How does credit risk affect cost management strategies? Evidence on the initiation of credit default swap and sticky cost behavior

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Published in Journal of Corporate Finance (2023) 80. DOI: 10.1016/j.jcorpfin.2023.102401

Abstract

In this paper, we examine the effect of credit defaults swaps (CDS) initiation on reference firms' cost management strategies. CDS contracts provide insurance protection for creditors, inducing a shift in bargaining power from borrowers to creditors and an excessive incidence of bankruptcy. Anticipating more intransigent creditors in debt renegotiations and higher bankruptcy risk, CDS firms are incentivized to mitigate risk through decreasing cost stickiness after CDS initiation, as cost stickiness lowers liquidity and triggers early covenant violations. We find that, on average, CDS initiation is associated with a decline in reference firms' cost stickiness. This association is more pronounced for less liquid, financially distressed, and lower credit quality firms. We also find that CDS firms with a reduction in cost stickiness will exhibit lower future bankruptcy risk than CDS firms without such as reduction in stickiness. Collectively, our findings suggest that the CDS-induced "empty creditor problem" causes reference firms to undertake more conservative cost management practices to alleviate downside risk.

Keywords: Credit risk, Credit default swaps, Empty creditors, Cost management, Cost stickiness, Cost behavior

1. Introduction

Credit default swaps (CDS), over-the-counter insurance contracts against the default of a loan or bond of a "reference entity", are among the most influential financial innovations in the credit derivative market. In a CDS contract, the CDS buyer (usually the creditor) makes periodic premium payments for protection against a debt default, which may include the debtor's payment failure, bankruptcy, restructuring, etc. If the reference entity defaults, the CDS seller pays the agreed amount to the CDS buyer as a compensation. Since the first CDS contract was initiated in 1994, the total value of CDS has increased tremendously to multi-trillion-dollar.[1] The widespread use of CDS significantly alters the traditional creditor-debtor contractual environment and risk exposure, which in turn may influence reference firms' risk management strategies. Focusing on an essential mechanism of risk management - cost management, this paper explores whether the initiation of CDS trading affects reference firms' cost management decisions.

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1 The total value of CDS has increased to an estimated notional amount of $62 trillion in 2007. Although the market value declined during the financial crisis period, it is still significantly large with $12 trillion by the end of our sample period (2015) and remain stable after that. We obtain the OTC derivatives statistics for CDS from the Bank of International Settlements website (stats.bis.org/statx/toc/DER.html).

Prior literature documents the benefits and costs of CDS trade inception. On the one hand, CDS transfer credit risk from lenders to CDS sellers and hence increase credit supply (Saretto and Tookes, 2013) and lower cost of capital for creditworthy borrowers (Ashcraft and Santos, 2009). On the other hand, the presence of CDS may expose borrowers to incremental risk (Bolton and Oehmke, 2011). Originally, lenders are willing to renegotiate with financially distressed borrowers on interest rate, length of debt, or payment amount to avoid borrowers' bankruptcy. CDS alter this traditional lender-borrower relationship by strengthening lenders' bargaining power in debt renegotiations: when borrowers are in insolvency, CDS-protected creditors may prefer pushing borrowers into bankruptcy rather than accepting a discount because the payout on the CDS is significant enough to cover the loss. This phenomenon, termed as the "empty creditor problem", may lead to *CDS reference firms*' greater credit risk and a higher likelihood of bankruptcy compared to *non-CDS firms* (Hu and Black, 2008; Bolton and Oehmke, 2011; Subrahmanyam et al., 2014).[2] Accordingly, it is important for CDS reference firms to adopt appropriate risk management strategies, such as increasing cash holdings, to avoid debt renegotiations and reduce bankruptcy risk (Subrahmanyam et al., 2017).

In addition to cash reserves, the theoretical framework developed by Gamba and Triantis (2014) predicts that real operational decisions can be utilized to alleviate risk, while empirical evidence on its effectiveness is scarce. To fill this void, this study focuses on cost management, which is tightly connected to corporate daily operations and reflects corporate decisions in resource deployment, capacity planning, budgetary control, and earnings generating activities.[3] We infer firms' cost management practices from their cost behavior. An emerging stream of literature identifies the asymmetric cost behavior termed as "cost stickiness", i.e., costs decrease less when sales fall than they increase when sales rise (Anderson et al., 2003; Kallapur and Eldenburg, 2005; Banker et al., 2011a; Banker et al., 2011b). It may occur because managers deliberately retain excess capacity during periods of weak demand with the expectation of future sales rebound (Anderson et al., 2003) or be driven by their empire-building incentives to maintain slack resources for personal consumption (Chen et al., 2012).

Building on the theoretical foundation developed by Bolton and Oehmke (2011) and Gamba and Triantis (2014), we expect that reference firms will decrease cost stickiness after CDS initiation due to the following two reasons. First, cost stickiness is a regular resource management tool to avoid the costs of reducing current capacity and ramping up resources in the future (Anderson et al., 2003). However, this deliberate decision may restrain firms' cash inflows from disposing of unutilized resources and lower firms' liquidity cushion. Second, firms with stickier costs will exhibit lower cost savings when sales decrease, leading to more volatile earnings that trigger early covenant violations and signal greater credit risk (Weiss, 2010; Jung et al., 2013). Altogether, high cost stickiness could increase the likelihood of debt renegotiations. Given that CDS firms attempt to avoid renegotiations with extracting creditors, they may expedite cutting unutilized resources and reducing costs when sales fall to enhance liquidity condition and earnings performance. At the same time, they may delay building up new resources when sales increase, resulting in slower cost growth. Taken together, after CDS initiation, firms may display a faster cost decrease when sales decline and a slower cost increase when sales rise, leading to less asymmetric cost behavior.

Alternatively, CDS initiation may be positively associated with borrowing firms' cost stickiness. CDS-protected creditors are less incentivized to monitor borrowers continuously because the default risk has been transferred to the CDS sellers (Morrison, 2005; Parlour and Winton, 2013). Such reduced monitoring may give borrowing firms more flexibility and opportunities to build their empire through slower cost cuts when sales go down and quicker expansion when sales go up, leading to stickier cost behavior (Chen et al., 2012). It is also possible that we will not find any changes in cost stickiness after the CDS initiation. In the post-CDS period, firms facing declining sales may expedite cost reduction to avoid debt renegotiations. In contrast, CDS firms with increasing sales may engage in risky expansion and increase costs more quickly due to the lack of creditor monitoring. Since costs move more rapidly in both scenarios, the cost asymmetry will not change after the CDS onset. Collectively, the association between CDS initiation and cost stickiness is an empirical question.[4]

We use Markit, a database offering end-of-day price updates for major CDS entities, to identify a firm's first CDS trading date. Our final sample includes 370 firms with CDS contracts introduced on their debt during the sample period 2000–2015. To control for selection bias and to rule out the possibility that a decrease in cost stickiness occurs for both CDS and non-CDS firms during the sample period, we construct a control sample of 781 non-CDS firms using propensity score matching based on the predicted probability of CDS-trade-initiation (Ashcraft and Santos, 2009; Martin and Roychowdhury, 2015). Following prior studies (Anderson et al., 2003; Chen et al., 2012; Weiss, 2010), we measure cost stickiness as the asymmetric change in SG&A costs (excluding advertising costs) between periods when sales rise and when sales fall. After controlling for other determinants of cost stickiness, we find that *only CDS firms*

[2] Anecdotal evidence also supports the severity of the empty creditor problem. For example, in 2019, Aurelius Capital Management LP, a CDS-protected bond holder of Windtream Holding Inc., accused Windstream of violating its bond covenant due to a 2015 spinoff of Windstream's telecommunications network assets. Following a $310 million judgment, Windstream filed for Chapter 11 bankruptcy but said the decision to file was not due to operational failures.

[3] For example, firms adjust human and physical resources upward and downward in response to market demand fluctuations, giving rise to cost changes. These adjustment decisions have a significant impact on liquidity and earnings volatility, thereby affecting firms' credit risk (Weiss, 2010; Jung et al., 2013). Therefore, cost management could be a practical risk management tool utilized by reference firms to mitigate increased default risk imposed by CDS trading.

[4] It is also possible that the impact of CDS initiation on cost stickiness depends on CDS firms' distress status. CDS firms may engage in aggressive cost cutting in distress status and conduct risky expansion due to lax monitoring in non-distress status. Therefore, we may observe a reduction in cost stickiness for distressed firms and an increase in cost stickiness for non-distressed firms after the onset of CDS contracts. We explore this possibility and discuss our results in Section 4.2.2.

experience a significant decrease in cost stickiness around the introduction of CDS trading. The decrease in stickiness is associated with both a slower cost increase when sales go up and a quicker cost reduction when sales go down. We further document that the association between CDS initiation and reduction in cost stickiness is more pronounced for less liquid, financially distressed, and lower credit quality firms, because these firms are more susceptible to the "empty creditor problem" and confront higher bankruptcy risk. In addition, we find that *CDS firms with a reduction in cost stickiness* will exhibit lower future bankruptcy risk than *CDS firms without such a reduction in stickiness*.

To address concerns that lenders are motivated to initiate CDS contracts for firms facing a potential decrease in cost stickiness or that our results are driven by other simultaneous changes in firm characteristics, we employ the foreign exchange derivative position of the firm's lenders and underwriters as an instrument variable and obtain similar results with an instrument variable approach. We also find that the reduction in cost stickiness is more pronounced for CDS firms positioned as industry followers than industry leaders. Our main results are robust to (1) limiting to representative industries; (2) controlling for the number of covenants, alternative liquidity enhancing actions, conditional conservatism, accrual earnings management, and shareholder governance; (3) using a firm-level measure of cost stickiness. We also utilize a change analysis and find that a greater reduction in cost stickiness will give rise to a larger decline in bankruptcy risk for CDS firms. Additionally, we explore the role of cost stickiness as a deliberate resource management tool in value creation by comparing the subsequent performance of *CDS* and *non-CDS firms with a similar decline in cost stickiness*. We find that CDS firms exhibit weaker future performance than non-CDS firms because the former group is excessively concerned about extracting creditors and removes slack resources too quickly, while the latter group adjust resources rationally based on demand forecasts.

Our study contributes to the literature in several ways. First, this paper helps illuminate the real effects and welfare implications of CDS, where mixed evidence has been provided by prior studies. On the one hand, with more transparent information environment and lenders' stronger ability to hedge against credit risk (Ashcraft and Santos, 2009; Saretto and Tookes, 2013), the CDS market may improve credit supply and increase reference firms' leverage ratios and valuable investments (Danis and Gamba, 2018). On the other hand, facing excessive tough creditors after CDS initiation, reference firms will hold more cash instead of undertaking investments and thus experience a decline in firm value (Subrahmanyam et al., 2017; Narayanan and Uzmanoglu, 2018). Our findings align with the prediction of the "empty creditor" model (Bolten and Oehmke 2011).[5] With growing evidence on the impact of CDS on liquidity management (Subrahmanyam et al., 2017), reporting conservatism (Martin and Roychowdhury, 2015), accrual earnings management (Hu et al., 2017), and firm competitiveness (Li and Tang, 2022), we focus on cost management and document a decline in cost stickiness after CDS initiation with potential negative performance consequences.[6] Thus, our findings shed light on the impact of empty creditors arising from CDS inception and its welfare implications from a new perspective.

Second, our study extends the risk management literature by highlighting the essential role of cost management in limiting firms' exposure to credit risk. Corporate risk management literature has shown that financial hedging and cash holdings are two major mechanisms to alleviate risk and improve firm value (Mello and Parsons, 2000; Campello et al., 2011; Almeida et al., 2017; Bolton et al., 2011; Gamba and Triantis, 2014). In the setting of CDS, Subrahmanyam et al. (2017) find that firms increase cash holdings to reduce refinancing risk after the CDS initiation. However, it is unclear whether firms could address the same issue via cost management, which reflects their real operational decisions on a day-to-day basis. We add to the risk management literature by providing the first empirical evidence that CDS firms will adjust their committed resources involved in daily operations to mitigate credit risk and display corresponding changes in cost behavior. Our paper suggests that cost management could be a critical channel of corporate risk management practices and calls researchers and practitioners' attention to its implications.

Third, a large stream of literature has investigated the drivers of cost stickiness, such as adjustment costs (Anderson et al., 2003), demand uncertainty (Banker et al., 2014), agency problems (Chen et al., 2012), managerial incentives to meet earnings targets (Kama and Weiss, 2013), etc. With respect to risk factors, prior literature documents that the equity market risk affects the degree of cost stickiness (Anderson et al., 2007). However, the credit market may have a different impact on borrowers' cost management decisions due to its stronger emphasis on downside risk, while the empirical evidence thus far has been weak.[7] To the best of our knowledge, this study is the first to show that, in addition to various product market and corporate governance factors, firms consider credit risk as an important determinant of cost management strategies. We utilize the initiation of CDS contracts as a shock to credit risk and find that it

[5] For example, we find that, anticipating the threat of more exacting creditors protected by CDS, reference firms will deploy resources and manage costs more tightly and cautiously to reduce default risk. This is consistent with Subrahmanyam et al. (2017) and Narayanan and Uzmanoglu (2018) that CDS firms increase cash reserves and allocate less cash to investments to avoid debt renegotiations, suggesting the failure of CDS to enhance welfare for the economy. In addition, we find that CDS firms' conservative cost management decisions will result in poorer subsequent financial performance than non-CDS firms, consistent with Narayanan and Uzmanoglu (2018) that firm value declines after CDS initiation.

[6] Martin and Roychowdhury (2015) find a decline in borrowers' reporting conservatism after the initiation of CDS trading, where reporting conservatism refers to the phenomenon that bad news is recognized in earnings more timely than good news. Notably, the asymmetric cost behavior documented in our study is different from the reporting conservatism (Banker et al., 2016). In this paper, we focus on managers' operational decisions rather than reporting decisions. Cost stickiness is also different from accrual earnings management documented in Hu et al. (2017). Cost management has real impacts on both earnings and liquidity. However, accrual-based earnings management implies that firms change accounting methods or estimates, such as the depreciation method for long-term assets and the estimate of bad debt expense, to obscure their true performance but without a direct impact on cash flows.

[7] Unlike equity investors who have claims to earnings and care more about firms' upside potential, creditors only expect to receive the principal plus interest and hence are more sensitive to borrowers' downside risk. Therefore, creditors may become more extracting and impose more restrictions on borrowing firms, especially during the declining periods.

will reduce the effectiveness of cost stickiness as a rational resource management tool.

The remainder of the paper is organized as follows. In section 2, we review related literature and develop hypotheses. In section 3, we discuss sample selection and empirical methods. Section 4 describes empirical results and section 5 presents additional tests. Section 6 concludes.

2. Literature review and hypothesis development

2.1. The CDS market

As of the end of 2021, the total notional value of CDS reaches approximately $8.809 trillion according to Bank for International Settlements website. Given this significant market size, a large stream of literature focuses on the "bright" and "dark" sides of CDS from a corporate finance perspective. With respect to the former, CDS protects investors by providing incremental information and hedging opportunities, thereby lowering cost of debt financing for creditworthy reference firms (Ashcraft and Santos, 2009). The CDS protection also allows lenders to relax costly collateral requirements and financial covenants in loan contracts, implying improved contracting efficiency (Shan et al., 2019). Additionally, the hedging opportunities provided by CDS contracts reduce frictions on the supply side of credit market, which allow reference firms to maintain higher leverage ratios and hold debts with extended maturities (Saretto and Tookes, 2013).

Although CDS were originally developed to hedge lenders' risk, they may increase the credit risk and bankruptcy costs faced by reference entities. Lenders' incentives to monitor borrowers in the traditional lender-borrower relationship are weakened by their CDS protections against negative credit outcomes, giving rise to borrowers' risk-taking behavior, greater credit risk, and higher cost of capital (Morrison, 2005; Parlour and Winton, 2013; Amiram et al., 2017; Narayanan and Uzmanoglu, 2018). Moreover, creditors will become tougher with the protection of CDS: they may prefer forcing financially distressed borrowers to file for bankruptcy rather than conceding in debt renegotiations, as bankruptcy triggers a contractual payoff from CDS sellers (Hu and Black, 2008). As a result, CDS firms will anticipate and confront greater bankruptcy risk after the initiation of CDS. Consistent with this notion, Subrahmanyam et al. (2014) provide empirical evidence that reference entities are more likely to experience a credit rating downgrade or file for bankruptcy in the post-CDS period. Accordingly, *CDS firms* will exhibit higher bankruptcy risk than *non-CDS firms*.

Anticipating tougher creditors in debt renegotiations and higher bankruptcy risk, reference firms may alter their corporate practices in different contexts accordingly. For example, Subrahmanyam et al. (2017) find that borrowing firms hold significantly more cash to mitigate refinancing risk after the inception of CDS trading. Fuller et al. (2018) provide empirical evidence that CDS firms will decrease net debt issuance but increase net equity issuance. Furthermore, with reduced lender monitoring introduced by CDS contracts, borrowing firms may exhibit a decline in reporting conservatism (Martin and Roychowdhury, 2015), an elevation in income-increasing discretionary accruals (Hu et al., 2017), and an increase in earnings forecasts with more intensive shareholder monitoring (Kim et al., 2018). Li and Tang (2022) find that reduced creditor monitoring and heightened shareholder risk-taking allow CDS firms to undertake more aggressive product market strategies to achieve market share expansion and long-term growth.[8]

2.2. Risk management

Risk management has become an integral part of corporate finance policies with hedging and liquidity management as two primary mechanisms. A strand of the corporate risk management literature has investigated firms' rationales and value implications of hedging. For instance, prior theoretical studies document that firms' hedging decisions are motivated by their needs to avoid distress costs, reduce external financing costs, lower expected taxes, and undertake value-creating investments (Smith and Stulz, 1985; Froot et al., 1993; Bessembinder, 1991). Accordingly, Nance et al. (1993) and Colquitt and Hoyt (1997) provide empirical evidence that hedging enables firms to reduce distress costs, decrease expected taxes, and alleviate the underinvestment problem. Campello et al. (2011) investigate the value implications of hedging by showing that it reduces cost of borrowing and investment restrictions, thereby improving firm value. While prior literature focuses on traded derivatives, Almeida et al. (2017) expand the definition of hedging by considering purchase obligations (forward contracts with suppliers) as an alternative hedging tool in risk management practices.

Another stream of literature sheds light on firms' optimal cash inventory and its vital role in risk management (Almeida et al., 2004; Faulkender and Wang, 2006; Dittmar and Mahrt-Smith, 2007; Bates et al., 2009). For example, Almeida et al. (2004) document that financially constrained firms are more likely to save cash out of cash flows, while Bates et al. (2009) find that firms tend to increase cash reserves when their cash flow risk is high. With respect to risk management, Bolton et al. (2011) propose a unified corporate finance framework and document that hedging and liquidity management are complementary risk management tools to mitigate systematic and idiosyncratic risks. Analyzing a dynamic integrated risk management strategy, Gamba and Triantis (2014) highlight the critical role of cash holdings in risk management and value creation especially when hedging is associated with high transaction costs. In the context of CDS, Subrahmanyam et al. (2017) find higher cash ratios for firms after the onset of CDS trading, indicating that cash

[8] The influence of CDS is not limited to reference firms only and may spill over to a large population of non-CDS firms. For example, Li and Tang (2016) find that when a supplier is more depended on CDS-reference customers, it could collect incremental customer information from the CDS market and perceive higher revenue risks associated with these CDS-reference customers. With such spillover effects of CDS along the supply chain, non-CDS suppliers tend to maintain lower leverage ratios to mitigate CDS customers' credit risk. Fuller et al. (2018) echo this view by showing that CDS affects both reference firms and their economically connected firms through the usage of trade credits.

reserves could decrease refinancing and bankruptcy risk.

In addition to financial hedging and cash holdings, cost management is another essential channel of risk management but has received relatively little attention from researchers. Existing literature in this area briefly documents that real operational decisions could provide benefits similar to those of hedging (Smith and Stulz, 1985) or develops a model that integrates it as a risk management strategy (Gamba and Triantis, 2014). However, empirical evidence on its effectiveness in mitigating risk is lacking. This is surprising given that cost management is tightly connected to corporate daily operations (i.e., maintenance and administration of a business) and has been perceived by industry practitioners as one of the most important corporate finance policies.[9] It reflects firms' resource commitment decisions in various areas and have a significant impact on liquidity conditions, earnings volatility, and credit risk (Weiss, 2010; Jung et al., 2013). Meanwhile, the quality of these decisions influences firms' operational efficiency and value creation (Jang and Yehuda, 2021). Therefore, it would be interesting to investigate whether firms respond to increased default risk induced by CDS trading through altering their cost management strategies and explore the potential value implications.

Firms' cost management strategies could be inferred from their cost behavior. Empirical evidence suggests that costs actually decrease less when sales fall than they increase when sales rise (Anderson et al., 2003; Banker et al., 2010; Rouxelin et al., 2017). This phenomenon is referred to as "cost stickiness." It may occur due to managers' deliberate decisions to keep excess capacity in the expectation of a future demand rebound (Anderson et al., 2003; Banker et al., 2010). Anderson et al. (2003) show that, when demand is unfavorable, rational managers trade-off the expected costs of carrying slack resources against anticipated adjustment costs of removing and restoring. If anticipated adjustment costs are relatively high, managers will choose to retain unutilized resources instead of removing them, resulting in sticky cost behavior. Cost stickiness may also result from managerial opportunism. Chen et al. (2012) show that empire-building managers cut costs too slowly when sales decline to increase personal utility from prestige and compensation, leading to a positive relation between managers' empire-building incentives and cost asymmetry. Kama and Weiss (2013) argue that managers slash redundant resources due to their incentives to meet or beat earnings targets, indicating that agency-driven incentives affect managers' resource adjustment decisions.

2.3. Hypothesis development

Drawing on prior studies on the CDS market and risk management, we investigate how credit risk imposed by CDS affects firms' cost management practices. Specifically, we utilize the setting of the CDS market to capture credit risk because the CDS market signals changes in borrowing firms' credit risk, particularly default risk, more rapidly and accurately than bond market do (International Organization of Securities Commissions 2012; Li and Tang, 2016).[10] Furthermore, as CDS trading is initiated by parties outside of the firm, it provides an ideal setting to examine whether a firm's cost management strategy changes in response to a shock to the firm's credit risk imposed by external parties.

We hypothesize that borrowing firms will respond to the CDS commencement through managing costs more conservatively due to the following two reasons. First, cost stickiness reflects firms' deliberate decisions to retain slack resources when sales decline, which will impair their ability to generate cash inflows from eliminating these resources and form liquidity cushion. Second, cost stickiness results in smaller cost savings and thus a greater earnings decline when sales fall (Weiss, 2010). This will lead to higher earnings volatility that accelerates covenant violations and triggers debt renegotiations. Therefore, firms with high cost stickiness may exhibit low liquidity cushion and poor earnings performance when sales decline, which in turn increase the likelihood of debt renegotiation and bankruptcy risk. Anticipating more intransigent creditors after CDS initiation (Bolton and Oehmke, 2011; Subrahmanyam et al., 2014), in sales-decreasing periods, borrowing firms will remove unutilized resources and cut costs more quickly than would be optimal to improve liquidity, boost earnings, and hence avoid covenant violations and renegotiations.[11] In the scenario of a sales rise, they may also slow down the process of building up new resources and growing costs to further enhance liquidity and earnings. Taken together, in the post-CDS-initiation period, a smaller growth in cost when sales rise coupled with a quicker cost-cutting when sales fall will reduce the cost asymmetry between sales-increase and sales-decrease periods, leading to a lower level of cost stickiness. We state the following hypothesis:

H1. The onset of CDS trading is associated with a decrease in cost stickiness.

Nevertheless, CDS initiation and cost stickiness may be positively associated. Facing less creditor monitoring after CDS initiation (Morrison, 2005; Parlour and Winton, 2013; Martin and Roychowdhury, 2015), managers have more opportunities to engage in empire-building activities, such as expanding operation too rapidly when sales go up and downsizing too slowly when sales go down,

[9] See, e.g., "Unlock the potential of cost & profitability management", 2020 KPMG Cost Management Benchmarking Report (https://home.kpmg/be/en/home/insights/2020/11/adv-unlocking-the-potential-of-cost-and-profitability-management.html).

[10] Prior literature provides evidence that the CDS market reveals incremental information, particularly negative credit news, to the bond market. This is because most traders of CDS are informed insiders, such as banks with private information on reference firms' payment ability and default risk. For example, Ismailescu and Phillips (2015) study the sovereign bond market and find that the initiation of CDS improves the pricing efficiency of sovereign bonds for high default risk countries. In addition, the CDS market's reaction to negative information is documented to be faster than the bond market. For instance, Norden (2017) show that CDS spreads reflect public and private information before rating announcements, while the adjustments in spreads are frequent before negative credit events but inactive before positive ones.

[11] The elimination of slack resources can be achieved through various actions such as scaling down production, dismissing workers and employees, reducing payroll and expenses, and disposing of fixed assets.

leading to a higher degree of cost asymmetry (Chen et al., 2012). It is also possible that CDS firms expedite cost cutting when they experience declining sales or engage in risky expansion when they generate sales increase with reduced creditor monitoring. As such, the cost asymmetry between sales increases and sales decreases will not change. Therefore, the association between CDS initiation and the borrowing firm's cost stickiness is an empirical question.

Next, we examine the cross-sectional variations in the association between CDS initiation and borrowers' cost stickiness. We first hypothesize that the association between CDS initiation and cost stickiness depends on the reference firms' liquidity. Prior study documents that liquidity becomes a serious concern of reference entities following the inception of CDS, because the empty creditors are unwilling to support borrowers (Subrahmanyam et al., 2017). As a result, CDS firms are incentivized to generate sufficient cash to meet their future financing needs (Subrahmanyam et al., 2017), which is difficult for firms with low liquidity. Therefore, we expect that illiquid firms will switch to cost management to avoid debt renegotiations and mitigate default risk.[12] In particular, they will accelerate cutting slack resources for a sales decrease, while slow down building up resources for a sales increase. We present the following hypothesis:

H2. A decrease in cost stickiness after the onset of CDS trading is more pronounced for borrowers with lower liquidity.

Next, the negative association between CDS initiation and borrowers' cost stickiness may be stronger when borrowing firms are financially distressed. Financially distressed firms are more likely to violate covenants and trigger debt renegotiations. At the same time, they have limited ability to obtain capital and rely more on their existing lenders to meet potential financing needs. As CDS-protected lenders become more inflexible in renegotiations, financially distressed borrowers are strongly motivated to boost earnings and avoid covenant violations. Therefore, they will cut costs more timely for a given sales decrease and grow costs less rapidly for a given sales increase, leading to a lower level of cost asymmetry. We present the following hypothesis.

H3. A decrease in cost stickiness after the onset of CDS trading is more pronounced for borrowers that are more financially distressed.

The association between CDS initiation and cost stickiness may vary with borrowing firm's credit quality. Firms with lower credit quality have limited alternative financing channels. Additionally, these firms are perceived to be risker, while creditors bear less reputation costs if risker borrowers experience credit events, such as default and bankruptcy (Martin and Roychowdhury, 2015). Therefore, anticipating greater lenders-intransigence after the onset of CDS trading, low credit quality borrowers are more concerned about the excessive incidence of bankruptcy forced by empty creditors. Accordingly, they have stronger incentives to reduce cost stickiness and mitigate bankruptcy risk. We state the following hypothesis.

H4. A decrease in cost stickiness after the onset of CDS trading is more pronounced for borrowers with lower credit quality.

Lastly, we expect that CDS firms that choose to decrease cost stickiness could adjust resources timely and hence mitigate credit risk successfully. If so, *CDS firms with a reduction in cost stickiness after CDS initiation* will exhibit lower bankruptcy risk than *CDS firms without such a reduction in cost stickiness*. We present the following hypothesis:

H5. CDS firms with a decrease in cost stickiness exhibit lower bankruptcy risk than CDS firms without a decrease in cost stickiness.

3. Data and research design

3.1. Data

We obtain CDS trading data from Markit and define the CDS introduction year as the first fiscal year in which the firm trades at least one five-year CDS contract. Table 1 reports our sample selection procedure. First, we identify 2256 U.S. firms that have initiated CDS contracts during 2000–2015. After removing the subsidiary firms' CDS contracts and keeping only the parent firms' CDS contracts, our CDS sample size is reduced to 1826 unique U.S. firms. We obtain financial information and credit ratings from Compustat and debt contract information from LPC Dealscan. We remove 1138 CDS firms when merging the CDS sample with Compustat and then drop 71 observations due to missing data in the propensity score matching analysis. After deleting missing data on all variables and requiring CDS firms to have at least one observation in three-years before and three-years after the CDS introduction year, we obtain a final sample of 370 unique CDS firms that spans from 2000 to 2015.[13]

3.2. Propensity score matching method

To address the concern that CDS firms' decrease in cost stickiness may be due to factors that lead to both a high likelihood of CDS initiation and a contemporaneous downward trend in cost stickiness, we employ the propensity score matching method. In particular, we construct a control group of non-CDS firms from Compustat and compare changes in cost stickiness between CDS and matched non-CDS firms. We use the following logistic model to predict the probability of CDS initiation as in Ashcraft and Santos (2009) and Martin

[12] This is also consistent with Gamba and Triantis (2014) that operational decisions is an alternative tool that interacts with liquidity and hedging policies to form an integrated risk management system.

[13] Our sample size decreases by 62.31% when merging with Compustat. This is similar to the reduction in sample size (55.66%) in Martin and Roychowdhury (2015).

Table 1
Sample selection.

Firm-year observations with CDS initiation year identified from Markit	2256
Removing subsidiary firms' CDS when both the parent and the subsidiary firms have CDS	1826
After merging CDS firms with Compustat	688
After subtracting observations with missing values of variables used to conduct propensity score matching	617
After requiring CDS firms to have at least one observation with non-missing values on cost stickiness and control variables in both the (−3,−1) and the (+1, +3) year windows around CDS initiation.	370

Notes: This table reports the sample selection procedure of the CDS observations from 2000 to 2015.

and Roychowdhury (2015):

$$Prob\left(CDS_{i,t}\right) = \beta_0 + \beta_1 Rating_{i,t-1} + \beta_2 S\&P_{i,t-1} + \beta_3 Lev_{i,t-1} + \beta_4 Margin_{i,t-1}$$
$$+ \beta_5 Size_{i,t-1} + \beta_6 RetVolatility_{i,t-1} + \beta_7 MB_{i,t-1} + \varepsilon_{i,t}, \quad (1)$$

where *CDS* is an indicator variable equal to one for firms with CDS initiation during the sample period, and zero otherwise. *Rating* is a numerical scale from 1 to 21 for S&P credit rating, in which a higher number represents a more favorable rating. *S&P* is an indicator variable equal to one for firms with an S&P credit rating, and zero otherwise. *Lev* is measured as total liabilities deflated by total assets. *Margin* is calculated as net income deflated by total sales. *Size* is the natural logarithm of total assets. *RetVolatility* is calculated as the standard deviation of monthly stock returns over a year. *MB* is measured as market value of equity over book value of equity. These variables are included to control for borrowing firms' credit risk and other characteristics. We include all firm-years for non-CDS firms and firm-years before the CDS initiation for CDS firms to estimate Eq. (1).

Appendix B shows the results of estimating Eq. (1). Our results are generally consistent with prior evidence that firms with lower credit risk and higher information visibility are more likely to be offered CDS contracts by CDS sellers (Martin and Roychowdhury, 2015). Using propensity scores of CDS trading estimated from Eq. (1), we identify five non-CDS firms with the closest matches in the same two-digit SIC code industry for each CDS firm in the year prior to the CDS initiation. Following Martin and Roychowdhury (2015), we allow each non-CDS firm to serve as a match for multiple CDS firms to minimize sample differences along various characteristics. However, even if a non-CDS firm could match with multiple CDS firms, it enters the sample only once every year. Our final control sample includes 781 unique non-CDS firms.

Table 2, Panel A presents the sample distribution by CDS introduction year for CDS and matched non-CDS firms. The number of CDS firms peaks in 2001 (130 firms, 35.14% of the CDS sample) and declines significantly after 2007. CDS initiation becomes infrequent in recent years (zero in 2013 and 2014, and two in 2015). Our control sample of non-CDS firms exhibits a similar pattern over the sample period. Table 2, Panel B shows the sample distribution by industry. We find that most CDS firms are in the manufacturing industry (18.38% of the CDS sample). Thereafter, 14.05% of CDS firms are concentrated in the wholesale, retail, and some services industries.

3.3. Empirical models

Consistent with Anderson et al. (2003), we use the following model to estimate the stickiness of costs:

$$\Delta log\left(Cost_{i,t}\right) = \beta_0 + \beta_1 \Delta log\left[Sales_{i,t}\right] + \beta_2 Dec_{i,t} {}^{*} \Delta log\left[Sales_{i,t}\right] + \varepsilon_{i,t} \quad (2)$$

where *Cost* is SG&A expenses minus advertising expenses.[14] *Sales* is sales revenue. *Dec* is an indicator variable equal to one if sales revenue in year *t* is below that in year *t-1*, and zero otherwise. The coefficient β_2 measures the degree of cost asymmetry between sales increase and sales decrease. When costs are sticky, they decrease less when sales fall than they increase when sales rise by an equivalent amount, suggesting a significantly negative β_2.

We employ the following model modified from (2) to compare the level of cost stickiness from the pre- to the post-CDS periods for CDS and non-CDS firms, respectively.[15]

[14] We follow prior literature to investigate the sticky behavior of SG&A expenses (Anderson et al., 2003; Chen et al., 2012; Weiss, 2010). Advertising cost behaves differently from other SG&A costs as it is relatively easy to cut. Therefore, we use SG&A minus advertising cost in all our analysis. Our results are robust to using SG&A costs instead of SG&A costs excluding advertising expense. We also investigate the behavior of advertising expense around the introduction of CDS contracts and do not find any significant changes in the stickiness of advertising expense after CDS initiation (results untabulated).

[15] Combining CDS and non-CDS firms and estimating a diff-in-diff model will create a four-way interaction term, $CDS_{i,t} * Post_{i,t} * Dec_{i,t} * \Delta\, log\, [Sales_{i,t}]$, which may complicate the interpretation of coefficients. As a robustness check, we estimate a diff-in-diff model with CDS firms and non-CDS firms. We find that CDS firms grow costs less quickly when sales rise and cut costs more aggressively when sales fall than non-CDS firms, supporting *H1* that CDS firms reduce cost stickiness more than matched non-CDS firms after the onset of CDS initiation.

Table 2
Sample distribution.

Panel A: Sample distribution by CDS onset year for both CDS and non-CDS firms

Fiscal Year	Total	CDS	Non-CDS
2000	36	10	26
2001	307	130	177
2002	161	57	104
2003	193	63	130
2004	158	48	110
2005	98	27	71
2006	57	9	48
2007	48	10	38
2008	21	3	18
2009	10	2	8
2010	10	1	9
2011	29	6	23
2012	14	2	12
2013	0	0	0
2014	1	0	1
2015	8	2	6
Total	1151	370	781

Panel B: Sample distribution by Fama-French industry classification

Fama-French Industry Group Name	Total	CDS	Non-CDS
Consumer NonDurables - Food, Tobacco, Textiles, Apparel, Leather, Toys	115	36	79
Consumer Durables - Cars, TV's, Furniture, Household Appliances	42	14	28
Manufacturing - Machinery, Trucks, Planes, Off Furn, Paper, Com Printing	185	68	117
Energy - Oil, Gas, and Coal Extraction and Products	82	39	43
Chemicals and Allied Products	56	31	25
Business Equipment - Computers, Software, and Electronic Equipment	178	41	137
Telecom - Telephone and Television Transmission	59	13	46
Utilities	4	2	2
Shops - Wholesale, Retail, and Some Services	190	52	138
Healthcare, Medical Equipment, and Drugs	73	28	45
Money Finance	19	6	13
Other - Mines, Constr, BldMt, Trans, Hotels, Bus Serv, and Entertainment	148	40	108
Total	1151	370	781

Notes: This table reports sample distribution by CDS initiation year (Panel A) and by industry (Panel B). The sample spans from 2000 to 2015. We identify five non-CDS firms for each CDS firm based on the propensity score matching method. For non-CDS firms, the year of CDS initiation is assumed from their matched CDS firms.

$$\Delta log\left(Cost_{i,t}\right) = \beta_0 + \beta_1 \Delta log\left[Sales_{i,t}\right] + \beta_2 Dec_{i,t} * \Delta log\left[Sales_{i,t}\right] + \beta_3 Post_{i,t} + \boldsymbol{\beta_4 Post_{i,t}} * \Delta log\left[\boldsymbol{Sales_{i,t}}\right] + \boldsymbol{\beta_5 Post_{i,t}} * \boldsymbol{Dec_{i,t}} * \Delta log\left[\boldsymbol{Sales_{i,t}}\right] + \sum_{j=1}^{N} \gamma_j Additional\ Controls_j + Industry\ Fixed\ Effects + \text{Year Fixed Effects} + \varepsilon_{i,t} \tag{3}$$

where *Post* is a dummy variable equal to one if an observation is in three years after the CDS initiation, and zero if an observation is in three years before the CDS initiation. The coefficient on $Post_{i,t} * \Delta log [Sales_{i,t}]$ captures the impact of CDS on cost changes when sales increase. A positive coefficient indicates that managers increase costs more rapidly (risky expansion) due to lax monitoring after the CDS initiation, while a negative coefficient suggests that managers choose to slow down the process of building up new resources and growing costs. At the same time, the coefficient on $Post_{i,t} * Dec_{i,t} * \Delta log [Sales_{i,t}]$ captures cost changes when sales go down. We expect a positive coefficient on this three-way interaction term for CDS firms, suggesting that these firms cut costs more quickly in response to sales decrease after the onset of CDS. We do not make any predictions on these two coefficients for the non-CDS firm.

We include firm characteristics and their interactions with $\Delta log [Sales_{i,t}]$ and $Dec_{i,t} * \Delta log [Sales_{i,t}]$ as control variables. We first control for firms' financial performance using profit margin (*Margin*). Prior research finds that firms with better financial performance are more efficient in cutting resources, leading to a lower degree of cost asymmetry (Chen et al., 2012). Next, we control for adjustment costs using employee intensity (*Employees*) and asset intensity (*Assets*). Anderson et al. (2003) document that the expected adjustment costs relative to the costs of carrying unutilized resources affect the degree of cost stickiness. We also control for firms' credit quality using their S&P credit rating (*Rating*), which affects their access to the credit market and thus may influence their incentives to adjust capacity. Finally, we control for year and industry fixed effects (based on two-digit SIC codes). Appendix A provides details on variable definitions.

Table 3
Summary statistics.

Panel A: Full Sample

Variable	N	Mean	Q1	Median	Q3	Std. Deviation
Cost	6336	1104.12	110.46	321.16	879.67	2397.242
Sales	6336	6123.40	798.36	1929.35	5292.39	12,558.42
Dec	6336	0.24	0.00	0.00	0.00	0.43
CDS	6336	0.33	0.00	0.00	1.00	0.47
Post	6336	0.52	0.00	1.00	1.00	0.50
Margin	6336	0.03	0.01	0.05	0.10	0.22
Employees	6336	5.35	2.37	4.07	6.31	5.25
Assets	6336	1.51	0.76	1.13	1.80	1.20
Rating	6336	8.49	0.00	10.00	13.00	6.06

Panel B: CDS Sample

Variable	N	Mean	Q1	Median	Q3	Std. Deviation
Cost	2079	1460.08	246.00	606.41	1467.66	2473.78
Sales	2079	8714.78	1870.30	3912.85	8920.25	13,811.06
Dec	2079	0.23	0.00	0.00	0.00	0.42
CDS	2079	1.00	1.00	1.00	1.00	0.00
Post	2079	0.54	0.00	1.00	1.00	0.50
Margin	2079	0.04	0.01	0.05	0.09	0.17
Employees	2079	4.58	2.29	3.96	5.68	4.13
Assets	2079	1.48	0.79	1.12	1.69	1.18
Rating	2079	12.71	10.00	13.00	15.00	3.30
Spread	2079	0.02	0.01	0.01	0.03	0.03
Liquidity	2003	0.59	0.27	0.47	0.77	0.54
InvestmentGrade	2079	0.66	0.00	1.00	1.00	0.47

Panel C: Non-CDS Sample

Variable	N	Mean	Q1	Median	Q3	Std. Deviation
Cost	4257	930.28	77.03	228.30	619.90	2339.65
Sales	4257	4857.84	570.07	1332.87	3450.11	11,693.62
Dec	4257	0.25	0.00	0.00	0.00	0.43
CDS	4257	0.00	0.00	0.00	0.00	0.00
Post	4257	0.51	0.00	1.00	1.00	0.50
Margin	4257	0.02	0.01	0.05	0.10	0.24
Employees	4257	5.73	2.42	4.13	6.76	5.68
Assets	4257	1.52	0.74	1.15	1.86	1.21
Rating	4257	6.43	0.00	8.00	11.00	6.03

Panel D: Pre-CDS (year t-1)

	CDS		Non-CDS		
Variable	Mean	Median	Mean	Median	Mean Diff
Cost	1409.89	585.8	1352.53	341.24	57.36*
Sales	8105.36	3787.22	6056.97	1793.60	2048.39***
Dec	0.27	0.00	0.26	0.00	0.01
Margin	0.03	0.05	0.05	0.05	−0.02***
Employees	4.82	4.32	5.27	3.97	−0.45**
Assets	1.46	1.08	1.41	1.09	0.05*
Rating	13.11	13.00	9.09	10.00	4.02***

Panel E: Post-CDS (year t + 1)

	CDS		Non-CDS			
Variable	Mean	Median	Mean	Median	Mean Diff	Mean Diff-in-Diff
Cost	1524.12	670.52	1593.35	394.68	−69.23	−126.59
Sales	8960.80	4356.40	7054.52	2052.80	1906.28***	−142.11
Dec	0.29	0.00	0.26	0.00	0.03	0.02
Margin	0.03	0.04	0.05	0.05	−0.02***	0.00

(*continued on next page*)

Table 3 (*continued*)

Panel E: Post-CDS (year t + 1)

Variable	CDS		Non-CDS		Mean Diff	Mean Diff-in-Diff
	Mean	Median	Mean	Median		
Employees	4.49	3.89	4.78	3.48	−0.29	0.16**
Assets	1.48	1.17	1.39	1.14	0.09	0.04*
Rating	12.66	13.00	9.04	10.00	3.62***	−0.40**

Notes: This table reports summary statistics of main variables for the full sample (Panel A), the CDS subsample (Panel B), the non-CDS subsample (Panel C), the CDS and the matched non-CDS subsamples in the pre-CDS period (one year before the CDS initiation) (Panel D), and the CDS and the matched non-CDS subsamples in the post-CDS period (one year after the CDS initiation) (Panel E). The full sample contains 6336 firm-year observations from 1997 to 2016.Variable definitions are presented in Appendix A. *, **, and *** denote significance based on two-tailed t-statistics at or below the 10%, 5%, and 1% levels, respectively.

3.4. Summary statistics

Table 3 reports descriptive statistics of variables for the CDS sample and the non-CDS sample matched by propensity score. The summary statistics for the full sample, the CDS subsample, and the non-CDS subsample are reported in Panels A, B, and C, respectively.[16] Panels D and E compare CDS and non-CDS firms in the pre- and the post-CDS periods, respectively. CDS firms on average exhibit higher sales, lower profit margin, and higher credit rating than non-CDS firms in both the pre- and the post-CDS periods. In addition, CDS firms exhibit lower employee intensity and higher asset intensity in the year prior to CDS initiation, while these differences disappear during the post-CDS period. To mitigate the concern that the differences in these attributes drive our results, we control for them in our models. Overall, Table 4 shows that sample characteristics of both CDS and matched non-CDS firms do not change significantly after CDS initiation.[17]

Table 4 presents the Pearson and the Spearman correlations among variables used in our main analysis. We find that *CDS* is positively correlated with costs, sales, and credit rating, suggesting that CDS firms on average display higher costs, sales, and credit ratings than matched non-CDS firms. Most of the correlations are less than 0.4, far below the 0.8 threshold of possible multicollinearity (Gujarati, 2003).[18] Pearson and Spearman correlations are similar in magnitudes, indicating that there are no obvious outliers.

4. Empirical results

4.1. Main results

Table 5 presents the results of estimating the association between the change in cost stickiness and CDS-initiation for CDS firms and matched non-CDS firms, respectively. Column (1) shows the results of estimating model (3) before including any control variables for CDS firms. The coefficient on $\Delta\log(Sales)$ is positive and significant (coefficient = 0.737, t-statistic = 18.99), indicating that total costs increase by 0.737% with a 1% increase in net sales revenue. The coefficient on $Dec*\Delta log(Sales)$ is negative and significant (coefficient = −0.398, t-statistic = −4.25), suggesting that SG&A expenses (excluding advertising expenses) are sticky. We find that, for CDS firms, the coefficient on $Post_{i,t} * \Delta\ log\ [Sales_{i,t}]$ is negative and significant (coefficient = −0.217, t-statistic = −3.01), while the coefficient on $Post_{i,t} * Dec_{i,t} * \Delta\ log\ [Sales_{i,t}]$ is positive and significant (coefficient = 0.401, t-statistic = 2.43). Our results show that, in response to CDS initiation, CDS firms slow down growing costs when sales increase and cut costs more quickly when sales decrease, leading to a lower degree of cost stickiness. These findings suggest that CDS firms are concerned about excessively tough creditors during both sales-increasing and sales-decreasing periods. Column (2) shows the results of estimating model (3) with control variables. We continue to find a significantly negative coefficient on $Post_{i,t} * \Delta\ log\ [Sales_{i,t}]$ and a significantly positive coefficient on $Post*Dec*\Delta log(Sales)$, suggesting that CDS firms exhibit a significant decrease in cost stickiness after CDS initiation.

[16] Because we require CDS firms and their matching non-CDS firms to have at least one observation in three-years before and three-years after the CDS initiation year, our sample period has been extended from (2000, 2015) to (1997, 2018). However, due to missing data on control variables, our final sample contains 6336 firm-year observations from 1997 to 2016.

[17] We also check the descriptive statistics of the increase in *Sales*, *Assets* (Total Assets/Sales), and unscaled total assets. For our CDS sample, the median values of *Sales*, *Assets*, and unscaled total assets increase by 15.03%, 8.33%, and 24.62%, respectively. For the non-CDS sample, the median values of these three variables increase by 14.45%, 4.59%, and 19.71%, respectively. The evidence suggests that CDS and matched non-CDS subsamples exhibit a similar pattern in sales change, cost change, and asset change over the sample period.

[18] We also calculate the variance inflation factor (VIF) for variable pairs with a correlation coefficient higher than 0.4. Untabulated results show that none of the VIF values is greater than 10, suggesting that there is no multicollinearity among the variables.

Table 4
Pearson and spearman correlations among variables.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	*Cost*		**0.84**	**−0.06**	**0.30**	**0.14**	**0.06**	**−0.07**	**−0.19**	**0.52**
(2)	*Sales*	**0.83**		**−0.09**	**0.36**	**0.16**	**0.05**	**−0.18**	**−0.30**	**0.60**
(3)	*Dec*	**−0.03**	**−0.05**		−0.02	−0.02	**−0.24**	**0.07**	**0.07**	**−0.06**
(4)	*CDS*	**0.10**	**0.14**	−0.02		**0.03**	0.01	**−0.07**	−0.01	**0.48**
(5)	*Post*	**0.08**	**0.10**	−0.02	**0.03**		**0.06**	**−0.12**	**0.03**	0.01
(6)	*Margin*	**0.06**	**0.05**	**−0.17**	**0.03**	**0.08**		**−0.15**	**0.18**	**0.17**
(7)	*Employees*	**−0.12**	**−0.16**	0.02	**−0.10**	**−0.08**	**−0.12**		**−0.07**	**−0.13**
(8)	*Assets*	**−0.09**	**−0.14**	**0.06**	−0.02	−0.01	**−0.20**	0.00		−0.02
(9)	*Rating*	**0.39**	**0.39**	**−0.04**	**0.49**	0.01	**0.14**	**−0.18**	**−0.05**	

Notes: This table reports Pearson (lower left) and Spearman (upper right) correlations among variables used in the main analysis. The sample period covers from 1997 to 2016. Variable definitions are presented in Appendix A. Bold figures indicate significant levels of less than 5%.

We also estimate model (3) for matched non-CDS firms and report estimation results in columns (3) and (4). The results show that the coefficients on *Post*Δlog(Sales)* and *Post*Dec*Δlog(Sales)* are both insignificant, indicating that control firms do not change cost stickiness as CDS firms do. The F-tests show that the differences between these two coefficients across CDS and non-CDS subsamples are significant at *p*-values of 0.0295 and 0.0143, respectively.[19]

Collectively, results in Table 5 suggest that *CDS firms* experience a greater decrease in stickiness than their matched *non-CDS firms* (*H1*), and this decrease in stickiness is associated with both a slower cost increase when sales go up and a quicker cost reduction when sales go down.[20]

4.2. Cross-sectional analyses

4.2.1. Liquidity

Next, we examine the association between CDS initiation and cost stickiness conditional on borrowing firms' liquidity condition, which is measured by operating cash flows deflated by average current liabilities in the CDS initiation year (Wahlen et al., 2014). We partition the CDS sample into three groups based on liquidity. Table 6 presents the estimation results for the two groups with the lowest (bottom one-third) and the highest (top one-third) liquidity. We find that, for firms with the lowest liquidity, the coefficient on $Post_{i,t} * \Delta \log [Sales_{i,t}]$ is significantly negative (coefficient = −0.421, t-statistic = −3.59) and the coefficient on $Post_{i,t} * Dec_{i,t} * \Delta \log [Sales_{i,t}]$ is significantly positive (coefficient = 0.554, t-statistic = 2.29). However, both coefficients are insignificant for firms with the highest liquidity (coefficient on $Post_{i,t} * \Delta \log [Sales_{i,t}]$ = −0.072, t-statistic = −0.74; coefficient on $Post_{i,t} * Dec_{i,t} * \Delta \log [Sales_{i,t}]$ = 0.050, t-statistic = 0.25). Our F-tests of the differences in these two coefficients across two groups are significant with *p*-values of 0.0023 and 0.0317, respectively. This evidence suggests that less liquid firms are more susceptible to lender intransigence following the initiation of CDS contracts, thereby slowing down cost expansion when sales increase and speeding up cost reduction when sales decrease. Overall, results in Table 6 support *H2* that the decrease in cost stickiness is more pronounced for CDS firms that are less liquid.

4.2.2. Financial distress

H3 predicts that the decrease in cost stickiness after CDS initiation is larger for CDS firms that are more financially distressed. We measure CDS firms' distress status by their 5-year CDS spreads in the year of CDS initiation. We partition the CDS sample into three groups based on their CDS spreads and compare the coefficients on $Post_{i,t} * \Delta \log [Sales_{i,t}]$ and $Post_{i,t} * Dec_{i,t} * \Delta \log [Sales_{i,t}]$ across distressed firms with the highest CDS spreads (top one-third) and non-distressed firms with the lowest CDS spreads (bottom one-third). In Table 7, we find that the coefficient on $Post_{i,t} * \Delta \log [Sales_{i,t}]$ is negative and significant for distressed firms (coefficient = −0.221, t-statistic = −2.00). In addition, the coefficient on $Post_{i,t} * Dec_{i,t} * \Delta \log [Sales_{i,t}]$ is positive and significant for distressed firms

[19] To evaluate the degree of cost stickiness, we also estimate model (2) for the pre- and post-CDS periods separately (results untabulated). For CDS firms prior to the initiation of CDS, the coefficient on *Dec**Δ*log*(*Sales*) is negative and significant. However, cost stickiness disappears after the onset of CDS: the coefficient on *Dec**Δ*log*(*Sales*) becomes insignificant. This is consistent with *H1* that CDS firms reduce cost stickiness in response to increased bankruptcy risk associated with CDS initiation. For non-CDS firms, we find that the coefficient on *Dec**Δ*log*(*Sales*) stays negative and significant during both periods. These results support our prediction that matched non-CDS firms do not show a similar decline in cost stickiness as CDS firms do.

[20] Our sample size is determined by the window around the CDS initiation. Similar to Martin and Roychowdhury (2015), we limit our sample period to three-years before and after the onset of CDS to capture its impact accurately. As a result, we obtain a CDS sample of 2079 firm-year observations, which is comparable to the CDS sample of 1996 firm-year observations in Martin and Roychowdhury (2015). We understand that a stream of existing CDS studies use all observations available in Compustat to investigate the CDS effects with a much larger sample. Therefore, we conduct two robustness checks. First, we include all CDS and non-CDS observations in Compustat and obtain a sample of 78,724 firm-year observations. Second, we include all CDS and *matched* non-CDS firm-year observations based on propensity score matching. As such, we obtain a sample of 14,955 firm-year observations, which is comparable to the sample size in other CDS research (i.e., 57,684 quarterly observations in Subrahmanyam et al. (2017)). With these two alternative samples, we continue to find a decline in reference firms' cost stickiness after the advent of CDS trading (results untabulated).

Table 5
Association between cost stickiness and the onset of CDS trading.

	Dependent Variable = *Δlog(Cost)*							
	(1) CDS		(2) CDS		(3) Non-CDS		(4) Non-CDS	
	Coefficients	(t-stat)	Coefficients	(t-stat)	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.737***	(18.99)	0.450***	(2.58)	0.735***	(20.66)	0.604**	(9.19)
*Dec*Δlog(Sales)*	−0.398***	(−4.25)	0.264	(0.75)	−0.250***	(−3.28)	0.182	(1.31)
Post	0.010	(0.83)	0.008	(0.66)	−0.005	(−0.56)	−0.008	(−0.87)
Post*Δlog(Sales)	**−0.217*** **	**(−3.01)**	**−0.204*** **	**(−2.90)**	**−0.027**	**(−0.56)**	**−0.022**	**(−0.45)**
Post*Dec*Δlog(Sales)	**0.401*** **	**(2.43)**	**0.362** **	**(2.29)**	**0.007**	**(0.07)**	**−0.082**	**(−0.84)**
Controls:								
Margin			−0.009	(−0.22)			−0.031	(−1.11)
*Margin*Δlog(Sales)*			0.103	(0.77)			0.157	(1.31)
*Margin*Dec*Δlog(Sales)*			−0.252	(−1.22)			−0.037	(−0.20)
Employees			0.000	(0.31)			0.001	(0.79)
*Employees*Δlog(Sales)*			0.013	(1.57)			0.004	(0.95)
*Employees*Dec*Δlog(Sales)*			−0.015	(−0.85)			0.000	(0.02)
Assets			0.013*	(1.83)			0.000	(0.10)
*Assets*Δlog(Sales)*			−0.000	(−0.00)			0.029	(1.81)
*Assets*Dec*Δlog(Sales)*			−0.103**	(−2.18)			−0.131***	(−3.93)
Rating			−0.001	(−0.36)			−0.000	(−0.27)
*Rating*Δlog(Sales)*			0.021*	(1.73)			0.007	(1.54)
*Rating*Dec*Δlog(Sales)*			−0.030	(−1.31)			0.001	(0.09)
Intercept	0.019	(0.88)	0.011	(0.28)	−0.027	(−1.52)	−0.024	(−1.09)
Industry Fixed Effect	Yes		Yes		Yes		Yes	
Year Fixed Effect	Yes		Yes		Yes		Yes	
F-test (*p-value*):								
*Post*Δlog(Sales)*	**0.0295**							
*Post*Dec*Δlog(Sales)*	**0.0148**							
N	2079		2079		4257		4257	
Adjusted R^2	0.4372		0.4523		0.4481		0.4668	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation. The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

Table 6
Association between cost stickiness and the onset of CDS trading conditional on liquidity conditional on the liquidity.

	Dependent Variable = *Δlog(Cost)*			
	(1) Low Liquidity		(2) High Liquidity	
	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.159	(0.55)	0.862***	(3.09)
*Dec*Δlog(Sales)*	0.784	(1.44)	−0.527	(−0.79)
Post	0.020	(1.44)	0.013	(0.71)
Post*Δlog(Sales)	**−0.421*** **	**(−3.59)**	**−0.072**	**(−0.74)**
Post*Dec*Δlog(Sales)	**0.554** **	**(2.29)**	**0.050**	**(0.25)**
Controls:				
Margin	0.005	(0.14)	0.211	−1.61
*Margin*Δlog(Sales)*	−0.092	(−0.68)	−0.798	(−1.29)
*Margin*Dec*Δlog(Sales)*	0.033	(0.17)	0.354	−0.35
Employees	0.004	(1.58)	−0.005	(−1.21)
*Employees*Δlog(Sales)*	0.001	(0.18)	0.017	−0.78
*Employees*Dec*Δlog(Sales)*	−0.007	(−0.34)	0.001	−0.03
Assets	0.003	(0.25)	0.039***	−3.58
*Assets*Δlog(Sales)*	0.001	(0.02)	−0.057	(−1.05)
*Assets*Dec*Δlog(Sales)*	−0.108**	(−2.08)	−0.012	(−0.12)
Rating	0.001	(0.43)	−0.004	(−1.10)
*Rating*Δlog(Sales)*	0.060**	(2.45)	−0.000	(−0.03)
*Rating*Dec*Δlog(Sales)*	−0.090**	(−2.23)	0.006	−0.13
Intercept	−0.222**	(−2.55)	0.049	(0.49)
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
F-test (*p-value*):				
*Post*Δlog(Sales)*	**0.0023**			
*Post*Dec*Δlog(Sales)*	**0.0317**			
N	667		675	
Adjusted R^2	0.4890		0.4612	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation conditional on firms' liquidity, where liquidity is measured as operating cash flows deflated by average current liabilities. We partition the CDS subsample into three groups based on liquidity. The results for firms with the lowest and the highest liquidity are reported in columns (1) and (2), respectively. The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed *t*-tests at or below the 10%, 5%, and 1% levels, respectively.

(coefficient = 0.778, t-statistic = 3.07). However, both coefficients are insignificant for non-distressed firms. The differences in the coefficients on $Post_{i,\ t} * \Delta\ log\ [Sales_{i,\ t}]$ and $Post_{i,\ t} * Dec_{i,\ t} * \Delta\ log\ [Sales_{i,\ t}]$ across the two groups are significant with p-values of 0.0672 and 0.0036, respectively. Overall, our results suggest that distressed borrowers slow down cost increase when sales increase and expedite cost cutting when sales decrease, supporting *H3* that the decline in costs stickiness after CDS initiation is more pronounced for firms that are more financially distressed.

4.2.3. Credit quality

H4 predicts that CDS firms with lower credit quality experience a greater decrease in cost stickiness than other firms do. Following Martin and Roychowdhury (2015), we define low-credit-quality firms as those with credit ratings below the investment grade and high-credit-quality firms as those with credit ratings above the investment grade. Table 8 reports the estimation results for low-credit-quality and high-credit-quality firms. For firms with credit ratings below the investment-grade, the coefficient on *Post** Δ*log*(*Sales*) is negative and significant (coefficient = −0.286, t-statistic = −2.78), while the coefficient on *Post*Dec**Δ*log*(*Sales*) is positive and significant (coefficient = 0.620, t-statistic = 3.29), suggesting that these firms reduce their cost stickiness after CDS initiation. However, the same coefficients are insignificant for firms above investment grade rating (coefficient on *Post**Δ*log*(*Sales*) = −0.103, t-statistic = −1.47; coefficient on *Post*Dec**Δ*log*(*Sales*) = 0.092, t-statistic = 0.48). F-tests show that the differences in these two coefficients across two groups are significant with p-values of 0.0881 and 0.0343, respectively. Consistent with *H4*, the results in Table 8 indicate that the decline in costs stickiness after CDS initiation is more pronounced for firms with lower credit quality, suggesting their stronger incentives to protect themselves against increased credit risk.

4.3. Future bankruptcy risk

In this section, we investigate whether CDS firms that choose to decrease cost stickiness are successful in mitigating increased bankruptcy risk following CDS initiation. We identify *CDS firms with a reduction in cost stickiness after CDS initiation* and *CDS firms without such a reduction in cost stickiness*, and then compare the subsequent bankruptcy risk between them. Following Anderson et al. (2007), we construct a firm-level measure of cost stickiness by calculating the change in a firm's cost-to-sales ratio between two consecutive years:

Table 7
Association between cost stickiness and the onset of CDS trading conditional on financial conditional on the financial distress.

Distress	Dependent Variable = Δlog(*Cost*)			
	(1) High CDS Spreads (Distress)		(2) Low CDS Spreads (Non-Distress)	
	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.015	(0.06)	0.983***	(3.93)
*Dec*Δlog(Sales)*	0.420	(0.78)	−0.905	(−1.54)
Post	−0.015	(−0.57)	0.012	(0.69)
Post*Δlog(Sales)	**−0.221****	**(−2.00)**	**−0.139**	**(−1.56)**
Post*Dec*Δlog(Sales)	**0.778*****	**(3.07)**	**0.097**	**(0.47)**
Controls:				
Margin	−0.045	(−0.57)	0.024	(0.47)
*Margin*Δlog(Sales)*	0.122	(0.70)	−0.077	(−0.14)
*Margin*Dec*Δlog(Sales)*	−0.282	(−0.74)	−1.002	(−1.28)
Employees	0.003	(0.83)	−0.005	(−1.33)
*Employees*Δlog(Sales)*	0.008	(1.09)	0.028	(1.54)
*Employees*Dec*Δlog(Sales)*	−0.002	(−0.08)	−0.025	(−1.05)
Assets	0.022	(1.42)	0.027**	(2.29)
*Assets*Δlog(Sales)*	0.014	(0.50)	−0.125**	(−2.23)
*Assets*Dec*Δlog(Sales)*	−0.003	(−0.04)	0.094	(1.16)
Rating	0.003	(0.82)	−0.002	(−0.76)
*Rating*Δlog(Sales)*	0.072***	(3.28)	−0.005	(−0.35)
*Rating*Dec*Δlog(Sales)*	−0.097**	(−2.17)	0.032	(0.83)
Intercept	0.011	(0.19)	−0.039	(−0.81)
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
F-test (*p-value*):				
*Post*Δlog(Sales)*	**0.0672**			
*Post*Dec*Δlog(Sales)*	**0.0036**			
N	693		693	
Adjusted R^2	0.5283		0.4947	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation conditional on financial distress, where financial distress is measured as CDS 5-year spreads in the initiation year. We partition the CDS subsample into three groups based on CDS spreads. Firms with high CDS 5-year spread are classified as financially distressed firms, while firms with low CDS spreads are classified as non-distressed firms. The results for firms in distressed and non-distressed subsamples are reported in columns (1) and (2), respectively. The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed *t*-tests at or below the 10%, 5%, and 1% levels, respectively.

$$Signal = \frac{Cost_{i,t}}{Sales_{i,t}} - \frac{Cost_{i,t-1}}{Sales_{i,t-1}} \quad (4)$$

where *Cost* is SG&A minus advertising expenses and *Sales* is sales revenue.[21] A positive value of the above signal during sales-decreasing periods reflects managers' deliberate retention of slack resources in anticipation of a future sales rebound, which is consistent with a firm's sticky cost behavior.[22] Then we define a dummy variable, *StickinessDecrease*, which equals to one for CDS firms if their stickiness measure, *Signal*, in any of the three years after CDS initiation (year +1, +2, +3) is lower than that in the year before CDS initiation (year −1), and zero for other CDS firms.[23]

[21] In our main and cross-sectional analyses, we follow Anderson et al. (2003) and regress log changes in costs on log changes in sales where β_2 in model (2) measures the degree of cost stickiness. However, this model does not provide a firm-year-specific measure of cost stickiness. Estimating firm-year-specific cost stickiness using a time-series regression of model (2) will reduce sample size substantially. Therefore, we choose to follow Anderson et al. (2007) to construct a firm-year-specific measure of cost stickiness. We also check the robustness of our main results using this alternative measure in Section 5.5 and find consistent results.

[22] Weiss (2010) constructs a firm-quarter measure of cost stickiness. This paper estimates cost stickiness for each firm-quarter and requires at least an increase and a decrease in sales during the last four quarters. Consistent with prior studies (Martin and Roychowdhury, 2015; Subrahmanyam et al., 2017), we investigate the impact of CDS initiation on a yearly basis because firms need a relatively long window to change their strategies and policies. If we aggregate the measure developed by Weiss (2010) to firm-years, our CDS sample will decrease by 76.3%. Therefore, we choose to follow Anderson et al. (2007) to construct a firm-year measure of cost stickiness.

[23] Our original CDS sample period is from 2000 to 2015. Due to the requirement of constructing *StickinessDecrease*, our sample period is extended to 1999–2018. Because we do not find any CDS firms that reduce cost stickiness in the period of 1999–2002 and we delete missing value on control variables, our final sample for this test spans from 2002 to 2017.

Table 8
Association between cost stickiness and the onset of CDS trading conditional on conditional on the investment grade.

Credit Quality				
	Dependent Variable = Δlog(*Cost*)			
	(1) Below Investment Grade		(2) Above Investment Grade	
	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.236	(0.71)	0.394	(1.36)
*Dec*Δlog(Sales)*	0.403	(0.75)	0.089	(0.12)
Post	0.008	(0.35)	0.010	(0.70)
Post*Δlog(Sales)	**−0.286*****	**(−2.78)**	**−0.103**	**(−1.47)**
Post*Dec*Δlog(Sales)	**0.620*****	**(3.29)**	**0.092**	**(0.48)**
Controls:				
Margin	−0.069	(−1.32)	0.263***	(2.89)
*Margin*Δlog(Sales)*	0.161	(0.95)	−1.202**	(−1.97)
*Margin*Dec*Δlog(Sales)*	−0.277	(−1.10)	0.959	(0.81)
Employees	0.003	(1.07)	0.001	(0.54)
*Employees*Δlog(Sales)*	0.008	(0.88)	0.004	(0.22)
*Employees*Dec*Δlog(Sales)*	−0.015	(−0.79)	0.037	(1.17)
Assets	0.008	(0.71)	0.009	(1.05)
*Assets*Δlog(Sales)*	0.020	(0.81)	0.007	(0.14)
*Assets*Dec*Δlog(Sales)*	−0.083	(−1.52)	−0.175*	(−1.81)
Rating	0.015**	(2.44)	−0.005*	(−1.79)
*Rating*Δlog(Sales)*	0.046	(1.30)	0.030	(1.46)
*Rating*Dec*Δlog(Sales)*	−0.064	(−1.09)	−0.023	(−0.47)
Intercept	−0.153**	(−2.08)	0.020	(0.48)
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
F-test (*p-value*):				
*Post*Δlog(Sales)*	**0.0881**			
*Post*Dec*Δlog(Sales)*	**0.0343**			
N	711		1368	
Adjusted R^2	0.4634		0.4629	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation conditional on credit quality, where credit quality is measured as S&P credit ratings. Firms with below investment grade rating and firms with above investment grade rating are reported in columns (1) and (2), respectively. The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

Following Whited and Wu (2006), we use the WW index (*WW*) as a proxy for firms' bankruptcy risk, where a higher value of the index indicates a higher level of financial distress.[24] We regress CDS firms' average *WW* in the subsequent three years on *StickinessDecrease*. In additional to controls in the main test, we follow prior studies (Campbell et al., 2008; Darrat et al., 2016) to control for accounting and market-based variables, including profitability (*Nimta*), liquidity (*Cashmta*), leverage (*Tlmta*), past excess stock returns (*Volatility*), idiosyncratic risk (*Exret*), relative firm size (*Rsize*), market to book ratio (*MB*), and fiscal year-end closing price (*Price*). Table 9 shows that the coefficient on *StickinessDecrease* is negative and significant (coefficient = −0.023, t-statistic = −2.53). This result is consistent with *H5* that *CDS firms with a reduction in cost stickiness* experience lower bankruptcy risk than *other CDS firms*. Suggesting that conservative cost management decisions help reference firms address increased bankruptcy risk caused by CDS initiation.

5. Additional analyses

5.1. Industry position

The effect of CDS initiation on cost stickiness may vary with a firm's relative industry position. We expect that, as industry followers face intensive industry competition, they are more concerned about losing market share and experiencing a decline in liquidity and operating performance. As a result, these firms possess stronger incentives to reduce cost stickiness to mitigate bankruptcy risk. we calculate *Relmv* as the average market value of all individual firms in an industry divided by the market value of a firm. A higher value of *Relmv* indicates that the firm is positioned as a follower rather than a leader in its industry.

Table 10 reports the estimation results for the two groups with the highest (top one-third) and the lowest (bottom one-third) *Relmv*. We find that, for industry followers with the highest *Relmv*, the coefficient on $Post_{i,t} * \Delta \log [Sales_{i,t}]$ is negative and significant (coefficient = −0.260, t-statistic = −2.36) and the coefficient on $Post_{i,t} * Dec_{i,t} * \Delta \log [Sales_{i,t}]$ is positive and significant (coefficient

[24] The WW index (Whited and Wu, 2006) uses a standard intertemporal investment model to construct a measure of firms' financial distress. Appendix A provides variable definitions.

Table 9
Association between cost stickiness decrease and future bankruptcy risk.

	(1)	
	Dependent Variable $=\overline{WW}_{(t+1,\ t+2,\ t+3)}$	
	Coefficient Estimates	(t-stat)
StickinessDecrease$_t$	**−0.023****	**(−2.53)**
Margin$_t$	0.060	(1.40)
Employees$_t$	−0.005***	(−2.88)
Assets$_t$	−0.008	(−1.19)
Rating$_t$	0.000	(0.12)
Nimta$_t$	−0.203**	(−2.09)
Cashmta$_t$	0.117*	(1.80)
Tlmta$_t$	−0.288***	(−8.01)
Volatility$_t$	0.565***	(5.56)
Exret$_t$	0.024**	(2.26)
Rsize$_t$	−0.018***	(−3.34)
Price$_t$	−0.032***	(−3.87)
MB$_t$	−0.001	(−1.13)
Intercept	−0.216***	(−2.59)
Industry Fixed Effect	Yes	
Year Fixed Effect	Yes	
Total N	1958	
Adjusted R^2	0.4365	

Notes: This table reports the results of estimating the association between future bankruptcy risk (average from $t + 1$ to $t + 3$) and cost stickiness decrease for CDS firms. The sample consists of CDS firms with and without cost stickiness decrease after CDS initiation. The subsample covers from 2002 to 2017. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

= 0.584, t-statistic = 2.19). For industry leaders with the lowest *Relmv*, both coefficients are insignificant (coefficient on $Post_{i,\ t}$ * Δ *log* [$Sales_{i,\ t}$] = −0.054, t-statistic = −0.58; coefficient on $Post_{i,\ t}$ * $Dec_{i,\ t}$ * Δ *log* [$Sales_{i,\ t}$] = −0.008, t-statistic = −0.03). Our F-tests of the differences in these two coefficients across two groups are marginally significant with *p*-values of 0.1301 and 0.0998, respectively. Therefore, our results show that the decrease in cost stickiness is more pronounced for CDS firms positioned as industry followers, suggesting that these firms are strongly motivated to avoid performance deterioration induced by fierce competition.[25]

5.2. Representative industries

We also examine the CDS effect on cost management within-industry. The sample distribution by industry based on Fama and French (1997) indicates that our CDS sample is concentrated in manufacturing (18.47%), shops wholesale, retail, and some services (13.80%), business equipment (10.58%), and consumer non-durables (9.52%).[26] Therefore, we examine the association between CDS onset and cost structure in these four representative industries. Table 11 reports the estimation results. We find that, in all the four industries, the coefficient on $Post_{i,\ t}$ * Δ *log* [$Sales_{i,\ t}$] are generally negative and significant, while the coefficient on $Post_{i,\ t}$ * $Dec_{i,\ t}$ * Δ *log* [$Sales_{i,\ t}$] are positive and significant. Overall, our main results hold in various representative industries.

5.3. Control for additional variables

In this section, we control for additional variables. First, given that lenders could strengthen their bargaining power by imposing more restrictions or decrease monitoring by loosening debt covenants, it is important to consider the effect of covenants. Therefore, we control for the number of covenants and re-estimate our model for CDS firms. Second, in addition to a reduction in cost stickiness, firms may take other actions to improve their liquidity and manage risk. As such, we control for firms' dividend cuts (*DividendCut*), equity issuance (*EquityIssue*), asset sales (*AssetSale*), and capital expenditure reduction (*CapxRed*) as alternative liquidity enhancing mechanisms. Finally, we control for earnings management (*DA*), conditional conservatism (*CScore*), and institutional ownership (*Tshare*) to

[25] We use alternative measures to proxy for the overall industry competition and find similar results. For example, we employ Herfindahl-Hirschman Index (*HHI*) to capture the market concentration in an industry. We also follow Hoberg et al. (2014) and Li and Tang (2022) to use product market fluidity to measure the intensity of industry competition as the similarity between a firm's products and its rival firms' products. We continue to find that the negative association between CDS initiation and cost stickiness is significant only for firms in highly competitive industries.

[26] In this section, we calculate the percentage based on firm-year observations in CDS sample (2079 CDS firm-year observations in total). We find similar representative industries if we calculate the percentage based on CDS unique firms (370 CDS firms in total) as presented in Panel B of Table 2. Firms in the energy industry also take a significant portion of the CDS sample (10.58%), but we do not find a decline in stickiness in this industry.

Table 10
Association between cost stickiness and the onset of CDS trading conditional on relative industry position.

	Dependent Variable = Δlog(*Cost*)			
	(1) Industry Followers		(2) Industry Leaders	
	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.192	(0.74)	0.120	(1.13)
*Dec*Δlog(Sales)*	0.025	(0.04)	1.469***	(3.00)
Post	0.025	(1.64)	0.005	(0.34)
Post*Δlog(Sales)	**−0.260****	**(−2.36)**	**−0.054**	**(−0.58)**
Post*Dec*Δlog(Sales)	**0.584****	**(2.19)**	**−0.008**	**(−0.03)**
Controls:				
Margin	−0.004	(−0.04)	0.097	(1.03)
*Margin*Δlog(Sales)*	0.216	(0.76)	−0.303	(−0.76)
*Margin*Dec*Δlog(Sales)*	−0.327	(−0.55)	0.565	(0.86)
Employees	0.006*	(1.71)	0.000	(0.09)
*Employees*Δlog(Sales)*	0.008	(0.47)	0.005	(0.17)
*Employees*Dec*Δlog(Sales)*	0.018	(0.66)	−0.063	(−1.16)
Assets	0.004	(0.25)	0.004	(0.30)
*Assets*Δlog(Sales)*	0.028	(0.85)	0.043	(1.26)
*Assets*Dec*Δlog(Sales)*	−0.158	(−0.97)	−0.189**	(−2.42)
Rating	−0.002	(−0.50)	−0.003	(−1.04)
*Rating*Δlog(Sales)*	0.049**	(2.28)	0.034***	(2.85)
*Rating*Dec*Δlog(Sales)*	−0.009	(−0.16)	−0.091***	(−3.06)
Intercept	−0.136**	(−2.37)	0.079	(1.14)
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
F-test (*p-value*):				
*Post*Δlog(Sales)*	**0.1301**			
*Post*Dec*Δlog(Sales)*	**0.0998**			
N	693		695	
Adjusted R^2	0.5273		0.3819	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation conditional on the relative industry position, where industry position is measured as industrial average market value relative to the focal firm's market value (*Relmv*). We partition the CDS subsample into three groups based on *Relmv*. Firms with high relative market value (*Relmv*) are classified as industry followers, while firms with low relative market value (*Relmv*) are classified as industry leaders. The results for industry followers and leaders are reported in columns (1) and (2), respectively. The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

address the concern that they may drive the association. Table 12 shows that our results remain qualitatively similar with these additional controls included.

5.4. Instrument variable approach

To address the concern of reverse causality and correlated omitted variables, we follow prior studies and use a two-stage least squares procedure by employing the foreign exchange derivative position of the firm's lenders and underwriters ($FX\ Deriv_{i,\ t-1}$) as an instrument (Subrahmanyam et al., 2017; Hu et al., 2017). We identify our sample firms' lending banks and underwriters from Dealscan and the Fixed Income Securities Database (FISD), and then obtain their foreign exchange hedging activities from the Fed Call Report. We calculate $FX\ Deriv_{i,\ t-1}$ as the average ratio of foreign exchange derivatives (non-trading) scaled by total assets over the last five years (Subrahmanyam et al., 2017; Hu et al., 2017).[27]

As in Subrahmanyam et al. (2017) and Hu et al. (2017), we define $Trading_{i,\ t}$ as a dummy variable which equals one if the firm has a CDS traded during the fiscal year, and zero otherwise. Both CDS and non-CDS firms are included in this analysis. In the first stage, we use $FX\ Deriv_{i,\ t-1}$ and other control variables to predict the probability of CDS trading and calculate the fitted value of $Trading_{i,\ t}$ (Ashcraft and Santos, 2009; Martin and Roychowdhury, 2015). In the second stage, we include the fitted value of $Trading_{i,\ t}$ and its corresponding interactions terms in the cost stickiness model.

Panel A of Table 13 shows the first stage regression results: the coefficient on *FX Derivative* is positive and significant (coefficient = 0.085; t-statistic = 3.65). The Wu-Hausman F-statistic of 10.17 (p-value = 0.00), thereby rejecting the null hypothesis that *Trading* is exogenous. The Cragg-Donald Wald F-statistic from the first-stage is 83.41, suggesting that our results do not suffer from the problem of

[27] This instrument satisfies the relevance condition because lenders and underwriters with larger hedging positions are more likely to trade CDS contracts of their borrowing firms. It also meets the exclusion restriction because lenders' and underwriters' hedging positions are unlikely to be related with borrowers' cost management strategies.

Table 11
Relation between cost stickiness and the onset of CDS trading in representative industries.

Dependent Variable = Δlog*(Cost)*	(1) Manufacturing		(2) Shops Wholesale, Retail, and Some Services		(3) Business Equipment		(4) Consumer Non-Durables	
	Coefficients	(t-stat)	Coefficients	(t-stat)	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	1.067**	(2.15)	1.168**	(2.46)	−0.008	(−0.02)	1.378**	(2.27)
*Dec*Δlog(Sales)*	−1.661	(−1.38)	−2.184**	(−2.41)	0.397	(0.64)	−0.619	(−0.51)
Post	0.071***	(2.87)	0.052	(1.15)	−0.012	(−0.44)	0.012	(0.29)
Post*Δlog(Sales)	**−0.318***	**(−1.76)**	**−0.312**	**(−1.22)**	**−0.086**	**(−0.51)**	**−0.908*****	**(−3.42)**
Post*Dec*Δlog(Sales)	**1.051****	**(2.57)**	**1.499***	**(1.85)**	**0.535***	**(1.89)**	**1.386****	**(2.51)**
Controls:								
Margin	0.323	(1.89)	−0.403	(−1.42)	0.049	(0.46)	−0.002	(−0.03)
*Margin*Δlog(Sales)*	−2.941**	(−2.41)	−2.325	(−0.58)	0.515	(0.76)	−1.221	(−0.66)
*Margin*Dec*Δlog(Sales)*	4.481**	(2.42)	6.111	(0.92)	−0.270	(−0.36)	0.773	(0.40)
Employees	0.009	(1.47)	0.015	(1.43)	0.001	(0.13)	0.006	(1.47)
*Employees*Δlog(Sales)*	−0.047	(−1.07)	−0.122	(−1.39)	−0.007	(−0.10)	−0.015	(−0.32)
*Employees*Dec*Δlog(Sales)*	0.172**	(2.37)	0.213	(1.46)	−0.010	(−0.12)	0.031	(0.41)
Assets	0.013	(0.56)	−0.025	(−0.81)	−0.006	(−0.39)	0.022	(0.73)
*Assets*Δlog(Sales)*	−0.351*	(−1.69)	0.207	(0.71)	0.088	(1.16)	−0.250	(−0.91)
*Assets*Dec*Δlog(Sales)*	0.437	(1.20)	−0.389	(−0.77)	−0.057	(−0.44)	0.359	(1.06)
Rating	−0.003	(−0.91)	0.003	(0.59)	−0.003	(−0.81)	0.001	(0.28)
*Rating*Δlog(Sales)*	0.049***	(2.86)	0.042	(1.01)	0.058*	(1.95)	0.029	(0.83)
*Rating*Dec*Δlog(Sales)*	−0.019	(−0.29)	0.001	(0.02)	−0.069	(−1.54)	−0.056	(−0.78)
Intercept	0.004	(0.06)	−0.099	(−1.38)	−0.051	(−0.76)	−0.014	(−0.21)
Industry Fixed Effect	Yes		Yes		Yes		Yes	
Year Fixed Effect	Yes		Yes		Yes		Yes	
N	384		287		220		198	
Adjusted R^2	0.5745		0.2933		0.5781		0.5237	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation in representative industries based on Fama and French (1997). The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

Table 12
Association between cost stickiness and the onset of CDS trading with additional controls.

	Dependent Variable = Δlog*(Cost)*					
	(1)		(2)		(3)	
	Coefficients	(t-stat)	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.153	(0.82)	0.367**	(2.26)	0.824***	(4.47)
*Dec*Δlog(Sales)*	0.515	(1.26)	0.336	(0.93)	−0.164	(−0.43)
Post	0.006	(0.44)	0.008	(0.62)	0.004	(0.34)
Post*Δlog(Sales)	**−0.184****	**(−2.39)**	**−0.194*****	**(−2.80)**	**−0.147****	**(−2.09)**
Post*Dec*Δlog(Sales)	**0.466*****	**(2.75)**	**0.383****	**(2.41)**	**0.339****	**(2.26)**
Controls:						
Margin	−0.030	(−0.72)	−0.011	(−0.26)	−0.001***	(−5.73)
*Margin*Δlog(Sales)*	−0.054	(−0.41)	0.075	(0.53)	−0.220	(−1.47)
*Margin*Dec*Δlog(Sales)*	0.068	(0.22)	−0.149	(−0.63)	0.100	(0.48)
Employees	0.000	(0.34)	0.001	(0.43)	0.000	(0.19)
*Employees*Δlog(Sales)*	0.012	(1.54)	0.008	(1.05)	0.007	(0.75)
*Employees*Dec*Δlog(Sales)*	−0.005	(−0.34)	−0.012	(−0.75)	0.009	(0.61)
Assets	0.019***	(2.57)	0.013*	(1.69)	0.017**	(2.19)
*Assets*Δlog(Sales)*	−0.021	(−1.02)	−0.004	(−0.14)	−0.038*	(−1.73)
*Assets*Dec*Δlog(Sales)*	−0.101*	(−1.92)	−0.093*	(−1.77)	−0.016	(−0.32)
Rating	−0.001	(−0.60)	−0.001	(−0.51)	−0.001	(−0.42)
*Rating*Δlog(Sales)*	0.040***	(3.18)	0.025**	(2.19)	0.009	(0.86)
*Rating*Dec*Δlog(Sales)*	−0.049*	(−1.85)	−0.033	(−1.31)	−0.021	(−0.96)
NCovenants	−0.002	(−0.53)				
*NCovenants*Δlog(Sales)*	−0.049	(−1.28)				
*NCovenants*Dec*Δlog(Sales)*	0.047***	(3.23)				
DividendCut			−1.665	(−1.57)		
*DividendCut*Δlog(Sales)*			5.586	(1.61)		
*DividendCut*Dec*Δlog(Sales)*			−35.538**	(−2.53)		
EquityIssue			0.279	(0.73)		
*EquityIssue*Δlog(Sales)*			1.691***	(2.69)		
*EquityIssue*Dec**Δlog*(Sales)*			5.478	(0.71)		
AssetSale			−0.536	(−1.11)		
*AssetSale*Δlog(Sales)*			2.511	(0.63)		
*AssetSale*Dec**Δlog*(Sales)*			−9.909	(−1.64)		
CapxRed			0.746***	(3.56)		
*CapxRed*Δlog(Sales)*			−1.486**	(−2.17)		
*CapxRed*Dec*Δlog(Sales)*			3.185*	(1.82)		
DA					0.177**	(2.12)
*DA*Δlog(Sales)*					−1.109***	(−2.91)
*DA*Dec*Δlog(Sales)*					0.953	(0.87)
CScore					−0.009	(−0.10)
*CScore*Δlog(Sales)*					−0.869	(−1.38)
*CScore*Dec*Δlog(Sales)*					−0.001	(0.00)
TShare						
*TShare*Δlog(Sales)*						
*TShare*Dec**Δlog*(Sales)*						
Intercept	0.054	(1.55)	0.001	(0.03)	−0.011	(−0.26)
Industry Fixed Effect	Yes		Yes		Yes	
Year Fixed Effect	Yes		Yes		Yes	
N	1984		2072		1971	
Adjusted R^2	0.4572		0.4667		0.4661	

	Dependent Variable = Δlog*(Cost)*			
	(4)		(5)	
	Coefficients	(t-stat)	Coefficients	(t-stat)
Δlog(Sales)	0.513*	(1.91)	0.379	(1.31)
*Dec*Δlog(Sales)*	−0.077	(−0.13)	0.374	(0.58)
Post	0.012	(0.99)	0.016	(1.18)
Post*Δlog(Sales)	**−0.165****	**(−2.26)**	**−0.174****	**(−1.97)**
Post*Dec*Δlog(Sales)	**0.373****	**(2.12)**	**0.558*****	**(3.35)**
Controls:				
Margin	0.017	(0.36)	0.033	(0.66)
*Margin*Δlog(Sales)*	−0.057	(−0.34)	−0.370*	(−1.74)
*Margin*Dec*Δlog(Sales)*	−0.162	(−0.51)	0.738*	(1.76)
Employees	−0.000	(−0.15)	0.001	(0.49)
*Employees*Δlog(Sales)*	0.019	(1.25)	0.002	(0.11)

(*continued on next page*)

Table 12 (*continued*)

	Dependent Variable = Δlog*(Cost)*			
	(4)		(5)	
	Coefficients	(t-stat)	Coefficients	(t-stat)
*Employees*Dec*Δlog(Sales)*	−0.027	(−0.88)	0.001	(0.04)
Assets	0.018**	(2.12)	0.028***	(3.07)
*Assets*Δlog(Sales)*	−0.027	(−0.96)	−0.093***	(−3.12)
*Assets*Dec*Δlog(Sales)*	−0.072	(−1.13)	0.026	(0.37)
Rating	−0.000	(−0.19)	−0.002	(−0.76)
*Rating*Δlog(Sales)*	0.019	(1.43)	0.028**	(2.05)
*Rating*Dec*Δlog(Sales)*	0.002	(0.07)	−0.024	(−0.88)
NCovenants			−0.002	(−0.70)
*NCovenants*Δlog(Sales)*			−0.076*	(−1.79)
*NCovenants*Dec*Δlog(Sales)*			0.041**	(2.41)
DividendCut			−1.150	(−1.21)
*DividendCut*Δlog(Sales)*			5.679*	(1.67)
*DividendCut*Dec*Δlog(Sales)*			−42.430***	(−2.68)
EquityIssue			0.111	(0.24)
*EquityIssue*Δlog(Sales)*			2.777**	(2.02)
*EquityIssue*Dec*Δlog(Sales)*			0.862	(0.05)
AssetSale			−1.172*	(−1.94)
*AssetSale*Δlog(Sales)*			5.535	(1.19)
*AssetSale*Dec*Δlog(Sales)*			−17.273*	(−1.97)
CapxRed			0.471**	(2.19)
*CapxRed*Δlog(Sales)*			−1.371*	(−1.88)
*CapxRed*Dec*Δlog(Sales)*			2.547	(1.40)
DA			0.069	(0.68)
*DA*Δlog(Sales)*			−0.498	(−1.02)
*DA*Dec*Δlog(Sales)*			0.033	(0.02)
CScore			0.014	(0.15)
*CScore*Δlog(Sales)*			−0.579	(−0.68)
*CScore*Dec*Δlog(Sales)*			−0.354	(−0.18)
TShare	0.028	(1.05)	−0.009	(−0.35)
*TShare*Δlog(Sales)*	−0.160	(−0.34)	−0.490	(−1.04)
*TShare*Dec*Δlog(Sales)*	−0.029	(−0.17)	0.178	(1.05)
Intercept	−0.027	(−0.60)	0.002	(0.04)
Industry Fixed Effect	Yes		Yes	
Year Fixed Effect	Yes		Yes	
N	1758		1611	
Adjusted R^2	0.4292		0.4476	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation controlling for additional variables. The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed *t*-tests at or below the 10%, 5%, and 1% levels, respectively.

weak instrument. Panel B of Table 13 shows a significantly negative coefficient on *Instrumented Trading*Δlog*(*Sales*) and a significantly positive coefficient on *Instrumented Trading*Dec*Δlog*(*Sales*), indicating that CDS firms experience a greater decrease in cost stickiness than non-CDS firms. Therefore, we find similar results using the instrument variable approach, thus alleviating the endogeneity concern.

5.5. *Firm-level measure of cost stickiness*

In this section, we repeat the main analysis using a firm-level cost stickiness measure, $Signal_{i,\ t}$, defined as the annual change in the ratio of SG&A costs (excluding advertising costs) to sales. A positive value of this measure during sales decreasing periods indicates that SG&A costs do not decrease proportionately when sales decrease, thereby suggesting cost stickiness (Anderson et al., 2007). We regress $Signal_{i,\ t}$ on $Post_{i,\ t}$ in the sample of CDS firms with decreasing sales to capture their changes in stickiness around the onset of CDS. Table 14 shows that the coefficient on $Post_{i,\ t}$ is negative and significant (coefficient = −0.010, t-statistic = −2.01), consistent with *H1* that CDS firms experience a decrease in cost stickiness in response to tough creditors after CDS initiation.[28]

5.6. *The effectiveness of reducing cost stickiness in mitigating risk*

In Section 4.3, we find that *CDS firms with a reduction in cost stickiness* experience lower bankruptcy risk than *CDS firms without a*

[28] The stickiness measure proposed by Anderson et al. (2007) is limited to firm-years with decreasing sales. As a result, our CDS sample size is reduced to 472 observations for this analysis.

Table 13
Association between cost stickiness and the onset of CDS trading using two-stage instrumental variable approach.

Panel A: First-Stage Results

	Dependent Variable = *Trading*	
	Coefficients	(t-stat)
FX Derivative	0.085***	(3.65)
Controls:		
Rating	0.031***	(9.11)
S&P	−0.163***	(−4.49)
Lev	0.056***	(4.88)
Margin	−0.000	(−0.58)
Size	0.026***	(12.57)
RetVolatility	−0.002***	(−3.53)
MB	−0.001**	(−2.49)
Intercept	−0.029	(−0.28)
Industry Fixed Effect	Yes	
Year Fixed Effect	Yes	
Total N	55,656	
Adjusted R^2	0.2606	
Wu-Hausman F-statistic	10.17 (*p-value* = 0.00)	
Cragg-Donald Wald F-statistic	68.11 (*p-value* = 0.00)	

Panel B: Second-Stage Results

	Dependent Variable = *Δlog(Cost)*	
	Coefficients	(t-stat)
Δlog(Sales)	0.160***	(3.63)
*Dec*Δlog(Sales)*	0.297***	(4.61)
Instrumented Trading	−0.166***	(−3.97)
Instrumented Trading*Δlog(Sales)	**−0.586*****	**(−2.91)**
Instrumented Trading*Dec*Δlog(Sales)	**0.589****	**(1.99)**
Controls:		
Rating	0.003*	(1.67)
*Rating*Δlog(Sales)*	0.021**	(2.29)
*Rating*Dec*Δlog(Sales)*	−0.016	(−1.17)
S&P	−0.008	(−0.64)
*S&P*Δlog(Sales)*	−0.109	(−1.30)
*S&P*Dec*Δlog(Sales)*	0.161	(1.35)
Lev	−0.005	(−0.59)
*Lev*Δlog(Sales)*	0.061	(1.23)
*Lev*Dec*Δlog(Sales)*	−0.022	(−0.31)
Margin	0.000	(0.21)
*Margin*Δlog(Sales)*	0.000	(0.04)
*Margin*Dec*Δlog(Sales)*	−0.000	(−0.12)
Size	0.007***	(4.77)
*Size*Δlog(Sales)*	0.060***	(6.89)
*Size*Dec*Δlog(Sales)*	−0.073***	(−5.66)
RetVolatility	0.001**	(1.99)
*RetVolatility*Δlog(Sales)*	0.004**	(2.16)
*RetVolatility*Dec*Δlog(Sales)*	−0.005	(−1.29)
MB	0.001***	(2.24)
*MB*Δlog(Sales)*	−0.004***	(−3.10)
*MB*Dec*Δlog(Sales)*	0.002	(0.72)
Employees	0.000**	(2.22)
*Employees*Δlog(Sales)*	0.001	(1.40)
*Employees*Dec*Δlog(Sales)*	−0.002	(−1.48)
Assets	0.005***	(4.57)
*Assets*Δlog(Sales)*	−0.014***	(−7.40)
*Assets*Dec*Δlog(Sales)*	0.009***	(2.92)
Intercept	0.026**	(2.00)
Industry Fixed Effect	Yes	
Year Fixed Effect	Yes	
Total N	55,656	
Adjusted R^2	0.3624	

Notes: This table reports the regression results of estimating the association between cost stickiness and CDS initiation using a two-stage Instrumental Variable Approach. *FX Derivative* is the instrument variable. Panel A reports the first-stage results and Panel B reports the second-stage results. In the first stage, we instrument *Trading* with *FX Derivative* and compute the fitted value of *Trading* as instrumented trading variable (*Instrumented Trading*). In the second stage, we replace the original *Trading* with the instrumented trading variable *(Instrumented Trading)*. The sample for the second stage regression covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed *t*-tests at or below the 10%, 5%, and 1% levels, respectively.

Table 14
Association between cost stickiness and the onset of CDS trading using the firm-level.

Cost Stickiness Measure Stickiness Measure		
	Dependent Variable = *Signal*	
	Coefficients	(t-stat)
Post	**−0.010****	**(−2.01)**
Controls:		
Margin	−0.000***	(−3.46)
Assets	0.013***	(6.97)
Employees	−0.000	(−0.83)
Rating	−0.000	(−0.66)
Intercept	0.009	(0.71)
Industry Fixed Effect	Yes	
Year Fixed Effect	Yes	
Total N	472	
Adjusted R^2	0.1764	

Notes: This table reports the results of estimating the association between cost stickiness and CDS initiation using the firm-level cost stickiness measure (Anderson et al., 2007). The sample covers from 1997 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

reduction in cost stickiness. In this section, we further examine the effectiveness of reducing cost stickiness in mitigating bankruptcy risk for *CDS firms* using a change analysis. We calculate ΔWW as the average WW index in three years after CDS initiation minus the WW index in one year before CDS initiation. Then we calculate changes in *Signal* as the average *Signal* in three years after CDS initiation minus *Signal* in the year before CDS initiation and multiple it by negative one (*ΔStickinessReduction*). As such, a higher value of *ΔStickinessReduction* indicates a greater reduction of cost stickiness. We also control for alternative liquidity enhancing mechanisms including changes in dividends *(ΔDividend*), changes in common shares outstanding (*ΔEquity*), changes in sale of PP&E (*ΔAssetSale*), and changes in capital expenditure (*ΔCapx*) using the same method. We regress ΔWW on these mechanisms for all CDS firms. Table 15 shows that the coefficient on *ΔStickinessReduction* is negative and significant (coefficient = −0.195, t-statistic = −2.86). This result suggests that a greater reduction in cost stickiness will give rise to a larger decline in bankruptcy risk after CDS initiation, highlighting the effectiveness of cost management in alleviating default risk.

5.7. Future firm performance

Although CDS firms can successfully mitigate bankruptcy risk through reducing cost stickiness, it is still important to consider the role of cost stickiness as a rational resource management tool to create value with a long-term horizon. Thus, we compare the subsequent performance of *CDS* and *non-CDS firms that experienced a decline in cost stickiness.* Prior literature finds that managers refrain from cutting slack resources for a temporary sales decline, because removing resources leads to high costs of adjusting resources downward and high costs of restoring capacity when sales rebound (Anderson et al., 2003; Chen et al., 2012; Kama and Weiss, 2013). This cost management decision will generate a certain level of cost stickiness. If CDS firms intentionally reduce cost stickiness due to excessive concerns about extracting creditors, they may experience lower future performance due to large restoring costs when sales bounce back or inability to maintain customers in the future. In contrast, non-CDS firms' decisions to cut cost stickiness is not driven by “empty creditors”, but managers' prediction that future demand will remain low. Therefore, we expect that *CDS firms with a reduction in cost stickiness* will exhibit lower future performance than *non-CDS firms with a similar reduction in cost stickiness*.

To test our prediction, we use *Signal* to measure cost stickiness and construct a subsample of *CDS firms with a reduction in stickiness after CDS initiation* and *matched non-CDS firms with a similar decline in cost stickiness during the same period.*[29] We compare the future performance between CDS and non-CDS firms using annual cross-sectional regressions (Patatoukas, 2012):

$$\Delta Performance_{i,t+1} = \beta_0 + \boldsymbol{\beta_1 CDS_{i,t}} + \sum_{j=1}^{N} \gamma_j Additional\ Controls_j + \text{Industry Fixed Effects} + \text{Year Fixed Effects} + \varepsilon_{i,t} \quad (5)$$

[29] Consistent with Section 4.3, we identify a firm as experiencing a decline in cost stickiness if *Signal* in any of the three years after CDS initiation (year +1, +2, +3) is lower than that in the year before CDS initiation (year −1). After deleting missing value on required variables, our final sample for this test spans from 2002 to 2016.

Table 15
Association between changes in cost stickiness and changes in bankruptcy risk.

	Dependent Variable = ΔWW	
	Coefficients	(t-stat)
ΔStickinessReduction	**−0.195*** **	**(−2.86)**
ΔDividend	−0.249	(−0.45)
ΔEquity	6.947	(1.08)
ΔAssetSale	−1.441	(−1.25)
ΔCapx	−1.623	(1.20)
Intercept	−0.154**	(−2.19)
Industry Fixed Effect	Yes	
Year Fixed Effect	Yes	
Total N	1885	
Adjusted R^2	0.7052	

Notes: This table reports the results of estimating the association between changes in cost stickiness and changes in bankruptcy risk. The sample covers from 2002 to 2017. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

where *Performance* is measured by return on equity (*ROE*), SG&A expenses minus advertising expenses deflated by equity (*SG&A*), and net sales deflated by equity (*REV*). *CDS* is a dummy variable equal to one if the firm has a CDS initiation during the sample period, and zero for non-CDS firms. We add control variables that have been documented as determinants of one-year-ahead changes in *Performance* (Patatoukas, 2012).

Table 16 provides the estimation results. Column (1) shows that, when $\Delta ROE_{i,\ t+1}$ is the dependent variable, the coefficient on $CDS_{i,\ t}$ is negative and significant (coefficient = −0.271, t-statistic = −2.03). This evidence suggests that for firms with a decrease in cost stickiness, CDS firms generate poorer future performance than non-CDS firms. Column (2) shows that, when we use changes in SG&A cost ratio ($\Delta SG\ \&\ A_{i,\ t+1}$) as the dependent variable, the coefficient on $CDS_{i,\ t}$ is positive and significant (coefficient = 0.055, t-statistic = 3.18), indicating that CDS firms' lower performance is at least partially driven by an increase in future costs. Column (3) shows the results using changes in sales ($\Delta REV_{i,\ t+1}$) as the dependent variable. We find that the coefficient on $CDS_{i,\ t}$ is insignificant (coefficient = −0.012, t-statistic = −0.18), suggesting that the decline in future performance is not driven by changes in future revenue.[30] Overall, our results imply that the inception of CDS incentivizes reference firms to reduce cost stickiness for risk management, but will decrease the effectiveness of cost stickiness as a rational resource management tool to create value in the long run.

6. Conclusion

This paper investigates the impact of CDS initiation on reference firms' cost management strategies. Based on a sample of 370 CDS firms and a control sample of 781 matched non-CDS firms, we find that the inception of CDS trading is associated with a decline in reference firm's cost stickiness. The decline in cost stickiness is greater for CDS firms with: (1) lower liquidity, (2) higher financial distress risk, and (3) lower credit quality. Our results remain robust to controlling for additional controls, employing an instrumental variable approach, and using a firm-level measure of cost stickiness.

There is an ongoing debate regarding the societal benefits and costs of CDS and its effectiveness as a tool in financial markets. Although CDS were originally developed to hedge risk, they have been criticized to be redundant securities and a driver of the US subprime crisis of 2007–2008 and the Eurozone sovereign debt crisis of 2010–2011 (Augustin et al., 2016).[31] Previous literature finds that the presence of CDS contracts leads to changes in corporate financing (Fuller et al., 2018), investing (Narayanan and Uzmanoglu, 2018), and liquidity policies (Subrahmanyam et al., 2017). Different from these studies, our paper sheds light on the overall welfare effect of CDS by focusing on reference firms' risk management practices. Our findings suggest that, facing extracting credits protected by CDS contracts, reference firms could adopt more conservative cost management strategies to mitigate bankruptcy risk. However, this decision impairs the effectiveness of cost stickiness as a tool to avoid large adjustment costs of committed resources, thereby decreasing firm value in the long run. Therefore, this research adds to the debate on the existence of CDS.

A caveat of our study is that data limitation prohibits us from identifying the purpose of the CDS transaction, i.e., whether the

[30] To address the concern that results on future performance test may be driven by the persistence of performance, we conduct the following analyses. First, we compare ex ante Altman (1968) *Z*-scores between CDS and non-CDS groups matched by propensity scores. We do not find any significant difference across the two groups. Second, we control for firms' lagged annual changes in Altman (1968) Z-score and continue to find a lower future performance (*ΔROE*) for CDS firms than for non-CDS firms. Third, we follow the "parallel trends" assumption to examine whether the trends in the outcome variable for the treatment and control groups prior to treatment are similar (Roberts and Whited, 2012). We find that the time-series trends of *ΔROE* are similar for CDS and matched non-CDS firms prior to the treatment, and that the difference in average *ΔROE* is statistically insignificant (t-statistic = −0.1570). Overall, the evidence suggests that CDS firms' weaker future financial performance is not driven by the persistence of performance, but can be a result of reduction in cost stickiness.

[31] For example, sophisticated investors may purchase default insurance for speculating incentives and accelerate the default of underlying debt that they do not own.

Table 16
Association between future performance and CDS initiation for firms with decreased cost stickiness.

	(1)		(2)		(3)	
	Dependent Variable = ΔROE_{t+1}		Dependent Variable = $\Delta SG\&A_{t+1}$		Dependent Variable = ΔREV_{t+1}	
	Coefficient Estimates	(t-stat)	Coefficient Estimates	(t-stat)	Coefficient Estimates	(t-stat)
CDS_t	**−0.271****	**(−2.03)**	**0.055*****	**(3.18)**	**−0.012**	**(−0.18)**
ΔROE_t	−0.110	(−0.86)	−0.035	(−0.32)	0.103	(0.67)
$\Delta Altman_t$	−0.016	(−0.58)	0.002	(0.72)	0.007	(1.16)
ΔRet_t	0.001	(0.07)	0.000	(0.01)	−0.004	(−0.29)
$\Delta Size_t$	−0.420	(−0.75)	0.049	(0.89)	0.240	(0.92)
ΔMB_t	0.425	(1.27)	0.010	(1.12)	0.073	(1.40)
$\Delta Beta_t$	−0.002	(−0.18)	−0.001	(−0.64)	−0.005	(−1.22)
ΔSG_t	0.064	(0.24)	0.130***	(3.16)	1.152***	(4.49)
ΔAQ_t	1.168	(1.38)	−0.174*	(−1.86)	−0.220	(−0.93)
ΔHHI_t	1.105	(0.68)	0.344	(1.01)	1.641	(1.35)
ΔATO_t	0.619	(1.40)	−0.091	(−1.59)	−0.043	(−0.22)
$\Delta Margin_t$	−2.438	(−1.26)	0.396*	(1.87)	0.531*	(1.94)
$\Delta Rating_t$	0.083	(1.62)	0.003	(0.50)	0.013	(0.56)
Intercept	0.003	(0.01)	0.051	(0.94)	−0.382	(−1.49)
Industry Fixed Effect	Yes		Yes		Yes	
Year Fixed Effect	Yes		Yes		Yes	
Total N	480		480		480	
Adjusted R^2	0.0801		0.1401		0.1468	

Notes: This table reports the results of estimating the association between future performance and CDS initiation for firms with cost stickiness decrease. The sample consists of CDS firms with a reduction in cost stickiness after CDS initiation and matched non-CDS firms experiencing a similar change in their cost stickiness during the same period. The subsample covers from 2002 to 2016. Variable definitions are presented in Appendix A. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed t-tests at or below the 10%, 5%, and 1% levels, respectively.

buyers purchase CDSs for hedging or for speculating incentives. However, regardless of the purpose of the CDS buyers, the borrowing firms will experience an increase in default risk and be incentivized to reduce cost stickiness. Therefore, our inferences do not change with this caveat. Future research could investigate whether firms' cost management strategies differ across different types of CDS buyers.

Data availability

Data will be made available on request.

Acknowledgement

All authors contribute equally to this paper. We thank helpful comments and suggestions from seminar participants at Fudan University, Southwestern University of Finance and Economics, and the 2018 American Accounting Association Annual Meeting. We acknowledge support from National Natural Science Foundation of China (72172038, 72241425, 72172118, 72002179, 72010107001, 71620107005), 111 Project (B18043), Sci-Tech Innovation Foundation of School of Management (Fudan University), GuangHua Talents Project of Accounting School (Southwestern University of Finance and Economics), China Research Center of Financial Law (Southwestern University of Finance and Economics), and Research Fund of Shanghai Data Exchange Corporation.

Appendix A. Variable definitions

Cost	SG&A expenses minus advertising expenses.
Sales	Total sales revenue.
Dec	A dummy variable equal to one if total sales revenue in year *t* is less than that in year *t-1*, and zero otherwise.
CDS	A dummy variable equal to one if the firm has a CDS initiation during the sample period, and zero for control firms.
Post	A dummy variable equal to one if an observation is in the three-year period after CDS initiation and zero for an observation in the three-year period preceding CDS initiation.
Margin	Net income deflated by total sales revenue.
Employees	Number of employees scaled by total sales revenue.
Assets	Total assets scaled by total sales revenue.
Rating	A numerical scale from 1 to 21 for S&P credit rating, in which a higher number represents a more favorable rating.
Liquidity	Operating cash flows deflated by average current liabilities.
Spread	CDS spreads in the year of CDS initiation.
InvesmentGrade	A dummy variable equal to one for firms with an S&P credit rating above BB+, and zero otherwise.

(*continued on next page*)

(*continued*)

WW	WW index, calculated as −0.091*CF- 0.062**DIVPOS* + 0.021**TLTD* - 0.044**LNTA* + 0.102**ISG* - 0.035* *SG*, where CF is the ratio of cash flow to total assets, *DIVPOS* is a dummy variable equal to one if the firm pays cash dividends and zero otherwise, *TLTD* is the ratio of long-term debt to total assets, *LNTA* is the natural log of total assets, *ISG* is the average sales growth in the firm's three-digit industry, and *SG* is the firm's sales growth.
Signal	$Signal = \frac{Cost_{i,t}}{Sales_{i,t}} - \frac{Cost_{i,t-1}}{Sales_{i,t-1}}$, where *Cost* is SG&A minus advertising expenses and *Sales* is total sales revenue.
StickinessDecrease	A dummy variable equal to one if the stickiness measure, *Signal*, in any of the three years after CDS initiation is lower than that in the year before CDS initiation when sales fall, and zero otherwise.
Nimta	Net income deflated by the sum of market value of equity and total liabilities.
Cashmta	Cash and short-term investment deflated by the sum of market value of equity and total liabilities.
Tlmta	Total liabilities deflated by the sum of market value of equity and total liabilities.
Volatility	Standard deviation of the residual derived from regressing monthly stock return on market return.
Exret	Cumulative annual return minus the value-weighted market return.
Rsize	Natural logarithm of the ratio of firm's market capitalization to the total market capitalization of all firms.
Price	Natural logarithm of stock price at the end of fiscal year.
MB	Market value of equity over book value of equity.
Relmv	Industrial average market value relative to the focal firm's market value.
NCovenant	Number of financial covenants in existing debt.
DividendCut	Dividends in year *t* minus that in year *t-1*. Dividends are deflated by beginning-of-year total assets.
EquityIssue	Common shares outstanding in the year *t* minus common shares outstanding in year *t-1*. Common shares outstanding are deflated by beginning-of-year total assets.
AssetSale	Sale of property, plant, and equipment deflated by beginning-of-year total assets.
CapxRed	Capital expenditures in the year *t* minus capital expenditures in year *t-1*. Capital expenditures are deflated by beginning-of-year total assets.
DA	Absolute value of discretionary accruals. Discretionary accruals are calculated as the residual from a regression of total current accruals on cash flows from operations in year *t-1*, *t*, and *t* + *1*, the change in revenue, and net property, plant, and equipment (Dechow and Dichev, 2002): $TCA_{i,t} = \beta_0 + \beta_1 CFO_{i,t-1} + \beta_2 CFO_{i,t} + \beta_3 CFO_{i,t+1} + \beta_4 \Delta Rev_{i,t} + \beta_5 PPE_{i,t} + \varepsilon_{i,t}$, where $TCA_{i,t} = \Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta STDEBT_{i,t}$, where *CFO* is the firm's cash flow from operations; $\Delta CA_{i,t}$ is the firm's change in current assets from year *t-1* to year *t*; $\Delta CL_{i,t}$ is the firm's change in current liabilities from year *t-1* to year *t*; $\Delta STDEBT_{i,t}$ is the firm's change in short-term debt from year *t-1* to year *t*; $\Delta Rev_{i,t}$ is the firm's change in revenues from year *t-1* to year *t*; and $PPE_{i,t}$ is the gross value of property, plant, and equipment.
Cscore	Conditional conservatism, which is a liner function of firm-specific characteristics as follows (Khan and Watts, 2009): $Cscore_{i,t} = \lambda_1 + \lambda_2 Size_i + \lambda_3 MB_i + \lambda_4 Lev_i$. It is estimated from the following annual cross-section regression model: $X_i = \beta_1 + \beta_2 D_i + R_i(\mu_1 + \mu_2 Size_i + \mu_3 MB_i + \mu_4 Lev_i) + D_i R_i(\lambda_1 + \lambda_2 Size_i + \lambda_3 MB_i + \lambda_4 Lev_i) + (\delta_1 Size_i + \delta_2 MB_i + \delta_3 Lev_i + \delta_4 D_i Size_i + \delta_5 D_i MB_{i,t} + \delta_6 D_i Lev_{i,t}) + \varepsilon_{i,t}$, where *X* is earnings; *R* is returns; and *D* is a dummy variable equal to one if *R* is negative, and zero otherwise; and other variables are previously defined.
Tshare	Average percentage of common equity shares held by institutional investors during the fiscal year.
FX Derivative	The average ratio of foreign exchange derivatives (non-trading) scaled by total assets over the last five years.
Trading	A dummy variable equal to one if the firm has a CDS traded during the fiscal year, and zero otherwise.
S&P	A dummy variable equal to one for firms with an S&P credit rating, and zero otherwise.
Lev	Total liabilities deflated by total assets.
Size	Natural logarithm of total assets.
RetVolatility	Standard deviation of monthly stock returns over a year.
ΔStickinessReduction	The average *Signal* in three years after CDS initiation minus *Signal* in the year before CDS initiation and multiple it by negative one.
ΔDividend	The average dividends in three years after CDS initiation minus the dividends in one year before CDS initiation. Dividends are deflated by beginning-of-year total assets.
ΔEquity	The average common shares outstanding in three years after CDS initiation minus the common shares outstanding in one year before CDS initiation. Common shares outstanding is deflated by beginning-of-year total assets.
ΔAssetSale	The average sale of PP&E in three years after CDS initiation minus the sale of PP&E in one year before CDS initiation. Sale of PP&E is deflated by beginning-of-year total assets.
ΔCapx	The average capital expenditures in three years after CDS initiation minus the capital expenditures in one year before CDS initiation. Capital expenditures are deflated by beginning-of-year total assets.
ROE	Net income deflated by average book value of equity.
SG&A	SG&A expenses minus advertising expenses deflated by average book value of equity.
REV	Total sales revenue deflated by average book value of equity.
Altman	Altman (1968) *Z*-score, calculated as 1.2 * (Current Assets – Current Liabilities) / Total Assets +1.4 * Retained Earnings / Total Assets +3.3 * Earnings before Interest and Taxes / Total Assets +0.6 * Market Value of Equity / Total Liabilities +0.999 * Sales / Total Assets.
Ret	Annual stock return.
Beta	Market model beta estimated from regressions of daily stock returns on the value-weighted market index returns over 12 months.
SG	Annual sales growth.
HHI	Herfindahl-Hirschman index of competition calculated as follows: $HHI_j = \sum_{i=1}^{I} s_{ij}^2$, where S_{ij} is the market share of firm *i* in industry *j*, defined using the firm's two-digit SIC code.
ATO	Total sales revenue deflated by beginning-of-year total assets.

Appendix B. Logistic regression results on probability of CDS trade initiation

	Dependent Variable = *CDS*	
	(1)	
	Coefficients	(z-stat)
Rating	−0.024	(−1.21)
S&P	1.533***	(5.84)
Lev	1.023***	(5.88)
Margin	−0.008	(−0.65)
Size	0.627***	(18.51)
RetVolatility	−0.010	(−1.37)
MB	−0.012*	(−1.73)
Intercept	−12.693***	(−11.98)
Industry Fixed Effect	Yes	
Year Fixed Effect	Yes	
Total N	75,568	
Pseudo R^2	0.3184	

Notes: This table reports the estimation results from a logistic model of predicting the probability of CDS onset. The sample period spans from 1997 to 2016. Both CDS and non-CDS firms are included. For CDS firms, only firm-years prior to the CDS initiation are included. Industry and year fixed effects are included. T-statistics are based on robust standard errors clustered at the firm level. *, **, and *** denote significance based on two-tailed *t*-tests at or below the 10%, 5%, and 1% levels, respectively.

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