Does Financial Derivative Hedging Reduce Firms' Financial Constraints?

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This study examines the relationship between the firms' derivative risk management and its financial constraints. Firms face a wedge between their internal and external financing for their investments. I test whether this wedge reduces firms' financial constraints when they hedge using interest rate, foreign currency, and commodity derivatives. Using an event study and a difference-in-differences framework around implementing Financial Accounting Standard (FAS) 123R, this study shows a strong causal relationship between derivative hedging and financial constraints. I find that net debt increases for the derivative hedging firms, on the other hand, cash holdings and net equity issuance decreases. When managers of non-financial corporations believe that their firm will face a liquidity shortage, they save more cash out of cash flow as a precautionary measure. Both cash flow-cash sensitivity and investment-cash flow sensitivity decrease. The analysis also shows that both the loan spread and the probability of covenant violation decrease after firms start derivative hedging. The main implication of the analysis is that risk management influences the asymmetric information between lenders and borrowers: the increase in risk management, the less the asymmetry.

Keywords: hedging, financial constraints, risk management, derivatives, financing, investments, cash to cash flow volatility, investment-cash flow sensitivity

INTRODUCTION

What explains the use of financial derivatives by financially constrained firms? This question is important for various stakeholders in the economy.[1] An extensive body of empirical risk management research is inconclusive as to whether financially constrained firms participate in risk management operations using derivative instruments.[2] The specific idea in this article is that increase in leverage, decrease in cash holdings, decrease in net equity issuance, and increase in total investment of firms, have been consequences of derivative usage. This article empirically analyzes the liquidity choices of financially constrained firms, guided by a theoretical model of Froot, Scharfstein, and Stein (1993). In addition, I provide evidence that different instruments such as interest rate, foreign currency, and/or commodity derivatives provide better hedging for reducing cash flow sensitivity of cash and investment-cash flow sensitivity.[3]

FIGURE 1
FINANCIALLY CONSTRAINED FIRMS HEDGING USING DERIVATIVE INSTRUMENTS FROM 1997-2015

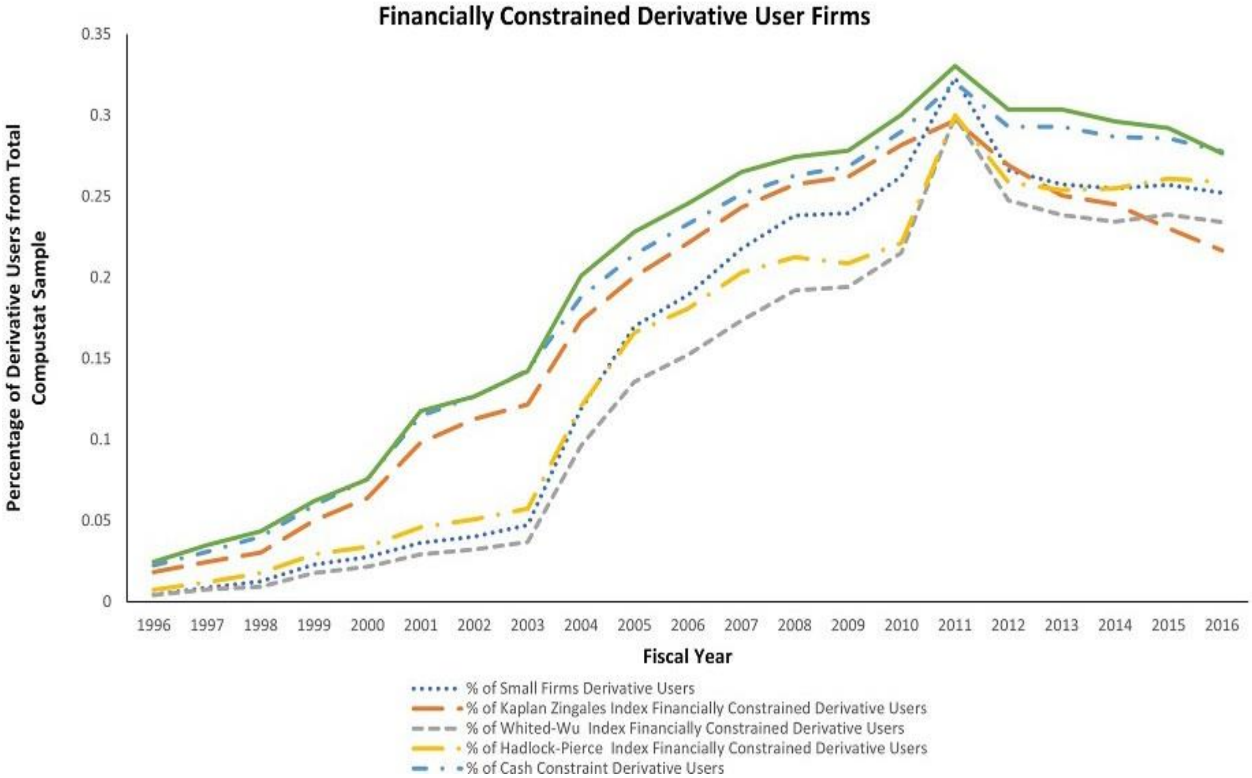

Figure 1 shows the relationship between changes in risk management of financial constraint firms using derivative instruments from 1997 to 2015. I plot four different proxies of firms' financial constraints and their derivative usage widely used in literature.

Increased usage of financial derivative instruments for hedging by non-financial firms, more specifically financially constrained firms, is absent in academic journals to the best of my knowledge. As shown in Figure 1, the usage of financial derivatives for hedging by financially constrained firms in the United States has increased by at least 150 percent since 1997. The increasing trend of hedging is consistent for all the popular proxies of financial constraints from previous finance research. Findings in this article suggest that the rise in hedging is a robust predictor of a decline in cash flow sensitivity of cash across a large number of firms since the mid-1990s.

This study aims to show that financial derivative hedging can help relieve firms' financial constraints.[4] This study identifies an exact mechanism through which hedging affects firms' financial constraints. Managers of non-financial corporations save more cash out of their cash flow as a precautionary measure, when they believe that their firm may face a future liquidity shortage. This study finds that when non-financial firms start hedging using derivatives, their cash holdings decrease, and their bank lines of credit and net debt are measured as ((total leverage−cash)/assets) increase. The finding that an increase in net debt is due to a decrease in the loan spreads is consistent with a decrease in firms' financial constraints. Furthermore, I show that the probability of covenant violation decreases after firms' start hedging. Hence, the firm builds an excellent reputation, allowing it to increase its capital structure's debt component. In the seminal paper, Almeida, Campello, and Weisbach (2004), using a sample of manufacturing firms, conclude that the cash flow sensitivity of cash is positive for financially constrained firms. A sample in this analysis shows a decreasing trend in cash-to-cash flow volatility and investment to cash flow sensitivity. On the other hand, when the firm stops derivative hedging, I find the opposite results. This research is in the spirit of Erel, Jang, and Weisbach (2015). They find that acquisitions relieve the target firms' financial constraints by reducing their sensitivity of cash-to-cash flow as well as the sensitivity of investment to cash flow. Therefore, the research question raised in this study is, "Does derivative hedging relieve firms' financial constraints?"

In his seminal study, Myers (1977) provides various theoretical solutions to resolve information asymmetry between creditors, borrowers, and investors. Further, in the pecking order theory, Myers and Majluf (1984) conclude that asymmetric information between lenders and borrowers is a primary concern for the firm in pursuing the best investment opportunity. This early literature and other follow-up empirical studies conclude that firms mainly rely on cash holdings rather than debt or equity issuance when the manager's information set tends to differ from that of the creditors and investors. Findings in this study suggest that derivative hedging helps reduce information asymmetry between managers and lenders. This research suggests that net debt increases following the initiation of the risk management program. The channel through which a net debt increases ex-ante is the decrease in loan spread and reduction in the probability of violation of the existing technical covenants (see Chava and Roberts (2008)). In addition, this study shows that the ex-post channel is the reduction in cash-to-cash flow volatility and investment-to-cash flow sensitivity for all firms and financially constrained firms sample, separately.

On the other hand, I find that net equity issuance (measured following Leary and Roberts (2014)) decreases after the derivative hedging starts. Hence, this result suggests that derivative hedging does not help to reduce information asymmetry in the equity market. The research question I address is crucial for finance scholars, policymakers, and practitioners alike.

For empirical corporate finance academicians, this research may provide the base to investigate more real and financial issues related to financial constraints firms' hedging policy. Further, hedging can increase cash flow, which prevents firms from bypassing investments such as R&D, advertising, etc. In a cross-sectional analysis, Li (2011) concludes that an increase in R&D intensity generates an abnormal return of 1.27% per month. Hence, asset-pricing scholars can extend this research regarding derivative hedging. Moreover, Campello, Graham, and Harvey (2010) suggest that the increase in the levels of investment of financially constrained firms may improve the strength of future economic growth, which is one of the critical questions for policymakers. Therefore, risk managers can use this research to implement their hedging policy in the presence of various risk exposure to firm characteristics.

Corporate risk management data for all U.S. firms are absent, so empirical research on financially constrained firms' derivative hedging behavior remains an open question. In derivative hedging literature, researchers considered only big firms by asset size or only one industry to maintain homogeneity of risk exposure and firm characteristics. Graham and Rogers (2002) find that hedging increases with firm size. Further, Géczy, Minton, and Schrand (2007) suggest that economies of scale exist to start a risk management program because of the fixed cost associated with it. In addition, Bodnar, Hayt, and Marston (1998) conclude that big firms are better equipped to cover the derivative positions than small firms. Besides, most of the proxies of financially constrained firms require the bottom three deciles (or lower median) of the total sample of observations from an index such as the log of assets size, Kaplan and Zingales, Hadlock- Pierce index.

Furthermore, Purnanandam (2008) develops a model and empirically demonstrates that firms facing financial distress tend to hedge more in industries with few major competitors. Hence, the previous literature either fail to identify the financial constraints firms' in their sample or had limited statistical power to explore the issue in their study (See Adam (2009)). In a seminal study of the real and financial implications of derivative hedging, Campello, Lin, Ma, and Zou (2011) analyze only a sample of 2718 firm-years in the 1996 to 2002 period. Similarly, in the present study, the sample period falls in the 1996 to 2016 period. On the other hand, Adam (2009), using a sample of the North American gold mining industry, shows that more financially constrained firms use collar strategies to hedge by selling calls and purchasing puts. Moreover, they find that the most financially constrained firms only pursue hedging strategies by buying call options. As a measure of financial constraints, Almeida et al. (2004) suggest small firms as one of the five proxies, which are more susceptible to capital market imperfection because typically they are young. Whereas previous studies focus on limited risk management instruments, single industries, or solely financially distressed firms, I employ a broader set of hedging instruments and diverse proxies for financial constraint. Hence, to the best of my knowledge, this study is the first to investigate the effect of derivative hedging on the liquidity choices and investment of financial constraints firms'.

While various hedging studies provide evidence that an optimal hedging increases firm value [e.g., Allayannis and Weston (2001), Pérez González and Yun (2013), and more], others [Guay and Kothari (2003), and Jin and Jorion (2006)] find a weak relationship between hedging and firm size for non-financial corporations. Campello et al. (2011) studied the effects of firms' hedging policies on their financing and investment using the tax-based instrumental variable approach. They find that hedgers get favorable financing terms on debt issuance, which helps them to avoid an under-investment problem. I provide direct evidence that hedging has a first-order impact on a firm's financial constraints.

This study builds on prior research insights by focusing on the firms' initiation of derivative usage to mitigate their financial constraints. Endogeneity is one of the biggest concerns cited in empirical corporate finance. The primary sources of endogeneity in this research are simultaneity and omitted variables. AAs derivative hedging implementation remains under firms' control, this study may also have an endogeneity problem. Further, Beatty, Petacchi, and Zhang (2012) find that hedging reduces agency cost of debt, which decreases interest rate charges. Hence, hedging and borrowing choices determine simultaneously. Moreover, to decrease simultaneity bias in event study analysis, I present all the results after excluding the firm-year observation in the derivative hedging start year. This longitudinal setting follows Roberts and Whited (2013) suggestion to use fixed effect for partial removal of omitted variable bias. Hence, the omitted variable issue is addressed with the help of firm, industry, and year fixed effects. This, in turn, helps to partially mitigate firm, industry, and year variation from the estimation.

Furthermore, I use an event study approach to reduce the endogeneity issue that examines the firms two years before and three years after engagement in risk management using derivative instruments. Previous research suggests that firms' debt covenant requires financial derivative hedging using interest rate derivatives. Hence, I exclude the first year of risk management establishment to avoid the simultaneity bias. In addition, I implement difference-in-differences analysis around the Financial Accounting Standard (FAS) 123R to show the consistency of results with that of the event study. Bakke, Mahmudi, Fernando, and Salas (2016) utilize the same regulation as a base to show causality between a decrease in executive's option pay and an increase in hedging intensity in the oil and gas industry. They argue that changes in compensation affect a manager's risk-taking behavior. In short, managers engage in more derivative hedging when an incentive to smooth cash flow is high.

Similarly, the prediction in this study for financially constrained firms is that an increase in derivative hedging results in a decrease in cash holdings, net equity issuance, cash-to-cash flow volatility, and investment-to-cash flow sensitivity. The question at hand requires the heterogeneous industry sample to distinguish a firm as a constrained or an unconstrained every year of the sample. On the other hand, the difference-in-differences methodology requires sample data on firms to have some homogeneity to interpret the causal effects of risk management for financial constraints firms. Hence, to match derivative users and non-users, the primary requirement is at the industry level or the level of risk exposure of firms. The rationale is that firms from the same industry may have similar risk exposure. Further, Leary and Roberts (2014) suggest that peer firms from the same industry possess identical capital structures. Therefore, when firms' debt level and/or investment remain similar, this suggests that their risk exposure also consists of some similarity.

Researchers have different prediction models of risk management for constrained firms. In their seminal study, Froot et al. (1993) predict that if a firm is financially constrained and faces non-linear risk exposure on its capital expenditure, then it should use option contracts for value maximization. On the other hand, the Rampini and Viswanathan (2010) model suggests that more collateral constrained firms should hedge less. This study finds an increasing trend of hedging by more constrained firms in recent years using popular proxies of financial constraints.[5]

As data on risk management is not readily available, I parse the firm's annual financial statements (10-K) for their derivative usage. To examine a decrease in a firms' financial constraints, a study requires a sample of firms' risk management data in order to perform event study, such as before and after hedging.

This study follows an analysis of Erel et al. (2015) for a non-financial corporation's sample of 7,980 firm-year observations of the data on financial variables available two years before and three years after the initiation of derivative hedging. Therefore, in this research, I employ the event study approach to measure the firm's liquidity choices and investment, in other words, to evaluate the extent to which the derivative usage led to improved access to capital.

I use most of the popular proxies of financial constraints in a particular firm before and after hedging to examine whether risk management can predict its growth. The vital measure utilized for the empirical analysis is the firm's cash holdings level if managers believe they may face more significant financial constraints in the future. Moreover, similar to Erel et al. (2015), I estimate the sensitivity of cash to cash flow and the sensitivity of investment to cash flow using Chow test. Hence, I predict optimal risk management using various derivative instruments can decrease cash holdings, cash to cash flow, and investment to cash flow sensitivity.

To perform a reliable test of hedging on various financial variables, precise identification of hedgers and non-hedgers firms is necessary for unbiased estimation. For those that do manage risk, the financial instrument to which firms hedge is vital to investigate the derivative risk management theories. The Statement of Financial Standards (SFAS) No. 105 [FASB 1990], effective from June 15, 1990, requires firms to report detailed information principally about financial instruments using an off-balance sheet detailing accounting gain or loss on risk management. Various earlier studies use survey data to examine the determinants of corporate hedging (Nance, Smith Jr, and Smithson (1993), Dolde (1995), Jalilvand (1999), Géczy et al. (2007)). In these studies, researchers surveyed firms and asked respondents about their derivatives usage policy. With the increase in disclosure in financial statements such as 10-K, several authors performed text analysis on these reports for qualitative disclosures and define hedgers as firms whose reports included references to terms such as "risk management", or "derivatives", or "hedging". In addition, they reference various derivative instruments such as "foreign currency derivatives" or "interest rate swaps" (Mian (1996) and Géczy, Minton, and Schrand (1997)). I improve upon these data parsing techniques and consider if firms specifically mention the use of derivatives for hedging purposes. This is important because a firm can hedge without financial derivatives such as foreign-denominated debt, which may act as a natural hedge of foreign revenue or purchase obligations. Hence, to the best of my knowledge, this is the first study that uses parsing techniques considering hedging using derivative phrases for comprehensive research.

DATA SAMPLE AND DERIVATIVE PARSING TECHNIQUES

Sample Selection

The main objective of this article is to explore firms' initiation of derivative hedging. In this research, I show that hedging affects the capital structure decision over time for a sample of the financial constraints firms'. This study uses non-financial and non-utility firms from the Compustat dataset on firm size, leverage, sales, investments, liquidity ratios, profitability, cash flows (CF), cash flow volatility, and return on assets (ROA). Financial firms (SIC code 6,000 to 6,999) may have different motives and strategies for risk management because they have high debt levels. In the United States, utility firms (SIC code 4,900 to 4,949) are highly regulated, affecting their derivative usage policy. To perform an analysis consistent with prior literature, I exclude observations that have missing data on total assets. In addition, this article uses Com- pustat datasets to create a sample of financial constraint indexes such as Kaplan-Zingales, Hadlock-Pierce, and Whited-Wu index.

Moreover, firms use private loans and lines of credit for future liquidity purposes to a great extent. I rely on Thomson Reuters DealScan data for information about firms' borrowing decisions for loans and bank lines of credit variables used in this study. Sufi (2007) provides detailed information on bank credit lines data for non-financial firms. Hence, the variables related to a loan are consistent with that of Sufi (2007).

Hedging Data Collection Process

In this analysis, the sample falls within the 1996 to 2016 time period.[6] I collected the derivative usage data from all the 10-K, 10KSB, 10KSB40, 10-K405, and 10-KT SEC documents (hereafter filing) with the help of matching hedge strings such as "we do use derivative for hedging," "Company uses financial derivatives only to hedge," and the various similar phrase. The program first converts the whole document text into uppercase and removes all the HTML code. Also, the parsing algorithm maintains only one space between words by deleting all the additional spaces and tabs. These steps help to remove errors in the textual analysis process. Therefore, a program creates a derivative variable 1 if it finds a required phrase in a filing and 0 if the search term is not in the filing. When the document contains a derivative hedging phrase (such as when derivative=1), then a parsing algorithm searches for the usage of a specific derivative instrument to build a comprehensive firm-level risk management dataset. Hence, a program executes scrapping for the interest rate, currency, and commodity derivatives usage keywords. To check data consistency, I manually read random samples of firm filings.

The filings download and the parsing algorithm builds using the R language software and extensively utilize third-party libraries. While doing textual analysis, this program may not recognize all the derivative user firms correctly. Therefore, the null hypothesis is that filing for a particular year does not use derivatives for hedging. This issue leads to a Type I error when the algorithm finds that the firm uses derivative hedging when it actually does not use it. That is the rejection of the null hypothesis. On the other hand, a Type II error appears when the algorithm finds that the firm does not use derivative hedging when it actually does use it. That is the acceptance of the null hypothesis.

For a Type I error, my algorithm searches for all the sentences in a document where required string found is related to firms' hedging. Hence, after this process, Type I error remains negligible. To resolve the Type II error, the text-analysis algorithm generates a file containing two lines before and after a search string position, similar to Sufi (2007). Then, another round of textual analysis performed on a small sample of firms to resolve Type II errors by reading sentences around the required string.

After creating a derivative variable, an algorithm further searches for a derivative instrument and stores a complete sentence in a separate document. This step is useful to find the firm's choice between linear and non-linear derivative contracts; that is, when the firm uses "Options", "Swaps", "Futures", or "Forwards". Adam (2009), using gold mining industry data, concludes that the most financially constrained firms use non- linear contracts, especially those involved in selling calls. Hence, the selection of a derivative instrument is essential for firms with varying levels of risk exposure and a capital structure.

SUMMARY STATISTICS

To evaluate the effect of initiation of hedging on the firm's financial constraints, I focus on its liquidity choices and insurance for future borrowing capacity, which are the bank lines of credit or revolving credit facility. Besides, the risk exposure of an individual and the combined derivative instrument examines the financial factors. Table 1 presents summary statistics for the sample of 7,980 firm-year observations from the 1,501 unique firms use in this analysis for event study methodology. This sample comprises only firms that start financial derivative hedging operations and keep risk management in place for the subsequent three years. The average size (log of total assets) of firms in a sample (1996-2002) is consistent with that of Campello et al. (2011), but sample use in this study (1996-2016) has a lower average firms' size and a standard deviation that is almost double than that of previous studies.[7] This change is because after 2011, around 23 percent of small firms (bottom median sorted by total assets) from total non-financial firms also participated in derivative hedging.

The statistics on all the financial variables in Table 1 are consistent with previous research on non-financial firms. The sample size on the loans and lines of credit is less than other financial factors because DealScan data consists of selective observations on bank loans. Around 40 percent of the firms use interest rate derivatives (IRD) for hedging in my sample, with the highest intensity of 1.45, among all three derivative instruments. Foreign exchange (FX) derivatives hedging with IRD is 1.68, especially for big and multinational firms. These firms manage fluctuation in their foreign sales with the help of a derivative instrument. More than 23 percent of the firms participate in FX hedging with or without the other strategies. All the results in Table 1 show consistency with that of previous seminal research (see Campello et al. (2011), Disatnik, Duchin, and Schmidt (2013), Allayannis and Weston (2001), and others).

TABLE 1
SUMMARY STATISTICS

	N	Average	SD	Min.	Max.
Firm Financial Factors					
Size	7980	6.287	1.686	2.62	10.376
Cash/Assets	7978	0.149	0.175	0	0.993
Net Debt/ Assets	7955	-0.149	0.175	-0.776	0.002
Cash Flow (CF)	7873	0.616	0.456	0.027	2.244
Leverage	7955	0.239	0.21	0	0.941
Tangibility	7963	0.298	0.242	0.007	0.904
Sale growth	5614	-2.121	1.22	-9.7	0.52
Gross Investment	7873	0.616	0.456	0.027	2.244
Div. and Rep.	7297	0.04	0.115	0	4.427
Unused Line of Credit	1126	0.402	0.341	0.001	1
Loan Spread (all in	1192	181.063	115.784	14.803	573.376
Spread drawn)	1117	0.634	0.336	0.005	1
Total Line of Credit					
Altman z	7566	1.444	2.333	-11.497	5.364
Firm Derivative Hedging Information					
Derivative Hedging Dummy	7980	0.600	0.490	0	1
Derivative Hedging Intensity	4640	1.450	1.270	0	4.810
IRD Hedging Dummy	7980	0.400	0.490	0	1
IRD Hedging Intensity	3096	1.240	1.230	0	4.730
FX Hedging Dummy	7980	0.230	0.420	0	1
FX Hedging Intensity	1832	1.030	1.160	0	4.370
Commodity Hedging Dummy	7980	0.110	0.310	0	1
Commodity Hedging Intensity	839	0.480	0.870	0	4.780
IRD * FX Dummy	7980	0.080	0.270	0	1
IRD * FX Intensity	634	1.680	2.960	0	16.140
IRD * Commodity Dummy	7980	0.050	0.210	0	1
IRD * Commodity Intensity	386	0.880	1.860	0	8.970
FX * Commodity Dummy	7980	0.030	0.180	0	1
FX * Commodity Intensity	275	0.820	2.280	0	15.760
IRD * FX * Commodity Dummy	7980	0.020	0.140	0	1
IRD * FX * Commodity Intensity	168	1.680	5.290	0	30.510
Macroeconomic Variable					
GDP/Price	7909	4.572	0.219	4.125	4.958
Credit Spread	6738	1.065	0.339	0.69	1.978
Term Spread	6738	0.759	0.593	-0.387	1.815

This table reports summary statistics of firm-year observations for the financial, derivative hedging, and macroeconomic variables used in the event study and the difference-in-differences analysis. The sample of firms are all non-financial firms in the annual Compustat database between 1996 and 2016. For the variable definition and creation, see Appendix 1. The continuous firm financial factor variables winsorized at the 1st and 99th percentile.

Table 2 presents the statistics of derivative hedgers and non-hedgers, individually and in combination. The propensity to save cash is higher among firms that manage the risk than non-hedgers. These results are consistent with those of Campello et al. (2011) and Disatnik et al. (2013). Further, univariate results for an individual hedging instrument suggest that the IRD and the commodity hedgers save less cash than their non-hedger counterparts. On the other hand, the FX derivative users save more cash than their non-user counterparts. The cash flow and gross investment are higher for firms that manage risk efficiently. The average investment of the commodity risk handling firms is 50 percent more than non-commodity hedgers. On average, interest rate and commodity derivative hedging firms also get better loan terms. However, it is difficult to draw inferences from both the summary statistics tables because endogeneity issue exists with derivative hedging within a firm. Secular trends and the changing composition of firms in the sample are likely to mask the incremental effect the hedging has on these variables. Hence, to evaluate the effect of hedging on firms' financial policies, holding firm composition constant over time and controlling for other factors statistically is essential.

METHODOLOGY

Event Study: Hedging Program Initiation

In this study, I use the generalized version of the Erel et al. (2015) model to show the effect of hedging initiation on various firms' liquidity choices and their variants. In particular, I estimate the following specification,

$$\frac{Cash}{Total\ Assets} = \alpha + \beta\ After\_Hedge + \gamma\ Controls + \varepsilon \tag{1}$$

where *After_Hedge* is a binary variable that takes a value of one after the hedging and a zero before risk management starts. After adding the control variables, the potential variations in this regression specification are between firm, industry, and year. Hence, to mitigate this variation firm, industry, and year fixed effects are included in equation 1 to estimate variables efficiently in a longitudinal setting. Also, to limit the impact of changing macroeconomic situations, I include nominal GDP (Gross Domestic Product) growth to price ratio, credit spread, and term spread. In all estimations, standard errors are corrected for clustering observations at the firm level.[8]

Moreover, firms do not start risk management operations in isolation. Beatty et al. (2012) argue that corporations simultaneously pursue debt financing and risk management decisions. In addition, researchers argue that capital requirement is high as well as a bit more sophistication is required to establish risk management strategies. Hence, simultaneity bias exists in the equation 1 specification. To address this issue, I exclude first year of hedging initiation in all regressions. Results are consistent even after excluding $year_t$ and keeping only $year_{t+1}$ & $year_{t+2}$ in all the specifications.[9]

In the Guay (1999)'s empirical model, impact of interest rate and foreign exchange rate hedging on firms' risk is measured over time. He showed that derivative usage could decrease firms' risk exposure. In addition, Donohoe (2015) uses derivative initiation in a difference-in-differences setting to address omitted variable bias in the cross-sectional data with levels tests of derivative users and non-users. Following similar techniques in the hedging literature to address an endogeneity issue, I show that derivative program initiation can help decrease financial constraints.

Difference-in-Differences Specification

Recently Bakke et al. (2016) used a quasi-natural experiment created by the FAS 123R standard on share-based payment to show a causal relationship between the firms' risk management and chief executive officers (CEO) option pay. They conclude that when corporations reduce a CEO's option pay, their propensity to hedge using derivatives increases. In this research, I argue that increasing derivative hedging at the firm level helps relieve the firms' financial constraints. As FAS 123R relates to executive option compensation, I utilize this regulation to examine hedging decisions within financially constrained firms. While the causality test in this article is imperfect, it complements my event study approach.

TABLE 2
SUMMARY STATISTICS ON THE FINANCIAL VARIABLES OF THE HEDGERS AND NON-HEDGERS

	Derivative Hedging		IRD Hedging		FX Hedging		Commodity Hedging	
Financial Variables	Non-User	User	Non-User	User	Non-User	User	Non-User	User
Size	7.197	7.392	7.126	7.546	7.293	7.386	7.296	7.399
Cash/Assets	0.098	0.094	0.101	0.089	0.094	0.103	0.099	0.072
Net Debt/ Assets	-0.097	-0.094	-0.1	-0.089	-0.094	-0.102	-0.099	-0.071
Cash Flow (CF)	0.09	0.094	0.091	0.094	0.093	0.089	0.094	0.083
Leverage	0.236	0.252	0.234	0.26	0.248	0.232	0.238	0.293
Tangibility	0.298	0.333	0.303	0.337	0.322	0.301	0.294	0.471
Sale growth	-2.062	-2.443	-2.124	-2.488	-2.235	-2.489	-2.277	-2.321
Gross Investment	0.611	0.684	0.625	0.691	0.664	0.609	0.613	0.914
Div. and Rep.	0.045	0.034	0.042	0.035	0.04	0.035	0.041	0.024
Unused Line of Credit	0.356	0.345	0.371	0.322	0.349	0.352	0.344	0.382
Loan Spread (all in spread drawn)	157.3	146.098	158.886	140.429	150.07	153.863	152.196	141.832
Total Line of Credit	0.612	0.57	0.617	0.55	0.593	0.565	0.586	0.603
Altman z	2.104	2.126	2.126	2.105	2.111	2.14	2.16	1.839

This table reports averages of all the financial variables of derivative hedgers and non-hedgers, including IRD, FX, and Commodity hedging. The sample of all non-financial firms in the annual Compustat database between 1996 and 2016 with non-missing data for all analysis variables. For the variable definition and creation see Appendix 1.

I argue that an increase in derivative hedging at the firm level help to relieve the firms' financial constraints. Therefore, I use a difference-in-differences (Diff-n-Diff) regression analysis around the FAS 123R compliance year i.e., fiscal year-end 2005 (base year). I use the years 2003 and 2004 as pre-event window, and the years after the implementation of the FAS 123R i.e., 2006 and 2007 post-event window to show the causality between firms' hedging and their financial constraints. Treated firms are derivative hedgers, and control firms are non-hedgers. Firms in a sample are heterogeneous in terms of industry, financial, and real measures; hence, to reduce a bias caused by unobserved confounding factors, I use the nearest neighbor matching of the propensity scores with a replacement (see, Becker and Ichino (2002)). In this matching technique, all the treated units find at least one match with the control group.

The treated sample is derivative users with increased risk exposure from a previous fiscal year. The control sample is the non-derivative users, even after increased risk exposure from a previous fiscal year. Both treated and control groups of firms belong to the same two-digit industry segment.

I estimate the following a Diff-n-Diff specification:

$$Dependent\ Variable_{i,t} = \alpha + \beta_1 Hedge_{Deriv_i} + \beta_2 Post_t + \beta_3 Hedge_{Deriv_i} * Post_t + \ Controls_{i,t} + Firm\ FE_i + \varepsilon_{i,t} \quad (2)$$

In equation 2, the main aim is to show the first-order effect of derivative hedging on the following dependent variables; cash to asset ratio, change in cash to asset minus cash ratio, change in investment to assets ratio, net debt to asset ratio, unused lines of credit. The value of treatment dummy $Hedge\_Deriv_i$ is one when firms hedge using derivative only after increase in the overall risk exposure from previous fiscal year, otherwise it is zero. The post event dummy $Post_t$ is one for fiscal years 2005, 2006 and 2007, otherwise it is zero for fiscal years 2003 & 2004. The important estimate supporting a financial constraints reduction hypothesis is that the treatment dummy $Hedge\_Deriv_i$ interacts with the post event dummy $Post_t$.

RESULTS

Effect of the Derivative Hedging Initiation on Cash to Total Assets

In Table 3 panel A, I attempt to show that, on average cash holdings of all firms (columns 1-4) and financially constrained firms (columns 5-8) in a sample decrease after they start a derivative hedging program. The seminal paper by Bates, Kahle, and Stulz (2009) suggests that non-financial U.S. firms' cash to asset ratio increased from 10.5 in 1980 to 23.2 in 2006. The results are very striking in this study. I find that for the complete sample in all columns, the cash to asset ratio significantly decreases by 0.7 to 1.2 percent, the coefficient on *After_Hedge* dummy variable (-0.007 to -0.012). In other words, the average value of cash holdings for the derivative users in Table 2, suggests that this decrease ranges on an average from 7.5 to 12.8 percent. This finding is consistent with and very close to that of Disatnik et al. (2013) and Erel et al. (2015). Also, Jensen (1986) predicts that firms with more significant agency problems save more cash without profitable investment opportunities. Without the control variables, the model in column 1 shows the adjusted R^2 of 0.039. With the inclusion of control variables such as total leverage (short and long term), tangibility, cash flow, and sales growth, column 4 shows the adjusted R^2 of 0.176. The result shows an almost five-fold increase in explanatory power. Cash flow and ROA are highly correlated; hence Column 4 includes cash flow but not ROA. The most important control variables affecting cash holdings of the firms are total leverage and tangibility. Both are negatively significant. The sign and significance levels are consistent with previous literature in the same specification.[10] Sample size decreases in columns 4 and 8, with the addition of sales growth, total leverage, and tangibility.

One of the agendas of this research is to show that the cash holdings of financially constrained firms decrease after they start derivative hedging. Bates et al. (2009) argue that the cash-to-asset ratio increases dramatically for non-dividend payer firms in their sample period of 27 years, i.e., from 1980 to 2006. This study's empirical analysis time range also coincides with previous studies. In the theoretical model, Jensen (1986) suggests that the firms' cash holdings increase when managers prefer not to distribute cash for dividends and also in the absence of good investment projects. This is another reason to examine non-dividend payer firms and their average cash to asset ratio after derivative hedging. Findings in Table 3, panel B suggest that non-dividend payer firms save more cash out of cash flow than a complete sample of firms (Panel A), when they start a hedging program. Besides, hedging literature argues that the cost of implementation of risk management strategies is high (see (Graham and Rogers (2002) and Bodnar et al. (1998))). Therefore, only big firms in terms of asset size can hedge effectively. In the seminal empirical study of corporate cash holdings, Opler, Pinkowitz, Stulz, and Williamson (1999) suggest that mostly financially unconstrained firms pay out more cash in a dividend. Farre-Mensa and Ljungqvist (2016a) show that among the firms classified as constrained under the non-dividend payers, 86 percent are unrated.

Furthermore, they show a higher correlation between non-dividend payer firms and that of the HP (Hadlock- Pierce) and WW (Whited-Wu) financial constraints indices. Hence, Table 3, panel B (columns 5-8) presents the result for non-dividend payer firms. In this analysis, I exclude the first year of derivative implementation by all the firms to address the endogeneity issue. The economic and statistical significance of the *After_Hedge* coefficient increases to a great extent for financially constrained firms. For these firms, the result suggests that the propensity to save cash out of cash flow decreases even if they do not pay dividends. The non-dividend paying firms save approximately 1.1 to 2.2 percent less cash out of cash flow over time after hedging initiation. Appendix 3 (Tables C1-C6, Column 1) shows that findings are robust using five measures of financial constraints.

Effect of the Derivative Hedging Initiation on the Lines of Credit

This section examines how financially constrained firms' other precautionary liquidity choices fare when corporations' cash holdings decrease at a statistically significant and economically important level. I show in Table 4, that after firms start risk management using derivatives, their unused and total bank lines of credit increase (revolving credit facility) in the regression specification models (columns 1-9). In column 10, total bank lines of credit is statistically insignificant, with a positive sign on the coefficient with the inclusion of sales growth as a control variable in the model. The increase in available lines of credit varies between 4.3 and 5.2 percentage points. The result suggests that derivative hedging helps firms rely more on debt for their future investment, which in turn avails tax savings on interest expenses (See Graham and Rogers (2002)). Moreover, columns 6-9 suggest increase in total line of credit around 2.7 to 3 percent. Unused lines of credit for a sample of constrained firms before initiation of the hedging suggests that a coefficient on *After_Hedge* is positive in all specifications. However, for unused lines of credit results are statistically and economically significant only financially constrained firms measured by small firms and Whited-Wu index (see, Appendix 3 Tables C1 and C3, Column 5).

Effect of the Derivative Hedging Initiation on Net Debt

The increase in bank lines of credit also gives rise to net debt over time after implementing hedging programs. The net debt is total firm debt minus cash, divided by total book assets. Bates et al. (2009) use a similar measure to show that net debt shows a sharp decrease in their sample period for non-financial U.S. firms. Results using the derivative hedging initiation show an opposite trend on net debt in this study. Moreover, Sufi (2007) provides extensive research on how bank lines of credit lead to an increase in total leverage. In Table 5, net debt shows significantly positive trends on *After_Hedge* in all the regression specifications. The coefficient on the before and after dummy suggests that the net debt increases by up to 1.3 percent, including control variables already used in finance and accounting literature. In columns 1-4, I used a complete sample of firms. Column 5 comprises only non-dividend paying financially constrained firms, resulting in a decrease in sample size. Hence, with the help of the results in Tables 3, 4, and 5, I can infer that hedging helps to relieve agency problems in the capital market. The adjusted R^2 is 0.21 for the column 5 model specification, suggesting that adding control variables improves regression fit. Results are consistent with the theoretical model of Mello and Parsons (2000); they hypothesized that the optimal hedge ratio depends on the firm's financial constraints, which in turn helps the borrower to increase their debt capacity. Appendix 3 (Tables C1-C6, Column 4) shows that findings are robust to using five measures of financial constraints.

TABLE 3
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVE ON FIRMS' CASH HOLDINGS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Total Sample First Year of Hedging					Panel B. Non-Dividend Payers and Excluding			
After_Hedge	-0.007* (0.003)	-0.006* (0.003)	-0.007** (0.003)	-0.012*** (0.004)	-0.011** (0.005)	-0.010* (0.005)	-0.011** (0.005)	-0.022*** (0.006)
Size	-0.018** (0.008)	-0.022*** (0.008)	-0.020*** (0.008)	0.014 (0.012)	-0.020** (0.010)	-0.022** (0.010)	-0.022** (0.010)	0.012 (0.016)
Cash Flow		0.022*** (0.005)		0.004 (0.028)		0.019*** (0.006)		0.021 (0.062)
ROA			0.021*** (0.005)				0.020*** (0.006)	
Leverage				-0.069*** (0.022)				-0.058* (0.030)
Tangibility				-0.527*** (0.042)				- 0.548*** (0.058)
Sale Growth				-0.003* (0.001)				-0.002 (0.003)

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Total Sample First Year of Hedging						Panel B. Non-Dividend Payers and Excluding		
GDP/Price	8.450***	8.495***	8.654***	0.823***	0.091*	0.085*	0.090*	0.060
	(0.142)	(0.136)	(0.150)	(0.215)	(0.047)	(0.049)	(0.047)	(0.082)
Credit Spread	0.081***	0.082***	0.082***	-0.021	-0.051**	-0.041*	-0.052**	-0.018
	(0.012)	(0.011)	(0.011)	(0.029)	(0.025)	(0.025)	(0.025)	(0.034)
Term Spread	-0.862***	-0.868***	-0.890***	-0.018	0.032*	0.031*	0.030*	0.043
	(0.024)	(0.023)	(0.025)	(0.023)	(0.018)	(0.018)	(0.018)	(0.029)
Constant	-41.436***	-41.646***	-42.427***	-3.641***	-0.102	-0.085	-0.087	0.111
	(0.686)	(0.657)	(0.719)	(1.075)	(0.185)	(0.195)	(0.186)	(0.305)
Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	6736	6262	6722	4409	3554	3243	3545	2251
adj. R2	0.039	0.05	0.044	0.176	0.028	0.029	0.032	0.154

This table reports coefficients estimated from the regression of the cash holding level (dependent variable) before and after derivative hedging represented in equation (1). After_Hedge is a dummy variable that equals one (zero) for the years after (before) a derivative hedging program started by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. In this table, I estimate the extent to which firms save cash out of cash flow for the complete sample and sample of financial constraint firms. Panel A (columns 1 through 4) consists of cash-to-total assets estimates before and after hedging for the total sample of firms. Panel B (columns 5 through 8) focuses on financially constrained firms categorized by the non-dividend payers, dated as of year t. The data is collected from the annual Compustat file over the 1996-2016 period. Hedging data parsed from firms' annual financial statements (10-K). The definition of all the variables and their creation is reported in Appendix 1. All the regression specifications are estimated using firm, year, and one-digit industry fixed effects. The heteroskedasticity consistent standard errors clustered at the firm level reported in parenthesis. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 4
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVE ON FIRMS' UNUSED AND TOTAL LINE OF CREDIT

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A. Unused Line of Credit (Dependent Variable						**Panel B. Total Line of Credit (Dependent Variable)**				
After_Hedge	0.048***	0.052**	0.046**	0.052**	0.043*	0.030**	0.028**	0.027*	0.028**	0.018
	(0.022)	(0.022)	(0.023)	(0.022)	(0.024)	(0.014)	(0.014)	(0.014)	(0.013)	(0.023)
Size	-0.087***	-0.084***	-0.089***	-0.084***	-0.152***	-0.112***	-0.100***	-0.112***	-0.104***	-0.121***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.036)	(0.028)	(0.029)	(0.028)	(0.030)	(0.033)
Cash Flow		-0.213		-0.11	0.13		-0.144		0.007	0.122
		(0.163)		(0.169)	(0.318)		(0.133)		(0.153)	(0.231)
ROA			-0.468**					-0.420***		
			(0.208)					(0.159)		
Leverage				0.197	0.330**				0.289***	0.263**
				(0.142)	(0.141)				(0.104)	(0.120)
Tangibility				0.444**	0.562***				0.534***	0.516***
				(0.184)	(0.197)				(0.144)	(0.169)
Sale growth					-0.002					-0.009
					(0.009)					(0.008)

Panel A. Unused Line of Credit (Dependent Variable)					Panel A. Unused Line of Credit (Dependent Variable)					
GDP/Price	-0.601	2.203***	-2.054***	2.031***	-0.319**	-5.812***	1.027***	-7.103***	0.876***	-0.309***
	(0.601)	(0.332)	(0.793)	(0.346)	(0.134)	(0.482)	(0.220)	(0.678)	(0.211)	(0.080)
Credit Spread	0.226***	0.167***	0.282***	0.166***	0.311**	0.271***	0.131***	0.320***	0.135***	0.152
	(0.012)	(0.017)	(0.028)	(0.019)	(0.133)	(0.009)	(0.012)	(0.022)	(0.013)	(0.096)
Term Spread	0.336***	-0.129***	0.616***	-0.109***	-0.008	1.064***	-0.081***	1.312***	-0.057***	0.006
	(0.072)	(0.025)	(0.130)	(0.026)	(0.080)	(0.061)	(0.009)	(0.113)	(0.011)	(0.052)
Constant	3.318	-9.995***	10.253***	-9.373***	2.411***	28.681***	-3.852***	34.820***	-3.332***	2.528***
	(2.990)	(1.635)	(3.853)	(1.677)	(0.523)	(2.431)	(1.086)	(3.344)	(1.039)	(0.331)
Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	934	892	932	888	643	926	884	924	880	637
adj. R2	0.365	0.33	0.378	0.348	0.436	0.446	0.406	0.461	0.441	0.502

This table reports coefficients estimated from a regression of unused line of credit (Panel A) and total line of credit (Panel B) on before and after derivative hedging represented in equation (1). After_Hedge is a dummy variable that is equal to zero (one) for the years before (after) a financial derivative hedging program started by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. In panel A, columns 1 through 5 reports the estimated marginal effect of derivative hedging on the unused lines of credit. In panel B, columns 6 through 10 reports the coefficient estimates from an event study fixed effect estimation of derivative hedging on the total lines of credit. The data is collected from the annual Compustat file over the 1996-2016 period. Hedging data parsed from the firm's annual financial statements (10-K). The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The heteroskedasticity consistent standard errors clustered at the firm level reported in parentheses. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

Effect of the Derivative Hedging Initiation on Net Equity Issuance

To explore more firms' liquidity choices after they start risk management, I examine firms' equity issuance decisions in the view of derivative hedging. The striking results in Table 6 show that firms' net equity issuance decreases by an average of up to 2.6 percentage points after initiating a derivative hedging program. The theory behind these findings goes back to the seminal study on a firm's corporate financing decision by Myers and Majluf (1984), well known as the pecking order theory. Using their model, they suggest that corporations prefer debt financing over equity issuance when the information asymmetry regarding firms' investment opportunities is higher. Results are consistent with the seminal study that firms rank debt higher over equity to finance their investment. In addition, empirical findings of Masulis and Korwar (1986), Asquith and Mullins Jr (1986), and Mikkelson and Partch (1986) conclude that following firms' equity issuance, stock prices show a sharp decline. The adjusted R^2 increases significantly when more con- trol variables are added in the regression specification (Column 4). To the best of my knowledge, this is the first study that shows a consistent negative effect of firms' derivative hedging on equity issuance. I find robust results for financially constrained small, unrated, and non-dividend paying firms.

Effect of the Derivative Hedging Initiation on Cash-to-Cash Flow Volatility and Investment to Cash Flow Sensitivity

Researchers and practitioners alike have argued unanimously that the main reason to hedge using the derivative is to decrease the cash flow volatility of a firm (See Bakke et al. (2016)). Furthermore, reduction in cash flow volatility increases the bank lines of credit observed by Sufi (2007) and others. Hence, this decrease helps to reduce information asymmetry between lenders and borrowers. In the financial constraints theory, Almeida et al. (2004) provide a theoretical framework in which the cash to cash flow sensitivity acts as a good measure of financial constraints. On the same line, Hankins (2011) finds that operational hedging sometimes substitutes financial hedging, which may also decrease cash flow volatility. In the specification similar to Erel et al. (2015), Table 7 (Columns 1-4), suggests that cash to cash flow volatility decreases after initiation of a hedging program. The prediction is that cash flow volatility is higher before the start of hedging at the firm level.

On the other hand, depending on the risk management effectiveness after hedging, cash flow volatility decreases. This cash flow behavior occurs because firms manage uncertainty in the same direction as risk exposures on their debt and assets. Moreover, to show that cash flow volatility decreases after a derivative hedging initiation, following Almeida et al. (2004), I estimate equation 1, with a dependent variable as the change in cash scaled by total assets, including cash and the change in cash divided by total assets excluding cash. To calculate cash flow volatility after the hedging initiation, I interact cash flow divided by total assets with a dummy variable *(After_Hedge)* for after derivative hedge. The null hypothesis to test for the estimation of cash flow volatility using the Chow test is that summation of the coefficient on cash flow and cash flow interacted with the *After_Hedge* dummy is zero and statistically significant. This Chow test estimation means that cash flow volatility after hedging does not change; in other words, derivative hedging does not affect cash-to-cash flow volatility. The alternative hypothesis is that the coefficient on cash flow and cash flow interacted with *After_Hedge* dummy is not zero and is statistically insignificant. The rejection of the null hypothesis means cash to cash flow volatility decreases following the risk management program at a firm level.

TABLE 5
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVES ON A FIRM'S NET LEVERAGE

(1) Fin. Constrained		(2)	(3)	(4)	(5)
Dependent Variable	Total Leverage less Cash / Assets (Nebt Debt / Assets)				
After_Hedge	0.006* (0.003)	0.006* (0.003)	0.006** (0.003)	0.010** (0.004)	0.013** (0.005)
Size	0.019**	0.022***	0.021***	0.013	0.011
	(0.008)	(0.008)	(0.008)	(0.012)	(0.014)
Cash Flow		-0.021***		-0.002	-0.005
		(0.005)		(0.028)	(0.035)
ROA			-0.020*** (0.005)		
Tangibility				0.545*** (0.044)	0.577*** (0.053)
Sale growth				0.003*	0.002
				(0.002)	(0.002)
GDP/Price	-8.442***	-8.481***	-8.630***	-2.101***	-1.203***
	(0.097)	(0.103)	(0.105)	(0.214)	(0.203)
Credit Spread	-0.081***	-0.083***	-0.082***	-0.201***	-0.186***
	(0.010)	(0.011)	(0.010)	(0.029)	(0.039)
Term Spread	0.862***	0.866***	0.887***	-0.173***	-0.100***
	(0.017)	(0.018)	(0.019)	(0.023)	(0.025)
Constant	41.391***	41.576***	42.307***	10.257***	5.773***
	(0.469)	(0.493)	(0.500)	(1.070)	(1.034)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	6717	6246	6703	4409	2961
adj. R2	0.043	0.053	0.047	0.181	0.208

In this table, I apply event study tests of before and after hedging initiation to the total leverage less of firms' cash holdings. The reported coefficient estimates from a fixed effect panel regression estimation using the complete sample (columns 1-4). Column 5 comprises a sample of only non-dividend paying firms. After_Hedge is a dummy variable that equals zero (one) for the years before (after) a derivative hedging program started by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. The regressions include firm, year, and 1-digit industry fixed effects. The definition of all the variables and their creation is reported in Appendix 1. The heteroskedasticity consistent standard errors clustered at the firm level reported in parenthesis. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

In Table 7, column 1, the coefficient on cash flow is positively significant, and the coefficient on cash flow interact with *After_Hedge* is negatively significant. This opposite sign on the coefficient suggests that the cash flow variability changes after hedging. The summation of the cash flow and cash flow interacted with *After_Hedge* is not zero and is statistically insignificant. Therefore, I reject the null hypothesis because the result shows the opposite signs on the coefficient, and their addition is not statistically significant using the Chow test. Similarly, after the inclusion of leverage and sales growth in the same regression specification, results in column 2 suggest rejecting the null hypothesis. The sign on cash flow coefficient before and after differ, and the Chow test suggests that their sum of coefficients is statistically insignificant. The results are consistent with the prediction that the cash-to-cash flow volatility decreases after initiating derivative risk management, after including leverage and sales growth. However, cash to cash flow sensitivity results are statistically and economically significant for only financially constrained firms measured by small firms and the Whited-Wu index (see Appendix 3 Tables C1 and C3, column 2).

Apart from cash-to-cash flow volatility, the investment-cash flow sensitivity is another widely debated measure of firms' financial constraints. And its usefulness is argued by Fazzari, Hubbard, and Petersen (2000) in great detail. This view of derivative hedging predicts that firms' under-investment problem may resolve after risk management starts. The one-period theoretical model by Froot et al. (1993) and the multi-period model of Adam (2009) both suggest that derivative hedging can relieve under-investment problems up to a great extent. Campello et al. (2011) provide empirical evidence for an increase in a firm's hedging intensity effect on its positive future investment growth only for big firms by asset size. In this study, the prediction is that hedging initiation decreases investment to cash flow sensitivity.

To estimate the degree of investment to cash flow volatility, a revised version of equation 1 use with the dependent variable as a change in gross investment. The estimation focuses on the cash flow, which interacted with the *After_Hedge* dummy coefficient in columns 3 and 4 of Table 7. To simplify the interpretation and maintain consistency, I use the same procedure as that of cash-to-cash flow volatility, i.e. significance test of summation of coefficients on cash flow and interaction of cash flow with that of *After_Hedge*.

The coefficient on cash flow is 0.168, significantly different from zero; this result suggests that firms are financially constrained before risk management starts. The coefficient on cash flow interacted with *After_Hedge* is significant at the 95 percent level, and value is -0.177. The negative sign on coefficient suggests that investment-cash flow sensitivity decreases after the use of derivative instruments starts at the firm level.

TABLE 6
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVE ON FIRM'S NET EQUITY ISSUANCE

	(1)	(2)	(3)	(4)
Dependent Variable	Net Equity Issue	Net Equity Issue	Net Equity Issue	Net Equity Issue
After_Hedge	-0.022*	-0.021*	-0.023*	-0.026*
	(0.012)	(0.012)	(0.013)	(0.015)
Size	-0.009	-0.008	0.000	-0.003
	(0.022)	(0.024)	(0.026)	(0.026)
Cash Flow (CF)			-0.224** (0.092)	-0.266** (0.118)
After_Hedge x CF				0.064
				(0.116)
ROA		-0.132		
		(0.088)		

	(1)	(2)	(3)	(4)
Leverage		-0.015	-0.021	-0.015
		(0.077)	(0.074)	(0.074)
Tangibility		-0.394** (0.156)	-0.385** (0.158)	-0.400*** (0.154)
GDP/Price	-1.226***	-2.751***	-1.991***	-2.111***
	(0.443)	(0.909)	(0.542)	(0.516)
Credit Spread	0.071*	0.056	0.044	0.056
	(0.037)	(0.042)	(0.044)	(0.045)
Term Spread	0.228***	0.400***	0.278***	0.295***
	(0.069)	(0.116)	(0.079)	(0.077)
Constant	6.001***	13.617***	9.859***	10.462***
	(2.141)	(4.470)	(2.647)	(2.511)
Firm Fixed Effects	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	1274	1269	1164	1164
adj. R2	0.071	0.085	0.097	0.097

This table reports coefficients estimated from the fixed effect regression model for Net Equity Issue on before and after the start of the financial derivative hedging program at the firm level following equation The dependent variable is Net Equity Issuance. The main independent variable is After_Hedge dummy variable that equals zero (one) for the years before (after) a derivative hedging program start by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm, year, and one digit industry fixed effects.

TABLE 7
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVE ON FIRMS' DIFFERENCE IN CASH TO TOTAL ASSETS

	(1)	(2)	(3)	(4)
Dependent Variable	Δ (Cash/(Assets-Cash))		Δ (Investment/Assets)	
After_Hedge	0.175* (0.106)	0.134** (0.068)	0.055*** (0.012)	0.049*** (0.017)
Size	0.405	0.09	-0.035*	-0.017
	(0.255)	(0.057)	(0.019)	(0.028)
Cash Flow	1.275**	0.806	0.168**	0.127
	(0.571)	(0.724)	(0.077)	(0.137)
After_Hedge x Cash Flow	-1.287**	-1.908**	-0.177**	-0.179
	(0.575)	(0.772)	(0.075)	(0.120)
Leverage		-0.172		0.158*
		(0.128)		(0.083)
Tangibility	-0.774***	-0.403*	0.678***	0.566***
	(0.236)	(0.221)	(0.096)	(0.145)
Sale growth		-0.023*		-0.004

		(0.012)		(0.006)
GDP/Price	19.182***	0.565*	-2.334***	-2.485***
	(3.767)	(0.316)	(0.371)	(0.777)
Credit Spread	0.953**	0.617***	0.189***	1.326***
	-0.388	-0.17	-0.032	-0.396
Term Spread	-1.250*	-0.021	0.297***	-0.234***
	(0.742)	(0.041)	(0.061)	(0.030)
Constant	-98.406***	-3.888**	11.264***	10.844***
	(17.632)	(1.618)	(1.779)	(3.472)
Firm Fixed Effects	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	5348	2874	5272	2817
adj. R2	0.042	0.144	0.057	0.089

The sample consists of firms that start their risk management program using the financial derivative for hedging purposes over the 1996-2016 period. Hedging data parsed using machine learning techniques from the firm's annual financial statements (10-K). The coefficients estimated from the fixed effect regression model for the difference in cash to total assets and a change in investments on before and after start of derivative hedging program at the firm level using specification in equation (1). After_Hedge is a dummy variable that equals zero (one) for the years before (after) a derivative hedging program start by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm, year, and one digit industry fixed effects. The heteroskedasticity consistent standard errors clustered at the firm level reported in parenthesis. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

The Chow test on the sum of both coefficients is insignificant; this result supports a research question that hedging relieves firms' financial constraints by reducing investment to cash flow sensitivity. The estimates in column 4 using the Chow test on cash flow and cash flow interacted with *After_Hedge* is also insignificant. Overall, results from Table 7 strongly suggest that hedging helps to decrease firms' financial constraints. Appendix 3 (Tables C2, C3, and C8 of Column 3) shows that findings are robust using three firms' financial constraints measures.

QUASI-NATURAL EXPERIMENT AROUND FAS 123R REGULATION

The risk management literature points to two causes of endogeneity: simultaneity between debt, investment, and hedging. Secondly, omitted variable bias because unknown factors affect derivative hedging. In addition, the single time-series difference panel specification in equation 1 can lead to a non-zero selection bias. This study address both endogeneity issues using the difference-in-differences methodology, which exploits the FAS 123R regulation enacted in the fiscal year 2005. Using the primary dependent variables in this analysis from Table 3 to 6, I show that cash holdings decrease, net debt increase, cash to cash flow volatility, and investment-cash flow sensitivity decreases. Table 8 shows an estimation of equation 2 specification with the response variable used in previous tables. The focus of this inquiry relies on a coefficient of *Hedge_Derv * Post*, which is a difference-in-differences coefficient.[11] The first difference is the increase in risk exposure with derivative instrument usage and non-usage. Before and after implementation of the FAS 123R rule is the second difference. This analysis also shows consistency with previous results, cash holdings of firm decrease by 7 percent (same in Table 3, Column 1). In addition, the Chow test on the coefficients of cash flow and cash flow interacted with the post-2005 dummy suggests that cash to cash flow volatility decreases. Similarly, investment-cash flow sensitivity decreases after the hedging intensity increases in 2005. The result is also consistent with previous analysis on net debt, which increases by about seven percentage points. The sign on the unused lines of credit is positive, consistent with Table 2, but insignificant. Moreover, gross investment increases for corporations when their hedging intensity increases after 2005.

The difference-in-differences methodology used to show consistent estimates for financially constrained (non-dividend payer) firms is similar to Table 8. In Table 9 column 1, the cash holdings to total assets de- crease by 1.2 percentage points for non-dividend payer firms. Previous literature uses non-payout firms as a financially constrained sample (See Farre-Mensa and Ljungqvist (2016a)). Further, the cash-to-cash flow volatility and the investment-cash flow sensitivity decrease suggests the Chow test for financially constrained firms. The net debt increases by 1.2 percent for non-dividend paying firms. The correlation between small and non-dividend payer corporations is 86 percent, which faces higher levels of information asymmetry in capital markets. Hence, a rise in net debt suggests that increasing hedging intensity helps remove information asymmetry between borrowers and lenders. In addition, for financially constrained firms, gross investment increases for financial derivative hedging users.

LOAN SPREADS AND PROBABILITY OF COVENANT VIOLATIONS

The decrease in information asymmetry between lenders and borrowers is observed in their covenant through loan spreads. Campello et al. (2011) find that spreads on loan decrease when hedging intensity increases; also, the number of covenants on future loan contracts are less. The results in Table 10 are consistent with previous literature using event study methodology. The loan spreads decrease after the initiation of derivative risk management. A dependent variable here is the log of loan spreads; the coefficient on *After_Hedge* is -0.127, negative and statistically significant in column 4, representing a 12.7 percent relative decrease in loan spread. This estimate is economically significant when the average loan spread of derivative users in Table 2 is 146.09 basis points. Therefore, the in-sample results in Table 9 suggest that hedging helps get better contractual terms on loans, which helps reduce an under-investment problem.

TABLE 8
THE EFFECT OF INCREASE IN RISK EXPOSURE AND DERIVATIVE HEDGING BEFORE AND AFTER IMPLEMENTATION OF FINANCIAL ACCOUNTING STANDARD (FAS 123R) IN FISCAL YEAR 2005

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
Hedge_Derv	0.005	0.023	0.008	-0.005	-0.004
	(0.003)	(0.030)	(0.012)	(0.003)	(0.017)
Post	0.004	0.104	-0.032*	-0.004	-0.044*
	(0.004)	(0.135)	(0.018)	(0.004)	(0.026)
Hedge_Derv* Post	**-0.007***	-0.079*	-0.011	**0.007***	**0.031**
	(0.004)	(0.048)	(0.013)	**(0.004)**	**(0.021)**
Size	-0.022***	0.03	-0.029	0.020***	-0.100***
	(0.007)	(0.251)	(0.025)	(0.007)	(0.030)
Cash Flow	0.02	**2.437***	**0.096**	-0.02	-0.336**
	(0.022)	**(1.323)**	**(0.078)**	(0.022)	(0.153)
Cash Flow *Post		**-0.015**	**-0.013**		
		(0.773)	**(0.057)**		
Tangibility	-0.528***	-1.647**	0.760***	0.530***	0.359**

	(0.039)	(0.813)	(0.143)	(0.039)	(0.159)
Leverage	-0.139***	0.726**	0.027	0.145***	0.299***
	(0.016)	(0.362)	(0.090)	(0.016)	(0.094)
GDP/Price	0.011	14.272	2.581***	-0.037	-0.008
	(0.193)	(9.156)	(0.993)	(0.194)	(1.586)
Credit Spread	0.022	4.228	0.685**	-0.029	0.032
	(0.057)	(2.718)	(0.291)	(0.057)	(0.465)
Term Spread	0.005	1.548	0.223**	-0.008	-0.025
	(0.021)	(1.002)	(0.109)	(0.021)	(0.172)
Firm Fixed Effects	YES	YES	YES	YES	YES
Observations	8238	7899	7818	8238	1420
adj. R2	0.141	0.011	0.023	0.143	0.139

This table reports coefficients estimated from equation 2 difference-in-differences regression model. For sub-sample of firms matched over same hedging risk exposure with or without derivative hedging firms (Hedge_Dervi). I exploit before and after FAS 123R (Post) regulation implementation on various firms' liquidity choices and investments. The post-event dummy $Post_t$ is one for fiscal years 2005, 2006 and 2007, otherwise it is zero for fiscal years 2003 & 2004. Hedge_Dervi is a firm-level hedging with positive risk exposure from the previous year's variable. Hedging data parsed from firm's annual financial statements (10- K). The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The heteroskedasticity consistent standard errors clustered at the firm level reported in parenthesis. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

TABLE 9
THE EFFECT OF INCREASE IN RISK EXPOSURE AND DERIVATIVE HEDGING BEFORE AND AFTER IMPLEMENTATION OF FINANCIAL ACCOUNTING STANDARD (FAS 123R) IN FISCAL YEAR 2005 FOR NON-DIVIDEND PAYERS

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets- Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
Hedge_Derv	0.007	0.035	0.01	-0.007	-0.005
	(0.005)	(0.053)	(0.017)	(0.005)	(0.039)
Post	0.009	0.165	-0.051**	-0.009	-0.099
	(0.006)	(0.190)	(0.026)	(0.006)	(0.062)
Hedge_Derv* Post	**-0.012***	**-0.149***	-0.001	**0.012***	**0.062**
	(0.006)	**(0.087)**	(0.017)	**(0.006)**	**(0.046)**
Size	-0.027***	-0.037	-0.046	0.025***	-0.131***
	(0.009)	(0.363)	(0.034)	(0.009)	(0.049)
Cash Flow	0.021	**3.127***	**0.171****	-0.023	-0.254
	(0.026)	**(1.650)**	**(0.076)**	(0.026)	(0.252)
Cash Flow * Post		**0.279**	**-0.056**		
		(1.032)	**(0.069)**		
Tangibility	-0.601***	-2.286*	0.925***	0.603***	0.353

	(0.060)	(1.230)	(0.189)	(0.059)	(0.312)
Leverage	-0.152***	1.115**	0.003	0.159***	0.443**
	(0.022)	(0.534)	(0.093)	(0.022)	(0.173)
GDP/Price	0.102	26.603	2.962**	-0.133	-1.27
	(0.315)	(17.023)	(1.423)	(0.315)	(3.115)
Credit Spread	0.051	7.752	0.773*	-0.06	-0.321
	(0.092)	(5.030)	(0.417)	(0.093)	(0.900)
Term Spread	0.018	2.851	0.251	-0.02	-0.167
	(0.034)	(1.852)	(0.156)	(0.034)	(0.342)
Firm Fixed Effects	YES	YES	YES	YES	YES
Observations	4725	4459	4409	4725	595
adj. R2	0.152	0.015	0.032	0.153	0.258

This table reports coefficients estimated from equation 2 difference-in-differences regression model for financially constrained firms (non-dividend payers). For sub-sample of financially constrained firms matched over risk exposure of either interest rate, foreign exchange, or commodity risk. The first difference is derivative (Hedge_Dervi=1) or non-derivative (Hedge_Dervi=0) hedging firms. The second difference is the before (Post=1) and after (Post=0) FAS 123R regulation implementation on various firm's liquidity choices and in- vestments. The post event dummy $Post_t$ is one for fiscal years 2005, 2006 and 2007, otherwise it's zero for fiscal years 2003 & 2004. Hedging data parsed from firm's annual financial statements (10-K). The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm, year, and one digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

TABLE 10
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVE ON LOAN SPREADS

	(1)	(2)	(3)	(4)
Dependent Variable	Loan Spreads	Loan Spreads	Loan Spreads	Loan Spreads
After_Hedge	-0.082*	-0.112*	-0.091**	-0.124*
	(0.046)	(0.065)	(0.045)	(0.066)
Size	-0.112	-0.192*	-0.112	-0.161
	(0.105)	(0.108)	(0.100)	(0.108)
Cash Flow (CF)	-1.532***	-0.476		
	(0.578)	(0.851)		
ROA			-1.502***	-0.965
			(0.515)	(0.866)
Leverage		0.598		0.57
		(0.398)		(0.410)
Tangibility	0.024	-0.016	0.04	0.044
	(0.414)	(0.526)	(0.424)	(0.526)
Sale Growth		-0.023		-0.018
		(0.025)		(0.024)
GDP/Price	1.192***	1.601***	1.175***	1.630***

	(0.287)	(0.263)	(0.274)	(0.260)
Credit Spread	0.496***	0.509***	0.471***	0.498***
	(0.069)	(0.116)	(0.066)	(0.109)
Term Spread	0.061	0.096*	0.065*	0.101**
	(0.037)	(0.049)	(0.037)	(0.050)
Constant	-0.086	-1.725	0.092	-1.977
	(1.358)	(1.221)	(1.284)	(1.230)
Firm Fixed Effect	NO	NO	NO	NO
Ind. Fixed Effect	NO	NO	NO	NO
Year Fixed Effect	YES	YES	YES	YES
Observations	1133	825	1187	859
adj. R2	0.18	0.165	0.176	0.175

In this table, I apply event study tests of before and after hedging initiation to the loan spread that firms get from creditors. The reported coefficient estimates from a cross-sectional regression estimation using the complete sample. Firms do not use loan consistently in their capital structure, hence fixed effect estimation is not necessary. After_Hedge is a dummy variable that equals zero (one) for the years before (after) a derivative hedging program started by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. The definition of all the variables and their creation is reported in Appendix 1. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

TABLE 11
THE EFFECTS OF INITIATION OF HEDGING USING FINANCIAL DERIVATIVES ON THE PROBABILITY OF COVENANT VIOLATION

	(1)	(2)	(3)	(4)
	Prob. of Cov. Violation$_t$	Prob. of Cov. Violation$_t$	Prob. of Cov. Violation$_{t+1}$	Prob. of Cov. Violation$_{t+1}$
After_Hedge	-0.061	-0.068	-0.163**	-0.131*
	(0.062)	(0.060)	(0.071)	(0.078)
Size	-0.065	-0.165	0.098	-0.087
	(0.194)	(0.162)	(0.165)	(0.139)
Cash Flow (CF)	-0.412		-0.722	
	(1.112)		(1.012)	
ROA		-2.524*** (0.895)		-2.492** (1.102)
Leverage	1.121***	1.214***	1.158	1.443*
	(0.421)	(0.336)	(0.904)	(0.783)
Tangibility	0.16	0.56	-0.17	0.749
	(0.419)	(0.414)	(0.663)	(0.641)
Sale Growth	-0.081**	-0.067*	-0.028	-0.048
	(0.040)	(0.036)	(0.029)	(0.036)
Z-Score	0.025	0.074	0.114	0.004
	(0.115)	(0.111)	(0.142)	(0.137)
GDP/Price	0.047	0.588	0.345	0.981
	(0.686)	(0.505)	(0.647)	(0.605)
Credit Spread	-0.076	-0.247	-0.128	-0.558*
	(0.189)	(0.216)	(0.185)	(0.299)
Term Spread	-0.213	-0.234	-0.171	-0.17
	(0.215)	(0.199)	(0.227)	(0.307)
Constant	0.211	-1.358	-2.108	-3.36

	(2.545)	(2.034)	(2.255)	(2.345)
Firm Fixed Effect	YES	YES	YES	YES
Ind. Fixed Effect	NO	NO	NO	NO
Year Fixed Effect	YES	YES	YES	YES
Observations	387	417	314	338
adj. R2	0.358	0.423	0.57	0.55

This table reports coefficients estimated from regression of probability of covenant violation before and after derivative hedging represented in equation (1). After_Hedge is a dummy variable that equals zero (one) for the years before (after) a derivative hedging program start by a firm. In this regression analysis, the sample consists of firms using derivative instruments two years before and three years after engagement in risk management. The data collected from annual Compustat's file over the 1996-2016 period. Hedging data parsed from firm's annual financial statements (10-K). The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm, year, and one digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

The channel through which information asymmetry between the creditors and borrowers decreases is the reduction in the probability of covenant violation, which sends a clear signal about the credibility of the borrower (Watts and Zimmerman (1978) and Watts and Zimmerman (1986)). Recently, Demerjian and Owens (2016) suggested an aggregate probability of covenant violation measures to reduce agency conflict. This increase in confidence gives better loan spreads on the new loan. Table 11 shows the aggregate probability decrease range is between -13.1 percent to -16.3 percent. This decrease is statistically significant. Results from Tables 10 and 11 suggest that lenders prefer borrowers with risk management strategies in place.

PLACEBO TEST MATCHING ON THE INDUSTRY ONE YEAR BEFORE HEDGING STARTS

In this section robustness test shows the consistency of all previously estimated regressions using the matching sample of similar financially constrained firms from the same industry. The placebo test in Table 12 consists of a sample of small firms with a mean log of total assets (size) is 4.963, which is much lower than the average size of all firms in an event study analysis (6.287). Estimation results also provide evidence that the matched firms show enough homogeneity between analyzed firms to reduce changes in their financing behavior. The results in Table 12 show consistency for small firms matched on a two-digit industry one year before they start hedging. This matching sample provides evidence that results from the event study and difference-in-difference analysis are not affected by the time series or the cross-sectional correlation. The result of a matched sample suggests that cash holdings to total assets decrease with a greater magnitude of -1.7 percent after they start hedging. The Chow test suggests that cash to cash flow sensitivity and investment cash flow volatility also reduce significantly. Net debt increased by around 1.7 percent after the initiation of the hedging program for small firms. In addition, results using the sample of only a small firm suggest that corporations get better contract terms on their loans; that is, a log of loan spreads decreases by 9.7 percent relative to the average loan spreads. Overall, coefficients in Table 12 provides more robustness to the research question for financially constrained corporations

Small Firms

A prior study by Opler, Pinkowitz, Stulz, and Williamson (2001) on corporate cash holdings suggests that smaller firms tend to hold more cash as a percentage of total assets than larger firms. In addition, small firms are more vulnerable to capital market imperfections because of less analyst coverage and institutional ownership. Therefore, they are unknown to investors. Hence, small firms face higher borrowing costs (price constraints) and credit rationing (quantity constraints). In this study, the firms with a bottom median of asset size are considered small firms, following the previous literature on financial constraints Almeida et al. (2004) and Hadlock and Pierce (2010). In addition, theoretically, Myers and Majluf (1984) argue that firms with total assets (size) on the lower end show a higher degree of information asymmetry. Table C1 presents results supporting a research question: hedging helps increase debt (2.01 percent) and decrease cash holdings (1.4 percent).[12] The widely used measure in firms' liquidity decision, cash to cash flow volatility, and investment-cash flow sensitivity decreases conclude using the Chow test. In other words, hedging at a firm level is one of the mechanisms to reduce information asymmetry in the capital market.

Kaplan and Zingales Index

Prior research suggests that small and financially constrained firms measured using different proxies are not perfectly correlated. Another widely used measure of the financial constraints, proposed by Kaplan and Zingales (1997) (KZ index), makes it clear that all firms face some form of a wedge between their internal and external cost of funds. To measure the level of firms' financial constraints according to the KZ index, I used method designed by Lamont, Polk, and Saaá-Requejo (2001).[13] This index loads positively on leverage and negatively on firms' cash flow, leverage, and cash holdings. To be consistent with previous literature, firms from the top median of the KZ index ranking marked as financially constrained, otherwise unconstrained, one year before the hedging program starts. The analysis in this section presents the effect of the risk management initiative on firms' financial constraints sorted by the KZ index. The results are reported in Table C2.[14] The firm's cash holdings (-0.5 percent), cash to cash flow volatility, and investment-cash flow sensitivity decrease significantly. Net debt (1 percent) and investment (3.4 percent) change after hedging increases. Hence, financially constrained firms sorted using the KZ index show a decrease in a wedge between the internal and external cost of funds after derivative hedging initiation.

Whited and Wu Index

The synthetic specification of the KZ index has widely criticized the presence of Tobin's Q variable in its calculations. Tobin's Q shows a great degree of measurement error (see Erickson and Whited (2000)). Instead of relying on the previous measures of financial friction in raising new capital, Whited and Wu (2006) (famously WW index) construct a new specification to measure a firm's financial constraints using the inter-temporal structural investment model. Hence, following the Hennessy and Whited (2007) estimation technique, the WW index build and firms are grouped as a constrained (top median) or unconstrained (bottom median) a year before the derivative hedging initiation (see Appendix 1). The generalized method of moments estimation suggests that firms that fall in the financially constrained sample show following characteristics; low analyst coverage, small, without bond rating, and under-invested. On the other hand, reducing under-investment is one of the most important reasons to pursue risk management. The findings in Table C3 suggest that firms that fall in the top median of the WW index save less cash (-1.4 percent) out of cash flow, their net debt increases (2.2 percent), and bank lines of credit increase (20 percent). Also, the change in investment is economically positive, 3.6 percentage points, and statistically significant. Further, cash-cash flow volatility and investment-cash flow sensitivity decrease are confirmed using the Chow test. Overall results in Table C3 find that firms' categorize as financially constrained shows a significant reduction in information asymmetry between the lenders and the borrowers.

Hadlock and Pierce Index

The essential factors for sorting firms in a financial constraints sample are firm size and age, as suggested by Hadlock and Pierce (2010) (HP). They also estimate ordered logit on all six variables included in the WW index and suggest that three other variables, such as sales growth, industry sales growth, and dividend dummy, have opposite signs and significance in their sample. In the HP index, age and size are negative, and size-square is positively loaded. Hence, I sort a complete sample and place firms in the upper median as financially constrained, otherwise unconstrained. When the HP index sorts firms, the estimation of equation 1 in this particular sample suggests consistency with prior regression analysis. Table C4 concludes that cash holdings decrease (-1.1 percent), change in investment (+2.4 percent), and net debt (+2.2 percent) increases with high statistical significance.

TABLE 12
PLACEBO TEST ON BOTTOM MEDIAN OF SMALL FIRMS BY ASSET SIZE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cash/ Asset	Δ(Cash / Assets)	Δ(Cash / Assets-Cash)	Net Debt /Assets	Net Equity Issue	Δ(Investment/ Assets)	Loan Spread	Unused Line of Credit
After_Hedge	-0.017***	-0.010*	0.095***	0.017***	-0.005	0.032***	-0.097*	0.028
	(0.004)	(0.005)	(0.031)	(0.004)	(0.018)	(0.011)	(0.058)	(0.029)
Size	0.000	0.004	0.010	0.000	-0.012	-0.003	-0.162***	-0.135***
	(0.004)	(0.003)	(0.013)	(0.004)	(0.011)	(0.004)	(0.032)	(0.018)
Cash Flow (CF)	-0.077***	0.068***	1.256***	0.079***	-0.379***	0.098**	-0.913***	0.233
	(0.016)	(0.024)	(0.127)	(0.015)	(0.065)	(0.049)	(0.304)	(0.153)
After_Hedge x Cash Flow		0.093***	-1.249***			-0.126**		
		(0.033)	(0.152)			(0.058)		
Leverage	-0.140***	-0.015	-0.006	0.150***	-0.062	0.000	1.134***	0.603***
	(0.016)	(0.017)	(0.066)	(0.015)	(0.054)	(0.023)	(0.166)	(0.094)
Tangibility	-0.338***	-0.051***	0.02	0.332***	0.002	0.066***	-0.261**	0.113
	(0.021)	(0.013)	(0.057)	(0.020)	(0.046)	(0.019)	(0.129)	(0.071)
Sale Growth	0.002	0.008***	-0.026***	-0.003	0.025***	-0.007**	0.034	0.009
	(0.002)	(0.002)	(0.010)	(0.002)	(0.007)	(0.003)	(0.021)	(0.011)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Cash/ Asset	Δ(Cash / Assets)	Δ(Cash / Assets-Cash)	Net Debt /Assets	Net Equity Issue	Δ(Investment/ Assets)	Loan Spread	Unused Line of Credit
GDP/Price	0.061***	0.000	-0.062	-0.058***	-0.046	0.047*	0.547***	-0.276***
	(0.021)	(0.017)	(0.076)	(0.021)	(0.066)	(0.026)	(0.187)	(0.102)
Credit Spread	0.000	0.002	0.058	0.000	-0.031	0.001	0.303***	-0.068
	(0.006)	(0.008)	(0.041)	(0.006)	(0.025)	(0.014)	(0.100)	(0.050)
Term Spread	0.020***	0.015***	0.005	-0.019***	0.023	0.004	0.054	-0.012
	(0.003)	(0.004)	(0.023)	(0.003)	(0.017)	(0.008)	(0.048)	(0.023)
Constant	0.020	0.012	-0.008	-0.029	0.444	-0.268**	3.321***	2.543***
	(0.091)	(0.077)	(0.351)	(0.091)	(0.317)	(0.120)	(0.816)	(0.452)
Observations	2373	2276	2035	2373	533	1998	268	218
adj. R2	0.239	0.028	0.062	0.247	0.304	0.017	0.316	0.532

This table reports coefficients estimates of our basic regressions using the sample of industry, size, and bottom median of small firms. For each firm in a sample, I match a similar firm by two digit industry code that had the closest assets at the year of derivative hedging. This placebo test perform on data two years before and three years after derivative hedging starts. After_Hedge is a dummy variable that equals zero (one) for the years before (after) a derivative hedging program start by a firm. The data collected from annual Compustat's file over the 1996-2016 period. Hedging data parsed from firm's annual financial statements (10-K). The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm, year, and one digit industry fixed effects. The heteroskedasticity consistent standard errors clustered at the firm level reported in parenthesis. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

Unrated Firms

Prior research in finance presents evidence that firms whose bond rating is not present fall in financial constraints samples (See Whited and Wu (2006)). Firms without rating on their debt (non-rated) sample tested in the same specification as that of equation 1 and using previously analyzed variables in this study. Results in Table C5 suggest that the cash to total asset ratio decreases by 1.5 percentage points for unrated firms. The cash-to-cash flow volatility and investment-cash flow sensitivity decreases significantly, suggested by opposite sign-on cash flow and cash flow interacted with *After_Hedge* and summation of both coefficients using the Chow test (in columns 2 and 3). Net debt (2.3 percent) and change in investment (6.1 percent) increases economically and statistically significantly.

Collateral Constrained Firms

Hahn and Lee (2009), in their model and empirical analysis of manufacturing firms, suggest that collateral- constrained, highly leveraged firms show a higher wedge in investment financing. They designed two proxies for firms that fall in the collateral-constrained sample, one without total debt and another including total debt. In addition, the third proxy consists of the total mortgage (variable) for its construction to test the effect of total collateral constraints on various financial variables (see Appendix 1). Tables C6, C7, and C8 suggest that their investment increases when firms sorted in collateral constraints sample initiate risk management.[15] Besides, their cash-to-cash flow volatility and investment-cash flow sensitivity decrease. Overall, evidence from these three tables shows the consistent result with previous tables that hedging helps to relieve the firm's financial constraints. These results are very important in five- and seven-factor asset pricing models because of positive changes in investment using risk management, which can also positively affect expected returns.

EFFECT OF THE DERIVATIVE HEDGING STOPPAGE

Previous research on corporate finance proves that a firm is an ongoing entity that changes its financing behavior over time. Similarly, firms can change their risk management behavior during their life cycle. Analyzing firms' stoppage of derivative risk management may provide additional robustness for the effect of derivatives on firms' financing. Therefore, the sample firms who pursue risk management initially and then stop for two years *(Stop_Hedge)* is created to estimate firms financing and investment using following regression specification:

$$\frac{Cash}{Total\ Assets} = \alpha + \beta\ Stop\_Hedge + \gamma\ Controls + \varepsilon \qquad (3)$$

The dependent variables used in equation 3 specification is the same as that of previous tables in this study, i.e., cash to total assets, net debt, and gross investment. The sample size for bank lines of credit and loan spread is minimal; therefore, their analysis is excluded in this section. The results of Table 13, especially on *(Stop_Hedge)* dummy (one after firms stop hedging and zero before stop), suggest that cash to total assets increases by approximately around 2.2 percent significantly. When research and development (R&D) control variables are added in a regression specification (column 2), cash holdings increase by around 3.0 percentage points. On the other hand, net debt shows negative signs on *(Stop_Hedge)* coefficient (column 3) but is statistically insignificant. Column 4 shows negatively significant results for net debt when firms stop using derivative hedging. These results suggest that firms save more cash to fund their investment when derivative hedging is not present in their risk management strategy. The last column indicates that gross investment decreases by around 19.9 percent points. This magnitude is enormous for the decrease in firms' investment — additional empirical tests are required to provide causality for this result. Overall, reducing risk management using derivative hedging suggests that firms are going into financial constraints. Results in Table 13 show consistency with the research question that effective hedging reduces firms' financial constraints.

TABLE 13
THE EFFECTS OF STOPPAGE OF HEDGING USING FINANCIAL DERIVATIVE ON FIRMS' FINANCIALS

	(1) Cash/Asset	(2) Cash/Asset	(3) Net Debt /Assets	(4) Net Debt /Assets	(5) Gross Investment
Stop_Hedge	0.022*	0.030*	-0.021	-0.029*	-0.199*
	(0.012)	(0.016)	(0.013)	(0.017)	(0.110)
Size	0.000	-0.009	0.000	0.009	0.374
	(0.038)	(0.043)	(0.038)	(0.044)	(0.319)
Cash Flow (CF)	-0.085	-0.07	0.095	0.081	
	(0.092)	(0.106)	(0.094)	(0.109)	
Total Payout	0.142	0.060	-0.152	-0.064	
	(0.141)	(0.140)	(0.145)	(0.153)	
Tangibility	-0.768***	-0.568*	0.788***	0.595*	1.347
	(0.198)	(0.297)	(0.202)	(0.302)	(3.747)
R and D		0.008		-0.008	
		(0.007)		(0.007)	
Constant	0.379	0.409	-0.381	-0.418	-1.895
	(0.228)	(0.248)	(0.230)	(0.252)	(2.608)
Firm Fixed Effect	YES	YES	YES	YES	YES
Observations	189	129	183	123	212
adj. R2	0.144	0.059	0.147	0.057	0.035

This table reports coefficients estimated from regression of various financial two years before and after stop- page of derivative hedging represented in equation (2). Stop_Hedge is a dummy variable that equals zero (one) for the years before (after) a derivative hedging program stopped by a firm. The data collected from annual Compustat's file over the 1996-2016 period. Hedging data parsed from firm's annual financial state -ments (10-K). The definition of all the variables and their creation reported in Appendix 1. All specifications are estimated using firm fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels respectively.

CONCLUSION

Firms mostly rely on financial derivative hedging for their risk management. If firms manage risk effectively, then they can reduce their financial constraints. This study has shown that financial derivative hedging helps firms relieve their financial constraints. Measuring firms' financial constraints is challenging based on what they say, do, or look like. Therefore, using the event study estimation, I analyzed the complete sample and sub-sample based on seven different proxies of financial constraints.[16] This strategy helps to link firms' initiation of hedging and reduction in financial constraints consistently.

In addition, this study utilizes the difference-in-differences methodology two years before and three years after implementing the FAS 123R rule to establish causality between firms' derivative risk management and financial constraints. Results present in this study show that effective financial derivative hedging is one of the channels through which the wedge between external and internal financing decreases. Public firms' hedging strategy helps them rely less on precautionary cash saving and new equity issuance and more on loans. Further, I provide robust evidence that gross investment increases for hedging firms.

The effect of hedging on financing and investment contributes to the decreases in cash-to-cash flow volatility and investment-cash flow sensitivity. The findings in this research contribute to the vast literature on risk management, financial constraints, and firms' liquidity choices. Overall, the results of this study conclude that derivative risk management reduces firms' financial constraints.

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ENDNOTES

1. See for example, Bernanke, Gertler, and Gilchrist (1996), Froot et al. (1993), Kaplan and Zingales (1997), Gomes, Yaron, and Zhang (2006) among others.
2. Previous research suggests that small firms face a higher degree of financial constraints. Graham and Rogers (2002) and Bodnar et al. (1998) argue that big firms have better expertise to hedge using financial derivatives and hedging increases with firm size.
3. Almeida et al. (2004) suggest that a firm's cash flow sensitivity of cash can capture financial constraints. Fazzari et al. (2000) conclude that investment-cash flow sensitivities provide a useful measure of firms' financial constraints.
4. Financially constrained firms may face higher wedge between its internal and external financing.
5. Financially constrained firms distinguish using proxies define in the finance literature such as the small firms, non-dividend payers, non-rated, collateral constrained, Kaplan-Zingales index, Whited-Wu index, Hadlock-Pierce index.
6. For event study analysis (After_Hedge), I use a complete sample from 1996 to 2016. However, for difference-in-differences (Diff- n-Diff) regression analysis around the FAS 123R implementation, I use a sample from 2003 to 2007 of derivative hedgers and non-hedgers (Hedge_Derv).
7. For each regression specification I provide regression analysis for a complete and financially constrained firms samples separately. Following convention, I sorted firms into median based on financial constraints index values in prior year. Hence, the average asset size of financially constrained firms sample is almost half that of total sample.
8. For event study regression analysis the sample consists of firms two years before and three years after engagement in risk manage- ment using derivative instruments.
9. The significance level increases in regression specification where loan spread and probability of covenant violations are dependent variables.
10. In Table IV. of Disatnik et al. (2013) infers that the cash flow hedging has an effect on firms' liquidity choices. Erel et al. (2015) in their cash-to-assets ratio as a dependent variable finds that total leverage is negatively significant.
11. I use *Hedge_Derv* dummy variable for financial derivative hedgers and non-hedgers firms before and after the implementation of the FAS 123R rule.
12. This table is available in the Appendix 3.
13. Please refer an appendix 1 for the construction of KZ index.
14. This table is available in the Appendix 3.
15. These three tables are available in the Appendix 3.
16. I used seven different proxies of firms' financial constraint measures: non-dividends paying firms, small firms, unrated firms, collateral constrained firms, or according to the KZ, HP, and WW indices.

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APPENDIX 1

Main firm's level variables:	**Definition:**
Derivative (Yes=1)	Derivative is an indicator equal to 1 if a firm engage in hedging using derivative contract. The variable created by parsing firm's financial statement (10- K) for their usage of derivative for hedging purpose. I read a text surrounding derivative keyword and code as one if combination of phrase suggests, "we do use derivative for hedging purpose". Moreover, I crawl through financial statement to check usage of different derivative contracts such as Interest Rate (IR), Currency (FX), and Commodity derivative. I assign one for respective derivative contract if used by firm for risk hedging. I include from our general COMPUSTAT sample firms with FIC "ISO Country code of incorporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
IR Hedging Dummy (Yes=1)	IR Hedging dummy set to 1 if firm manage interest rate risk using interest rate (IR) derivative contracts. I search for various derivative contracts use by firm such as IR swaps, IR forwards etc. in their financial statement for hedging purpose. I include from our general COMPUSTAT sample firms with FIC "ISO Country code of incorporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
FX Hedging Dummy (Yes=1)	FX Hedging dummy set to 1 if firm manage interest rate risk using foreign currency (FX) derivative contracts. I search for various derivative contracts use by firm such as FX options, FX forwards etc. in their financial statement for hedging purpose. I include from our general COMPUSTAT sample firms with FIC "ISO Country code of

	incorporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
Comm. Hedging Dummy (Yes=1)	Comm. Hedging Dummy set to 1 if firm manage commodity price risk using commodity (Comm.) derivative contracts. I search for various derivative contracts use by firm such as Comm. options, Comm. forwards etc. in their financial statement for hedging purpose. I include from our general COM- PUSTAT sample firms with FIC "ISO Country code of incorporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
GDP Growth	Annual percentage nominal growth of GDP in dollars.
Log of total assets/GDP	Log total assets divided by GDP is the logarithm of start of fiscal year total assets (COMPUSTAT item at) in year 2005 real dollars.
Cash/Assets	Cash is the ratio of cash and marketable securities (COMPUSTAT's item che) to book assets (COMPUSTAT's item at). The variable is winsorized at the 1st and 99th percentiles of its distributions. I include from our general COMPUSTAT sample firms with FIC "ISO Country code of incorporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
Cash Flow Volatility	Cash Flow Volatility is a ratio of standard deviation of annual cash flows from operations (COMPUSTAT's item oibdp) to the book assets (COMPU- STAT's item at) of respective year over the four fiscal year. The variable is winsorized at the 1st and 99th percentiles of its distributions. I include from our general COMPUSTAT sample firms with FIC "ISO Country code of in- corporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
Unrated	Unrated firms is a binary variable represents one if do not have credit rating either from Moody's, Fitch, S&P, or Duff & Phelps otherwise zero, using data obtained from COMPUSTAT (COMPUSTAT item splticrm) .
Rated	Rated firms is a binary variable represents one if have a rating either from Moody's, Fitch, S&P, or Duff & Phelps otherwise zero, using data obtained from COMPUSTAT (variable splticrm) .
Investment Volatility	Investment Volatility is a ratio of standard deviation of annual cash flows from operations (COMPUSTAT's item oibdp) to the book assets (COMPU- STAT's item at) of respective year over the four fiscal year. The variable is winsorized at the 1st and 99th percentiles of its distributions. We include from our general COMPUSTAT sample firms with FIC "ISO Country code of incorporation" is "USA", total assets larger than $1 million in every sam- ple year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
Leverage	Leverage is the ratio of long term total debt (COMPUSTAT's item dltt) plus total debt in current liabilities (COMPUSTAT's item dlc) to the total book assets (COMPUSTAT's item at). The variable is winsorized at the

	1st and 99th percentiles of its distributions. We include from our general COMPUS- TAT sample firms with FIC "ISO Country code of incorporation" is "USA", total assets larger than $1 million in every sample year and non-financial firms except (SICs 6000–6999). I use sample period 1996–2016.
M/B	M/B is the ration of market-to-book value of the firm. M is the market value, closing share price times common shares outstanding. B is the book value of common shareholder's equity as of the end of fiscal year.
Net Debt	Leverage-cash/total assets
Net Equity Issuance	COMPUSTAT items [(dlttt+ dlct) − (dltt(t −1) + dlc(t −1))]/at(t −1)
Credit Spread	The difference between the yields of average BAA corporate bond and AAA corporate bond.
Nondividend payers	Nondividend payers is a binary variable represent one if firms do not pay dividend on a common stock otherwise zero (COMPUSTAT item dvc).
Dividend payers	Dividend payers is a binary variable represent one if firms pay dividend on a common stock otherwise zero (COMPUSTAT item dvc).
Tangibility	Tangibility is the net property, plant, and equipment(COMPUSTAT item ppent over total assets).
KZ Index	KZ Index is computed as –1.001909 [(ib+dp)/lagged ppent] + 0.2826389 [(at + prcc_ f×csho - ceq - txdb)/at] + 3.139193 [(dltt + dlc)/(dltt + dlc + seq)] – 39.3678 [(dvc + dvp)/lagged ppent] – 1.314759 [che/lagged ppent], where all variables in italics are Compustat data items. Following Lamont, Polk, and Saa-Requejo (2001), firms are sorted into median based on their index values in the previous year. Firms in the top median are coded as constrained and those in the bottom median are coded as unconstrained.
WW Index	WW Index is computed as –0.091 [(ib + dp)/at] – 0.062 [indicator set to one if dvc + dvp is positive, and zero otherwise] + 0.021 [dltt/at] – 0.044 [log(at)] + 0.102 [average industry sales growth, estimated separately for each three- digit SIC industry and each year, with sales growth defined as above] – 0.035 [sales growth], where all variables in italics are COMPUSTAT data items. Following Hennessy and Whited (2007) and Whited and Wu (2006), firms are sorted into median based on their index values in the previous year. Firms in the top median are coded as constrained and those in the bottom median are coded as unconstrained.
HP Index	HP Index is computed as –0.737 Size + 0.043 Size2 – 0.040 Age, where Size equals the log of inflation-adjusted COMPUSTAT item at (in 2005 dol- lars), and Age is the number of years the firm is listed with a non-missing stock price on COMPUSTAT. In calculating the index, I follow Hadlock and Pierce (2010) and cap Size at (the log of) $4.5 billion and Age at 37 years. Following a literature, firms are sorted into median based on their index val- ues in the previous year. Firms in the top median are coded as constrained and those in the bottom median are coded as unconstrained.

APPENDIX 2

Financial Derivative Instrument	Keywords Used for Parsing
Interest Rate derivative (IRD)	"INTEREST RATE SWAP," "INTEREST RATE CAP," "INTEREST RATE COLLAR," "INTEREST RATE FLOOR," "INTEREST RATE FORWARD," "INTEREST RATE OPTION," AND "INTEREST RATE FUTURES"
Foreign Currency Derivative (FX)	"CURRENCY RATE FUTURE," "FOREIGN EXCHANGE SWAP," "CURRENCY SWAP," "FOREIGN EXCHANGE RATE SWAP," "CURRENCY RATE SWAP," "FOREIGN EXCHANGE CAP," "CURRENCY CAP," "CURRENCY FORWARD," "CURRENCY RATE FORWARD," "FOREIGN EXCHANGE OPTION," "CURRENCY OPTION," "FOREIGN EXCHANGE RATE CAP," "CURRENCY RATE CAP," "FOREIGN EXCHANGE COLLAR," "CURRENCY COLLAR," "FOREIGN EXCHANGE RATE COLLAR," "CURRENCY RATE COLLAR," "FOREIGN EXCHANGE FLOOR," "CURRENCY FLOOR," "FOREIGN EXCHANGE RATE FLOOR," AND "CURRENCY RATE FLOOR" "FOREIGN EXCHANGE FORWARD," "FORWARD FOREIGN EXCHANGE," "FOREIGN EXCHANGE RATE FORWARD," "FOREIGN EXCHANGE RATE OPTION," "CURRENCY RATE OPTION," "FOREIGN EXCHANGE FUTURE," "CURRENCY FUTURE," "FOREIGN EXCHANGE RATE FUTURE."
Commodity Derivative	COMMODITY FORWARDS," "COMMODITY OPTIONS," AND "COMMODITY FUTURES", SOYBEANS CONTRACTS, OILSEEDS CONTRACTS, WHEAT CONTRACTS, CORN CONTRACTS, RICE CONTRACTS, COTTON CONTRACTS, SUGARBEETS CONTRACTS, CATTLE CONTRACTS, SWINE CONTRACTS, SHEEP AND WOOL CONTRACTS, CRUDE PETROLEUM AND NATURAL GAS CONTRACTS, LIQUID NATURAL GAS CONTRACTS, COAL CONTRACTS, ANTHRACITE COAL CONTRACTS, GOLD ORES CONTRACTS, SILVER ORES CONTRACTS, LEAD AND ZINC ORES CONTRACTS, PETROLEUM REFINERY PRODUCTS CONTRACTS, IRON AND STEEL MILLS CONTRACTS, and others

To create the nonfinancial corporations' derivative hedging usage dataset sample for the period 1996- 2016, I parsed 10-K, 10-K405, 10-KT, 10KSB40, and 10KSB filings and their amendments for keywords related to interest rate, foreign currency, and commodity derivatives. First, I parsed the financial statement to gather information related to hedging using derivatives. The algorithm analyzed every sentence where risk management keywords were available to find when firms' mentioned their usage of derivative hedging instruments. Second, to confirm that financial derivative is used for hedging and not for speculation, I examine sentences related to hedging only in the presence of risk exposure. This step is necessary to verify derivative usage only for risk hedging. Third, following Manconi, Massa, and Zhang (2017), I searched sentences for interest rate and foreign currency derivative exposure and its instruments. In addition, for commodity derivatives traded contracts, I use table C of Almeida, Hankins, and Williams (2017). The following table presents all the keywords used in the textual analysis of financial statements for risk management data. In addition, similar to Huang, Peyer, and Segal (2013) risk exposure calculation method, I used the number of times hedging instruments were present in a financial statement in a particular firm-year.

APPENDIX 3

TABLE C14
A SAMPLE OF SMALL FIRMS BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	-0.014*	0.07	0.039**	0.021***	0.325***
	(0.008)	(0.079)	(0.018)	(0.008)	(0.105)
Size	-0.005	0.212**	-0.01	0.008	-0.363***
	(0.018)	(0.085)	(0.034)	(0.018)	(0.064)
Cash Flow (CF)	-0.004	0.54	0.077	0.045	1.383**
	(0.032)	(0.753)	(0.130)	(0.032)	(0.542)
After_Hedge x CF		-1.621*	-0.116	-0.128***	-1.505**
		(0.963)	(0.097)	(0.030)	(0.685)
Leverage	-0.111***	-0.594**	0.176**	0.102***	0.076
	(0.026)	(0.248)	(0.090)	(0.026)	(0.245)
Tangibility	-0.592***	-1.103***	0.456**	0.577***	-0.553
	(0.067)	(0.376)	(0.208)	(0.066)	(0.707)
Sale growth	-0.004*	-0.032*	-0.004	0.004*	0.023*
	(0.002)	(0.017)	(0.006)	(0.002)	(0.014)
GDP/Price	3.197	5.084	0.9	-7.538**	-1.300***
	(3.179)	(3.343)	(1.458)	(2.993)	(0.316)
Credit Spread	0.119**	-2.192	-0.144	0.073	-1.635***
	(0.052)	(1.670)	(0.185)	(0.049)	(0.502)
Term Spread	0.221	-0.243	0.126**	-0.447*	1.100***
	(0.255)	(0.507)	(0.059)	(0.240)	(0.273)
Constant	-15.676	-23.617	-4.519	37.038**	9.794***
	(15.896)	(15.265)	(7.041)	(14.966)	(1.783)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	2678	2068	2013	2678	302
adj. R2	0.187	0.116	0.105	0.206	0.65

This table reports coefficients estimated for a sub-sample of small firms (bottom median of firm size) before and after initiating the derivative hedging program at the firm level. All the estimation is based on panel regression explaining firm-level hedging initiation with the help of various firm characteristics used in prior corporate risk management literature. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment-to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C15
A SAMPLE OF KAPLAN-ZINGALES ((KZ)) INDEX FOR FINANCIALLY CONSTRAINED FIRMS BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	-0.005*	0.082	0.034**	0.010*	0.046
	(0.003)	(0.064)	(0.014)	(0.005)	(0.035)
Size	-0.011***	0.005	-0.011**	0.011***	-0.165***
	(0.003)	(0.004)	(0.005)	(0.003)	(0.008)
Cash Flow (CF)	-0.067*	1.149	0.109	0.112***	0.061
	(0.037)	(0.745)	(0.092)	(0.041)	(0.200)
After_Hedge x CF		-0.912	-0.232**	-0.071	-0.153
		(0.698)	(0.096)	(0.044)	(0.292)
Leverage	-0.073***	0.041	0.05	0.098***	0.361***
	(0.016)	(0.075)	(0.037)	(0.016)	(0.087)
Tangibility	-0.311***	-0.064*	0.110***	0.248***	0.117*
	(0.025)	(0.036)	(0.031)	(0.017)	(0.065)
Sale growth	0.001	-0.016*	-0.009**	-0.003**	-0.002
	(0.001)	(0.008)	(0.004)	(0.001)	(0.009)
GDP/Price	0.070***	-0.066**	0.012	-0.025***	0.340***
	(0.020)	(0.028)	(0.021)	(0.009)	(0.047)
Credit Spread	0.004	0.146*	0.001	-0.144***	-0.578**
	(0.005)	(0.079)	(0.071)	(0.027)	(0.266)
Term Spread	0.012***	-0.045	-0.012	0.031***	0.554***
	(0.003)	(0.032)	(0.021)	(0.008)	(0.105)
Constant	-0.106	-0.083	-0.345*	0.105	1.922***
	(0.090)	(0.202)	(0.199)	(0.091)	(0.408)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	3006	2396	2341	3006	451
adj. R2	0.163	0.06	0.084	0.261	0.549

This table reports coefficients estimated following equation 1 panel regressions containing dependent variables from tables 3-6. For a sub-sample of financially constrained firms fell in the top median of KZ index (see Appendix 1) two years before the initiation of the hedging program at the firm level. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment-to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C16
A SAMPLE OF FINANCIALLY CONSTRAINED FIRMS AS PER WHITED-WU (WW) DESIGNED INDEX BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	-0.014*	0.071	0.036**	0.022***	0.200**
	(0.007)	(0.077)	(0.015)	(0.007)	(0.080)
Size	-0.012	0.141	-0.013**	0.016	-0.112
	(0.018)	(0.090)	(0.005)	(0.018)	(0.072)
Cash Flow (CF)	0.005	0.571	0.123	0.045	0.515
	(0.031)	(0.800)	(0.095)	(0.032)	(0.362)
After_Hedge x CF		-1.585*	-0.171*	-0.146***	-0.917*
		(0.874)	(0.095)	(0.029)	(0.485)
Leverage	-0.127***	-0.522**	0.031	0.114***	0.222
	(0.030)	(0.247)	(0.038)	(0.029)	(0.233)
Tangibility	-0.594***	-0.985**	0.075***	0.579***	0.495
	(0.064)	(0.449)	(0.027)	(0.062)	(0.401)
Sale growth	-0.001	-0.042**	-0.008*	0.002	0.027
	(0.002)	(0.018)	(0.004)	(0.002)	(0.017)
GDP/Price	3.542	4.505	0.033	-7.898***	-0.278
	(2.984)	(3.088)	(0.023)	(2.794)	(0.224)
Credit Spread	0.147***	-1.952	-0.049	0.047	-0.056
	(0.049)	(1.485)	(0.073)	(0.046)	(0.079)
Term Spread	0.251	-0.08	-0.124***	-0.477**	0.037
	(0.239)	(0.402)	(0.047)	(0.224)	(0.030)
Constant	0.283	-1.346	-0.559	-0.263	-11.975*
	(0.303)	(0.960)	(0.376)	(0.298)	(6.298)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	2750	2140	2084	2750	317
adj. R2	0.193	0.106	0.043	0.216	0.194

This table reports coefficients estimated following equation 1 panel regressions containing dependent vari- ables from tables 3-6. For a sub-sample of financially constrained firms fell in the top median of WW index (see Appendix 1) two years before the initiation of the hedging program at the firm level. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment-to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C17
A SAMPLE OF FINANCIALLY CONSTRAINED FIRMS AS PER HADLOCK-PIERCE (HP) DESIGNED INDEX BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	-0.011**	0.044	0.024**	0.022***	0.038
	(0.005)	(0.093)	(0.012)	(0.006)	(0.047)
Size	-0.029**	0.086	-0.011**	0.030**	-0.155***
	(0.015)	(0.068)	(0.005)	(0.014)	(0.008)
Cash Flow (CF)		-1.564	-0.149	-0.164***	-0.589
		(1.347)	(0.093)	(0.038)	(0.451)
After_Hedge x CF	-0.015	-1.061	0.111	0.074**	0.039
	(0.044)	(0.880)	(0.104)	(0.034)	(0.225)
Leverage	-0.130***	-0.276	0.038	0.117***	0.393***
	(0.026)	(0.206)	(0.045)	(0.027)	(0.098)
Tangibility	-0.493***	-0.461	0.134***	0.485***	0.158**
	(0.065)	(0.345)	(0.038)	(0.064)	(0.074)
Sale growth	-0.003	-0.018	-0.010**	0.004*	0
	(0.002)	(0.014)	(0.004)	(0.002)	(0.010)
GDP/Price	-11.853***	-34.827**	0.018	-3.344**	0.240***
	(1.500)	(16.675)	(0.023)	(1.498)	(0.022)
Credit Spread	-0.059	-9.887**	-0.01	-0.248***	-0.043
	(0.047)	(4.820)	(0.072)	(0.044)	(0.042)
Term Spread	-0.961***	-3.594**	-0.133**	-0.274**	0.328***
	(0.124)	(1.725)	(0.057)	(0.124)	(0.030)
Constant	59.594***	183.891**		16.379**	-
	(7.531)	(88.116)		(7.519)	
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	2671	2061	2005	2671	395
adj. R2	0.217	0.169	0.129	0.249	0.448

This table reports coefficients estimated following equation 1 panel regressions containing dependent vari- ables from tables 3-6. For a sub-sample of financially constrained firms fell in the top median of HP index (see Appendix 1) two years before the initiation of the hedging program at the firm level. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment-to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C18
A SAMPLE OF UNRATED FIRMS BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	-0.015**	0.077	0.061***	0.023***	0.035
	(0.007)	(0.072)	(0.018)	(0.005)	(0.075)
Size	-0.011	0.074	-0.007	0.003	-0.06
	(0.018)	(0.048)	(0.027)	(0.013)	(0.145)
Cash Flow (CF)	0.005	0.061	0.088	0.044	-0.206
	(0.031)	(0.403)	(0.133)	(0.029)	(0.585)
After_Hedge x CF		-1.149	-0.2	-0.145***	-0.308
		(0.789)	(0.128)	(0.026)	(0.599)
Leverage	-0.128***	-0.237*	0.186**	0.102***	0.866***
	(0.030)	(0.143)	(0.088)	(0.021)	(0.261)
Tangibility	-0.592***	-0.837***	0.663***	0.535***	1.025**
	(0.064)	(0.250)	(0.163)	(0.048)	(0.411)
Sale growth	-0.001	-0.022**	-0.002	0.003**	-0.005
	(0.002)	(0.009)	(0.004)	(0.002)	(0.014)
GDP/Price	3.554	5.763	-1.977***	0.291*	-2.994
	(2.987)	(5.165)	(0.602)	(0.166)	(9.472)
Credit Spread	0.147***	0.321	0.008	0.199***	-5.873
	(0.049)	(0.277)	(0.045)	(0.017)	(16.900)
Term Spread	0.252	-0.188	-0.057**	0.179***	-0.517
	(0.239)	(0.238)	(0.028)	(0.014)	(2.131)
Constant	-17.436	-29.039	9.533***	-2.035**	21.578
	(14.942)	(25.773)	(3.021)	(0.826)	(65.337)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	2750	3207	3148	3817	510
adj. R2	0.193	0.092	0.076	0.212	0.301

This table reports coefficients estimated for a sub-sample of unrated firms before and after initiating the derivative hedging program at the firm level. As Faulkender and Petersen (2006) and Farre-Mensa and Ljungqvist (2016b) suggest, the unrated firm faces the highest financial constraints to getting debt from the public markets. All the estimation is based on panel regression explaining firm-level hedging initiation with the help of various firm characteristics used in prior corporate risk management literature. The Depen- dent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment-to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C19
A SAMPLE OF CASH CONSTRAINED FIRMS BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	0.007**	0.013**	0.051*	-0.001	0.029
	(0.003)	(0.007)	(0.029)	(0.005)	(0.064)
Size	-0.012	0.023*	-0.014	0.012	-0.117
	(0.010)	(0.014)	(0.032)	(0.010)	(0.072)
Cash Flow (CF)	-0.001	0.066	0.101	0.028	-1.305*
	(0.029)	(0.052)	(0.299)	(0.039)	(0.716)
After_Hedge x CF		0.106	-0.29	-0.073	0.678
		(0.067)	(0.276)	(0.049)	(0.611)
Leverage	-0.038**	-0.008	0.200*	0.040**	0.482**
	(0.017)	(0.022)	(0.118)	(0.017)	(0.221)
Tangibility	-0.336***	-0.240**	0.384**	0.335***	0.729**
	(0.044)	(0.095)	(0.176)	(0.043)	(0.322)
Sale growth	0.000	-0.003*	-0.003	0.000	-0.008
	(0.001)	(0.002)	(0.005)	(0.001)	(0.014)
GDP/Price	0.947	-0.392	-0.251	-5.252***	-0.445
	(0.592)	(0.248)	(0.579)	(0.597)	(0.714)
Credit Spread	0.113***	0.052	0.054	0.081***	-0.138*
	(0.013)	(0.053)	(0.087)	(0.014)	(0.083)
Term Spread	0.039	0.045	0.042	-0.264***	0.268***
	(0.047)	(0.038)	(0.040)	(0.048)	(0.088)
Constant	-4.495	1.723	1.076	25.691***	1.076
	(2.960)	(1.204)	(2.763)	(2.986)	(2.763)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	3203	2593	2539	3203	523
adj. R2	0.176	0.112	0.089	0.182	0.454

This table reports coefficients estimated for a sub-sample of cash constrained (bottom median of cash to assets ratio) (see, Denis and Sibilkov (2010)) before and after initiating the derivative hedging program at the firm level. All the estimation is based on panel regression explaining firm-level hedging initiation with the help of various firm characteristics used in prior corporate risk management literature. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment-to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C20
A SAMPLE OF COLLATERAL CONSTRAINED (WITHOUT DEBT OR MORTGAGE) FIRMS BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1)	(2)	(3)	(4)	(5)
	Cash/Asset	Δ (Cash/ Assets-Cash)	Δ (Investment /Assets)	Net Debt /Assets	Unused Line of Credit
After_Hedge	-0.001	0.019	0.075**	0.007	0.076
	(0.004)	(0.014)	(0.032)	(0.006)	(0.065)
Size	0.000	0.054**	-0.020	0.001	-0.033
	(0.014)	(0.023)	(0.030)	(0.014)	(0.079)
Cash Flow (CF)	0.019	0.161	0.483	0.013	-0.137
	(0.034)	(0.118)	(0.370)	(0.043)	(0.534)
After_Hedge x CF		0.030	-0.506	-0.074	-1.018
		(0.133)	(0.322)	(0.060)	(0.663)
Leverage	-0.062***	-0.075*	0.220*	0.063***	0.789***
	(0.022)	(0.046)	(0.117)	(0.022)	(0.224)
Tangibility	-0.343***	-0.335***	0.432**	0.348***	0.703
	(0.052)	(0.118)	(0.193)	(0.052)	(0.434)
Sale growth	-0.001	-0.001	-0.005	0.001	-0.014
	(0.001)	(0.003)	(0.005)	(0.001)	(0.010)
GDP/Price	1.242***	1.762***	4.699**	-2.544***	0.197
	(0.221)	(0.347)	(1.902)	(0.223)	(0.791)
Credit Spread	0.072**	0.336***	0.684***	-0.301***	-0.204***
	(0.028)	(0.055)	(0.250)	(0.030)	(0.070)
Term Spread	0.050**	0.099**	0.226	-0.243***	0.204**
	(0.024)	(0.047)	(0.157)	(0.024)	(0.082)
Constant	-5.993***	-2.512	-24.172**	12.728***	-0.707
	(1.111)	(1.767)	(9.707)	(1.124)	(3.484)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES

Observations	3162	2552	2495	3162	509
adj. R2	0.128	0.072	0.084	0.136	0.586

This table reports coefficients estimated for a sub-sample of collateral constrained (bottom median of col- lateral constraint proxy without debt or mortgage) (see, Almeida and Campello (2007)) before and after initiating the derivative hedging program at the firm level. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment- to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE C21
A SAMPLE OF COLLATERAL CONSTRAINED FIRMS (WITH DEBT AND WITHOUT MORTGAGE) BEFORE THE INITIATION OF HEDGING USING FINANCIAL DERIVATIVE

	(1) Cash/Asset	(2) Δ (Cash/ Assets-Cash)	(3) Δ (Investment /Assets)	(4) Net Debt /Assets	(5) Unused Line of Credit
After_Hedge	0.002	-0.022	0.065**	0.005	0.080
	(0.004)	(0.037)	(0.027)	(0.005)	(0.067)
Size	0.001	0.072***	-0.028	0.000	-0.082
	(0.013)	(0.024)	(0.024)	(0.012)	(0.075)
Cash Flow (CF)	0.011	-0.470	0.465*	0.011	-0.007
	(0.026)	(0.549)	(0.257)	(0.032)	(0.590)
After_Hedge x CF		0.298	-0.480**	-0.087*	-0.652
		(0.304)	(0.236)	(0.050)	(0.648)
Leverage	-0.052***	-0.118**	0.195*	0.051***	0.644**
	(0.019)	(0.057)	(0.110)	(0.019)	(0.249)
Tangibility	-0.374***	-0.429***	0.320*	0.381***	0.850**
	(0.046)	(0.111)	(0.182)	(0.046)	(0.395)
Sale growth	-0.001	-0.001	-0.003	0.001	-0.021*
	(0.001)	(0.003)	(0.005)	(0.001)	(0.013)
GDP/Price	1.141***	-12.552***	0.315*	-2.386***	0.292
	(0.203)	(3.675)	(0.188)	(0.205)	(0.791)
Credit Spread	0.063**	-1.633***	0.070**	-0.287***	-0.12
	(0.026)	(0.509)	(0.032)	(0.027)	(0.081)
Term Spread	0.039*	-1.144***	-0.168***	-0.226***	0.144
	(0.022)	(0.335)	(0.013)	(0.022)	(0.088)
Constant	-5.494***	63.880***	-1.566*	11.939***	-1.027
	(1.013)	(18.819)	(0.923)	(1.028)	(3.479)
Firm Fixed Effects	YES	YES	YES	YES	YES
Ind. Fixed Effects	YES	YES	YES	YES	YES

Year Fixed Effects	YES	YES	YES	YES	YES
Observations	3279	2669	2612	3279	521
adj. R2	0.137	0.065	0.062	0.149	0.511

This table reports coefficients estimated for a sub-sample of collateral constrained (bottom median of collateral constraint proxy with debt and without mortgage) (see, Almeida and Campello (2007)) before and after initiating the derivative hedging program at the firm level. The Dependent variable in Column 1 is the cash to total assets, a continuous variable used in prior research (see, Opler et al. (1999)). In Column 2, I estimate the same model with the dependent variable as the change in net cash to total assets less cash, as in Erel et al. (2015). The model in column 2 is used to measures cash-to-cash flow sensitivity (After_Hedge x CF). The change in investment to total assets variable act as a dependent variable in Column 3, to measure investment- to-cash flow sensitivity (After_Hedge x CF) as in Almeida et al. (2004). In Column 4, the dependent variable is net debt to total assets. The dependent variable in Column 5 is the unused lines of credit. The definition of all the variables and their creation is reported in Appendix 1. All specifications are estimated using firm, year, and one-digit industry fixed effects. The symbols ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.