Corporate Hedging, Contract Rights, and Basis Risk*

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ABSTRACT

A hedging portfolio may be terminated by a counterparty when a firm experiences an "event of default," such as a credit downgrade, non-payment, or bankruptcy filing. Counterparties often exercise such termination right and are more likely to do so if the firm owes them money, leaving the firm exposed to risk at the worst possible time. We build the theoretical model and show that although the termination right reduces the costs of hedging, it is inefficient because the counterparty exercising the right does not consider the externality imposed on a firm. Firms hedge less because of the termination right, particularly when bankruptcy costs are high, and have a lower probability of survival. Our results help explain why firms in distress reduce their derivative portfolios and why they may shift to physical delivery contracts. Using hand-collected data and textual analysis, we find that the termination rights are exercised in 62% of default cases and that the key predictions of the model are supported by the data.

JEL codes: G30, G32

Keywords: hedging, risk management, derivatives, event of default, distress, basis risk, ISDA, Master Agreement

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I. Introduction

Derivative contracts are highly standardized and are typically governed by the International Swaps and Derivatives Association (ISDA) Master Agreements that apply to over-the-counter (OTC) derivative transactions.[1] To protect a counterparty against a failure to pay and to reduce counterparty risk, a standard agreement contains an "event of default" clause, which may be triggered by a firm's default on its obligations, bankruptcy filing, misrepresentation, credit downgrade, covenant violation, or a merger without full assumption of liabilities. Triggering an event of default gives the counterparty the right, but usually not the obligation, to close its derivative agreement with the firm prior to maturity, and this right is often exercised in practice. In this paper, we examine the exercise policy of the termination right and study how derivative terminations affect firms' hedging policies and the probability of firm survival. We show that because both the availability of the termination right to a counterparty and the incentive to exercise it are negatively correlated with firm performance, firms are deprived of their hedging portfolios precisely when hedging has most value.

To determine the optimal exercise policy of the termination right from a counterparty's perspective, we build a theoretical model that incorporates the realistic frictions. First, all else equal, the derivative counterparty that originated the contract (usually a large bank) may be reluctant to terminate the contract if it values continuing business with the firm (e.g., because of recontracting costs or the ability to cross-sell other products). Second, when there is a significant probability of costly firm bankruptcy or liquidation following an event of default, the counterparty may prefer to exercise the right to receive the immediate cash payment rather than to recover it from the firm later, when the value of firm's assets and collateral may be reduced. Likewise, in case when the counterparty is expected to procure

[1] A major advantage of OTC derivatives over exchange-traded derivatives is that they are flexible and allow the counterparties to tailor the terms of the contracts to suit their desired risk profiles, take large positions without a significant price impact, or enter into contracts with longer maturities. More than 90% of end-users indicate that they use OTC derivatives (Franzen (2000)) and their notional amount grew by 2022 to more than $600 trillion (Bank for International Settlements).

a payment with its contract termination notice it may be benefitial to continue with the contract as it may take years to verify and prove the right to payment.[2]

Using the model, we show that the hedging contract is terminated optimally when the fair value of the derivative portfolio to the counterparty is positive and exceeds a certain threshold. More precisely, the counterparty exercises its right when it expects a settlement payment which is higher than the expected value of keeping the contract active. We also show that the value of this option increases in expected bankruptcy costs and in basis risk. Intuitively, the latter is because basis risk increases the likelihood that the firm experiences an event of default at the time when it owes money to the counterparty, which makes it more likely that the exercise threshold is reached.

The implication of this finding is simple. A firm is likely to end up losing its hedging contract in the situation when it needs protection the most. As we argued, the termination option becomes active only when the firm already experiences one of the contractual "events of default" and therefore already likely to be financially distressed. Additionally, the probability of the option exercise is higher when, through the basis risk, the distressed firm owes a payment (instead of expecting a payment, as it would be the case for a perfect hedge). Finally, the termination of the hedging portfolio is also more likely when the bankruptcy is expected to be more costly.

The model shows that the early termination of the derivative portfolio by the counterparty is inefficient in a sense that it benefits the counterparty exercising the right less than it hurts the firm. This is because the benefit to the counterparty accrues mainly because it can claim its contractual payments early, before they are reduced by potential bankruptcy costs. Yet,

[2] In the past, counterparties often relied on Section 2(a)(iii) of the Master Agreement to claim that, when they opt not to terminate the contract, they may refrain from making payments owed to the defaulted entity for as long it remains in default (McNamara and Metrick (2019)). However, the legal interpretations of the applicability of Section 2(a)(iii) vary: several cases in London resulted in a court determination that Section 2(a)(iii) is effective to suspend payment obligations of a non-defaulting party until the default is cured, potentially resulting in an indefinite suspension of such obligations; yet, U.S. bankruptcy court in New York effectively took the opposite view, determining that Section 2(a)(iii) is in violation of the automatic stay provisions.

for the firm, losing the hedging portfolio at a time of distress increases the probability of its liquidation, which taxes *all* assets of the firm. For this reason, even though consenting to the early termination option reduces the cost of derivatives to the firm, the disadvantage of higher ex-post risk outweighs the ex ante cost savings. In turn, the inefficiency of hedging portfolio termination reduces the firm's incentive to enter hedging positions. Somewhat counter-intuitively, the termination right can make a firm want to hedge less when its bankruptcy costs are high. This is because the counterparty is more likely to exercise the termination right with higher bankruptcy costs. Overall, although hedging is still desirable for risk reduction, the inefficiency of the termination right reduces the value of hedging to the firm.

To test the predictions of the model about the exercises of contract termination rights and to see whether these events can contribute to explaining evidence on low corporate hedging in distress, we collect data from several sources. First, we obtain detailed data on the hedging portfolios of firms during the period 1999-2020 for several industries where we can precisely measure risk exposures: crude oil and natural gas hedges by oil and gas producers (SIC 1311), jet fuel hedges by commercial airlines (SIC 4512), diesel fuel hedges by coal producers (SIC 1220), and metal hedges by steel producers (SIC 3310-3330).[3] Second, to broaden our inference beyond firms in these industries, we use textual analysis for all firms in Compustat/SEC universe and calculate their hedging intensity based on the frequency of hedging-related words used in their 10-K forms (e.g., 'risk management', 'derivative', 'hedg', 'swap', 'collar', etc.). Third, we obtain information on the events of default from the database compiled by Dou, Taylor, Wang, and Wang (2021) and Ma, Tong, and Wang (2021), as well as from the UCLA LoPucki Bankruptcy Research Database that records bankruptcy petitions by large U.S. firms. Finally, we hand-collect the information on derivative terminations by the counterparties around the events of default.

[3]These industries provide an excellent setting to study risk management practices due to their strong exposures to commodity prices and the existence of well-developed derivative markets. For many other industries, the bulk of hedging focuses on interest rate or foreign exchange risks.

Using our detailed industry sample, we find that counterparties exercise their termination rights in 62% of default cases and are more likely to do so when the fair value of the derivative portfolio is positive. The estimate of the frequency of the exercise is conservative because firms are not obligated to disclose it. Further, consistent with many of the previous studies, we find that corporate hedging using financial derivatives drops substantially when the firm experiences an event of default. For example, controlling for firm and year fixed effects, we find that firms in both the broad Compustat/SEC sample and the detailed industry sample are approximately 16% less likely to use derivatives once an event of default clause has been triggered. Similarly, firms' hedge ratios and hedge maturities drop by 15% and 6 months, respectively. All of these effects are significantly more pronounced for high-cost ("prepackaged/prenegotiated") than low-cost ("free fall") bankruptcies,[4] which is consistent with the model's prediction that terminating derivatives is more attractive for the counterparties when a prospective bankruptcy is perceived to be more costly.

That derivative contracts can be terminated following an event of default offers a novel complementary explanation for why distressed firms tend to have low hedge ratios (see, e.g., Rampini, Sufi, and Viswanathan (2014) and Almeida, Hankins, and Williams (2021)). Whenever an event of default clause is triggered, the affected contracts are effectively removed from the books, and it appears as if the firm unwinds its hedging positions. Additionally, the continuing event of default, fixed costs, or collateral constraints may impede the company's ability to quickly re-contract to the prior level. Firms state in the disclosures that entering a new contract would be difficult. While it is certainly possible that firms are voluntarily decreasing their use of derivatives in distress (e.g., because of collateral constraints or risk-shifting incentives near default), we also find that the relation between firms' observed hedge ratios and the occurrence of events of default is driven almost entirely by cases with con-

[4]The prenegotiated and prepackaged bankruptcies are generally considered to be less costly because there is a preliminary agreement reached between shareholders and creditors on the terms of a reorganization plan. Such bankruptcies typically allow firms to save on legal fees and tend to settle faster (see, e.g., Tashjian, Lease, and McConnell (1996) and Betker (1997)).

firmed derivative terminations by the counterparties. These results suggest that derivative terminations may be one of the reasons why firms do not hedge in distress and provide a complimentary explanation to the one proposed by Rampini and Viswanathan (2010).

To mitigate a potential concern that derivative terminations simply proxy for a deterioration of firm financial condition, we perform an additional test for firms in the coal industry. The coal industry presents a useful laboratory because coal firms hedge both using financial derivatives, which are governed by the ISDA Master Agreements, and supply agreements, which are not. If derivative terminations simply proxy for worse financial conditions and firms voluntarily unwind their hedging programs once in distress, then both hedging with derivatives and hedging with supply agreements should be affected. In contrast, we find that only hedging with derivatives drops following events of default, while hedging with supply agreements is unaffected, which is consistent with derivative terminations causing a decline in corporate hedging when an event of default is triggered. In addition, these results give further support to the findings by Almeida, Hankins, and Williams (2021), who document that hedging with purchase obligations (PO) does not drop significantly in distress and that firms often substitute purchase obligations for financial derivatives once in distress.

Finally, we identify the variation in the decision of counterparties to terminate their derivative contracts that is unrelated to firm financial condition. Specifically, we estimate the movements in the moneyness of the derivative portfolio by tracking the movements in the price of the hedged commodity during the one month before an event of default is triggered and leverage the fact that exercise is more likely when the portfolio is in-the-money for the counterparty. Consistent with derivative terminations accounting for low hedging in distress, we find that firms experience substantially larger drops in their hedge ratios and maturities when the events of default are triggered following an appreciation in the price of the hedged commodity.

The paper is organized as follows. In the next section, we provide background and a brief overview of the existing literature. We then present a simple model of optimal exercise of the termination option, determine the value of this option, and study the role of the basis risk and moneyness. In the next two sections, we describe our data sources, construction of the main variables, and the procedure for textual search and discuss the empirical results. The last section concludes.

II. Institutional Background

Here we briefly describe the contingencies and consequences of terminating a hedging position under the ISDA Master Agreement. Most over-the-counter derivative contracts are governed by the Master Agreements, with the standard being the ISDA Master Agreements of 1992, 2002, or 2012 published by the International Swaps and Derivatives Association (ISDA.org).[5] These contracts serve all OTC derivative transactions, both in the United States and internationally, and help to avoid negotiations of the legal terms on a transaction-by-transaction basis. The ISDA Master Agreements describe how parties can enter into bilateral contracts, make payments, and arrange collateral, and they also contain termination clauses intended to reduce credit exposure if one of the parties defaults on its obligations (Franzen (2000)). Finally, these agreements are not product-specific, meaning that parties who signed a bilateral agreement for a particular class of transactions can make all future transactions subject to the same agreement and only need to negotiate the economic terms, such as notional amount or maturity.

The ISDA Master Agreement contains eight standard events of default, which allow the non-defaulting party to close the derivative position before maturity, but most agreements

[5]The main difference between the 1992 ISDA and the 2002 ISDA Master Agreements stemmed from the calculation of amounts owed on early termination (see, e.g., Charles (2012) and McNamara and Metrick (2019)). The 1992 ISDA agreement allowed the choice between the "Market Quotation" or "Loss" methods. The "Market Quotation" method required the non-defaulting party to procure three quotations from leading dealers on the amounts they would expect to pay or receive to enter into a replacement transaction with the non-defaulting party, whereas the "Loss" method required the non-defaulting party to make a good faith determination of its total losses or gains stemming from the termination. In contrast, the 2002 ISDA agreement introduced a hybrid "Close-Out" approach.

include additional events in the attached schedules or credit support annexes. The standard events for the party at fault include: a) failure to pay; b) breach of agreement; c) failure of the external credit support; d) misrepresentation; e) default on other (separately specified) transaction; f) cross-default; g) bankruptcy of the firm; and h) merger without full assumption of liabilities. In addition, there are "termination" events which, although nobody is at fault, warrant the early termination of the transactions, such as a change in tax law resulting in taxes being imposed on transactions, illegality, or a merger of a party resulting in a deterioration in its credit quality. Finally, the parties can specify additional termination events in the agreement and these events are typically credit-related, such as credit downgrades by one or more specified credit rating agencies of a firm's outstanding long-term debt.

Upon an event of default or a termination event with respect to one party (the "defaulting party"), the other party is entitled to terminate all the outstanding transactions or the affected transactions pursuant to a termination event, value them and net out amounts owed by the defaulting party from any amounts that may be owed to the defaulting party. Only the party with the greater debt is liable to pay the netted amount. The single agreement concept reduces counterparty credit risk by ensuring that settlement payments, margin payments, and close-out payments only flow from the party who owes the greater amount.

There are two important moments to keep in mind. First, the event of default or termination event create an option, but usually not the requirement, to close the agreement. There are a number of scenarios where a party may not wish to close out an ISDA Master Agreement, even where an event of default has occurred. For example, if the close-out would result in it having to make a sizeable payment to the defaulting party, then the non-defaulting party may not be inclined to exercise its right to terminate. Second, as most other agreements, the derivative agreements typically provide for the "grace period" before they can be closed, to give the opportunity to react to an event. Grace periods therefore provide parties with an opportunity to remedy the issue that might otherwise give rise to an event of default. A right to close out is only exercisable for as long as the relevant event of default or termination event is continuing. If the underlying event is remedied or otherwise ceases to exist, then the right to terminate is lost and the transactions continue as before.

Once the qualified event is triggered and the position is to be closed, the parties must decide on how to calculate and net the final payment. The ISDA Master Agreement provides that the close-out amount is determined by assessing the amount of the losses or costs incurred (or the gains realized) in replacing the terminated transactions or by providing the economic equivalent of the material terms of the terminated transactions. The early termination amount is a net amount. Where termination values are separately calculated in respect of individual transactions or groups of transactions, they are added to produce the single early termination amount. Close-out netting has advantages from several perspective. For example, when analyzing the amount of overall financial exposure of a firm to each of its counterparties, credit departments will base the amount on the net exposure when a legally enforceable netting agreement is in place.

In sum, the hedging contracts may be closed after a number of events, including default, bankruptcy, credit downgrade, or a merger. Following such events, the final amount is calculated as a replacement value of the position to be cancelled, and the payments for the multiple positions are netted.

III. Literature

Our paper contributes to the literature on corporate hedging, which examines determinants of risk management policies and channels for firm value creation. Corporate hedging can increase shareholder value by reducing tax liability and increasing debt capacity (Smith and Stulz (1985), Graham and Smith (1999), Graham and Rogers (2002), Leland (1998), Haushalter (2000)), reducing financing costs and improving access to finance (Bolton, Chen, and Wang (2011), Cornaggia (2013)), increasing corporate investment and international trade (Froot, Scharfstein, and Stein (1993), Campello, Lin, Ma, and Zou (2011), Jung (2021)), reducing costs of financial distress (Smith and Stulz (1985), Fehle and Tsyplakov (2005), Purnanandam (2008), Gilje and Taillard (2017), Ellul and Yerramilli (2013)), improving contract terms with firm customers, creditors, and managers (Bessembinder (1991)), increasing expected firm profits when revenues and costs are nonlinearly related to prices (Mackay and Moeller (2007)), and alleviating information asymmetries (DeMarzo and Duffie (1995), Manconi, Massa, and Zhang (2018)). Several papers focus on the role of managerial risk-aversion and compensation contracts (Stulz (1984), Tufano (1996), Knopf, Nam, and Thornton (2002), Bodnar, Giambona, Graham, and Harvey (2019)), lender interests and binding covenants (Babenko, Bessembinder, and Tserlukevich (2023)), and economies of scale (Mian (1996), Nance, Smith, and Smithson (1993), Geczy, Minton, and Schrand (1997)) as determinants of hedging policies. We contribute to this literature by showing that derivative contract terminations have significant explanatory power for firms' observed hedging outcomes and may impede firms from realizing the full benefits of hedging.

Our work is related to recent studies examining the preferential treatment of derivatives in bankruptcy (see, e.g., Roe (2011), Bolton and Oehmke (2015)). Specifically, Bolton and Oehmke (2015) model priority conflicts in bankruptcy between debtholders and derivative counterparties by comparing the cases when the derivatives have priority in bankruptcy over all other senior claims and when they do not. Their work shows that the privileged status of derivatives effectively transfers default risk to debtholders, thereby increasing the cost of borrowing and increasing the need for hedging, while the positive effect of the privileged status of derivatives comes from cross-netting benefits for derivative writers who serve as counterparties to many firms with imperfectly correlated defaults. Our work differs from Bolton and Oehmke (2015) in that we focus on the optimal exercise policy of contract termination rights prior to costly firm liquidation and consider the effect of termination rights on firm hedging policy and survival.

The literature pioneered by Rampini and Viswanathan (2010) focuses on the role of collateral constraints for hedging by constrained firms. Their insight is that the opportunity cost of engaging in risk management is forgone current investment and therefore constrained firms hedge less. Subsequently, Rampini, Sufi, and Viswanathan (2014) test the theory predictions using a sample of 23 U.S. commercial airlines and find that more financially constrained airlines, i.e., those that have lower net worth and lower credit ratings, are less likely to hedge fuel costs.[6] They also find that fuel hedging drops when airlines enter distress, i.e., when their credit ratings decrease to CCC+ or below or they enter bankruptcy. Bretscher, Schmid, and Vedolin (2018) argue that risk management through swaps is inherently risky for constrained firms and show that although constrained firms hedge more, they are left more exposed to risk even after hedging. Consistent with findings by Rampini, Sufi, and Viswanathan (2014), we find that firms' hedge ratios decrease by 25% to 29% when they are in default (e.g., in Chapter 11), but we also find that the negative changes in the hedge ratios are strongly associated with the events of derivative contract terminations by firm counterparties.

Our study also contributes to the literature on risk management by means other than OTC derivative. Recent papers by Almeida, Hankins, and Williams (2017) and Almeida, Hankins, and Williams (2021) show that purchase obligations (POs), which are the forward contracts with suppliers, are used by many firms as a risk management tool. Almeida, Hankins, and Williams (2021) build a model where POs relax the firm liquidity constratraint and find that firms in distress shift away from derivatives and use more POs. We argue that the important difference between POs and derivatives is that the former are not subject to the ISDA Master Agreements, which allows firms that use them to stay hedged following an event of default. Consistent with this argument, we find that counterparty derivative

[6] Rampini, Viswanathan, and Vuillemey (2020) and Vuillemey (2019) also provide evidence that higher net worth by banks and financial institutions is associated with more hedging using data on interest rate and foreign exchange risk hedging.

terminations have no significant explanatory power for the dynamics of POs in distress, while they can explain the dynamics of hedging with derivatives.

Another strand of literature focuses on the question how hedging is affected by supply of derivatives. Giambona and Wang (2020) use for identification a regulatory change in treatment of derivatives in bankruptcy that allowed derivative counterparties to circumvent the automatic stay provision of the U.S. Bankruptcy Code: The Safe Harbor Reform of 2005. They find that following the reform, fuel hedging by airlines has increased, especially for financially distressed airlines that are affected more by the reform. In a related paper, Hu and Shan (2022) find, however, that firms that use derivatives borrow less and pay higher loan spreads following the 2005 reform, which is consistent with priority conflicts between debtholders and derivative counterparties.

IV. Model

To develop the intuition and motivate our empirical analysis, we build a model of firm hedging. The firm has risky cash flows and fixed liabilities and holds a portfolio of derivatives that partially hedges its cash flow risk. When the cash flows are sufficiently low, the firm may experience an event of default, which gives its derivative counterparties a right to terminate their derivative contracts with the firm early. Subsequent to the event of default, the firm may either recover or be liquidated, depending on further cash flow realizations, the counterparty's decision to terminate or continue the contract, and the performance of the derivative portfolio.

A. Preliminaries

There are three dates: 0, 1, and 2. The firm has random cash flows at date 1 and date 2, $C_1 \in \{C_1^L, C_1^H\}$ and $C_2 \in \{C_2^L, C_2^H\}$, with the corresponding probability that the cash flow is low at date t of p_t. In addition, the firm has fixed liabilities D_1 and D_2 due at dates 1 and

2, respectively (see Figure 1).

Unless stated otherwise, we assume that the counterparty issuing derivatives is safe and for simplicity refer to it as a bank. A standard hedging contract is signed between a firm and a bank at date 0. The contract matures and settles at date 2, unless there is an event of default at date 1.[7] Specifically, if the firm experiences an event of default at date 1 (prior to contract maturity), the bank has the right to terminate the contract with the firm by settling it at the current fair value V_1. A positive value of V_1 means that the firm owes money to the bank, and a negative value means that the bank owes money to the firm.[8]

We assume that the value of the derivative portfolio to the bank is binomial: $V_1 \in \{V_1^L, V_1^H\}$, $V_1^L < 0, V_1^H > 0$. Following Bolton and Oehmke (2015), we assume that the value V_1 is linked to some underlying asset, such as a commodity price, which is imperfectly correlated with the firm's cash flows. Specifically, we assume

$$P[V_1^H|C_1^H] = P[V_1^L|C_1^L] = \rho, \tag{1}$$

$$P[V_1^H|C_1^L] = P[V_1^L|C_1^H] = 1 - \rho, \tag{2}$$

where $\rho \in [\frac{1}{2}, 1]$ captures the fact that the derivative portfolio is a hedging asset, with a higher value of ρ implying lower *basis risk*. For example, when $\rho = 1$, the firm never has to pay to the bank a large amount V_1^H when its cash flow is low.

To model the decision of the bank to terminate the derivative contract at $t = 1$, we need to specify when an event of default occurs. In practice, the event of default is more likely when the firm has a low cash flow and could be triggered, among other things, by a firm's credit downgrade, covenant violation, misrepresentation, or a missed interest payment. For simplicity, we assume that the default is triggered by a net worth covenant violation, i.e., the event of default occurs when a firm's cash flow net of the liabilities and the value of the

[7]In the main analysis, we focus on the default by the firm and postpone the discussion of the default by the bank to later sections.

[8]Throughout the paper, we denote by V_t a value of the derivative to the bank, implying that the value of the derivative to the firm is $-V_t$.

derivative portfolio is negative

$$C_1 - D_1 - V_1 < 0. \tag{3}$$

Further, we assume that the above condition is satisfied only if both $C_1 = C_1^L$ and $V_1 = V_1^H$. Thus, the event of default occurs when the firm's cash flow is low and the value of the derivative portfolio moves against the firm.

Given an event of default, the bank has the right to either continue the contract with the firm until maturity or to terminate it early, in which case the bank simply recovers the contract's current value V_1. We assume that continuing the contract with the firm, as opposed to terminating it, has benefits for the bank, $\theta > 0$, which are realized only if the firm is not liquidated. These benefits could capture the value of the ongoing relationship between the firm and the bank (e.g., the bank can cross-sell other products to the firm or has an informational advantage over other market participants).[9]

Finally, we assume that if by the time of liquidation there is an outstanding derivative contract of value V_2 (either because there was no default at $t = 1$ or because the bank chose not to terminate the contract), the final netted payment is subject to costs. Specifically, if at $t = 2$ either the firm or the bank owes a payment, we assume that this payment is reduced by a proportional cost, α, which we refer to as bankruptcy costs. These costs can capture the delays in obtaining payments from a liquidated firm or capture the fact that the payment of the money owed to the bankrupt firm is often postponed, sometimes by several years in case of complex bankruptcies, and it could be negotiated down (see, e.g., Roe (2011) and McNamara and Metrick (2019)).[10]

We model the evolution of the derivative portfolio from $t = 1$ to $t = 2$ as binomial, $V_2 \in \{V_1 + \Delta_H, V_1 + \Delta_L\}$, $\Delta_H > 0$, $\Delta_L < 0$, and assume that the innovations in the

[9]Because the probability of being liquidated is higher for low-performing firms, the value of the ongoing relationship with such firm is also lower.

[10]The model could be easily extended to acommodate the asymmetric cost levied on the positive and negative contract payments.

derivative value are positively correlated with the firm's cash flows

$$P(\Delta_H | C_2^H) = P(\Delta_L | C_2^L) = \rho, \tag{4}$$

$$P(\Delta_L | C_2^H) = P(\Delta_H | C_2^L) = 1 - \rho. \tag{5}$$

Because the derivative is fairly priced at $t = 1$, we impose $V_1 = E(V_2)$, implying the following restriction on the probabilities

$$(1 - p_2)(\rho\Delta_H + (1 - \rho)\Delta_L) + p_2((1 - \rho)\Delta_H + \rho\Delta_L) = 0. \tag{6}$$

For example, in a simpler case when the high and low cash flows are equally likely, $p_2 = 1/2$, this condition implies that the value of the hedging portfolio increases and decreases by the same amount, $\Delta_H = -\Delta_L$.

The firm can only be liquidated at $t = 2$. Whether it is liquidated depends on firm's cash flows and the performance of the derivative portfolio. Specifically, the firm is liquidated if

$$C_1 + C_2 - D_1 - D_2 - V_2 < 0. \tag{7}$$

We assume that for this condition to be satisfied it is necessary that the firm receive two low cash flow realizations C_1^L and C_2^L. Further, the liquidation condition is satisfied if $V_2 = 0$ (firm is liquidated after low cash flows if it did not hedge) or $V_2 = V_1^L + \Delta_H$ (the firm that did not default may be liquidated later if the derivative portfolio moves against the firm), and that the condition is not satisfied with $V_2 = V_1^H + \Delta_L$ (defaulted firm is not liquidated if the derivative portfolio performs well.) These conditions imply, in particular, that hedging is valuable and that firms that continue to hedge beyond $t = 1$ have better chances of avoiding costly liquidation because the payoff from the derivative portfolio can help mitigate the negative cash flow shock.

We also make the following simplifying assumption.

Assumption 1. $C_1^L + C_2^L > \frac{1-\rho}{\rho}(V_1^H + \Delta_H)$.

This assumption is always satisfied when there is no basis risk, $\rho = 1$. When, on opposite, basis risk is the highest, $\rho = 1/2$, this assumption implies that the total firm's cash flows are larger than the portfolio that hedges these cash flows (the hedge ratio does not exceed one even when hedging is most efficient).

B. Optimal Exercise Policy

Here we examine the exercise policy of the right to terminate the derivative contract early. Recall that the option is only available if the firm experiences an event of default. The bank terminates the derivative contract at $t = 1$ if it receives a payment V_1^H which is greater than the expected continuation value

$$\begin{aligned} V_1^H &> (1-p_2)(V_1^H + \rho\Delta_H + (1-\rho)\Delta_L + \theta) + p_2\rho(V_1^H + \Delta_L + \theta) \\ &\quad + p_2(1-\rho)\big(V_1^H + \Delta_H\big)\,(1-\alpha). \end{aligned} \tag{8}$$

The first two terms in (8) reflect the expected value to the bank if the firm recovers, either because its cash flows improve (the first term) or because the hedging portfolio offsets the low cash flows (the second term). The last term in (8) represents the payoff to the bank in case of firm liquidation.

Using the condition (6), we can therefore rewrite (8) as

$$V_1^H > \frac{\theta(1 - p_2 + \rho p_2)}{\alpha p_2(1-\rho)} - \Delta_H \equiv V^*. \tag{9}$$

Intuitively, the bank terminates the contract early when its expected losses in case of firm liquidation are higher than the expected value of continuing business with the firm in case of recovery. From (9), there are several key comparative statics. First, the contract is more likely to be terminated by the bank if the value of the derivative today is high. This is because a higher value exposes the bank to higher expected bankruptcy costs. Second, a higher bankruptcy costs parameter, α, makes the termination of the contract more attractive, and particularly so when the basis risk, $1-\rho$, is high. Finally, the higher benefits of contract continuation, θ, naturally imply the lower incentive to terminate the contract early.

C. The Value of Termination Right

If the termination right is exercised by the bank, i.e., $V_1^H > V^*$, then the expected value of the termination right at $t = 0$ is

$$R_0 = p_1(1-\rho)\left(\alpha p_2(1-\rho)(V_1^H + \Delta_H) - \theta(1 - p_2 + p_2\rho)\right). \tag{10}$$

The first term in (10) is the reduction in bankruptcy costs on the expected payment to the bank in case of firm liquidation, while the second term is the relationship value in case the firm is not liquidated. Both terms are multiplied by $p_1(1-\rho)$ which is the probability of the option exercise.

The value of the derivative termination right decreases in the value of continuing business with the firm, θ, and increases in bankruptcy cost parameter, α, and basis risk of the hedging portfolio. In fact, in case of zero basis risk ($\rho = 1$), the termination right has no value for the bank. Naturally, the right also has no value if it is never optimal for the bank to exercise it, i.e., $V_1^H < V^*$. Assuming that the derivative contract is priced competitively, the termination right makes the contract cheaper for the firm by amount R_0.

D. Termination Right Inefficiency.

Although the termination right makes the derivatives cheaper for the firm by the amount R_0, it has a negative effect on the probability of firm survival, which in turn increases expected bankruptcy costs. We show below that the second effect dominates. When the derivative contract is terminated, the firm experiences liquidation in an additional state where liquidation could have been avoided by hedging. Conditional on V_1^H and derivative termination, the probability of firm liquiduation is p_2. Conditional on V_1^H and no termination, the probability of liquiduation is $p_2(1-\rho)$. Hence, the termination right decreases the ex ante probability of firm survival by the probability of V_1^H multiplied by the difference in liquidation probabilities conditional on V_1^H, which is $p_1 p_2 \rho(1-\rho)$.

Assuming that the bankruptcy costs are levied on the total firm's cash flows, $C_1^L + C_2^L$, the termination right increases the expected bankruptcy costs by

$$\Delta BC = p_1 p_2 \rho (1-\rho)\alpha (C_1^L + C_2^L). \tag{11}$$

The following proposition shows that the termination right is inefficient, in a sense that the expected losses to the firm from the increased probability of liquidation ΔBC are larger than the gains to the counterparty from terminating the contract early R_0.

Proposition 1. *If $V_1^H > V^*$, then the termination right results in a deadweight loss*

$$L = p_1(1-\rho)(p_2(\alpha\rho(C_1^L + C_2^L) - \alpha\,(1-\rho)\,(V_1^H + \Delta_H)) + \theta\,(1 - p_2 + p_2\rho))) > 0. \tag{12}$$

The intuition is most transparent if we set $\theta = 0$. In this case, the inefficiency appears because $\alpha\rho(C_1^L + C_2^L) > \alpha\,(1-\rho)\,(V_1^H + \Delta_H)$, which means that the termination of the hedging portfolio imposes bankruptcy costs on all firm cash flows, while it decreases the bankruptcy costs for the bank that are levied only on the value of derivatives. From Assumption 1, the bankruptcy costs on firm cash flows dominate. Finally, conditional on exercise, higher θ increases the deadweight losses associated with the termination right. This is because the bank's loss of expected benefit from continuing the contract with the firm leads to the bank offering a smaller discount for having a termination option.

E. The Incentive to Hedge and Bankruptcy Costs

Here we consider the benefits of hedging to the firm, with and without the termination right, and examine how the firm's incentive to hedge depends on bankruptcy costs. Perhaps somewhat surprisingly, we find that when the bank has the termination right, higher bankruptcy costs can lower a firm's incentive to hedge. Define the threshold bankruptcy cost parameter α^* as $V_1^H = V^*(\alpha^*)$

Corrolary 1. *The termination right reduces a firm's incentive to hedge. With the termination right, the firm's expected benefits from hedging are given by*

$$H = \alpha(C_1^L + C_2^L)p_1p_2\rho, \quad \textit{if } \alpha < \alpha^* \tag{13}$$

$$H = \alpha(C_1^L + C_2^L)p_1p_2\rho^2, \quad \textit{if } \alpha > \alpha^*, \tag{14}$$

and they are non-monotonic in bankruptcy costs α.

Proof. Take as a benchmark the expected bankruptcy costs of a firm that does not hedge and is therefore liquidated after two low cash flows, $BC = p_1p_2\alpha(C_1^L + C_2^L)$. Then, the corresponding expression for the firm that hedges, $BC((1-\rho)(1-\rho)+\rho(1-\rho))$, produces (13), while the corresponding expression for the firm that hedges but can have its portfolio terminated is $BC((1-\rho)+\rho(1-\rho))$, which produces (14). Note that $\rho^2 < \rho < 1$. □

The corrolary shows that, all else equal, firms with higher bankruptcy costs will not necessarily have a higher incentive to hedge. As the Corrolary shows, the benefits to hedging drop discountinuously at α^* (note that $\rho^2 < \rho$). The intuition is that the termination right is more likely to be exercised by the bank when the bankruptcy costs are higher, and the exercise of the termination right deprives the firm of hedging precisely when hedging has most value to the firm and could reduce the likelihood of firm liquidation.

F. Discussion: Derivative Collateralization and Settlement Frequency

So far we have assumed that the derivatives obligations cannot be collaterized. This assumption is reasonable for many firms where lending agreements prohibit the firm to post any collateral to derivative counterparties (Babenko, Bessembinder, and Tserlukevich (2023)).[11] Further, as pointed out by Bolton and Oehmke (2015), full collaterization of all claims means that the firm is never in default and there is never a conflict of interest between firm owners

[11] Typically, the lending agreement would not allow the firm to collateralize its derivative contracts unless the contract's counterparty is the lender.

and derivative counterparties. Nevertheless, derivative contracts may be partially collateralized in some firms or industries (e.g., firms in the airline industry frequently post collateral to derivative counterparties).

Here we consider an extension of the model and examine the role of derivative collateralization for the exercise policy of the derivative termination right. To model collateral, we assume that part of cash flow, C_0, is realized early at $t = 0$, and that it can be used to post collateral to derivative counterparties.[12] To keep the model consistent with our prior assumptions, we reduce the cash flow at $t = 1$ by amount C_0, i.e., $C_1 \in \{\tilde{C_1^L} = C_1^L - C_0, \tilde{C_1^H} = C_1^H - C_0\}$.

The posted collateral affects the payoff to the counterparty in case of firm liquidation, and hence it affects the decision of the counterparty to exercise its termination right. If, by the time of liquidation, there is an outstanding derivative contract with value $V_2 > 0$, then the final netted payment is $C_0 + (1-\alpha)(V_2 - C_0)$. The collateral captures the priority of derivatives in bankruptcy and allocates the amount C_0 to a counterparty before the bankruptcy costs are levied on all assets. The condition for exercising the termination right by the counterparty at $V_1 = V_1^H$ is

$$\begin{aligned} V_1^H &> (1-p_2)(V_1^H + \rho\Delta_H + (1-\rho)\Delta_L + \theta) + p_2\rho(V_1^H + \Delta_L + \theta) \\ &\quad + p_2(1-\rho)\left(C_0 + (1-\alpha)(V_1^H + \Delta_H - C_0)\right), \end{aligned} \tag{15}$$

which can be simplified further using the fair-pricing condition

$$V_1^H > \frac{(1 - p_2 + \rho p_2)\theta}{\alpha p_2(1-\rho)} - \Delta_H + C_0 = V^* + C_0. \tag{16}$$

This condition implies that the posted collateral, C_0, increases the threshold for the exercise of the termination right, and that when the posted collateral is sufficiently large, the right is never exercised by the counterparty and has zero value. If the right is exercised at V_1^H,

[12] To keep the discussion short, we omit modeling the endogenous liquidity constraint that limits the pledgeable amount (see, e.g., Almeida, Hankins, and Williams (2021)).

i.e., $V_1^H > V^* + C_0$, then the value of the right is

$$\begin{aligned}\tilde{R}_0 &= p_1(1-\rho)\left(\alpha p_2(1-\rho)(V_1^H + \Delta_H - C_0) - \theta(1 - p_2 + \rho p_2)\right) \qquad (17)\\ &= R_0 - \alpha C_0 p_1 p_2 (1-\rho)^2.\end{aligned}$$

Thus the posted collateral not only reduces the incentive of the counterparty to exercise the termination right, but also reduces the value of the right whenever exercise is optimal. We continue to assume that the bankruptcy costs are levied on all firm's assets, which are now reduced by the amount of collateral, $C_1^L + C_2^L - C_0$. Given this assumption, the bondholders receive all assets, net of the derivative payments and bankruptcy costs.

Proposition 2. *If $V_1^H > V^* + C_0$, then the termination right results in a deadweight loss*

$$\begin{aligned}\tilde{L} &= p_1(1-\rho)\left(\alpha p_2\left(\rho(C_1^L + C_2^L - C_0) - (1-\rho)(V_1^H + \Delta_H - C_0)\right) + \theta(1 - p_2 + \rho p_2)\right)\\ &= L - p_1 p_2 \alpha C_0 (1-\rho)(2\rho - 1) > 0. \qquad (18)\end{aligned}$$

The proposition shows that the inefficiency associated with the termination becomes smaller with the posted collateral, C_0.

V. Data Sources

Our analysis requires data on firms' derivative portfolios, dates and details of the events of default where the modification to these portfolios may have occurred, and the auxiliary data on the underlying asset returns which allows us to estimate the moneyness of the derivative portfolios.

A. Events of Default

We obtain information on the events of default from several sources. Most of the events come from the sample of Chapter 11 and Chapter 7 bankruptcy filings contained in the Florida-UCLA-LoPucki Bankruptcy Research Database, which however does not cover cases by smaller firms with assets worth $100 million or less, measured in 1980 dollars. We therefore extend this dataset using events of default from the database compiled by Dou, Taylor, Wang, and Wang (2021) and Ma, Tong, and Wang (2021).[13]

Identification of default events builds on the approach of Campbell, Hilscher, and Szilagyi (2008), Gilson, John, and Lang (1990), and Gilson (1997) who study distressed firms. Similar to Campbell, Hilscher, and Szilagyi (2008), the database defines a default event as the first of the following events: Chapter 7 or Chapter 11 bankruptcy filing, delisting due to insolvency (delisting code 572), and a default or selective default rating by a rating agency. This expanded measure of failure (relative to measuring only bankruptcy filings) allows to capture some instances in which firms fail but reach an agreement with creditors before an actual bankruptcy filing, such as pre-court liquidation or pre-court reorganization (e.g., Gilson, John, and Lang (1990); Gilson (1997); Dou, Taylor, Wang, and Wang (2021)).

Finally, we separately hand-collect additional default events for four industries where we have detailed hedging data: oil and gas producers, coal producers, scheduled airlines, and steel producers. We obtain the information on the events by searching their 10-K and 10-Q statements for the keywords associated with the non-payment or default. For cases when multiple events of default are triggered, we identify the date of the first event of default. We search only for the events leading to default, because tracing other types of events listed in the ISDA Master Agreements (e.g., mergers without assumption, credit downgrades, suspected fraud, or covenant violation) is substantially more complicated.[14]

[13]Database of default events expands the set of bankruptcy events, it was developed or found applications in Chen, Dou, Guo, and Ji (2020), Ma, Tong, and Wang (2021), Dou, Taylor, Wang, and Wang (2021), Liu, Schmid, and Yaron (2020). This database merges the information on bankruptcies filed by public, nonfinancial U.S. firms from 1981 to 2012 using New Generation Research's Bankruptcydata.com, Public Access to Court Electronic Records (PACER), National Archives at various locations, and U.S. Bankruptcy Courts for various districts. We are grateful to Winston Dou and Wei Wang for kindly sharing their data with us.

[14]For example, mergers announcements do not always make it clear if they are done without assumption and there is no post-merger information on the acquired firm's hedging portfolio. Not all credit downgrades may result in an event of default since the thresholds may be defined privately in the schedules to the ISDA Master Agreements and may be different for the secured and unsecured debt. Finally, events of default related to misrepresentation and fraud are not defined in a standard way.

B. Hedging Portfolios

The basic information on the extent of firm risk management for all firms is constructed using the Compustat measure of the derivative gains and losses, while the detailed information on the firm hedging portfolios, for certain industries, is available from their annual financial statements.

Specifically, we follow the previous literature to construct a "dummy" variable for hedging based on the variables available through the Compustat for all U.S. public firms. Compustat reports variables AOCIDERGL and CIDERGL, that represent the unrealized derivative gain or loss and the derivative gains or losses. The data availability starts in January 2001. When one or both variables are different from zero, we infer that the company used derivatives in that particular year.

We also use data from U.S. oil and gas producing firms (SIC Code 1311 'Crude Petroleum and Natural Gas Extraction') that have non-missing accounting data in COMPUSTAT. We build and expand on the methodology in Babenko, Bessembinder, and Tserlukevich (2023) and Babenko and Tserlukevich (2021).

For each firm, we download the annual statements (10-K or 10-KSB) from SEC EDGAR for the period 1999-2020. We drop observations with no reported production of oil or natural gas and firm-years for which no corresponding annual reports are available. The resulting sample consists of 454 unique firms and 3,990 firm-year observations. To calculate a firm's hedge ratio (intensity of hedging) for crude oil and natural gas, we first sum, separately for each commodity, all notional amounts for the reported outstanding derivatives for the fiscal year directly following the reporting year. We then divide the hedged volume by the size of the underlying exposure, which we set to the next year's respective production of oil or gas.

C. Construction of Derivative Portfolio Moneyness

Additional sources of data are necessary to estimate moneyness of the portfolios. For the detailed sample of four industries, we collect the fair value of derivatives reported at the last fiscal year-end prior to the event of default in firms' financial statements. For consistency, we collect the fair values only for commodity hedging and ignore interest rate swaps and currency derivatives. For the sample of oil and gas producers, we also estimate the moneyness of derivative portoflios based on the movements of WTI crude oil spot prices during the one month before the firm experiences an event of default.

D. Textual Analysis of Financial Statements

We use the standard tools to read the firm's annual statements that help us estimate the extent of derivative use and to search for the default events that affected the derivative portfolios. Tools used in textual analysis (see Loughran and McDonald (2016) for the survey) have been used to identify financing constraints (Hoberg and Maksimovic (2015) and Bodnaruk, Loughran, and McDonald (2016)), the firm-level degree of innovation (e.g., Hoberg, Phillips, and Prabhala (2014)), competition within or between the industries (e.g., Ball, Hoberg, and Maksimovic (2015), Hoberg and Phillips (2016)), or the role of financial regulators (Lowry, Michaely, and Volkova (2020)). Many studies used the textual analysis tools to measure the similarities or differences in statements; for example, Cohen, Malloy, and Nguyen (2020) measure the similarity of the consecutive statements by the same firm concluding that this similarity is positively associated with the realized stock returns. Especially relevant for our study are a set of recent papers that use textual analysis to investigate the information about hedging in 10-K statements (e.g., Zhou et al (2022)).

For this part of the analysis, we examine the annual statements of all Compustat firms with the available CIK identifier, over the period from 2000, when the derivatives disclosure became standard, to 2022. The annual (10-K) statements are retrieved from the SEC's

EDGAR statements, ignoring any subsequently filed restatements. Before proceeding with the main analysis, we search the header for the firm name, identifier, the date of the report, and the stated end-of-fiscal-year date. A firm-year observation is dropped if we are unable to find the name of the firm, the date of the report, or the end of the fiscal year in the statement. Appendix Table B provides the summary of variables used in the analysis.

To search for the relevant events of default we parse the document and search for the fragments that satisfy the following conditions. The fragment must contain any keyword (including wildcards) that indicates that that the contract has ended ("cancel", "terminat", "liquidat", "unwound"), any of the keywords pointing to the nature of the contract ("deriv", "hedg", "swap", "position") and any of keywords pointing to the reason for termination or a governing document ("event of default", "master agreement", "master contract", "ISDA", "hedging agreement"). Text fragments that satisfy conditions are automatically extracted to be read manually. Our procedure for the event search is conservative, in a sense that it can undercount but not overcount the events.

To identify and quantify the derivative use, we run a simple wordcount in the text, looking for the words, including the wildcards ("collar", "derivative", "hedg", "risk management", "forwards", "futures", "swaps"). Finally, for normalization, we also count the total number of whole words in the annual statement.

E. Defaults of Derivative Providers

The providers of derivatives can also be in default and bankruptcy, albeit less frequently than the firms that use derivatives. Two particularly striking examples stand out: Lehman Brothers Holdings Inc. default on September 15th 2008 and the default of Enron Corp. on November 30, 2001, both of which had large sales of derivatives.

The differences from the derivative users default are as follows. Defaults of large counterparty is a systemic event, which may be correlated with the state of the economy but which is more likely to affect the firms exposed to the defaulted counterparty. For example, Lehman at the time of the default had about six thousand ISDA master contracts, each containing many open derivative positions. Further, the Enron's or Lehman's default is only indirectly correlated with the financial position of the firm, in other words the counterparty default may be considered exogenous to the dealings of the corporation. Finally, a peculiar feature emerging from the cases when the derivative providers defaulted is that any outstanding amount to the defaulted providers was usually delayed and deemed to be ambiguous. Again, considering Lehman brothers' derivative division as an example, we observe that some of the claims from the derivative counterparties are still unpaid.[15]

VI. Empirical Results

We start by documenting how firms' hedging portfolios change around an event of default triggered by bankruptcy filings and/or non-payment. For this purpose, we focus on the detailed sample because it allows us to measure more precisely the exposure of the firm to the commodity price and the corresponding hedge ratio. The top two panels of Figure 2 show the dynamics of the average hedge ratio and the fraction of firms hedging for the full detailed sample, and the bottom two panels show the dynamics of the average hedge ratio for two industries: oil and gas producers (SIC code 1311) and scheduled airlines (SIC code 4512). Overall, there is a sharp decline in both the hedge ratios (from 37% to 24%) and the fraction of firms hedging (from 72% to 53%) in the year when an event of default is triggered. Further, the decline is completely reversed the following year.

Figure 3 shows the dynamics of corporate hedging by the type of bankruptcy, where we classify all bankruptcies into "prenegotiated/prepackaged" and "free fall" categories. The model predicts that, all else being equal, the counterparty is more likely to terminate the derivative contract once an event of default has been triggered if it expects large bankruptcy costs. The prenegotiated and prepackaged bankruptcies are generally considered to be less

[15] The liquidation of Lehman Brothers Inc. is pending in the United States Bankruptcy Court for the Southern District of New York before Judge Shelley C. Chapman under Case Number 08-01420-scc

costly because there is a preliminary agreement reached between firm shareholders and significant creditors on the terms of a reorganization plan prior to the filing of the bankruptcy petition with the Court. Such bankruptcies may allow firms to save on legal and professional fees and tend to settle faster in the Court (see, e.g., Tashjian, Lease, and McConnell (1996) and Betker (1997). In our sample, the average time spent in bankruptcy is 172 days for prenegotiated/prepackaged bankruptcies in our sample, whereas it is 614 days for free fall bankruptcies). Consistent with the predictions of the model, Figure 2 shows that the average hedge ratios and the fraction of firms hedging drop more sharply when an event of default is associated with free fall bankruptcies. For example, the fraction of firms hedging decreases from one year prior to the year of the event of default by approximately 12% for prenegotiated/prepackaged bankruptcy cases, and it decreases by approximately 37% for free fall bankruptcy cases.

In Panel A of Table 1, we report summary statistics for the main variables in the Compustat/SEC sample. Following Almeida, Hankins, and Williams (2021), we classify a firm as a derivative user if the firm posts (positive or negative) unrealized gains or losses (variable AOCIDERGL, "Accumulated Other Comprehensive Income - Derivative Unrealized Gain/Loss") or if it has non-zero derivative gains/losses reported after net income (CIDERGL, "Comprehensive Income - Derivative Gains/Losses"). According to this measure, derivatives are used by approximately 19.9% of Compustat firms. Hedging intensity, measured by the number of hedging-related words mentioned in a firm's 10-K filing divided by the total number of words in the 10-K, averages 0.122%. Notably, the correlation between the two measures of hedging is fairly high at 60% despite significant differences in variable construction. We also report that firms in the sample spend, on average, 0.6% of firm-years in bankruptcy, with 0.2% of firm-years associated with high-cost (free fall) bankruptcies. Relatedly, the average frequency of default-related words is 0.039% in the sample, and this variable is positively correlated with the bankruptcy indicator, with a correlation of 24%.

Finally, the table also reports statistics for several firm characteristics that we use as control variables in our tests.

Panels B and Panel C provide summary statistics for the detailed sample that consists of firms in four industries: oil and gas producers (SIC 1311), scheduled airlines (SIC 4512), coal producers (SIC 1220), and steel producers (SIC 3310-3330). We focus on these four industries because firms operating in them have a clear and measurable exposure to commodity prices, which allows us to measure their hedge ratios more precisely.

Specifically, oil and gas firms typically enter into swaps, collars, and option positions to hedge crude oil and natural gas prices, and we calculate their hedge ratio as the number of barrels of oil equivalent hedged for the next year, divided by the number of barrels of oil equivalent produced next year. A barrel of oil equivalent (BOE) is the amount of energy that is equivalent to the amount of energy in one barrel of crude oil and is deemed to have the same amount of energy content as 6,000 cubic feet of natural gas.

Airlines mostly hedge the prices of jet fuel, which is a major input to their production and accounts for approximately 20% of operating costs. They typically hedge by using derivative instruments linked to prices of heating oil, crude oil, petroleum, diesel, and jet fuel, and we use as a measure of hedge ratio the percentage of next year anticipated fuel needs hedged.

For coal firms, we also consider hedging of their important input to production – diesel price – which is typically hedged using derivatives such as swaps, futures, and options. In addition, we also record the percentage of anticipated coal production hedged by these firms, which almost invariably is done through long-term delivery contracts and supply agreements. Importantly for our purposes, these contracts are not considered derivatives and therefore are not regulated by the ISDA Master Agreements. The counterparty (buyer of coal) cannot terminate the agreement if the firm (supplier of coal) experiences an event of default, but there are provisions for penalties ("liquidated damages") if the supplier breaches the agreement and fails to supply the contracted quantities at a specified time.

Finally, steel producers often hedge inputs to production, which amounts to hedging the prices of zinc, aluminum, nickel, copper, energy prices, and precious metals. For these firms, we take as the measure of hedging the highest fraction of metal hedged.

Perhaps not surprisingly, we find that firms in the detailed sample hedge more aggressively than firms in the broad Compustat/SEC sample. In fact, 63.3% of firms in the detailed sample use derivatives and 51.9% of firms use derivatives to hedge commodity prices. Notably, information in the detailed sample allows to glean the details of firms' hedging portfolios. Specifically, the hedge ratio for this sample averages 27.4% and maturity of derivative contracts averages 13.6 months. We also observe that firms in this sample spend more time in bankruptcy, with 3.8% of firm-years having a bankruptcy, of which 2.2% are "prepackaged/prenegotiated" bankruptcies and 1.6% are "free-fall" bankruptcies. Firms in the detailed sample have similar median net worth as firms in the Compustat/SEC sample, but have substantially higher asset tangibility and leverage and lower market-to-book ratios.

Table 1 also provides statistics for the sample of bankrupt firms that are also part of the detailed sample. As expected, these firms have higher leverage ratios, averaging 57.7%, and lower market-to-book ratios and firm networth, averaging 1.103 and -0.113, respectively. The average fair value of derivatives at the last fiscal year-end before bankruptcy is positive at $39.6 million, indicating that hedging is at least partly effective. In fact, only in 22.7% of cases, firms report negative fair value of derivatives the year before bankruptcy, whereas it is positive for 48.9% of firms. For those firms that have some derivatives prior to the bankruptcy, we also search their SEC filings for any of the events associated with derivative terminations. Specifically, we set derivative terminations equal to one if either in the year directly prior to the bankruptcy filing, the year of bankruptcy filing, or the year following the firms mention in their 10-K or 10-Q forms that the counterparties terminated derivatives following an event of default. In cases when we find no such statements, but the firm has SEC filings at least in the year of bankruptcy, we set derivative terminations to zero. Thus, to the extent that some firms experience derivative terminations but do not disclose such facts in their financial statements, our measure of derivative terminations may be biased downward. Nevertheless, we find that 62.1% of firms explicitly mention in the annual statements that all or some their outstanding derivative positions have been terminated by the counterparty.

We next examine the relation between a firm's bankruptcy filing and its hedging policy in the broad Compustat/SEC sample. Table 2 gives the results of OLS regressions with firm and year fixed effects, where in columns 1-3 the dependent variable is derivative user (based on reported derivative gains and loses) and in columns 4-6 it is hedging intensity (based on the number of hedging-related words in a firm's 10-K). As the results indicate, the incidence of bankruptcy has a negative and significant effect on the use of derivatives. The fraction of firms using derivatives drops by 16.3% during firm-years with bankruptcies, and this effect is significantly more pronounced for high-cost than low-cost bankruptcies (22.7% vs. 11.3%). The latter finding is consistent with the view that terminating derivatives is more attractive for the counterparties when a bankruptcy is perceived by them to be more costly.

Since derivative terminations can be triggered by any event of default (even if no bankruptcy petition was filed), we also examine how hedging changes when the frequency of default-related words in a firm's 10-K increases. Here too we find that hedging decreases when the firm starts to report more words related to default, although the economic magnitude of the effect is smaller. The results in columns 4-6 focus on a continuous measure of hedging which is obtained through the textual search of firms' 10-Ks. In line with other results, we find that hedging intensity decreases by approximately 0.051%, which is approximately 41.8% of the mean value. We also find that the decrease in hedging intensity at the incidence of bankruptcy is more pronounced for high-cost rather than low-cost bankruptcies, with the coefficients corresponding to 61.5% and 26.2% decrease relative to the mean.

In Table 3 we report the corresponding results for the detailed sample, where we can measure hedging portfolios more precisely. The dependent variables are the hedge ratio (in columns 1-2), the hedge maturity (in columns 3-4), and an indicator variable equal to one if the firm hedges commodity price exposure (in columns 5-6). Similar to the previously reported results for the broad Compustat/SEC sample, we find that bankruptcy has a significant negative effect on hedging. For example, as columns 1 and 2 show, high-cost free fall bankruptcy is associated with 23.5% decrease in hedge ratios, compared to a 7.6% decrease for the low-cost (prepackaged/prenegotiated) bankruptcy.

While the results in Table 2 and 3 are consistent with our explanation that bankruptcies trigger events of default and result in substantial derivative terminations by the counterparties, they can also be consistent with other explanations. For example, firms may be voluntarily decreasing their use of derivatives because shareholders benefit from risk-shifting near default or because a combination of collateral constraints and worsening financing conditions causes firms to voluntarily unwind their hedging programs to save cash for other needs. To address these concerns, we leverage our detailed sample, where we observe whether the firm experienced any derivative terminations by the counterparties around a particular bankruptcy petition filing or other event of default.

Figure 4 illustrates the dynamics of firm's hedge ratios around the year of an event of default for cases with confirmed derivative terminations and without. As is evident from the figure, the decrease in both hedge ratios and the fraction of firms hedging commodity prices is more pronounced for firms that experience derivative terminations. For example, the fraction of firms hedging decreases from 100% (only firms that hedged are considered) to approximately 43% for cases with derivative terminations and to 74% for firms without confirmed terminations. Interestingly, hedging ratios and the fraction of firms hedging rebound rather quickly and are similar for cases with confirmed derivative terminations and without two years after an event of default has been triggered.

Table 4 examines the relation between hedging policies and bankruptcies with confirmed derivative terminations and without in a multivariate regression with firm and year fixed effects. The results convey similar intuition to Figure 4, with hedge ratios, hedge maturities, and fraction of firms hedging commodity prices decreasing significantly more when bankruptcy filing is associated with derivative terminations by the counterparties. These results help to allay the concerns that a decrease in corporate hedging at the incidence of bankruptcy is driven by firms' voluntary decisions to hedge less because of the changing incentives of shareholders, collateral constraints, or some other reasons.

To further mitigate these concerns and to address a specific issue that derivative terminations may also proxy for a more severe deterioration of firm financial condition, we consider an additional test from the coal industry. As mentioned previously, the coal industry presents a useful laboratory because it hedges both using diesel derivatives, which are governed by the ISDA Master Agreements, and using coal supply agreements, which are not. If derivative terminations simply proxy for worse financial conditions and firms voluntarily wind down their hedging programs, then we should see that both hedging with derivatives and hedging with supply agreements are affected. In contrast, if firms hedging drops because of counterparties exercising their right to terminate the derivatives, we should see that only hedging with derivatives is affected, while hedging with supply agreements is not. This is indeed what we see in Table 5. For example, the hedge ratios calculated using diesel derivatives used to hedge the anticipated diesel fuel needs decrease by approximately 30.2% at the onset of bankruptcies with confirmed derivative terminations. In contrast, the hedge ratios calculated using the fraction of coal hedged through supply agreements are not significantly affected by bankruptcies with confirmed derivative terminations and show a small positive coefficient. Overall, these results are consistent with derivative terminations causing a decline in corporate hedging when an event of default is triggered and the firm hedges using derivatives and do not support a story that derivative terminations simply proxy for greater incentive of the firm to voluntary decrease its hedging. In addition, these results also may help explain the findings by Almeida, Hankins, and Williams (2021), who find that hedging with purchase obligations (PO) does not drop significantly in distress and that firms often substitute purchase obligations for financial derivatives when they are in distress.

We next examine a direct prediction of our model that derivative terminations are related to moneyness of the derivative contract at the time when an event of default is triggered. Table 6 presents the results of OLS regressions and logit models, where the dependent variable is equal to one if there are derivative terminations by the counterparties reported in the firm's 10-K around the event of default and is zero otherwise. We use as an explanatory variable the measure of the reported fair value of derivatives, which is cited in the ISDA Master Agreements as the estimated amount to be paid by the derivative counterparty to the firm to settle the contract upon termination. As the table shows, a larger fair value of derivatives reported by the firm is associated with significantly lower probability of termination, which is consistent with the predictions of the model. For example, based on the results in column 5, if at the fiscal-year end prior to bankruptcy filing or other known date of default the firm has a negative fair value of derivatives (which means a positive value for the counterparty), the probability of terminations increases by approximately 38.2%.

Finally, in Table 8 we present an additional test that helps to further distinguish alternative explanations to low corporate hedging in distress. In this test, we limit the sample of firms to oil and gas producers and construct the return to oil based on movements in West Texas Intermediate (WTI) crude oil spot price during the one month prior to an event of default. The idea is that when an oil and gas firm defaults following an increase in oil prices, its hedging portfolio is more likely to be in-the-money for the counterparty and therefore it is more likely to experience derivative terminations. Importantly, here we do not consider whether and how much the firm actually hedges (since it may be endogenous) and simply rely on the fact that oil and gas firms on average hedge low oil prices. The results in Table 8 show that indeed the negative effect of bankruptcy on firm hedging policies is more pronounced for firms that defaulted following an increase in the spot price of crude oil. For example, hedge ratios decrease by 32.1% after bankruptcies that follow high oil returns, whereas they decrease by 13.2% for bankruptcies that follow low oil returns.

VII. Conclusion

A derivative contract may be terminated by the issuing counterparty when a firm experiences an event of default, and we document that counterparties exercise their termination rights in approximately 62% of default events associated with bankruptcy petitions. We build a simple theoretical model to examine the optimal exercise policy and value of the termination right. Counterparties are more likely to exercise their termination rights when they expect to receive a net payment from the other party. The value of the termination right increases in basis risk and bankruptcy costs, and it decreases in the value to the counterparty of business continuation with a firm and a greater ability to postpone or negotiate payments in default.

Intuitively, the exercise of the option depends on the incentive of the counterparty and the value of the hedging portfolio. First, the decision to exercise presents a simple trade-off: on the one hand, an immediate payment that can be obtained from the defaulted firm upon closing the contract, but on the other hand the contract closure means a loss of continuing business because the defaulted counterparty can recover. Second, the "fair value" of the derivative portfolio plays a crucial role. When a defaulted party has a high-value portfolio (and is expected to pay), the counterparty prefers to sever the contract avoiding recovery of the payment from a bankrupt firm. However, when the defaulted party has a negative fair value portfolio (i.e., expecting a payment), the incentive of the counterparty is the opposite: it finds optimal to keep the contract alive so that the ambiguity about the payment amount, the time value of money, and the possibility that the derivative value reverses, all reduces the expected payment.

Using detailed data on hedging portfolios, we show that hedge ratios, hedge maturities, and the fraction of firm hedging commodity prices decrease significantly when the firm experiences an event of default, but that most of this decrease is attributed to derivative terminations by the counterparties. We also show that hedging using supply agreements, which are governed by different contractual terms and do not have standard event of default clauses, does not show any decrease when firms experience bankruptcies and derivative terminations. Overall, our results provide a novel explanation to low observed corporate hedging using derivatives in distress.

Appendix A. Treatment of Hedging Contracts in Default

1. *"On October 1, 2008, we received a notice of early termination from BNP Paribas ("BNP") with respect to our natural gas and interest rate swap derivatives" (Aurora Oil & Gas Corp., 2008-12-31, in default with lenders).*

"The Company's Bankruptcy Petition in July 2015 represented an event of default under Sabine's existing derivative agreements resulting in a termination right by counterparties on all derivative positions at July 15, 2015. Additionally, certain of the Company's derivative positions were terminated prior to July 15, 2015 as a result of defaults under Sabine's derivative agreements that occurred prior to the filing of the Bankruptcy Petition." (Forest Oil Group, 10-K report for 2015, in Chapter 11 bankruptcy)

2. *"On June 14, 2018, the Company's hedging counterparty, Koch Supply & Trading LP, terminated the only outstanding hedge contract resulting in a settlement of $0.5 million."* (PetroQuest Energy Inc., 2019, in Chapter 11 bankruptcy)

3. *"The convertible note hedging transactions have since been terminated in connection with our Chapter 11 proceedings."* (Stone Energy Corp. 2016-12-31, in Ch. 11 bankruptcy)

4. *"In February 2010, the administrative agent under our credit facilities liquidated all of our existing hedge contracts and applied the proceeds thereof to amounts owed under the facilities. As a result, our production is currently unhedged."* (Saratoga Resources Inc., 10-K report for 2010, in Chapter 11 bankruptcy)

Forced liquidation of derivative positions. *"Pursuant to ARP's restructuring support agreement, ARP completed the sale of substantially all of its commodity hedge positions on July 25, 2016 and July 26, 2016 and used the proceeds to repay $233.5 million of borrowings outstanding under the ARP's first lien credit facility"* (Atlas Energy Group, LLC, 2017-12-31, referring to a defaulted Subsidiary "ARP")

5. *"Our hedging arrangements contain standard events of default, including cross default provisions, that, upon a default, provide for (i) the delivery of additional collateral, (ii) the*

termination and acceleration of the hedge, (iii) the suspension of the lenders' obligations under the hedging arrangement" (ATP Oil and Gas, 10-K report for 2010)

6. *"The filing of the Chapter 11 Petitions triggered an event of default under each of the agreements governing our derivative transactions ("ISDA Agreements")... As a result, our counterparties were permitted to terminate, and did terminate, all outstanding transactions governed by the ISDA Agreements."* (Breitburn Energy Partners, 10-K report for 2016)

7. *"our ability to enter into new commodity ... will be dependent upon either entering into unsecured hedges or obtaining Bankruptcy Court approval to enter into secured hedges. As a result, we may not be able to enter into additional commodity derivatives covering our production in future periods on favorable terms or at all."* (Blue Ridge Mountain Resources 2015-12-31, in Ch. 11 bankruptcy)

8. (sample language in ISDA schedule) *"The following shall constitute Additional Termination Events...a "Ratings Event I" shall occur with respect to Party A if the long-term and short-term senior unsecured deposit ratings of Party A cease to be rated at least A and A-1 by Standard & Poor's Ratings Service... "Ratings Event II" shall occur with respect to Party A if the long-term senior unsecured deposit rating of Party A ceases to be rated higher than BBB-..."* (Schedule of ISDA Master Agreement 2007-02-21 between Credit Suisse as a counterparty (Party A), and the World Omni Auto Receivables)

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Figure 1. Model Diagram

The figure shows the evolution of a firm's cash flows, C_t, fixed liabilities, D_t, and the value of the derivative portfolio to the bank, V_t, over time and across states. Parameter α represents bankruptcy costs levied in the event of firm liquidation, and parameter θ captures the value to the counterparty of continuing business if the firm is not liquidated.

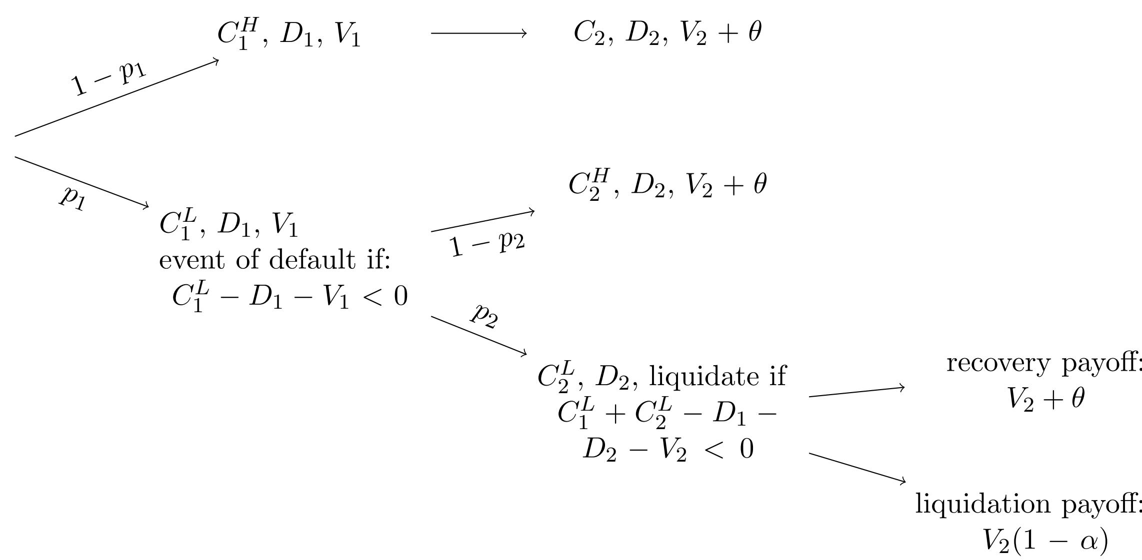


Figure 2. Events of Default and Hedging

The top two panels show the evolution around the event of defaults of the average hedge ratios and the fraction of firms hedging the commodity prices for the full detailed sample. The bottom panels show the average hedge ratios around the events of default for two industries: oil and gas firms (SIC 1311) and scheduled airlines (SIC 4512). Year 0 indicates the year during which the bankruptcy petition was filed.

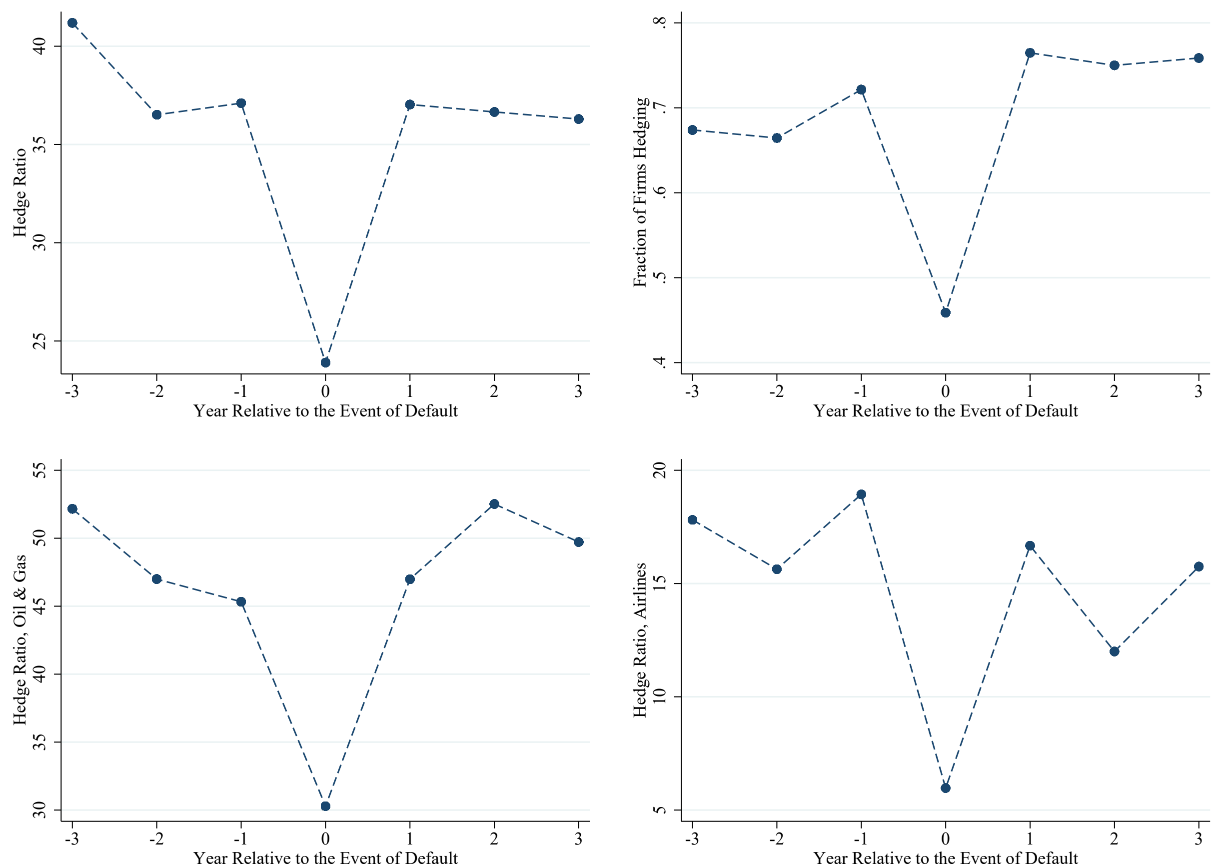


Figure 3. Type of Bankruptcy

The top panel shows the evolution of the average hedge ratio around the event of default, separately for firms that experience a prenegotiated or prepackaged bankruptcy and for firms that experience a "free fall" bankruptcy. The bottom panel shows the average fraction of firms hedging the commodity prices around the event of default, separately for firms that experience a prenegotiated or prepackaged bankruptcy and for firms that experience a "free fall" bankruptcy. All variables are defined in the Appendix A.

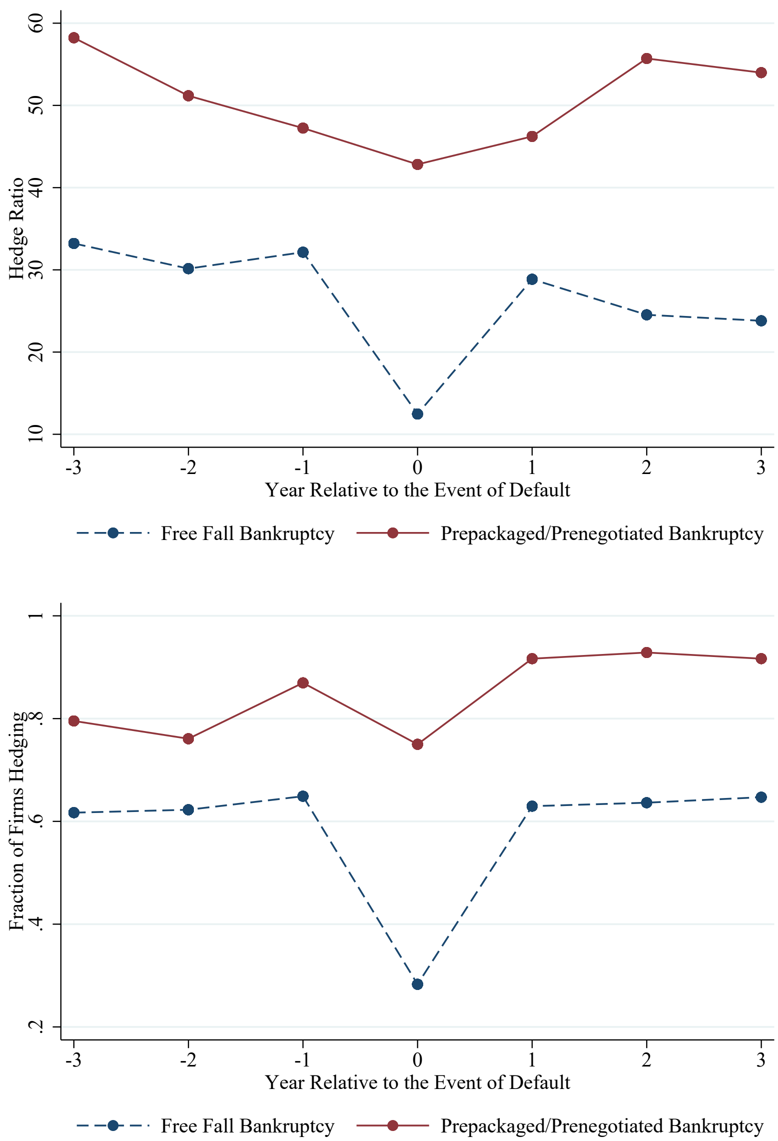
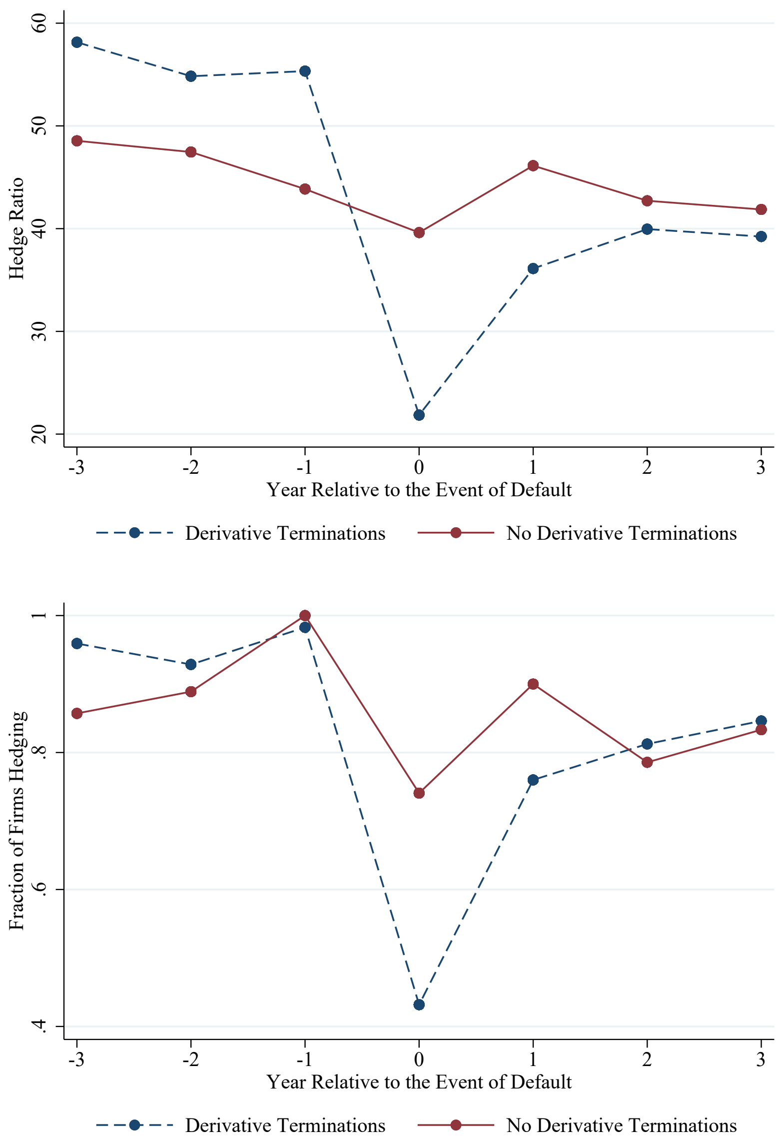


Figure 4. Derivative Terminations and Risk Management

The top panel shows the average hedge ratio around the event of default, separately for the cases with the derivative terminations by the counterparties reported in firms' 10-K forms and without such reported terminations. The bottom panel shows the average fraction of firms hedging the commodity prices around the event of default, separately for the cases with the derivative terminations by the counterparties reported in firms' 10-K forms and without such reported terminations. All variables are defined in the Appendix A.



Appendix B. Variable Definitions

Variable	Definition
Derivative user	An indicator variable equal to one if the firm has non-zero unrealized gains or losses (AOCIDERGL, "Accumulated Other Comprehensive Income - Derivative Unrealized Gain/Loss") or non-zero derivative gains/losses reported after net income (CIDERGL, "Comprehensive Income - Derivative Gains/Losses"), and it is equal to zero otherwise (Compustat).
Hedging intensity	The number of hedging-related words in a firm's 10-K divided by the total word count (keywords: hedging, hedge(s), hedged, derivative(s), swap(s), collar(s), risk management, futures, forward contract, and forwards) (SEC EDGAR).
Commodity hedger	An indicator variable equal to one if the firm hedges commodity prices during the year (detailed sample).
Hedge ratio	Oil and gas firms: The sum of the outstanding notional amounts of oil and gas derivatives for the next fiscal year, divided by the next year oil and gas production (%). We use the universal MMcfe energy units, with one barrel of oil being equivalent to six thousand cubic feet of natural gas. Airlines: the percentage of fuel expenses hedged. Coal firms: the percentage of expected diesel expenses hedged (detailed sample).
Hedge maturity	Maximum maturity of outstanding commodity hedges (detailed sample).
Bankruptcy	Chapter 11 or Chapter 7 bankruptcy during the fiscal year (UCLA-LoPucki BRD, supplemented with additional data, as explained in the text).
Low-cost bankruptcy (prepackaged)	Chapter 11 or Chapter 7 bankruptcy during the fiscal year that is classified as prepackaged or prenegotiated (UCLA-LoPucki BRD).
High-cost bankruptcy (free fall)	Chapter 11 or Chapter 7 bankruptcy during the fiscal year that is NOT classified as prepackaged or prenegotiated (UCLA-LoPucki BRD).
Default-related words frequency	The number of default-related words in a firm's 10-K form divided by the total word count (keywords: default(ed), event of default, bankrupt, bankruptcy, and Chapter 11) (SEC EDGAR).
Firm size	The logarithm of the book value of assets.
Market-to-book ratio	The sum of long-term and short-term debt and the market value of equity, divided by the book value of assets.
Book leverage	The sum of long- and short-term debt, divided by the book value of assets.
Firm networth	Total stockholders equity, divided by the book value of assets.
Asset tangibility	Net plant, property and equipment, divided by the book value of assets.

Table 1. Summary Statistics The table reports the summary statistics. The sample in Panel A (Compustat/SEC Sample) consists of all US-incorporated firms during the period 1999-2020 that have non-missing accounting information in COMPUSTAT. The sample in Panel B (Detailed Sample) consists of all US-incorporated oil and gas producing firms (SIC Code 1311), commercial airlines (SIC 4512), coal producing firms (SIC 1220), and steel producing firms (SIC 3310-3320) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. All variables are defined in Appendix A.

Panel A: Compustat/SEC Sample	*N*	*Mean*	*Std. Dev.*	*p25*	*p50*	*p75*
Derivative user	128,181	0.199	0.400	0	0	0
Asset tangibility	140,810	0.235	0.273	0.024	0.115	0.362
Book assets ($B)	140,810	9.347	89.891	0.026	0.215	1.325
Firm size	140,810	5.159	2.974	3.291	5.370	7.189
Firm networth	140,810	0.009	2.497	0.171	0.469	0.716
Market-to-book ratio	140,810	4.243	13.794	0.687	1.163	2.317
Book leverage	140,810	0.150	0.180	0.002	0.085	0.227
Bankruptcy	140,810	0.006	0.077	0	0	0
High-cost bankruptcy (free fall)	140,810	0.002	0.039	0	0	0
Low-cost bankruptcy (prepackaged)	140,810	0.004	0.066	0	0	0
Hedging intensity (%)	79,571	0.122	0.170	0.011	0.043	0.169
Default-related words frequency (%)	79,571	0.039	0.059	0.006	0.019	0.045

Panel B: Detailed Sample	*N*	*Mean*	*Std. Dev.*	*p25*	*p50*	*p75*
Derivative user	3,990	0.633	0.482	0	1	1
Commodity hedger	3,825	0.519	0.500	0	1	1
Hedge ratio (%)	3,825	27.382	41.285	0	4.481	49.186
Hedge maturity (months)	3,975	13.622	17.853	0	12	24
Log hedge maturity	3,975	1.659	1.605	0	2.565	3.219
Bankruptcy	3,975	0.038	0.191	0	0	0
High-cost bankruptcy (free fall)	3,975	0.016	0.124	0	0	0
Low-cost bankruptcy (prepackaged)	3,975	0.022	0.147	0	0	0
Asset tangibility	3,975	0.663	0.242	0.489	0.736	0.865
Firm size	3,975	6.112	2.400	4.519	6.260	7.841
Firm networth	3,975	0.319	1.031	0.246	0.432	0.588
Market-to-book ratio	3,975	1.655	5.207	0.710	0.992	1.487
Book leverage	3,975	0.255	0.207	0.089	0.218	0.381

Panel C: Bankruptcy Sample	*N*	*Mean*	*Std. Dev.*	*p25*	*p50*	*p75*
Hedge ratio (%), t-1	140	37.104	46.345	0	27.968	60.093
Hedge ratio (%), t	131	23.719	30.307	0	9.000	47.424
Hedge ratio (%), t+1	41	41.667	34.315	9.120	45.988	64.845
Commodity hedger, t-1	140	0.721	0.450	0	1	1
Commodity hedger, t	131	0.527	0.501	0	1	1
Commodity hedger, t+1	41	0.805	0.401	1	1	1
Hedge maturity (months), t-1	142	16.415	16.193	0	12	24
Hedge maturity (months), t	132	11.917	14.530	0	4	24
Hedge maturity (months), t+1	42	17.643	12.558	12	13.500	24
Derivative fair value ($M), t-1	141	39.630	169.964	0	0	17.500
Negative derivative fair value, t-1	141	0.227	0.420	0	0	0
Positive derivative fair value, t-1	141	0.489	0.502	0	0	0
Derivative termination	95	0.621	0.488	0	1	1
Asset tangibility	138	0.741	0.182	0.649	0.794	0.888
Firm size	138	6.630	1.721	5.638	6.719	7.778
Firm networth	138	-0.113	0.664	-0.201	0.047	0.250
Market-to-book ratio	135	1.103	1.890	0.601	0.772	1.069
Book leverage	135	0.577	0.210	0.441	0.629	0.782

Table 2. Events of Default and Risk Management (Compustat/SEC Sample)

The table reports the estimates of the OLS regressions. The sample consists of all firms in Compustat (except utilities SIC Codes between 4000 and 4999) during the period 2001-2020 that have non-missing accounting and hedging information. The dependent variable in columns 1-3 is equal to one if the firm has non-zero unrealized gains or losses or non-zero derivative gains/losses reported after net income in Compustat, and it is equal to zero otherwise. The dependent variable in columns 4-6 is equal to the number of hedging-related words in a firm's 10-K divided by the total word count (in %). Default-related words frequency is equal to the number of default-related words in a firm's 10-K divided by the total word count (in %). All other variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:		*Derivative User*			*Hedging Intensity*	
Bankruptcy	-0.163***			-0.051***		
	[-5.99]			[-5.75]		
High-cost bankruptcy (free fall) (a)		-0.227***			-0.075***	
		[-4.40]			[-4.77]	
Low-cost bankruptcy (prepackaged) (b)		-0.113***			-0.032***	
		[-4.33]			[-3.85]	
Default-related words frequency			-0.062**			-0.162***
			[-2.07]			[-14.11]
Firm size	0.031***	0.031***	0.042***	0.018***	0.018***	0.018***
	[16.07]	[16.14]	[12.30]	[14.15]	[14.21]	[13.84]
Market-to-book ratio	0.001***	0.001***	0.001***	0.000	0.000	0.000
	[15.08]	[15.08]	[10.90]	[0.70]	[0.70]	[0.28]
Asset tangibility	-0.023***	-0.023***	-0.012	-0.002	-0.002	-0.001
	[-2.86]	[-2.86]	[-0.65]	[-0.26]	[-0.26]	[-0.16]
Firm networth	-0.003***	-0.003***	-0.004***	-0.005***	-0.005***	-0.005***
	[-7.31]	[-7.40]	[-7.01]	[-12.03]	[-12.06]	[-12.42]
Book leverage	0.090***	0.090***	0.123***	0.025***	0.025***	0.032***
	[7.09]	[7.06]	[6.39]	[3.84]	[3.82]	[4.89]
Constant	0.030***	0.029***	-0.026	0.017**	0.016**	0.024***
	[2.96]	[2.91]	[-1.28]	[2.24]	[2.19]	[3.16]
Observations	126,864	126,864	74,595	78,453	78,453	78,453
R-squared	0.699	0.699	0.684	0.755	0.755	0.756
t-stat for $(a) - (b)$	n/a	-1.97**	n/a	n/a	-2.42**	n/a
Industry FE	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 3. Events of Default and Risk Management (Detailed Sample)

The table reports the estimates of the OLS regressions. The dependent variable in columns 1-2 is the hedge ratio (%); the dependent variable in columns 3-4 is the hedge maturity, measured as the logarithm of one plus the number of months till expiration of the contract with the longest maturity; and the dependent variable in columns 5-6 is an indicator equal to one if the firm hedges commodity price exposure and is equal to zero otherwise. The sample consists of all US-incorporated oil and gas producing firms (SIC Code 1311), commercial airlines (SIC 4512), coal producing firms (SIC 1220), and steel producing firms (SIC 3310-3320) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. All variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	*Hedge Ratio*		*Hedge Maturity*		*Commodity Hedger*	
Bankruptcy	-14.959***		-0.572***		-0.165***	
	[-3.27]		[-3.96]		[-3.75]	
High-cost bankruptcy		-23.464***		-0.875***		-0.234***
(free fall) (a)		[-2.95]		[-3.76]		[-3.26]
Low-cost bankruptcy		-7.638		-0.304*		-0.105**
(prepackaged) (b)		[-1.63]		[-1.87]		[-2.16]
Firm size	4.914***	5.029***	0.225***	0.229***	0.057***	0.058***
	[2.96]	[3.06]	[4.76]	[4.85]	[3.88]	[3.96]
Market-to-book ratio	0.288*	0.288*	0.011*	0.011*	0.004*	0.004*
	[1.73]	[1.78]	[1.82]	[1.87]	[1.87]	[1.89]
Asset tangibility	0.307	0.491	0.089	0.097	0.062	0.063
	[0.03]	[0.05]	[0.37]	[0.40]	[0.82]	[0.84]
Firm networth	0.636	0.419	0.013	0.005	0.003	0.001
	[0.66]	[0.45]	[0.41]	[0.17]	[0.26]	[0.09]
Book leverage	1.468	1.316	0.445***	0.440***	0.167***	0.166***
	[0.27]	[0.25]	[2.90]	[2.89]	[3.46]	[3.48]
Constant	-3.016	-3.757	0.111	0.086	0.090	0.084
	[-0.34]	[-0.42]	[0.39]	[0.30]	[0.97]	[0.90]
Observations	3,815	3,815	3,965	3,965	3,815	3,815
R-squared	0.565	0.566	0.767	0.768	0.751	0.752
t-stat for $(a) - (b)$	n/a	-1.71*	n/a	-2.01**	n/a	-1.49
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 4. Bankruptcies with Derivative Terminations and Without (Detailed Sample)

The table reports the estimates of the OLS regressions. The dependent variable in column 1 is the hedge ratio (%); the dependent variable in column 2 is the hedge maturity, measured as the logarithm of one plus the number of months till expiration of the contract with the longest maturity; and the dependent variable in column 3 is an indicator variable equal to one if the firm hedges commodity price exposure and is equal to zero otherwise. The sample consists of all US-incorporated oil and gas producing firms (SIC Code 1311), commercial airlines (SIC 4512), coal producing firms (SIC 1220), and steel producing firms (SIC 3310-3320) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. All variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Dependent Variable:	*Hedge Ratio*	*Hedge Maturity*	*Commodity Hedger*
Bankruptcy with derivative	-30.861***	-1.198***	-0.420***
terminations (a)	[-4.07]	[-5.09]	[-6.02]
Bankruptcy without derivative	-7.977*	-0.303*	-0.053
terminations (b)	[-1.83]	[-1.88]	[-1.07]
Firm size	4.990***	0.228***	0.058***
	[2.98]	[4.80]	[3.94]
Market-to-book ratio	0.264*	0.010*	0.003*
	[1.68]	[1.73]	[1.79]
Asset tangibility	0.579	0.098	0.066
	[0.06]	[0.40]	[0.87]
Firm networth	0.608	0.012	0.002
	[0.66]	[0.40]	[0.23]
Book leverage	1.452	0.445***	0.167***
	[0.27]	[2.99]	[3.56]
Constant	-3.636	0.089	0.080
	[-0.40]	[0.31]	[0.85]
Observations	3,815	3,965	3,815
R-squared	0.567	0.769	0.754
t-stat for $(a) - (b)$	-2.62***	-3.14***	-4.28***
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

Table 5. Placebo Test: Hedging with Derivatives and Hedging with Supply Agreements

The table reports the estimates of the OLS regressions. The sample consists of coal producing firms (SIC 1220) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. In columns 1-3 we consider hedging using derivatives (coal firms hedge input, diesel fuel, using derivatives). In columns 4-6, we consider hedging using supply agreements, which are physical delivery contracts that do not involve derivatives (coal firms hedge output, coal, using supply agreements). The dependent variable in columns 1 and 4 is the hedge ratio (%); the dependent variable in columns 2 and 5 is the hedge maturity, measured as the logarithm of one plus the number of months till the expiration of the contract with the longest maturity; and the dependent variable in columns 3 and 6 is an indicator variable equal to one if the firm hedges commodity price exposure and is equal to zero otherwise. All variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	*Hedge Ratio*	*Hedge Maturity*	*Commodity Hedger*	*Hedge Ratio*	*Hedge Maturity*	*Commodity Hedger*
Bankruptcy with	-30.199***	-1.473***	-0.518***	0.324	0.055	-0.057
derivative terminations (a)	[-8.26]	[-5.00]	[-5.34]	[0.12]	[0.32]	[-1.50]
Bankruptcy without	0.536	-0.273	-0.064	-15.729	-0.476	-0.185
derivative terminations (b)	[0.06]	[-1.11]	[-0.62]	[-1.10]	[-0.74]	[-1.06]
Firm size	2.627	-0.070	-0.001	0.186	0.074	0.049
	[0.38]	[-0.22]	[-0.01]	[0.06]	[0.53]	[1.48]
Market-to-book ratio	0.101	0.002	0.001	-0.076	-0.001	-0.000
	[0.98]	[0.51]	[0.95]	[-0.84]	[-0.71]	[-0.32]
Asset tangibility	8.197	0.610	0.056	6.227	-0.368	0.085
	[0.61]	[0.94]	[0.33]	[0.58]	[-1.25]	[0.67]
Firm networth	-0.193	0.015	0.006	-0.972	-0.009	-0.023
	[-0.15]	[0.26]	[0.29]	[-0.67]	[-0.34]	[-1.23]
Book leverage	32.594***	1.579**	0.384*	-6.084	0.111	-0.131
	[3.00]	[2.62]	[1.90]	[-0.54]	[0.21]	[-1.62]
Constant	-20.934	0.310	0.040	70.710***	2.532***	0.493*
	[-0.54]	[0.17]	[0.07]	[3.24]	[2.84]	[1.94]
Observations	202	220	202	209	195	209
R-squared	0.746	0.738	0.750	0.928	0.954	0.961
t-stat for $(a) - (b)$	-3.18***	-3.13***	-3.21***	1.10	0.80	0.72
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Hedging type		Diesel Derivatives			Coal Supply Agreements	

Table 6. Derivative Terminations and Fair Value at Default

The dependent variable is equal to one if there are derivative terminations by the counterparties reported in firm's 10-K forms during the year when there is an event of default or the year following, and is equal to zero otherwise. Specifications 1-2 and 4-5 are estimated using the OLS regressions, specifications 2 and 4 are estimated using logit model. All independent variables are measured at the last fiscal year-end before the event of default. The sample consists of bankrutcies by oil and gas producing firms (SIC Code 1311), commercial airlines (SIC 4512), and coal producing firms (SIC 1220) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. All variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Derivative fair value ($000's)	-0.559***	-0.657***	-7.539***			
	[-3.27]	[-3.03]	[-2.61]			
Negative derivative fair value				0.321***	0.382***	2.323***
				[3.38]	[3.68]	[2.74]
Hedge ratio		0.001	0.008		0.000	0.002
		[1.31]	[1.28]		[0.34]	[0.42]
Firm size		-0.012	0.056		-0.018	-0.067
		[-0.26]	[0.26]		[-0.44]	[-0.34]
Market-to-book ratio		0.264***	1.880*		0.253***	2.147*
		[2.76]	[1.86]		[2.72]	[1.82]
Asset tangibility		-0.667	-5.304*		-0.685	-3.749
		[-1.24]	[-1.71]		[-1.30]	[-1.47]
Firm networth		0.399***	2.543**		0.448***	3.054**
		[4.54]	[2.46]		[4.38]	[2.36]
Book leverage		0.113	0.408		0.246	0.931
		[0.38]	[0.25]		[0.97]	[0.58]
Constant	0.403**	0.726	0.958	0.291**	0.611	-0.140
	[2.23]	[1.27]	[0.38]	[2.17]	[1.33]	[-0.07]
Observations	94	88	88	94	88	88
(Pseudo) R-squared	0.073	0.144	0.152	0.118	0.205	0.184
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	OLS	OLS	Logit	OLS	OLS	Logit

Table 7. Strength of Relationship and Effect of Bankruptcy on Hedging (Detailed Sample) The table reports the estimates of the OLS regressions. The dependent variable in column 1 is the hedge ratio (%); the dependent variable in column 2 is the hedge maturity, measured as the logarithm of one plus the number of months till expiration of the contract with the longest maturity; and the dependent variable in column 3 is an indicator variable equal to one if the firm hedges commodity price exposure and is equal to zero otherwise. *Strength of Relationship* is the number of years the firm existed in COMPUSTAT until the year of observation. The sample consists of all US-incorporated oil and gas producing firms (SIC Code 1311), commercial airlines (SIC 4512), coal producing firms (SIC 1220), and steel producing firms (SIC 3310-3320) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. All variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Dependent Variable:	*Hedge Ratio*	*Hedge Maturity*	*Commodity Hedger*
Bankruptcy	-28.858***	-1.124***	-0.304***
	[-3.48]	[-3.86]	[-3.64]
Bankruptcy×Strength of Relationship	1.148**	0.046**	0.011**
	[2.12]	[2.36]	[2.01]
Strength of Relationship	21.835	0.764	0.303
	[1.32]	[0.90]	[1.07]
Firm size	4.965***	0.227***	0.057***
	[2.98]	[4.83]	[3.94]
Market-to-book ratio	0.287*	0.011*	0.004*
	[1.74]	[1.82]	[1.86]
Asset tangibility	0.728	0.105	0.067
	[0.08]	[0.43]	[0.90]
Firm networth	0.522	0.008	0.002
	[0.55]	[0.27]	[0.15]
Book leverage	1.340	0.440***	0.166***
	[0.25]	[2.87]	[3.45]
Constant	-211.279	-7.290	-2.793
	[-1.35]	[-0.89]	[-1.04]
Observations	3,815	3,965	3,815
R-squared	0.566	0.768	0.752
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

Table 8. Oil Price Movements Before Bankruptcy and Effect of Bankruptcy on Hedging (Oil & Gas Firms)

The table reports the estimates of the OLS regressions. The dependent variable in column 1 is the hedge ratio (%); the dependent variable in column 2 is the hedge maturity, measured as the logarithm of one plus the number of months till expiration of the contract with the longest maturity; and the dependent variable in column 3 is an indicator variable equal to one if the firm hedges commodity price exposure and is equal to zero otherwise. *Positive Oil Return* is equal to one if during the one-month prior to a firm's bankruptcy the spot price of crude oil increased and is equal to zero otherwise. *Negative Oil Return* is equal to one minus *Positive Oil Return*. The sample consists of all US-incorporated oil and gas producing firms (SIC Code 1311) during the period 1999-2020 that have non-missing accounting information in COMPUSTAT and non-missing hedging data in 10-K or 10-KSB public filings. All variables are defined in Appendix A. T-statistics based on heteroskedasticity-consistent standard errors clustered by the firm are reported in brackets. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
Dependent Variable:	*Hedge Ratio*	*Hedge Maturity*	*Commodity Hedger*
Bankruptcy×Positive 1-Month	-32.064***	-0.825***	-0.261***
Oil Return	[-3.14]	[-3.25]	[-3.70]
Bankruptcy×Negative 1-Month	-13.198	-0.482**	-0.169***
Oil Return	[-1.46]	[-2.05]	[-2.74]
Firm size	5.059***	0.234***	0.065***
	[2.69]	[4.50]	[4.21]
Market-to-book ratio	0.440*	0.015*	0.004
	[1.73]	[1.74]	[1.63]
Asset tangibility	0.814	0.460*	0.124
	[0.07]	[1.71]	[1.40]
Firm networth	2.159	0.067	0.020
	[1.41]	[1.46]	[1.41]
Book leverage	2.336	0.544***	0.188***
	[0.33]	[2.83]	[3.32]
Constant	4.869	0.178	0.116
	[0.46]	[0.56]	[1.15]
Observations	2,613	2,626	2,613
R-squared	0.518	0.751	0.726
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes