Firm Diversification Affects Liquidity Management: The Role of Lines of Credit*

CHRISTINA ATANASOVA†

July 2018

Abstract

I examine whether organizational form matter for corporate liquidity, focusing on the effect of business diversification on firms' choice between bank lines of credit and cash holdings. I find that diversified firms have relied on bank lines of credit more than their focused counterparts, as they have increased their liquidity in the last two decades. I test several theoretical explanations for this finding. First, I find no evidence that diversified firms with lower aggregate risk (beta) have a higher probability of obtaining credit lines or use higher amounts of revolving credit than the higher beta firms. However, high idiosyncratic risk of borrowers hinders their access to credit lines. This effect is larger for smaller and for non-investment grade firms. My results are consistent with the monitored liquidity insurance hypothesis, where diversified firms with lower liquidity risk and hedging demand use more bank lines of credit.

JEL Classification: G30; G31; G32

Keywords: Cash holdings, bank lines of credit, corporate diversification, internal capital markets, liquidity risk.

---

*I am grateful to Eduardo Schwartz, Frederick Willeboordse and the seminar participants at the University of Canterbury, University of Otago, and Simon Fraser University for providing valuable comments and suggestions.

†Beedie School of Business, Simon Fraser University. E-mail: cva3@sfu.ca.

1 Introduction

Corporate liquidity and its unprecedented rise over the last few decades have attracted the attention of academics and practitioners, trying to understand what has been the driving force behind this increase. In particular, corporate liquidity management is different for diversified versus focused firms. In this paper, I use a large sample of US non-financial publicly traded firms, for the period from 2002 to 2017, to examine the effect of diversification on firm's choice between cash holdings and bank lines of credit. I find that the total liquidity (cash holdings plus credit lines) of diversified firms has increased in the same way as the liquidity of focused firms. However, diversified firms are more likely than concentrated firms, to use bank lines of credit instead of cash.[1] I propose an explanation for the lower cash holdings of diversified firms, where their lower liquidity risk and idiosyncratic volatility enables them to substitute credit lines for (relatively more costly) cash holdings.[2]

The number of studies examining corporate cash holdings has soared since the early 2000s, reflecting the growth in the cash balances held by U.S. firms at that time. For example, Bates, Kahle, and Stulz (2009) document that the average cash-to-assets ratio of US listed industrial firms has doubled since 1980s. Comin and Philippon (2006) and Boileau and Moyen (2016), among others, suggest that the steady growth in corporate liquidity is related to the fact that the cash flow risk that firms face has become more pronounced. Falato et al (2014) argue that there has been a significant rise in intangible capital that has shrunk collateral and therefore

[1] A line of credit, revolving credit facility or loan commitment is a nominal debt capacity against which the firm draws funds. It is provided by one or multiple banks (syndication). The firm pays a commitment fee on the unused portion and a predetermined interest rate on the used portion.

[2] There are several reasons why bank lines of credit could be relatively more advantages than cash holdings. First, lines of credit entail commitments to provide firms with liquidity only when valuable investment opportunities arise thus limiting managerial agency costs associated with holding cash. Second, firms deduct fees and interest payments on the line of credit whereas they pay tax on the interest generated on their cash reserves. Finally, returns on cash are generally lower than the cost of debt often used to finance it.

shifted corporate liquidity towards cash holdings. The increase in cash holdings, however, has not been the same for all firms. Duchin (2010) points out that the average cash holdings of standalone firms are almost double the cash holdings of diversified firms. I set out to further explore diversified firms' liquidity management, by augmenting liquidity to include bank lines of credit, and considering the effect of diversification on firms' choice between cash holdings and credit lines. I find that when I take credit lines into account, diversified firms have relied on revolving credit more than their focused counterparts. These findings are illustrated in a simple way in Figure 1.

Panel (a) of Figure 1 shows a plot of the ratio of cash holdings to assets for diversified and focused firms, whereas Panel (b) shows a plot of the ratio of the amount of revolving credit to assets for the two subsamples of firms. The figure shows that while the cash to assets ratio has been significantly higher for focused firms, the ratio of the committed amount of revolving credit to assets has been significantly higher for diversified firms. These illustrations are developed further in my formal regression analysis, where I use measures of diversification that account for the correlation in cash flows and investment opportunities across the business divisions of the multi-segment firms. The results show that diversified firms with less correlated segment cash flows and investment opportunities on average rely more on lines of credit to insure liquidity shocks than comparable portfolios of focused firms. My estimates suggest that one standard-deviation increase in the correlation in investment opportunities corresponds to a decrease of 12.05% in the average probability of obtaining a line of credit and 5.09% decrease in the average ratio of bank liquidity to total liquidity. Overall, the results show that the extent of firm diversification is related to the corporate use of credit lines versus cash.

Recently, a growing number of both theoretical and empirical studies have examined the trade-off between bank lines of credit and corporate cash holdings. The theoretical literature on corporate liquidity is motivate by frictions that prevent firms from obtaining external finance to fund profitable investment opportunities or

to cover cash shortfalls. Holmstrom and Tirole (1998), for example, show that relying on future debt or equity issuance is insufficient to provide liquidity for firms that face costly external financing. In their model, when a liquidity shock is realized, the borrower must retain a large enough stake in the project to motivate her to be diligent. If the liquidity shock is large enough, the borrower will not be able to obtain funds even if the project is profitable. Agency costs in this set up force the borrower to buy liquidity insurance (a line of credit). Similarly, Acharya, Almeida and Campello (2007) show that cash holdings dominate spare debt capacity for financially constrained firms whose funding needs are clustered in states of the world in which cash flows are low.

In this paper, I consider several explanations for why corporate diversification matter for liquidity management. The first explanation argues that diversified firms have lower risk. Hann, Ogneva and Ozbas (2013) show that the coinsurance (the imperfect correlation of cash flows) among a diversified firm's segments may help reduce not only idiosyncratic risk but also systematic risk. Diversified firms are able to transfer resources from cash-rich to cash-poor segments in some states and thus avoid some of the counter-cyclical deadweight costs that focused firms cannot avoid.

Acharya, Almeida and Campello (2013) develop a model of the trade-offs firms face when choosing between holding cash and obtaining a bank line of credit. They argue that firm's exposure to aggregate risk (firm's beta) is a fundamental determinant of how firms choose their liquidity management policies. In their model, a bank line of credit is an insurance against liquidity shortfall. It has, however, a drawback that banks may not be able to guarantee liquidity in the states of the world when the demand for funds under the outstanding lines exceeds the supply of funds coming from healthy firms. Aggregate (systematic) risk thus creates a cost to credit lines and the ability of banks to supply liquidity depends on the extent to which firms are subject to correlated (systematic) liquidity shocks.

To test Acharya, et al's (2013) model, I examine the extent to which corporate diversification reduces the aggregate (systematic) risk of the firm and therefore facil-

itates access to bank credit lines. Assuming that a firm's financing needs go up when its stock market return goes down, Acharya, et al (2013) argue that the relevant measure of firm's aggregate risk exposure is the standard stock market-based (unlevered) beta. They show that the negative relationship between the aggregate risk exposure and credit line-to-cash ratio is robust across different measures of exposure, e.g. cash flow beta, asset based beta and tail beta.

Alternatively, there are studies that highlight the importance of idiosyncratic risk of bank borrowers. Gatev and Strahan (2006) also argue that banks have a unique ability to hedge against market-wide (aggregate) liquidity shocks since deposit inflows provide funding for loan demand shocks that follow declines in market liquidity. These flows allow banks to meet loan demand from borrowers drawing funds from credit lines without running down their holdings of liquid assets. In addition, Emmons, Gilbert and Yeager (2004) simulates the mergers of US regional banks both within and across economic market areas by combining their call report data. They find that the bulk of the portfolio diversification effects appear to be unrelated to diversification across market areas but, instead, are related to bank size. Finally, Acharya, Hasan and Suanders (2006) study the effect of loan portfolio focus versus diversification on the risk-return characteristics of bank portfolios. They find that diversification is not guaranteed to produce superior performance and/or greater safety for banks. For high-risk banks, diversification reduces bank return while producing riskier loans whereas for low-risk banks, diversification produces an inefficient risk-return trade-off.

Overall, my empirical results do not support the hypothesis that diversified firms with lower aggregate (systematic) risk use more credit lines than higher beta firms. Conceptually, banks can hedge systematic risk easily and cheaply in the financial markets. On the other hand, diversified firms with high idiosyncratic volatility, have a lower probability of obtaining credit lines and use lower amounts of revolving credit.

Next, I consider an extension to the risk explanation, motivated by Acharya, Almeida, Ippolito and Perez-Orive's (2014) notion that banks use credit lines to

provide firms with a form of "monitored" liquidity insurance. A fully committed credit line (a full and irrevocable insurance) creates incentives for the firm to engage in risky investments that increase the risk of liquidity shocks. The bank retains its right (for example through covenants) to revoke access to the line of credit if it obtains a signal that the firm may engage in liquidity risk-taking. Bank monitoring and revocation happens in the same states when the firm needs the credit line the most. Thus firms with high liquidity risk and hedging needs may find that the cost of a bank credit line is too high (both direct and indirect, i.e. interests and fees as well as the expected costs of revocation) and therefore switch to cash holdings.

My results are consistent with the monitored liquidity insurance hypothesis, where diversified firms with lower liquidity risk and hedging demand use credit lines and firms with higher liquidity risk save cash. My findings are also in line with the results in Disatnik, Duchin and Schmidt (2014) who show that firms that are more exposed to traded sources of risk such as foreign currency and commodity price risk use more derivatives-based hedging and are more likely to use credit lines rather than cash to insure the remaining liquidity risk.

My final explanation examines the effect of financial constraints and diversification on firm's choice between cash holdings and credit lines. Kuppuswamy and Villalonga (2016) analyze the recent financial crisis and find that financial constraints play an important role in determining the value of diversification. I use size and investment grade as proxies for financial constraints and show that the effect of diversification on corporate liquidity is stronger for smaller and non-investment grade firms.

My paper is positioned at the intersection of two strands of the literature: corporate liquidity (cash holdings and bank lines of credit) and corporate diversification. Until the late 1990s, the consensus among researchers and practitioners was that corporate diversification leads to an average discount on firm value. Recent studies have questioned the assumption that inefficient diversification destroys value. These studies suggest that the diversification discount might stem from self-selection bias

and the endogeneity of diversification decisions, or even from data and measurement problems. For example, Villalonga (2004) provides evidence that self-selection by firms with different investment opportunities can explain (at least some of) the diversification discount. Santalo and Becerra (2008) show that the effects of diversification is heterogeneous across industries, whereas Kuppuswamy and Villalonga (2016) find that there is a change in the diversification discount over time associated with the role that financial constraints play in determining the value of diversification.

My paper is also related to the growing literature on corporate cash policies.[3] The central tenet of this literature is that the cash to assets ratios predicted by calibrations from standard models are much smaller than their empirical counterparts (see Riddick and Whited, 2009). Recent studies have tried to explain the observed increase in corporate cash holdings. Falato, Kadyrzhanova and Sim (2013) show that agency costs or precautionary motives, as well as other standard cross-sectional determinants of corporate liquidity have been relatively stable over time and thus have provided only a marginal explanation for the upward trend in US corporate cash holdings. Their study provides support for the hypothesis that the increasing reliance on intangible capital has been the most important determinant of this upward trend. Boileau and Moyen (2015), on the other hand, show that economy wide reduction in the cost of holding liquidities and an increase in risk explain the increase in cash holdings and the wide spread use of credit lines. Their structural estimation results show that the precautionary and liquidity motives (increased risk exposure) has translated into higher levels of corporate liquidity.[4]

[3]See for example Nikolov and Whited (2014), Gamba and Triantis (2008), Anderson and Carverhill (2012), Hugonnier, Morellec, and Malamud (2015a,b), Bolton, Chen, and Wang (2011, 2013, 2015), Falato, Kadyrzhanova, and Sim (2013), and Eisfeldt and Muir (2016).

[4]Previous studies have also examined the relationship between corporate governance and cash holdings. Dittmar et al. (2003) find that firms in countries with poor shareholder protection hold much more cash than firms in countries with good shareholder protection. Kalcheva and Lins (2007) also suggest that entrenched managers hold more cash, especially in countries where shareholder protection is weak. Harford et al. (2008) suggest that country level governance enforcement is

My paper differs from the literature on corporate cash holdings as it does not focus exclusively on cash. Instead, I consider the firm's choice between different liquidity management policies. In that respect, my work is related to the theoretical work in Bolton, Chen, and Wang (2011), Boileau and Moyen (2016) and Nikolov, Schmid and Steri (2017). In Boileau and Moyen's (2016), firms do not hold cash and credit lines simultaneously.[5] Nikolov, Schmid and Steri (2017), on the other hand, examine the determinants of corporate liquidity management through an estimated dynamic model of corporate investment and financing. When external finance is costly, firms absorb shocks and cover liquidity needs via cash holdings and draw-down on their credit lines. In contrast to cash, they model credit lines as a contingent liquidity that is limited by covenants and collateral constraints.

Previous empirical studies have also linked diversification and corporate liquidity and have argued that diversified firms naturally have different liquidity policies. For example, they have less cash reserves as they have used them in previous acquisitions. Other studies have suggested that diversified firms are larger, and economies of scales allow them to hold less liquid assets. Duchin (2010) shows that diversified firms have lower cash balances because they enjoy the benefits of coinsurance. Firms hold precautionary cash so that they will not forego future profitable investment opportunities. The imperfect correlation in investment opportunities and cash flows between business divisions reduces the diversified firm's exposure to the risk of mismatch between investment opportunities and sources of funds available and thus decreases the amount of precautionary cash balances the firm has to hold.

The main contribution of my paper is to document that diversified firms have increased their liquidity since the late 1990s, but unlike their focused counterparts, they have relied more on bank credit lines. The empirical evidence is not consistent with the hypothesis that diversified firms with lower aggregate risk (lower beta) have a higher probability of obtaining credit lines or use higher amounts of revolving credit

more important than firm-level determinants. In countries with poor legal shareholder protection, managers can hoard cash easier than those in countries with strong legal shareholder protection.

[5]In their model, credit lines are defaultable short term debt.

than higher beta firms. High idiosyncratic volatility and high liquidity risk (hedging needs), on the other hand, hinders access to bank credit lines.

Finally, I contribute to the literature on corporate liquidity, diversification and financial constraints. Amedia et al. (2004) study the cash flow sensitivity of cash and empirically document a link between the propensity to save out of cash flows and financial constraints. Faulkender and Wang (2006) provide evidence that cash is more valuable when held by financially constrained firms. Harford et al (2011) argue that firms save to insure against refinancing risk and document an inverse relationship between debt maturity and cash holdings which is stronger when credit market conditions are tighter. I also document that the diversification effect on corporate liquidity management (i.e. the choice between cash holdings and credit lines) is stronger for smaller and non-investment grade firms.

The remainder of this paper is organized as follows. Section 2 describes the sample data and presents some summary statistics. Section 3 presents the methodology used in this paper. Section 4 discusses the empirical results and their interpretation, and examines possible explanations for the relationship between corporate diversification and liquidity management policies. Section 5 considers some robustness tests and Section 6 concludes.

2 Data and Summary Statistics

2.1 Sample Data

I begin with the universe of all US publicly traded firms in the COMPUSTAT Fundamentals and COMPUSTAT Segments databases for the period 1992 to 2017. I collect annual firm-level accounting data for each company as well as segment-level accounting data for each business segment at the 4-digit SIC level. I apply the commonly used criteria to filter the sample. I exclude financial (primary SIC between

6000 and 6999) and utility (primary SIC between 4900 and 4999) companies.[6] I eliminate observations for which total assets, total sales, operating income, share price, number of shares outstanding, and cash holdings (cash and short-term investment) are missing as well as if cash holdings exceed total assets and if leverage ratios are greater than one. I also remove observations with missing segment industry codes. For the purposes of the analysis, I identify business segments at the 3-digit SIC level.[7] Multi-segment firms are those with two or more distinct 3-digit SIC code business segments whereas single-segment firms have only one such segment. A more refined industry stratification will significantly reduce the number of single-segment firms (in each industry) used to calculate industry averages and impute segment-level data.

For all focused firms in COMPUSTAT, I calculate average q and cash flow in each 3-digit SIC industry.[8] The diversification in investment opportunities for a multi-segment firm is calculated as the difference between the firm's (portfolio's) q volatility based on the actual cross-segment correlations in q and the volatility assuming perfect cross-segment correlation of one. The measure captures the reduction in q volatility as a result of the (imperfect) correlation between the investment opportunities of the business divisions of a multi-segment firm. The measure is zero for focused firms, negative for multi-segment firms and the lower the level of cross-segment correlation, the smaller (more negative) the measure suggesting better degree of diversification. Similarly, I calculate the measure of cross-segment diversification in cash flows as the difference between the firm's cash flow volatility using the actual cross-segment correlations in cash flows and the volatility assuming perfect cross-segment correlation of one.

To construct a measure of credit line usage, I collect data from the CAPITAL

[6]Multi-segment companies with financial divisions are not excluded, if the financial division is not the primary business segment.

[7]I define a segment as non-operating if the segment SIC code is 9999 (see Glaser and Muller, 2010). A non-operating segment is not counted as a business segment.

[8]To calculate the standard deviations of q and cash flow, I require at least 5 non-missing values in the 10-year window. I use the same procedure when calculating industry sales volatility.

IQ database for the period 2002-2017.[9] I use price data in CRSP to calculate the (unlevered) systematic and idiosyncratic volatility. Finally, I merge the variables from COMPUSTAT, CAPITAL IQ and the CRSP databases. The final sample consists of 3,601 companies (26,511 firm-year observations).

The definitions of the main variables for the study are provided in Table A1 in the Appendix. I use operating income before depreciation as the standard measure of cash flow and market-to-book ratio of net assets (q) as a measure for firm's investment opportunities. I use non-cash book assets (total assets - cash) to scale cash flow, market value of assets, tangible assets, and net working capital. Firms are likely to jointly determine cash holdings and credit lines usage. This may lead to a mechanical negative correlation between any measure scaled by total assets (including cash) and the amount of revolving credit used since the two sources of funds (cash and credit lines) are substitutes. A disadvantage of using non-cash assets in place of total assets is that it generates extreme outliers for firms whose assets are primarily comprised of cash. To avoid potential problems with extreme values, I examine the distribution of each variable and winsorize the 5th and 95th percentiles.

2.2 Summary Statistics

Panel A of Table 1 summarizes the financial characteristics of the sample firms. It shows wide variations in firm characteristics and significant differences between single and multi-segment firms. The average level of cash holdings is 14.11% and the standard deviation is 17.76%. Similar to the results in Duchin (2010), the average multi-segment firm has 10.42% cash holdings whereas the ratio for the average single-segment firm is 17.31%. While, multi-segment firms have relied less on cash than focused firms, they have a higher probability of obtaining a bank line of credit and have used larger amounts of revolving credit (as a percentage of total liquidity) over the sample period. The sample probability of obtaining a bank line of credit for all

[9]Prior to 2002, the coverage in CAPITAL IQ is very poor. I start the COMPUSTAT sample ten years prior to 2002 so that I can calculate the volatility of q and cash flow.

firms is 39.36%. The average multi-segment firm has a probability of 47.74% whereas probability for the average single segment firm is only 34.92%. The average firm has a bank-to-total liquidity ratio of 31.69% for the sample comprising of all firms. The ratio is 33.20% for the average multi-segment firm versus 30.35% for the average focused firm. The differences in means between the two groups are significant at conventional levels.

The average firm in the sample has $4,204 millions in book assets and a market-to-book ratio (Tobin's q) of 1.70. The summary statistics show that multi-segment firms are significantly larger (as measured by book assets), have smaller q and higher proportion of tangible assets, larger cash flows and more leverage than single-segment firms. Finally, Panel B of Table 1 shows that the (unlevered) betas for the two types of firms are not significantly different but multi-segment firms have significantly lower idiosyncratic risk and smaller financing gap (larger correlation between q and cash flows) than single-segment firms.

[Table 1]

2.3 Measuring Corporate Diversification

The average number of segments (at 3-digit SIC level) for the diversified firms in our sample is 2.80. Previous studies have used the number of segments or a dummy variable indicating whether a firm has more than one segment as a proxy for diversification (see, for example, Opler et al., 1999 and Subramaniam et al., 2011). There are, however, several problems with this measure. First, even though we use a 3-digit SIC classification, the degree of correlation between the investment opportunities and cash flows varies across industries. Therefore, larger number of segments, by itself, does not necessarily mean higher degree of diversification. Second, as shown by Duchin (2010), the effect of the number of segments does not remain significant when alternative diversification measures are used in cash holdings regressions. Finally, diversification measures based on the number of reported segments are subject to measurement errors (Erdorf et al., 2012).

In this study, I use Duchin's (2010) measures of diversification based on the correlation between the investment opportunities and cash flows of the business divisions of multi-segment firms. If a multi-segment firm is treated as a portfolio of focused firms (its segments), then the volatility of the firm (portfolio) maybe less than the weighted-sum of the volatility of its segments due to the (likely) imperfect cross-segment correlations. The volatility of the investment opportunities in a given industry is calculated as the 10-year standard deviation of the annual q of all focus firms in that industry. I use the average q of all focused firms in each 3-digit SIC industry as a proxy for the investment opportunities of a business segment from that industry. The diversification in investment opportunities for a multi-segment firm is calculated as the difference between the firm's (portfolio's) q volatility based on the actual cross-segment correlations in q and the volatility assuming perfect cross-segment correlation of one. Similarly, I calculate the measure of cross-segment diversification in cash flows as the difference between the firm's cash flow volatility using the actual cross-segment correlations in cash flows and the volatility assuming perfect cross-segment correlation of one. I include the number of segments as a control variable in all regression specifications.

Table 1 Panel B summarizes the diversification measures used in this paper. For the multi-segment firms, the mean of q correlation is -0.031. The mean of cash flow correlation is -0.006. For the single-segment firms, the diversification measures are zero. Panel B also reports q and cash flow volatility calculated using cross-segment correlations of one. The mean q volatility is 0.27 for multi-segment firms, and 0.34 for focused firms. The mean of cash flow volatility is 0.04 for multi-segment firms, and 0.08 for focused firms. The next section discusses the research design of the study.

3 Empirical Specification

To examine the effect of corporate diversification on the probability of having bank lines of credit and the reliance on bank liquidity (the committed amount of credit lines), I use two dependent variables. First, I use a dummy variable that equals one if the firm had a line of credit. Second, I construct a measure of bank liquidity (amount of credit lines committed) to total liquidity (bank liquidity plus cash and short-term investment). In all regressions, standard errors are clustered at the firm level and all specifications include year and firm fixed effects.

My first set of results is based on the following specification:

$$\begin{aligned} Liquidity_{i,t} =& \alpha_i + \beta_1 Qdiv_{i,t-1} + \beta_2 CFdiv_{i,t-1} + \gamma_1 firm\ controls_{i,t-1} \\ &+ \gamma_2 year\ dummies_t + \epsilon_{i,t} \end{aligned} \tag{1}$$

where $Liquidity_{i,t}$ is either a dummy variable that equals one if the firm has a line of credit or it is the ratio of bank liquidity to total liquidity for firm i in year t. $Qdiv_{i,t-1}$ measures the degree of diversification in q (the reduction in q volatility due to imperfect correlation between the investment opportunities of the business divisions of a multi-segment firm) for firm i in year $t-1$. Similarly, $CFdiv_{i,t-1}$ measures the degree of diversification in cash flow, calculated the same way as q correlation. *Firm controls* is a vector of other firm-level characteristics that may influence corporate liquidity. I include the number of business segments (specified at 3-digit SIC level), firm size (the natural logarithm of total assets), firm-level q and cash flow, non-cash net working capital, as well as industry level q and cash flow volatility. I also include the median within-year standard deviation of sales for all firms in firm i's 3-digit SIC group to measure industry-level seasonality.[10]

My first set of results shows that better diversified firms have a higher probability of obtaining a bank line of credit and rely on bank liquidity more than their focused counterparts. I search for possible explanations for this result. I examine the extent

[10]Firms in 3-digit industries that exhibit large degree of seasonality in sales may need lines of credit to manage working capital and inventories.

to which corporate diversification reduces the aggregate risk of the borrower and therefore facilitates access and lowers the cost of bank lines of credit. Acharya et al (2013) argue that banks create liquidity for firms by pooling their idiosyncratic risks. Firms with high aggregate risk, however, find it costly to get credit lines from banks and instead they have to save cash despite the higher opportunity cost and liquidity premium.

Alternatively, I hypothesize that corporate diversification lowers the idiosyncratic risk of the borrower so that better diversified firms (with lower idiosyncratic risk) have a higher probability of obtaining a bank credit line because banks can hedge aggregate risk but cannot easily diversify idiosyncratic risk. Comin and Philippon (2006) document that the recent decline in aggregate volatility has been accompanied by a large increase in firm-specific risk that is correlated with the increase in R&D investment. Gatev and Strahan (2006) argue that banks have a unique ability to hedge against market-wide liquidity shocks (aggregate risk) since deposit inflows provide funding for loan demand shocks that follow declines in market liquidity. Brown and Din (2011) show that bailout interventions are more likely if the crisis is systemic, while bank closures happen more often in case of isolated bank failures.

My second set of results is based on the following specification:

$$\begin{aligned} Liquidity_{i,t} =& \alpha_i + \beta_1 Qdiv_{i,t-1} + \beta_2 CFdiv_{i,t-1} + \beta_3 Risk_{i,t-1} + \beta_4 Qdiv_{i,t-1} \times Risk_{i,t-1} \\ &+ \beta_5 CFdiv_{i,t-1} \times Risk_{i,t-1} + \gamma_1 firm\ controls_{i,t-1} + \gamma_2 year\ dummies_{t-1} + \epsilon_{i,t} \end{aligned} \tag{2}$$

where $Risk_{i,t}$ is a measure of (i) aggregate risk or (ii) idiosyncratic risk. The aggregate risk is the (unlevered) beta of firm's i assets calculated from equity beta and a Merton-KMV formula (see Acharya, Almeida and Campello, 2013). Idiosyncratic risk is calculated by decomposing total asset risk on its systematic and idiosyncratic components. Using the Merton-KMV betas and variances, the systematic component for firm i at time t can be estimated as:

$$SysVar\,KMV_{i,t} = Beta\,KMV_{i,t}^2 \times Var\,KMV_t$$

where $Var\ KMV_t$ is the unlevered variance of the market. I compute $Var\ KMV_t$ as the value-weighted average of firm-level asset variances, $Var\ KMV_{i,t}$. The systematic component is essentially the variance of asset returns that is explained by the market. Given this formula, the idiosyncratic component can be computed as the square root of the total asset variance $Var\ KMV_{i,t}$ minus $SysVar\ KMV_{i,t}$.[11] The rest of the variables in specification (2) are the same as in specification (1).

Next, I consider a complementary explanation, provided by Acharya, Almeida, Ippolito and Perez-Orive (2014), based on the notion that banks use credit lines to provide firms with a form of "monitored" liquidity insurance. A fully committed credit line (i.e. a full and irrevocable insurance), creates incentives for the firm to engage in risky investments that increase the risk of liquidity shocks. The bank retains its right (for example through covenants) to revoke access to the line of credit if it obtains a signal that the firm may engage in liquidity risk-taking. Bank monitoring and revocation happens in the same states when the firm needs the credit line the most. Thus firms with high liquidity risk and hedging needs may find that the cost of a bank credit line is too high (both direct and indirect, i.e. interests and fees as well as the expected costs of revocation) and therefore switch to cash holdings.

My third empirical specification is as follows:

$$\begin{aligned} Liquidity_{i,t} =& \alpha_i + \beta_1 Qdiv_{i,t-1} + \beta_2 CFdiv_{i,t-1} + \beta_3 FG_{i,t-1} + \beta_4 Qdiv_{i,t-1} \times FG_{i,t-1} \\ &+ \beta_5 CFdiv_{i,t-1} \times FG_{i,t-1} + \gamma_1 firm\ controls_{i,t-1} + \gamma_2 year\ dummies_{t-1} + \epsilon_{i,t} \end{aligned} \tag{3}$$

where $FG_{i,t}$ is a measure of firm i hedging needs and liquidity risk in year t. This is the "financing gap" measure computed as the correlation between cash flows and investment opportunities. Acharya, et al. (2007) point out that firms with low correlation between their cash flows and investment opportunities have higher hedging

[11] The results remain the same when I use the idiosyncratic volatility for the stock of firm i, estimated for each year using daily return data, based on a regression projection of stock returns using a five factor model.

needs as well as high liquidity risk exposure. Other variables are the same as in specification (1).

Finally, I examine how financial constraints affect the relationship between corporate diversification and the choice between bank liquidity and cash holdings. My fourth empirical specification is as follows:

$$\begin{aligned} Liquidity_{i,t} =& \alpha_i + \beta_1 Qdiv_{i,t-1} + \beta_2 CFdiv_{i,t-1} + \beta_3 FC_{i,t-1} + \beta_4 Qdiv_{i,t-1} \times FC_{i,t-1} \\ &+ \beta_5 CFdiv_{i,t-1} \times FC_{i,t-1} + \gamma_1 firm\ controls_{i,t-1} + \gamma_2 year\ dummies_{t-1} + \epsilon_{i,t} \end{aligned} \tag{4}$$

where $FC_{i,t}$ is the financial constraints variable. We use firm size and investment grade (Almeida et al., 2004, Denis and Sibilkon, 2009) to categorize firm-years into a financially constrained group (FC takes a value of 1) and an unconstrained group (FC takes a value of 0). Firms with size below (above) the median total non-cash assets and firms with non-investment (investment) grade make up the constrained (unconstrained) group. Other variables are the same as in specification (1). The next section discusses the estimation results.

4 Results

In this section, I discuss the estimation results and their implications for the hypotheses outlined in section 3. First, I focus on the effect of correlation in investment opportunities and cash flows on corporate liquidity as specified in regression equation (1). Table 2 reports the estimation results: columns (1) and (2) include all firms, column (3) and column (4) only the diversified firms in the sample. I estimate equation (1) for diversified firms only in order to address the concern that the relationship between diversification and corporate liquidity is driven by self-selection. Diversified and focused firms may not face the same investment opportunity set or have the same ability to undertake and fund profitable investment projects. In addition, diversified firms may naturally hold less cash and bank liquidity than focused firms do because they have used it to expand operations by acquiring new divisions.

The results show that even among diversified firms, higher cross-segment correlation (lower degree of diversification) is associated with lower probability of obtaining a line of credit and a lower bank to total liquidity ratios on average. All specifications control for firm and year fixed effects and are estimated with robust standard errors clustered at firm level. From columns (1) and (2), one standard-deviation increase in the correlation in investment opportunities corresponds to a decrease of 12.05% in the average probability of obtaining a line of credit and 5.09% decrease in the average ratio of bank liquidity to total liquidity. The results in columns (3) and (4) have the same direction and similar magnitude as the results in columns (1) and (2). This suggests that the findings are not driven by the difference between focused and diversified firms in the sample.

[Table 2]

Table 2 also suggests that the cross-segment diversification in cash flows and the industry-level correlation between q and cash flows do not have significant effects on corporate liquidity. This is consistent with results found by Duchin (2010). The effects of the other control variables are as expected. Larger firms have higher probability of obtaining a line of credit and have larger bank liquidity-to-total liquidity ratios whereas firms with better growth/investment opportunities (higher q) and higher level of cash flows have a higher probability of obtaining a bank line of credit and rely more on bank liquidity. Firms facing higher level of operational risk (higher q volatility and higher cash flow volatility) also rely more on bank liquidity.

Table 2 documents a positive relationship between the inter-segment diversification in investment opportunities and corporate liquidity. Next, I examine possible explanations for the diversification effect on corporate liquidity, in particular, the effect of (unlevered) aggregate and idiosyncratic risk as well as the effect of liquidity risk and hedging needs. Finally, I test whether binding financial constraints have an effect on the relationship between corporate diversification and liquidity management.

[Table 3]

Table 3 reports the estimation results from regression specification (2), using two types of risk measures: the (unlevered) beta of firm's assets and firm's idiosyncratic risk. The coefficients of the diversification measures and the control variables are consistent with those in Table 2. Based on column (1), firms with higher idiosyncratic risk have a lower probability of obtaining a line of credit whereas firm's systematic risk does not affect both the probability of obtaining revolving credit and/or the bank liquidity to total liquidity ratio. The coefficient of the interaction term between idiosyncratic risk and diversification in investment opportunities is positive and significant, suggesting that the diversification effect on liquidity is weaker for these firms. The rest of the control variables have the same sign and magnitude as the results in Table 2.

Table 4 reports the estimation results from equation (3). I consider the role of liquidity risk and the hedging needs of the borrower in determining the choice between credit line and cash holdings. I use the firm-level correlation between investment opportunities and cash flow as a measure of the financing gap. The coefficients of the diversification measures and control variables are consistent with those reported in tables 2 and 3. In columns (1) and (2), higher values of the financial gap variable indicate lower correlation between cash flow and investment opportunities. Consistent with previous studies, firms faced with larger financing gap hold more cash. The coefficients of the interaction terms between cash flows and investment opportunities and q correlation are negative, indicating a stronger diversification effect for these firms.

[Table 4]

To evaluate the magnitude of the impact of liquidity on the interaction between q diversification and corporate liquidity, I compare the diversification effects at different levels of the financing gap variable. For example, with the mean value for the financial gap variable, one standard-deviation increase in the diversification in investment opportunities corresponds to 13.09% increase in the probability of obtaining a line of credit for the average firm. When the financial gap is one standard deviation above

the mean (higher liquidity risk and hedging needs), the diversification effect becomes only 1.93% for the average firm.

Next, I examine the role of financial constraints. Table 5 reports the estimation results from equation (4), with two proxies for financial constraints: firm size, and the investment grade of firm's debt. The magnitude of the coefficients of the cross-segment diversification in investment opportunities are larger than those reported in Table 2, while the coefficients of the control variables are comparable. Unconstrained (large and investment grade) firms have a higher probability of obtaining bank line of credit, as suggested by the positive and significant coefficients of financial constraints in columns (1) and (3).

Further, there is some evidence to support our hypothesis that financial constraints strengthen the relation between diversification in Q and corporate liquidity. In column (1), one standard-deviation increase in Q diversification corresponds to an average of 12.89% increase in the probability of obtaining a line of credit for financially constrained firms, while the effect is only 10.03% for firms in the less constrained group.

[Table 5]

5 Conclusions

This paper provides evidence on the relationship between corporate liquidity and diversification. Previous studies have documented a negative diversification effect on corporate cash holdings. My results indicate that this negative effect is due to the fact that diversified firms are able to substitute cash for bank liquidity, i.e. lines of credit. The results show that one standard deviation increase in q correlation (decrease in diversification) decreases the probability of obtaining revolving credit by 12.05% and the amount of bank liquidity to total liquidity by 5.09%. I search for a possible explanation for this diversification effect on corporate liquidity.

My results do not support the hypothesis that diversified firms with lower sys-

tematic risk (lower beta) have a higher probability of obtaining credit lines or use higher amounts of revolving credit than the higher beta firms. On the other hand, high idiosyncratic volatility hinders corporate access to credit lines. The empirical results also are consistent with the monitored liquidity insurance hypothesis, where diversified firms with lower liquidity risk and hedging demand use more bank lines of credit. This effect is larger for smaller and for non-investment grade firms. Overall binding financial constraints strengthen the value of diversification for corporate liquidity management.

References

[1] Acharya, Viral V., Iftekhar Hasan and Anthony Saunders, 2006. Should Banks Be Diversified? Evidence from Individual Bank Loan Portfolios, *The Journal of Business* 79(3), 1355-1412.

[2] Acharya, Viral V., Heitor Almeida, and Murillo Campello, 2007. Is cash negative debt? A hedging perspective on corporate financial policies, *Journal of Financial Intermediation* 16, 515-554.

[3] Acharya, Viral V., Heitor Almeida, and Murillo Campello (2013), Aggregate Risk and the Choice between Cash and Lines of Credit, *The Journal of Finance*, 68: 2059-2116.

[4] Almeida, Heitor, Murillo Campello, and Michael S. Weisbach, 2004. The Cash Flow Sensitivity of Cash, *The Journal of Finance* 59-4, 1777-1804.

[5] Acharya, Almeida, Ippolito and Perez-Orive, 2014. Credit Lines as Monitored Liquidity Insurance: Theory and Evidence, *Journal of Financial Economics* 112, p. 287-319.

[6] Anderson, R., and A. Carverhill. 2012. Corporate liquidity and capital structure, *Review of Financial Studies* 25:797-837.

[7] Bates, Thomas W., Kathleen M. Kahle, and Rene M. Stulz, 2009. Why Do U.S Firms Hold so Much More Cash than They Used To?, *The Journal of Finance* 64-5, 1985-2021.

[8] Bebchuk, Lucian, Alma Cohen, and Allen Ferrell, 2009. What Matters in Corporate Governance?, *The Review of Financial Studies* 22-2, 783-827.

[9] Boileau, M., Moyen, N., 2016. Corporate cash savings and credit line usage, *International Economic Review* 57, 1481-1506.

[10] Bolton, P., Chen, H., Wang, N., 2011. A unified theory of Tobin's q, corporate investment, financing, and risk management, *Journal of Finance* 66, 1545-1578.

[11] Bolton, Patrick, Hui Chen, and Neng Wang, 2013. Market timing, investment, and risk management, *Journal of Financial Economics* 109, 40-62.

[12] Bolton, P., Chen, H., Wang, N., 2015. Debt, taxes, and liquidity. Unpublished working Paper. MIT.

[13] Chava, Sudheer, and Michael R. Roberts, 2008, How Does Financing Impact Investment? The Role of Debt Covenants, Journal of Finance 63, 2085-2121

[14] Comin, D., Philippon, T., 2005. The rise in firm-level volatility: causes and consequences. In: NBER Macroeconomics Annual 20. MIT Press, pp. 167-228.

[15] Eisfeldt, A., and T. Muir. 2016. The joint dynamics of internal and external nance. Working Paper, UCLA

[16] Denis, David J., and Valeriy Sibilkov, 2010. Financial Constraints, Investment, and the Value of Cash Holdings, *The Review of Financial Studies* 23-1, 247-269.

[17] Dittmar, Amy, Jan Mahrt-Smith, 2007. Corporate governance and the value of cash holdings, *Journal of Financial Economics* 83, 599-634.

[18] Dittmar, Amy, Jan Mahrt-Smith, and Henri Servaes, 2003. International Corporate Governance and Corporate Cash Holdings, *The Journal of Financial and Quantitative Analysis* 38-1, 111-133.

[19] Disatnik, D., Duchin, R. and Schmidt, B. (2014) Cash Flow Hedging and Liquidity Choices. *Review of Finance*, 18:715-748.

[20] Duchin, Ran, 2010. Cash Holdings and Corporate Diversification, *The Journal of Finance* 65-3, 955-992.

[21] Emmons, W., A. Gilbert and T. Yeager, 2004. Reducing the Risk at Small Community Banks: Is it Size or Geographic Diversification that Matters?, *Journal of Financial Services Research*, 25(2-3), 259-81.

[22] Erdorf, Stefan, Thomas Hartmann-Wendels, Nicolas Heinrichs, and Michael Matz, 2012. Corporate Diversification and Firm Value: A Survey of Recent Literature, Working Paper.

[23] Faleye, Olubunmi, 2007. Classified boards, firm value, and managerial entrenchment, *Journal of Financial Economics* 83, 501-529.

[24] Falato, A., Kadyrzhanova, D., Sim, J., 2013. Rising intangible capital, shrinking debt capacity, and the US corporate savings glut. Unpublished working paper, The Federal Researve Board.

[25] Foley, C. Fritz, Jay Hartzell, Sheridan Titman, and Garry J. Twite, 2007. Why do firms hold so much cash? A tax-based explanation, *Journal of Financial Economics* 86-3, 579-607.

[26] Faulkender, M. and R. Wang (2006). Corporate Financial Policy and the Value of Cash. *The Journal of Finance*, 61: 1957-1990

[27] Gamba and Triantis (2008), Gamba, A., and A. Triantis. 2008. The value of nancial exibility, *Journal of Finance* 63:226396

[28] Gatev, E. and P. Strahan (2006). Banks' Advantage in Hedging Liquidity Risk: Theory and Evidence from the Commercial Paper Market. *The Journal of Finance*, 61: 867-892

[29] Glaser, Markus, and Sebastian Muller, 2010. Is the diversification discount caused by the book value bias of debt?, *Journal of Banking & Finance* 34, 2307-2317.

[30] Glaser, Markus, Florencio Lopez-De-Silanes, and Zacharias Sautner, 2013. Opening the Black Box: Internal Capital Markets and Managerial Power, *The Journal of Finance* 68-4, 1577-1631.

[31] Griliches, Zvi, 1981. Market value, R&D, and Patents, *Economic Letters* 7-2, 183-187.

[32] Harford, Jarrad, 1999. Corporate Cash Reserves and Acquisitions, *The Journal of Finance* 54-6, 1969-1997.

[33] Harford, Jarrad, Satter A. Mansi, and William F. Maxwell, 2008. Corporate governance and firm cash holdings in the US, *Journal of Financial Economics* 87, 535-555.

[34] Holmstrom, B., and J. Tirole. 1998. Private and Public Supply of Liquidity. *Journal of Political Economy* 106:1-40.

[35] Capital Supply Uncertainty, Cash Holdings, and Investment, with Julien Hugonnier and Erwan Morellec, *Review of Financial Studies*, 2015, 28(2), 391-445.

[36] Credit Market Frictions and Capital Structure Dynamics, with Julien Hugonnier and Erwan Morellec, *Journal of Economic Theory*, 2015, 157, 1130-1158

[37] Jensen, Michael C., 1986. Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers, *The American Economic Review* 76-2, 323-329.

[38] Kalcheva, Ivalina, and Karl V. Lins, 2007. International Evidence on Cash Holdings and Expected Managerial Agency Problems, *The Review of Financial Studies* 20-4, 1087-1112.

[39] Keynes, John Maynard, 1936. The General Theory of Employment, Interest, and Money.

[40] Kim, Chang-Soo, David C. Mauer, and Ann E. Sherman, 1998. The Determinants of Corporate Liquidity: Theory and Evidence, *The Journal of Financial and Quantitative Analysis* 33-3, 335-359.

[41] Kuppuswamy, V. and B. Villalonga (2016) Does Diversification Create Value in the Presence of External Financing Constraints? Evidence from the 2007-2009 Financial Crisis, *Management Science*, 62:4, 905-923

[42] La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny, 1998. Law and Finance, *Journal of Political Economy* 106-6, 1113-1155.

[43] Lamont, Owen, 1997. Cash Flow and Investment: Evidence from Internal Capital Markets, *The Journal of Finance* 52-1, 83-109.

[44] Lins, Karl V., Henri Servaes, and Peter Tufano, 2010. What drives corporate liquidity? An international survey of cash holdings and lines of credit, *Journal of Financial Economics* 98, 160-176.

[45] Lyandres, Evgeny, and Berardino Palazzo, 2014. Cash holdings, competition, and innovation, Working Paper.

[46] Maksimovic, Vojislav, and Gordon Phillips, 2007. Conglomerate firms and internal capital markets, *Handbook of Empirical Corporate Finance*, edited by Espen Eckbo, North-Holland.

[47] McLean, R. David, 2011. Share issuance and cash savings, *Journal of Financial Economics* 99, 693-715.

[48] McLean, R. David and Mengxin Zhao, 2014. Capital Market Development and Externally Financed Cash Savings, Woking Paper.

[49] McLean, R. David and Mengxin Zhao, 2015. Precautionary Cash Savings and Finance: Global Evidence, Woking Paper.

[50] Mikkelson, Wayne H., and M. Megan Partch, 2003. Do Persistent Large Cash Reserves Hinder Performance?, *The Journal of Financial and Quantitative Analysis* 38-2, 275-294.

[51] Morellec, Erwan, Boris Nikolov, and Francesca Zucchi, 2013. Competition, Cash Holding, and Financing Decisions, Working Paper.

[52] Nikolov, B., and T. Whited, 2014. Agency conicts and cash: estimates from a dynamic model. *Journal of Finance*, 69, 1883-1921.

[53] Nikolov, Boris and Schmid, Lukas and Steri, Roberto, 2017. Dynamic Corporate Liquidity, Working paper

[54] Opler, Tim, Lee Pinkowitz, Rene Stulz, and Rohan Williamson, 1999. The determinants and implications of corporate cash holdings, *Journal of Financial Economics* 52, 3-46.

[55] Ozbas, Oguzhan, and David S. Scharfstein, 2010. Evidence on the Dark Side of Internal Capital Markets, *The Review of Financial Studies* 23-2, 581-599.

[56] Pinkowitz, Lee, Rene M. Stulz, and Rohan Williamson, 2006. Does the Contribution of Corporate Cash Holdings and Dividends to Firm Value Depend on Governance? A Cross-country Analysis, *The Journal of Finance* 61-6, 2725-2751.

[57] Pinkowitz, Lee, Rene M. Stulz, and Rohan Williamson, 2012. Multinationals and the High Cash Holdings Puzzle, *Fisher College of Business* Working Paper 2012-03-010.

[58] Rajan, Raghuram, Henri Servaes, and Luigi Zingales, 2000. The Cost of Diversity: The Diversification Discount and Inefficient Investment, *The Journal of Finance* 55-1, 35-80.

[59] Riddick, L. and T. Whited, 2009. The Corporate Propensity to Save. *The Journal of Finance*, 64: 1729-1766.

[60] Sanchez, Juan M, and Emircan Yurdagul, 2013. Why are U.S. firms holding so much cash? An exploration of cross-sectional variation, *Federal Reserve Bank of St. Louis Review* 95-4, 293-325.

[61] Santalo, Juan and Manuel Becerra, 2008. Competition from Specialized Firms and the Diversification-Performance Linkage, *Journal of Finance*, 63, (2), 851-883

[62] Scharfstein, David S., and Jeremy C. Stein, 2000. The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment, *The Journal of Finance* 55-6, 2537-2564.

[63] Sharpe, Andrew, and Ian Currie, 2008. Competitive intensity as driver of innovation and productivity growth: A synthesis of the literature, *CSLS Research Report* 2008-3.

[64] Shin, Hyun-Han, and Rene M. Stulz, 1998. Are internal capital markets efficient?, *The Quarterly Journal of Economics* 113-2, 531-552.

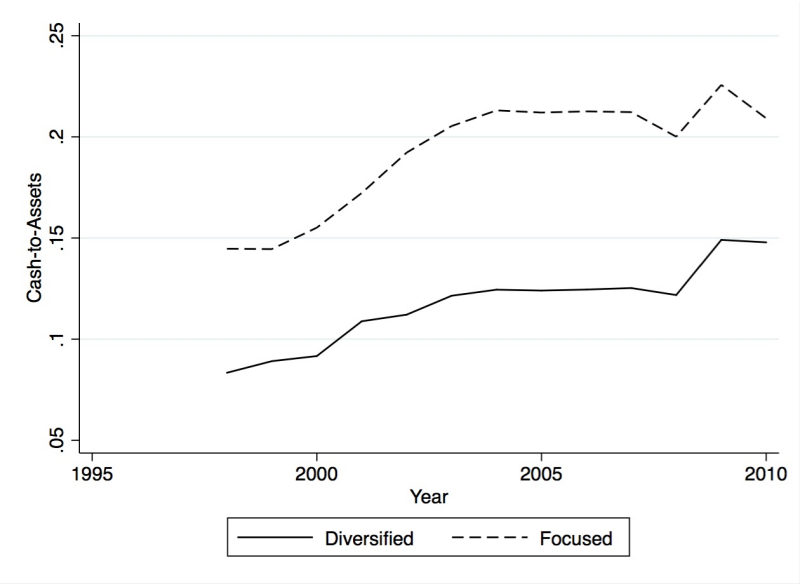
[65] Spamann, Holger, 2010. The "Antidirector Rights Index" Revisited, *The Review of Financial Studies* 23-2: 467-486.

[66] Subramaniam, Venkat, Tony T. Tang, Heng Yue, and Xin Zhou, 2011. Firm structure and corporate cash holdings, *Journal of Corporate Finance* 17, 759-773.

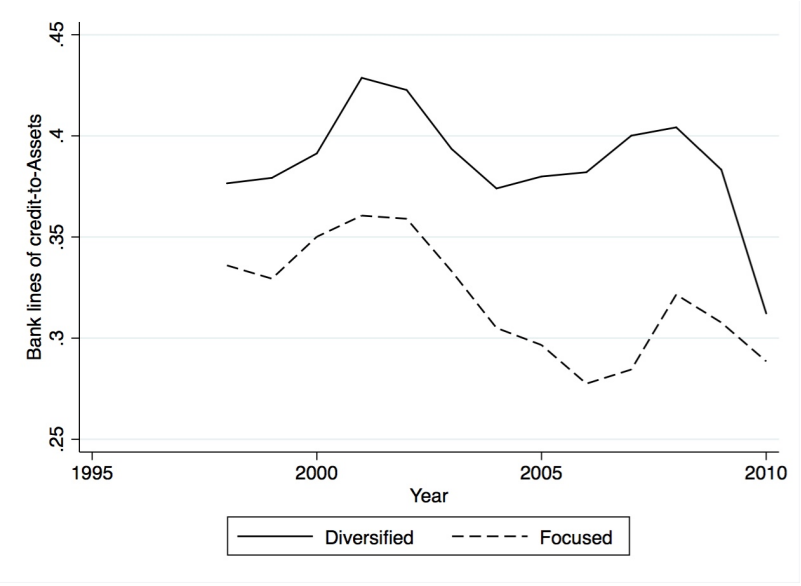
[67] Sufi, Amir, 2009. Bank Lines of Credit in Corporate Finance: An Empirical Analysis, *The Review of Financial Studies* 22-3, 1057-1088.

[68] Villalonga (2004) Villalonga, B., 2004a. Diversication discount or premium? New evidence from the business information tracking series. Journal of Finance 59, 479-506.

[69] Whited, Toni M., and Guojun Wu, 2006. Financial constraints risk, *Review of Financial Studies* 19-2, 531-559.



(a) Cash-to-Assets Ratio for Diversified and Focused Firms



(b) Credit Lines (committed amount at initiation)-to-Assets Ratio for Diversified and Focused Firms

Figure 1: Corporate Diversification and Liquidity

Table 1: Summary statistics

The table presents summary statistics for three samples of firms: (i) all firms; (ii) single-segment firms; and (iii) multi-segment firms. The sample consists of 3,601 US publicly traded companies for the period from 2002 to 2017. Multi-segment firms are those with two or more operating segments defined by the 3-digit SIC. The last column reports p-values from t-tests for differences in means. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	all firms			single-segment firms		multi-segment firms		difference in
	mean	std dev	median	mean	std dev	mean	std dev	means
Panel A: Firm characteristics								
Cash holdings	14.93%	17.76%	8.14%	17.32%	19.62%	10.43%	12.39%	6.89%***
Has line of credit {0,1}	39.36%	48.86%	0.00%	34.92%	47.67%	47.74%	49.95%	-12.82%***
Bank-to-total liquidity	31.69%	1.87	0.00%	30.35%	1.73	33.20%	0.88	-2.85%**
Size, in millions USD	4,204	17,186	363	2,593	12,005	7,240	23,800	-4,647***
Asset tangibility	28.71%	21.77%	23.27%	27.90%	22.50%	30.25%	20.24%	-2.35%***
q	1.70	1.10	1.35	1.79	1.21	1.52	0.82	0.27***
Cash flow	10.00%	24.07%	12.32%	9.02%	28.52%	11.84%	11.59%	-2.82%***
Leverage	21.29%	18.45%	19.00%	19.71%	18.83%	24.27%	17.31%	-4.56%***
Net working capital	26.16%	24.69%	24.81%	28.44%	26.77%	21.70%	19.23%	6.74%***
Panel B: Diversification and risk measures								
Number of segments	1.68	1.06	1.00	1.00	0.00	2.80	1.06	-1.80***
q correlation	-0.003	0.014	0.00	0.00	0.00	-0.031	0.018	0.03***
CF correlation	-0.001	0.005	0.00	0.00	0.00	-0.006	0.005	0.01***
q volatility	0.32	0.19	0.31	0.34	0.18	0.27	0.11	0.07***
CF volatility	0.05	0.14	0.05	0.08	0.07	0.04	0.03	0.04***
Unlevered beta	1.01	0.41	0.99	1.01	0.43	1.01	0.36	0.0017
Idiosyncratic volatility	0.13	0.06	0.12	0.14	0.07	0.11	0.06	0.03***
Financial gap	0.06	0.41	0.05	0.02	0.45	0.07	0.27	-0.05***

Table 2: Corporate liquidity and firm diversification

The table presents coefficient estimates from regressions relating the use of lines of credit to firm and industry-level characteristics. The sample consists of non-financial and non-utility US publicly listed firms for the period from 2002 to 2017. Variable definitions are in Appendix A1. Standard errors are robust and clustered by firm; p-values are included in brackets. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	All Has a line of credit (1)	All Bank-to-total liquidity (2)	Diversified Has a line of credit (3)	Diversified Bank-to-total liquidity (4)
Q correlation	-0.296***	-0.391**	-0.248***	-0.389***
	(0.000)	(0.002)	(0.006)	(0.007)
CF correlation	-0.0425*	-0.00733	-0.0263	-0.0478**
	(0.015)	(0.778)	(0.535)	(0.023)
Number of segments	-0.0042	-0.0030	-0.0044041	-0.0035
	(0.274)	(0.224)	(0.642)	(0.161)
ln (assets)	0.0314***	0.0244***	0.015***	0.0283***
	(0.000)	(0.000)	(0.000)	(0.000)
Q volatility	-0.0251***	-0.0271***	-0.0505155	-0.0332***
	(0.000)	(0.000)	(0.103)	(0.000)
CF volatility	-0.1329***	-0.1129***	-0.0951997	-0.093**
	(0.000)	(0.000)	(0.101)	(0.011)
Firm CF	0.0144***	0.0294***	0.0402***	0.0211***
	(0.000)	(0.000)	(0.000)	(0.002)
Tobin's Q	0.0237***	0.0287***	0.0267***	0.0302***
	(0.000)	(0.000)	(0.000)	(0.000)
Net working capital	-0.0419***	-0.0489***	-0.0455***	-0.0522***
	(0.000)	(0.000)	(0.000)	(0.000)
Year F.E.	Yes	Yes	Yes	Yes
Firm F.E	Yes	Yes	Yes	Yes
Adjusted R^2	0.597	0.712	0.772	0.663
No. of Observations	26,511	26,511	8,990	8,990

Table 3: The diversification effect on the choice between cash and credit lines

The table presents estimates from regressions explaining the role of risk on the relationship between the diversification and corporate liquidity. The sample consists of non-financial and non-utility firms from for the period from 2002 to 2017. p-values based on robust standard errors clustered by firm are in brackets. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	asset beta	*asset beta*	*idiosynctratic risk*	*idiosynctratic risk*
	Has a line of credit	Bank-to-total liquidity	Has a line of credit	Bank-to-total liquidity
	(1)	(2)	(3)	(4)
Q correlation	-0.1430***	-0.1605***	0.1896	-0.2211
	(0.005)	(0.003)	(0.178)	(0.318)
CF correlation	0.2417	0.1620	-0.4673**	-0.6404*
	(0.248)	(0.439)	(0.031)	(0.097)
Risk	-0.0647	-0.0212	-0.0012***	-0.0091**
	(0.28)	(0.522)	(0.001)	(0.022)
Risk * Q correlation	-0.4132	-1.2650	-0.1328**	-0.0547***
	(0.271)	(0.194)	(0.044)	(0.008)
Risk * CF correlation	-2.5271	0.1653	-0.2055**	-0.1701
	(0.278)	(0.968)	(0.017)	(0.193)
Number of segments	-0.0032	-0.0023	-0.0029	-0.0024
	(0.289)	(0.466)	(0.252)	(0.348)
ln (assets)	0.0250***	0.0248***	0.0246***	0.0247***
	(0.000)	(0.000)	(0.000)	(0.000)
Q volatility	-0.0275***	-0.0275***	-0.0267***	-0.0269***
	(0.001)	(0.001)	(0.001)	(0.000)
CF volatility	-0.1068***	-0.1071***	-0.1137***	-0.1242***
	(0.001)	(0.001)	(0.000)	(0.000)
Firm CF	0.0279***	0.0280***	0.0295***	0.0293***
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0288***	0.0287***	0.0286***	0.0287***
	(0.000)	(0.000)	(0.000)	(0.000)
Net working capital	-0.0441***	-0.0439***	-0.0487***	-0.0487***
	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.712	0.713	0.712	0.712
No. of Observations	26,511	26,511	26,511	26,511

Table 4: Liquidity risk and the diversification effect on corporate liquidity

The table presents estimates from regressions explaining the relation between liquidity risk and the diversification effect on corporate liquidity. The sample consists of non-financial and non-utility firms for the period from 2002 to 2007. p-values based on robust standard errors clustered by firm are in brackets. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	firm-level financial gap	*firm-level financial gap*	*industry-level financial gap*	*industry-level financial gap*
	Has a line of credit	Bank-to-total liquidity	Has a line of credit	Bank-to-total liquidity
	(1)	(2)	(3)	(4)
Q correlation	-0.5793***	-0.3181**	-0.2059*	-0.3259*
	(0.007)	(0.036)	(0.054)	(0.054)
CF correlation	-0.1957	0.3143	-0.8115**	-0.4215**
	(0.119)	(0.571)	(0.027)	(0.027)
Financial gap	0.0057**	0.0036*	0.0120***	0.0070***
	(0.048)	(0.052)	(0.001)	(0.001)
FG * Q correlation	-0.2266**	-0.0773**	-0.0176	-0.0176
	(0.038)	(0.039)	(0.815)	(0.815)
FG * CF correlation	-0.5430	0.0132	-0.3089	-0.1489
	(0.186)	(0.963)	(0.157)	(0.237)
Number of segments	-0.0031	-0.0034	-0.0033	-0.0031
	(0.219)	(0.205)	(0.181)	(0.181)
ln (assets)	0.0237***	0.0258***	0.0246***	0.0245***
	(0.000)	(0.000)	(0.000)	(0.000)
Q volatility	-0.0270***	-0.0250***	-0.0280***	-0.0254***
	(0.000)	(0.003)	(0.000)	(0.000)
CF volatility	-0.1123***	-0.1050***	-0.1107***	-0.1207***
	(0.000)	(0.001)	(0.000)	(0.000)
Firm CF	0.0293***	0.0302***	0.0297***	0.0231***
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0287***	0.0284***	0.0287***	0.0287***
	(0.000)	(0.000)	(0.000)	(0.000)
Net working capital	-0.0490***	-0.0427***	-0.0486***	-0.0443***
	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.712	0.715	0.712	0.712
No. of Observations	26,511	26,511	26,511	26,511

Table 5: Financial constraints and the diversification effect on corporate liquidity

The table presents estimates from regressions explaining the relation between financial constraints and the diversification effect on corporate liquidity. The sample consists of non-financial and non-utility firms for the period from 2002 to 2017. p-values based on robust standard errors clustered by firm are in brackets. Significance at the 1%, 5%, and 10% levels is represented by ***, **, and *, respectively.

	size	*size*	*investment grade*	*investment grade*
	Has a line of credit	Bank-to-total liquidity	Has a line of credit	Bank-to-total liquidity
	(1)	(2)	(3)	(4)
Q correlation	-0.5793***	-0.3181**	-0.2059*	-0.0059*
	(0.007)	(0.036)	(0.054)	(0.054)
CF correlation	-0.1957	-0.3143	-0.8115**	-0.0012**
	(0.119)	(0.571)	(0.027)	(0.017)
Financial constraints	-0.0057	-0.0036*	-0.0120***	-0.0201***
	(0.148)	(0.052)	(0.001)	(0.001)
FC * Q correlation	-0.2266**	-0.0773	-0.0176	-0.0276
	(0.038)	(0.339)	(0.815)	(0.415)
FC * CF correlation	-0.5430	0.0132	-0.3089	-0.1089
	(0.186)	(0.963)	(0.157)	(0.237)
Number of segments	-0.0031	-0.0034	-0.0033	-0.0033
	(0.219)	(0.205)	(0.181)	(0.281)
ln (assets)	0.0237***	0.0258***	0.0246***	0.0242***
	(0.000)	(0.000)	(0.000)	(0.000)
Q volatility	-0.0270***	-0.0250***	-0.0280***	-0.0262***
	(0.000)	(0.003)	(0.000)	(0.000)
CF volatility	-0.1123***	-0.1050***	-0.1107***	-0.1007***
	(0.000)	(0.001)	(0.000)	(0.000)
Firm CF	0.0293***	0.0302***	0.0297***	0.0327***
	(0.000)	(0.000)	(0.000)	(0.000)
Tobin's Q	0.0287***	0.0284***	0.0287***	0.0287***
	(0.000)	(0.000)	(0.000)	(0.000)
Net working capital	-0.0490***	-0.0427***	-0.0486***	-0.0454***
	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.712	0.715	0.712	0.712
No. of Observations	13,256	13,255	10,126	16,326

Appendix A1: Variable definitions

Variable	Definition
Panel A: Firm characteristics	
Cash holdings	(Cash + short-term investment) / non-cash assets.
Has a line of credit	1 if a firm has a revolver or 364-day facility in Dealscan.
Bank-to-total liquidity	Line of credit amount/(Line of credit amount+ cash + short-term investment).
Size	Total assets, in millions USD; In regressions, I use log of total assets.
Asset tangibility	Tangible assets / non-cash assets.
CF (Cash flow)	Operating income before depreciation / non-cash assets.
q (market-to-book)	(Total assets - book value of equity + market value of equity - cash)/ non-cash assets.
Leverage	Book leverage = (long term debt + short-term debt) / non-cash assets.
Net working capital	Net working capital / non-cash assets
Panel B: Diversification and risk measures	
Number of segments	The number of business segments defined at 3-digit SIC level.
q correlation	The difference between firm's sales-weighted volatility in q considering actual inter-segment correlations and the volatility assuming perfect inter-segment correlation of 1.
CF correlation	The difference between firm's sales-weighted volatility in cash flow considering actual inter-segment correlations and the volatility assuming perfect inter-segment correlation of 1.
q volatility	The standard deviation of q based on the past 10-year period.
CF volatility	The standard deviation of cash flow based on the past 10-year period.
Aggregate risk (unlevered beta)	Calculated from equity beta and a Merton-KMV formula (see Acharya, Almeida and Campello, 2012).
Idiosyncratic risk	The idiosyncratic volatility calculated as the difference between total risk and systematic risk.
Financing gap	Firm-level and industry-level correlation between Tobin's q and cash flow.
Investment grade	1 if firm's credit rating is BBB- or higher and 0 otherwise.