Do Firms Hedge During Distress?

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Abstract:
Firms are less likely to use financial derivatives as they approach distress, even though theory predicts risk management is more valuable in these situations. By expanding the definition of hedging to include purchase obligations (POs) - non-cancelable forward contracts with suppliers – we are able to understand how firms hedge and whether hedging matters. We provide the first evidence that firms rely on POs during distress, often switching from derivatives to these contracts. Firms also initiate POs in response to liquidity shocks. Moreover, compared to hedging with derivatives, hedging with POs enables higher investment levels during times of financial distress. Firms adjust – but do not cease - hedging near distress and this mitigates underinvestment.

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How do firms manage risk and do risk management decisions depend on a firm's financial condition? Expected distress costs should theoretically increase the value of risk management (Smith and Stulz, 1985; Rauh, 2009) so firms should have stronger incentives to hedge when closer to financial distress. Yet, in practice, financial constraints can affect a firm's ability to hedge in a variety of ways. Prior work highlights that derivatives require collateral, lines of credit often have debt covenants, and cash carries a liquidity premium (Acharya *et al.*, 2014; Rampini, Sufi, and Viswanathan, 2014). Thus, risk management options may be limited precisely when a firm's hedging need is largest. Consistent with this intuition, firms appear to stop using financial derivatives as they approach distress (Purnanandam, 2008; Rampini, Sufi, and Viswanathan, 2014). Using a unique hand-collected panel of forward contracts with suppliers, this paper revisits whether firms cease hedging as their financial condition worsens and evaluates whether the ability to hedge affects a firm's ability to invest during times of distress.

Purchase obligations - non-cancelable supply contracts - are a widely used hedging tool (Almeida, Hankins, and Williams, 2017) but are generally less explored in the academic literature. By expanding the definition of hedging beyond exchange-traded derivatives to include these forward contracts, we document that firms continue to hedge as they approach distress, often switching from financial derivatives to purchase obligations. Our evidence therefore supports a more holistic view of risk management, similar in spirit to Bolton, Chen, and Wang (2011) and Almeida, Campello, Cunha, and Weisbach (2014) which connect derivatives hedging to broader liquidity management. Moreover, we show that PO usage enables firms to maintain higher investment levels in distress, consistent with theoretical predictions in Froot *et al* (1993).

There are numerous reasons why PO contracts may be available when alternative risk management options, such as derivatives, are not. The trade credit literature finds that suppliers are better positioned than financial institutions to provide liquidity during downturns (e.g., Garcia-Appendini and Montoriol-Garriga, 2013). Even if firms in distress are barred from traditional derivative markets due to collateral constraints, their suppliers may still be willing to write forward contracts. Suppliers also have an additional incentive to assist customers during temporary negative shocks because the supplier's value is a function of customers' future cash flows (Petersen and Rajan, 1997). If the customer is likely to continue its operations, the expected value of its long-term cash flows to the supplier may offset any increased risk associated with financial distress. Further, evidence on long-term supply contracts shows that supplier-customer contracts rarely have collateral requirements and frequently are not subject to financial covenants (Costello, 2013). We expect that collateral requirements and financial covenants are even less likely for purchase obligations given their relatively shorter horizons (generally 1-3 years). This flexibility makes POs advantageous to customers during distress.

Following up on these arguments, we build a simple theoretical framework to understand the choice between derivatives and POs when firms face collateral constraints. The model captures the flexibility associated with PO contracts by assuming that firms can pledge more future income to suppliers than to financial institutions. This additional source of pledegability creates an advantage for POs relative to a derivatives contract when a firm's financial position is weaker. In particular, we study how a firms' existing hedging strategy affects a firm's ability to invest when its financial position weakens. Firms may choose to hold an imperfect hedging position in order to save pledgeable income, which limits the firm's ability to finance investments in bad states of the world. In contrast, POs can be collateralized using the additional pledgeable income that the supplier can extract from the firm, allowing the PO-reliant firm to increase investment in bad states of the world relative to a firm relying on futures. Nevertheless, POs do not always dominate futures because firms are likely to pay a premium to hedge using POs depending on the terms that they can negotiate with their suppliers. If this premium is large enough, firms may choose to hedge using futures despite pledgeability constraints. In addition, the stronger is a firm's financial health, the more it can hedge when using the future's contract. Thus, stronger financial health reduces the relative cost of hedging with futures.

Our results confirm that firms increase purchase obligation usage as their financial condition worsens and reduce derivatives usage. A potential concern with these results is that the standard proxies for distress (such as Z-scores) may capture economic rather than financial distress. In our baseline results, we distinguish between economic and financial distress by using operating margins, as in Andrade and Kaplan (1998). Financial distress leads firms to stop using derivatives and to initiate the use of purchase obligations, while firms entering economic distress do not show increased propensities to use purchase obligations. In addition, we also consider the impact of a likely exogenous shock to financial constraint. Specifically, we use the failure of a firm's line of credit lead arranger as a shock to a firm's financial condition (Sufi, 2009, Chava and Purnanandam, 2011). Firms experiencing this shock increase their usage of purchase obligations, relative to firms that do not suffer this financial shock. This evidence supports the hypothesis that firms adjust their hedging choices as their financial condition deteriorates and that suppliers play a role in the risk management policies of financially distressed firms.

Next, we study the effect of existing purchase obligations on investment during times of distress. We start by comparing the investment behavior of firms that hedge with purchase obligations (PO hedgers) with firms that hedge using derivatives (futures hedgers) – a control group of firms which are on average larger and financially stronger (Almeida, Hankins, and Williams, 2017). We find that PO hedgers invest relatively more than futures hedgers during distress events. Although a firm's hedging decision is endogenous, limiting the sample to active hedgers and making financial hedgers the control group minimizes the potential bias. All of these firms actively manage input cost volatility and the control group should have greater financial flexibility. Further, since our hypothesis that distress leads to an increased reliance on forward contracts with suppliers corresponds with evidence from the trade credit literature, we ensure that changing trade credit relationships do not drive our results.[1]

We employ two additional approaches to address endogeneity concerns. First, we consider a specification in which we use the failure of a firm's line of credit lead arranger as a shock to a firm's financial condition to better distinguish between financial and economic distress. Next, we instrument for the presence of PO hedging (relative to futures hedging) using supplier characteristics. With each approach, we document higher capital expenditures for PO hedgers relative to futures hedgers following distress.

We therefore uncover evidence that supports the prediction in Froot et al (1993) that hedging during distress may alleviate underinvestment. Our evidence is also consistent with Petersen and Rajan (1997), which suggests that suppliers will assist customers in financial distress but not in economic distress. In highlighting the importance of purchase obligations to firms in distress, our paper contributes to the literatures on the impact of financial distress (Opler and Titman, 1994; Andrade and Kaplan, 2002; Campello, *et al.*, 2011), the interaction between product markets and corporate hedging (Adam, Dasgupta, and Titman, 2007), and how constrained firms manage risk (Fehle and Tsyplakov, 2005; Rampini and Viswanathan, 2010).

[1] As we show in Section 1, purchase obligations are likely to relax financing constraints by more than trade credit financing does, despite the fact that both rely on increased pledgeability when contracting with suppliers. The key argument is that the firm can use POs to transfer cash across future states by making additional payments to suppliers in good states of the world.

We organize the paper as follows. Section 1 provides intuition from our model to generate our testable hypotheses. Section 2 describes our hand-collected data on purchase obligations and derivatives use as well as the rest of the panel data used in the analysis. Section 3 documents changing risk management choices as firms enter distress. Although this conclusion is consistent with evidence from the trade credit literature on the importance of suppliers to firms in distress (Petersen and Rajan, 1997), it contradicts the implication that distressed firms stop hedging (Rampini, Sufi, and Viswanathan, 2014). In Section 4, we document that distressed firms with purchase obligations maintain higher investment levels – consistent with Bessembinder (1991) and Nance, Smith, and Smithson (1993). By including purchase obligations, we gain a broader picture of how distressed firms operate and a richer understanding of product market relationships. This has important implications for agency conflicts in distressed firms (e.g., Stulz, 1990, Purnanandam 2008). Section 5 concludes.

1. Theory of Risk Management Alternatives and Effects on Investment

We develop a simple theoretical framework to understand the determinants of a firm's choice between hedging through purchase obligations (POs) or futures contracts, focusing on the role of financial health. We also examine the model's implications for investment conditional on financial distress.

We present this model in Appendix B. The model closely resembles that in Almeida, Hankins and Williams (AHW 2017). In the model, we assume that the firm can use POs or futures to manage its exposure to positions such as variation in input prices (e.g., hedgeable shocks). In addition, the firm is exposed to a shock that cannot be hedged with futures or POs (non-hedgeable shock). The modeling of this shock follows Holmstrom and Tirole (1998). The firm either holds cash or uses a bank credit line to manage this liquidity shock. It can also use cash to manage the hedgeable exposure, but as shown in AHW (2018) this strategy will typically be inefficient if futures are available because cash consumes more pledgeable income (collateral) than futures.

The firm's hedging policy is potentially affected by collateral constraints as in Rampini and Viswanathan (2010). In this paper, we follow Holmstrom and Tirole and model the collateral constraint as a quantity constraint on the firm's pledgeable income. Limited pledgeable income creates a motivation for hedging, as a negative shock to cash flow arising from the hedgeable position may cause inefficient liquidation of the firm's investment. In addition, limited pledgeability affects the firm's choice of which tool it uses for hedging. The futures position requires the firm to post collateral initially (at the time the futures position is opened) while the PO (forward) contract can be settled *ex-post*.[2] Because of this wedge, hedging through POs can increase the firm's pledgeable income and relaxes financial constraints. This mechanism reduces the desirability of futures for financially weak firms, as in Rampini and Viswanathan (2010). However, unlike exchange traded derivatives, POs are the product of a bargaining game between customers and suppliers. Some firms will have more or less ability to negotiate favorable terms with their suppliers and this may affect the cost of using POs. We capture this situation by assuming that the firm must pay a premium to hedge using POs.[3]

One of our goals is to examine the model's implication for investment conditional on financial distress. In particular, we want to study how the firms's existing hedging strategy affects a firm's ability to invest when its financial position weakens. To do so, we depart from AHW

[2] The *ex-post* settlement of purchase obligations can arise from the supplier's greater ability to extract pledgeable income from the buyer. In the model, we capture this situation by assuming that the firm can pledge more income to the counterparty of the forward contract (e.g. the supplier) than to other external financiers. The trade credit literature relies on a similar rationale to motivate the positive response of trade credit to negative financial shocks (Petersen and Rajan, 1997, Garcia-Appendini and Montoriol-Garriga, 2013, Shenoy and Williams, 2017).
[3] AHW (2018) also model settlement risk as an additional friction that the firm incurs when using POs. We abstract from settlement risk here.

(2017) by assuming that the firm can choose the fraction of the required future investment that it decides to finance in the bad state of the world. The "bad state" in the model is the one in which both the non-hedgeable and the hedgeable shock materialize, requiring the firm to use its liquidity and hedging positions to help finance the required investment. While the firm would like to finance the entire investment, it may be constrained in its ability to do so and may have to scale down.[4]

Because the futures position must be collateralized with the firm's pledgeable income, it may become optimal for the firm to reduce its futures position in order to save pledgeable income (as in Rampini and Viswanathan (2010)). An imperfect hedging position will then limit the firm's ability to finance its investment in the bad state of the world. In contrast, the PO can be collateralized using the additional pledgeable income that the supplier can extract from the firm, allowing the PO-reliant firm to increase investment in the bad state of the world relative to a firm relying on futures. Notice that this result does not mean that POs always dominate futures. The premium associated with the PO contract may be high if the firm's supplier has significant bargaining power, and thus a firm may still choose to use futures despite imperfect hedging arising from limited pledgeability.[5]

In addition, the stronger is a firm's financial health, the more it can hedge when using the future's contract. Thus, financial health reduces the effective cost of hedging with futures. The effective cost of hedging using futures also depends on the expected losses of not being able to finance investments in the bad state of the world. When these losses are low, futures become more attractive relative to POs (which provide greater insurance against underinvestment in bad states).

We summarize here the specific implications that we derive from the model

[4] In particular, we assume that the costs of hedging with POs and futures are low enough that firms would always choose to fully hedge against the shock in the absence of a pledgeability constraint.
[5] Notice also that a high PO premium does not necessarily tighten the pledgeability constraint because the firm can pledge more income when using the PO contract.

1. Firms are more likely to choose POs over futures if the premium associated with PO contracts is low.

2. Firms are more likely to choose POs over futures if their financial position is weak. For such firms using the futures contract exposes them to significant underinvestment risk in bad states of the world.

3. Firms that choose POs over futures have a greater ability to finance their investments when their financial positions weaken (e.g., in financial distress).

Implications 1. and 2. are also derived in AHW (2017). Our contribution in this paper is to focus on testing Implication 2 as well as introducing and testing Implication 3 (which is new to this paper).

We also consider the possibility that the firm may borrow from the supplier to mitigate the cash flow impact of the hedgeable shock. That is, conditional on being in the bad state of the world, the firm can use the additional pledgeable income that the supplier can capture to raise additional financing (e.g., trade credit financing). The model then shows that the PO is a more efficient way to use the additional pledgeable income that contracting with the supplier can provide, relative to trade credit. The key advantage of the PO relative to trade credit is that the firm can use POs to transfer cash *across* states. For example, suppose the firm uses the PO to insure against the increase in the price of an input. If the price of the input goes down rather than up, the firm will make an additional payment to the supplier (the difference between the guaranteed and the market price). This additional payment compensates the supplier for the better terms it can provide in the bad state (when the price goes up). Thus, purchase obligations are likely to relax financing constraints by more than trade credit financing does, despite the fact that both rely on the same source of pledgeability.

2. Data

2.1. Purchase obligations, commodity derivatives, and investment

Our variable of interest is a firm's use of purchase obligations. A purchase obligation contractually obligates the customer to purchase a specific quantity at a predefined price from a supplier, thereby resembling a forward contract. All firms are required to report these contracts in 10-K filings since December 15, 2003.[6] Thus, the sample consists of all Compustat firm-years with a year-end between 12/15/2003–12/31/2015 and an available 10-K filing on the SEC's EDGAR site. *PO Contract* is an indicator variable that equals one if the firm reports using a purchase obligation, and zero otherwise. *Commodity Contract* is an indicator variable equal to one if the firm reports using commodity derivatives in its 10-K filings, and zero otherwise. We follow the methodology in Almeida, Hankins, and Williams (2017) and use a combination of automated Perl scripting and hand collection to collect these two variables. We note in the summary statistics in Table 1 that PO users represent 23% of the population whereas commodity derivative users represent 19%. These data are consistent with Guay and Kothari (2003) and Almeida, Hankins and Williams (2017), who note that a large percentage of a firm's risks are unhedgeable with traditional derivatives.

To avoid the concern that firms with purchase obligations are financially stronger or more sophisticated at risk management than the average firm, we often limit our control group to financial hedgers. *PO_Hedge* is an indicator variable which equals one if the firm uses a purchase obligation (*PO Contract*) and zero if the firm uses commodity derivatives (*Commodity Contract*). We also collect the total dollar amount of POs committed to over the next five years to create a

[6] One exception is for small businesses with revenues and a public float less than $25 million.

continuous variable. We scale the sum of PO commitments by cost of goods sold in the prior year to create *PO/COGS*.

This paper examines both the form of hedging as well as the impact of hedging on investment near distress. We measure investment as *CAPEX*, defined as $CAPEX_t/Total\ Assets_{t-1}$. We use lagged assets as the denominator to isolate changes in CAPEX not total assets and our goal is to interpret the effect on the numerator.

2.2. Financial Distress and Shocks

Although our broad focus is on whether firms adjust risk management in distress, we recognize that the form of distress may matter. Suppliers may assist financially distressed but economically viable customers yet avoid more seriously economically distressed firms. We define corporate distress as an Altman's (1968) Z score less than 1.81 and entering distress is based on a change in that variable relative to the prior year. Following Andrade and Kaplan (1998), *Financial Distress* equals one if the firm has a positive operating margin but is in distress (as defined by Z-score less than 1.81) while *Econ Distress* equals one if the firm has a Z-score less than 1.81 and a negative operating margin.

We also use the failure of a firm's line of credit lead arranger as a shock to a firm's financial constraints. Sufi (2009) argues that the lack of a credit line is a good proxy variable for a financially constrained firm and Chava and Purnanandam (2011) also use bank shocks to proxy for constraint. We begin by identifying firms that have a line of credit using Perl script. We use search terms identical to those in Sufi (2009). After identifying firms with credit lines, we identify their lead arrangers using DealScan. *LOC_Shock* equals one if the firm's lead arranger on a line of credit failed during the prior year. DealScan reports a range of relationship titles. We define lenders classified as lead arranger, mandated arranger, coordinating arranger, bookrunner, and senior managing agent as primary lending relationships and we categorize these as lead arrangers. Bank failures are identified from FDIC data and major investment bank failures during 2008. We also update our data to represent bank mergers and subsidiary names using the data from Schwert (2018).

2.3. Instruments and other control variables

We additionally control for *Ln(Total Assets)*, defined as the natural log of the firm's total book assets, *Sales*, defined as the firm's total revenues divided by total book assets, and *R&D Intensity*. Further, given that trade credit may play a role in the supplier/customer purchasing relationship, especially during times of distress, we control for *AP* in our tests, defined as the firm's outstanding accounts payables divided by total assets. All variables are defined in the Appendix.

For our instrumental variables (IV) tests, we require instruments correlated with both the choice of PO versus derivatives as well as the interaction of that variable with the distress variable. We use three primary instruments *(% Input Traded*, *Supplier Tangibility*, and *Supplier Bargaining Power*, all described in detail below) which relate to the choice between risk management tools but not directly related to within firm changes in investment. Then, we use the interaction of the supplier characteristics instruments with the distress measure to instrument for the interaction. We present test statistics on the validity and strength of the instruments in the results section.

First, we proxy for the availability of financial hedging using *% Input Traded*. Almeida, Hankins, and Williams (2017) find it is positively associated with the use of futures and negatively correlated with purchase obligations use. To construct this variable, we follow their methodology and start with the 2002 Bureau of Economic Analysis' (BEA) benchmark Input-Output (IO) tables and the November 2009 issue of *Futures* magazine to identify all six-digit Input-Output industries that are traded on a major financial exchange. *FuturesMarket* is equal to one if the six-digit IO industry output is traded actively on a futures market, zero otherwise. We code this variable as zero for steel-exposed industries prior to the introduction of steel futures in late 2008 and one subsequent to the introduction of steel futures. For each downstream industry in the IO tables, we identify all six-digit upstream industries and weight each upstream industry's *FuturesMarket* value by the percentage of input supplied to each customer industry. Thus, *% Input Traded* is the weighted sum of all upstream industries' *FuturesMarket* value. We map this weighted-average supplier industry variable from the BEA IO Tables to each firm's two-digit NAICS industry in Compustat.

Next, we calculate two supplier industry characteristics that relate to the use of purchase obligations. *Supplier Tangibility* is related to supply contract settlement risk and the usefulness of purchase obligations as a hedge while *Supplier Bargaining Power* is associated with the use of purchase obligation for contracting/industrial organization issues. Both are calculated in a manner similar to the *% Input Traded*. We calculate each supplier industry's *Tangibility* following Almeida and Campello (2007) and then use two-digit NAICS codes to construct *Industry Tangibility* as the median industry measure. We then sales weight these industries using the BEA IO tables to calculate *Supplier Tangibility*. For each customer industry, we weight each six-digit supplier industry characteristic by the percentage of input they supply to the customer industry according to the "Use" table from the Input-Output tables.

$$Supplier\ Tangibility\ = \sum_{\substack{i=1 \\ i \neq j}}^{n} Industry\ Input\ Coefficient_{ij}\ \times Industry\ Tangibility_i$$

where *j* is the firm's primary six-digit IO industry, and *i* is the six-digit IO industry for each supplier industry, *n* is the number of industries which sell inputs to the reference firm, and the *Industry Input Coefficient* is the percentage of industry *j*'s input which comes from industry *i*.

We can calculate the *Supplier Bargaining Power* for each supplier industry using two-digit NAICS codes and then sales-weight them using the IO tables. For each customer industry, we weight each six-digit supply industry characteristic by the percentage of input they supply to the customer industry according to the "Use" table from the Input-Output tables.

$$Supplier\ Bargaining\ Power\ = \sum_{\substack{i=1 \\ i\neq j}}^{n} Industry\ Input\ Coefficient_{ij}\ \times Industry\ HHI_i$$

where *j* is the firm's primary six-digit IO industry, and *i* is the six-digit IO industry for each supplier industry, *n* is the number of industries which sell inputs to the reference firm, *Industry HHI* is the Herfindahl index of the industry and the *Industry Input Coefficient* is the percentage of industry *j*'s input which comes from industry *i*.

3. Distress and POs

3.1. Cross-sectional variation by distress

In contrast to the early theoretical literature on corporate hedging (i.e., Froot, Scharfstein, and Stein (1993)), Rampini, Sufi, and Viswanathan (2014) document that collateral constraints bind, leaving distressed firms less likely to use financial derivatives. Building on the Almeida, Hankins, and Williams (2017) evidence that POs are an alternative hedging tool; we begin revisiting this question in a univariate setting.

Table 2 Panel A summarizes the pre-distress risk management choices of firms in the year before a firm enters either economic or financial distress. Firms entering economic distress are less likely to use derivatives or purchase obligations than firms entering financial distress, consistent with the literature that argues that distress may limit hedging options. However, firms entering financial distress show hedging levels on par to the full sample as reported in Table 1.

Next, we consider time-series changes in our PO and derivatives variables on the extensive margin. First, we create *Stop Derivatives Use*, which equals one if the firm reported using commodity derivatives at *t*-1 and does not report the derivatives at *t*, zero otherwise. We also generate *New PO Contract*, which equals one if the firm reports using a PO at time *t* and no PO at *t*-1, zero otherwise. We then estimate *t*-tests based on the form of distress. A firm "enters" one of these distress conditions when the variable equals zero at *t*-1 and one at time *t*.

In Panel B, we document that firms are significantly more likely to stop using financial derivatives upon entering distress than firms which are not. However, the change in hedging is limited to the population entering financial distress. Moreover, we document a significant higher PO initiation in the *Financial Distress* subsample. As financially distressed firms cease using financial hedging, we observe an increased reliance on forward contracts with suppliers. The same cannot be said for the *Econ Distress* subsample, consistent with suppliers being unwilling to support customers with poor economic prospects (Petersen and Rajan (1997)).

Since the evidence indicates that firms entering financial distress appear to switch between using financial derivatives and using purchase obligations, we test this intuition directly in Table 2 Panel C. We observe that firms which stop using derivatives are more likely to initiate a new PO contract. This is true whether we compare them to the full population of firms or limit the analysis to firms using derivatives in the prior year. Figure 1 also documents this substitution graphically. We center *t*=0 around the *Enter Financial Distress* date and graph the percentage of the sample initiating new contracts or halting their financial derivatives in a given year. We indeed document that the percentage of firms that stop hedging with derivatives increases in *t*-1 and the initiation of new POs increases at time *t*. In sum, our univariate evidence is consistent with firms halting financial derivatives usage in distress, consistent with prior literature. However, in contrast to the notion that firms cease hedging, we find that firm change their risk management - using more POs.

3.2. Multivariate tests – hedging and distress

Table 3 presents multivariate evidence on the change in hedging behavior near distress. We regress *New PO Contract* and *Stop Derivatives Use* on our distress measures but we now control for firm-level characteristics as well as industry and year controls to absorb unobserved heterogeneity. Panel A shows that firms entering financial distress are more likely to initiate purchase obligations and stop derivatives use. As expected, we document no change for firms entering economic distress, who already likely faced more limited hedging options. Further, we explore switching between derivatives and purchase obligations. Panel B documents that firms which stop derivatives use are more likely to initiate a purchase obligation contract, but only if the firm has a positive operating margin in the prior year. Suppliers appear willing to support financially distressed customers when the customer has relatively stronger economic prospects.

Table 4 expands this evidence on the changing hedging behavior to examine the intensive margin. We examine changes in the level of PO use across subsamples based expected costs of distress as identified in Opler and Titman (1994). Specifically, we split the sample based on whether the firm operates in an industry with an HHI above/below the industry median, whether the firm's revenues are above/below $100 million, and whether the R&D investment is high/low (defined as above the median for non-zero R&D firms). As discussed by Opler and Titman, these firms may face higher costs of distress. For example, smaller firms may have more difficulty accessing external capital markets, rivals in concentrated industries have larger expected gains to eliminating financial weaker competitors, and firms in high-R&D supply chains produce more specialized products and are more at risk of losing customers when distressed. We expect to see firms increasing POs more in response to distress when they are in these three subsamples. Models 1 and 2 present the splits on HHI, Models 3 and 4 show results split on revenues, and Models 5 and 6 contain the results for R&D. While firms facing higher distress costs should increase their level of risk management, the use of purchase obligations may be moderated by supplier incentives. Consistent with the cost of distress literature, we find that *Enter Fin Distress* increases purchase obligation levels for concentrated industries and firms with high R&D. Interestingly, the size results are more consistent with the trade credit literature where larger downstream firms are more important to a supplier. We document that only larger firms entering financial distress increase their use of purchase obligations, most likely reflecting the willingness of suppliers to write those forward contracts.

If POs are recognized as a hedging tool for constrained firms, we would expect firms to initiate new contracts when hit by an exogenous liquidity shock. Table 5 presents evidence on PO use in response to a shock to the firm line of credit. (As noted in Section 2, *LOC_Shock* equals one if the firm's lead arranger on a line of credit failed during the prior year.) We run this analysis on the full sample as well as limiting it to financially healthy firms (Z > 3) to preclude the concern that the firm contributed to the bank's failure. Across both samples, firms exposed to a LOC shock are more likely to initiate a new PO contract. This is robust to the inclusion of industry or firm fixed effects and all regressions include year dummies and firm-level control variables. Coupled with existing evidence that distressed firms lose the ability to hedge through financial markets (i.e, Rampini, Sufi, and Viswanathan (2014)), firms appear to attempt to replace the lost ability to hedge in financial markets via product-market contracts. Interestingly, we document little relationship between the LOC shock and financial hedging. To the extent that the liquidity shock of losing the lead arranger on one's line of credit is unrelated to the firm's collateral position, we view these results as consistent with Rampini, Sufi, and Viswanathan. Like the evidence on POs, this speaks to the importance of hedging in distress.

4. Hedging, Distress, and Investment

4.1. Hedging, distress, and underinvestment – OLS results.

So far, we have shown hedging activity changes – but does not cease – when firms approach distress or experience an exogenous shock. We now explore the implications for investment policy. As POs are the result of contracting between two firms, we do not have exogenous variation in their availability but take two distinct approaches to addressing this issue. As discussed earlier, we compare PO users to firms using financial hedging (*PO_Hedge)* to minimize the concern that using POs is correlated with financially stronger firms (where suppliers are willing to write contracts) or firms managing input price risk differ from the average firm. Focusing on *PO_Hedge* – and specific treatment/control group – allows us to highlight how the investment outcome varies with distress depending on the type of hedging. In other words, conditional on the firm's decision to hedge input costs, we are interested in whether their specific hedging choice (POs or derivatives) affects the ability to invest in distress. We regress *CAPEX* on *PO_Hedge,* interacted with our distress measures discussed in Section 2.2. Specifically, we estimate several versions of the following empirical model in Table 6:

$$CAPEX_{it} = f_t + k_t + \beta_1 DistressMeasure_{i,t-1} + \beta_2 PO\_Hedge_{i,t-1} + \beta_3 DistressMeasure_{i,t-1} * PO\_Hedge_{i,t-1} + \sum_{i=4}^{n} B_i \, Control + e. \quad (1)$$

where *i*, and *t* index firm and time, respectively. f_t and k_t represent firm and time fixed effects, respectively. *DistressMeasure* represents either *Fin Distress*, *Econ Distress*, or *LOC Shock* depending on the model. All specifications include firm and year fixed effects.

As expected, *Fin Distress*, *Econ Distress*, and *LOC Shock* have significantly negative coefficients for the full sample. This implies that both forms of distress lead to lower subsequent investment for firms hedging with derivatives (*PO_Hedge* = 0). As predicted by Froot, Scharfstein, and Stein (1993), the inability to hedge during distress leads to underinvestment. However, the result is more nuanced for PO users. The significantly positive interaction effects between *PO_Hedge*FinDistr* and *PO_Hedge*LOC Shock* indicate that firms using POs to hedge are less prone to the collateral-type problems affecting firms hedging via financial markets and this partially offsets the underinvestment problem in distress. In Model 4, we restrict the sample to firms with a Z-Score over 3 in order to reduce concerns that bank failures were non-randomly related to the firm's financial standing. We continue to find statistically significant results suggesting that firms using POs to hedge invest at higher levels. We further note that *PO_Hedge*EconDistr* is statistically insignificant, consistent with the argument that suppliers are only willing to assist customers likely to survive as a going concern.

Broadly, the above results are consistent with the hypotheses that 1) firms that use commodity derivatives to hedge indeed face limitations when they are constrained, leading to an underinvestment problem, and 2) firms that use POs to hedge are able to partially offset this problem in financial distress.

4.2. Instrumental Variables

We confirm that POs enable distressed firms to maintain higher investment using an instrumental variable analysis. Since our interest is in the interaction of hedging and distress, we must instrument for both *PO_Hedge* and *PO_Hedge*Distress*. As discussed in Section 2.3, our primary instruments are *% Input Traded*, *Supplier Tangibility* and *Supplier Bargaining Power*, as well as all three variables interacted with the *Distress* measure. which proxy for the cost and settlement risk of purchase obligation contracts (Almeida, Hankins, and Williams (2017)).[7] Table 7 reports the coefficient estimates as well as the relevant test statistics related to first stage F statistics, under-identification, and weak instrumental variables. The first system (columns 1-3) includes fixed effects and the second system (columns 4-6) include firm and year fixed effects

Our IV results in Table 7 are consistent with the evidence that risk management choices affect investment. The negative coefficient on the *Financial Distress* across both systems of models (columns 3 and 6) indicates a drop in investment related to poor financial conditions while the interactions of *PO_Hedge* Financial Distress* are consistently positive and statistically significant in both systems. That is, while investment drops around financial constraint, firms hedging with purchase obligations are better able to maintain their investment levels, relative to firms using futures and controlling for intertemporal heterogeneity in investment. Further, the test statistics in the baseline specification indicate no reason to believe that the instruments are weak or invalid with F-statistics of 16.550 and 28.540 for the first stage regressions predicting *PO_Hedge* and *PO_Hedge*Distress*, respectively. We also note that in the first-stage models predicting the direct effect *PO_Hedge*, the instruments *% Input Traded* and *Supplier Tangibility* are significant (columns 1 and 4). In the first-stage models predicting the interaction term

[7] Note that our results are also robust to adding additional instruments, such as *% Input Traded*, which proxies for the availability of exchange-traded derivatives.

PO_Hedge Financial Distress*, the instruments *Supplier Tangibility*Financial Distress* and *Supplier Bargaining Power*Financial Distress* are significant.

4.3. Cash and Trade Credit

One potential concern is that firms can also use cash as a financial hedging tool (i.e., Almeida et al (2014)). We therefore test whether or not firms increase cash holdings in response to economic shocks in Table 8. We estimate an OLS model in Model 1. Models 2 and 3 are IV models with firm fixed effects, and firm and year fixed effects, respectively. (For conciseness, we only report the second stage results in this table but the instruments are the same as in Table 7.) We detect no significant relation between *PO_Hedge* Financial Distress* and changes in *Cash*.

A related concern is that there may be a spurious correlation between PO behavior and trade credit activity. For example, suppliers are known to issue more downstream trade credit to distressed customers (e.g., Shenoy and Williams, 2017). Cunat (2007) and Garcia-Appendini and Monteriol-Garriga (2013) find that suppliers are liquidity providers during periods of financial constraint. The enhanced investment activity may therefore be the result of improved trade credit financing, and the PO usage would then be generated by a spurious correlation between increased trade credit activity and purchasing activity. Although we control for trade credit in our multivariate tests, we directly address this issue by considering AP as the dependent variable in models 4-6 of Table 8. We document at negative coefficient on *PO_Hedge* Financial Distress*, suggesting that increasing trade credit does not explain the increased propensity to use POs in distress. We omit lagged AP in these tests to avoid the dynamic panel problem, although our results are robust to including this control variable.

All of the multivariate analysis on the impact of PO during distress is consistent across Tables 6 - 8. Hedging with supply contracts appears to help firms alleviate the underinvestment problem for firms with financial (not economic) distress or those facing an exogenous shock. This buttresses earlier evidence that purchase obligations are a risk management tool (Almeida, Hankins, and Williams, 2017). Forward contracts with suppliers provide a useful hedge during times of distress, enabling higher investment levels than firms which hedge with derivatives.

5. Conclusions

This paper revisits the question of how and whether firms hedge in distress. Countering newer empirical evidence that firms appear to reduce risk management near distress we expand the definition of risk management to include purchase obligations and find results more consistent with theoretical predictions of Froot *et al.* (1993). Firms entering financial distress are more likely to use POs than financial derivatives for hedging, even switching risk management from derivatives to supply contracts. This is consistent with the trade credit evidence on the importance of suppliers in times of distress. Importantly, the ability to hedge using POs allows firms to minimize underinvestment during financial distress.

This paper highlights that firms continue to hedge in distress, but adjust their risk management choices. Moreover, this impacts investment. POs sidestep the collateral constraints associated with financial derivatives and appear to provide more flexibility for less-severely distressed firms.

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Figure 1

This Figure shows changes in contract initiation (*New PO Contract*) and the discontinuation of financial hedging (*Stop Hedging*) around firms that *Enter Financial Distress* at time *t*.

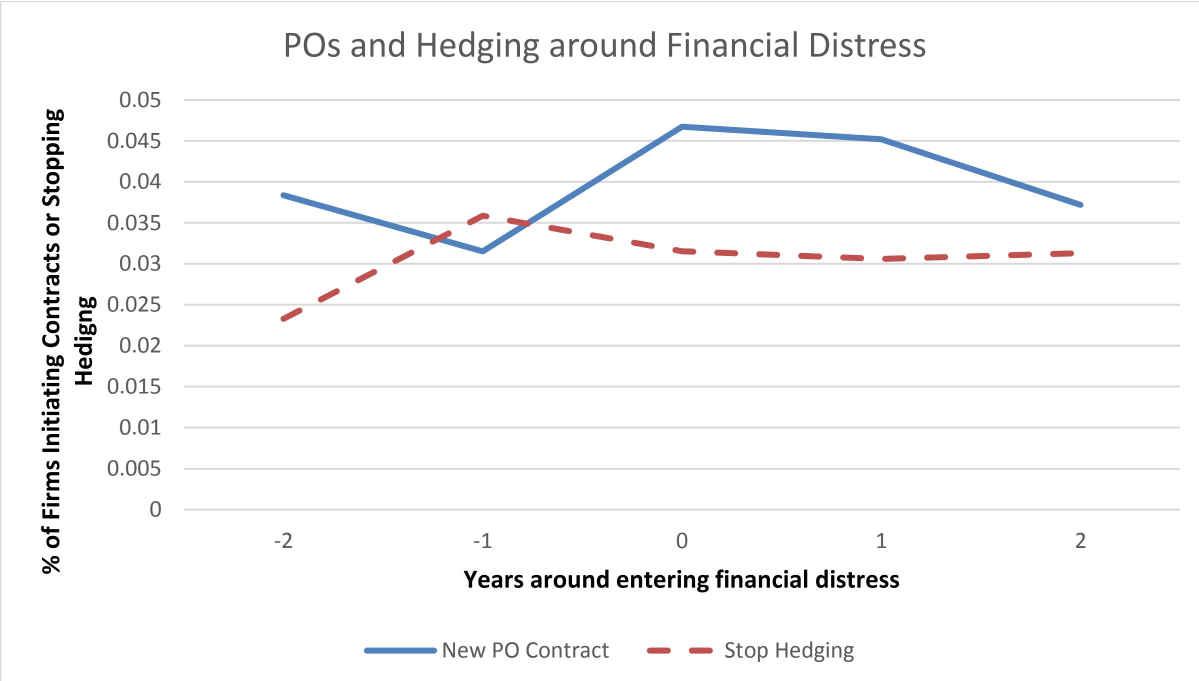

Table 1 – Summary Statistics

This table reports summary statistics for the key variables in the paper. *Purchase Obligation* is a variable that equals 1 if a firm reports using purchase obligations in its 10-K filing, 0 otherwise. *Derivative User* is a variable that equals 1 if the firm reports using commodity derivatives in its 10K filings, 0 otherwise. *PO_Hedge* is a variable that equals 1 if a firm uses *Purchase Obligations* and 0 if a firm is a *Derivative User*. All other variables are defined in the Appendix.

Variable Name	Mean	Median	25th Pct	75th Pct	Std Dev	N
Hedging Characteristics						
Purchase Obligation	0.23	0.00	0.00	1.00	0.42	50,534
Derivative User	0.19	0.00	0.00	0.00	0.39	50,534
PO_Hedge	0.64	1.00	0.00	1.00	0.48	15,117
Distress Variables						
Z-score	35.43	3.18	1.03	7.94	1230.25	39,781
Financial Distress	0.02	0.00	0.00	0.00	0.13	38,030
Econ Distress	0.02	0.00	0.00	0.00	0.13	38,030
Firm Characteristics						
CAPEX	0.05	0.02	0.01	0.06	0.08	45,720
Ln(TotalAssets)	5.96	6.08	4.32	7.62	2.43	45,993
Sales/Assets	0.85	0.67	0.26	1.18	0.81	45,956
AP	0.15	0.06	0.03	0.12	0.31	45,810
Cash	0.24	0.12	0.04	0.31	0.32	45,990
Supplier Characteristics						
% Input Traded	0.03	0.01	0.00	0.03	0.06	46,497
Supplier Tangibility	0.25	0.25	0.24	0.27	0.03	41,269
Supplier Bargaining Power	0.04	0.04	0.03	0.04	0.01	41,488

Table 2 – Cross-sectional Differences in Hedging

This table presents cross-sectional differences hedging behavior for firms entering either economic or financial distress. Panel A documents differences before entering distress between the two groups. Panel B documents changes in hedging at the time of entering distress. Panel C documents switching between derivatives and purchase obligations. All variables are defined in the Appendix.

Panel A

	Entering Econ Distress			Entering Fin Distress				
	N	Mean	St Dev	N	Mean	St Dev	diff	Pr(T < t)
Commodity Hedger $_{t-1}$	998	0.144	0.352	920	0.272	0.445	0.127	0.000
PO Contract $_{t-1}$	998	0.138	0.345	920	0.234	0.423	0.095	0.000
PO/Total Assets $_{t-1}$	728	0.018	0.092	794	0.025	0.125	-0.004	0.107

Panel B

	Enter Distress			Not Entering Distress				
	N	Mean	St Dev	N	Mean	St Dev	diff	Pr(T < t)
Stop Derivatives Use								
Enter Fin Distress	920	0.032	0.175	48,651	0.018	0.132	-0.014	0.001
Enter Econ Distress	998	0.018	0.133	48,573	0.018	0.133	0.000	0.486
New PO Contract								
Enter Fin Distress	920	0.047	0.211	48,651	0.032	0.176	-0.015	0.006
Enter Econ Distress	998	0.031	0.174	48,573	0.032	0.177	0.001	0.585

Panel C

	Stop Derivatives Use			Not Stopping				
	N	Mean	St Dev	N	Mean	St Dev	diff	Pr(T < t)
New PO Contract								
Full Sample	923	0.046	0.209	49,611	0.032	0.175	-0.014	0.009
Derivatives User at t-1	923	0.046	0.209	6,675	0.036	0.187	-0.009	0.079

Table 3 – Distress and Hedging Choices

This table reports multivariate logit regressions that predict changes in risk management. Panel A documents binary changes in hedging at the time of entering distress (*New PO Contract*, *Stop Derivatives Use*). Panel B documents that switching from derivatives to purchase obligations is conditional on financial health. *Stop Derivatives* equals one of the firm ceases using financial derivatives. Firm controls include lagged Ln(Total Assets), Sales, R&D Intensity, and Accounts Payable. Standard errors are clustered at the firm level and are robust to arbitrary heteroskedasticity. Standard errors are reported in parentheses and ***, **, *, and + represent statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

Panel A

	New PO Contract		Stop Derivatives Use	
Enter Fin Distress	0.331*		0.420*	
	(0.161)		(0.197)	
Enter Econ Distress		-0.021		0.154
		(0.190)		(0.258)
N	44874	44874	44729	44729
Firm Controls	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes

Panel B

	New PO Contract							
	Positive Operating Margin $_{t-1}$				Negative Operating Margin $_{t-1}$			
Stop Deriv $_{t}$	0.306+	0.191			-0.252	-0.364		
	(0.170)	(0.173)			(0.520)	(0.525)		
Stop Deriv $_{t-1, t, t+1}$			0.219+				0.069	
			(0.117)				(0.311)	
Stop Deriv $_{t, t+1}$				0.255+				0.148
				(0.136)				(0.349)
N	31407	31135		31135	9370	9071		9071
Firm Controls	No	Yes		Yes	No	Yes		Yes
Industry Dummies	No	Yes		Yes	No	Yes		Yes
Year Dummies	No	No		Yes	No	No		Yes

Table 4 – Increased Use of POs

This table reports multivariate regressions that predict the continuous PO variable, *PO/COGS* where COGS is measured in the prior year. Following Opler and Titman (1994), we split the sample by median industry concentration (HHI), revenues above/below $100 million, and high/low R&D firms. Firm controls include lagged *Ln(Total Assets)*, *Sales*, *Accounts Payable*, and *R&D Intensity*. Standard errors are clustered at the firm level and are robust to arbitrary heteroskedasticity. Standard errors are reported in parentheses and ***, **, *, and + represent statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

	PO/COGS$_{t-1}$					
	Industry Concentration		Sales		R&D	
	Above Med	Below Median	> $100m	< $100m	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)
Enter Fin Distress $_{t-1}$	0.055+	-0.022	0.037+	-0.080	0.189*	0.017
	(0.031)	(0.031)	(0.022)	(0.085)	(0.081)	(0.022)
Ln (Total Assets) $_{t-1}$	-0.015	-0.060***	-0.046***	-0.048	-0.097**	-0.035**
	(0.017)	(0.015)	(0.012)	(0.034)	(0.037)	(0.012)
Sales $_{t-1}$	-0.069**	-0.064**	-0.084***	-0.05	-0.248**	-0.065***
	(0.023)	(0.025)	(0.018)	(0.039)	(0.078)	(0.016)
AP $_{t-1}$	0.167	-0.179	0.105	-0.142	-0.627	-0.02
	(0.198)	(0.135)	(0.146)	(0.206)	(0.646)	(0.114)
R&D Intensity $_{t-1}$	0.017	-0.263*	-0.127	-0.075	0.142	-0.099
	(0.101)	(0.112)	(0.164)	(0.106)	(0.253)	(0.078)
N	4741	4745	8062	1424	1050	8436
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5 – Exogenous Distress and Hedging

This table reports multivariate logit regressions that predict *New PO Contract* and *Stop Derivatives*. *LOC Shock* represents an exogenous financial shock - the failure to the firm's lead arranger on its credit line. To avoid concerns that the firm contributed to the bank's failure, we rerun all analysis with only financially health firms (Z>3). All models also contain control variables, along with firm, year, and industry fixed effects. Standard errors are clustered at the firm level and are robust to arbitrary heteroskedasticity. Standard errors are reported in parentheses and ***, **, *, and + represent statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

	New Contract				Stop Derivatives			
	All		Z > 3		All		Z > 3	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LOC Shock $_{t-1}$	0.447**	0.536***	0.566**	0.757***	-0.171	-0.373	-0.104	-0.351
	(0.137)	(0.160)	(0.175)	(0.214)	(0.266)	(0.285)	(0.364)	(0.389)
Ln (Total	0.125***	0.152*	0.109***	0.135	0.106***	0.058	0.086***	0.118
Assets) $_{t-1}$	(0.011)	(0.073)	(0.014)	(0.093)	(0.015)	(0.094)	(0.022)	(0.142)
Sales $_{t-1}$	0.047	0.053	0.026	-0.009	0.058	0.036	0.079	0.088
	(0.041)	(0.117)	(0.048)	(0.151)	(0.050)	(0.134)	(0.062)	(0.205)
AP $_{t-1}$	-0.825**	0.266	-0.721*	0.001	-0.065	0.155	-0.333	0.81
	(0.302)	(0.465)	(0.339)	(1.009)	(0.181)	(0.410)	(0.328)	(1.406)
R&D	0.113	-0.195	0.228	-0.102	0.111	1.077	0.22	1.729+
Intensity $_{t-1}$	(0.190)	(0.462)	(0.239)	(0.597)	(0.344)	(0.660)	(0.522)	(1.041)
N	45773	11396	27954	7185	45628	6463	27672	3268
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	No	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes	No	Yes

Table 6 – Distress, Hedging, and Investment

This table reports multivariate regressions that predict *CAPEX* using *PO_Hedge* and a variety of distress measures. *PO_Hedge* equals one if the firms uses purchase obligations and zero if the firm exclusively uses derivatives. All models also contain control variables, along with a variety of firm, year, and/or industry-year fixed effects. Standard errors are clustered at the firm level and are robust to arbitrary heteroskedasticity. Standard errors are reported in parentheses and ***, **, *, and + represent statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

	CapEx $_t$ / Assets $_{t-1}$			
Subsample	All	All	All	Z>3
	(1)	(2)	(3)	(4)
PO_Hedge $_{t-1}$	-0.003	0.001	0.000	0.002
	(0.003)	(0.003)	(0.003)	(0.003)
*PO_Hedge*FinDistr $_{t-1}$*	0.018***			
	(0.005)			
*PO_Hedge*EconDistr $_{t-1}$*		0.008		
		(0.011)		
*PO_Hedge * LOC Shock $_{t-1}$*			0.021***	0.018*
			(0.006)	(0.008)
Fin Distress $_{t-1}$	-0.035***			
	(0.004)			
Econ Distress $_{t-1}$		-0.030**		
		(0.010)		
LOC Shock $_{t-1}$			-0.011*	-0.006
			(0.005)	(0.007)
Total Assets $_{t-1}$	-0.024***	-0.026***	-0.026***	-0.016***
	(0.003)	(0.003)	(0.003)	(0.003)
Sales $_{t-1}$	-0.001	-0.001	0	0.010*
	(0.003)	(0.003)	(0.003)	(0.004)
AP $_{t-1}$	0.008	0.011	0.008	-0.031
	(0.011)	(0.011)	(0.011)	(0.027)
R&D Intensity $_{t-1}$	-0.021*	-0.018+	-0.024*	-0.01
	(0.010)	(0.011)	(0.010)	(0.012)
N	14978	14978	14978	9037
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 7 – IV Estimates

This table reports multivariate instrumental variables (IV) estimates that predict *CAPEX* using instrumented *PO_Hedge* and *PO_Hedge*Distress*. We instrument using lagged *% Input Traded*, *Supplier Tangibility*, and *Supplier Bargaining Power*, as well as the interaction between all three variables with our financial distress measure. All models also contain control variables, along with a variety of firm and year fixed effects. Standard errors are clustered at the firm level and are robust to arbitrary heteroskedasticity. Standard errors are reported in parentheses and ***, **, *, and + represent statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively.

	PO_Hedge_{t-1}	$PO\_Hedge * Dist_{t-1}$	$CapEx_t / Assets_{t-1}$	PO_Hedge_{t-1}	$PO\_Hedge * Dist_{t-1}$	$CapEx_t / Assets_{t-1}$
	1st Stage	1st Stage	2nd Stage	1st Stage	1st Stage	2nd Stage
	(1)	(2)	(3)	(4)	(5)	(6)
	IV with Firm FE			IV with Firm FE and Year FE		
*PO_Hedge * Dist* $_{t-1}$			0.060***			0.059**
			(0.017)			(0.019)
PO_Hedge $_{t-1}$			0.060**			0.132**
			(0.020)			(0.049)
% Input Traded	-0.191***	0.053**		-0.214***	0.053**	
	(0.000)	(0.007)		(0.000)	(0.007)	
Supplier Tangibility $_{t-1}$	-1.132***	0.330***		-0.329+	0.570***	
	(0.000)	(0.000)		(0.076)	(0.000)	
Supplier Bargaining Power $_{t-1}$	0.478	-0.352+		0.427	-0.270	
	(0.190)	(0.094)		(0.391)	(0.360)	
*%Traded*FinDistress* $_{t-1}$	0.145	-0.087		0.177	-0.074	
	(0.203)	(0.504)		(0.111)	(0.564)	
*SupTang*FinDistress* $_{t-1}$	-0.228	-3.008***		-0.296	-3.037***	
	(0.365)	(0.000)		(0.236)	(0.000)	
*SupBarg*FinDistress* $_{t-1}$	-0.050	2.992***		-0.018	3.002***	
	(0.931)	(0.000)		(0.975)	(0.000)	
Financial Distress $_{t-1}$	0.045	1.205***	-0.058***	0.056	1.210***	-0.054***
	(0.516)	(0.000)	(0.010)	(0.414)	(0.000)	(0.012)

(continued)

Table 7 *(continued)*

Total Assets $_{t-1}$	0.025***	0.003	-0.028***	0.005	-0.003	-0.025***
	(0.000)	(0.452)	(0.002)	(0.533)	(0.565)	(0.003)
Sales $_{t-1}$	-0.011	-0.012*	-0.001	-0.011	-0.012*	0.001
	(0.217)	(0.019)	(0.003)	(0.246)	(0.025)	(0.003)
AP $_{t-1}$	-0.008	0.011	0.012	-0.020	0.007	0.01
	(0.615)	(0.421)	(0.009)	(0.206)	(0.621)	(0.009)
R&D Intensity $_{t-1}$	0.085**	-0.003	-0.032***	0.047	-0.014	-0.026**
	(0.003)	(0.852)	(0.009)	(0.112)	(0.444)	(0.010)
N	13986	13986	13986	13986	13986	13986
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes
First Stage F Stat	16.550	28.540		4.340	29.320	
First Stage F Stat P Value	0.000	0.000		0.000	0.000	
Underidentification P Value			0.000			0.000
Weak Identification F statistic			16.557			4.246
Stock Yogo 10% Threshold			9.480			9.480

Table 8 – Cash and Trade Credit

This table reports multivariate OLS and instrumental variables (IV) estimates that predict *Cash* or *AP* using *PO_Hedge* and *PO_Hedge*Distress*. We treat these two variables as endogeneous in our IV models We instrument using lagged *% Input Traded*, *Supplier Tangibility*, and *Supplier Bargaining Power*, as well as the interaction between all three variables with our financial distress measure. All models also contain control variables, along with a variety of firm and year fixed effects. Standard errors are clustered at the firm level and are robust to arbitrary heteroskedasticity. Standard errors are reported in parentheses and ***, **, *, and + represent statistical significance at the 0.1%, 1%, 5%, and 10% levels, respectively. All models include a mixture of firm and year fixed effects.

	$Cash_t / Assets_{t-1}$			$AP_t / Assets_{t-1}$		
	OLS, FE	IV with FE		OLS, FE	IV with FE	
	(1)	(2)	(3)	(4)	(5)	(6)
*PO_Hedge * Dist* $_{t-1}$	-0.008	-0.003	-0.007	-0.002	-0.043*	-0.041*
	(0.005)	(0.021)	(0.019)	(0.006)	(0.021)	(0.019)
PO_Hedge $_{t-1}$	0.008	0.148***	0.055	0	0.185***	0.115
	(0.005)	(0.043)	(0.066)	(0.004)	(0.047)	(0.070)
Financial Distress $_{t-1}$	-0.005	-0.002	-0.004	-0.013*	0.012	0.009
	(0.004)	(0.012)	(0.010)	(0.005)	(0.010)	(0.009)
Total Assets $_{t-1}$	-0.063***	-0.058***	-0.063***	-0.042***	-0.047***	-0.043***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Sales $_{t-1}$	-0.008	-0.005	-0.007	0.039**	0.041***	0.040***
	(0.010)	(0.008)	(0.009)	(0.014)	(0.011)	(0.012)
AP $_{t-1}$	0.099	0.101+	0.100+			
	(0.076)	(0.061)	(0.061)			
R&D Intensity $_{t-1}$	0.386***	0.396***	0.384***	0.084	0.069	0.078
	(0.091)	(0.082)	(0.082)	(0.064)	(0.051)	(0.050)
N	14822	13833	13833	15024	14041	14041
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	Yes	No	Yes

Appendix A

This Appendix reports the definitions for the variables used in this study.

Variable Name	Definition
Hedging Characteristics	
Purchase Obligation	Indicator variable that equals one if the firm reports using purchase obligations in its 10K, zero otherwise.
Derivative User	Indicator variable that equals one if the firm reports using commodity derivatives in its 10K, zero otherwise, using the list in Almeida, Hankins, and Williams (2017)
PO_Hedge	Indicator variable that equals one if the firm uses POs, zero if it uses commodity derivatives.
PO/COGS	Dollar value of PO commitments over next five years divided by cost of goods sold.
Distress Variables	
Z-score	Z-score from Altman (1968)
Financial Distress	Indicator variable that equals one if the firm has a Z-score less than 1.81 and it has a positive operating margin.
Econ Distress	Indicator variable that equals one if the firm has a Z-score less than 1.81 and it has a negative operating margin.
Firm Characteristics	
CAPEX	Capital expenditures at time t (CAPEX) scaled by total assets (AT) at time t-1
TotalAssets	Compustat variable AT.
Sales/Assets	Total sales scaled by total assets (REVT/AT)
AP	Accounts payables divided by total assets (AP/AT)
Cash	Cash divided by lagged total assets (CHE/AT)
Supplier Characteristics	
% Input Traded	Percentage of the firm's input traded on futures markets, using the BEA tables and commodity derivative definitions from Almeida, Hankins, and Williams (2017)
Supplier Tangibility	Weighted-average percentage of suppliers' tangibility ratios, using the BEA tables and the tangibility definition from Almeida and and Campello (2007).
Supplier Bargaining Power	Weighted-average supplier industry HHI, using the BEA tables.

Appendix B

We use a simple liquidity management model along the lines of Holmström and Tirole (1998). Start with an initial (date-0) investment = I, which is fixed. The firm also starts with net worth A > 0. The investment produces a payoff R at the final date (date 2). At date-1, the firm has to make an additional (random) investment to continue the project. If this investment is not made, the project is liquidated and produces zero. With probability λ, the required investment is ρ, and it is zero in the other state. We assume that $\rho < R$ (so that continuation is efficient in state λ), and that $R > I + \lambda \rho$ (so the project is positive NPV). Everyone is risk-neutral, and the discount rate is 1 for simplicity.

The main friction is that the firm faces a limited pledgeability constraint. As in Holmstrom and Tirole, limited pledgeability arises from a moral hazard problem. In order to produce the payoff R, the manager must retain an amount equal to $R^b < R$. If the manager's share of the payoff is less than R^b, the manager misbehaves and chooses an (inefficient) action that reduces the overall payoff but produces private benefits for the manager. Thus, pledgeable income is equal to $\rho_0 = R - R^b$.

We assume that $\rho_0 < \rho$. This assumption means that the manager cannot generate sufficient pledgeable income to pay for the random investment in case it happens, and must hold liquidity (see Almeida, Campello, Cunha and Weisbach (2014) for further discussion). We assume that the firm holds cash to manage the exposure to the random investment. The minimum amount of cash that the firm must hold is:

$$C^* = \rho - \rho_0 \qquad (1)$$

Following Holmström and Tirole (1998), we assume that there is a liquidity premium q associated with cash holdings (the firm pays a price q > 1 for cash at the initial date 0). Given this, the firm will be able to continue in state λ if:

$$A + \rho_0 > I + \lambda\rho + (q - 1)\, C^* \qquad (2)$$

We assume that this condition holds (that is, the firm has sufficient pledgeable income to fund I, λρ and the date-0 liquidity premium). The associated payoff is:

$$U^* = R - I - \lambda\, \rho - (q - 1)\, C^* \qquad (3)$$

which we assume to be greater than zero (the project is still positive NPV after accounting for the liquidity premium).

In addition to the shock in state λ, the firm is exposed to a (zero mean) additional shock which is modeled as in Almeida, Hankins and Williams (2018). With probability x = 0.5, there is a shortfall equal to −μ, and with probability (1 − x) = 0.5 the firm gains μ. The key difference between this shock and the previous one is that the exposure associated with x can be hedged, either with an operational hedge or derivatives. For example, we can assume that the variation in the required investment ρ is not contractible (it is firm-specific and due to the firm's own performance), while the exposure μ is due to variation in input prices. State x is a state in which input prices are high.

How does the exposure associated with x affect the firm? Notice that eliminating the exposure in state 1 − λ is irrelevant. It reduces the variance of cash flows but has no effect on investment policy or the firm's payoff. On the other hand, in state λ, the firm has an incentive to eliminate this exposure because it will cause inefficient liquidation. If the firm holds cash equal to C^* and input prices go up (state x), then the firm will face a shortfall equal to −μ and will not have sufficient pledgeable income to continue.

We depart from Almeida, Hankins and Williams (2018) by assuming that the firm can choose the fraction of the required investment $\rho + \mu$ that it decides to pay in the bad state λx (partial liquidation). One possible interpretation is that the firm reduces its demand for inputs and thus needs to scale down if both shocks ρ and μ happen. We denote this fraction by θ, so that the firm invests $\theta(\rho + \mu)$. We assume that if $\theta < 1$, there is a linear effect on both the payoff of the investment and pledgeable income. The total payoff goes to θR, and pledgeable income goes to $\theta\rho_0$.

Hedging with futures

The firm can hedge the risk associated with x by opening a futures position. The firm commits to making a payment which we denote by $f \leq \mu$ if the shock does not happen, in exchange for receiving a payment equal to f if the shock does happen. For each f, and given the optimal cash holding of C^*, the firm's budget constraint in state $\lambda(1 - x)$ is:

$$\rho_0 + C^* - f = \rho - \mu. \qquad (4)$$

The firm always continues in this state since $C^* = \rho - \rho_0$ is sufficient to cover the shortfall in pledgeable income. In state λx there can be partial continuation and thus the budget constraint is:

$$\theta\rho_0 + C^* + f = \theta(\rho + \mu). \qquad (5)$$

The firm's hedging position f is a function of the fraction that the firm chooses to continue:

$$f(\theta) = \theta\mu - (1 - \theta) C^* = \theta\mu - (1 - \theta)(\rho - \rho_0) \qquad (6)$$

In particular if $\theta = 1$ (no liquidation), we must have full hedging ($f = \mu$). Partial liquidation allows the firm to reduce its hedging position to $f(\theta) < \mu$.

As in Almeida, Hankins and Williams (2018), the main friction associated with futures comes from the margin account that the firm needs to open with the futures exchange. We assume that the required amount is given by ζf, with $\zeta < 1$. The margin account will then be equivalent to an increase in cash holdings (it needs to be in place at date-0). Assuming that the exchange pays an interest rate on the margin account that is equivalent to what the firm earns on liquid assets, the margin account will create a liquidity premium equal to $(q - 1)\zeta f$. Thus, when using futures the firm will achieve the following payoff:

$$U_f(\theta) = (1-\lambda)R + (\lambda/2)(R - \rho) + (\lambda\theta/2)(R - \rho) - (q - 1)(C^* + \zeta f(\theta)) - I =$$

$$= R - I - \lambda\rho - (\lambda(1 - \theta)/2)(R - \rho) - (q - 1)(C^* + \zeta f(\theta)) \quad (7)$$

In this expression the term $(\lambda(1-\theta)/2)(R - \rho)$ is the cost of liquidating the project (which happens with probability $\lambda(1-\theta)/2$), and $(q - 1)\zeta f(\theta)$ is the cost of the margin position. We assume that partial liquidation of the project reduces the payoff function $U_f(\theta)$, that is:

$$\frac{\partial U_f(\theta)}{\partial \theta} = \frac{\lambda}{2}(R - \rho) - (q - 1)\zeta(\mu + \rho - \rho_0) > 0 \quad (8)$$

If this assumption does not hold the futures position is too costly implying that the optimal θ is zero. Assumption (8) rules out this trivial case.

The futures position $f(\theta)$ is feasible when:

$$A + \rho_0 + (\lambda(1 - \theta)/2)(\rho - \rho_0) \geq I + \lambda\rho + (q - 1)(C^* + \zeta f(\theta)) \quad (9)$$

In this expression, notice that partial liquidation $\theta < 1$ relaxes the feasibility constraint. Thus, given the assumption in (8), the optimal solution with futures hedging is to pick the highest possible θ that satisfies equation (9).

Result 1: Under futures hedging, the optimal θ is equal to $\min(\theta^*, 1)$, where θ^* is defined as:

$$A + \rho_0 + (\lambda(1 - \theta^*)/2)(\rho - \rho_0) \geq I + \lambda\rho + (q - 1)(C^* + \zeta f(\theta^*)) \quad (10)$$

Notice that θ^* is an weakly increasing function of A and ρ_0. The associated futures position is:

$$f(\theta^*) = \theta^*\mu - (1 - \theta^*)(\rho - \rho_0) \quad (11)$$

And the payoff is given by Equation (7) evaluated at θ^*.

Hedging with purchase obligations

We model hedging using supply contracts (purchase obligations or POs) as in Almeida, Hankins and Williams (2018). If one assumes that the exposure μ is due to variation in input prices then hedging with POs is equivalent to contracting on date-0 on a fixed price that does not depends on the specific realization of input prices. This position can be interpreted as a position in a forward contract. The firm commits to making a payment of $F \leq \mu$ to the supplier if input prices decrease, and receives a payment equal to F if input prices increase.

The trade-off of using POs also follows AHW. Given that the variation in input prices is zero mean, the actuarially fair date-0 price would be zero. However, given that the supplier may have some bargaining power, the price is likely to be positive (and increasing with the supplier's bargaining power). Thus, the ex-ante price for a forward position of F is $kF > 0$.

As in AHW, the key advantage of a forward contract with a supplier is that it can relax financing constraints. As is standard in the trade credit literature, the supplier may be in a position to extract more pledgeable income from buyers relative to external investors due to the value of the trading relationship, better monitoring technology or additional information about the costumer. We capture this idea by assuming that pledgeable income goes up to $\rho'_0 > \rho_0$ for contracts that have the supplier as a counterparty. Other than a purchase obligation, costumers and supplier can use trade credit to mitigate the variation in input prices.

We assume throughout that the increase in pledgeable income is sufficient to pay the premium in the forward contract, that is $k\ \mu \leq \rho'_0 - \rho_0$. We also assume that hedging with the supply contract increases the firm's payoff, which requires that $\frac{\lambda}{2}(R - \rho) > k\ \mu$.

Under these assumptions the feasibility constraint for a forward contract is the same as in the case with no hedging (equation (2) above). Thus, with the forward contract partial liquidation is never optimal ($\theta_F = 1$). In particular, the firm always chooses a forward position equal to $F^* = \mu$ (full hedging). The firm's ex-ante payoff is however reduced by the magnitude of the forward premium:

$$U_F = R - I - \lambda \rho - (q - 1) C^* - k\mu \qquad (12)$$

AHW also allow for an additional friction affecting hedging with forward contracts which is that there can be counterparty settlement risk. We abstract from this possibility here. In addition, notice that we are assuming that cash holdings are constant at C* in both cases (hedging with futures or forwards). There can be meaningful interactions between hedging and optimal cash holdings in both cases. In particular, the firm may be able to use the additional pledgeable income $\rho'_0 - \rho_0$ to reduce cash holdings. In that case the financing advantage of purchase obligations may increase. We abstract from this possibility for now.

Before analyzing the trade-off between forwards and futures, consider the possibility that the firm may borrow from the supplier to mitigate the negative shock μ. That is, conditional on being in the bad state λx the firm can use the additional pledgeable income $\rho'_0 - \rho_0$ to raise funding to pay for the outflow μ. That possibility, which would capture trade credit financing, requires the firm to have sufficient pledgeable income to pay for μ, that is it requires that $\rho'_0 - \rho_0 \geq \mu$. In addition, as in the discussion above it is likely that the supplier will be in a position to charge a premium for the trade credit financing. Denote this premium by k_μ. The feasibility constraint for trade credit is then that $\rho'_0 - \rho_0 \geq (1 + k_\mu)\mu$.

Notice that this feasibility constraint is very likely to be tighter than that for the purchase obligation ($\rho'_0 - \rho_0 \geq k\mu$). There is no reason why k_μ should be lower than the premium k that the firm pays for the forward contract. More importantly, the key advantage of the forward contract is that the firm can use it to transfer cash across states. In exchanging for receiving a transfer of cash equal to μ in the bad state λx, the firm makes an additional payment μ in the good state $\lambda(1-x)$. This transfer of cash across states cannot be replicated by trade credit financing since it is a “spot contract”. That is the main reason why the purchase obligation is likely to relax financing constraints by more than trade credit financing.

We summarize this discussion in the following result:

Result 2: Under forward (purchase obligation) hedging, if $k\,\mu \leq \rho'_0 - \rho_0$ and $\frac{\lambda}{2}(R - \rho) > k\mu$, the optimal continuation policy is $\theta = 1$ and the forward position is $F^* = \mu$ (full hedging). The associated payoff is given by U_F in equation (12). In addition, if $k < 1 + k_\mu$ the purchase obligation weakly dominates trade credit financing.

Given results 1 and 2 it is straightforward to compare the payoffs of the two options (futures and forwards) and derive implications. We have that:

$$U_F - U_f(\theta^*) = (\lambda(1 - \theta^*)/2)(R - \rho) + (q - 1)\zeta f(\theta^*) - k\mu \qquad (13)$$

Thus the analysis generates the following implications, which are summarized in result 3:

Result 3: The firm is more likely to choose forwards over futures if

- k is small;
- A and ρ_0 are small;
- $\lambda(R - \rho)$ is large;
- $(q - 1)\zeta$ is large.

The first result is obvious given that k captures the forward premium. The second result comes from the fact that increases in A and ρ_0 relax the firm’s financing constraint and thus make futures hedging more appealing relative to forwards. The third result comes from the fact that using futures exposes the firm to liquidity risk when $\theta^* < 1$. Thus when the expected liquidation loss is high firms are more likely to choose forwards. Finally, result 4 captures the fact that if the required margin position is larger or more costly futures become less attractive.

Finally, notice that the solution derived here has the property that $\theta^* \leq 1 = \theta_F$. Thus, firms that use the forward contract in equilibrium exhibit higher investment, conditional on the liquidity shock happening. This result is a direct consequence of the fact that purchase obligations relax financing constraints. If the cost of the purchase obligation is high (because suppliers have a lot of bargaining power for example), then some firms may find it optimal to use futures. Since futures contracts tighten financing constraints, firms that chooses futures may have to engage in partial hedging and invest less (e.g., liquidate more) in equilibrium to meet feasibility constraints.