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Credit default swaps, exacting creditors and corporate liquidity management☆

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ABSTRACT

We investigate the liquidity management of firms following the inception of credit default swaps (CDS) markets on their debt, which allow hedging and speculative trading on credit risk to be carried out by creditors and other parties. We find that reference firms hold more cash after CDS trading commences on their debt. The increase in cash holdings is more pronounced for CDS firms that do not pay dividends and have a higher marginal value of liquidity. For CDS firms with higher cash flow volatility, these increased cash holdings do not entail higher leverage. Overall, our findings are consistent with the view that CDS-referenced firms adopt more conservative liquidity policies to avoid negotiations with more exacting creditors.

1. Introduction

Credit default swaps (CDS) have been one of the major innovations in global financial markets in recent decades and are the main construct in the multi-trillion-dollar credit derivatives market. CDS allow creditors to hedge credit risk without formal borrower approval. As a result, CDS can affect the creditor-borrower relationship, and have implications for corporate financial management. Indeed, there is anecdotal evidence that corporate financial executives, such as chief financial officers (CFOs) and treasurers, take CDS market positions into account in practice.[1] In

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[1] "Too big to ignore: Debt derivatives markets are encroaching on corporate finance decisions." *CFO Magazine*, September 26, 2007, avail-

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this paper, we empirically examine how the introduction of CDS trading on the debt of individual firms affects corporate liquidity.

The theoretical foundation for our empirical analysis was developed by Bolton and Oehmke (2011) and Bolton, Chen, and Wang (2011). In this formulation, there is a tension between the benefits and costs of CDS: On the one hand, CDS help increase the current credit supply because creditors can transfer part of their credit risk into the CDS market; on the other hand, the existence of CDS may change the relationship between creditors and borrowers and impose future financing constraints—or costs—on borrowers. Bolton and Oehmke (2011) show that lenders can use CDS to gain bargaining power over borrowers in renegotiations and become more exacting, i.e., "tougher" creditors—particularly when engaged with borrowers facing financial distress. As a consequence, borrowers may attempt to avoid such renegotiations under these circumstances. Bolton, Chen, and Wang (2011) present a framework in which firms consider liquidity and risk management jointly and note that the marginal value of liquidity is a major determinant of corporate financial policies. The key determinant of corporate financial policies in their model is the cash-capital ratio of the firm. Moreover, cash can be a more effective risk management tool when other types of hedging are more costly owing to margin requirements and other frictions. If CDS transform lenders into tough bargaining parties, the marginal value of liquidity after CDS trading will be higher because of the need to avoid the contingency of renegotiation. We, therefore, expect that corporate cash holdings will be higher following the initiation of CDS trading on a firm's debt.

Nevertheless, creditor monitoring may be less stringent after the introduction of CDS trading on a firm's debt (Parlour and Winton, 2013). In this case, the borrowing firm may engage in risk shifting and hold less cash, which has a high opportunity cost, to maximize the value of equity. Moreover, conventional risk management analysis suggests that, when lenders can hedge their risk efficiently, borrowers may not have to undertake costly hedging strategies, which means that they can hold less cash. In addition, considering the relaxed credit supply constraint that applies after CDS trading begins on a firm, the borrowers' precautionary demand for cash holdings may decrease. The ultimate impact of CDS will reflect the tension between these conflicting effects. Thus, the net effect of CDS on corporate cash holdings is best determined empirically.

We construct a comprehensive data set covering the introduction of CDS trading on corporate debt to study the effects of CDS on cash holdings. We rely on multiple data sources to pin down the dates of CDS introduction for particular firms. Over the 1997–2009 period, we identify 901 CDS introductions for U.S. corporations with data from the Center for Research in Security Prices (CRSP) and Compustat. Our first main finding is that introducing CDS trading on a firm leads to an increase in the firm's cash holdings, after controlling for existing determinants of corporate cash holdings. The effect is also quantitatively important: The average level of cash holdings as a proportion of total assets is 2.6 percentage points higher following the introduction of CDS trading on a firm, compared to the average level of cash holdings for those firms before CDS introduction, which is approximately 9.5% of total assets. Our finding of the CDS effect on cash holdings is robust to variations in the model specification and the selection of firms for CDS trading. We employ both propensity score matching and instrumental variable (IV) methods to address the endogeneity concern that firms facing a potential increase in cash holdings may be the very ones selected for CDS trading. The CDS effect on cash holdings remains statistically significant, even after the matching of firms based on CDS trading propensities and following such instrumentation.

The CDS effects on cash holdings found in the panel data analysis also hold in the time series, and are consistent with the mechanism of exacting creditors. CDS-induced empty creditors may affect firms both ex ante and ex post. As discussed above, ex ante, creditors' monitoring incentives are weakened because of CDS protection. As a result, firms may take on more risk by holding lower liquidity cushions. Ex post, CDS-protected creditors tend to be tougher in the process of renegotiation, which increases firms' precautionary demand for liquidity. When making cash-holding decisions, corporate managers will balance their "risk-taking incentive," arising from the decreased creditor monitoring, and their "precautionary demand for liquidity," arising from the exacting creditor threat. When the marginal value of liquidity is high (low), it is more likely that the potential effect of the threat of exacting creditors will dominate (be dominated by) that of decreased monitoring by creditors. In line with this prediction, we find that CDS firms closer to financial distress, as measured by deterioration in their credit quality and poor stock market performance, exhibit larger increases in their cash holdings. However, the CDS effect on cash holdings is significant only for firms without bank debt, which suggests that for firms with bank debt, the decreased bank monitoring effect may offset the increased precautionary demand for cash holdings due to empty creditors. Moreover, the CDS effect is more pronounced for firms with more CDS contracts outstanding and for firms without dividend payments, which suggests that both the magnitude of the threat of exacting creditors and the marginal value of liquidity play important roles.

It would be tempting to argue that, if cash is simply regarded as negative debt, then the increase in cash holdings may imply a decrease in leverage. However, Saretto and Tookes (2013) and Subrahmanyam, Tang, and Wang (2014) find that firm leverage and default risk are both higher after the introduction of CDS trading. Indeed, we too find that the high-cash phenomenon coexists with the high-leverage phenomenon after CDS trading is introduced. We reconcile these seemingly contradictory findings regarding cash holdings and leverage using the theoretical framework of Bolton, Chen, and Wang (2011) to further

able online at http://www.cfo.com/printable/article.cfm/-9821507?origin=archive (retrieved on May 11, 2014).

illuminate the joint effects of CDS on cash and leverage.[2] Bolton, Chen, and Wang (2011) show that firms may issue additional debt and hold the proceeds as cash to weather potential financial stress. Moreover, firms may simply raise capital when market conditions are favorable, even without an immediate financial need, as shown in a prior paper by Bolton, Chen, and Wang (2013). In their model, when a firm's credit risk increases, a high debt–high cash holdings strategy is more favorable from the shareholder's perspective than a low debt–low cash holdings strategy, even for the same level of net debt, based on the increase in the marginal value of cash holdings associated with increases in leverage. Therefore, CDS trading may simultaneously lead to higher cash holdings and higher leverage. In support of this conjecture, we find evidence that firms sometimes raise debt and hold some of the proceeds as cash. However, there are situations in which firms do not increase leverage but nonetheless increase their cash holdings. For example, when firms experience high cash flow volatility, they increase their cash holdings—because of the high marginal value of liquidity—but not their leverage after CDS trading is initiated.

Our study helps illuminate the dynamics of corporate liquidity in general and cash holdings in particular. Bates, Kahle, and Stulz (2009) document a dramatic increase in corporate cash holdings in recent years. We conjecture that the advent of the credit derivatives market may have partially contributed to this increase because CDS pose a potential threat to corporate decision makers. The creditor concern can also increase refinancing risk, which has been shown by Harford, Klasa, and Maxwell (2014) to be a determinant of corporate cash holdings. Our paper also contributes to an understanding of the sources of cash and the seemingly contradictory findings of high cash holdings coexisting with high leverage among CDS firms. While Saretto and Tookes (2013) document the increase in the leverage of CDS firms owing to the credit supply effect, i.e., the fact that CDS-protected creditors are more willing to lend, our paper provides new insights into how firms respond to the potentially perverse incentives of CDS-protected creditors. In particular, we find evidence that CDS firms adopt more conservative liquidity management policies: Overall, they borrow more and save part of the proceeds of new debt issuance as cash holdings.

Our findings shed new light on the real effects of credit derivatives on corporate financial management. Although CDS, along with other derivatives, have been labeled "financial weapons of mass destruction," they remain robust and effective financial tools for hedging credit risk and are widely utilized by financial institutions as a result.[3] Indeed, banks' use of CDS has even expanded since the 2007–2009 financial crisis as a result of the gradual implementation of the Basel III benchmarks and the capital relief that CDS provide to banks under the new regulations. Thus, increases in cash holdings remain an unintended consequence of the active participation of lenders, such as banks, in the CDS market.

The paper proceeds as follows. Section 2 presents the related literature and the development of our hypotheses. In Section 3, we describe our sample and empirical methods. Section 4 presents our main empirical results regarding the effect of CDS on cash holdings. The alternative mechanisms through which CDS affect corporate financial decisions and the sources of cash for corporations are discussed in Section 5. Section 6 concludes.

2. The theoretical framework and its testable predictions

We motivate our empirical analysis by sketching the framework underlying the hypotheses that follow. Although we do not present a formal model in this study, we draw upon prior work in the field to convey the key economic intuition. The corporate financing and debt renegotiation scenario involving the contingency of financial distress that we sketch out sets the stage for our subsequent empirical analysis: An entrepreneur must finance an investment project, given a choice between debt and outside equity. The firm must pay creditors a pre-specified amount as part of the loan contract on an intermediate date. There is a possibility of renegotiation between the two counterparties if the reported cash flow on the intermediate date is insufficient to meet the firm's obligations to its debt holders. This situation can arise either when the cash flow is actually low and reported as such by the entrepreneur, or when the entrepreneur declares an artificially low cash flow, despite the cash flow in fact being sufficient to make payments to debt holders. In the latter case, the borrowing firm may strategically report an artificially low cash flow so as to divert part of the cash flow to equity holders. In either event, renegotiation of the debt ensues, and the firm could be liquidated if it fails or could continue to operate following a renegotiated agreement between the firm and its debt holders. In anticipation of such financial distress and the consequently uncertain renegotiation prospects, the firm may prefer to hoard sufficient cash to secure the intermediate payment and avoid renegotiation should the realized cash flow become low. This is the key insight developed by Hart and Moore (1998) and employed in the context of CDS by Bolton and Oehmke (2011) in a discrete-time setting.[4] Bolton, Chen, and Wang ([2011,2013,2014]) present a continuous-time variation of this setting in which the information and incentive problems are modeled in a reduced-form fashion, giving rise to external financing costs.

In the classic sense pioneered by JPMorgan, banks buy CDS to hedge their credit exposures, freeing up their balance sheets to fund additional corporate loans.[5]

[2] As discussed above, in the Bolton, Chen, and Wang (2011) framework, the marginal value of cash holdings is a function of leverage, among other variables. Therefore, if leverage changes following the inception of CDS trading, we should jointly consider cash holdings and leverage.

[3] Berkshire Hathaway annual report for 2002: http://www.berkshirehathaway.com/2002ar/2002ar.pdf.

[4] Hart and Moore (1998) derive sufficient conditions for the debt contract to be optimal in this context, whereas other models focus on equity, debt, or both. This study was also the first to show that it is optimal for the borrower to simultaneously hold cash and take on leverage when renegotiation is costly.

[5] The introduction of CDS contracts in the early 1990s was largely motivated by corporate financing needs in the context of constrained bank

Bolton and Oehmke (2011) use this central insight to propose the first theory of corporate finance in the academic literature to consider the presence of CDS contracts, arguing that CDS simultaneously raise the creditor's bargaining power and act as a device for borrowers to pay out more of their cash flow to debt holders. The former argument arises from the reduced credit exposure of creditors, who can thus extract more from these debtors in their renegotiations. Simultaneously, debtors are less incentivized to strategically negotiate down their debt commitments. Nevertheless, there is a greater likelihood of default in the context of exacting creditors, which can even result in bankruptcy rather than efficient recapitalization; this is particularly true when creditors buy more CDS protection than their risk exposures necessitate for hedging purposes, leading them to become so-called "empty creditors." Employing similar reasoning, Arping (2014) argues that CDS may even discourage the use of debt in anticipation of such an eventuality. The increase in credit supply and bankruptcy risk associated with CDS trading is empirically corroborated by Saretto and Tookes (2013) and Subrahmanyam, Tang, and Wang (2014), respectively.[6] Differently from the previous literature, the focus of this study is on examining how firms' corporate liquidity policies are influenced by the presence of CDS trading.[7]

Firms may attempt to avoid the renegotiations with exacting CDS-protected creditors by increasing their cash holdings. As firms become riskier after CDS trading is initiated (as documented by Subrahmanyam, Tang, and Wang (2014)), they accumulate higher cash reserves due to precautionary motives and rely on cash more than on lines of credit for liquidity management (as argued by Acharya, Davydenko, and Strebulaev (2012); Acharya, Almeida, and Campello (2013)). Moreover, the marginal value of liquidity is a major determinant of corporate financial policies (as noted by Bolton, Chen, and Wang (2011)). If CDS transform lenders into tough bargaining parties, the marginal value of liquidity after CDS trading will be higher because a bigger cash pile helps reduce the contingency of debt renegotiation. Therefore, this line of analysis predicts that firms are likely to increase their cash holdings following the introduction of CDS trading, when the marginal value of liquidity is high.

In addition to the exacting creditor theory, other theories also have implications for the relationship between CDS trading and cash holdings. A reasonable conjecture is that banks may reduce debtor monitoring when they can buy CDS on firm debt (as in Morrison (2005); Parlour and Winton (2013)). In such cases, the borrower may engage in risk shifting (see, e.g., Campello and Matta (2013); Karolyi (2013)). Such moral hazard may result in less cash holding by the firm, particularly as a firm nears financial distress or bankruptcy, in accordance with agency theories of cash, as discussed by Harford, Mansi, and Maxwell (2008). Therefore, the exacting creditor and monitoring arguments yield contradictory predictions, particularly for firms close to financial distress.[8] Thus, we have the following prediction:

Hypothesis 1 (CDS, Exacting Creditors, and Cash Holdings). If the exacting creditor effect dominates risk-shifting incentives, then the cash holdings of firms will increase after CDS trading is initiated on their debt.

In addition to the above testable hypothesis, we conjecture that the contrast between the exacting creditor and risk-shifting effects will be most evident when firms are closer to financial distress. As discussed above, CDS-protected empty creditors may affect corporate incentives both ex ante and ex post. When making decisions regarding the size of the cash holdings, corporate managers compare the ex ante decreased monitoring effects with the ex post exacting creditor effects, given the marginal value of liquidity. When the marginal value of liquidity is high, the ex post effects of empty creditors are likely to dominate the ex ante effects of decreased monitoring. Therefore, a special setting in which to test the above hypothesis is one that conditions CDS effects on the financial conditions of CDS firms.

We further use the framework of Bolton, Chen, and Wang (2011) to develop more predictions regarding the mechanisms behind the CDS effect on corporate cash holdings. Bolton, Chen, and Wang's formulation shows that the firm may be in one of three regions, depending on the state of its intermediate cash flow: payout, internal financing, and external financing or liquidation. The marginal value of liquidity is low in the payout region, and high in the external-financing region, because of external-financing frictions. Thus, for firms in the payout region (dividend payers), the threat from the empty creditors is minimal, because the firms have adequate liquidity. It is, therefore, less optimal for these firms to accumulate even more cash. They may even have an incentive to take on more risk in the form of a smaller liquidity cushion in light of decreased creditor monitoring. Compared with dividend payers, dividend nonpayers have a higher marginal value of liquidity and a greater incentive to increase their cash holdings, because of the presence of exacting creditors after the introduction of CDS trading. Thus, using dividend payout as a proxy for the marginal value of liquidity, we expect:

balance sheets (see, e.g., Tett (2009)). Some of these determinants of CDS trading are also discussed by Oehmke and Zawadowski (2017).

[6] Augustin, Subrahmanyam, Tang, and Wang (2014) provide an overview of the literature on CDS relating to corporate finance, placing this issue in context, while Augustin, Subrahmanyam, Tang, and Wang (2017) discuss some of the issues that arise for future research in the area. Bolton and Oehmke (2013) also discuss the strategic conduct of CDS market participants in this setting.

[7] Almeida, Campello, Cunha, and Weisbach (2014) survey the literature on liquidity management and call for further examination to distinguish the dramatic increase in cash holdings in recent years from the time-series patterns of other forms of liquidity management, such as (bank) lines of credit.

[8] The weakened monitoring of the firm after CDS trading may further affect its cost of debt (Ashcraft and Santos, 2009; Che and Sethi, 2014), and increases its precautionary cash holdings. Given the importance of bank lenders in monitoring, the increase in the firm's cash holdings due to decreased monitoring and increased borrowing costs should be more relevant for firms with bank debt. In the following hypotheses, we focus on distinguishing the exacting creditor mechanism from the monitoring mechanism, and discuss this alternative channel for an increase in cash holdings in Section 5.2.2.

Hypothesis 2 (CDS Effects and Dividend Payment). Through the exacting creditor channel, the effect of CDS on cash holdings will be more pronounced for firms that do not pay dividends.

A similar argument can be made for firms with financial constraints of differing levels of stringency. Moreover, to further examine the risk-shifting incentives of the borrower, we can condition the CDS effect on banks' monitoring incentives. Specifically, for firms characterized by greater bank-loan dependency, relaxed monitoring may trigger more risk shifting, resulting in less cash holding after CDS trading begins on their debt. However, the decreased monitoring effect is expected to be less pronounced for firms characterized by less bank-loan dependency, given the important role of bank lenders in monitoring (as documented in Hadlock and James (2002)). In such cases, the cash-holding decision of these firms will be affected more by the threat of exacting creditors.

Under the unified corporate finance framework, there are different ways to manage firm risk and the possible joint effects of CDS trading on both cash and leverage.[9] Given the finding that leverage is increased after CDS trading begins (Saretto and Tookes, 2013), this framework and its predictions help us to understand the sources of cash and the seemingly contradictory finding of high cash and high leverage for CDS firms. Cash should not simply be regarded as negative debt when firms face heightened risk, as argued by Acharya, Almeida, and Campello (2007). Firms may raise external funds, e.g., issue new equity (Bolton, Chen, and Wang, 2013) or debt (Bolton, Chen, and Wang, 2014), hoarding the proceeds as cash even when there is no immediate use for the funds, particularly under benign market conditions at issuance. The notion that firms may issue long-term debt and save the proceeds as cash was first suggested by Hart and Moore (1998) in a context in which there is a possible renegotiation stage in the interim.[10] Bolton, Chen, and Wang (2014) present a dynamic model of optimal capital structure and liquidity management. In their model, firms face external-financing frictions and need to use liquidity reserves to service outstanding debt (i.e., debt-servicing costs). The interactions between the two factors exacerbate the precautionary demand for cash. Therefore, financially constrained firms will, on the one hand, exploit the increased credit supply consequent upon the introduction of CDS trading to increase their leverage, and on the other hand hold more cash for precautionary reasons.[11]

A unique prediction of the Bolton, Chen, and Wang (2014) model is that firms will increase their leverage when cash flow volatility increases (instead of decreasing their leverage, as other structural models predict) and hold more cash because the high leverage–high cash strategy is better from equity holders' perspective than the low leverage–low cash strategy, even for the same level of net debt. Bolton, Chen, and Wang (2014, Fig. 3, Panels A and B), show that, when cash flow volatility is in the highest region, leverage decreases and cash holdings increase with cash flow volatility. In this setting, the high marginal value of cash increases the demand for cash but the concern about debt-servicing costs, i.e., that debt payments may drain the firm's valuable liquidity reserves, decreases the demand for leverage. These divergent relationships between cash and leverage provide a suitable setting in which to test these theoretical predictions. Based on this framework, cash flow risk can be used as a proxy for a firm's demand for both leverage and cash. Since the effect of CDS trading on corporate financial policies also depends on the firm's demand for leverage and precautionary cash savings, we expect that the impact of CDS trading on leverage and cash holdings is also a function of cash flow volatility.

Hypothesis 3 (Cash Flow Volatility, Cash, and Leverage). The effect of CDS trading on cash holdings increases with reference firms' cash flow volatility; the CDS effect on leverage decreases with reference firms' cash flow volatility.

In the following empirical analysis sections, we test the above predictions bearing in mind the concern that CDS trading may be endogenous. We address such concerns carefully, using IVs and following the prior literature, including Saretto and Tookes (2013) and Subrahmanyam, Tang, and Wang (2014).

3. Data and empirical specification

3.1. Data

We use CDS transaction data to identify a sample of firms with CDS contracts referencing their debt. Our CDS transaction data come from CreditTrade and the GFI Group. In contrast to the CDS quote data employed in some previous studies, our data contain *actual* trading records with complete contractual information. Given the over-the-counter nature of CDS contracts, we use the first CDS trading date in our sample as the CDS introduction date and investigate changes in corporate cash holdings following the onset of CDS trading. We further cross-check this CDS sample against the Markit database, which provides end-of-day valuations based on a survey of broker-dealers. In an auxiliary analysis, we also utilize more detailed transaction information and construct continuous measures of CDS exposure. The combined sample covers the period from June 1997 to April 2009 and includes 901 North American corporations that had CDS initiated on their debt at some time during the sample period. The industry coverage of the firms on which CDS are traded (henceforth, CDS firms) in our sample is quite diversified.

[9] The central theme highlighted by Bolton, Chen, and Wang (2011) is that "cash management, financial hedging, and asset sales are integral parts of dynamic risk management." Gamba and Triantis (2014) also emphasize the value created by a dynamically integrated risk management strategy. We thank the referee for suggesting that we study the simultaneous effects of CDS on cash and leverage.

[10] This insight is further explored by Acharya, Huang, Subrahmanyam, and Sundaram (2006) and Anderson and Carverhill (2012), who show that cash increases with the level of long-term debt. Eisfeldt and Muir (2014) document a positive relationship between debt issuance and cash accumulation.

[11] In a different modeling framework, Hugonnier, Malamud, and Morellec (2015) show a similar result whereby, when firms face capital supply uncertainty, they may issue debt and hold the proceeds as cash.

Most are in the manufacturing, transportation, and communications sectors.[12] Our data on corporate cash holdings and other firm characteristics are obtained from the Compustat database. Following Bates, Kahle, and Stulz (2009), we measure cash holdings as the ratio of cash and marketable securities to total assets.[13] We also obtain bank lenders' and underwriters' information from Dealscan and the Fixed Income Securities Database (FISD), lenders' FX hedging data from Call Report, firms' Standard & Poor (S&P) credit ratings data from Compustat, and bank debt dependence data from Capital IQ.

Panel A of Table 1 presents a year-wise summary of CDS trading and cash ratios for all firms in the Compustat database during the 1997–2009 period: the number of Compustat firms (column 2), the number of CDS firms (columns 3 and 4), and cash ratios for firms without and with CDS trading (columns 5 and 6). As the third column of the table shows, CDS trading was initiated on the largest number of new firms during the 2000–2003 period. As shown in the fifth and sixth columns, similarly to the findings in Bates, Kahle, and Stulz (2009), there is an increasing trend over time in the cash ratios for both non-CDS and CDS firms in our sample, but the increase is relatively larger for CDS firms: The average cash ratio for non-CDS firms increases by 16% from 1997 to 2009, whereas the corresponding increase in the cash ratio is 43% for CDS firms, which have lower cash ratios to begin with. As shown in Subrahmanyam, Tang, and Wang (2014), CDS firms are relatively large compared with their non-CDS counterparts. Large firms generally hold less cash due to economies of scale: They incur lower unit transaction costs in converting fixed assets into liquid assets. In our sample, the average cash ratio for non-CDS firms (0.209) is more than twice that for CDS firms (0.082).

Summary statistics of firm characteristics are provided in Table 1, Panel B. Most of our analysis is of CDS firms and their matching firms (we will discuss matching methods in Section 4.2 below). In the regression sample, the average cash ratio is 0.095 and the average leverage ratio is 0.274. On average, 57.2% of firms in the matching sample pay dividends. The Pearson correlation coefficient between *Cash* and *Leverage* is −0.318. In addition to cash flow volatility, the cash ratio has a high correlation with measures of the future investment opportunity set, including the *Market to book* and *R&D/Sales* ratios (0.311 and 0.509, respectively).

3.2. The baseline empirical specification

We employ the regression model used in Opler, Pinkowitz, Stulz, and Williamson (1999) and Bates, Kahle, and Stulz (2009) to investigate the effect of CDS on corporate cash holdings. The dependent variable is the ratio of cash and marketable securities to total assets, which is regressed on a set of determinants of cash holdings and other controls, including firm fixed effects. The determinants of cash holdings in our empirical specifications of cash-holdings models are motivated by the transaction and precautionary explanations for cash holdings. The set of independent variables includes industry cash flow risk (*Industry sigma*), the ratio of cash flow to total assets (*Cash flow/Assets*), a measure of investment opportunities (*Market to book*), the logarithm of total assets (*Size*), the working capital ratio (*Net working capital/Assets*), capital expenditure (*Capital expenditure*), leverage (*Leverage*), the ratio of research and development to sales (*R&D/Sales*), dividend payments (*Dividend dummy*), the ratio of acquisitions to total assets (*Acquisition activity*), and the proportion of foreign pretax income (*Foreign pretax income*). We explain the variable construction and data sources in the Appendix.

We use an indicator variable in the model specification to estimate the impact of CDS trading on corporate cash holdings, following Ashcraft and Santos (2009), Saretto and Tookes (2013), and Subrahmanyam, Tang, and Wang (2014). Our key independent variable, *CDS trading*, is a dummy variable that equals one for a CDS firm after the inception of CDS trading on the firm's debt and zero before that time. The regression analysis is conducted on a sample that includes CDS firms and non-CDS firms. Given the unobservable differences between firms, we control for firm fixed effects in our panel data analysis. Therefore, the coefficient for *CDS trading* captures the impact of the inception of CDS trading on cash holdings.

A challenge in establishing the causal effects of CDS trading on corporate cash holdings is the potential endogeneity of CDS trading, as firms are selected into CDS trading. It is possible that an unknown third factor jointly affects the introduction of CDS trading and corporate cash holdings. In that case, the observed effects on cash holdings might not be caused by the CDS contracts but might result from the impact of this third factor. We use multiple methods to address this endogeneity concern, including propensity score matching analysis and an IV approach, which are discussed below.

Because firms may make their financing and risk management decisions simultaneously, we further investigate the CDS effect in a unified framework of corporate policies by jointly estimating debt and cash policies in a simultaneous equation system. Our analysis of leverage follows Saretto and Tookes (2013) and Subrahmanyam, Tang, and Wang (2014), but incorporates the liquidity decision into the analysis.

4. CDS trading and cash holdings

In this section, we establish the empirical relationship between CDS trading and corporate cash holdings as a first step toward an understanding of the mechanisms of the CDS effects, discussed in the next section. We consider the potential endogeneity of CDS trading by using propensity score matching and IVs.

[12] We use the entire sample, including financial firms, in our main analysis and report the estimation results. However, we also conduct an analysis in which financial firms are excluded. The estimation results in Internet Appendix Table A2 show that our findings are similar in all cases, whether we include or exclude financial firms.

[13] Although the ratio of cash and marketable securities to total assets is the conventional measure of cash holdings, we also analyze alternative measures of the cash ratio and obtain similar results: The CDS effects are robust to these alternative definitions of cash holdings.

Table 1
Summary statistics.

This table provides summary statistics for our sample firms. Panel A reports the distribution of firms in our sample, including those with CDS traded, and their average cash ratios, by year, between 1997 and 2009. The overall sample of firms is taken from Compustat, and includes all companies in that database during 1997–2009. The CDS data are taken from CreditTrade and the GFI Group. There are 901 firms in the sample that have CDS traded at some point during the sample period of June 1997 to April 2009. We measure the cash ratio as cash and marketable securities divided by total assets. The first column in the table is the year. The second column shows the total number of U.S. companies included in the Compustat database. The third column reports the number of firms for which CDS trading was initiated during that year. The fourth column presents the number of firms with active CDS trading during each year. The last two columns report average cash ratios for non-CDS and CDS firms, respectively. Panel B provides summary statistics of firm characteristics for the matching sample discussed in Section 4.2. *Leverage* is the book value of the long-term debt plus debt in current liabilities, divided by total assets. *Industry cash* is the industry mean cash ratio across two-digit SIC codes. *Industry leverage* is the industry mean leverage ratio across two-digit SIC codes. *Industry sigma* is the industry cash flow risk, measured by the mean cash flow volatility across two-digit SIC codes. *Cash flow/Assets* is the ratio of cash flow to total assets, where cash flow is defined as the earnings after interest and related expenses, income taxes, and dividends. *Market to book* is the book value of assets minus the book value of equity plus the market value of equity, all divided by the book value of assets. *Size* is the logarithm of total assets. *Net working capital/Assets* is measured as net working capital minus cash, divided by total assets. *Capital expenditure* is the ratio of capital expenditure to total assets. *R&D/Sales* is the ratio of R&D to sales. *Dividend dummy* is a dummy variable that equals one if the firm pays a common dividend. *Acquisition activity* is the ratio of acquisitions to total assets, and *Foreign pretax income* is the ratio of foreign pretax income to total assets. († from June 1997, ‡ until April 2009)

Panel A: CDS trading and cash ratios by year

(1)	(2)	(3)	(4)	(5)	(6)
Year	Total # of firms	# of New CDS firms	# of Active CDS firms	Non-CDS firm cash ratio	CDS firm cash ratio
1997†	9366	22	22	0.187	0.072
1998	9546	58	72	0.191	0.070
1999	9545	55	106	0.202	0.068
2000	9163	102	196	0.200	0.064
2001	8601	172	334	0.201	0.072
2002	8190	221	547	0.203	0.081
2003	7876	93	582	0.221	0.090
2004	7560	58	593	0.221	0.095
2005	7318	73	629	0.224	0.092
2006	6993	28	533	0.226	0.089
2007	6651	9	418	0.225	0.084
2008	6223	9	375	0.205	0.088
2009‡	5686	1	234	0.216	0.103
Total/Average		901		0.209	0.082

Panel B: Summary statistics for propensity-score-matched sample

	Mean	StdDev	Q1	Median	Q3
Cash	0.095	0.114	0.017	0.048	0.134
Leverage	0.274	0.171	0.154	0.257	0.370
Industry cash	0.171	0.098	0.091	0.138	0.243
Industry leverage	0.259	0.080	0.197	0.243	0.310
Industry sigma	0.083	0.046	0.046	0.072	0.109
Cash flow/Assets	0.023	0.029	0.014	0.023	0.035
Market to book	1.936	1.312	1.198	1.516	2.131
Size	8.391	1.334	7.554	8.300	9.273
Net working capital/Assets	0.043	0.143	-0.031	0.031	0.123
Capital expenditure	0.033	0.035	0.009	0.021	0.044
R&D/Sales	0.027	0.052	0.000	0.000	0.028
Dividend dummy	0.572	0.495	0.000	1.000	1.000
Acquisition activity	0.022	0.037	0.000	0.002	0.025
Foreign pretax income	0.021	0.039	0.000	0.005	0.034

4.1. Changes in corporate cash holdings around CDS introduction

The summary statistics in Panel A of Table 1 suggest that there is an increase in the cash ratios of both CDS and non-CDS firms. To demonstrate that CDS firms experience a more significant increase in this ratio, we focus on changes in the cash ratio around the inception of CDS trading (defined as date 0). Fig. 1 depicts changes in the cash ratios of CDS and non-CDS firms from one year before the inception of CDS trading to zero (−1,0), one (−1,1), two (−1,2), and three (−1,3) years following the inception of CDS trading. Non-CDS matching firms are selected from a sample of firms that do not have CDS trading at any time during the entire sample period. For each CDS firm, we find a non-CDS matching counterpart that has a similar probability of CDS trading at the time of CDS introduction (we will discuss matching methods in Section 4.2 below; the results are similar if we match firms by industry and size). We observe an overall increasing trend in the cash ratio for both CDS and non-CDS firms; however, the increase is more pronounced for CDS firms. While the

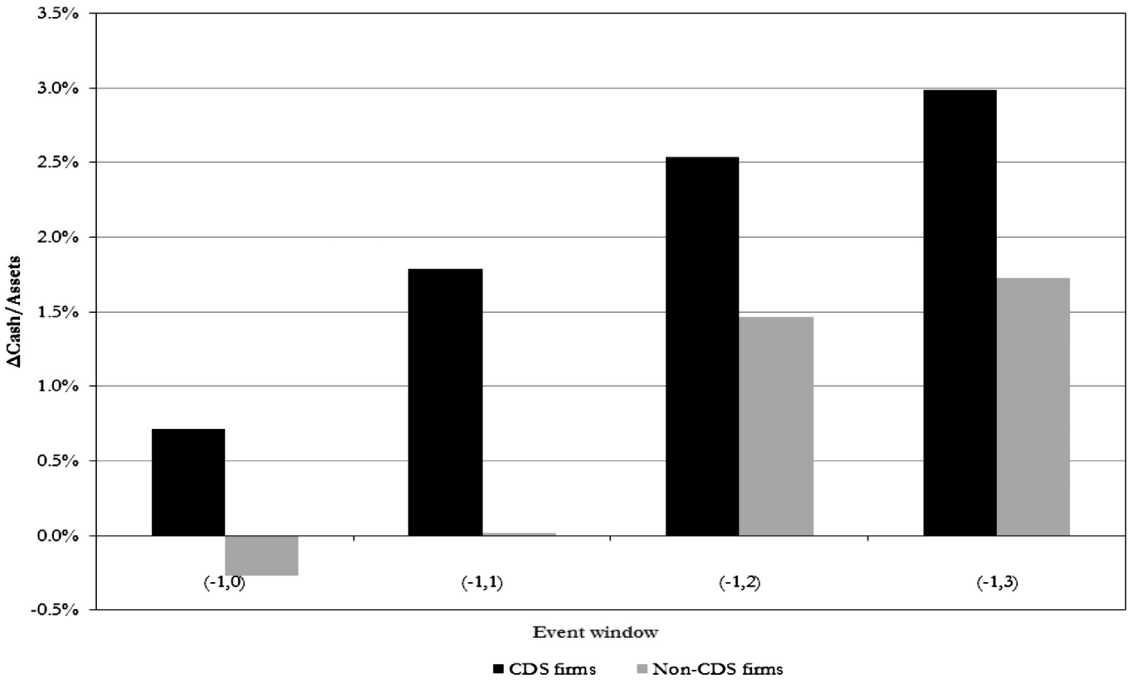

Fig. 1. Changes in cash ratios around the introduction of CDS. This figure plots the changes in cash ratios for firms with CDS and their corresponding matching firms, from one year before the inception of CDS trading to zero, one, two, and three years after the inception of CDS trading. Matching firms are selected based on propensity scores. For each CDS firm, we select a non-CDS matching firm based on propensity scores that measure the probability of CDS trading at the time of CDS introduction. Propensity scores are estimated from Model 3 of the probability of CDS trading presented in Internet Appendix Table A1 Panel A. See Section 4.2.1 for the discussion of the propensity-score-matched sample. The cash ratio is measured as the ratio of cash and marketable securities to total assets. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group.

cash ratio decreases slightly for non-CDS firms from year −1 to year 0, we observe a 0.7% increase in the cash ratio for CDS firms during the same period of time. From year −1 to year +3, the increase in cash holdings for CDS firms is 1.25% more than that for non-CDS matching firms. Given the mean cash ratio of 9.5% across CDS firms and their non-CDS matched firms, the 1.25% additional increase in the cash ratio for CDS firms is economically meaningful. Therefore, we obtain a preliminary indication from this figure that the increase in the cash ratio over the years is greater for CDS firms following the introduction of CDS trading, than for their non-CDS counterparts.

4.2. Impact of CDS trading on cash holdings

4.2.1. Propensity score matching

The endogeneity of CDS trading complicates the interpretation of the impact of CDS trading on cash holdings. It is possible that investors may anticipate a firm's increase in cash holdings and initiate CDS trading on it as a result. Of course, we control for firm fixed effects in all model specifications, thereby accounting for the time-invariant differences in characteristics between CDS and non-CDS firms, which may partially address this issue. However, it remains necessary to address the endogeneity issue directly. To that end, we implement alternative econometric methodologies, suggested by Li and Prabhala (2007) and Roberts and Whited (2012), to control for endogeneity. We use propensity score matching and an IV approach to estimate the CDS effect after controlling for the selection of firms into the CDS sample.

To implement these approaches, we first predict the presence of CDS trading for individual firms. Following Ashcraft and Santos (2009), Saretto and Tookes (2013), and Subrahmanyam, Tang, and Wang (2014), the prediction model for CDS trading is estimated utilizing a probit specification with a dependent variable that equals one after the introduction of CDS trading and zero otherwise. The CDS prediction models are reported in Internet Appendix Table A1 Panel A. Table A1 Panel A shows that CDS trading can be explained reasonably well by the explanatory variables, which have a pseudo-R^2 of approximately 38.9%. We further construct a propensity-score-matched sample based on the CDS prediction model: for each CDS firm, we find one non-CDS matching firm with a similar propensity score for CDS trading. Next, we run the cash-holdings analysis on this matched sample. In constructing our propensity-score-matched sample, we use four different propensity score matching criteria to choose matching firms: (1) the one non-CDS firm nearest the CDS firm in terms of propensity score; (2) the one non-CDS firm with a propensity score nearest the CDS firm's and within a difference of 1%; (3) the two non-CDS firms with propensity scores nearest the CDS firm's; and (4) the two non-CDS firms with propensity scores nearest the CDS firm's and within a difference of 1%.

Roberts and Whited (2012) discuss the "parallel trends" assumption, which requires "any trends in outcomes for

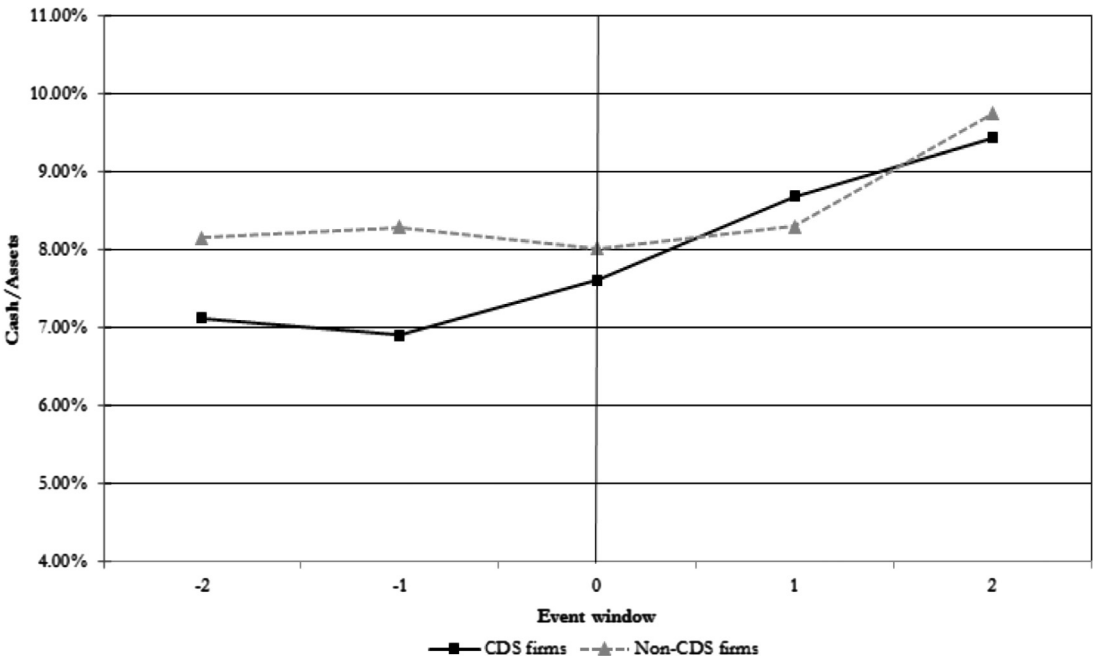

Fig. 2. Cash ratios for CDS firms and propensity-score-matched non-CDS firms. This figure plots cash ratios for firms with CDS and their corresponding matching firms, from two years before the inception of CDS trading to two years after the inception of CDS trading. For each CDS firm, we select a non-CDS matching firm based on propensity scores that measure the probability of CDS trading at the time of CDS introduction. Propensity scores are estimated from Model 3 of the probability of CDS trading presented in Internet Appendix Table A1 Panel A. See Section 4.2.1 for the discussion of the propensity-score-matched sample. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group.

the treatment and control groups prior to treatment to be the same." Given the central importance of this assumption to the difference-in-differences estimator, we first compare trends in cash ratios during the pre-treatment era. The results are presented in Fig. 2. We compare the cash holdings of CDS firms and their propensity-score-matched firms from two years prior to the CDS treatment to two years following treatment. We find that CDS firms have slightly lower cash ratios than non-CDS firms before treatment. Afterwards, CDS firms catch up with their matching firms and exhibit a larger increase in cash holdings. Importantly, there is no significant difference in the time-series trends of the cash ratios for CDS and non-CDS matching firms during the pre-treatment era. Following Roberts and Whited (2012), we also conduct a *t*-test of the difference in the average growth rates of the cash ratios of CDS and control firms prior to the treatment. The *t*-test results indicate that the cash growth rate difference is not statistically significant (*t*-statistic=−1.288) before CDS introduction. Therefore, it appears that the propensity-score-matched sample satisfies the parallel trends assumption.[14]

We then conduct the propensity score matching analysis. Unlike the case in which all non-CDS firms are included in the Compustat sample as the control group, firms in the restricted propensity-score-matched sample are more comparable with one another. Table 2 presents the regression results.[15] In all these specifications, the coefficient estimates for *CDS trading* are significantly positive, which indicates that corporate cash holdings increase after CDS trading has been introduced. The economic magnitudes are also substantial: For example, compared with the sample mean cash ratio of 9.5% for this restricted sample, the 2.6% change in cash holdings following the introduction of CDS, in the results using "nearest one" matching, represents a 27.4% increase in the mean cash ratio.[16]

The coefficients for the control variables in this propensity-score-matched sample are consistent with prior findings. As predicted, firms with high cash flow risk, as measured by *Industry sigma*, hold more precautionary cash. The negative sign of the coefficient for *Size* relates to economies of scale involved in holding cash: large firms hold proportionately less cash. The coefficient of *Capital*

[14] Internet Appendix Table A1 Panel B compares relevant characteristics between CDS firms and their propensity-score-matched non-CDS firms at the time of CDS introduction. We find that cash holdings, leverage, and distance-to-default for CDS firms and non-CDS propensity-score-matched firms are similar (i.e., statistically indistinguishable), suggesting that the matching method is appropriate. Although CDS firms are slightly larger in size than non-CDS firms, they have a similar probability of CDS trading on their debt at the time of CDS introduction.

[15] We use all four alternative propensity score matching criteria discussed above to assess the robustness of our propensity score matching results. Propensity scores are calculated based on Model 3 in Internet Appendix Table A1 Panel A. We also use all three CDS prediction models as a robustness check.

[16] We conduct a placebo test in the propensity-score-matched sample and present the results in Internet Appendix Table A2 Panel C. We use data from the 1980s, when there was no CDS trading, and perform the cash-holdings analysis using pseudo-CDS firms and their control groups. We find no effect of these artificial CDS introductions on cash holdings.

Table 2
CDS trading and cash holdings: propensity score matching.

This table presents the estimates of the effect of CDS on corporate cash holdings in a sample including firms with CDS and non-CDS propensity-score-matched firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. Propensity-score-matched firms are selected based on propensity scores estimated from Model 3 of the probability of CDS trading presented in Internet Appendix Table A1 Panel A. We use four different propensity score matching criteria to choose matching firms: (1) the one non-CDS firm nearest the CDS firm in terms of propensity score; (2) the one non-CDS firm with the propensity score nearest the CDS firm's and within a difference of 1%; (3) the two non-CDS firms with the propensity scores nearest the CDS firm's; and (4) the two non-CDS firms with the propensity scores nearest the CDS firm's and within a difference of 1%. To estimate the impact of CDS trading on the corporate cash holdings, we include CDS variables in the model specifications. *CDS trading* is a dummy variable that equals one if the firm has CDS traded on its debt one year before time *t*. The coefficient of interest is that of *CDS trading*, which captures the impact of the inception of CDS trading on cash holdings. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Cash			
	Nearest one matching	Nearest one PS diff< 1%	Nearest two matching	Nearest two PS diff< 1%
CDS trading	0.026***	0.025***	0.027***	0.027***
	(0.006)	(0.006)	(0.006)	(0.006)
Industry sigma	0.060	0.055	0.081	0.089**
	(0.044)	(0.038)	(0.050)	(0.043)
Cash flow/Assets	−0.008	−0.043	−0.010	−0.059
	(0.070)	(0.062)	(0.079)	(0.063)
Market to book	−0.001	−0.001	−0.000	−0.000
	(0.002)	(0.002)	(0.002)	(0.003)
Size	−0.025***	−0.022***	−0.027***	−0.021***
	(0.007)	(0.006)	(0.007)	(0.006)
Net working capital/Assets	−0.058	−0.054	−0.044	−0.040
	(0.055)	(0.049)	(0.060)	(0.048)
Capital expenditure	−0.166***	−0.170***	−0.176***	−0.185***
	(0.025)	(0.026)	(0.030)	(0.031)
Leverage	−0.048	−0.061*	−0.055	−0.062
	(0.039)	(0.036)	(0.048)	(0.041)
R&D/Sales	0.243**	0.246**	0.238*	0.242*
	(0.111)	(0.110)	(0.132)	(0.136)
Dividend dummy	−0.017	−0.017	−0.021*	−0.017*
	(0.010)	(0.010)	(0.011)	(0.009)
Acquisition activity	−0.181***	−0.151***	−0.188***	−0.136**
	(0.058)	(0.055)	(0.067)	(0.061)
Foreign pretax income	0.223***	0.213***	0.257***	0.248***
	(0.058)	(0.056)	(0.063)	(0.060)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
Clustered standard error	Yes	Yes	Yes	Yes
N	40668	36426	57684	48872
R^2	75.25%	74.57%	73.53%	72.81%

expenditure is negative and significant because capital expenditure creates assets that can be used as collateral for future borrowing, thus reducing the precautionary demand for cash holdings. As found in the previous literature, the sign of the *Leverage* coefficient is negative.[17] *R&D/Sales* is a measure of future growth opportunities. Firms with higher R&D expenditure incur greater costs as a result of financial constraints, because they must plan for future investment opportunities and, therefore, must hold more cash. The coefficient of *Acquisition activity* has the same sign as that for *Capital expenditure*, which is expected, as acquisitions and capital expenditure are likely to be substitutes for one another. Multinational firms with foreign income (*Foreign pretax income*) may seek to hold more cash due to taxes associated with repatriating foreign income, as documented in Foley, Hartzell, Titman, and Twite (2007).

We note that the propensity score matching approach is only effective in controlling for the *observable* differences in firm characteristics between the treatment and control groups. It is, however, possible that there is an unobservable variable that drives both the introduction of CDS trading and corporate cash holdings; if this supposition were true, then propensity score matching would not effectively address the endogeneity in this setting. In the next section, we seek to mitigate this concern by using the IV approach to address the endogeneity issue directly.

4.2.2. The IV approach

To allow for the possibility of time-varying unobserved heterogeneity across firms, we estimate a two-stage least squares (2SLS) model with IVs in which the indicator variable, *CDS trading*, is treated as endogenous. Specifically, cash holdings and the CDS contract status of a firm can

[17] Leverage and cash policies might be jointly determined. Firms may use cash to reduce leverage, and leverage might be a source of cash. We address possible simultaneous financing and liquidity management decisions in detail in Section 5.4.

be modeled as follows:

$$Cash = \boldsymbol{\beta}\mathbf{X} + \gamma_1 CDS\ trading + \boldsymbol{\delta}\mathbf{Y} + \epsilon,$$
$$CDS\ trading^{*} = \boldsymbol{\lambda}\mathbf{Z} + \omega,$$
$$CDS\ trading = 1, if\ CDS\ trading^{*} > 0;$$
$$\text{CDS trading} = 0, otherwise. \quad (1)$$

The dependent variable in the above specification is the cash ratio, which is measured by the ratio of cash and marketable securities to total assets. **X** is a vector of determinants of cash holdings, and **Y** is a vector of other controls, such as firm fixed effects. The coefficient of interest is γ_1, which captures the impact of CDS on corporate cash holdings. The instrumented variable *CDS trading** represents the latent propensity of a firm to have CDS trading introduced on its debt. In the above specification, *CDS trading* is allowed to be endogenous because $corr(\epsilon, \omega) \neq 0$. For identification, we include IVs that affect a firm's propensity for CDS introduction, but do not affect its cash holdings directly—other than through the impact of CDS introduction. Therefore, **Z** in Eq. (1) includes the IVs.

Our choice of IVs is motivated by both econometric and economic considerations. We use both *Lender FX usage* and *Lender Tier 1 capital* as instruments (Saretto and Tookes (2013) and Subrahmanyam, Tang, and Wang (2014) provide more details on the construction of these IVs). Econometrically, the relevance condition is met based on the results in Internet Appendix Table A1 Panel A, which show that CDS trading is significantly associated with *Lender FX usage* and the *Lender Tier 1 capital* ratio. The instruments we use are economically sound because they are associated with the overall hedging interest of lenders or credit suppliers. Specifically, lenders with larger hedging positions are generally more likely to trade the CDS of their borrowers. Moreover, banks with lower capital ratios have a greater need to hedge the credit risk of their borrowers via CDS.[18]

The fitted value of *CDS trading* is included in the second-stage analysis of the determinants of cash holdings. Table 3 presents the estimation results. To show the robustness of our results, we present IV results for each IV separately and the two IVs jointly. In Model 1, we only employ *Lender FX usage* as the IV. In Model 2, *Lender Tier 1 capital* is the IV. In Model 3, we use both *Lender FX usage* and *Lender Tier 1 capital* as instruments. We find that *Instrumented CDS trading* has positive and significant coefficient estimates in all model specifications, suggesting that the presence of CDS contracts leads to higher cash ratios even after it has been ensured that the key independent variable is identified. Therefore, the evidence supports a causal interpretation of the effect of CDS trading on corporate cash holdings.[19]

Table 3
CDS trading and cash holdings: an instrumental variable approach.

This table presents the second-stage estimation of the two-stage IV estimation results. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. The second-stage analysis looks at the impact of CDS on corporate cash holdings in a sample including firms with CDS and all non-CDS firms in Compustat. In Model 1, we employ *Lender FX usage* as the IV, which is a measure of the FX hedging activities carried out by the firm's lending banks and underwriters. In Model 2, *Lender Tier 1 capital* is the IV, which measures the Tier 1 capital ratio of the bank lenders. In Model 3, we use both *Lender FX usage* and *Lender Tier 1 capital* as instruments. The coefficient of interest is that of *Instrumented CDS trading*, which captures the impact of the inception of CDS trading on cash holdings. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Cash		
	(1)	(2)	(3)
Instrumented CDS trading	0.062***	0.038**	0.045**
	(0.023)	(0.016)	(0.019)
Industry sigma	0.077***	0.076***	0.076***
	(0.016)	(0.016)	(0.016)
Cash flow/Assets	0.065***	0.068***	0.068***
	(0.009)	(0.009)	(0.009)
Market to book	0.008***	0.008***	0.008***
	(0.001)	(0.001)	(0.001)
Size	−0.009***	−0.010***	−0.010***
	(0.001)	(0.001)	(0.001)
Net working capital/Assets	−0.046***	−0.046***	−0.046***
	(0.004)	(0.004)	(0.004)
Capital expenditure	−0.211***	−0.207***	−0.206***
	(0.012)	(0.012)	(0.012)
Leverage	−0.083***	−0.083***	−0.083***
	(0.005)	(0.005)	(0.005)
R&D/Sales	0.200***	0.199***	0.199***
	(0.014)	(0.014)	(0.014)
Dividend dummy	0.006***	0.006***	0.006***
	(0.002)	(0.002)	(0.002)
Acquisition activity	−0.198***	−0.192***	−0.190***
	(0.013)	(0.014)	(0.013)
Foreign pretax income	0.004*	0.004*	0.004*
	(0.002)	(0.002)	(0.002)
Time fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
Clustered standard error	Yes	Yes	Yes
N	307672	307672	307672

5. Mechanisms and sources of cash

The results, thus far, suggest that firms increase their cash holdings following the introduction of CDS trading on their debt. However, CDS can change creditors' incentives in multiple ways. Ex ante, when a firm is far from distress, creditors with access to CDS protection are more willing to lend based on the risk mitigation effect of CDS, which also weakens creditors' monitoring incentives. Ex post, when the firm is in distress, empty creditors tend to be tougher and are incentivized to push the firm into bankruptcy, i.e., the exacting creditor effect. These diverse empty creditor incentives have different effects on firms' behavior. Whereas the exacting creditor effect predicts more

[18] It is notable that the instruments we use are not weak: We find that the Sargan *F*-test statistics are above 10.0 for both IVs, thus strongly rejecting the hypothesis of weak instruments.

[19] Instead of using the regime variable, *CDS trading*, which equals one after CDS trading was introduced, we utilize detailed information about the notional amount of CDS contracts outstanding to construct a continuous measure of CDS exposure and present the results in Internet Appendix Table A3. Firms with greater relative proportions of outstanding CDS are likely to demonstrate the CDS effect more strongly. The analysis is conducted using the CDS sample, and we again find a significant and positive coefficient estimate for *CDS outstanding/Total debt*. These findings suggest that greater CDS exposure leads to higher corporate cash holdings.

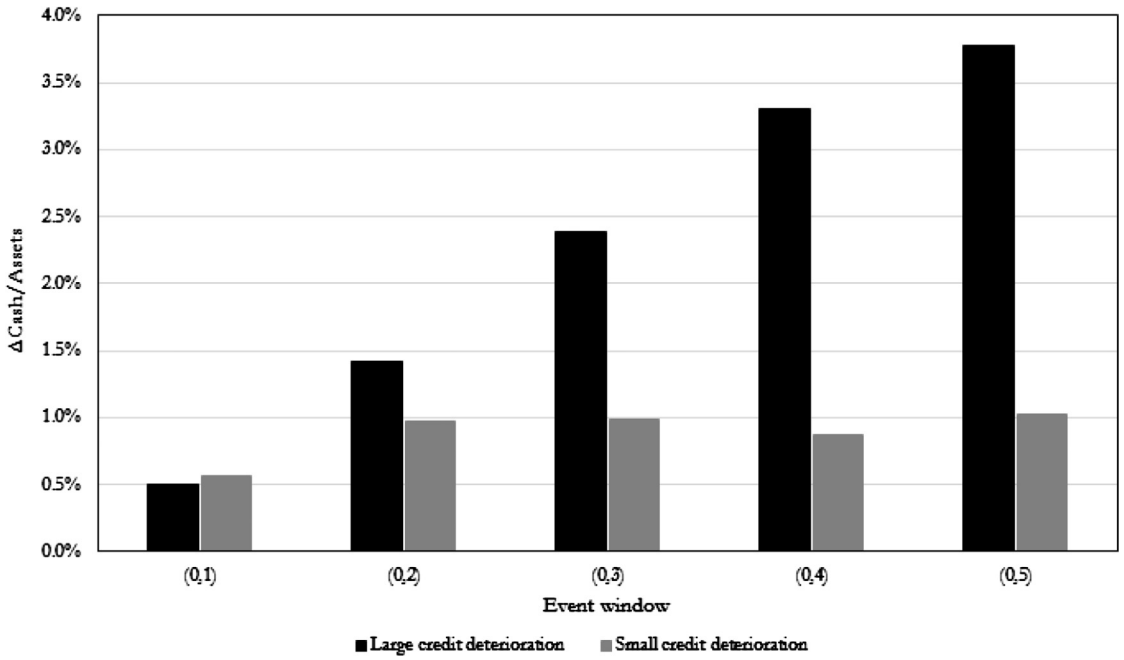

Fig. 3. Credit quality deterioration and cash holdings. This figure compares cash ratios for CDS firms with large credit quality deterioration and small credit quality deterioration. Large credit deterioration firms are CDS firms whose credit ratings were downgraded more than twice within the five years after CDS introduction. Among the 879 CDS firms with S&P credit ratings in Compustat, we identified 212 CDS firms as having large credit deterioration. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group.

conservative liquidity policies, there are other implications associated with reduced monitoring by creditors. The decreased monitoring incentives of empty creditors may induce CDS firms to take on more risk in the form of a lower liquidity cushion. In addition to the risk-taking effect, governance by other parties may offset the effect of decreased monitoring by creditors. For instance, internal governance may be strengthened to compensate for the lack of monitoring by creditors. Moreover, weakened monitoring may further affect the cost of debt (Ashcraft and Santos, 2009; Che and Sethi, 2014), which increases precautionary cash savings. In this section, we investigate the mechanisms of CDS effects and compare the ex ante and ex post effects of empty creditors based on the tension in the relationship between cash holdings and CDS trading.

5.1. Firms' precautionary considerations

In this section, we identify settings in which the ex post effects of empty creditors (i.e., exacting creditor effects) dominate the ex ante effects of decreased monitoring. We expect a greater increase in cash holdings under these conditions. When making the optimal cash holdings decision, corporate managers compare ex ante decreased monitoring effects with ex post exacting creditor effects, and consider the marginal value of liquidity. When the marginal value of liquidity is high, firms have a greater precautionary demand for cash holdings and are, therefore, more concerned about exacting empty creditors. Hence, in this case, it is more likely that the ex post effects of empty creditors will dominate the potential ex ante effects of decreased monitoring.

5.1.1. Credit quality deterioration

Firms nearing financial distress have a higher marginal value of liquidity and a greater precautionary demand for cash. The managers of such firms are more concerned about exacting empty creditors. Therefore, the exacting creditor effects are expected to dominate in this scenario. To investigate these effects, we first compare cash holdings of CDS firms that have suffered a large deterioration in credit quality with cash holdings of CDS firms that have suffered a small deterioration. The results are presented in Fig. 3. Firms with large deteriorations in credit quality are defined as the subsample of CDS firms whose credit ratings were downgraded more than twice within five years of CDS introduction. Among the 879 CDS firms with an S&P credit rating in Compustat, we identify 212 CDS firms as having experienced a large deterioration in credit quality. We then compare the changes in the cash ratios of firms in the large and small deterioration groups from the CDS introduction date to one, two, three, four, and five years after it. Compared with CDS firms with small deteriorations in credit quality, CDS firms with large deteriorations in credit quality exhibit greater increases in their cash ratios after the introduction of CDS trading. From the CDS introduction year to five years thereafter, the increase in the cash ratios of CDS firms with larger deteriorations in credit quality is 2.7% more than that for CDS firms with small deteriorations in credit quality.

We next conduct an analysis of cash holdings in the subsample of distressed firms. Following Gilson, John, and Lang (1990) and Demiroglu and James (2015), we classify a firm as financially distressed if its stock return is in the bottom 5% of the market for two consecutive years. Us-

Table 4
Effect of CDS in the distressed sample.

This table presents the estimates of the effect of CDS on corporate cash holdings in a sample of distressed firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. If a firm's stock return is in the bottom 5% of the market for two consecutive years, we classify it as a financially distressed firm. We identify 684 distressed firms, 18 of which are CDS firms. In the first model, we conduct the cash-holdings analysis in the distressed sample. The sample period is 1997–2009, based on quarterly observations. In the second model, we keep observations from five years prior to distress until the distress year. *Distress* is a dummy variable that equals one for the distress year. This allows us to compare cash holdings for distressed firms in the year leading up to distress relative to that in the five years prior to distress. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Cash	
	Whole period	Distress window[-5y,0]
CDS trading	0.056**	0.078**
	(0.026)	(0.035)
CDS trading× Distress		0.047**
		(0.022)
Distress		0.010
		(0.007)
Industry sigma	0.153**	0.062
	(0.061)	(0.099)
Cash flow/Assets	0.038	−0.010
	(0.028)	(0.035)
Market to book	0.007***	0.005**
	(0.002)	(0.002)
Size	−0.011***	−0.011**
	(0.004)	(0.005)
Net working capital/Assets	−0.044***	−0.060***
	(0.015)	(0.022)
Capital expenditure	−0.260***	−0.263***
	(0.060)	(0.068)
Leverage	−0.105***	−0.054***
	(0.016)	(0.020)
R&D/Sales	0.308***	0.360***
	(0.037)	(0.057)
Dividend dummy	0.008	0.013
	(0.016)	(0.024)
Acquisition activity	−0.212***	−0.232***
	(0.069)	(0.086)
Foreign pretax income	0.011***	0.137**
	(0.003)	(0.059)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
Clustered standard error	Yes	Yes
N	19993	8446
R^2	72.65%	81.31%

ing this definition, we identify 684 distressed firms, 18 of which are CDS firms. We then conduct the cash-holdings analysis in this distressed subsample. As shown in the second column of Table 4, among all financially distressed firms, cash holdings increased by 5.6% for distressed CDS firms, which is greater in magnitude than the 2.6% increase for CDS firms in the baseline model of the full sample (see Table 2). To investigate time-series effects, in the third column of Table 4, we retain observations from five years prior to distress until the distress event, [-5y, 0]. *Distress* is a dummy variable that equals one in the distress year and zero otherwise. This allows us to compare the cash holdings of distressed firms in the year leading up to distress, to the holdings in the five years prior to distress. We find a positive coefficient for *CDS trading× Distress*, indicating an increase in cash holdings leading up to the distress date for firms with CDS during this five-year window. As a robustness check, we also select firms in the bottom 10% of stock returns for two consecutive years as an alternative financial distress sample. The results are robust to the alternative selection criterion. Therefore, these time-series results augment our cross-sectional findings and are consistent with our main theme that firms hold more cash after CDS trading begins, due to concerns about exacting creditors, when credit quality deteriorates.

5.1.2. Dividend payout

We next investigate the CDS effect for dividend-paying firms and their non-dividend-paying counterparts, using dividend payout as a proxy for the marginal value of liquidity. Based on the cash inventory management model of Miller and Orr (1966), the results in Bolton, Chen, and Wang (2011,2014) show that a firm's cash policy involves a double-barrier policy characterized by the marginal value of liquidity, and continuous management between barriers. At the upper barrier (i.e., in the payout region), the marginal value of cash is low. Threats from empty creditors are minimal because the firm has adequate liquidity, and thus, it is less optimal for the firm to accumulate even more cash. These firms may have greater incentives to take on more risk in the form of a lower liquidity cushion after a decrease in creditor monitoring. Therefore, we expect the ex post effects of empty creditors to be less important for dividend payers. For nonpayers of dividends, the marginal value of cash is higher, so that such firms may have greater incentives to increase their cash holdings due to precautionary motives. Thus, the ex post effects of empty creditors may dominate for these dividend nonpayers.

Table 5 provides the estimation results, which are consistent with these predictions. Firms are classified into *Dividend nonpayers* and *Dividend payers*, based on dividend payment information from Compustat for the three years preceding the CDS introduction date. We separate firms based on pre-determined dividend information, owing to the potential simultaneity between cash holdings and dividends. As a robustness check, we also use alternative year observations to identify the pre-determined dividend policy. Cash-holdings models are then separately estimated for *Dividend nonpayers* and *Dividend payers*. The second and third columns in this table report the findings for firms that do not pay dividends, and those that do, respectively. As expected, the coefficients for *CDS trading* are significantly positive in the cash model for nonpayers of dividends, which have a higher precautionary demand for cash holdings and are more concerned about exacting creditors. For dividend payers, CDS trading does not significantly affect cash holdings, which is consistent with the prediction that the value of cash is low for firms in the dividend-payout region. We further test for the difference between the coefficients of *CDS trading* for *Dividend nonpayers* and *Dividend payers*, respectively, in Table 5. We find that the two groups' coefficients are significantly different from one another ($\chi^2 = 10.01$, p-value< 0.01). Hence, the findings in Table 5 are supportive of Hypothesis 2.

Table 5
Dividend payout and the CDS effects on cash holdings.

This table presents the estimates of the effect of CDS on corporate cash holdings in a sample including firms with CDS and non-CDS propensity-score-matched firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. Firms are separated into *Dividend nonpayers* and *Dividend payers* based on dividend payment information three years before the CDS introduction date. The coefficient of interest is that of *CDS trading*, which captures the impact of the inception of CDS trading on cash holdings. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Cash	
	Dividend nonpayers	Dividend payers
CDS trading	0.034***	0.005
	(0.006)	(0.007)
Industry sigma	0.099	−0.021
	(0.062)	(0.033)
Cash flow/Assets	0.042	−0.194
	(0.068)	(0.142)
Market to book	0.000	−0.012
	(0.002)	(0.008)
Size	−0.029***	−0.007
	(0.007)	(0.005)
Net working capital/Assets	−0.033	−0.115***
	(0.058)	(0.036)
Capital expenditure	−0.197***	−0.120***
	(0.037)	(0.030)
Leverage	0.026	−0.165***
	(0.036)	(0.050)
R&D/Sales	0.215*	0.261***
	(0.127)	(0.088)
Dividend dummy	−0.000	−0.036**
	(0.006)	(0.017)
Acquisition activity	−0.199***	−0.057
	(0.053)	(0.040)
Foreign pretax income	0.222**	0.197***
	(0.089)	(0.050)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
Clustered standard error	Yes	Yes
N	22633	18035
R^2	76.53%	57.27%

5.2. Risk shifting and monitoring

We further examine the risk-shifting incentives of the borrower, and condition the CDS effect on banks' monitoring incentives. We identify settings in which firms have greater risk-shifting incentives, and are more strongly affected by decreased bank monitoring. If risk-shifting and bank-monitoring effects dominate ex post exacting creditor effects, we expect a decrease in cash holdings after CDS trading begins.

5.2.1. Financial constraints

Financially distressed firms may have greater risk-shifting incentives than normal firms (Eisdorfer, 2008). Such borrowers may engage in risk shifting in the form of a lower liquidity cushion following a decrease in creditor monitoring, particularly when they are closer to financial distress or are operating under stringent financial constraints. However, the exacting creditor and monitoring arguments may yield contradictory predictions in this scenario. The exacting creditor implication of the empty creditor theory is that more financially constrained firms may be more concerned about the impact of CDS trading. Almeida, Campello, and Weisbach (2004) find that firms facing greater capital market frictions, i.e., financially constrained firms, are more likely to retain more cash from their free cash flows. Similarly, because financially constrained firms have fewer alternative external financing options when their lenders become exacting CDS-protected creditors, they tend to build up greater cash holdings after CDS trading is introduced on their debt. Therefore, if the decreased monitoring effect dominates, we expect the cash holdings of financially constrained firms to be negatively affected by CDS trading.

Table 6 examines the impact of CDS trading on cash holdings, conditional on firms' financial constraints. Following previous literature, firms are separated into constrained and unconstrained categories based on their financial constraint index. Both the *KZ index* (proposed by Kaplan and Zingales (1997)) and the *WW index* (proposed by Whited and Wu (2006)) are used to measure the tightness of financial constraints facing a firm: the higher the index value, the more financially constrained the firm. Next, we conduct the cash-holdings analysis and compare the behavior of financially constrained and financially unconstrained firms. Again, the variable of interest is *CDS trading*, which captures the CDS trading impact and is conditional on a firm's financial constraints. We find that CDS trading increases the cash holdings of both financially constrained and unconstrained firms, with a slightly higher increase for financially constrained firms.[20] Therefore, the positive sign of CDS trading for constrained firms indicates that the decreased monitoring effect is not the dominant mechanism. Hence, the results are consistent with the *exacting creditor* mechanism.

5.2.2. Bank-loan dependency

Bank lenders play an important role in monitoring firms (as argued by Hadlock and James (2002)); hence, bank-loan dependency can be used as a proxy for the extent of creditor monitoring.[21] We implement this measure of firms' dependence on bank debt, based on Capital IQ data, and condition the cash-holdings analysis on this bank-loan dependency measure. The monitoring channel discussed earlier predicts that the decreased monitoring of creditors after the introduction of CDS trading may induce firms to take more risk in the form of a lower liquidity cushion. Given the importance of bank lenders in credit monitoring, the

[20] When we test for the difference in the coefficients across subsamples, we cannot reject the null hypothesis that the coefficients for CDS trading are statistically similar for constrained and unconstrained firms at the 5% level. The insignificant difference may be due to the offsetting effect of the risk-shifting channel, which predicts a greater decrease in cash holdings for constrained firms. Overall, the positive impact of CDS trading on cash holdings is consistent with the dominant effect of the *exacting creditor* argument.

[21] We thank the referee for suggesting this measure. We measure the ratio of bank debt to total debt, based on debt structure information from Capital IQ. In our sample of CDS firms and their propensity-score-matched counterparts, the mean ratio of bank debt to total debt is 0.25, and the median is zero, with a standard deviation of 0.38. Our measure is similar to those in existing studies such as Colla, Ippolito, and Li (2013) and Saretto and Tookes (2013).

Table 6
CDS trading and cash holdings: financial constraints.

This table presents the estimates of the effect of CDS on corporate cash holdings in a sample including firms with CDS and non-CDS propensity-score-matched firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. Firms are separated into *Constrained* and *Unconstrained* categories based on their financial constraint index. Both the KZ index (Kaplan and Zingales, 1997) and the WW index (Whited and Wu, 2006) are used as measures of financial constraints. The coefficient of interest is that of *CDS trading*, which captures the impact of the inception of CDS trading on cash holdings. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Cash			
	KZ index		WW index	
	Unconstrained	Constrained	Unconstrained	Constrained
CDS trading	0.012***	0.024***	0.016***	0.024***
	(0.005)	(0.006)	(0.004)	(0.008)
Industry sigma	0.001	0.073	0.007	0.128**
	(0.042)	(0.064)	(0.040)	(0.057)
Cash flow/Assets	−0.184	0.073	0.058	−0.060
	(0.113)	(0.063)	(0.046)	(0.081)
Market to book	0.001	−0.001	0.002	−0.002
	(0.002)	(0.003)	(0.002)	(0.004)
Size	−0.014***	−0.025***	−0.010***	−0.023***
	(0.005)	(0.008)	(0.004)	(0.007)
Net working capital/Assets	−0.048**	−0.029	−0.020	−0.076
	(0.022)	(0.064)	(0.032)	(0.049)
Capital expenditure	−0.051	−0.170***	−0.086***	−0.200***
	(0.032)	(0.031)	(0.029)	(0.034)
Leverage	−0.020	−0.035	−0.070	−0.061*
	(0.029)	(0.039)	(0.062)	(0.034)
R&D/Sales	0.476***	0.227**	0.168	0.210*
	(0.137)	(0.103)	(0.126)	(0.124)
Dividend dummy	−0.024*	−0.027*	−0.019**	−0.020
	(0.013)	(0.015)	(0.007)	(0.019)
Acquisition activity	−0.081**	−0.216**	−0.095***	−0.157***
	(0.037)	(0.085)	(0.030)	(0.060)
Foreign pretax income	0.150*	0.141**	0.145***	0.224***
	(0.076)	(0.068)	(0.044)	(0.071)
Time fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
Clustered standard error	Yes	Yes	Yes	Yes
N	19766	20902	20279	20389
R^2	78.3%	72.4%	80.46%	71.2%

decreased monitoring effect after CDS introduction is expected to be more pronounced for firms with bank debt. The corporate managers of these firms will make their cash-holding decisions by balancing their "risk-taking incentive" that is due to the decreased monitoring by creditors against their "precautionary demand for liquidity" that is due to the exacting creditor threat. For firms without bank debt, the decreased monitoring effect is less pronounced, and corporate managers' decisions are affected more by the exacting creditor threat. This is partially confirmed in our empirical analysis; as shown in Table 7, we find that CDS trading increases corporate cash holdings by 3.3% for firms *Without bank debt*. However, the effect is not significant for firms *With bank debt*. The insignificant effect of CDS trading on cash holdings for firms *With bank debt* is consistent with the decreased monitoring channel, which may offset the increased precautionary demand for cash holdings due to exacting empty creditors. Therefore, we find evidence that the ex post effect of empty creditors dominates the potential ex ante effect of decreased monitoring in the overall sample, especially for the subsample of firms without bank debt.

In addition to the risk-taking incentive, the decreased monitoring effect may also predict an increase in cash holdings. As discussed earlier, firms' borrowing costs may be higher due to decreased monitoring after CDS trading (Ashcraft and Santos, 2009; Che and Sethi, 2014), which further increases their precautionary cash savings. Therefore, the monitoring mechanism can affect the firms' cash holdings through both increased risk taking (implying a decrease in cash holdings) and increased borrowing costs (implying an increase in cash holdings). Given the importance of bank lenders in monitoring, the increase in cash holdings due to decreased monitoring/increased borrowing costs should be more relevant for firms with bank debt. However, we find that the increase in cash holdings after CDS introduction is only significant for firms without bank debt. Therefore, the results in Table 7 also indicate that the increased borrowing cost channel is not the driving force behind the cash increase.

We also explore the distinctive role of monitoring from the perspective of corporate governance. Corporate governance is another factor that may restrict the risk-taking behavior of borrowers. We expect CDS firms with better governance to be less affected by relaxed bank monitoring after CDS introduction and to exhibit a larger increase in cash holdings. We find evidence (as documented in Internet Appendix Table A4) that firms with poor corporate

Table 7
CDS trading and cash holdings: bank-loan dependency.

This table presents the estimates of the effect of CDS on corporate cash holdings in a sample including firms with CDS and non-CDS propensity-score-matched firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. Firms are separated into *With bank debt* and *Without bank debt* categories based on bank-loan dependency information from Capital IQ. The coefficient of interest is that of *CDS trading*, which captures the impact of the inception of CDS trading on cash holdings. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Cash	
	With bank debt	Without bank debt
CDS trading	0.007	0.033***
	(0.005)	(0.009)
Industry sigma	−0.053	0.144**
	(0.034)	(0.070)
Cash flow/Assets	−0.092	0.046
	(0.113)	(0.079)
Market to book	−0.001	−0.001
	(0.004)	(0.002)
Size	−0.031**	−0.023***
	(0.014)	(0.007)
Net working capital/Assets	−0.089**	−0.052
	(0.045)	(0.068)
Capital expenditure	−0.019	−0.165***
	(0.035)	(0.033)
Leverage	−0.012	−0.052
	(0.039)	(0.046)
R&D/Sales	0.480**	0.024
	(0.200)	(0.142)
Dividend dummy	−0.014	−0.013
	(0.010)	(0.012)
Acquisition activity	−0.071**	−0.252***
	(0.035)	(0.078)
Foreign pretax income	0.159***	0.322***
	(0.053)	(0.123)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
Clustered standard error	Yes	Yes
N	18141	22527
R^2	65.56%	77.16%

governance exhibit smaller increases in cash holdings after the introduction of CDS trading.[22] Therefore, the evidence is consistent with ex ante decreased monitoring effects and good governance, but the overall effect is dominated by precautionary considerations and ex post empty creditor effects.

5.3. The sources of increases in cash holdings

When there are external financing costs, corporate financial policies regarding leverage and liquidity are intertwined (Bolton, Chen, and Wang, 2011). In this setting, cash cannot simply be regarded as negative debt. Depending on the marginal value of liquidity, firms may prefer to issue additional debt and save the proceeds as cash holdings when their hedging needs are high (as argued by Acharya, Almeida, and Campello (2007)). For a given level of net debt, a high debt–high cash strategy better positions

[22] We use the entrenchment index (E-index) of Bebchuk, Cohen, and Ferrell (2009) to measure corporate governance.

Table 8
Source of cash and long-term debt issuance.

In this table, we jointly estimate the marginal cash savings and debt issuance decisions, in the samples of CDS firms and propensity-score-matched non-CDS firms, respectively. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. $\Delta Debt$ is the ratio of the net long-term debt issuances to the total book value of assets, and $\Delta Cash$ is the change in the holdings of cash and other marketable securities divided by total assets. *Lag debt* and *Lag cash* are lagged levels of long-term debt and cash holdings scaled by total assets. The sample period is 1997–2009, based on annual observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	CDS firms		Non-CDS firms	
	$\Delta Debt$	$\Delta Cash$	$\Delta Debt$	$\Delta Cash$
Cash flow/Assets	0.205***	0.163***	0.067	0.322***
	(0.038)	(0.014)	(0.047)	(0.015)
Market to book	0.007***	0.001	−0.001	−0.001
	(0.003)	(0.001)	(0.002)	(0.001)
Size	−0.034***	−0.006***	−0.031***	−0.023***
	(0.003)	(0.001)	(0.004)	(0.002)
$\Delta Cash$	0.159*		0.568***	
	(0.096)		(0.102)	
Lag debt	0.320***		0.489***	
	(0.016)		(0.018)	
$\Delta Debt$		0.093***		0.005
		(0.020)		(0.017)
Lag cash		−0.259***		−0.239***
		(0.010)		(0.011)
N	6281	6281	5123	5123
R^2	44.06%	22.74%	44.8%	33.02%

firms to be in a lower credit risk region than does a low debt–low cash strategy (as suggested by Bolton, Chen, and Wang (2014)). Moreover, under stochastic financing conditions, firms have both a precautionary savings motive and a market timing motive. Firms may time the market and obtain external financing during favorable market conditions (in a period of low external financing costs) even when there is no immediate need for external funds (as argued by Bolton, Chen, and Wang (2013)). Eisfeldt and Muir (2014) also predict a positive relationship between debt issuance and accumulated liquidity. Firms raise external financing and use it for liquidity accumulation when the cost of their external financing is low or the benefit they gain from liquidity accumulation is high. Under this unified framework of corporate policies, we expect CDS firms to time their financing decisions by borrowing more, ex ante, under favorable borrowing conditions in the market, and to simultaneously increase their cash holdings due to precautionary motives, i.e., to be characterized by both high leverage and high cash holdings after the introduction of CDS.

We investigate whether debt issuance is an important source of cash holdings for CDS firms. In Table 8, we jointly estimate the marginal cash savings and debt issuance decisions of CDS firms and non-CDS firms, respectively. $\Delta Debt$ is the ratio of net long-term debt issuances to the total book value of assets, and $\Delta Cash$ is the change in holdings of cash and other marketable securities divided by total assets. We follow the previous literature, such as Acharya, Almeida, and Campello (2007), and use *Cash flow/Assets, Market to book, Size*, and *Lag debt* or *Lag cash* (i.e., lagged levels of long-term debt and cash

holdings scaled by total assets) as controls. The results indicate that both cash flow and long-term debt issuances are important sources of cash for CDS firms, as evidenced by the positive and significant coefficients for *Cash flow/Assets* and $\Delta Debt$ (0.163 and 0.093, respectively). Increased cash flow augments debt capacity, whereas long-term debt issuance significantly increases cash holdings. However, for non-CDS firms, the main source of cash is operating cash flow, as shown by the significant and positive coefficient for cash flow (0.322). Moreover, the coefficient for $\Delta Debt$ is insignificant (0.005) in the change-in-cash model for non-CDS firms. Therefore, long-term debt issuance does not appear to significantly increase the cash holdings of non-CDS firms.

5.4. The joint effect of CDS trading on corporate finance

The financing and liquidity management policies of firms are likely to be jointly determined. We investigate the joint CDS effects on cash and leverage using a simultaneous equations system in this section, to shed light on the overall effects of CDS on corporate finance in the unified framework.

5.4.1. Cash and leverage

Our finding of an increase in cash holdings following introduction of CDS trading may imply a decrease in leverage because firms may wish to preserve their debt capacity for future contingencies if cash is, in fact, negative debt. However, Saretto and Tookes (2013) and Subrahmanyam, Tang, and Wang (2014) find that firm leverage is higher after the inception of CDS trading. To understand the joint effect of CDS on leverage and cash, we further estimate the leverage and cash equations simultaneously using 2SLS procedures. In the leverage equation, we include *Cash*, based on the idea that firms may use cash to pay down leverage. In the cash equation, *Leverage* is included because additional leverage might be a source of cash. In addition to the conventional determinants of leverage and cash holdings, we also add industry variables for identification in the simultaneous equations model. As discussed in Saretto and Tookes (2013), the potential simultaneity of corporate policies is expected to occur at the firm level. The theoretical link between cash and leverage comes from the firm's marginal value of liquidity. When the marginal value of liquidity is low, firms may prefer to preserve their debt capacity for future contingencies. In this setting, cash is, in fact, negative debt. When the marginal value of liquidity is high, firms may issue more debt and save part of the proceeds as cash holdings (high leverage and high cash), suggesting cash is *not* equivalent to negative debt consistent with Acharya, Almeida, and Campello (2007). Industry leverage (cash holdings) should not affect the cash-holdings (leverage) decisions of individual firms, after the firm-level variables have been controlled for. Therefore, *Industry leverage* is included in the leverage model, but excluded from the cash model. Similarly, *Industry cash* is included in the cash model, but excluded from the leverage model.

Table 9 reports the estimated coefficients of the leverage and cash models. We find that cash and leverage policies are indeed intertwined, as evidenced by the significant coefficients for cash and leverage in the simultaneous equations model. More importantly, both cash and leverage increase following the introduction of CDS trading in the joint estimation. The coefficients for *CDS trading* are positive and statistically significant in both the leverage and cash models. These results suggest the presence of substitution effects between leverage and cash holdings (i.e., less conservative leverage but more conservative cash holdings). The evidence for this is consistent with the argument that cash is not negative debt. Moreover, the magnitudes of the coefficients are economically significant, with a larger increase in leverage than in the cash ratio (0.040 and 0.018, respectively).

In sum, the results in this section indicate that CDS trading increases both firm leverage and cash holdings, suggesting that cash is not equivalent to negative debt.

Table 9
Simultaneous effect of CDS on leverage and cash.

This table presents the estimates of the simultaneous effect of CDS on corporate leverage and cash holdings in a sample including firms with CDS and non-CDS propensity-score-matched firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. The leverage and cash equations are estimated simultaneously by two-stage least squares procedures. The coefficient of interest is that of *CDS trading*, which captures the impact of the inception of CDS trading on cash holdings and leverage. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Leverage	Cash
CDS trading	0.040***	0.018***
	(0.002)	(0.003)
Cash	−0.582***	
	(0.069)	
Industry leverage	0.147***	
	(0.018)	
Leverage		0.173*
		(0.095)
Industry cash		0.401***
		(0.030)
Industry sigma	0.002	0.029***
	(0.013)	(0.009)
Cash flow/Assets	−0.224***	0.050*
	(0.021)	(0.026)
Market to book	−0.014***	0.002*
	(0.001)	(0.001)
Size	−0.028***	−0.024***
	(0.002)	(0.001)
Net working capital/Assets	−0.050***	−0.035***
	(0.007)	(0.005)
Capital expenditure	−0.191***	−0.125***
	(0.021)	(0.016)
R&D/Sales	−0.004	0.271***
	(0.030)	(0.022)
Dividend dummy	−0.023***	−0.012***
	(0.002)	(0.002)
Acquisition activity	0.077***	−0.209***
	(0.019)	(0.019)
Foreign pretax income	-0.050**	0.232***
	(0.023)	(0.020)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
Clustered standard error	Yes	Yes
N	40293	40293
R^2	71.46%	69.05%

Debt issuance is an important source of cash for CDS firms. On average, the increase in leverage after CDS trading begins is greater than that in cash holdings.[23]

5.4.2. Cash flow risk

CDS trading increases leverage due to an increased credit supply (Saretto and Tookes, 2013). However, the effect of CDS trading on corporate policies also depends on firms' demand for leverage and precautionary cash savings. Cash flow risk can be used as a proxy for a firm's demand for both leverage and cash.

A unique and surprising prediction of the Bolton, Chen, and Wang (2014) model concerns the firm's response to cash flow volatility. In that model, conditional on debt financing, financially constrained firms would raise their debt levels to increase their cash buffers in response to an increase in their cash flow volatility. For CDS firms with high cash flow risk, the demand for debt is lower. When cash flow volatility reaches sufficiently high levels, "debt financing becomes more costly than equity due to the toll of debt servicing costs on corporate liquidity" (Bolton, Chen, and Wang, 2014). Therefore, an increase in cash flow risk reduces the demand for leverage. With high cash flow risk, the marginal value of liquidity is that much greater. Firms may choose to build larger cash reserves to reduce the probability of liquidation. Thus, an increase in cash flow risk increases the demand for precautionary cash holdings. We therefore expect CDS firms with greater cash flow risk to exhibit smaller increases in leverage but larger increases in cash holdings.

To investigate the effects of cash flow volatility, we include *Cash flow volatility* and the interaction term *CDS trading*× *Cash flow volatility* in the simultaneous equations model. The estimation results are presented in Table 10, where we measure *Cash flow volatility* for each firm. We find that CDS trading increases both leverage and cash. Moreover, the positive association between CDS trading and cash holdings increases with firms' cash flow risk. The coefficient for the interaction term *CDS trading*× *Cash flow volatility* is positive and significant in the cash model, which is consistent with our expectations, because the value of cash is higher for firms with greater cash flow risk (and thus a higher precautionary demand for cash). However, the effect of CDS on leverage decreases with cash flow risk. The coefficient for the interaction term *CDS trading*× *Cash flow volatility* in the leverage model is −0.055, which is also statistically significant. These findings are consistent with the predictions of Bolton, Chen, and Wang (2014) in that firms may choose the high leverage–high cash strategy in response to external financing frictions. However, when the cost of debt is high (high cash flow risk), firms may increase their cash holdings, but decrease their leverage as a result of concerns over debt-servicing costs.

[23] Lines of credit are an alternative tool for liquidity and risk management. As a robustness check, we estimate a three-equation model in which leverage, cash holdings, and lines of credit are jointly determined. We find that CDS trading increases both leverage and cash holdings. However, the CDS impact on lines of credit is not significant (Internet Appendix Table A5).

Table 10
Cash flow volatility and the CDS effects on cash and leverage.

This table presents the estimates of the simultaneous effect of CDS on corporate leverage and cash holdings in a sample including firms with CDS and non-CDS propensity-score-matched firms. The overall sample of firms is taken from Compustat. The CDS data are taken from CreditTrade and the GFI Group. The leverage and cash equations are estimated simultaneously by two-stage least squares procedures. *Cash flow volatility* is a measure of an individual firm's cash flow risk. The coefficients of interest are those of *CDS trading* and *CDS trading*× *Cash flow volatility*, which capture the impact of the inception of CDS trading on cash holdings and leverage. The sample period is 1997–2009, based on quarterly observations. See the Appendix for variable definitions. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

	Leverage	Cash
CDS trading	0.042***	0.018***
	(0.002)	(0.003)
CDS trading× *Cash flow volatility*	−0.055***	0.032**
	(0.016)	(0.013)
Cash flow volatility	0.029***	0.021***
	(0.005)	(0.004)
Cash	−0.572***	
	(0.066)	
Industry leverage	0.145***	
	(0.018)	
Leverage		0.140
		(0.093)
Industry cash		0.403***
		(0.030)
Cash flow/Assets	−0.224***	0.042
	(0.021)	(0.026)
Market to book	−0.014***	0.002
	(0.001)	(0.001)
Size	−0.029***	−0.024***
	(0.002)	(0.001)
Net working capital/Assets	−0.053***	−0.035***
	(0.007)	(0.005)
Capital expenditure	−0.192***	−0.127***
	(0.021)	(0.016)
R&D/Sales	−0.015	0.266***
	(0.030)	(0.022)
Dividend dummy	−0.023***	−0.013***
	(0.002)	(0.002)
Acquisition activity	0.079***	-0.208***
	(0.019)	(0.019)
Foreign pretax income	-0.052**	0.229***
	(0.023)	(0.020)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
Clustered standard error	Yes	Yes
N	40287	40287
R^2	71.74%	69.93%

6. Conclusion

This paper investigates the impact of credit default swaps (CDS) on corporate risk and liquidity management. Using a comprehensive data set tracking the introduction of trading in North American corporate CDS between 1997 and 2009, we find evidence that the initiation of CDS trading on firms' debt increases their cash holdings. On average, cash ratios for firms increase by 2.6 percentage points following the introduction of CDS trading on their debt. Given a mean cash ratio of 9.5% for CDS firms, this increase is economically significant. This finding of increased cash holdings prevails even after we control for endogeneity of the introduction of CDS trading using propensity score

matching and instrumental variable estimation. The empirical results are consistent with the predictions of the CDS-protected, "empty creditor" model of Bolton and Oehmke (2011): Exacting creditors tend to be excessively "tough" negotiators after CDS trading has been introduced on a firm's debt. Anticipating the potential threat of these exacting creditors, firms hold more cash ex ante so as to be able to manage their future liquidity needs.

Our finding is consistent with the insights of Bolton, Chen, and Wang ([2011,2013,2014]) that the optimal level of cash holdings depends on the marginal value of cash. We also find that part of the cash increase following the introduction of CDS trading can be attributed to debt issuance. However, when firms are characterized by high cash flow volatility, the increase in cash holdings is more pronounced than the increase in leverage after the introduction of CDS trading.

Our research contributes to the ongoing debate regarding the real effects of CDS. In contrast to the redundant security argument that is the basis of derivatives pricing, growing empirical evidence suggests that CDS increase the credit supply, corporate leverage, and bankruptcy risk. However, we delve further into firms' responses to the increase in credit risk than previous studies have done, by showing that CDS trading affects both corporate liquidity policies and risk management practices. We identify and contrast both the ex ante and ex post effects of "empty creditors" that result from the introduction of CDS trading.

These findings have implications for policy discussions regarding the welfare effects of CDS markets. On the one hand, CDS trading can increase the credit supply and help increase the CDS firms' leverage. If the additional funding is used to finance valuable new investment projects, benefiting shareholders and possibly other stakeholders as well, this increase might be welfare enhancing. On the other hand, firms might simply hold on to the new funds in the form of corporate cash reserves based on precautionary motives. In that case, the increased borrowing capacity might not necessarily translate into higher welfare benefits for the economy.[24] Future research can provide more evidence and an even more comprehensive picture of CDS effects on corporate finance, to help market participants and regulators develop more effective policies and practices.

Appendix. Variable definitions

[24] For example, in the current context of industrialized economies suffering anaemic growth, strong motives to hold additional cash might complicate (and even work against) government efforts to stimulate the economy by lowering corporate borrowing costs by means of fiscal and monetary measures. It is frequently argued that firms tend to postpone valuable investments, not because of the higher cost of borrowing, but because of precautionary motives that drive them to accumulate additional liquidity.

Variable	Definition
Cash	The ratio of cash and marketable securities to total assets. *Source: Compustat*
ΔCash	The change in the holdings of cash and marketable securities divided by total assets. *Source: Compustat*
Lag cash	The ratio of cash and marketable securities to total assets in the previous year. *Source: Compustat*
Leverage	The book value of the long-term debt plus debt in current liabilities, divided by total assets. *Source: Compustat*
ΔDebt	The ratio of net long-term debt issuances to total assets. *Source: Compustat*
Lag debt	The ratio of long-term debt to total assets in the previous year. *Source: Compustat*
CDS trading	A dummy variable that equals one if the firm has CDS traded on its debt one year before the current month. *Source: CreditTrade, GFI, Markit*
Industry cash	The industry mean cash ratio across two-digit Standard Industrial Classification (SIC) codes. *Source: Compustat*
Industry leverage	The industry mean leverage across two-digit SIC codes. *Source: Compustat*
Industry sigma	The industry cash flow risk, measured by the mean cash flow volatility across two-digit SIC codes. *Source: Compustat*
Cash flow volatility	Cash flow standard deviation for the previous ten years, with at least three observations needed for the standard deviation to be calculated. *Source: Compustat*
Cash flow/assets	The ratio of cash flow to total assets, where cash flow is defined as the earnings after interest and related expenses, income taxes, and dividends. *Source: Compustat*
Market to book	The book value of assets minus the book value of equity plus the market value of equity, all divided by the book value of assets. *Source: Compustat*
Size	The logarithm of total assets. *Source: Compustat*
Net working capital/Assets	Net working capital minus cash, divided by total assets. *Source: Compustat*
Capital expenditure	The ratio of capital expenditure to total assets. *Source: Compustat*
R&D/Sales	The ratio of R&D to sales. R&D is set to zero if missing. *Source: Compustat*
Dividend dummy	A dummy variable that equals one if the firm pays a common dividend. *Source: Compustat*
Acquisition activity	The ratio of acquisitions to total assets. *Source: Compustat*
Foreign pretax Income	The ratio of foreign pretax income to total assets. *Source: Compustat*
Lender FX usage	A measure of the average FX hedging activities carried out by the firm's lending banks and underwriters. *Source: Dealscan, FISD, Call Report*
Lender Tier 1 capital	A measure of the average Tier 1 capital ratio of the bank lenders. *Source: Dealscan, FISD, Compustat*
Distress	A dummy variable that equals one in the distress year. If a firm's stock return is in the bottom 5% of the market for two consecutive years, we classify it as financially distressed. *Source: CRSP*
Dividend nonpayers/Payers	Dummy variables indicating whether firms pay dividends or not. *Source: Compustat*
KZ/WW index	Measures of financial constraints based on Kaplan and Zingales (1997) and Whited and Wu (2006). *Source: Compustat, CRSP*
With/Without bank debt	Dummy variables indicating firms' dependence on bank debt. *Source: Capital IQ*
CDS/Non-CDS firms	Dummy variables indicating whether firms have CDS traded on their debt at some point during the sample period. *Source: CreditTrade, GFI*

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