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Credit Default Swaps and Risk-Shifting

Murillo Campello

Cornell University and NBER
campello@cornell.edu

Rafael Matta

University of Amsterdam
rmatta2@uiuc.edu

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Abstract

Credit default swaps (CDSs) are thought to ease borrowing by protecting lenders against default. This paper develops a model of the demand for CDS when borrowers choose the riskiness of investment and verification is imperfect. The model shows that CDSs may lead to risk-shifting, increasing the probability of default. Our model provides new insights on the role of CDS during the recent financial crisis.

JEL Classification Numbers: G33, D86, D61.

Keywords: CDS, Risk-Shifting, Financing Efficiency, Regulation.

1 Introduction

The 2008–9 crisis brought attention to the trading of credit default swaps. Since then, there is debate about whether CDSs contributed to the crisis and how one might regulate CDS markets.¹ Surprisingly, however, little is known about why CDS contracts exist in the first place. We know little about the role of CDSs in financial markets, what contracting inefficiencies they address, or whether they affect the availability of credit in the economy. Understanding these issues should strike anyone as an important step for improving financial architecture over the next decade.

A CDS is a bilateral agreement between a debt protection seller and a debt protection buyer. The buyer makes periodic payments to the seller in exchange for compensation in the event a borrower defaults on its debt. Hu and Black (2008) argue that CDS contracts can give rise to the *empty creditor problem* (see also Bolton and Oehmke (2011)). Simply put, lenders protected by CDS have low incentives to participate in out-of-court restructurings of distressed firms even when continuation would be optimal. The incentives to engage in restructuring are even lower if lenders “overinsure;” that is, their protection payoff surpasses the maximum amount they can receive in restructurings.

While there is interest in the impact of CDSs on creditor–borrower relations, the literature lacks a model that examines important questions about those contracts. In this paper, we develop a model of CDS contracting when borrowers choose the riskiness of their investments and verification is imperfect. To our knowledge, this study is the first to examine the optimal demand for CDS in a setting that incorporates these real-world complexities. Creditors choose the amount of CDS protection to modulate their bargaining power in distress times and our analysis shows how this impacts borrowers’ project risk choices.

In a nutshell, our model shows that CDSs lead to risk-shifting, increasing the probability of default. This implies that the economy would have a higher probability of facing a crisis in the presence of CDSs. While the empty creditor problem worsens a crisis due to inefficient ex post liquidation, the risk-taking behavior problem increases the odds of downturns in the first place.

2 Model Setup

There are three risk neutral players: a borrower, a lender, and a competitive CDS provider. The game is played in three periods $t = 0, 1, 2$. The borrower has an amount A of funds and has a project that needs $I > 0$ of investment in $t = 0$. He turns to a lender to obtain $I - A$ to finance his project.

If investment takes place in $t = 0$, it generates outcome $o_1 \in \{0, y_1\}$ in $t = 1$. We assume that o_1 is non-verifiable. The borrower chooses the probability p that $o_1 = y_1$, where $p \in [\underline{p}, \bar{p}]$. Essentially, the borrower chooses the safeness (in terms of first-order stochastic dominance) of the project by selecting its success probability. The probability chosen is observable, but cannot be verified by a court.

The lender makes a take-it-or-leave-it offer to the borrower. A contract specifies a repayment

¹Title Dodd-Frank Act gives the SEC regulatory authority over swaps, including CDSs.

$\tilde{R}_1(\tilde{o}_1)$ to be made in $t = 1$, where $\tilde{o}_1 \in \{0, y_1\}$ is the outcome reported by the borrower. We assume limited liability, $\tilde{R}_1(\tilde{o}_1) \leq \tilde{o}_1$. Accordingly, $\tilde{R}_1(0) = 0$, and a contract is characterized by $R_1 \equiv \tilde{R}_1(y_1)$.

After the project's risk is determined, the lender decides whether to buy a CDS. If the lender buys CDS, she chooses the repayment that accrues if a "credit event" occurs in $t = 1$, paying a fee f to the CDS provider. We model the payment received by the lender in liquidation following practice in CDS markets. The lender retains the investment's liquidation value (normalized to zero) and receives the compensation π . Since the CDS market is competitive, f is fairly priced. A credit event occurs if the borrower defaults (reports $\tilde{o}_1 = 0$) and the lender refuses to renegotiate.

At $t = 1$, outcome o_1 is realized. If the borrower reports $\tilde{o}_1 = y_1$, the project continues and yields $o_2 = y_2$ in $t = 2$. The borrower's payoff is $y_1 - R_1 + y_2$ and the lender receives R_1 . We assume that y_2 cannot be contracted upon, but is verifiable in $t = 2$. We assume that the verification technology is imperfect: an amount $(1 - \delta)y_2$ of the continuation outcome cannot be verified by the courts and remains with the borrower.

If the borrower reports $\tilde{o}_1 = 0$, the lender chooses between renegotiation and liquidation. If the lender refuses to renegotiate, the borrower defaults. The project is then liquidated and the lender receives π , while the borrower receives o_1 . If the lender renegotiates, the parties bargain over $\tilde{y}_2 \equiv \delta y_2$ in $t = 2$. The lender then receives x and the borrower receives $o_1 + (1 - \delta)y_2 + \tilde{y}_2 - x$, where x is the renegotiation game outcome.

3 Equilibrium and Results

We first investigate what happens when the borrower triggers renegotiation ($\tilde{o}_1 = 0$) and the lender accepts it. Under the Nash-bargaining solution, the borrower's and lender's disagreement payoffs are 0 and π , respectively. The bargaining outcome is

$$x(\pi) = \frac{1}{2}\tilde{y}_2 + \frac{1}{2}\pi. \quad (1)$$

Equation (1) shows that the lender's share of the continuation value is increasing in the amount of CDS protection π . For our purposes, we assume that $x(0) > 0$. This implies that liquidation is ex post inefficient and the lender prefers renegotiation to liquidation.

3.1 CDS, Renegotiation, and Default

The lender refuses to renegotiate if $\pi > x(\pi)$ and engages in renegotiation if $\pi \leq x(\pi)$. An increase in π not only affects the threat point of liquidation (one-to-one), but also the renegotiation outcome in a linear fashion (with slope smaller than one). Therefore, there exists a unique threshold π^* such that the lender is indifferent between liquidation and renegotiation. We assume that the lender renegotiates if she is indifferent between the payoff of renegotiation and that of bankruptcy. This leads to our first proposition.

Proposition 1 *Suppose the borrower triggers renegotiation. The lender refuses to renegotiate if $\pi > \pi^*$ and engages in renegotiation if $\pi \leq \pi^*$, where $\pi^* = \tilde{y}_2$.*

Proposition 1 says that the lender's maximum payoff consistent with renegotiation obtains when she buys CDS protection in the amount of π^* . Although protection above π^* increases the lender's economic ownership, it reduces her interest to renegotiate, leading to default. Credit protection above π^* results in *overinsurance*, while credit protection equal to π^* results in *just-insurance*.

We now derive the borrower's decision to strategically call for renegotiation when the project succeeds ($o_1 = y_1$). If the borrower reports the truth ($\tilde{o}_1 = y_1$), his payoff is $y_1 - R_1 + y_2$. This payoff must be compared to that when he lies ($\tilde{o}_1 = 0$). In this case, if the lender renegotiates, the borrower's payoff is $y_1 + (1 - \delta)y_2 + \tilde{y}_2 - x(\pi)$. If the lender does not renegotiate, the borrower's payoff is y_1 . We assume that the borrower does not lie when he is indifferent between diverting cash flows and reporting the truth. The results are summarized in Proposition 2.

Proposition 2 *Suppose the project succeeds. Then:*

- (1) *If the lender does not overinsure, the borrower triggers renegotiation if and only if $R_1 > x(\pi)$.*
- (2) *If the lender overinsures, the borrower triggers renegotiation if and only if $R_1 > y_2$.*

Proposition 3 characterizes the lender's optimal decision regarding the level of CDS protection.

Proposition 3 *The lender's demand for CDS protection is determined as follows:*

- (1) *For $R_1 > y_2$, the lender just-insures.*
- (2) *For $R_1 \in (\delta y_2, y_2]$,*
 - (i) *the lender overinsures if $R_1 > \frac{\delta y_2}{p}$, and*
 - (ii) *the lender just-insures if $R_1 \leq \frac{\delta y_2}{p}$.*
- (3) *For $R_1 \leq \delta y_2$, the lender just-insures.*

It follows from Proposition 3 that $R_1 > y_2$, $\delta y_2 < R_1 \leq \frac{\delta y_2}{p}$, and $R_1 = \delta y_2$ all yield the same payoff to the lender. In this case, we assume the lender chooses $R_1 = \delta y_2$, which precludes strategic renegotiation. Therefore, the lender chooses $R_1 \in (\delta y_2, y_2]$ only if she overinsures.

3.2 CDS, Debt Repayment, and the Economy

If the lender chooses $R_1 = \delta y_2$, her payoff is

$$\Pi(\delta y_2) \equiv \delta y_2. \tag{2}$$

If the lender chooses $R_1 = y_2$, her payoff is

$$\Pi(y_2) \equiv py_2. \quad (3)$$

Proposition 4 characterizes the lender's optimal repayment.

Proposition 4 *If $p > \delta$, the lender chooses $R_1 = y_2$ and if $p \leq \delta$, the lender chooses $R_1 = \delta y_2$.*

If the lender overinsures, she forces the borrower into bankruptcy. This maximizes debt repayments when the investment is successful. However, liquidation is ex ante bad for lenders because the CDS payment cancels out with the CDS fee (CDS are fairly priced) and the liquidation value is low.

Therefore, the lender overinsures if and only if the probability of success is sufficiently high.

3.3 Project Choice and Financing

The lender's payoff with just-insurance is δy_2 , thus the project is financed if and only if $A \geq I - \delta y_2$. We classify the borrower's financial condition according to his initial funding, A . If $A \geq I - \delta y_2$ the borrower is *financially unconstrained*, whereas if $A < I - \delta y_2$ the borrower is *financially constrained*. We denote by $\bar{A}$ and $\underline{A}$ the amount of funds of financially unconstrained and financially constrained borrowers, respectively. The borrower's payoff under just-insurance is

$$p(y_1 - \delta y_2 + y_2) + (1 - p)[(1 - \delta)y_2 + \tilde{y}_2 - \delta y_2] = py_1 + (1 - \delta)y_2. \quad (4)$$

With overinsurance, the lender's payoff is py_2 and the project is financed if and only if $A \geq I - py_2$. We assume that a financially constrained borrower can be financed under overinsurance. Formally, there exists $p^* \in [\underline{p}, \bar{p}]$ such that $\underline{A} = I - p^*y_2$. The borrower's payoff under overinsurance is

$$p(y_1 - y_2 + y_2) + (1 - p)0 = py_1. \quad (5)$$

The borrower's payoff with overinsurance is increasing in the probability of success, implying the financially constrained borrower chooses $p = \bar{p}$. The financially unconstrained borrower, however, can choose whether he is financed with either overinsurance or just-insurance. The highest payoff with overinsurance is $\bar{p}y_1$. According to Proposition 4, the maximum payoff consistent with just-insurance obtains when $p = \delta$ and is given by $\delta y_1 + (1 - \delta)y_2$. We summarize these results in Proposition 5.

Proposition 5 *Suppose the financially constrained borrower can be financed with overinsurance. Then*

- (1) *The financially constrained borrower optimally chooses $\bar{p}$ (which induces overinsurance).*
- (2) *The financially unconstrained borrower optimally chooses δ (which induces just-insurance) over $\bar{p} \geq \delta$ if and only if $\bar{p} \leq \bar{c} \equiv \delta + (1 - \delta)\frac{y_2}{y_1}$.*

4 Efficiency and Regulatory Constraints on CDSs

In our model, efficiency requires no liquidation given default. It follows that it is always efficient for the lender to just-insure. CDS just-insurance improves debt capacity and does not cause the empty creditor problem. This result questions the reform proposals made by Hu and Black (2008), who argue that lenders' CDS positions should be limited to positive net economic ownerships. Our model says that, in this case, restructuring proceeds would be reduced when just-insurance is optimal.

Overinsurance, however, is inefficient if the project can be financed in the absence of CDS markets. According to Proposition 5, the empty creditor problem is less relevant when it is optimal for the financially unconstrained borrower to choose δ over $\bar{p}$. In this case, empty creditors appear if and only if the project cannot be financed without overinsurance. The problem, however, is that of risk-shifting behavior that is induced by CDSs.

The financially unconstrained borrower choosing a riskier project is inefficient if and only if

$$\bar{p}(y_1 + y_2) > \delta(y_1 + y_2) + (1 - \delta)y_2,$$

or $\bar{p} \geq \underline{c} \equiv \delta + (1 - \delta) \frac{y_2}{y_1 + y_2}$. This condition along with the second result of Proposition 5 leads to Proposition 6.

Proposition 6 *There is inefficient risk-shifting if and only if*

$$\underline{c} \leq \bar{p} < \bar{c}.$$

Proposition 6 is the most important result of our paper. It says that CDSs might lead to risk-shifting. The intuition is the following. CDSs increase the lender's bargaining power in distress renegotiations. If the lender overinsures, she liquidates the borrower when the project fails. As a result, the borrower is prevented from capturing rents in the bad state, which maximizes the debt repayment in the good state. All in all, the borrower's payoff is minimized.

If the lender just-insures, she does not commit to unconditional liquidation in the bad state. Instead, she positions herself so as to bargain over the surplus stemming from restructuring. At the same time, the borrower retains a fraction of the restructuring value when verification of funds is imperfect, which results in a lower debt repayment in the good investment state. Therefore, the borrower's payoff is higher under just-insurance compared to that under overinsurance.

Since the lender prefers to overinsure if and only if the investment probability of success is high, the financially unconstrained borrower might benefit from choosing a riskier project so as to induce the lender to just-insure. This will be the case when the highest payoff under overinsurance — attained when the highest probability of success $\bar{p}$ is chosen — is lower than that under just-insurance — obtained when a riskier project with probability $\delta \leq \bar{p}$ is chosen. In other words, risk-shifting occurs when $\bar{p}$ is sufficiently low.

Finally, risk-shifting is inefficient if and only if choosing the safest investment results in a higher aggregate payoff. This is true when $\bar{p}$ is high enough.

Our results imply that the economy could have a higher probability of facing a crisis in the presence of CDSs. While the empty creditor problem worsens a crisis due to inefficient ex post liquidation, the risk-taking behavior problem increases the odds of downturns in the first place.

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Referee Appendix - Not Intended for Publication

Proof of Proposition 3. Suppose $R_1 > y_2$. In this case borrower always triggers renegotiation. The lender's payoff is

$$x(\pi) - f$$

if she buys a CDS with $\pi \leq \pi^*$ and $\pi - f$ if she buys a CDS with $\pi > \pi^*$. In the former case, since a credit event never occurs and the CDS provider is competitive, $f = 0$. The lender's payoff is maximized when she chooses $\pi = \pi^*$, which yields her a payoff of δy_2 . In the latter case, the competitive CDS provider charges $f = \pi$ and the lender's payoff is 0 regardless of his CDS position. Therefore, since $\delta y_2 > 0$, the lender buys a CDS with $\pi = \pi^*$. Suppose $R_1 \in (\delta y_2, y_2]$. If the lender buys a CDS with $\pi \leq \pi^*$, then

$$R_1 > \delta y_2 = x(\pi^*) \geq x(\pi).$$

Therefore, the borrower always triggers renegotiation. The lender's payoff is $\delta y_2 - f$. Because a credit event never occurs, the competitive CDS provider charges $f = 0$. Therefore, the lender's payoff is δy_2 . If the lender buys a CDS with $\pi > \pi^*$, then since $R_1 \leq y_2$, the borrower does not trigger strategic renegotiation. The lender's payoff is

$$pR_1 + (1 - p)\pi - f.$$

Since the breakeven condition for the competitive CDS provider is

$$f = \pi(1 - p),$$

the lender's payoff is pR_1 . Therefore, the lender buys a CDS with $\pi > \pi^*$ if and only if

$$\begin{aligned} pR_1 > \delta y_2 &\iff \\ R_1 &> \frac{\delta y_2}{p}. \end{aligned}$$

Suppose $R_1 \leq \delta y_2$. In this case the borrower never calls for strategic renegotiation. In the lender buys a CDS with $\pi \leq \pi^*$, his payoff is

$$pR_1 + (1 - p)x(\pi) - f.$$

Since a credit event never occurs, the competitive CDS provider charges $f = 0$. Since the lender's payoff is increasing in π , it is optimal to choose $\pi = \pi^*$. Therefore, the lender's payoff is

$$pR_1 + (1 - p)\delta y_2.$$

If the lender buys a CDS with $\pi > \pi^*$, then his payoff is

$$pR_1 + (1 - p)\pi - f.$$

Because the competitive CDS provider charges $f = \pi(1 - p)$, the lender's payoff is pR_1 . Clearly, it is optimal for the lender to demand $\pi = \pi^*$. ■