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"The Impact of Security Trading on Corporate Restructurings"

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The Impact of Security Trading on Corporate Restructurings*

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Abstract

Hedge funds are heavily involved in corporate restructurings. A concern is that funds might short the equity of their debtors and reject beneficial debt restructuring proposals. We analyze how the cost of acquiring these positions affects the profitability of such strategies. We show that there is rejection of beneficial proposals when a fund is a prevalent debtholder that can trade in the firm's equity *or* when even if the fund has to build both positions markets are disconnected, i.e., there is no exchange of order flow information. In both cases rejection occurs only when non-strategic investors' trading is positively skewed.

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1 Introduction

Corporate restructurings can prove disruptive for a firm's operations and have real effects on production and investment. Done successfully they can help realize firm value while failure to do so can prove detrimental to the firm and some — if not all — of its claimholders. Such a major corporate event is a firm's debt restructuring which can be triggered by either outright default or by the violation of a debt covenant. Notably, in an overwhelming number of firms that underwent debt restructurings there was some involvement by hedge funds. According to Li, Jiang, and Wang (2012) hedge funds were present in 94% of the biggest Chapter 11 (debt restructuring) filings in the United States between 1996-2007; their exposure in 79% (55%) of the cases was in the debt (equity) of the distressed firm, while the time in which funds gained that exposure varied between before and after the filing.[1]

Restructuring procedures rely on the assumption that claimholders' economic exposure and voting (decision) rights are perfectly intertwined. However, non-traditional funds, such as hedge funds and private equity funds, have the ability to enter a more diverse spectrum of strategies that are forbidden to other more regulated financiers.[2] Here, we focus on the ability of these funds to short the equity of their debtors, which significantly weakens the intertwinement hypothesis and can affect the efficiency of restructurings procedures.

There is a plethora of popular press articles[3] as well as articles in the law literature[4] that provides anecdotal evidence on the "misbehavior" of funds going after "good" companies and forcing them into bankruptcy. In the words of Skeel Jr. and Partnoy (2006):

> "...But one widely rumored explanation is that, in addition to their position as financiers
> of Tower (Automotive), the hedge funds also had shorted its stock, that is, they bor-
> rowed Tower stock and stood to profit if the value of the stock declined. *Some bankers*,
> as the Wall Street Journal later reported, *believe hedge funds triggered the (Chapter 11)*

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[1]In their empirical study Li, Jiang, and Wang (2012) explore the role of hedge funds in distressed firms. However, they do not have data on funds short positions or CDS purchases and so their empirical predictions are not comparable with the theoretical results in this paper.

[2]For example, commercial banks in the United States are only allowed to have long positions in the equity of their clients. Other non-commercial banking institutions can have both debt and equity (long), see Jiang, Li, and Shao (2010).

[3]See Durfee (2006), Taub (2005), Sakoui (2008), and Economist Staff (2009).

[4]See Skeel Jr. and Partnoy (2006), Kahan and Rock (2007), Hu and Black (2008), and Ayotte and Morrison (2009).

filing to make their short positions worth more..." [emphasis added]

What is particularly missing from the narratives provided thus far is the endogenous nature of the funds' "toeholds" in companies undergoing debt restructurings. It is certainly not hard to imagine situations where *given* a fund's positions in the securities of a firm the fund might pursue a strategy which is contrary to other claimholders' interests. However, the *cost*, i.e., the market price paid, of building these positions and its impact on the overall profitability — and hence applicability — of the strategy is usually overlooked. Our paper fills this gap by developing a game-theoretic model of debt restructuring and trading. Our model features the strategic interaction between the firm's manager, who represents equityholders and proposes the plan, and a fund, which can trade in both the firm's debt and equity.

Our main contribution is to derive the market conditions under which the fund's presence will lead to the rejection of beneficial proposals. We show that the fund's behavior is harmful for the firm either when the fund has a significant *pre-existing* position in the firm's debt & trades in the firm's equity *or* when the fund has to build both positions but markets are disconnected, i.e., there is no exchange of order flow information between the equity and debt markets. In either case, a requirement for the proposal to be rejected is that other investors' trades are positively skewed. So when others' trading is not skewed or when markets are connected, i.e., there is perfect exchange of order flow information between markets, there is no rejection of beneficial proposals, and hence no deadweight loss to firm value from the fund's presence. Intuitively, the connectedness between markets and other investors' trading affect the fund's ability to build profitable positions in the firm's securities by *camouflaging* its trades.

The effect of trading on restructurings is of particular interest given the current economic environment where many corporations — and even countries — need to restructure their debt, and issues of short-selling and trading in credit-default-swaps (CDS) are closely monitored by regulators.[5]

We consider a firm whose outstanding debt and equity are publicly traded. The firm is in financial distress and wishes to restructure its debt. We posit that the proposal is beneficial for the firm in the sense that if accepted it will yield a higher firm-value than if rejected; we term the

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[5]In Section 7.2 we describe, in the context of our model, the similarities and differences between a short equity position and a CDS position.

outcome if the proposal is accepted as "continuation" and the outcome in the case of rejection as "liquidation." The restructuring proposal is a take-it-or-leave-it offer of a promised payment to debtholders conditional on continuation of the firm's operations; the promised payment is credible, and the continuation and liquidation values of the firm are known. The proposal is made by the firm's manager, who is not subject to agency problems, and wants to maximize equity value. Debtholders decide on whether to accept or reject the proposal by a terminal decision date. After the proposal is announced and before a decision is made investors can trade the firm's debt or equity. Trade (in either debt or equity) is intermediated by a competitive market-maker, à la Kyle (1985). Two types of investors trade with the market-maker: the fund, and other traders with uninformative, non-strategic trades.[6]

If there is full disclosure of the fund's positions when the manager makes the proposal and no trading following the proposal then the fund's presence does not lead to rejection of the proposal, and hence does not affect firm value. This is because we are in a bargaining game with complete information in which the party with the bargaining power (here the manager) can always find a split of the available surplus that the other party (here the fund and other debtholders) will accept.[7] The fund just shifts the "bargaining power" from one claimholder to the other depending on its underlying positions (this case is analyzed in Section 3). Our goal is to then show how the restructuring procedure is affected by the manager's uncertainty over the fund's positions, uncertainty which is created by the fund's trading following the proposal.[8]

The uncertainty of the manager when she makes the proposal of the fund's potential debt and equity positions complicates the manager's proposal choice. The manager must choose between giving a low enough payoff to equity holders and guaranteeing continuation or a high payoff to equity holders while risking liquidation. The important complication is that in order to build up the relevant positions, the fund must pay for them in the market, and to the extent that the market-makers anticipate its actions, some of the gains will be lost. Of course we may reasonably expect that the presence of the fund which is a (potential) influential debtholder and has the ability

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[6]Trading of distressed securities is not prohibited in the United States, though some distressed securities might be delisted from major exchanges like the New York Stock Exchange; trading continues, however, in secondary markets.

[7]Our results thus also relate to the bargaining literature with endogenous information asymmetries, see Gul (2001) and Lau (2008). The cause of the asymmetry of information in our case comes from the fund's trading activity.

[8]It is reasonable to assume that most "opportunistic" trade occurs after the proposal, since it is the very announcement of restructurings that attracts the so called "vulture funds." Nonetheless, the case where there is trade only before the proposal is between the full disclosure case and the case of trade following the proposal analyzed in the paper (for a more detailed discussion see Section 7.1).

to short-sell equity will lead to higher payoffs for debtholders, and lower payoffs for equityholders, both relative to the case where the fund was absent and we only had pure debtholders.[9] It is less obvious whether liquidation would arise in equilibrium.

When the fund trades across two markets we have to consider different cases concerning the information each market has about the other. When markets are disconnected (Section 5) so that order flows are not observed across markets the fund's actions in one market do not affect its market impact in the other. In this case, under *any* proposal, the fund finds it optimal to acquire enough debt and become the *pivotal* debtholder, i.e., one who can unilaterally decide on the outcome.[10] Since this has no effect on its equity trading the cost of becoming pivotal can be viewed as "sunk." The sunk-ness of the cost makes the disconnected markets case *equivalent* to the case of an existing pivotal debtholder fund that only trades in the firm's equity. This latter case is analyzed in Section 4, which is important methodologically and facilitates our analysis in the rest of the paper.

Given this equivalence we show that if the fund is an existing pivotal blockholder *or* markets are disconnected then in equilibrium we will get liquidation with positive probability. A necessary condition is that other investors' trading in the equity market is positively skewed. Within our model this translates to a range for the probability of other investors buying equity. However, although there is a range of probabilities of other traders going long for which the corresponding probability of continuation is less than one the relationship is *non-monotonic*. In particular the probability of continuation is U-shaped vs the probability of other investors buying the firm's equity, in the relevant positive skew range. The U-shape captures the tradeoff of the positive skew in others' trading: on one hand it makes a short position by the fund easier to hide (since it leads to a zero aggregate order) but on the other hand mitigates its profitability.

So from the fund's perspective it is not clear whether it would want to short-sell equity and destroy firm value by rejecting the proposal. However, the fund's potential reluctance is exactly what leads the manager to be bolder, in the sense that in equilibrium she finds it optimal to risk some positive probability of liquidation for a higher expected value for shareholders. Hence it is the *combination* of the fund's strategy and the manager's objective to maximize the payoff to equityholders (and not firm value) that leads to the inefficient outcome. Notably in the "standard"

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[9]The ability of debtholders to short equity can thus mitigate deviations from priority, as studied by the bankruptcy literature, e.g., Eberhart and Weiss (1998).

[10]For our analysis, whenever the fund acquires debt it becomes the pivotal debtholder.

market when others' trading is not skewed, i.e., it is symmetric, there is no liquidation.

With connected markets (Section 6), i.e., when each market observes the order flow of the other perfectly, things are quite different. The fund will become the pivotal debtholder in equilibrium but the cost of doing so now depends on the fund's actions in the equity market. The fund faces a more informationally complete market and so, in equilibrium, it will randomize (mix) over going long or short in the equity of the firm more aggressively, i.e., for a wider range of managerial proposals, to realize any gains from trade. This will increase the manager's uncertainty when she makes the proposal, and significantly limits the payoff she can secure for equityholders, in turn forcing her to make a proposal that guarantees continuation. This will be true for any value of the probability of others purchasing equity because the information exchange between markets supersedes the information from others' trading. Of course, as expected, regardless of the connectedness of markets, equityholders are hurt and debtholders benefit by the fund's presence, relative to the pure debtholders case.[11]

The fund's strategy belongs to the family of capital structure arbitrage strategies. Capital structure arbitrage strategies rely on discrepancies or inefficiencies between the markets of multiple securities of the same firm. In our case the discrepancy between the equity and the debt market that allows the fund to make a profit is what we term disconnectedness. So the exchange of timely information between markets will make this strategy non-profitable, since in our connected markets case the fund makes zero profits and is indifferent between entering the market altogether or not.[12]

Our results about the probability of rejection of beneficial proposals as well as about the split of surplus even if proposals are accepted have significant empirical implications. For example an implication is that firms with securities that trade in connected markets will have a higher debt capacity than those which trade in disconnected markets. We present our empirical and policy implications in detail in Section 7.4. Finally, even though for clarity and consistency our paper is written using the language of debt restructurings a simple relabelling of the main actors in our model allows us to replicate our analysis for merger proposals. This relabelling as well as other institutional features of merger proposals are presented in Section 7.3.

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[11]Bharath, Panchapegesan, and Werner (2007) observe in the data that post 2000, debtholders seem to benefit more during Chapter 11 renegotiations, an observation consistent with our model's predictions.

[12]Of course besides connectedness there are other market characteristics that can limit this arbitrage, such as short-selling fees, transaction costs, and margin requirements.

1.1 Some Related Literature

How strategic traders take actions that affect firm value is also the topic of Kyle and Vila (1991), Maug (1998), and Kahn and Winton (1998). In our paper, we derive the optimal trading and voting decision over the proposal of the fund, and most importantly the value of the proposal is endogenous and is determined by the manager. A very related paper is Brav and Mathews (2011) where the authors study the issue of "empty voting," i.e., when a hedge fund can establish separate positions in the firm's shares and votes, and show how this can actually increase efficiency in some cases. Also, Spamann (2012) considers the issue of trading in multiple securities of a firm and "negative voting." Both of these papers however do not have the manager as a strategic player , which is a very important aspect of our model.

Goldstein and Guembel (2008), and Khanna and Mathews (2012) focus on short-selling, and show how funds can use their information to manipulate the market. The main difference from these papers is that in our model trading is not driven by the fund's superior information (or because it wants to manipulate the market) but because it can affect the outcome. This is the difference also with Caballé and Krishnan (1994) where the authors study trading in multiple-securities in a Kyle (1985) environment. Furthermore, Caballé and Krishnan (1994) make the assumption of connectedness so to the best of our knowledge ours is the first paper to contrast the optimal behavior of a strategic trader when market-makers observe order flows on other markets versus when they do not.

In a contemporaneous paper Bolton and Oehmke (2011) study the problem of a firm's debt financing in the presence of "empty creditors," i.e., creditors who can hedge their economic exposure through the use of credit derivatives.[13] They show that although overinsurance in the CDS markets can increase the probability of liquidation, after the firm defaults,[14] the existence of credit derivatives disciplines the firm's manager in that it deters her from strategic default. In terms of theme Bolton and Oehmke (2011) and our paper are very related, however, the focus of the analysis is different: they derive the initial debt contract and the corresponding optimal CDS position, to contrast the aforementioned ex post and ex ante (default) effects. We analyze the derivation

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[13]The empirical literature on empty creditors has been limited by the available date and has so far returned mixed results, see, e.g., Bedendo, Cathcart, and El-Jahel (2010) and Danis (2012).

[14]The rationale, as also highlighted in Yavorsky, Bauer, Gates, and Marshella (2009), is the increased negotiation power of debtholders in the presence of CDS insurance. This effect is also present in our paper.

and the outcome of the restructuring proposal — which is driven by the strategic behavior of the manager and the fund — and show how these are influenced by certain market conditions. So, one of our contributions is to show under which market conditions we obtain the disciplinary effect that Bolton and Oehmke (2011) identified without a deadweight loss due to liquidation.[15]

The rest of the paper is structured as follows. Section 2 presents the model. In Section 3 we present the benchmark case of no trading and full disclosure. We proceed to the case of a prevalent debtholder in Section 4. Section 5 contains the disconnected markets case, while Section 6 the connected markets case. Some relevant issues (ex-ante trade, CDS, and merger proposals) and the implications of our model are discussed in Section 7, while Section 8 concludes. All proofs are in the Appendix.

2   Model

Our canonical example is a firm with publicly traded debt and equity.[16] The firm has either outright defaulted on its debt obligations or anticipates financial hardships in the future, and so wishes to restructure its debt. The firm's manager makes a restructuring proposal which is a split of the firm's value, conditional on acceptance of the proposal (continuation), between debt and equity holders. She chooses the proposal to maximize equityholders' expected value, an objective which is usually rationalized by postulating that the manager holds some (small) equity stake in the company and no other claims in it. In our case, the manager's assumed objective emphasizes that the outcome of the debt restructuring process depends on the conflict between claimholders. Note that our restructuring model is a particular case of Hart and Moore (1998) in which equityholders have all the bargaining power.[17]

The expected continuation firm value, y, is known and certain at the time of the proposal, i.e., there are no agency problems arising from the manager's private information and/or choice of effort. In the event of rejection of the proposal the firm can be thought of as liquidated with (expected) value of liquidation l, known to all when the proposal is made. The *main* assumption we make

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[15]Very similar issues to Bolton and Oehmke (2011) are also studied in Campello and Matta (2012).

[16]We are not going to distinguish between senior and junior debt, or between preferred and common shares. Debtholders are senior claimants while equityholders are residual claimants.

[17]Varying the bargaining power in favor of debtholders would make rejection of the proposal (liquidation) less probable in our model but would not alter our qualitative results.

throughout the paper is that $y > l$, i.e., continuation is better than liquidation from a firm value perspective. This allows us to analyze inefficient outcomes as in our motivating example about Tower Automotive. Furthermore, equityholders receive nothing in the event of liquidation, i.e., the liquidation value is not enough to cover residual debt claims; this last assumption is standard in the literature and in our case offers some expositional clarity.

Our focus is on an unregulated profit-maximizing investment fund, which has the following distinguishing feature from other investors: it can hold both debt and equity claims and, in particular, it can short the equity of its debtor.[18] Other investors in the firm, in addition to not being able to hold both claims at the same time, are totally uninformed (or equivalently naive) about the existence of the fund and its incentives. All are risk neutral, and the risk-free interest rate is zero.

Debtholders are the ones who decide to accept or reject the proposal by a terminal decision date. Inside bankruptcy — or for other restructurings such as merger proposals, see Section 7.3 — there is a formal vote by the debtholders so that the outcome of the vote is binding for all.[19] Outside bankruptcy there is no formal vote on the restructuring, debtholders have to accept or reject on an individual basis. However, bankruptcy filings (as in the case of Tower) — or even outright liquidation — can occur if not enough key debtholders agree to the plan. To abstract from the way the actual outcome is determined we will posit that if the fund decides to acquire debt (or already owns debt) then it becomes the *pivotal debtholder* in the sense that rejection or acceptance of the proposal relies solely on the fund regardless of others' individual actions (or votes). On the other hand if there are only *pure debtholders* (i.e., those who only hold debt but no equity claims in the firm) we view them as small, and atomistic, in the sense that they judge the proposal solely based on what it pays in continuation versus what it pays in liquidation. Admittedly this is a reduced form model of an actual debt restructuring procedure in which the proposal is the result of negotiations between equity and debt holders, and the outcome may be challenged by a judge. Our main goal here is, however, to highlight the role of trading in the procedure.

Trading happens after the proposal but before the decision date. There are two markets, one for debt and one for equity. Each is intermediated by a market-maker à la Kyle (1985) who observes aggregate order flows from his own market. If he *only* observes his own market's flows we call markets *disconnected*, while if he sees flows also from the other market we call markets

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[18]It is without loss of generality that the fund does not short-sell debt since it gains nothing by doing so.
[19]Usually votes corresponding to 2/3 of the value of debt outstanding are needed to pass these proposals.

connected. Aggregate flows in each market come from two sources, the fund and other investors. Other investors' are non-strategic, and their trades are not driven by the fundamentals of the firm. Both the market-makers when they set prices as well as the manager when she makes the proposal know the existence of the fund and understand its incentives.

In the next section we consider the benchmark case in which there is full disclosure and no trading allowed between the proposal date and the terminal decision date.

3 Benchmark Cases

3.1 Pure Debtholders

The manager's proposal is equivalent to a payment to equityholders conditional on continuation, E, so that the promised payment to debtholders is $D \triangleq y - E$.[20] Hence, *after* the proposal has been made and *before* a decision has been reached an equity claim on the firm is an asset that pays E in the event of continuation and zero otherwise, while a debt claim is an asset that pays D in the event of continuation and l otherwise.

The probability of each outcome depends on the decision of the debtholders. Pure debtholders can be seen as a "representative" debtholder who accepts the proposal if $D \geq l \Rightarrow E \leq y - l$, and reject the proposal if $D < l$. Let then $E_0 \triangleq y - l$, which is strictly greater than zero since $y > l$; E_0 is the maximum promised payment to equityholders, conditional on continuation, for which pure debtholders would be in favor of continuation. E_0 is a measure of how much better continuation is than liquidation, or more generally how much more beneficial is the acceptance of the manager's proposal versus a rejection. Hence it is the surplus over which debtholders and equityholders bargain.[21]

3.2 Fund with Exogenous Positions

We start from the basic case in which the fund's positions in debt and equity are exogenous and known, and do *not* change until the decision date. Let $x_E \in \{-1, 0, 1\}$, and $x_D \in \{0, 1\}$, be the fund's positions in equity and debt, respectively. The discrete possible values of the fund's equity and debt positions allow us to focus on the direction of trade rather than quantity. The

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[20]We use the symbol "$\triangleq$" to denote definition.

[21]In this full-information bargaining game it is straightforward that the Nash bargaining solution is $E_0/2$.

symmetry between long and short positions in equity, and the choice of one unit are normalizations that facilitate exposition.[22] Then, given the fund's possible positions, its payoff conditional on continuation, i.e., by accepting the proposal is

$$x_E\, E + x_D\, D = x_E\, E + x_D(y - E),$$

while its payoff conditional on liquidation, i.e., by rejecting the proposal is

$$x_E\, 0 + x_D\, l = x_D\, l.$$

The fund is pivotal for the outcome if $x_D = 1$ and not pivotal if $x_D = 0$. So, for a proposal E by the manager, we have, concerning the fund's payoff:

- If $x_D = 0$, the fund is not pivotal. Others accept for $E \leq E_0$ in which case the fund gets $x_E\, E$, while they reject for $E > E_0$ in which case the fund gets 0.

- If $x_D = 1$, the fund is pivotal. It then accepts for

$$x_E\, E + D \geq l \Rightarrow (1 - x_E)E \leq E_0$$

  and rejects otherwise. Hence, it accepts for: (i) *all* proposals if $x_E = 1$, (ii) proposals such that $E \leq E_0$ if $x_E = 0$, (iii) proposals such that $E \leq E_0/2$ if $x_E = -1$.

Hence continuation occurs in the following cases:

1. $\{x_E = -1 \text{ and } x_D = 1\}$, for $E \leq E_0/2$,

2. $\{x_E \in \{-1, 0, 1\} \text{ and } x_D = 0\}$ or $\{x_E = 0 \text{ and } x_D = 1\}$, for $E \leq E_0$,

3. $\{x_E = 1 \text{ and } x_D = 1\}$, for all E.

If the manager knows the fund's positions she proposes $E_0/2$ in case 1, E_0 in case 2, and y, i.e., all the continuation value, in case 3.[23] All these proposals achieve continuation with probability one, and hence, in this full information case, maximize the expected value of equity, which is the

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[22]In Section 7.2 we discuss "shorting" of more than one units and how it affects our results.
[23]No short-term borrowing is allowed.

manager's objective. In the fund's absence, the manager, as mentioned, guarantees continuation by proposing E_0. So, in all cases 1-3 firm value is *not* affected by the fund's existence since continuation is achieved with probability one, as in the pure debtholders case. Hence,

Remark 1. *In the case of full disclosure and no trading, firm value is not affected by the presence of the fund.*

Furthermore, a fund that has shorted its debtor's equity benefits debtholders and hurts equity-holders. The reverse is true when the fund is long the equity of its debtor since then equityholders receive the maximum possible promised payment.

However, if the manager does not know the fund's positions and has exogenous prior beliefs p_1, p_2, $1 - p_1 - p_2$ over cases 1, 2, and 3, above, respectively, then we might get liquidation with positive probability. To see this, note that in this case the manager picks E to maximize:

$$p_1 \, E \, \mathbb{I}(E \leq E_0/2) + p_2 \, E \, \mathbb{I}(E \leq E_0) + (1 - p_1 - p_2)E \quad =$$

$$[p_1 \, \mathbb{I}(E \leq E_0/2) + p_2 \, \mathbb{I}(E \leq E_0) + (1 - p_1 - p_2)] \, E,$$

where $\mathbb{I}(\cdot)$ is the indicator function. The term in the square brackets above is the probability of continuation. Clearly the manager chooses between expected values of equity $E_0/2$, $(1-p_1)E_0$, and $(1 - p_1 - p_2)y$, which correspond to proposals $E_0/2$, E_0, and y, and probabilities of continuation 1, $(1 - p_1)$, and $(1 - p_1 - p_2)$, respectively. Depending on the parameter values any of these three proposals may be optimal. In general, in the uncertainty case, expected firm value before the decision weakly decreases, since the probability of continuation is weakly less than one. This uncertainty, however, might benefit some claimholders in the expected sense. In what follows we *endogenize* these probabilities by studying the role of trading after the manager's proposal and before the decision date, and analyze the equilibria that arise under different market conditions.

4 Exogenous Positions in Debt, Trading in Equity

We will begin our analysis by first taking the fund's position in debt as given and known, and see what its optimal policy is in acquiring the equity of the firm in the market, after the proposal but before the decision is made. This is a case which is very important methodologically and facilitates

greatly our analysis in the rest of the paper. Furthermore, it is applicable in scenarios where debt holdings' filings are far more frequent than their equity counterparts.

We assume that trading in the firm's equity is facilitated by a risk-neutral market-maker. The equity market-maker observes the manager's proposal, knows the continuation and liquidation values, and comprehends the fund's existence and incentives. In the spirit of Kyle (1985) he receives aggregate orders (from the fund and other, non-strategic investors), computes the probability of continuation, and sets the price of equity equal to its expected value.

As before, let $x_E \in \{-1, 0, 1\}$ and $x_D \in \{0, 1\}$ be the fund's positions in equity and debt, respectively. It is assumed that the fund has no capital constraints and initially no equity position. If $x_D = 0$ the manager always proposes E_0 that leads to continuation with probability one. The market-maker, who has the same information as the manager, anticipates this and prices equity at exactly E_0. In this case the fund is indifferent between trading or not since its profit is zero in both cases.

However, if $x_D = 1$ the fund is pivotal and what the manager proposes depends on her beliefs about the fund's trade. Given proposal E the fund's problem is to choose $x_E \in \{-1, 0, 1\}$ to maximize its profit

$$
\Pi^1(x_E; E) =
\begin{cases}
\max\{E + D, l\} - \mathbb{E}[p_E | x_E = 1], & x_E = 1, \\
\max\{-E + D, l\} + \mathbb{E}[p_E | x_E = -1], & x_E = -1, \\
\max\{y - E, l\}, & x_E = 0,
\end{cases}
$$

$$
=
\begin{cases}
\max\{y, l\} - \mathbb{E}[p_E | x_E = 1], & x_E = 1, \\
\max\{-2E + y, l\} + \mathbb{E}[p_E | x_E = -1], & x_E = -1, \\
\max\{y - E, l\}, & x_E = 0,
\end{cases}
$$

$$
=
\begin{cases}
y - \mathbb{E}[p_E | x_E = 1], & x_E = 1, \\
\max\{E_0 - 2E, 0\} + l + \mathbb{E}[p_E | x_E = -1], & x_E = -1, \\
\max\{E_0 - E, 0\} + l, & x_E = 0,
\end{cases}
$$

where we used the definitions of $D = y - E$, $E_0 = y - l$, and the fact that $y > l$. The "max" operators above signify the decision of the fund to accept or reject the proposal, which determines the overall outcome since the fund is pivotal. Moreover, the expectations over the price of equity

p_E capture the fact that the fund does not know the aggregate demand in equity when it places its order.

Observe that when the fund goes long in equity, $x_E = 1$, it always accepts for any proposal E. Similarly, it accepts when it goes short, $x_E = -1$, only when $E \leq E_0/2$, and accepts if it is a pure debtholder, $x_E = 0$, only when $E \leq E_0$. Hence, for proposals $E \leq E_0/2$ the fund accepts regardless its position, that is we get continuation with probability one, and the price of equity is $p_E = E$. This makes the fund indifferent between trading (long or short) or not, in equity, since its profit is $y - E$ in all cases.

Now, for $E \in (E_0/2, E_0]$ the fund chooses x_E to maximize,

$$
\Pi_C^1(x_E; E) = \begin{cases} y - \mathbb{E}[p_E | x_E = 1], & x_E = 1, \\ l + \mathbb{E}[p_E | x_E = -1], & x_E = -1, \\ y - E, & x_E = 0, \end{cases}
$$

where the subscript C in Π_C^1 signifies that for this regime of proposals a pure debtholder would accept the proposal (which would lead to continuation). We see that the strategy $\{x_E = 0\}$ is always weakly dominated by the strategy $\{x_E = 1\}$ since for all E, $\mathbb{E}[p_E | x_E = 1] \leq E$. Hence we ignore it and focus on the strategies $\{x_E = 1\}$ and $\{x_E = -1\}$.[24]

Similarly for $E \in (E_0, y]$ the fund chooses x_E to maximize,

$$
\Pi_L^1(x_E; E) = \begin{cases} y - \mathbb{E}[p_E | x_E = 1], & x_E = 1, \\ l + \mathbb{E}[p_E | x_E = -1], & x_E = -1, \\ l, & x_E = 0, \end{cases}
$$

where L in Π_L^1 signifies that for this regime of proposals a pure debtholder would reject the proposal (which would lead to liquidation). We see that the strategy $\{x_E = 0\}$ is always weakly dominated by the strategy $\{x_E = -1\}$ since for all E, $\mathbb{E}[p_E | x_E = 1] \geq 0$. Again, we ignore it and focus on the strategies $\{x_E = 1\}$ and $\{x_E = -1\}$. That is the fund always (weakly) prefers to trade for any

---

[24]The non-inclusion of weakly dominated strategies is consistent with agents' *caution* and not just agents' rationality, as mentioned in Mas-Colell, Whinston, and Green (1995, Section 8.F). This in turn implies that the equilibria we analyze are trembling hand-perfect.

proposal $E \in (E_0/2, y]$ and so we drop the subscripts C and L from its profit function and write,

$$\Pi^1(x_E; E) = \begin{cases} y - \mathbb{E}[p_E|x_E = 1], & x_E = 1, \\ l + \mathbb{E}[p_E|x_E = -1], & x_E = -1. \end{cases}$$

To proceed with our equilibrium calculation we need to specify the derivation of the price by the market-maker. Let $z_E \in \{-1, +1\}$ be the level of others' trading, and $\nu_E \triangleq \mathbb{P}[z_E = 1]$ be the probability of other traders going long.[25]

The standard model considers noise traders who trade for (exogenous) liquidity-driven reasons and are long or short equity with equal probability, $\nu_E = 1/2$. As mentioned for our results having ν_E as a free parameter is crucial. One possible interpretation for values of $\nu_E \neq 1/2$ is market sentiment. Sentiment-driven traders may take one side of the market or the other for unfundamental reasons which are driven by behavioral biases as explained in Baker and Wurgler (2007). Then $\nu_E - 1/2$ is a measure of the sentiment (bias) in the market; when it is positive other traders are more likely to buy and hence express a positive sentiment, when it is negative they tend to sell and so we have a negative sentiment. In the rest of the paper we say that other investors' trades are not skewed when $\nu_E = 1/2$ and positively skewed when $\nu_E > x$, for any $x \in (1/2, 1)$.

The market-maker observes aggregate demand $y_E \triangleq x_E + z_E$ and sets the equilibrium price as follows,

$$\begin{aligned} p_E &= \mathbb{E}[\mathbb{I}(\text{continuation}) \, E \mid y_E] \quad &(1) \\ &= \mathbb{P}[\text{continuation} \mid y_E] \, E \\ &= \mathbb{P}[x_E = 1 \mid y_E] \, E \\ &= \begin{cases} E, & y_E = 2, \\ \frac{(1-\nu_E)\lambda_E}{(1-\nu_E)\lambda_E + \nu_E(1-\lambda_E)} E, & y_E = 0, \\ 0, & y_E = -2, \end{cases} \end{aligned}$$

where $\lambda_E \triangleq \mathbb{P}[x_E = 1]$, i.e., λ_E is the market-maker's belief that the fund will go long in the equity of the firm in equilibrium. As it is common in these models the fund "camouflages" its trades when other traders take the opposite side of the market, i.e., when the aggregate flow is zero. Observe,

---

[25]Note that we do not consider the case $z_E = 0$ because it would not enhance the fund's ability to camouflage as x_E cannot be zero (the action $\{x_E = 0\}$ is weakly dominated).

however, that here the extent to which that leads to any gains for the fund will depend also on the probability of other traders going long ν_E.

The following proposition describes the fund's equilibrium behavior as given by λ_E, and the resulting probability of continuation, for proposals $E \in [0, y]$.

Proposition 1. *In the case where the fund is pivotal, $x_D = 1$, its equity trading behavior varies as follows with the value of the proposal E.*

(i) *For $E \in [0, E_0/2]$, the fund is indifferent, i.e., $\lambda_E \in (0, 1)$; continuation occurs with probability one.*

(ii) *For $E \in (E_0/2, E_0/(1 + \nu_E)]$, it buys, i.e., $\lambda_E = 1$; continuation occurs with probability one.*

(iii) *For $E \in (E_0/(1 + \nu_E), \min\{E_0/\nu_E, y\})$, it mixes, i.e., $\lambda_E = \nu_E \frac{E_0/E - \nu_E}{E_0/E(2\nu_E - 1) - (2\nu_E^2 - 1)}$; continuation occurs with probability $\lambda_E < 1$.*

(iv) *For $E \in [\min\{E_0/\nu_E, y\}, y]$, it sells, i.e., $\lambda_E = 0$; continuation occurs with probability zero, i.e., we always have liquidation.*

Since the fund is pivotal it can unilaterally decide on the outcome. The fund then trades in equity to change its bargaining power over the split of the surplus E_0. The decision on whether to go long or short the equity (as we saw no trade is weakly dominated) of the firm will depend on the proposed E and how that and the fund's own actions affects the price. For low proposals, the region in case *(i)* of Proposition 1, debtholders receive the maximum they possibly can, the fund accepts the proposal no matter its underlying positions and so it is indifferent between going long or short. For intermediate low proposals, the region of case *(ii)*, debtholders receive most of the surplus, the price of equity is not significant and hence the fund is willing to buy and essentially align itself with the firm's interest. For high proposals, the region of case *(iv)*, debtholders receive little of the surplus and hence the cost of equity is high, this makes a short position profitable for the fund. Note that the region of case *(ii)* shrinks with ν_E, while the one of region *(iv)* expands, capturing the fact that when the fund takes one side of the market it benefits more (in terms of the price it pays) when other traders take the opposite. Of course the market-maker takes into account ν_E in his pricing and so there is a limit to the benefit to the fund, which is exactly captured by the endpoints of these regions.

Now, for high intermediate proposals, the region of case *(iii)*, the fund cannot profit from going long or short with certainty: the market-maker's pricing policy will undercut all the fund's gains from trade, and so to profit the fund mixes, i.e., it randomly chooses with probability λ_E between going long or short. Since the fund decides on the outcome this probabilistic behavior also results in a positive probability of liquidation. Observe that both the length of the region of case *(iii)* as well as the mixing probability depend on ν_E. The length of the region is non-monotonic in ν_E (it first increases and then decreases), while the effect on the mixing probability is also non-monotonic and furthermore depends on the value of the proposal E. Of course for a fixed ν_E, for higher proposal values (so for more promised value to equityholders) the probability that the fund will go long, λ_E, drops.

The manager anticipates the fund's strategy and picks proposal $E \in [E_0/(1 + \nu_E), \min\{E_0/\nu_E, y\}]$, to maximize the equityholders' expected payoff

$$J(E) \triangleq \nu_E \frac{\frac{E_0}{E} - \nu_E}{\frac{E_0}{E}(2\nu_E - 1) - (2\nu_E^2 - 1)} E. \tag{2}$$

The above expression attains a maximum since we are maximizing a continuous, bounded function over a compact interval (Weierstrass Theorem). The question is whether the manager will ever pick $E > E_0/(1 + \nu_E)$ and risk liquidation, and if so whether $E \geq E_0$, so that the proposal exceeds the one in the pure debtholders case. The answers to these questions and their consequences for claimholders' expected values, as well as the probability of continuation (and hence firm value) are given by the following proposition, which describes the manager's equilibrium behavior.

Proposition 2. *We have that*

(i) For $0 < \nu_E < \underline{\nu_E} \triangleq \sqrt{5}/2 - 1/2$, the manager picks

$$E = E_0/(1 + \nu_E) \in (E_0/2, E_0),$$

with

$$J(E_0/(1 + \nu_E)) = E_0/(1 + \nu_E) \in (E_0/2, E_0),$$

and probability of continuation equal to one.

(ii) For $\underline{\nu_E} \leq \nu_E < 1$, she picks

$$E = E_1 \triangleq \begin{cases} \frac{1-2\nu_E+\sqrt{3-1/\nu_E-2\nu_E}}{1-2\nu_E^2} E_0, & \text{for } \nu_E \neq 1/\sqrt{2} \\ E_0/\sqrt{2}, & \text{for } \nu_E = 1/\sqrt{2} \end{cases} \in (E_0/(1+\nu_E), E_0) \subset (E_0/2, E_0),$$

with

$$J(E_1) = \frac{\nu_E}{1 + 2\nu_E \left(\nu_E - 1 + \sqrt{3 - 1/\nu_E - 2\nu_E}\right)} E_0 \in (E_0/(1+\nu_E), E_0) \subset (E_0/2, E_0),$$

and probability of continuation

$$\lambda_E^* \triangleq \frac{\nu_E}{2\nu_E - 1 + \sqrt{3 - 1/\nu_E - 2\nu_E}} < 1.$$

Given this we derive the debtholders' payoff as well as the firm value in equilibrium. For the fund we substitute the optimal proposal and equilibrium mixing probability into Π^1 using equation (4) (see proof of Proposition 2 in the Appendix) for the expected price of equity to the fund when it goes long.

Corollary 1. *We have that*

(i) For $0 < \nu_E < \underline{\nu_E} = \sqrt{5}/2 - 1/2$ the debtholders' payoff is $y - E_0/(1+\nu_E) \in (y - E_0, y - E_0/2)$, the fund's payoff is $y - E_0/(1 + \nu_E)$, and firm value is y.

(ii) For $\underline{\nu_E} \leq \nu_E < 1$ the debtholders' payoff is

$$y - (1 - \lambda_E^*)E_0 - J(E_1) \in (y - E_0, y - E_0/2),\,^{26}$$

the fund's payoff is

$$y - E_1\nu_E - E_1(1 - \nu_E)^2 \frac{\lambda_E^*}{(1 - \nu_E)\lambda_E^* + \nu_E(1 - \lambda_E^*)},$$

---

[26]We have $\lambda_E^* E_0 > J(E_1) \Rightarrow y - (1 - \lambda_E^*)E_0 - J(E_1) > y - E_0$; and, $J(E_1) > E_0/(1 + \nu_E) > E_0/2 \Rightarrow y - (1 - \lambda_E^*)E_0 - J(E_1) < y - E_0/2$.

and firm value is

$$\lambda_E{}^* y + (1 - \lambda_E{}^*) l.$$

So, for any value of ν_E the optimal proposal made by the manager is below the proposal in the pure debtholders' case E_0 (see Section 3.1) but above the minimal proposal $E_0/2$, i.e., the proposal that a pivotal fund would accept *even* if it was short the equity of the firm (see Section 3.2). Similarly, equityholders' payoff is above their minimal payoff (corresponding to the minimal proposal) but below their payoff in the pure debtholders case. Reversely, debtholders' payoff is above their pure debtholders payoff but below their maximal payoff (corresponding to the minimal proposal). Hence, the fund's presence hurts equityholders and benefits dedtholders relative to the pure debtholders case. However, since equityholders' payoff is always greater than $E_0/2$ they prefer the uncertainty imposed by the fund's (potential) trading to the situation that the manager knows with certainty that the fund is short the equity of the firm and is a pivotal debtholder.

The fund given the optimal proposal of the manager behaves as follows in equilibrium. For $\nu_E < \underline{\nu_E}$ it always goes long equity and accepts the proposal so the probability of continuation in this case is one. The market-maker anticipates this behavior and charges the fund accordingly, so that in equilibrium the fund's net payoff from its equity position is zero, i.e., the fund in equilibrium is indifferent between trading in the equity of the firm or not. In this case the fund is like a pure debtholder. In contrast, for $\nu_E > \underline{\nu_E}$ the fund mixes between going long or short equity. When it is long it accepts the proposal, and when it is short it rejects it, and so in this region of ν_E we have a positive probability of liquidation. This mixing leads to a positive net payoff from trading in equity for the fund and differentiates it from a pure debtholder.

Hence the manager's uncertainty over the fund's equity position has significant implications for firm value. If others' trading is such that ν_E is less than $\underline{\nu_E}$ then firm value is maintained. In particular:

Remark 2. *When others' trading in the equity market is not skewed, $\nu_E = 1/2$, firm value is maintained in equilibrium, even with a pivotal debtholder fund who can trade in the equity of the firm.*

However, the uncertainty destroys firm value when others' trading is positively skewed, $\nu_E \in (\underline{\nu_E}, 1)$, since then liquidation occurs with positive probability, $1 - \lambda_E{}^* > 0$. So, for $\nu_E \in (\underline{\nu_E}, 1)$, the

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manager, in order to maximize equityholders' value, prefers to increase the promised continuation payment to them and in the process risks liquidation. The positive skew, on one hand, makes the trades of others more predictable but on the other hand facilitates the fund's short-selling. Since this is fully comprehended by the market-maker the end result will depend on the value of the proposal, which is determined by the manager. The manager takes into account the fund's strategy given the underlying market conditions while she tries to maximize equityholders' expected value. When $\nu_E \in (\underline{\nu_E}, 1)$ the manager's best response is to "sacrifice" some firm value (in expectation) to garner more for equityholders by making a bolder proposal than otherwise. Bolder in the sense that it gives shareholders a higher expected payoff but also may lead to liquidation with positive probability. So it is the *combination* of the manager's incentives and the fund's presence that may lead to liquidation.

In Figure 1 we plot the manager's proposal, the equityholder's expected payoff and the probability of continuation, which is also the probability of the fund going long, all in equilibrium as given by Proposition 2, for $\nu_E \in (0, 1)$. We set $E_0 = 1$ and so the y-axis ranges from $E_0/2$ to E_0. We see that for values of ν_E greater than $\underline{\nu_E} = \sqrt{5}/2 - 1/2$ the probability of continuation is U-shaped in ν_E. So for several values of ν_E on the long-side we observe exactly the phenomenon described above: the fund initially finds it more and more enticing to go short as this will lead to more probable zero aggregate flow; however at a certain point (around $\nu_E = 0.8$) the effect coming from the market-maker's pricing rule kicks in and so the fund's incentives to go short lessen. In particular when the market-maker is certain others' trading has value 1, i.e., when $\nu_E = 1$, she can perfectly observe the fund's trades, this leads to zero profits for the fund, and guarantees continuation. Very characteristically we also see the "boldness" in the manager's proposal which comes into effect exactly at $\underline{\nu_E}$.

In Figure 2 we plot the equilibrium expected profits of the fund, together with those of the equityholders, debtholders, as well as the firm value, as given by the expressions in Corollary 1, for $\nu_E \in (0, 1)$. We set $l = 0.1$ and $E_0 = 1$, and so the y-axis ranges from l to $y = E_0 + l$.[27] We see how the fund's existence clearly benefits debtholders and hurts equityholders (for the whole range of ν_E), since equityholders get less than $E_0 = 1$ and debtholders get more than $l = y - E_0 = 0.1$, which is what they would have gotten in the pure debtholders case. Observe that the fund always

---

[27]We chose a low l so that the curves do not cross and we get a cleaner picture. Of course for higher l the profits of the equityholders and the fund/debtholders intersect, and for even higher ones, the later can exceed the former.
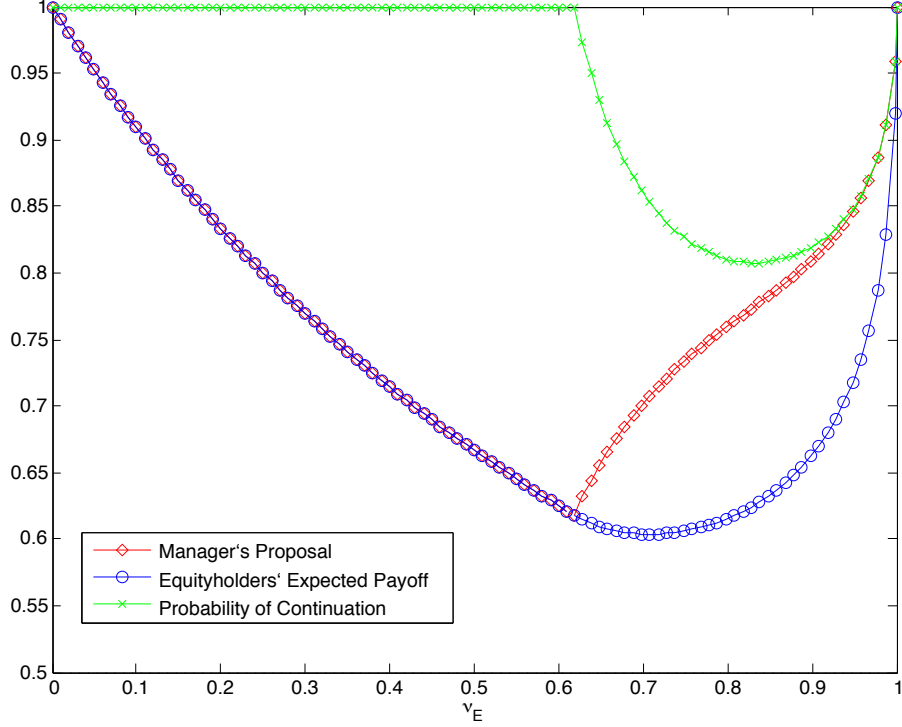
Figure 1: Numerical illustration of the manager's proposal, the equitylholder's expected payoff, and the probability of continuation, all in equilibrium as given by Proposition 2, for $\nu_E \in (0, 1)$ and $E_0 = 1$.

makes more than a pure debtholder since it also has debt and only trades in equity (long or short) when there is a profitable opportunity. Most importantly we see how the fund's existence also leads to a deadweight loss in firm value when others' trading is positively skewed.

We rely heavily on the analysis of this section and on the aforementioned results in the following two sections where we allow the fund to trade in both the debt and the equity of the firm.

5   Trading in Both Debt and Equity: Disconnected Markets

In this section we begin our investigation of the optimal strategy of the fund when it can trade both in the debt and the equity of the firm. It is assumed that the fund has no initial positions in either debt or equity, and no capital constraints. Since we have two markets, one for debt and one for equity we study two cases in terms of the information each market-maker has. In the disconnected markets case, of this section, each market-maker just observes the aggregate order in his own market and has no information on the other market's aggregate order. In the connected
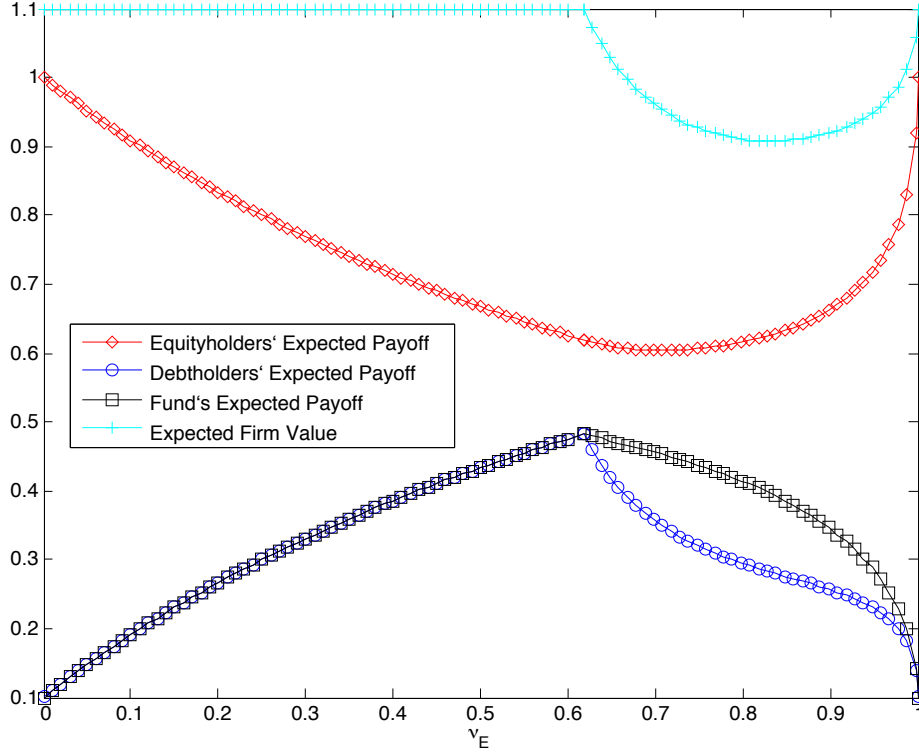
Figure 2: Numerical illustration of the equityholders' expected payoff, the debtholder's expected payoff, the fund's expected payoff, and the expected firm value, all in the equilibrium of Proposition 2, for $\nu_E \in (0,1)$, $l = 0.1$, and $E_0 = 1$.

markets case, of the next section, an aggregate order in one market is perfectly observed from the other, and vice versa.[28]

Let $x_E \in \{-1, 0, 1\}$, and $x_D \in \{0, 1\}$ be the trading positions of the fund in equity and debt, respectively. As before, for proposals $E \in [0, E_0]$ pure debtholders accept, while for $E \in (E_0, y]$ they reject. This is relevant in the case where the fund chooses not to trade in debt, $x_D = 0$, since then it cannot affect the outcome. Again, for $E \in [0, E_0/2]$ there is always continuation since, even if the fund is pivotal and it shorts equity, it still prefers for the firm to continue. In that case the price of equity, p_E, and debt, p_D, are equal to E and D respectively. The fund is then indifferent between trading or not (in either market) since its profit is always zero. Now, for $E \in (E_0/2, E]$

---

[28]These two cases are, of course, extremes of a continuum of scenarios in which each market-maker receives a noisy signal of the aggregate order in the other market.

the profit of the fund in each case is,

$$
\Pi_C^2(x_E, x_D; E) = \begin{cases}
y - \mathbb{E}[p_E | x_E = 1] - \mathbb{E}[p_D | x_D = 1], & x_E = 1,\ x_D = 1, \\
E - \mathbb{E}[p_E | x_E = 1], & x_E = 1,\ x_D = 0, \\
0, & x_E = 0,\ x_D = 0, \\
l + \mathbb{E}[p_E | x_E = -1] - \mathbb{E}[p_D | x_D = 1], & x_E = -1,\ x_D = 1, \\
-E + \mathbb{E}[p_E | x_E = -1], & x_E = -1,\ x_D = 0,
\end{cases}
$$

while for proposals $E \in (E_0, y]$, the profit of the fund in each case is

$$
\Pi_L^2(x_E, x_D; E) = \begin{cases}
y - \mathbb{E}[p_E | x_E = 1] - \mathbb{E}[p_D | x_D = 1], & x_E = 1,\ x_D = 1, \\
-\mathbb{E}[p_E | x_E = 1], & x_E = 1,\ x_D = 0, \\
0, & x_E = 0,\ x_D = 0, \\
l + \mathbb{E}[p_E | x_E = -1] - \mathbb{E}[p_D | x_D = 1], & x_E = -1,\ x_D = 1, \\
\mathbb{E}[p_E | x_E = -1], & x_E = -1,\ x_D = 0.
\end{cases}
$$

Let $\preceq$ denote weak dominance, i.e., if we write $A \preceq B$ then strategy A is weakly dominated by strategy B. Then the following result allows us to greatly simplify the above expressions by the exclusion of weakly dominated strategies.

Lemma 1. *We have*

(i) For $E \in (E_0/2, E_0]$

$$
\{x_E = -1,\ x_D = 0\} \preceq \{x_E = 0,\ x_D = 0\} \preceq \{x_E = 1,\ x_D = 0\} \preceq \{x_E = 1,\ x_D = 1\}.
$$

(ii) For $E \in (E_0, y]$

$$
\{x_E = 1,\ x_D = 0\} \preceq \{x_E = 0,\ x_D = 0\} \preceq \{x_E = -1,\ x_D = 0\} \preceq \{x_E = -1,\ x_D = 1\}.
$$

So for any proposal and no matter the price of equity p_E the fund prefers to become pivotal and affect the outcome. Crucial for this to hold is that the fund's debt position does not affect the price of equity and vice versa. Hence the fund can separate its debt trading decision from its

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equity trading decision. This is a point to which we will come back later in our discussion. Hence the only two actions that survive for the whole range of proposals are $\{x_E = 1, x_D = 1\}$ and $\{x_E = -1, x_D = 1\}$. Furthermore, since the fund is pivotal irrespective of its long or short equity position, the pure debtholders' behavior is irrelevant and so we need not distinguish between Π_C^2 and Π_L^2, and can write for $E \in (E_0/2, y]$

$$\Pi^2(x_E, x_D; E) = \begin{cases} y - \mathbb{E}[p_E|x_E = 1] - \mathbb{E}[p_D|x_D = 1], & x_E = 1, x_D = 1, \\ l + \mathbb{E}[p_E|x_E = -1] - \mathbb{E}[p_D|x_D = 1], & x_E = -1, x_D = 1. \end{cases}$$

Regarding the market prices p_D of debt and p_E of equity, we assume, again, that there is noise trading in equity, of level $z_E \in \{-1, 1\}$, with $\nu_E = \mathbb{P}[z_E = 1]$, but also, now, in debt, of level $z_D \in \{0, 1\}$, with $\nu_D \triangleq \mathbb{P}[z_D = 1]$. Noise trading is independent across markets, and from the fund's orders. In this disconnectedness case, the equity market-maker observes only $y_E = x_E + z_E$ and the debt market-maker observes only $y_D \triangleq x_D + z_D$, and set prices for equity and debt according to the following equations, respectively,

$$\begin{aligned} p_E &= \mathbb{E}[\mathbb{I}(\text{continuation})E|y_E] = \mathbb{P}[\text{continuation}|y_E]E, \\ p_D &= \mathbb{E}[\mathbb{I}(\text{continuation})(y - E)|y_D] + \mathbb{E}[\mathbb{I}(\text{liquidation})l|y_D] \\ &= \mathbb{P}[\text{continuation}|y_D](y - E) + \mathbb{P}[\text{liquidation}|y_D]l. \end{aligned}$$

Moreover, exactly because markets are disconnected, the price of becoming pivotal that enters the fund's calculations, $\mathbb{E}[p_D|x_D = 1]$, is the same, regardless of whether the fund decides to go long or short equity. The debt market-maker knows this and sets

$$p_D = \lambda_E(y - E) + (1 - \lambda_E)l, \tag{3}$$

for all values of aggregate demand y_D,[29] where, as before, $\lambda_E = \mathbb{P}[x_E = 1]$. Similarly the equity

---

[29]Even for the *off-equilibrium* aggregate order $\{y_D = 0\}$.

market-maker sets,

$$
p_E \;=\; \begin{cases} E, & y_E = 2, \\[6pt] \dfrac{(1-\nu_E)\lambda_E}{(1-\nu_E)\lambda_E + \nu_E(1-\lambda_E)}E, & y_E = 0, \\[6pt] 0, & y_E = -2. \end{cases}
$$

From the above expressions it is apparent that the equilibrium calculation of this section is equivalent to the one of Section 4 for the case that the fund has a pivotal, i.e., $x_D = 1$, exogenous position of debt. The intuition is that due to the disconnectedness, not only the fund finds it (weakly) dominant to become pivotal but also the cost of doing so is the same either it goes long or short in equity and so it can be viewed as a "sunk-cost." The fund then has to optimize only over its equilibrium equity position as in the previous section. Hence:

Remark 3. *The equilibrium (equity trading and decision over the proposal by the fund, and the proposal by the manager) in the disconnected markets case is the same as in the case with a pivotal debtholder fund that trades in the equity of the firm following the proposal.*

Thus the equilibrium equity trading of the fund in this case is, again, described by Proposition 1, while the manager's optimal decision is given by Proposition 2, and the debtholders' payoff and firm value by Corollary 1. However, now, the fund has to build both positions so in the calculation of its payoff we have to take into account the cost of becoming pivotal which is given by equation (3). In particular, given the separation of the fund's decision over its equity and debt trading, which we exploited, the fund's payoff in this case is just the fund's payoff as given in Corollary 1 minus the right hand side of equation (3).

Corollary 2. *We have that*

(i) For $0 < \nu_E < \underline{\nu_E} = \sqrt{5}/2 - 1/2$, the fund's payoff is zero.

(ii) For $\underline{\nu_E} \le \nu_E < 1$, the fund's payoff is

$$
(1 - \lambda_E{}^*)E_0 - E_1\nu_E - E_1\lambda_E{}^* \left[\frac{(1 - \nu_E)^2}{(1 - \nu_E)\lambda_E{}^* + \nu_E(1 - \lambda_E{}^*)} - 1 \right],
$$

where $\lambda_E{}^*$ and E_1 are defined in Proposition 2.

So, when the fund has to build both positions in a disconnected markets environment it does not make any profit for $\nu_E \in (0, \underline{\nu_E})$ and hence it is indifferent to enter the market altogether. However, when others' trading is positively skewed, $\nu_E \in (\underline{\nu_E}, 1)$, the fund makes a strictly positive profit. We plot the fund's payoff as given by Corollary 2 in Figure 3.
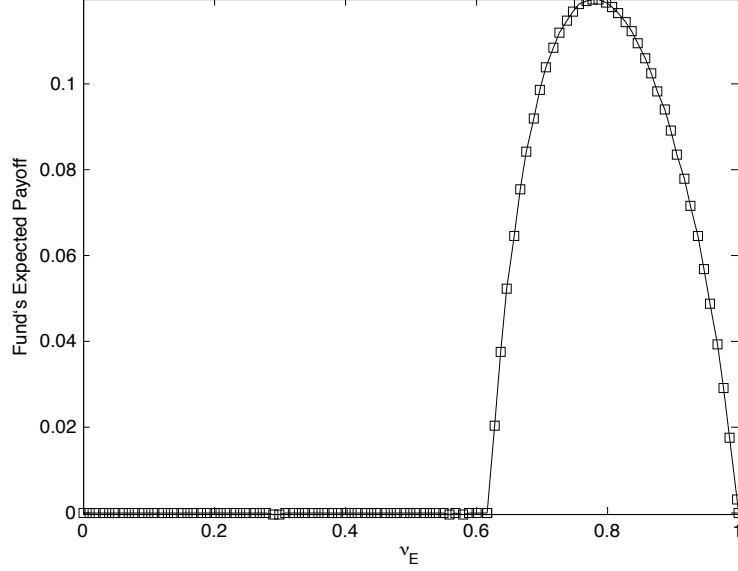

Figure 3: Numerical illustration of the fund's expected payoff when markets are disconnected, for $\nu_E \in (0, 1)$, $l = 0.1$, and $E_0 = 1$.

Moreover, recalling our discussion after Corollary 1 in Section 4 the fund's existence hurts shareholders, as it reduces their expected payoff, and benefits debtholders, as it increases theirs, relative to the pure debtholders case. More importantly firm value is affected when others' trading in the equity market exhibits a positive skew. In this case the fund's and the manager's strategies make liquidation probable and lead to a deadweight loss. However, rephrasing Remark 2 for the case of this section:

Remark 4. *When others' trading in the equity market is not skewed, $\nu_E = 1/2$, firm value is maintained in equilibrium, even when markets are disconnected and the fund needs to trade in both the debt and the equity of the firm.*

In the next section we consider the case of connected markets.

6 Trading in Both Debt and Equity: Connected Markets

In the disconnected markets case of the previous section each market-maker only observes the aggregate order in his own market and has no information on the other market's aggregate order. In the case of this section, connected markets, an aggregate order in one market is perfectly observed from the other, and vice versa. Hence, this creates a more informationally complete environment in which the fund contemplates trading in order to maximize its profit.[30] For proposals $E \in [E_0/2, E_0]$ this profit is equal to,

$$\Pi_C^3(x_E, x_D; E) =$$

$$
\begin{cases}
\max\{E + D, l\} - \mathbb{E}[p_E|x_E = 1,\, x_D = 1] - \mathbb{E}[p_D|x_E = 1,\, x_D = 1], & x_E = 1,\, x_D = 1, \\
E - \mathbb{E}[p_E|x_E = 1,\, x_D = 0], & x_E = 1,\, x_D = 0, \\
0, & x_E = 0,\, x_D = 0, \\
\max\{-E + D, l\} + \mathbb{E}[p_E|x_E = -1,\, x_D = 1] - \mathbb{E}[p_D|x_E = -1,\, x_D = 1], & x_E = -1,\, x_D = 1, \\
-E + \mathbb{E}[p_E|x_E = -1,\, x_D = 0], & x_E = -1,\, x_D = 0,
\end{cases}
=
$$

$$
\begin{cases}
y - \mathbb{E}[p_E|x_E = 1,\, x_D = 1] - \mathbb{E}[p_D|x_E = 1,\, x_D = 1], & x_E = 1,\, x_D = 1, \\
E - \mathbb{E}[p_E|x_E = 1,\, x_D = 0], & x_E = 1,\, x_D = 0, \\
0, & x_E = 0,\, x_D = 0, \\
l + \mathbb{E}[p_E|x_E = -1,\, x_D = 1] - \mathbb{E}[p_D|x_E = -1,\, x_D = 1], & x_E = -1,\, x_D = 1, \\
-E + \mathbb{E}[p_E|x_E = -1,\, x_D = 0], & x_E = -1,\, x_D = 0.
\end{cases}
$$

Notice how each expectation over the market prices of debt and equity now depends on both trading positions, since both aggregate (i.e., together with those of other investors) demands are observed across the two markets. It is still true for this range of proposals that

$$\{x_E = -1,\, x_D = 0\} \preceq \{x_E = 0,\, x_D = 0\} \preceq \{x_E = 1,\, x_D = 0\},$$

as in the disconnected markets case, since our arguments there did not depend on the information of the market-makers (and the resulting conditioning of the fund in its calculations of expected

---

[30]Again, $x_E \in \{-1, 0, 1\}$, and $x_D \in \{0, 1\}$ are the trading positions of the fund in equity and debt, respectively. As before for proposals $E \in [0, E_0]$ pure debtholders accept, while for $E \in (E_0, y]$ they reject. This is relevant in the case where the fund chooses not to trade in debt, $x_D = 0$, since then it cannot affect the outcome. Also, we will have the same "indifference" equilibrium as before in the case where the proposal $E \in [0, E_0/2]$.

prices). However, we cannot determine whether the fund will become pivotal or not when it is long the equity of the firm solely based on weak dominance as we did in the disconnected markets case, i.e., here

$$\{x_E = 1, \, x_D = 0\} \not\preceq \{x_E = 1, \, x_D = 1\}.$$

Hence, by ignoring weakly dominated strategies the fund's profit for each case is,

$$\Pi^3_C(x_E, x_D; E) \;=\; \begin{cases} y - \mathbb{E}[p_E | x_E = 1, \, x_D = 1] - \mathbb{E}[p_D | x_E = 1, \, x_D = 1], & x_E = 1, \, x_D = 1, \\ E - \mathbb{E}[p_E | x_E = 1, \, x_D = 0], & x_E = 1, \, x_D = 0, \\ l + \mathbb{E}[p_E | x_E = -1, \, x_D = 1] - \mathbb{E}[p_D | x_E = -1, \, x_D = 1], & x_E = -1, \, x_D = 1. \end{cases}$$

Similarly for proposals $E \in (E_0, y]$, the profit of the fund in each case is

$$\Pi^3_L(x_E, x_D; E) \;=\; \begin{cases} y - \mathbb{E}[p_E | x_E = 1, \, x_D = 1] - \mathbb{E}[p_D | x_E = 1, \, x_D = 1], & x_E = 1, \, x_D = 1, \\ -\mathbb{E}[p_E | x_E = 1, \, x_D = 0], & x_E = 1, \, x_D = 0, \\ 0, & x_E = 0, \, x_D = 0, \\ l + \mathbb{E}[p_E | x_E = -1, \, x_D = 1] - \mathbb{E}[p_D | x_E = -1, \, x_D = 1], & x_E = -1, \, x_D = 1, \\ \mathbb{E}[p_E | x_E = -1, \, x_D = 0], & x_E = -1, \, x_D = 0. \end{cases}$$

Again, as in Section 5, we have

$$\{x_E = 1, \, x_D = 0\} \preceq \{x_E = 0, \, x_D = 0\} \preceq \{x_E = -1, \, x_D = 0\},$$

but

$$\{x_E = -1, \, x_D = 0\} \not\preceq \{x_E = -1, \, x_D = 1\},$$

and so by ignoring weakly dominated strategies the fund's profit for each case is,

$$\Pi^3_L(x_E, x_D; E) \;=\; \begin{cases} y - \mathbb{E}[p_E | x_E = 1, \, x_D = 1] - \mathbb{E}[p_D | x_E = 1, \, x_D = 1], & x_E = 1, \, x_D = 1, \\ l + \mathbb{E}[p_E | x_E = -1, \, x_D = 1] - \mathbb{E}[p_D | x_E = -1, \, x_D = 1], & x_E = -1, \, x_D = 1. \\ \mathbb{E}[p_E | x_E = -1, \, x_D = 0], & x_E = -1, \, x_D = 0. \end{cases}$$

Noise trading is as before but now both the market-makers observe $y_E = x_E + z_E$ and $y_D = x_D + z_D$, and set prices for equity and debt according to the following equations, respectively,

$$
\begin{aligned}
p_E &= \mathbb{E}[\mathbb{I}(\text{continuation})E|y_E, y_D] = \mathbb{P}[\text{continuation}|y_E, y_D]E, \\
p_D &= \mathbb{E}[\mathbb{I}(\text{continuation})(y - E)|y_E, y_D] + \mathbb{E}[\mathbb{I}(\text{liquidation})l|y_E, y_D] \\
&= \mathbb{P}[\text{continuation}|y_E, y_D](y - E) + \mathbb{P}[\text{liquidation}|y_E, y_D]l.
\end{aligned}
$$

Let $\alpha \triangleq \mathbb{P}[x_D = 1|x_E = 1]$, i.e., the probability the fund is pivotal given that it is long in equity, $\beta \triangleq \mathbb{P}[x_D = 1|x_E = -1]$, i.e., the probability the fund is pivotal given that it is short in equity, and again $\lambda_E = \mathbb{P}[x_E = 1]$, i.e., the probability that the fund goes long equity.[31] We describe the equilibrium behavior of the fund as given by λ_E, α, and β, and the resulting probability of continuation, for $E \in [0, y]$ in the following proposition.

Proposition 3. *In the case of connected markets for debt and equity the fund's trading behavior varies as follows with the value of the proposal E.*

(i) For $E \in [0, E_0/2]$, the fund is indifferent on which side to trade in equity, i.e., $\lambda_E \in (0, 1)$, and is also indifferent on whether to become pivotal, $\alpha \in (0, 1)$, and $\beta \in (0, 1)$; continuation occurs with probability one.

(ii) For $E \in (E_0/2, y]$, the fund mixes its equity trading, i.e., $\lambda_E = E_0/(2E)$, and becomes pivotal either it is long or short equity, i.e., $\alpha = \beta = 1$; continuation occurs with probability $\lambda_E < 1$.

So for low proposals, case *(i)*, the fund has exactly the same incentives as before: it is indifferent between all positions and makes zero profit for any proposal in that range. Now for any other proposal, case *(ii)*, the information completeness of the market leads the fund to mix aggresively, i.e., for the whole range of proposals in order to make any profit. Again the mixing probability, i.e., the probability of going long equity, is decreasing with the value of the proposal but observe that it does *not* depend on others' trading probabilities. The intuition is that cross-market inferences matter much more now than inferences based on knowledge of others' trading.

---

[31]These probabilities depend on the region in which the possible values of the proposal lie but for notational brevity we will omit this dependence.

Since for all proposals $E > E_0/2$ the fund will reject with positive probability, the issue is now whether the manager will pick one of these proposals and sacrifice firm value to satisfy equityholders as she did in the disconnected markets case. Given the fund's behavior the manager has to solve the following problem,

$$\max_{E \in [0,y]} \quad E\,\mathbb{I}\,(E \leq E_0/2) + (E_0/2)\mathbb{I}\,(E > E_0/2),$$

from which it is easy to see that she is indifferent for any point E between $E_0/2$ and y. If maximizing the probability of continuation is her secondary objective then she picks $E = E_0/2$,[32] which guarantees continuation, essentially by making the fund indifferent between trading or not. So we state the following without proof.

Proposition 4. *In the connected markets case the equilibrium strategy of the manager is to propose $E = E_0/2$ that leads to continuation with probability one. The fund makes zero profit in equilibrium, while debtholders' payoff is $y - E_0/2$, equityholders' is $E_0/2$, and firm value is y.*

Since the fund makes zero profits in equilibrium it is indifferent between trading or not. It is the fund's mere presence that changes the incentives of the manager in making the proposal. In particular, in this case, the presence of the fund inflicts the maximum damage to equityholders since it reduces their share of the surplus to $E_0/2$ which is the minimum they can get in any circumstances given our assumptions. In particular, contrasting the equityholders' payoff here with Proposition 2, we conclude that in the presence of the fund equityholders prefer disconnected markets than connected markets, as the former lead to a higher expected payoff for equityholders (for any value of ν_E). The reverse is true for debtholders who are maximally benefited with connected markets (since they receive $y - E_0/2$) and hence strictly prefer them to disconnected markets. In addition, these effects in connected markets come at no forfeiture of firm value, which is y since the probability of continuation is one, and so there is no deadweight loss in this case.

The intuition for the result is as follows: Since the fund can only affect the outcome by acquiring debt it does so in equilibrium. However, due to the connectedness the cost of acquiring debt and becoming pivotal depends on whether the fund is going long or short equity, and hence cannot be

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[32]This is a reasonable assumption to make since, although the manager is indifferent, she would otherwise be deliberately hurting firm value by proposing $E > E_0/2$.

separated from the decision over the fund's equity position and viewed as sunk (as it is the case in the previous section). The information exchange between markets makes it harder for the fund to "hide" and in equilibrium forces it to mix between going long or short equity over a wider range of proposals. The fund actually mixes in a way that equalizes the equityholders' payoff over that range. The manager, in contrast to the disconnected markets case, cannot achieve a higher expected payoff for equityholders by increasing E and risking liquidation, and her best response is then to pick the proposal that at least guarantees continuation with probability one. For that proposal the fund is essentially indifferent between trading or not, since it makes no profit in equilibrium. The fund here is the equivalent of a "credible threat" by the debtholders to the manager that if she does not give them the maximum allowed payoff then the fund will destroy some of the firm value.

7   Implications and Further Issues

In the following subsections we mention how our framework can be modified to address closely related issues and discuss certain implications of our model.

7.1   Ex-ante Trade

In Sections 5-6 we considered the case where there is trade only following the manager's proposal. An alternative would be to have trade before but not after the proposal. If there is trade before the proposal and the manager observes the fund's resulting positions then we are in the benchmark case we analyzed in Section 3, where we showed that the manager can always find a proposal to guarantee continuation. On the other hand if the manager just observes order flows (or equivalently prices) then she can only imperfectly infer the fund's positions. She then uses this information to decide on the proposal.

By having trade, as in Sections 5-6, only following the proposal we do not give the manager such informational advantage. Moreover, although when the manager makes her choice first she commits to a particular proposal this does not give any extra information to the fund.[33] So, the subgame perfect equilibria we calculate by backward induction in Sections 5-6 are (some of the) equilibria of a (hypothetical) simultaneous move game between the manager and the fund.

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[33]Note that there is no asymmetry of information, since neither the fund nor the manager have any private information.

Therefore, we would expect the outcome when there is only trade before the proposal to be a "convex combination" of the outcome in the full disclosure case, Section 3, and of the equilibria we describe in Sections 5-6. In particular we still expect liquidation to occur with positive probability under similar market conditions. A full treatment of the ex-ante trade case is an interesting topic for future research.

7.2 Credit Default Swaps

A CDS (or similarly a recovery swap) that is triggered by liquidation is an asset that pays zero if there is continuation and pays a positive nominal amount otherwise. So in the context of our model, a CDS claim with nominal E (the proposed payment to equityholders) is equivalent to a short equity claim plus a certain amount E paid regardless of the outcome.

This equivalence holds only if the CDS and the equity markets have equal probability (of continuation) assessments. So our model also encompasses the case in which there is no trade in equity but there is trade in CDS, even of this restrictive type. Hence our argument in favor of connectedness also applies between the debt and CDS markets.[34].

An important point is that the equivalence of short equity claims and CDS in our framework also relies on the assumption that the proposed payoff is credible, and the continuation/liquidation values are known. Lack of credibility of the manager's proposal (e.g., due to agency problems) would not allow investors to infer the probability of continuation just by observing the price of equity or the price of debt.[35] Then a CDS (with a constant nominal) would be the only clear indicator of the probability of continuation.

But a more important difference between the equity and CDS markets is that CDS contracts are in zero-net supply, essentially allowing a buyer of a CDS to overinsure by acquiring CDS that have a nominal value which is a multiple of the buyer's underlying debt positions (if any). In the context of our model — simplifying somewhat — this would correspond to a short position of more than one unit; as an example consider a fund that has a "short-equity" position of two units and is also a pivotal debtholder. Then the proposal E that would make the fund indifferent between

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[34]Qualitatively this statement will hold even if we use a different — more realistic — microstructure model for the CDS market, e.g., the over-the-counter search market with frictions of Duffie, Garleanu, and Pedersen (2005)

[35]This would correspond to not being able to factor out E in the expectation calculation of p_E, see for example equation (1).

liquidation and continuation is

$$-2E + y - E = 0 + l \Rightarrow E = E_0/3,$$

clearly less than $E_0/2$, which was the case before, see Section 3.2. Then this $E_0/3$ would play exactly the same role as $E_0/2$ played in our analysis. Hence the zero-net supply nature of derivatives markets would lead to an even bigger "squeeze" of value from equityholders in the restructuring procedure, but as long as the conditions we prescribed are met, firm value will not be affected even in this (modest) overinsurance case.[36]

7.3 Merger Proposals

Our model about how trading and, in particular, short-selling can affect real outcomes, and how the informational structure of markets is related to these real outcomes can be applied equally well to the study of merger proposals.[37,38] In both debt restructurings and merger proposals there are two parties which hold tradeable securities and bargain over the split of a surplus which comes from combining the underlying assets corresponding to these securities.

To adapt our analysis for merger proposals requires a simple relabelling of the main actors in the model. The "manager" and the "debtholders" in our model are the shareholders of the acquirer firm (simply acquirer) and the shareholders of the target firm (simply target), respectively. The acquirer makes a take-it-or-leave-it offer on how to split the value of the combined firm to the target. As mentioned, in merger proposals, in contrast to outside bankruptcy debt restructurings, there is formal voting by the target. If the offer is accepted the value of the combined firm is V_C, if it is rejected the valuations of the acquirer and the target are V_A and V_T, respectively. The merger is dimmed beneficial (value improving) if $V_C > V_A + V_T$, which captures the potential value of synergies between the two firms.

The fund then is either an existing or a potential shareholder (or a group of shareholders) of

---

[36]If the swap nominal exceeds the surplus $E_0 = y - l$ then the manager will not be able to find a proposal to guarantee continuation (even in the full information case) and so liquidation is imminent. It is as if one of the two bargaining parties can guarantee itself all (or even more of) the available surplus if negotiations fail.

[37]We thank an anonymous referee for proposing this application of our model.

[38]Several examples of hedge funds' involvement in mergers can be found in Hu and Black (2006), Hu and Black (2007), and Kahan and Rock (2007).

the target who can short-sell the equity of the acquirer.[39] In the cases where the shares that the fund procures in the target bear no votes then there is an inherent event risk. This risk however is eliminated (or significantly mitigated) if the shares allow the fund to be a pivotal (or near pivotal) shareholder. In the case of Henderson Investment reported in Hu and Black (2006, Pages 834-835) a proposal was rejected by a negative vote of *only* 2.7% of the outstanding shares.

Reinterpreting our main results the existence of the fund in this scenario has two effects: The first is that it increases the bargaining power of the target and hence it increases the share of the merger surplus the target receives. The other is that under certain circumstances it can lead to the rejection of the beneficial merger proposal with positive probability. The circumstances that can lead to this are (i) when the fund is an existing shareholder of the target when the proposal is made, or (ii) even if it is not if the equity markets for the shares of the target and the acquirer are disconnected. In both (i) and (ii) we need the rest of the market to have a positive sentiment about the acquirer and hence to tend to buy its equity. Disconnectedness can occur if the two firms are listed in different exchanges with different liquidity characteristics, or if the "short" actually happens through an opaque derivatives market.[40] Since the strategy we describe shifts value from the equityholders of the bidder to the ones of the target this may lead, in general, to a potential bidder being less willing to make a merger proposal if it foresees such behavior from the shareholders of the target.

7.4   Empirical and Policy Implications

Our analysis yields predictions for the outcome of restructurings in terms of the probability of success of a proposal and the resulting split of the surplus between claimholders. These rely on measuring the connectedness between markets and the probability of other traders going long. In practice the debt and equity markets differ in many important aspects.[41] Besides innate connectedness we can also imagine funds trading in such a way so as to create a gap of information across

---

[39]This is not the typical long-the-target, short-the-acquirer merger arbitrage strategy. There the arbitrageur is speculating that the merger will happen but there is some inefficiency so that the target's stock price is undervalued relative to the share of the consolidated profits target shareholder's will receive.

[40]Note that this is different than the effects found in Burkart and Lee (2010) where strategies rely on asymmetric information between other investors and the fund.

[41]Corporate bonds are usually traded over-the-counter while corporate equity trades in a central exchange. Hotchkiss and Ronen (2002) and Downing, Underwood, and Xing (2009) showed that the debt market lags the equity market and so the debt market is less informationally efficient. This lagged response differs for different kind of bonds and in different countries, and so we would expect our measure of connectedness to also vary.

markets by, for example, placing orders through different dealers. Moreover, skewed trades by *non-strategic* investors can be attributed to market sentiment which is a commonly studied concept in financial markets and various measures have been proposed for it, see Baker and Wurgler (2007). So, an innovation of our paper is to highlight how sentiment in the equity market can get channeled to real economic decisions like corporate restructurings, through the fund's presence.

Our predictions in terms of the probability of success are:

P1: When there is a fund who is a significant (pivotal) debtholder at the time of a restructuring, then a beneficial proposal is likely to be rejected if others' trading in the equity market is skewed (Proposition 2); and will not be rejected if it is not skewed (Remark 2).

P2: If there is no fund who is an existing debtholder at the time of a restructuring then a beneficial proposal is likely to be rejected if markets are disconnected and others' trading in the equity market is skewed (Remark 3); if either others' trading is not skewed (Remark 4) *or* markets are connected (Proposition 4) there will be no rejection.

In terms of split of surplus, comparing (beneficial) restructuring proposals in which funds are present versus not:

P3: In restructurings where a fund is present (either before or after the proposal) debtholders receive more of the available surplus (discussion after Proposition 2 and Proposition 4).

Also irrespective of the time of entry and whether others' trading is skewed or not:

P4: Debtholders receive at least as much of the available surplus when a firm's securities trade in connected versus disconnected markets (discussion after Proposition 4); reversely for equity-holders.[42]

The above also affects the initial financing decision of the firm, and in particular the extent to which it can borrow in the debt market. So, in the cross-section of firms:

P5: Firms with securities that trade in connected markets have a higher debt capacity than those which trade in disconnected markets, all else equal.

---

[42]We say "at least as much" because if the fund is an existing pivotal debtholder connectedness does not play a role.

In terms of policy a natural prescription would be to ban short-selling following the proposal, making sure that all pre-existing positions are disclosed, such that bargaining is efficient. However, "synthetic" shorts using derivatives can be used instead, so it is better to advocate for more transparency and exchange of timely information between markets hence addressing the connectedness issue. However, when the hedge fund has a "toehold" in the company in that it has a pre-existing debt position, then a short-selling ban following the proposal is optimal from a firm value perspective.[43]

8   Conclusions

Debt restructurings are important corporate events that have attracted many hedge funds. The concern arising from the funds' involvement is that they might pursue strategies that are detrimental for the firm and its claimholders. Such a strategy is the purchase of debt and the shorting of equity (or purchase of credit derivatives) followed by the rejection of beneficial proposals. A crucial question is then under what market conditions the fund will find it profitable to execute such a strategy. To address this we presented a simple model of a firm's debt restructuring proposal and its outcome in the presence of a non-traditional fund that can trade in the debt and equity of the firm. If the fund acquires debt then it can affect the outcome of the restructuring proposal. The manager represents equityholders and makes the proposal anticipating the fund's possible involvement.

We showed that the effect on firm value depends crucially on two characteristics, the connectedness between the markets for debt and equity and the probability of other investors going long in the firm's equity, which determines whether other investors' trading is skewed or not. In the case of disconnected markets (or when the fund is an existing pivotal debtholder) the fund's existence and its ability to short equity lead to inefficient liquidations with positive probability when others' trading is skewed (e.g., due to positive sentiment). This inefficiency arises from the combination of the manager's objective and the fund's presence. In contrast, in the case of connected markets or when others' trading is not skewed there is no detrimental effect on firm value. As we would expect, regardless of the effect on firm value, it is the firm's debtholders who benefit by the fund's presence, while equity holders get a lower expected value than if there are only pure debtholders,

---

[43]For merger proposals our empirical predictions P1-P4, as well as policy implications, hold given the same relabelling described in Section 7.3.

i.e., debtholders who only have debt but no equity position in the firm.

Appendix

Proof of Proposition 1. For the equilibrium in the case where $E \in [0, E_0/2]$ see the main text. Now for $E \in (E_0/2, y]$ we have

$$
\begin{aligned}
\mathbb{E}[p_E | x_E = 1] &= \mathbb{E}[p_E | y_E = 2]\mathbb{P}[z_E = 1] + \mathbb{E}[p_E | y_E = 0]\mathbb{P}[z_E = 1] \\
&= E\,\nu_E + E(1 - \nu_E)\frac{(1 - \nu_E)\lambda_E}{(1 - \nu_E)\lambda_E + \nu_E(1 - \lambda_E)}, \qquad (4) \\
\mathbb{E}[p_E | x_E = -1] &= \mathbb{E}[p_E | y_E = 0]\mathbb{P}[z_E = 1] + \mathbb{E}[p_E | y_E = -2]\mathbb{P}[z_E = -1] \\
&= E\,\nu_E\frac{(1 - \nu_E)\lambda_E}{(1 - \nu_E)\lambda_E + \nu_E(1 - \lambda_E)}. \qquad (5)
\end{aligned}
$$

Then the fund will choose an action according to the following relation

$$
\Pi^1(1; E) \gtrless \Pi^1(-1; E) \iff
$$

$$
y - E\,\nu_E - E(1 - \nu_E)\frac{(1 - \nu_E)\lambda_E}{(1 - \nu_E)\lambda_E + \nu_E(1 - \lambda_E)} \gtrless l + E\,\nu_E\frac{(1 - \nu_E)\lambda_E}{(1 - \nu_E)\lambda_E + \nu_E(1 - \lambda_E)} \iff
$$

$$
E_0 \gtrless E\frac{(1 - \nu_E)\lambda_E(1 + \nu_E) + \nu_E^2(1 - \lambda_E)}{(1 - \nu_E)\lambda_E + \nu_E(1 - \lambda_E)}.
$$

We want to see if $\lambda_E = 1$ is an equilibrium. For this, from above, we would need $E_0 > E(1 + \nu_E)$ or

$$
E < \frac{E_0}{1 + \nu_E}.
$$

This can be true only in the case where $E \in (E_0/2, E_0]$. Similarly we want to see if $\lambda_E = 0$ is an equilibrium. For this, from above, we would need $E_0 < E\,\nu_E$ or

$$
E > \frac{E_0}{\nu_E}.
$$

This can be true only in the case where $E \in (E_0, y]$ *and* $E_0/\nu_E < y$. Now, the indifference condition for a mixed equilibrium leads to

$$
\begin{aligned}
E_0 &= E \frac{(1 - \nu_E)\lambda_E(1 + \nu_E) + \nu_E^2(1 - \lambda_E)}{(1 - \nu_E)\lambda_E + \nu_E(1 - \lambda_E)} \iff \\
\lambda_E &= \nu_E \frac{E_0/E - \nu_E}{E_0/E(2\nu_E - 1) - (2\nu_E^2 - 1)}.
\end{aligned}
$$

Now we show that for $E \in [E_0/(1 + \nu_E), E_0/\nu_E]$ this is a well defined probability $\lambda_E \in (0, 1)$. Note that,

- $E_0/E - \nu_E > 0 \iff E < E_0/\nu_E,$

- Given the above,

  - For $\nu_E > 1/2$

    $$
    E_0/E(2\nu_E - 1) - (2\nu_E^2 - 1) > \nu_E(2\nu_E - 1) - (2\nu_E^2 - 1) = 1 - \nu_E > 0,
    $$

  - For $\nu_E < 1/2$

    $$
    E_0/E(2\nu_E - 1) - (2\nu_E^2 - 1) > (1 + \nu_E)(2\nu_E - 1) - (2\nu_E^2 - 1) = \nu_E > 0,
    $$

- Given these

$$
\nu_E(E_0/E - \nu_E) < E_0/E(2\nu_E - 1) - (2\nu_E^2 - 1) \iff E_0/E < 1 + \nu_E \iff E > E_0/(1 + \nu_E).
$$

Furthermore for $E \notin [E_0/(1 + \nu_E), E_0/\nu_E]$ we have $\lambda_E \notin (0, 1)$.

Note that if $y < E_0/\nu_E$ then we just restrict attention to $[E_0/(1 + \nu_E), y]$. Hence for $E \in [E_0/(1 + \nu_E), \min\{E_0/\nu_E, y\}]$ the fund mixes between going long and short with probability λ_E given above. $\qquad \square$

Proof of Proposition 2. We are looking for the maximum of $J(E)$ given by equation (2) in the interval $E \in [E_0/(1 + \nu_E), \min\{E_0/\nu_E, y\}]$. In the arguments below we will look for a maximum in $E \in [E_0/(1 + \nu_E), E_0/\nu_E]$. Of course if $E_0/\nu_E < y$ this is innocuous. The concern then is if $E_0/\nu_E > y$ and the maximizer we identify is larger than y. We will show that this is not the case.

We have that $J(E_0/\nu_E) = 0 < E_0/(1 + \nu_E) = J(E_0/(1 + \nu_E))$, so E_0/ν_E cannot be the solution for any $\nu_E \in (0, 1)$. So the solution is either $E_0/(1 + \nu_E)$ or an internal one.

- For $\nu_E = 1/\sqrt{2}$ the first order condition (FOC) has one real solution, $E_1 = E_0/\sqrt{2}$, with $J(E_1) = E_0/(4(\sqrt{2} - 1)) > E_0/(1 + 1/\sqrt{2})$, and second derivative equal to $(3\sqrt{2} - 4)/(1 - \sqrt{2})^3 < 0$, so it is a maximum.

- For $\nu_E \in (1/2, 1/\sqrt{2}) \cup (1/\sqrt{2}, 1)$ the FOC has two real solutions (and no real solutions otherwise).,

$$E_1 \triangleq \frac{1 - 2\nu_E + \sqrt{3 - 1/\nu_E - 2\nu_E}}{1 - 2\nu_E^2} E_0,$$

$$E_2 \triangleq \frac{1 - 2\nu_E - \sqrt{3 - 1/\nu_E - 2\nu_E}}{1 - 2\nu_E^2} E_0.$$

  - $E_2 > E_0/\nu_E$ for all $\nu_E \in (0, 1)$ and hence cannot be a solution.

  - $E_1 < E_0/(1 + \nu_E)$ for $\nu_E < \sqrt{5}/2 - 1/2$, and $E_1 \in (E_0/(1 + \nu_E), E_0/\nu_E)$ for $\nu_E \geq \sqrt{5}/2 - 1/2$.

  - $J'(E_0/(1 + \nu_E)) < 0$ for $\nu_E < \sqrt{5}/2 - 1/2$, and $J'(E_0/(1 + \nu_E)) \geq 0$ for $\nu_E \geq \sqrt{5}/2 - 1/2$.

  - $J'(E_0/\nu_E) < 0$ for all $\nu_E \in (0, 1)$.

Hence the solution for $\nu_E < \sqrt{5}/2 - 1/2$ is $E_0/(1 + \nu_E)$ with $J(E_0/(1 + \nu_E)) = E_0/(1 + \nu_E)$, and probability of continuation one. While for $\nu_E \geq \sqrt{5}/2 - 1/2$ the solution is

$$E_1 = \begin{cases} \frac{1 - 2\nu_E + \sqrt{3 - 1/\nu_E - 2\nu_E}}{1 - 2\nu_E^2} E_0, & \text{for } \nu_E \neq 1/\sqrt{2}, \\ E_0/\sqrt{2}, & \text{for } \nu_E = 1/\sqrt{2}, \end{cases}$$

with

$$J(E_1) = \frac{\nu_E}{1 + 2\nu_E \left(\nu_E - 1 + \sqrt{3 - 1/\nu_E - 2\nu_E}\right)} E_0,$$

and probability of continuation

$$\lambda_E^* \frac{\nu_E}{2\nu_E - 1 + \sqrt{3 - 1/\nu_E - 2\nu_E}}$$

It is easy to see that $E_0/(1 + \nu_E) \in (E_0/2, E_0)$, and that both E_1 and $J(E_1)$ are greater than $E_0/(1 + \nu_E)$ and less than E_0 for $\nu_E > \sqrt{5}/2 - 1/2$.

Since the maximizer we identified is less than E_0 it is also strictly less than y and so it is the maximizer for all $E \in [E_0/(1 + \nu_E), \min\{E_0/\nu_E, y\}]$.

$\square$

Proof of Lemma 1. We consider two cases depending on whether pure debtholders decide to accept or reject the proposal.

Case 1: $\underline{E \in (E_0/2, E_0]}$. We know that p_E is the (perceived by the market) probability of continuation times E, while p_D is the probability of continuation times $y - E$ plus the probability of liquidation times l. In particular the expectation over p_E can never exceed E. So strategy $\{x_E = -1, x_D = 0\}$ is weakly dominated by $\{x_E = 0, x_D = 0\}$, which is, in turn, weakly dominated by strategy $\{x_E = 1, x_D = 0\}$. Hence, by ignoring weakly dominated strategies the fund's profit for each case is,

$$
\Pi_C^2(x_E, x_D; E) = \begin{cases} y - \mathbb{E}[p_E|x_E = 1] - \mathbb{E}[p_D|x_D = 1], & x_E = 1,\ x_D = 1, \\ E - \mathbb{E}[p_E|x_E = 1], & x_E = 1,\ x_D = 0, \\ l + \mathbb{E}[p_E|x_E = -1] - \mathbb{E}[p_D|x_D = 1], & x_E = -1,\ x_D = 1. \end{cases}
$$

We now show that the fund always finds it optimal to be pivotal when it is long equity, so in the notation of Section 4, $\alpha = \beta = 1$. It suffices to show that

$$
y - E \geq \mathbb{E}[p_D|x_D = 1],
$$

for $E \in (E_0/2, E_0]$. Let $\mathbb{P}_{mkt}[\text{liquidation}]$ be the perceived by the market probability of liquidation, then

$$
\mathbb{E}[p_D|x_D = 1] = (1 - \mathbb{P}_{mkt}[\text{liquidation}])(y - E) + \mathbb{P}_{mkt}[\text{liquidation}]\, l.
$$

Since $E \leq E_0$ we have $y - E \geq l$, and $y - E$ is certainly greater or equal to the convex combination of itself and something smaller. Since strategy $\{x_E = 1, x_D = 0\}$ is weakly

dominated by strategy $\{x_E = 1, x_D = 1\}$ we write,

$$\Pi_C^2(x_E, x_D; E) = \begin{cases} y - \mathbb{E}[p_E | x_E = 1] - \mathbb{E}[p_D | x_D = 1], & x_E = 1, \ x_D = 1, \\ l + \mathbb{E}[p_E | x_E = -1] - \mathbb{E}[p_D | x_D = 1], & x_E = -1, \ x_D = 1. \end{cases}$$

Case 2: $\underline{E \in (E_0, y]}$. Similarly as above, strategy $\{x_E = 1, x_D = 0\}$ is weakly dominated by $\{x_E = 0, x_D = 0\}$, which is, in turn, weakly dominated by strategy $\{x_E = -1, x_D = 0\}$. Hence by ignoring weakly dominated strategies

$$\Pi_L^2(x_E, x_D; E) = \begin{cases} y - \mathbb{E}[p_E | x_E = 1] - \mathbb{E}[p_D | x_D = 1], & x_E = 1, \ x_D = 1, \\ l + \mathbb{E}[p_E | x_E = -1] - \mathbb{E}[p_D | x_D = 1], & x_E = -1, \ x_D = 1. \\ \qquad\qquad + \mathbb{E}[p_E | x_E = -1], & x_E = -1, \ x_D = 0. \end{cases}$$

We now show that the fund always finds it optimal to be pivotal when it is short equity, i.e., $\alpha = \beta = 1$. It suffices to show that

$$l \ \geq \ \mathbb{E}[p_D | x_D = 1],$$

for $E \in (E_0, y]$. We have,

$$\mathbb{E}[p_D | x_D = 1] \ = \ (1 - \mathbb{P}_{mkt}[\text{liquidation}])(y - E) + \mathbb{P}_{mkt}[\text{liquidation}] \, l.$$

Since $E > E_0$ we have $l > y - E$, and l is certainly greater or equal to the convex combination of itself and something smaller. Since strategy $\{x_E = -1, x_D = 0\}$ is weakly dominated by strategy $\{x_E = -1, x_D = 1\}$ we write,

$$\Pi_L^2(x_E, x_D; E) = \begin{cases} y - \mathbb{E}[p_E | x_E = 1] - \mathbb{E}[p_D | x_D = 1], & x_E = 1, \ x_D = 1, \\ l + \mathbb{E}[p_E | x_E = -1] - \mathbb{E}[p_D | x_D = 1], & x_E = -1, \ x_D = 1. \end{cases}$$

$\square$

Proof of Proposition 3. Since the markets in debt and equity are connected the perceived probabilities of continuation and liquidation between the two markets are going to be the same. We

consider two cases depending on whether pure debtholders decide to accept or reject the proposal.[44]

Case 1: For $E \in (E_0/2, E_0]$ we have,

$$
\Pi_C^2(x_E, x_D; E) = \begin{cases}
\mathbb{P}_{mkt}[\text{liquidation}|x_E = 1, x_D = 1]E_0, & x_E = 1, x_D = 1, \\
\mathbb{P}_{mkt}[\text{liquidation}|x_E = 1, x_D = 0]E, & x_E = 1, x_D = 0, \\
(1 - \mathbb{P}_{mkt}[\text{liquidation}|x_E = -1, x_D = 1])(2E - E_0), & x_E = -1, x_D = 1,
\end{cases}
$$

The "*mkt*" subscript in the probabilities above is meant to stress that these are the market perceived probabilities of liquidation that the fund tries to assess given its action and its prior on noise trading; in this case, of course, $\beta = 1$.

For $e \in \{-1, 1\}$, and $d \in \{0, 1\}$ we have

$$
\mathbb{P}_{mkt}[\text{liquidation}|x_E = e, x_D = d] =
$$
$$
\mathbb{P}_{mkt}[\text{liquidation}|x_E = e, x_D = d, z_E = 1, z_D = 1]\mathbb{P}[z_E = 1, z_D = 1] +
$$
$$
\mathbb{P}_{mkt}[\text{liquidation}|x_E = e, x_D = d, z_E = 1, z_D = 0]\mathbb{P}[z_E = 1, z_D = 0] +
$$
$$
\mathbb{P}_{mkt}[\text{liquidation}|x_E = e, x_D = d, z_E = -1, z_D = 1]\mathbb{P}[z_E = -1, z_D = 1] +
$$
$$
\mathbb{P}_{mkt}[\text{liquidation}|x_E = e, x_D = d, z_E = -1, z_D = 0]\mathbb{P}[z_E = -1, z_D = 0] =
$$
$$
\mathbb{P}[x_E = -1, x_D = 1|y_E = e + 1, y_D = d + 1]\nu_E \nu_D +
$$
$$
\mathbb{P}[x_E = -1, x_D = 1|y_E = e + 1, y_D = d]\nu_E(1 - \nu_D) +
$$
$$
\mathbb{P}[x_E = -1, x_D = 1|y_E = e - 1, y_D = d + 1](1 - \nu_E)\nu_D +
$$
$$
\mathbb{P}[x_E = -1, x_D = 1|y_E = e - 1, y_D = d](1 - \nu_E)(1 - \nu_D),
$$

Note that

$$
\mathbb{P}_{mkt}[\text{liquidation}] = 1 - \mathbb{P}_{mkt}[\text{continuation}] = \mathbb{P}[x_E = -1, x_D = 1],
$$

---

[44]For $E \leq E_0/2$ see discussion in the main text.

and,

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = 2, y_D = 2] = 0,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = 2, y_D = 1] = 0,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = 0, y_D = 2] = K,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = 0, y_D = 1] = \Lambda,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = 2, y_D = 0] = 0,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = 0, y_D = 0] = 0,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = -2, y_D = 2] = 1,$$

$$\mathbb{P}[x_E = -1, x_D = 1 | y_E = -2, y_D = 1] = 1,$$

where[45]

$$K \triangleq \frac{\nu_E(1 - \lambda_E)}{\nu_E(1 - \lambda_E) + (1 - \nu_E)\alpha\lambda_E},$$

$$\Lambda \triangleq \frac{\nu_E(1 - \nu_D)(1 - \lambda_E)}{(1 - \nu_E)(1 - \nu_D)\alpha\lambda_E + \nu_E(1 - \nu_D)(1 - \lambda_E) + (1 - \nu_E)\nu_D(1 - \alpha)\lambda_E},$$

so that

$$\mathbb{P}_{mkt}[\text{liquidation} | x_E = 1, x_D = 1] = K(1 - \nu_E)\nu_D + \Lambda(1 - \nu_E)(1 - \nu_D),$$

$$\mathbb{P}_{mkt}[\text{liquidation} | x_E = 1, x_D = 0] = \Lambda(1 - \nu_E)\nu_D.$$

We consider the following possibilities for an equilibrium,

- If $\alpha = 1$, i.e., the fund prefers to become pivotal when it is long in equity, then

$$K = \Lambda = \frac{\nu_E(1 - \lambda_E)}{\nu_E(1 - \lambda_E) + (1 - \nu_E)\lambda_E},$$

so that

$$\Pi_C^2(1, 1; E) = K(1 - \nu_E)E_0 > K(1 - \nu_E)\nu_D E = \Pi_C^2(1, 0; E),$$

---

[45]The probability $\mathbb{P}[x_E = -1, x_D = 1 | y_E = -2, y_D = 0]$ is omitted because the action $\{x_E = -1, x_D = 0\}$ is weakly dominated.

and this is an equilibrium.

- If $\alpha = 0$, i.e., the fund prefers not to become pivotal when it is long in equity, then

$$
\begin{aligned}
K &= 1, \\
\Lambda &= \frac{\nu_E(1 - \nu_D)(1 - \lambda_E)}{\nu_E(1 - \nu_D)(1 - \lambda_E) + (1 - \nu_E)\nu_D\lambda_E} < 1,
\end{aligned}
$$

so that

$$
\Pi_C^2(1, 1; E) = (1 - \nu_E)\left[\nu_D + \Lambda(1 - \nu_D)\right]E_0 > (1 - \nu_E)\Lambda\nu_D E_0 > (1 - \nu_E)\Lambda\nu_D E = \Pi_C^2(1, 0; E),
$$

so this cannot be an equilibrium.

Hence in equilibrium, the fund always becomes pivotal either it is long or short in equity, i.e., $\alpha = \beta = 1$, and $K = \Lambda$. Given this we also have that,

$$
\begin{aligned}
\mathbb{P}_{mkt}[\text{liquidation}|x_E = -1, x_D = 1] &= K\nu_E\nu_D + \Lambda\nu_E(1 - \nu_D) + (1 - \nu_E)\nu_D + (1 - \nu_E)(1 - \nu_D) \\
&= K\nu_E + (1 - \nu_E),
\end{aligned}
$$

so that,

$$
\Pi_C^2(-1, 1; E) = (1 - K)\nu_E(2E - E_0).
$$

We consider the following possibilities for an equilibrium,

- If $\lambda_E = 1$, i.e., the fund prefers to go long in equity, then $K = 0$ and

$$
\Pi_C^2(1, 1; E) = 0 < \nu_E(2E - E_0) = \Pi_C^2(-1, 1; E),
$$

so this cannot be an equilibrium.

- If $\lambda_E = 0$, i.e., the fund prefers to go short in equity, then $K = 1$ and

$$
\Pi_C^2(-1, 1; E) = 0 < (1 - \nu_E)E_0 = \Pi_C^2(1, 1; E),
$$

44

so this cannot be an equilibrium.

Any mixed equilibria should be such that

$$
\begin{aligned}
\Pi_C^2(-1, 1; E) &= \Pi_C^2(1, 1; E) \iff \\
(1 - K)\nu_E(2E - E_0) &= K(1 - \nu_E)E_0 \iff \\
\lambda_E &= \frac{E_0}{2E},
\end{aligned}
$$

which is a well defined probability since $E > E_0/2 > 0$.

Case 2: Similarly, for $\underline{E \in (E_0, y]}$ we have,

$$
\Pi_L^2(x_E, x_D; E) = \begin{cases}
(1 - \mathbb{P}_{mkt}[\text{continuation}|x_E = 1, x_D = 1])E_0, & x_E = 1, x_D = 1, \\
\mathbb{P}_{mkt}[\text{continuation}|x_E = -1, x_D = 1])(2E - E_0), & x_E = -1, x_D = 1, \\
\mathbb{P}_{mkt}[\text{continuation}|x_E = -1, x_D = 0])E, & x_E = -1, x_D = 0.
\end{cases}
$$

In this regime, of course, $\alpha = 1$, i.e., the fund always becomes pivotal when it is long in equity. Note that

$$
\mathbb{P}_{mkt}[\text{continuation}] = 1 - \mathbb{P}_{mkt}[\text{liquidation}] = \mathbb{P}[x_E = 1, x_D = 1],
$$

so similar calculations as before yield

$$
\begin{aligned}
\mathbb{P}[x_E = 1, x_D = 1|y_E = 2, y_D = 2] &= 1, \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = 2, y_D = 1] &= 1, \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = 0, y_D = 2] &= K', \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = 0, y_D = 1] &= \Lambda', \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = -2, y_D = 2] &= 0, \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = -2, y_D = 1] &= 0, \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = 0, y_D = 0] &= 0, \\
\mathbb{P}[x_E = 1, x_D = 1|y_E = -2, y_D = 0] &= 0,
\end{aligned}
$$

where[46]

$$K' \triangleq \frac{(1 - \nu_E)\lambda_E}{\nu_E \beta(1 - \lambda_E) + (1 - \nu_E)\lambda_E},$$

$$\Lambda' \triangleq \frac{(1 - \nu_E)(1 - \nu_D)\lambda_E}{(1 - \nu_E)(1 - \nu_D)\lambda_E + \nu_E(1 - \nu_D)\beta(1 - \lambda_E) + \nu_E\nu_D(1 - \beta)(1 - \lambda_E)},$$

so that

$$\mathbb{P}_{mkt}[\text{continuation}|x_E = -1, x_D = 1] = K'\nu_E\nu_D + \Lambda'(1 - \nu_D)\nu_E,$$

$$\mathbb{P}_{mkt}[\text{liquidation}|x_E = -1, x_D = 0] = \Lambda'\nu_E\nu_D.$$

We consider the following possibilities for an equilibrium,

- If $\beta = 1$, i.e., the fund prefers to become pivotal when it is short in equity, then

$$K' = \Lambda' = \frac{(1 - \nu_E)\lambda_E}{\nu_E\beta(1 - \lambda_E) + (1 - \nu_E)\lambda_E},$$

  so that

$$\Pi_L^2(-1, 1; E) = \nu_E K'(2E - E_0) > \nu_E K'E = \nu_E\Lambda'E > \nu_E\nu_D\Lambda'E = \Pi_L^2(-1, 0; E),$$

  and this is an equilibrium.

- If $\beta = 0$, i.e., the fund prefers not to become pivotal when it is short in equity, then

$$K' = 1,$$

$$\Lambda' = \frac{(1 - \nu_E)(1 - \nu_D)\lambda_E}{(1 - \nu_E)(1 - \nu_D)\lambda_E + \nu_E\nu_D(1 - \lambda_E)} < 1,$$

  so that,

$$\Pi_L^2(-1, 0; E) = \nu_E\nu_D\Lambda'E < \nu_E[\nu_D + (1 - \nu_D)\Lambda'](2E - E_0) = \Pi_L^2(-1, 1; E),$$

  so this cannot be an equilibrium.

---

[46]The probability $\mathbb{P}[x_E = 1, x_D = 1|y_E = -2, y_D = 0]$ is omitted because the action $\{x_E = 1, x_D = 0\}$ is weakly dominated.

Hence in equilibrium, the fund always becomes pivotal irrespective of its long or short position in equity, i.e., $\alpha = \beta = 1$, and $K' = \Lambda'$. Given this we also have that,

$$\mathbb{P}_{mkt}[\text{liquidation}|x_E = 1, x_D = 1] \quad = \quad (1 - K')(1 - \nu_E),$$

so that,

$$\Pi_L^2(1, 1; E) \quad = \quad (1 - K')(1 - \nu_E)E_0.$$

We consider the following possibilities for an equilibrium,

- If $\lambda_E = 1$, i.e., the fund prefers to go long in equity, then $K' = 1$ and

$$\Pi_L^2(1, 1; E) = 0 < \nu_E(2E - E_0) = \Pi_L^2(-1, 1; E),$$

so this cannot be an equilibrium.

- If $\lambda_E = 0$, i.e., the fund prefers to go short in equity, then $K' = 0$ and

$$\Pi_L^2(-1, 1; E) = 0 < (1 - \nu_E)E_0 = \Pi_L^2(1, 1; E),$$

so this cannot be an equilibrium.

Any mixed equilibria should be such that

$$
\begin{aligned}
\Pi_L^2(-1, 1; E) &= \Pi_L^2(1, 1; E) \iff \\
K'\nu_E(2E - E_0) &= (1 - K')(1 - \nu_E)E_0 \iff \\
\lambda_E &= \frac{E_0}{2E},
\end{aligned}
$$

which is a well defined probability since $E > E_0/2$.

Hence also in this case the unique equilibrium is $\alpha = \beta = 1$ and $\lambda_E = E_0/(2E)$. $\qquad \square$

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