non-US data sets. Our findings confirm the high EAD documented in previous studies. We show that usage varies with firm-level and line-level characteristics and economic cycles.

We find that for defaulted firms EAD is indeed high. Usage reaches a high level approximately two years before default. Non-defaulted firms, on average, have lower usage levels. For both defaulters and non-defaulters, usage is higher if default risk is higher. This finding raises the question of whether or not banks charge sufficient spreads to cover the higher usage by riskier borrowers: a subject that warrants further study.

Usage measurements are also related to commitment size, collateral type and banks' internal ratings. Our findings suggest that banks monitor lines with poorer internal ratings more closely. We observe that during the recent recession usage ratios increased, especially for non-defaulted firms.

7. Addendum

The data used in this paper runs up to 2010. We have received additional data feeds after the submission of the primary paper. We reran the analysis with the data up to 2012 Q4. Our full data set now has 1.6 million quarterly observations on 145,000 firms from 2001–2012. The conclusions and observations made in the paper remain valid with the updated data file.

Table 10 summarizes the usage and LEQ ratios for defaulted firms and non-defaulted firms with the updated data. Compared with the results reported in Table 2, the statistics on the usage ratio for defaulted firms are slightly different. The statistics on LEQ ratio for defaulted firms changed little. For non-defaulted firms, the 25th percentile of the usage ratio increases from 0% to 9%; median of the LEQ ratio increases from 3% to 12%; the 75th percentile of the LEQ ratio increases from 45% to 51%; the other statistics are similar to previous results.

Table 10 USAGE AND LEQ STATISTICS: UNLISTED FIRMS FROM THE CRD

	MEAN	25 TH PERCENTILE	MEDIAN	75 TH PERCENTILE
PANEL A: DEFAULTED FIRMS AT DEFAULT QUARTER				
Usage	82%	75%	96%	100%
LEQ	48%	1%	50%	92%
PANEL B: NON-DEFAULTED FIRMS				
Usage	51%	9%	53%	90%
LEQ	28%	0%	12%	51%

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