A theory of LBO activity based on repeated debt-equity conflicts ☆

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ABSTRACT

We develop a theory of leveraged buyout (LBO) activity based on two elements: the ability of private equity-owned firms to borrow against their sponsors' reputation with creditors and externalities in sponsors' reputations due to competition and club formation. In equilibrium, the two sources of value creation in LBOs, operational improvements and financing, are complements. Moreover, sponsors that never add operational value cannot add value through financing either. Club deals are beneficial ex post by allowing low-reputation bidders with high valuations to borrow reputation from high-reputation bidders with low valuations, but they can destroy value by reducing bidders' investment in reputation. Unlike leverage of independent firms, driven only by firm-specific factors, buyout leverage is driven by economy-wide and sponsor-specific factors.

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1. Introduction

Leveraged buyouts (LBOs) have been an important element of the merger and acquisition market over the last three decades. Value creation in LBO transactions is generally attributed to two sources: operational improvements and the benefits of higher leverage involving tax shields and improved management incentives. However, private equity (PE) firms are sometimes accused of doing nothing but levering up their portfolio companies.[1] Buyout activity has followed a boom-and-bust pattern and has

[1] For example, as one former investment banker put it, "Private equity is nothing more than incredibly brilliant financial engineering" (Gary Rivlin, Daily Beast, February 21, 2012). The academic literature provides evidence consistent with a positive effect of LBOs on tax benefits from increased leverage (e.g., Guo, Hotchkiss, and Song, 2011; Cohn, Mills, and Towery, 2014), operating performance (e.g., Kaplan, 1989; Lichtenberg and Siegel, 1990; Boucly, Sraer, and Thesmar 2011; Acharya, Gottschalg, Hahn, and Kehoe, 2013), monitoring of the management (e.g., Cornelli and Karakas, 2014), and innovative activity (Lerner, Sorensen, and Strömberg, 2011). See Cumming, Siegel, and Wright (2007) and Kaplan and Strömberg (2009) for reviews.

been negatively related to aggregate credit spreads and the market risk premium.[2] Leverage in LBO transactions has also varied substantially over time and, unlike leverage of public firms, has been strongly driven by economy-wide factors (Axelson, Jenkinson, Strömberg, and Weisbach, 2013) and PE sponsor characteristics (Demiroglu and James, 2010). The industry is characterized by a high level of competition and frequent formation of clubs, in which two or more PE firms jointly bid for the target.[3]

Motivated by these stylized facts, this paper develops a theory of buyout activity that analyzes the following three sets of questions. First, how is the PE sponsor's ability to add value through financing decisions related to its ability to add value through operational changes? Are these two sources of value creation complements or substitutes, and can it be that PE firms add value only through financing decisions without making any operational improvements, as is sometimes claimed? Second, what determines club formation, and what are the positive and negative effects of club deals on the value created in LBO transactions? Third, what factors determine aggregate LBO activity, buyout leverage, and other deal characteristics? In particular, why do economy-wide factors have a much stronger effect on buyout leverage than on leverage of public firms, and how do these factors affect the composition of winning acquirers and PE firms' payoffs?

Our model is based on two key elements: the idea that PE-owned firms borrow against their sponsors' reputational capital and externalities between PE sponsors' reputations. Specifically, while debt is beneficial for tax and incentive reasons, it creates a conflict between shareholders and debtholders, which is especially pronounced when the firm is in financial distress (e.g., Jensen and Meckling, 1976; Myers, 1977). One prominent example of such conflicts of interest is dividend payouts, often accompanied by the issuance of additional debt and leading to rating downgrades.[4] In 2012 alone, PE-owned firms borrowed a record $64 billion to fund dividends, and this amount increased further in 2013 (Wall Street Journal, 2013). PE firms have also been accused of delaying efficient liquidation of portfolio firms (a form of asset substitution) and of walking away from financially distressed firms at times when an additional investment of capital and effort

would allow a more efficient resolution of distress (a form of debt overhang). A recent example involving multiple alleged debt-equity conflicts is the bankruptcy of Energy Future Holdings, an electric utility company formed in the largest LBO in history. The creditors sued the company alleging pervasive conflicts of interest, including excessively high PE firms' fees, inefficient investment to avoid breaking up the company, delaying restructuring, and lack of diversification.[5]

Despite these conflicts of interest, PE firms are able to significantly lever up the companies they acquire. The first key element of our model is the idea that such high leverage is possible because, for a given leverage, debt-equity conflicts are less severe when the firm is owned by a PE sponsor than by dispersed public shareholders because a PE-owned firm can use more assets to borrow against. If a firm is publicly owned, it can borrow only against its own assets. In contrast, a PE-owned firm borrows both against its own assets and against the PE sponsor's reputational capital with creditors. Because, in the future, the sponsor will have other portfolio companies that will raise debt financing, it cares about the payoff of creditors in the current portfolio company, and this can partly alleviate the debt-equity conflict of interest. PE sponsors believe that "if they get a reputation for over-leveraging portfolio companies and then leaving them to their fate, they won't be able to execute new deals" (Institutional Investor, 2004). Consistent with this view, Moody's has been tracking PE sponsors' aggressiveness in paying large dividends and incorporating it into its credit ratings on LBO deals (Moody's, 2008).[6]

The second key element of our model is externalities between PE firms' reputations with creditors. These externalities arise because PE firms compete for targets and because they can form clubs. In the model, there is a large market of long-lived PE firms and targets that are available every period. Each target can potentially increase in value from the buyout. This added value comes from two sources: financing decisions and operational changes. Each target is matched to two potential acquirers, PE firms, that compete in an auction. We later allow PE firms to form a club and bid jointly. PE firms can differ in the skills of their general partners (GPs): A high-skill firm is more likely to create a higher operational value. After the bidding stage, the acquirer chooses how much to lever

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[2] See Haddad, Loualiche, and Plosser (2014), Kaplan and Strömberg (2009), and Ljungqvist, Richardson, and Wolfenzon (2008).

[3] Gorbenko and Malenko (2014b) show that an average auction won by a financial bidder involves five or more other financial bidders that signed confidentiality agreements. Officer, Ozbas, and Sensoy (2010) and Boone and Mulherin (2011) show that almost half of PE deals in recent years entailed a consortium of several PE firms.

[4] According to Harry Resis, a veteran portfolio manager who bought the bonds that were used to finance the buyout of Nalco Co. and were later downgraded following a dividend recapitalization, "The sponsors reward themselves with a dividend, and we got rewarded with a downgrade on our holdings" (Institutional Investor, 2004). In a more recent example, the creditors of bankrupt Mervyn's sued Mervyn's PE owners for stripping Mervyn's of valuable real estate assets, while paying themselves hundreds of millions of dollars in management fees and dividends. See "Buyout firms pay $166 mln to end suit over Mervyn's sale" (Reuters, October 8, 2012). Other examples include lawsuits for dividend payments against the PE owners of Powermate Corporation in 2008, Refco in 2007, and KB Toys in 2005.

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[5] Energy Future Holdings filed for Chapter 11 on April 29, 2014. According to the petition filed by creditors, the company "wasted nearly a year and many hundreds of millions of dollars pursuing their doomed Project Olympus," "continued its 'amend and pretend' campaign, while continuing to fail to address the underlying problems in the Debtors' businesses," and "lost opportunities to diversify its generation fleet, implement efficiency changes, and otherwise take steps to optimize performance and revenues."

[6] Existing empirical evidence also supports the notion that the PE sponsor's identity and reputation affect the cost of debt financing and the sponsor's post-buyout behavior (Demiroglu and James, 2010; Ivashina and Kovner, 2011; Hotchkiss, Smith, and Strömberg, 2014; Huang, Ritter, and Zhang, 2014). For example, Hotchkiss, Smith, and Strömberg (2014) show that financially distressed firms backed by a PE firm are more likely to receive a capital injection from their owners than firms without a PE owner, suggesting that the debt overhang problem is less pronounced for PE-backed firms.

up the target and finances the rest with the PE fund's capital. The ability to raise debt is limited by the agency conflict between shareholders and creditors: Shareholders can divert value from creditors. Diversion is inefficient and results in a deadweight loss. Ex ante, the PE firm would like to commit to not diverting value because it bears the cost of diversion by paying a high interest rate on debt. The PE firm's need to access the debt market repeatedly creates this commitment ability endogenously. However, this commitment ability is limited and depends on economy-wide and sponsor-specific factors, as well as the extent of competition between PE firms and their ability to form clubs.

Our results are as follows. First, the two sources of value creation in LBOs are complements: PE firms' ability to make operational improvements enhances their ability to add value through financing, leading buyout leverage to increase with PE sponsor skills. More generally, if a PE sponsor's operational skills are unobserved by the market, then the higher is the perceived skill of the sponsor, the more leverage can it add to the target. Moreover, the ability to make operational improvements is necessary for value creation through financing: If PE firms never add any operational value, no buyouts take place.

The intuition is as follows. If the PE firm could commit to not diverting value from creditors, buyout leverage would be determined by the usual trade-offs, such as the benefits of tax shields and management incentives versus the costs of financial distress and inefficient investment. However, due to the agency problem, the equilibrium leverage is potentially different from this target-specific optimal leverage and is determined by the commitment power of the PE firm. The PE firm takes as much debt as creditors are willing to lend at a low interest rate, i.e., the maximum amount of debt given which it will refrain from diversion. A higher ability to add value through operational changes increases the importance of future deals relative to the benefits of diversion from the current portfolio company and thereby increases the PE sponsor's commitment power, allowing it to take more debt. Hence, differences in PE firms' quality are amplified: Firms with more skilled GPs gain even more advantage because of their higher ability to lever up their portfolio companies. In a more general setting, in which PE firms' skills are not perfectly known to the market, the sponsor's commitment power is determined by its perceived skill, which is updated over time. Interpreting the sponsor's perceived skill as reputation for operational skill and its ability to commit to no diversion as reputation for not expropriating creditors, we conclude that the two types of reputation are complementary to each other.

Importantly, in the extreme case, when PE firms never add any operational value, PE-owned firms have no borrowing advantage over non-PE-owned firms despite PE sponsors' repeated deal making. As a result, PE firms cannot add any value through financing either, and LBO activity disappears completely. Therefore, the view that PE firms do nothing but lever up their portfolio companies is inconsistent with our results: Operational improvements are necessary for buyouts to take place. The reason for this result is competition among PE firms

for targets. If a PE firm can add value only by levering up its targets, it has no competitive advantage over other PE firms, and all benefits from additional leverage accrue to target shareholders through the buyout premium. The PE firm thus does not earn abnormal profits in any future deals, which implies that it has no reputational capital to back up the debt of its current portfolio company. A general point here is that a PE firm needs to have a competitive advantage over its rivals to be able to create value through debt financing.

We also show that incentives of PE firms to invest in reputation for non-diversion, and therefore value created through financing, are higher in common-value deals (when different PE firms obtain the same value from acquiring the target but differ in their estimates of this value) than in private-value deals (when different PE firms obtain different values from acquiring the target). This is because when a PE firm diverts value, it harms its ability to compete with other PE firms for future deals, and the damage is considerably higher in common-value transactions than in private-value transactions.

Our second set of results relates to club formation. Club deals can have both a positive effect due to synergies among club members and a negative effect due to PE firms' reduced incentives to invest in reputation for non-diversion. The positive effect of club deals is that they allow bidders to borrow reputation for non-diversion from each other. If a low-reputation bidder can add significant value through operational improvements in a given target, while a high-reputation bidder cannot, then the club as a whole creates a higher value from the deal than each of the bidders can create on its own. The low-reputation bidder benefits by borrowing reputation from the high-reputation bidder, which allows the club to raise financing on favorable terms. The high-reputation bidder, in turn, benefits by capturing part of the surplus that the low-reputation bidder adds to the target through operations. While club deals are beneficial ex post, they can be detrimental ex ante because they could negatively affect PE firms' commitment power. A bidder who trades off the benefits of diversion against the costs of losing its reputation with creditors could have lower incentives to preserve its reputation for non-diversion, realizing that it will be able to borrow reputation from more reputable bidders in the future by forming a club with them. We show that this negative ex ante effect can dominate, leading to reduced buyout activity and a lower expected value from buyouts, despite the positive ex post effect of club formation in any given deal. This negative effect is different from the critique that club deals transfer wealth from target shareholders to bidders by reducing competition (e.g., Officer, Ozbas, and Sensoy, 2010; Marquez and Singh, 2013). We emphasize that club deals can have a negative effect on the joint surplus of bidders and the target, rather than resulting only in a wealth transfer.

Our final set of results deals with the determinants of buyout activity, leverage, and other deal characteristics. Consistent with the observed empirical evidence (Axelson, Jenkinson, Strömberg, and Weisbach, 2013; Demiroglu and James, 2010), equilibrium buyout leverage is determined

not only by target-specific factors, but also by PE sponsor characteristics and economy-wide factors, such as discount rates and expectations of future deal activity. In contrast, leverage of non-PE-owned firms in our model is driven only by their characteristics. Intuitively, buyout leverage is primarily determined by the PE sponsor's commitment power. When discount rates are lower, future deals are more important to PE sponsors relative to current deals, so the PE firm's commitment ability is higher, increasing buyout leverage. Increased debt capacity, in turn, implies that PE firms can add more value through financing, so aggregate buyout activity increases as well, consistent with the evidence in Haddad, Loualiche, and Plosser (2014). Interestingly, the sensitivity of buyout activity to discount rates depends on the information environment. If uncertainty about PE sponsors' skills is high, then an increase in the discount rate, which destroys commitment power of all PE firms except those with a high reputation for skill, causes a higher drop in buyout activity than if uncertainty about PE sponsors' skills is low.

Our paper builds on previous research that examines the role of repeated interactions in alleviating agency conflicts due to players' reputational incentives. The idea that repeated borrowing can help mitigate the agency problems of debt goes back to Jensen and Meckling (1976). Diamond (1989) models reputation acquisition in debt markets and studies how the incentive effect of reputation evolves over time.[7] De Fontenay (2014) provides a detailed discussion of the importance of repeated interactions in private equity. Our main theoretical contribution to the literature on reputation is the analysis of externalities in players' reputations that arise due to club formation and competition in auctions.[8] Because of externalities, our model is related to papers that study the effect of product market competition on firms' incentives to maintain reputation for producing high-quality products.[9]

The paper also contributes to the literature on leveraged buyouts. One strand of this literature examines the determinants of aggregate buyout activity. Variation in LBO activity is often attributed to debt market mispricing or changes in the supply of credit.[10] Relatedly, Martos-Vila, Rhodes-Kropf, and Harford (2014) study how debt market overvaluation can explain the changing proportion of financial buyers relative to strategic buyers. In contrast, our theory features efficient capital markets and no changes in credit supply. Axelson, Strömberg, and

Weisbach (2009) show how the agency conflict between general and limited partners can rationalize the financial structure of PE funds and derive implications for deal activity and investment performance. In Haddad, Loualiche, and Plosser (2014), buyout activity is driven by the trade-off between higher cash flow growth under private ownership and underdiversification of LBO investors. Burkart and Dasgupta (2015) obtain procyclicality of hedge fund activism in a model in which hedge funds lever up target firms to signal their ability and note that their model can also apply to the PE industry. Different from these papers, our focus is on the post-buyout conflict between PE firms and creditors, the role of repeated deal making, and externalities in PE firms' reputations due to club formation and competition. Club formation has also been examined by Marquez and Singh (2013), who focus on the trade-off between reduced competition and value creation due to the club aggregating individual bidders' values. In contrast, we analyze the costs and benefits of club deals through the lens of PE firms' reputation with creditors.[11]

The remainder of the paper is organized as follows. Section 2 describes the model setup, studies the target as an independent firm, and considers the benchmark case of a single deal. Section 3 analyzes the model in which PE firms have identical skill, and Section 4 considers the model in which PE firms differ in their skills. Section 5 studies club formation. Section 6 analyzes the common value setting. Section 7 discusses observed variation in buyout activity and buyout leverage in the context of the model, and Section 8 provides new empirical implications of the model. Finally, Section 9 concludes. The proofs of all propositions are presented in the Appendix, whereas the proofs of all lemmas, corollaries, and supplementary results are relegated to the Online Appendix.

2. Model setup

Time is discrete, indexed by $t = 0, 1, 2, \ldots$, and the horizon is infinite. There are three types of agents: creditors, PE firms, and targets. All agents are risk-neutral. The financial market is competitive, and all agents discount future payoffs at the rate r. There is a continuum of measure two of infinitely lived PE firms. Each PE firm is characterized by skill χ of its GPs, which determines the PE firm's ability to add value to the average target through operational improvements.[12] In addition, in every period, there is a continuum of measure $\gamma \in [0, 1]$ of targets.

The timeline, illustrated in Fig. 1, is as follows. At the beginning of every period, each target is matched to two PE firms, which are random draws from the population of PE firms. By buying out the target, a PE firm can create

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[7] Diamond (1991) extends Diamond (1989) by distinguishing between bank debt and public debt. Prior to Diamond (1989), reputation in repeated borrowing was modeled by John and Nachman (1985).

[8] In addition, leverage in our model is endogenous, which allows us to study the determinants of buyout leverage vis-à-vis leverage of public firms.

[9] See, e.g., Hörner (2002), Kranton (2003), and Bar-Isaac (2005). Relatedly, Winton and Yerramilli (2015) develop a model to study a bank's incentives to monitor loans in the originate-to-distribute market and have an extension that examines competition among banks. In the context of repeated interactions, Bond and Rai (2009) point to a positive externality between borrowers' repayment decisions, which arises if lender's viability depends on how many borrowers repay.

[10] See, e.g., Kaplan and Stein (1993), Acharya, Franks, and Servaes (2007), Kaplan and Strömberg (2009), Shivdasani and Wang (2011) and Axelson, Jenkinson, Strömberg, and Weisbach (2013).

[11] Relatedly, Povel and Singh (2010) study the effects of stapled finance, which is common in LBO transactions, on competition between bidders and the expected price paid to the seller. Our paper abstracts from the incentives of sellers to arrange such financing for the bidders.

[12] Empirical evidence in Kaplan and Schoar (2005), Phalippou and Gottschalg (2009), and Robinson and Sensoy (2013) suggests a substantial variation in the perceived skills of GPs, proxied by past performance and fund size.

value through two potential channels. One channel is leverage, which provides tax benefits and can restrict empire-building by the target's management. The other channel is operational and governance changes, such as cost-cutting, eliminating unproductive assets, improved monitoring, and management changes. For brevity, we refer to such changes as operational improvements. We model operational improvements by assuming that the target can be either successful or not, and the PE sponsor affects the probability that the target succeeds.

Formally, there are two states, $s \in \{B, G\}$, that determine whether the target is successful ($s=G$) or not ($s=B$). Upon matching with the target, PE firm i learns its probability q_i of state G, i.e., the probability with which the target will succeed under its management. The PE firm's skill χ_i determines how likely a typical target is to succeed. In other words, the PE firm's skill affects its ability to manage companies in a way that minimizes chances of bad states. Specifically, if the PE firm's skill is χ_i, q_i is an independent draw from the distribution function $F(\cdot | \chi_i)$ with density $f(\cdot | \chi_i)$ and full support on $[\underline{q}, \overline{q}]$, $0 \leq \underline{q} < \overline{q} \leq 1$. Section 3 considers the case in which all PE firms are identical in skill. In Section 4, PE firms differ in their skills, and the market learns about firms' skills over time. The assumption that draws of q are PE firm specific means that values are private. In Section 6, we consider a model with common values and show that PE firms have stronger incentives to invest in reputation for non-diversion when values are common.

If the target remains independent, its probability of success is given by $q_T \in (0, \overline{q})$. If $q_T > \underline{q}$, a realization of q_i can be smaller than q_T, corresponding to the idea that the firm's operations are sometimes more efficient under public ownership. Depending on q_i and the cost of financing determined in equilibrium, each PE firm decides whether to bid for the target. If no firm decides to bid, the target remains independent. If only one firm decides to bid, it makes a take-it-or-leave-it offer to the target. If both firms decide to bid, they compete for the target in an English (open ascending-bid) auction, where the price is gradually increased until only one bidder remains. We look at the unique equilibrium in weakly dominant strategies: Each firm bids up to its maximum willingness to pay.

The acquirer (PE firm) then decides on the capital structure of the target. It chooses amount of debt D_i due at the end of the period and raises debt in the competitive market. The rest is financed from the PE firm's own capital. Thus, the acquirer becomes the only shareholder of the target. We assume that PE firms are financially unconstrained, so the only reason to use debt is because debt can increase the target's value. If the target remains independent, its shareholders also choose amount $\tilde{D}$ due at the end of the period and raise debt in the competitive market.

At the end of the period, the state $s \in \{B, G\}$ (the target's success or failure) is realized and publicly observed. The value of the target is X_B in the bad state and $X_G + g(D)$ in the good state, where $\Delta_X \equiv X_G - X_B > 0$ and D is the debt that the target's shareholders took: D_i if it was acquired by PE firm i and $\tilde{D}$ if it remained independent. Thus, the PE firm can add value by operational changes (by increasing the probability of a high cash flow realization) and by using different leverage than the independent target would use. Function $g(D)$ reflects the

benefits of debt due to tax shields and improved management incentives and the costs of debt due to inefficient investment. We model these effects in a reduced-form way through $g(D)$ and provide microfoundations for this function based on tax shields and the free cash flow argument of Jensen (1989) in the section "Microfoundation for the benefits of debt" in the Appendix. The trade-off between these costs and benefits determines the unconstrained optimal amount of debt D^*, which maximizes $g(D)$. Specifically, we assume that $g(0) = 0$, $g'(D) > 0$, $g''(D) < 0$, and $g'(D^*) = 0$ for some finite $D^* > 0$.

After the state is realized, shareholders (the PE firm or current owners if the target remains independent) can expropriate creditors by diverting any amount between zero and the realized value. Diverting x of the cash flows generates λx in value to shareholders, where $\lambda < 1$. Thus, diversion is inefficient. This specification encompasses different ways in which the debt-equity conflict of interest can be manifested: dividends that decrease total firm value, debt overhang (e.g., not injecting additional cash although it would allow a more efficient resolution of financial distress), and delaying efficient liquidation.

Finally, all agents receive their payoffs. After that, the game is repeated. Past realizations of cash flows and diversion decisions are observable but not verifiable. Thus, we assume that diversion cannot be contracted away, for example, by covenants. This assumption is reasonable for some conflicts of interest (e.g., debt overhang) but could be less so for others (e.g., dividend payouts). As we discuss in the conclusion, covenants provide an alternative, albeit costly and imperfect, way to resolve debt-equity conflicts, and introducing them into the model would lead to a number of additional implications.

We impose the following restriction on the parameters.

Assumption 1. $(1-\lambda)X_B < D^* \leq (1-\lambda)(X_G + g(D^*))$.

The first inequality implies that, given debt D^*, diversion in the bad state is optimal for shareholders. This is because the cash flow from diversion, λX_B, is greater than the cash flow remaining after paying out the debt, $\max(X_B - D^*, 0)$. Without this condition, the agency problem between creditors and shareholders would not exist. The second inequality guarantees that, given debt D^*, diversion in the good state is not optimal. Moreover, given the properties of $g(D)$, this assumption also implies that diversion is not optimal in the good state for any $D \leq D^*$.[13] The assumption that diversion does not occur in the good state is not inconsistent with the evidence that PE-owned firms frequently pay dividends in good times as well. The reason is that dividends paid in the good state are often not detrimental to debtholders and therefore should not be considered as diversion of value. Consistent with this, Hotchkiss, Smith, and Strömberg (2014) do not find evidence that dividend recapitalizations influence the probability of default.

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[13] To see this, note that, given debt D, diversion in the good state is suboptimal if $\beta(D) \equiv g(D) - \frac{D}{1-\lambda}$ exceeds $-X_G$. Because $\beta'' < 0$ and $\beta'(D^*) < 0$, then $\beta(D) \geq \min(\beta(0), \beta(D^*))$ for $D \in [0, D^*]$. Because $\beta(0) = 0$ and $\beta(D^*) \geq -X_G$ by Assumption 1, then $\beta(D) \geq \min(\beta(0), \beta(D^*)) \geq -X_G$.

Period t Period $t+1$

(1)	(2)	(3)	(4)	(5)
A target is matched to two PE firms. Each PE firm learns the value it can create.	PE firms bid for the target. The winner chooses the leverage of the target.	The state is realized.	The PE firm decides how much value to divert.	All agents receive cash flows.

Beginning of the period   End of the period
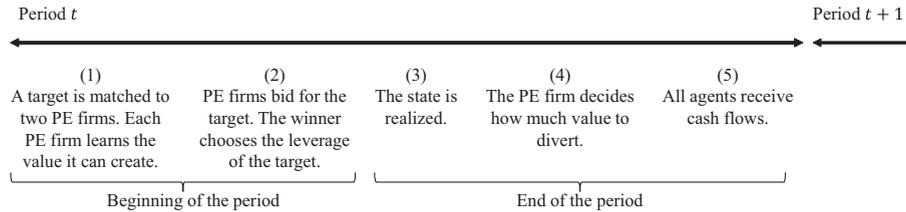
Fig. 1. Timeline of the model.

Finally, we introduce the following notations. We denote $x^+ \equiv \max(x,0)$ and $[x]_a^b \equiv \min(\max(x,a),b)$ for $b \geq a$. In other words, x^+ equals x truncated by zero from below, and $[x]_a^b$ equals x truncated by a from below and by b from above.

2.1. Target as an independent firm

As a prerequisite, we solve for debt policy and valuation of the target if it remains an independent firm. Before presenting the analysis, we discuss the important difference between non-PE-owned firms and firms that are owned by a PE sponsor. The distinguishing feature of PE ownership compared with public dispersed ownership is not repeated borrowing by the PE sponsor per se. Non-PE-owned firms borrow repeatedly, too. Instead, the distinguishing feature of a PE-owned firm is that it can back its borrowing with more assets. A non-PE-owned firm borrows only against its own assets, that is, assets in place and growth options. In contrast, a PE-owned firm borrows both against its own assets and against the reputational capital of the PE sponsor, reflected in its payoff from future deals. Effectively, debt of a PE-owned firm is backed both by the firm's own assets and by some fraction of the assets of the PE sponsor's future portfolio companies. To illustrate this point, consider a highly levered firm that suffers a negative shock to its assets in place. This can lead to the well-known debt overhang problem (Myers, 1977): If the firm is owned by dispersed shareholders and managers maximize shareholder value, the firm passes up positive net present value (NPV) projects because shareholders bear the full investment cost, while a large fraction of benefits goes to debtholders. Debt overhang takes place irrespectively of whether or not the firm is a repeated borrower, as the value of the firm's assets already incorporates all expected future interactions.[14] In contrast, if the firm is owned by a PE sponsor, the sponsor could invest in positive NPV projects despite the fact that shareholders (i.e., the sponsor) lose on them, because the sponsor gets rewarded through different portfolio companies in the future.

To summarize, the difference between PE-owned and non-PE-owned firms is that PE-owned firms effectively back their debt with assets of other targets acquired by the PE sponsor in the future. For simplicity, we capture this difference by assuming that the target borrows only once if it is non-PE-owned. But, for the above argument, the

reasoning would not be different if the target borrowed repeatedly.

Consider the equilibrium debt that the target would take as an independent firm. Given debt D, diversion in the bad state occurs if

$$(X_B - D)^+ < \lambda X_B \Leftrightarrow D > (1-\lambda)X_B. \tag{1}$$

The target thus chooses between two options: (1) taking the unconstrained optimal debt D^* and diverting value from creditors in the bad state and (2) taking the highest possible debt given which it will not divert value, $D = (1-\lambda)X_B$. Under the first option, the target can capture the benefits of higher leverage, but it also has to bear the expected deadweight loss from diversion, $\frac{(1-q_T)(1-\lambda)X_B}{1+r}$, by paying a high interest rate on debt. This is because creditors, anticipating that they will be expropriated in the bad state, are willing to invest less given the promised payment D^*. We assume that the loss from diversion is sufficiently high relative to the benefits of higher leverage, so that the second policy is optimal for the target. Because $q_T \leq \overline{q}$, this is ensured by the following condition.

Assumption 2. The loss from diversion is high: $\frac{(1-\overline{q})(1-\lambda)X_B}{\overline{q}} \geq g(D^*) - g((1-\lambda)X_B)$.

Assumption 2 is plausible because, if it were violated, leverage of the target would sometimes decrease in a buyout, which is inconsistent with empirical evidence, except perhaps in rare cases.[15] Under Assumption 2, the following result holds.

Lemma 1. *If the target remains independent, it takes debt* $D = (1-\lambda)X_B$ *and does not divert value in the bad state. The value of the target if it remains independent is*

$$V_0 \equiv \frac{q_T(X_G + g_0) + (1-q_T)X_B}{1+r}, \tag{2}$$

where $g_0 \equiv g((1-\lambda)X_B)$.

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[14] The degree of debt overhang depends on the frequency of borrowing (equivalently, average debt maturity) in a nontrivial way (Diamond and He, 2014).

[15] In unreported results, we have also analyzed the case in which Assumption 2 is violated. All results of the main model remain the same, and the only change concerns the N-equilibrium, defined in Section 3. In particular, if a PE firm is unable to commit to no diversion, then, instead of borrowing $(1-\lambda)X_B$ and not diverting value, it borrows D^* and diverts value if the bad state is realized. The implication of this result is that when the loss from diversion is low, buyout leverage is a U-shaped function of drivers of deal activity and the skill of the PE sponsor.

2.2. Single-deal setting

We next analyze debt policy under PE ownership. As a benchmark, consider the case in which each PE firm does only one deal.

2.2.1. Commitment case

Suppose first that each PE firm can commit to not diverting value from creditors. The proof of Lemma 2 shows that if PE firm i takes debt D_i, its maximum willingness to pay for the target is $V_0 + \frac{(q_i - q_T)\Delta_X + q_i g(D_i) - q_T g_0}{1+r}$, where V_0 is the stand-alone value of the target, given by (2). The premium the bidder is willing to pay over V_0 is determined by the operational improvements it can make (if $q_i > q_T$) and the value it can create by levering up the target (if $g(D_i) > g_0$). Therefore, if PE firm i acquires the target, it pays V_0 if the other bidder does not participate in the auction (i.e., if $\left(q_j - q_T\right)\Delta_X + q_j g(D_j) - q_T g_0 < 0$) and pays $V_0 + \frac{(q_j - q_T)\Delta_X + q_j g(D_j) - q_T g_0}{1+r}$ if the other bidder participates. Hence, the payoff of PE firm i conditional on realizations q_i, q_j is

$$\frac{1}{1+r}\left[(q_i - q_T)\Delta_X + q_i g(D_i) - q_T g_0 - \left(\left(q_j - q_T\right)\Delta_X + q_j g(D_j) - q_T g_0\right)^+\right]^+.$$
(3)

Because D^* maximizes $g(D)$, the acquirer finds it optimal to take debt D^*. Thus, if the PE firm is able to commit to no diversion, it can always add value through financing. Lemma 2 summarizes the equilibrium in this case.

Lemma 2. Suppose PE firms can commit to no diversion. Then a target is acquired if and only if $(\max(q_1, q_2) - q_T)\Delta_X + \max(q_1, q_2)g(D^*) - q_T g_0 > 0$, irrespective of r, γ. The bidder with the highest value q_i acquires the target, irrespective of bidders' skills χ_1, χ_2. The acquirer takes debt D^*.

2.2.2. No commitment case

The analysis of the no commitment case, presented in the proof of Lemma 3, is similar to the analysis of the optimal debt policy of a target as an independent firm. Each PE firm faces a trade-off between taking the unconstrained optimal debt D^* but bearing the loss from diversion ex ante and taking a lower debt $(1-\lambda)X_B$, given which it refrains from diversion. Under Assumption 2, the optimal debt level is $(1-\lambda)X_B$, which coincides with the debt of the target as an independent firm. We summarize this analysis in Lemma 3.

Lemma 3. Suppose PE firms cannot commit to no diversion. Then a target is acquired if and only if $\max(q_1, q_2) > q_T$, irrespective of r, γ. The bidder with the highest value q_i acquires the target, irrespective of bidders' skills χ_1, χ_2. The acquirer takes debt $(1-\lambda)X_B$.

The PE firm's maximum willingness to pay for the target, $V_0 + \frac{(q_i - q_T)(\Delta_X + g_0)}{1+r}$, is strictly smaller than in the case with commitment because it cannot add any value through financing. Thus, the PE firm would like to commit to not diverting value but cannot do so due to the short-term nature of its interactions with creditors. Compared with the case of commitment, deal activity is lower: Only

PE firms that can generate a positive value through operational changes, $q_i > q_T$, choose to undertake the deal.

We next analyze the general model, in which PE firms repeatedly find potential targets. Due to PE firms' repeated deal making, their reputation with creditors becomes important to them. Thus, to obtain future financing on favorable terms, they might want to refrain from diverting value from creditors, i.e., commitment to no diversion becomes possible. This commitment ability can lead PE-owned firms to optimally borrow more than they would borrow as independent firms and thereby allows PE sponsors to create value through financing in addition to operational improvements.

For brevity, we use the following notations for the rest of the paper: $\Delta_g \equiv g(D^*) - g_0$ and

$$z_R(q) \equiv \frac{(q - q_T)(\Delta_X + g_0) + q\Delta_g 1_{R=1}}{1+r}.$$
(4)

Here $z_1(q)$ ($z_0(q)$) denotes the maximum willingness to pay for the target above its stand-alone value V_0 of a PE firm that has (does not have) a reputation for non-diversion, i.e., that can (cannot) commit to no diversion.

3. Model with identical PE firms

In this section, we analyze the setting where PE firms do not differ in their skill. In each period, the PE firm that acquires the target makes two decisions. First, it chooses the amount of debt used to finance the buyout. Second, if the bad state is realized, it decides whether to divert value. By Assumption 1, diversion in the good state is suboptimal even in the single-deal setting, and hence it is suboptimal in the repeated-deal setting as well.

We look for equilibria in symmetric pure strategies, in which, in every period, all PE firms take the same amount of debt and either divert all value in the bad state or do not divert. Let D denote the equilibrium level of debt and $e \in \{0, 1\}$ denote the equilibrium diversion decision, where $e = 0$ ($e = 1$) stands for no diversion (diversion) in the bad state. Recall that in the single-deal setting, diversion in the bad state is optimal if and only if $D > (1-\lambda)X_B$. Hence, if $D \le (1-\lambda)X_B$, then $e = 0$. However, unlike in the single-deal setting, PE firms can now refrain from diversion even if $D > (1-\lambda)X_B$ due to their concerns about reputation.

We focus on equilibria in which creditors play a grim trigger strategy.[16] In particular, if a PE firm deviates from its equilibrium strategy, either by diverting value when

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[16] Grim trigger strategies is a common way to model reputation in repeated games. A player's reputation is the history of his past "good actions." As soon as a player deviates from a "good action," other players are assumed to believe that he will deviate in the future, too, so the game moves to a sequence of one-shot Nash equilibria. Mailath and Samuelson (2006) provide an overview of approaches to modeling reputation, one of which is the grim trigger strategy approach. Another way to model reputation is the "crazy types" approach. In the context of our model, if some PE firms are "honest" in the sense that they never divert value from creditors, then other PE firms have incentives to abstain from diversion to pretend to be "honest" and thereby obtain cheap financing. In such a model, a PE firm's reputation for non-diversion would be the outsiders' belief that it is "honest," which would evolve over time. It is easy to see that our results would continue to hold in such a model as well. Because our focus is not on how reputation evolves over time, we adopt the first approach for simplicity.

$e=0$ or by taking debt $D' \neq D$, creditors expect this PE firm to divert value in the future whenever it takes debt $D > (1-\lambda)X_B$.[17] Note that a PE firm's deviation from the equilibrium strategy has no effect on the incentives of other PE firms and thus does not change their actions. Therefore, considering the deviation of a single firm in isolation is sufficient.

As shown in Lemma 4 below, there always exists an equilibrium that is a repetition of the single-period game without commitment characterized by Lemma 3. In this equilibrium, to refrain from diversion, PE firms take the same low amount of debt as the independent target, $(1-\lambda)X_B$. In the repeated-deal setting, however, the need to raise financing for future deals enhances PE firms' ability to commit to no diversion, and thus more efficient equilibria can exist as well. If the ability to commit is sufficiently high, an equilibrium can exist in which PE firms take the unconstrained optimal debt D^* and yet pay low interest rates because they never divert value. This equilibrium is a repetition of the single-period game with commitment characterized by Lemma 2. If the ability to commit is in the intermediate range, PE firms will not refrain from diversion if the amount due is D^* but will refrain from diversion if the amount due is slightly lower. In this case, PE firms could prefer to take a lower than optimal debt $D < D^*$ and pay a low interest rate, rather than take D^* and pay a high interest rate. This argument implies that the set of potential equilibria is the following.

1. *N-equilibrium* (no commitment equilibrium): PE firms take debt $(1-\lambda)X_B$ and do not divert value.
2. *C-equilibria* (constrained commitment equilibria): PE firms take debt $D \in ((1-\lambda)X_B, D^*)$ and do not divert value.
3. *U-equilibrium* (unconstrained commitment equilibrium): PE firms take debt D^* and do not divert value.[18]

Lemma 4 characterizes the necessary and sufficient conditions for each of these equilibria to exist.

Lemma 4. The N-equilibrium always exists. The C-equilibrium with debt D exists if and only if

$$\lambda X_B - (X_B - D)^+ \leq \frac{\gamma}{r}\mathbb{E}\big[(q_1 - q_T)\Delta_X + q_1 g(D) - q_T g_0$$

$$- \big((q_2 - q_T)\Delta_X + q_2 g(D) - q_T g_0\big)^+\big]_0^{q_1(g(D)-g_0)}. \tag{5}$$

The U-equilibrium exists if and only if condition (5) holds for $D = D^*$.

Intuitively, PE firms refrain from diverting value only if the benefit from diversion today [the left-hand side of condition (5)] is lower than the benefit of preserving their reputation for non-diversion and obtaining cheap financing in future deals [the right-hand side of condition (5)].

Because multiple equilibria can coexist, we use the efficiency criterion to select among them. We call one equilibrium more efficient than the other if the expected value from deals, given by

$$\frac{\gamma}{r}\mathbb{E}[\max(0, (q_1 - q_T)\Delta_X + q_1 g(D) - q_T g_0, (q_2 - q_T)\Delta_X + q_2 g(D) - q_T g_0)], \tag{6}$$

is higher in the first equilibrium. If two equilibria coexist, we select the more efficient equilibrium. Because $g(D)$ increases in D for $D \leq D^*$, (6) implies that the U-equilibrium is the most efficient among all equilibria, the N-equilibrium is the least efficient, and, among any two C-equilibria, the equilibrium with the higher debt level is more efficient.

In the most efficient equilibrium, the PE firm takes the highest amount of debt (up to D^*) given which it will refrain from diversion, i.e., the highest debt that allows financing to be raised on favorable terms. As the PE firm's commitment power declines, this level of debt declines as well. Combining the efficiency refinement and Lemma 4 allows us to derive the equilibrium buyout leverage as a function of PE sponsors' skill, the discount rate r, and the mass of targets γ (which can be interpreted as expectations of future buyout activity). The reason these factors affect buyout leverage is that they affect the PE firm's concerns about its reputation with creditors and thereby its commitment power. In particular, a more skilled PE firm expects to capture higher rents in future deals and hence cares more about its reputation with creditors, which increases its commitment power. Similarly, a decrease in the discount rate or an increase in expectations about future activity increases the value of future deals relative to today's benefits of diversion and also increases the PE firm's commitment power. This argument implies the following result.

Proposition 1. The level of debt in the most efficient equilibrium decreases in r and increases in γ. Furthermore, suppose that $q \stackrel{d}{=} q_0 + c$, where $c > 0$ is any constant and q_0 is distributed with full support on $[\underline{q}, \overline{q}]$. Then, the level of debt in the most efficient equilibrium increases in c.

In Section 7, we relate the implications of Proposition 1 to the existing empirical evidence about the determinants of buyout activity and leverage.

The formulation of Proposition 1 assumes that the skill of all PE firms in the economy increases simultaneously (q_i shifts by c for all firms). As a result, the effect of skill (parameter c) on the firm's payoff from future deals is muted because it is accompanied by an increase in competition. Thus, the statement will be even stronger if we increase the skill of one PE firm while keeping the skill of other firms fixed. In particular, consider a modified setup, in which all firms but one have the same skill χ, and the skill $\tilde{\chi}$ of the remaining firm can change independently

of χ. Lemma 5 shows that as the PE firm's skill increases in the sense of first-order stochastic dominance (FOSD), the leverage it takes increases.

Lemma 5. Suppose that all PE firms but one have skill χ, the remaining firm has skill $\tilde{\chi}$, and $D(\tilde{\chi})$ denotes the level of debt it takes in the most efficient equilibrium. If the distribution $F(q|\chi)$ satisfies first-order stochastic dominance, then $D(\tilde{\chi})$ increases with $\tilde{\chi}$.

Proposition 1 and Lemma 5 show that the two sources of value creation in LBOs — operational changes and financing decisions — are complements. The higher is a PE firm's ability to add value through operations, the higher is its ability to add value through financing because it can raise more debt at a low interest rate. Moreover, Proposition 2 and Corollary 1 imply that the ability to add value through operations is necessary to create any value through financing.

Proposition 2. Suppose that the distribution of q is degenerate: $\Pr(q = q_0) = 1$ *for some* q_0. *Then, only the N-equilibrium exists.*

Corollary 1. Suppose that PE firms never add or destroy any operational value: $\Pr(q = q_T) = 1$. *Then, PE firms have no borrowing advantage over independent targets and LBOs never happen.*

Corollary 1 helps evaluate the popular claim that PE firms do not create operational improvements and only load up targets with debt. It shows that this claim is not consistent with the equilibrium: Without any operational improvements, PE-owned firms would not be able to borrow on more favorable terms than non-PE-owned firms, and hence buyouts would never happen. Thus, PE firms' ability to add value through debt financing crucially relies on their ability to add operational value.

This result arises because of externalities between competing PE firms. A PE firm's ability to commit to not diverting value from creditors depends on its net payoff from future deals. Because PE firms compete for deals, the only way for a PE firm to have a positive net payoff from future deals is to have a competitive advantage over other PE firms in the market. If a PE firm never adds operational value, it never has any competitive advantage: Even if it can take additional debt, other PE firms can do the same, so the added value from debt is reflected in the premium and fully accrues to shareholders of the target. Thus, if a PE firm has no ability to make operational improvements, its net payoff from future deals is zero, so it cannot pledge its future payoff to credibly promise not to divert value. As a result, the PE firm has no borrowing advantage over stand-alone target companies despite doing repeated deals.

While a PE firm that *never* adds any operational value can *never* add value through financing, a feature of equilibrium is that a PE firm that does not add operational value in a *given* deal can nevertheless add value through financing in this deal. In particular, if the PE firm expects to add operational value in at least some future deals, then some current deals can go through even though no operational improvements are made. Intuitively, the ability to add operational value to some future targets gives the PE firm a competitive advantage and allows it to keep part of the future surplus instead of giving it away entirely to shareholders of the targets. Hence, the PE firm can pledge this future surplus to credibly promise not to divert value today, which allows it to borrow on more favorable terms than the target.

The general insight here is that, to create value through debt financing, a PE firm needs a competitive advantage over other PE firms in the market. While in the current model, a competitive advantage is achieved via operational improvements that other PE firms cannot mimic, other microfoundations of a competitive advantage are possible, too. In Section 6, for example, we show an analog of this result in the model with common values, in which the competitive advantage of a PE firm comes through its private knowledge of the potential for value creation in a deal.

4. Model with heterogeneous PE firms

In this section, we extend the model of Section 3 by allowing PE firms to differ in their operational skills and for the market to learn about PE firms' skills over time. This analysis is important because, in practice, a PE firm's reputation for skill is arguably at least as important as its reputation for not expropriating creditors. As we show, there is an interesting interaction between the two types of reputation, which leads to additional implications.

Assume that each PE firm can be either of high ($\chi = H$) or low ($\chi = L$) skill. If a target is managed by a low-skill PE firm, the probability of a good state, q, is drawn from distribution $f(q|L)$. If a target is managed by a high-skill PE firm, the probability of a good state is drawn from distribution $f(q|H)$, which dominates $f(q|L)$ in the sense of FOSD. As time goes by, new PE firms arrive to the market and some existing PE firms leave. Every period, each existing PE firm leaves the market with probability $\varphi \in (0, 1)$, and mass 2φ of new PE firms enters the market. The total mass of PE firms in the market thus equals two in every period. The skill of every new PE firm is either high or low with equal probabilities, independent of the skill of other PE firms. The skill of a PE firm is not known by anyone when it enters the market. However, as time goes by, participants learn about the skill of each PE firm by observing its realizations of q.

To keep the learning environment tractable, we make two simplifying assumptions. First, when a target is matched to PE firms i and j, realizations q_i and q_j are observed by all market participants. Thus, information about the skill of each PE firm is symmetric among all PE firms and investors. Second, distributions $f(q|H)$ and $f(q|L)$ satisfy

$$f(q|H) = \begin{cases} pf(q) & \text{if } q \in \left[\frac{1}{2} - d, \frac{1}{2} + d\right], \\ (1-p)f_H(q) & \text{if } q \in \left[\frac{1}{2} + d, \overline{q}\right], \\ 0 & \text{otherwise}, \end{cases} \quad (7)$$

$$f(q|L) = \begin{cases} pf(q) & \text{if } q \in \left[\frac{1}{2}-d, \frac{1}{2}+d\right], \\ (1-p)f_L(q) & \text{if } q \in \left[\underline{q}, \frac{1}{2}-d\right], \\ 0 & \text{otherwise,} \end{cases} \qquad (8)$$

where the distribution densities $f(\cdot)$, $f_H(\cdot)$, and $f_L(\cdot)$ have full support on the corresponding intervals. This distribution assumption makes learning simple and tractable. If $q \in \left[\frac{1}{2}+d, \overline{q}\right]$ is realized, the market infers that the PE firm is high-skill because the low-skill PE firm never gets such a realization of q. Similarly, if $q \in \left[\underline{q}, \frac{1}{2}-d\right]$ is realized, the market infers that the PE firm is low-skill. Finally, if $q \in \left[\frac{1}{2}-d, \frac{1}{2}+d\right]$ is realized, the market does not update its belief about the quality of the PE firm because these intermediate realizations of q are equally likely for both high- and low-skill PE firms. It follows that at any time there are three types of firms: firms whose skill has been revealed to be high, $\theta = H$; firms whose skill has been revealed to be low, $\theta = L$; and firms whose skill is still unknown, $\theta = U$.[19]

Let $\mu_H(t)$, $\mu_L(t)$, and $\mu_U(t)$ denote the mass of PE firms of each type at the beginning of period t. In what follows, we solve for the stationary equilibria, in which the distribution of types does not change over time. Lemma 6 shows that there exists a unique stationary distribution of types, characterized by the masses (μ_H, μ_L, μ_U) of the three types of PE firms at the beginning of each period.

Lemma 6. There exists a unique stationary distribution of PE firms' types, characterized by $\mu_H = \mu_L = \frac{1}{2}\frac{(1-\varphi)(1-p)\gamma}{1-(1-\varphi)(p\gamma+1-\gamma)}$ *and* $\mu_U = \frac{\varphi}{1-(1-\varphi)(p\gamma+1-\gamma)}$.

Lemma 6 implies that the mass of firms of unknown skill increases in φ, the fraction of new firms that enter the market each period, and increases in p, the probability that a PE firm's realization of q does not reveal its skill to the market.

To simplify the analysis, we assume that the function $g(D)$ equals g_0 on the interval $[(1-\lambda)X_B, D^*)$ and then jumps to $g(D^*) > g_0$ at the point D^*. As before, $g(D)$ increases for $D < (1-\lambda)X_B$ and decreases for $D > D^*$. Based on the arguments in Sections 2 and 3, this assumption implies that PE firms take debt D^* if, given this debt level, they can commit to not diverting value and take debt $(1-\lambda)X_B$ otherwise.

As previously, we focus on equilibria in symmetric pure strategies, in which all firms of the same type follow the same pure strategy in every period. The first condition of Assumption 1 implies that diversion in the bad state is optimal in the single-deal setting, and the second condition of Assumption 1 guarantees that diversion in the good state never occurs. Hence, any symmetric pure strategy equilibrium is characterized by a set ϱ of types of PE firms, $\varrho \subseteq \{H, L, U\}$, such that types $\theta \in \varrho$ take debt D^* and do not

    [19] A more standard assumption would be that distributions $f(q|H)$ and $f(q|L)$ have common support and can be ranked in terms of dominance. This assumption would complicate the learning problem significantly because the probability that a PE firm is high-skill could take any value from zero to one and, thus, there would be a continuum of types of firms. The economic intuition behind our analysis does not rely on the fact that there are only three types in the model, so we expect our results to be general.

divert value (i.e., have a reputation for not expropriating creditors), while types $\theta \notin \varrho$ take debt $(1-\lambda)X_B$ (i.e., do not have this reputation). Let $R(\theta)$ denote whether type θ has reputation for non-diversion: $R(\theta) = 1$ if $\theta \in \varrho$, and $R(\theta) = 0$ otherwise.

Let z denote the PE firm's maximum willingness to pay for the target over its stand-alone value V_0. Recall that z equals $z_0(q)$ $(z_1(q))$ for a PE firm without (with) a reputation for non-diversion, where $z_R(q)$ is given by Eq. (4). Denote the density of the stationary distribution of z by $\eta(z)$. This density depends on the stationary distribution of types μ_H, μ_L, and μ_U, calculated in Lemma 6, as well as on what types of PE firms are able to commit to no diversion in equilibrium, ϱ.

Let $V_R(\theta)$ denote the expected value to type $\theta \in \{H, L, U\}$ if it has a reputation for non-diversion, and let $V_{NR}(\theta)$ denote the expected value to type θ if it does not have this reputation. Then, type θ is not willing to divert value from creditors if and only if

$$\lambda X_B - (X_B - D^*)^+ \leq V_R(\theta) - V_{NR}(\theta). \qquad (9)$$

The next lemma derives $V_R(\theta) - V_{NR}(\theta)$ as a function of the stationary distribution $\eta(\cdot)$.

Lemma 7. The value from reputation for non-diversion to type $\theta \in \{H, L\}$ is given by

$$V_R(\theta) - V_{NR}(\theta) = \frac{\gamma(1+r)}{r+\varphi} \int \int [z_1(q) - z^+]_0^{q\Delta_g/(1+r)} f(q|\theta)\eta(z)\, dq\, dz, \qquad (10)$$

and the value of reputation for non-diversion to type $\theta = U$ is given by

$$V_R(U) - V_{NR}(U) = \frac{1}{2}(V(H) - V_{NR}(H) + V(L) - V_{NR}(L))$$

$$+ \frac{\frac{1}{2}\frac{p(1+r)}{r+\varphi}}{\frac{}{\gamma} + (1-\varphi)(1-p)} \int \int \left([z_1(q) - z^+]_0^{q\Delta_g 1_{R(H) = 0}/(1+r)} \right.$$

$$+ [z_1(q) - z^+]_0^{q\Delta_g 1_{R(L) = 0}/(1+r)} \Big) f(q)\eta(z)\, dq\, dz, \qquad (11)$$

where $V(\theta) = V_R(\theta)$ if $R(\theta) = 1$ and $V(\theta) = V_{NR}(\theta)$ if $R(\theta) = 0$.

Similar to the model with identical firms, there exist multiple Nash equilibria because reputation for non-diversion can be self-sustaining. To select among equilibria, we define the following selection criterion.

Assumption 3 (Equilibrium selection). An equilibrium must satisfy the monotone reputation property: For any pair $(\theta, \hat{\theta}) \in \{H, U, L\}^2$, if $V_R(\theta) - V_{NR}(\theta) \leq V_R(\hat{\theta}) - V_{NR}(\hat{\theta})$ for every possible density $\eta(\cdot)$, then $R(\theta) \leq R(\hat{\theta})$. In case multiple equilibria satisfying the monotone reputation property exist, then the more efficient equilibrium is selected.

Intuitively, the monotone reputation property means that if the value from reputation for non-diversion for type $\hat{\theta}$ is always weakly higher than for type θ, regardless of the distribution of bids of rival bidders, then it cannot be the case that type $\hat{\theta}$ does not have commitment power, while type θ does. While such Nash equilibria exist, to support them, expectations must be unreasonable: Types with a higher value from reputation for non-diversion must be expected

to divert more in the future. The second part of the selection criterion is similar to the one used in Section 3.

Using the monotone reputation property and the expressions for $V_R(\theta) - V_{NR}(\theta)$ derived in Lemma 7, we obtain the following characterization of equilibria.

Proposition 3. In any equilibrium, $R(L) \leq R(U) \leq R(H)$.

The intuition is as follows. The higher is the perceived skill of the PE firm, the higher operational value it expects to create in future deals. Hence, it is more important for higher types to preserve their reputation for not expropriating creditors to be able to finance future deals on favorable terms ($V_R(\theta) - V_{NR}(\theta)$ increases with type). In that sense, Proposition 3 complements the results in Section 3 by showing that a PE firm's ability to add operational value enhances value creation through financing even in a more general setting, where PE firms' operational skills are unknown to the market. Interpreting θ as a PE firm's reputation for skill, this result suggests that the two types of reputation (reputation for skill and reputation for not expropriating creditors when the bad state is realized) are complementary to each other.

Proposition 3 implies that there are four possible equilibria.

1. *N-equilibrium*: All types of PE firms take debt $(1-\lambda)X_B$.
2. *H-equilibrium*: Type-*H* firms take debt D^* and do not divert value, while type-*U* and type-*L* firms take debt $(1-\lambda)X_B$.
3. *HU-equilibrium*: Type-*H* and type-*U* firms take debt D^* and do not divert value, while type-*L* firms take debt $(1-\lambda)X_B$.
4. *HUL-equilibrium*: All types of PE firms take debt D^* and do not divert value.

Because the expected value from deals is higher when more PE firms can commit to not diverting value, the *HUL*-equilibrium is the most efficient, followed by the *HU*-equilibrium, the *H*-equilibrium, and then the *N*-equilibrium. Lemma A.1 in the Online Appendix specifies the necessary and sufficient conditions for the existence of each equilibrium and shows that, similar to the model with identical firms, a lower discount rate r improves PE firms' ability to commit to no diversion.

We next compare the properties of the equilibria and derive implications for buyout activity and the composition of acquirers.

Proposition 4. (1) *The probability of a deal taking place is the highest in the HUL-equilibrium, followed by the HU-equilibrium, the H-equilibrium, and then the N-equilibrium.* (2) *The fraction of targets acquired by PE firms perceived to be high-skill is the highest in the H-equilibrium and is higher in the HU-equilibrium than in the HUL-equilibrium.*

Combining the first statement of the proposition with the efficiency refinement and the comparative statics in r from Lemma A.1 implies that buyout activity decreases with r. Intuitively, higher discount rates decrease PE firms' ability to commit to no diversion, reducing the value they can add through financing and thus deal activity. The

second statement shows that the equilibria are characterized by a different composition of acquirers. In the *H*-equilibrium, a bidder who is perceived to be high-skill can lever up the target more than bidders of unknown skill or bidders who are perceived to be low-skill. Such a bidder can therefore outbid other types of bidders even if the operational value it creates in the current deal is the same as, or lower than, the value created by them. As a result, PE firms that are perceived to be high-skill acquire a disproportional fraction of targets in the *H*-equilibrium. For a similar reason, the fraction of targets acquired by PE firms perceived to be high-skill is higher in the *HU*-equilibrium than in the *HUL*-equilibrium. Combining this with the efficiency refinement and the comparative statics in r implies that the fraction of deals done by acquirers perceived to be high-skill is an inverted U-shape function of the discount rate. Fig. 2 illustrates both implications of Proposition 1.

The equilibrium has interesting comparative statics in the characteristics of the information environment, φ and p. Unlike the discount rate, these parameters have a non-monotonic effect on deal activity. Consider the effect of an increase in φ, which captures how stable the PE industry is, i.e., whether there is a notable exit of existing firms and entry of new firms. Lower stability (higher φ) has two effects on the equilibrium. The direct effect is that it decreases the expected lifetime of each PE firm, which decreases the benefit of preserving the reputation for not expropriating creditors and makes it more difficult to commit to no diversion. The indirect effect of a higher φ is that it increases the fraction μ_U of firms whose skill is unknown to the market. This has a positive effect on deal activity in the *HU*-equilibrium, when firms with unknown skill are able to borrow at favorable rates, and a negative effect on deal activity in the *H*-equilibrium, when only firms known to be high-skill are able to borrow at favorable rates. This argument implies that, in general, stability of the PE industry can have a non-monotonic effect on LBO activity. A similar argument applies to parameter p, which captures the speed with which a PE firm's skill gets revealed in the market.[20]

Note also that uncertainty about PE firms' skills (which increases with φ and p) affects the sensitivity of buyout activity to large changes in discount rates. Suppose that in bust times only PE firms that are known to be high-skill are able to borrow at favorable rates (i.e., the *H*-equilibrium is played). In contrast, in boom times, PE firms of unknown skill are also able to borrow at favorable rates (i.e., the *HU*- or the *HUL*-equilibrium is played). Consider an increase in the

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[20] First, similar to the effect of φ, an increase in p increases the fraction μ_U of firms whose skill is unknown. In addition, a change in p affects the sustainability of different equilibria. To see this, consider the *HU*-equilibrium and the incentives of a type-*U* bidder to preserve its reputation for non-diversion. On the one hand, an increase in p reduces the likelihood that the bidder will soon be revealed as low-skill and become unable to get financing on favorable terms. On the other hand, an increase in p decreases the reputational payoff of high-skill bidders because they are now less likely to add value and outbid their rivals in future deals [the distribution $f(q|H)$ decreases in terms of FOSD]. The former effect increases the bidder's incentives to sustain its reputation for non-diversion, while the latter effect decreases them.
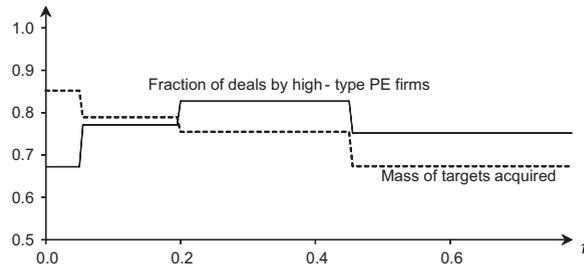
Fig. 2. Buyout activity and composition of acquirers. The figure illustrates Proposition 4 by plotting how (1) deal activity (measured as the mass of targets acquired each period) and (2) the fraction of targets acquired by private equity firms perceived to be high-skill depend on the discount rate r. The parameters are: $X_B = 4$, $X_G = 5$, $\lambda = 0.7$, $D^* = 1.5$, $g(D^*) = 1$, $g_0 = 0.5$, $q_T = 0.5$, $\underline{q} = 0$, $\overline{q} = 0.7$, $d = 0.1$, $p = 0.5$, $\varphi = 0.1$, $\gamma = 0.9$, and f, f_H, f_L are uniform. The discount rate r corresponds to the rate over the length of the investment.

discount rate that switches the *HU-* (or *HUL-*) equilibrium to the *H*-equilibrium. The higher is the uncertainty about PE firms' skills, the smaller is the fraction of firms known to be high-skill. Therefore, such an increase in the discount rate leads to a greater tightening of credit and a greater drop in buyout activity in uncertain PE markets relative to PE markets where sponsors' skills are known. Fig. 3 illustrates this effect: The gap between deal activity in the *H*-equilibrium and the *HU-* (or *HUL-*) equilibrium increases with φ. The effect of parameter p is similar.

5. Club deals

In practice, PE firms frequently form clubs and bid for the target as a group (Officer, Ozbas, and Sensoy, 2010; Boone and Mulherin, 2011). A common view is that PE firms form clubs to restrict competition and thereby extract rents from shareholders of the target.[21] Here, we analyze another motive for the formation of clubs, unrelated to competition: reputation borrowing. Specifically, if a PE firm cannot commit to not diverting value from creditors but can make significant operational improvements in a given target, it can team up with a PE firm that can commit to no diversion but cannot make significant operational improvements. Because diverting value hurts the reputation of all members of the club, teaming up with a high-reputation PE firm is a commitment device to not divert value. This allows the first firm to borrow the reputation of the second firm and the second firm to capture part of the operating value created by the first firm. In this section, we study the effect of club deals and reputation borrowing on buyout activity and the value created in buyouts. Our main result is that even though club formation is always beneficial in the context of a single deal, it can nevertheless destroy value in the takeover market overall by lowering PE firms' ex ante incentives to invest in reputation for no diversion.

5.1. Timeline

We extend the model of Section 4 to allow club formation. The timeline is as follows. In each period, the target is matched to two PE firms, characterized by probabilities q_1 and q_2 that the target is successful under their ownership. These probabilities are observed by all players. The two bidders then decide whether to form a club and undertake the buyout as a group. If they do so, the probability that the target is successful is $\max(q_1, q_2)$. We assume that there are infinitesimal positive costs of club formation, so that the club is formed if and only if it is strictly efficient to do so, i.e., if the bidders' joint surplus with the club is strictly higher than in the absence of the club. If the club is not formed, the two PE firms bid for the target. As in the model without club deals, bidding takes place through the English auction, and each firm bids up to its maximum willingness to pay. If the club is formed, the club makes a take-it-or-leave-it offer to the target. If the target rejects this offer, the bidders go back to competing through the English auction. Hence, the target's payoff if the club is formed is never smaller than its payoff in the absence of the club. We deliberately abstract from the effects of club deals on competition to focus solely on their effects on bidders' reputation.

Finally, if the target accepts the offer and the buyout takes place, the two bidders divide the surplus from the club according to the Nash bargaining solution with equal sharing, in which the status quo point is the set of payoffs in the absence of the club. Thus, each club member gets its payoff in the English auction plus half of the additional surplus generated due to club formation.

5.2. Analysis

According to the monotone reputation property criterion and the arguments in Section 4, there are again four potential equilibria: *HUL-*, *HU-*, *H-*, and *N*-equilibria. We first find the conditions under which the club is formed. The club is not beneficial and hence is not formed if the two bidders have the same reputation for non-diversion. Thus, on the equilibrium path, the club can be formed only in the *HU-* and the *H*-equilibria and only if the two bidders have different types, only one of which can commit to no diversion. Consider any of these two equilibria and

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[21] Although, in the model, we abstract from the effects of club deals on competition, our argument implies that this rent transfer can have a positive effect on the total value created in LBOs: Higher future rents can relax the no diversion constraint of PE sponsors and thereby lower their conflict of interest with creditors.
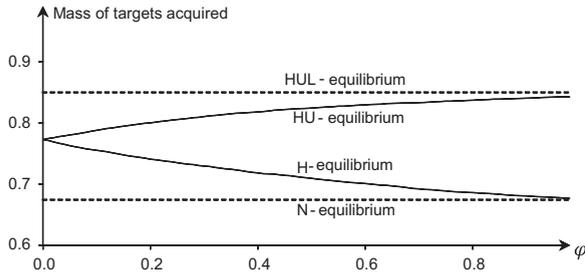
Fig. 3. Effect of uncertainty about private equity firms' skills on deal activity. The figure plots deal activity (measured as the mass of targets acquired each period) as a function of φ in four different types of equilibria of the model with heterogeneous private equity firms. The parameters are: $X_B = 4$, $X_G = 5$, $\lambda = 0.7$, $D^* = 1.5$, $g(D^*) = 1$, $g_0 = 0.5$, $q_T = 0.5$, $\underline{q} = 0$, $\overline{q} = 0.7$, $d = 0.1$, $p = 0.5$, $r = 1.1^5 - 1$, $\gamma = 0.9$, and f, f_H, f_L are uniform.

suppose that Bidder 1 cannot commit to no diversion and Bidder 2 can. The bidders' expected joint value from acquiring the target is $V_0 + z_1(\max(q_1, q_2))$ with the club and $V_0 + \max(z_0(q_1), z_1(q_2))$ without the club, where $z_R(q)$ is given by Eq. (4). Hence, the club is formed only if $q_1 > q_2$, and the expected surplus from club formation is given by $(z_1(\max(q_1, q_2)) - [\max(z_0(q_1), z_1(q_2))]^+)^+$, which can be rewritten as

$$S_{club}(q_1, q_2) = [z_1(q_1) - [z_1(q_2)]^+]_0^{q_1 \Delta_g/(1+r)}. \tag{12}$$

To analyze how club formation affects the sustainability of equilibria with reputation for non-diversion, we formulate Lemma 8.

Lemma 8. If club deals are allowed, the HUL-equilibrium exists if and only if

$$\lambda X_B - (X_B - D^*)^+ \le V_R^{HUL}(L) - V_{NR}^{HUL}(L) - \frac{\gamma(1+r)}{2(r+\varphi)} \mathbb{E}[S_{club}|\chi_1 = L], \tag{13}$$

the H-equilibrium exists if and only if

$$\lambda X_B - (X_B - D^*)^+ \le V_R^H(H) - V_{NR}^H(H)$$
$$+ \frac{\gamma(1+r)}{2(r+\varphi)}\big((\mu_L + \mu_U)\mathbb{E}[S_{club}|\chi_1 = L, \chi_2 = H]$$
$$- \mu_H \mathbb{E}\big[S_{club}|\chi_1 = H, \chi_2 = H\big] - \frac{\mu_U(1-p)}{2}\mathbb{E}[S_{club}|\chi_1 = H,$$
$$q_2 \in \Big[\frac{1}{2} + d, \overline{q}\Big]\Big]\big), \tag{14}$$

and the HU-equilibrium exists if and only if

$$\lambda X_B - (X_B - D^*)^+ \le V_R^{HU}(U) - V_{NR}^{HU}(U) - \Delta_V, \tag{15}$$

where $V_R^\varrho(\theta)$ and $V_{NR}^\varrho(\theta)$ are the values of type θ in the ϱ-equilibrium without club deals without diversion and upon diversion, respectively, $\varrho \in \{HUL, HU, H\}$, and $\Delta_V > 0$.

First, consider how club formation affects the sustainability of the HUL-equilibrium. Without the last term on the right-hand side, condition (13) is equivalent to the sustainability condition of the HUL-equilibrium in the model without club deals. Because the last term is negative, the ability to form clubs has a negative effect on the sustainability of the HUL-equilibrium. Intuitively, the last term reflects the reduced incentives to build a

reputation for non-diversion due to the possibility of borrowing reputation: If a PE firm destroys its reputation by diverting value, it is able to get cheap debt financing by forming a club with a high-reputation bidder. As a consequence, the punishment for diversion is smaller if club deals are possible, so the HUL-equilibrium is less likely to exist.

Next, consider the H-equilibrium. Different from condition (13), the right-hand side of condition (14) has three additional terms relative to the sustainability condition of the H-equilibrium in the model without club deals, and the first term is positive. The positive first term reflects the added incentives to build a reputation for non-diversion due to the ability to lend reputation to a low-reputation bidder and thereby receive part of that bidder's value from the deal. The two negative terms are similar to the negative term in condition (13) and reflect the reduced incentives to build a reputation for non-diversion due to reputation borrowing. The presence of the positive term implies that the overall effect of club deals on the sustainability of the H-equilibrium is ambiguous and depends on the stationary distribution of PE firms' types. In particular, as we show in the proof of Proposition 5, if φ and p are both large enough, type H finds it easier to refrain from diversion in the H-equilibrium if club deals are allowed. Intuitively, in this case, the probability of meeting a high-reputation bidder is very small, so reputation borrowing is unlikely.

Finally, as condition (15) demonstrates, the presence of club deals negatively affects the sustainability of the HU-equilibrium. Even though both the positive effect from reputation lending and the negative effect from reputation borrowing are present in this case, the negative effect dominates. Intuitively, the effect of reputation lending is small compared with the effect of reputation borrowing because relatively few high-valuation bidders need a reputation for non-diversion.

While the effect of club deals on the sustainability of the H-equilibrium is ambiguous when there is uncertainty about PE firms' skill, the negative effect always dominates if PE firms' skill is observed. (In this case, there are only three possible equilibria: the N-, the H-, and the HL-equilibrium.) Intuitively, in this case, the benefit of a high-skill PE firm from lending its reputation for non-diversion to a low-skill PE firm is relatively small because the low-skill firm is less likely to create a larger operational value than the high-skill firm. We summarize these two sets of results in Proposition 5.

Proposition 5.

1. *Allowing club deals has a negative effect on the sustainability of the HUL- and the HU-equilibrium and an ambiguous effect on the sustainability of the H-equilibrium.*
2. *Suppose that PE firms' skill is observed, i.e., $\varphi = 0$. Then, allowing club deals has a negative effect on the sustainability of both the HL- and the H-equilibrium.*

We conclude that club deals have a twofold effect on the expected total value from LBO deals. The direct effect is

positive: Ex post, club deals increase efficiency because they allow synergies from reputation borrowing. However, there is also an indirect ex ante effect: Club deals affect bidders' incentives to invest in a reputation for non-diversion. In particular, when PE firms' skill is observed, which is the case in stable markets, club deals make it more difficult for bidders to commit to no diversion. Corollary 2 describes which of the two effects dominates.

Corollary 2. Suppose that PE firms' skill is observed, i.e., $\varphi = 0$, and let $\rho = \frac{\gamma}{r}$. There exist $\rho_1, \rho_2, \rho_1^c, \rho_2^c$, where $\rho_i < \rho_i^c$, $\rho_1 < \rho_2$, $\rho_1^c < \rho_2^c$, such that relative to the case in which club deals are not allowed, the expected value from buyouts if club deals are allowed is

1. *the same if $\rho < \rho_1$ or $\rho > \rho_2^c$;*
2. *higher if $\rho_1^c < \rho < \rho_2$; and*
3. *lower if $\rho_1 < \rho < \rho_1^c$ or $\rho_2 < \rho < \rho_2^c$.*

Intuitively, the values ρ_1 and ρ_1^c (ρ_2 and ρ_2^c) stand for the cutoff values of ρ above which there exists the *H*-equilibrium (the *HL*-equilibrium) without and with club deals, respectively. According to Part 2 of Proposition 5, $\rho_i < \rho_i^c$. Hence, under the efficiency refinement, when ρ is in (ρ_1, ρ_1^c) or (ρ_2, ρ_2^c), the equilibrium switches from the *H*- to the *N*-equilibrium or from the *HL*- to the *H*-equilibrium, respectively, once club deals are allowed. This decreases the expected value from buyouts. In contrast, in the region (ρ_1^c, ρ_2), the *H*-equilibrium is selected both with and without club deals. In this case, allowing club deals leads to additional synergies from reputation borrowing, which increases the expected value from buyouts.

Finally, consider how the probability of club deals changes with drivers of buyout activity. Club deals occur with a positive probability only in the *HU*- and the *H*-equilibrium, and hence the probability of club deals is zero when discount rates are very low or very high. In particular, suppose that there is no uncertainty about PE firms' skills (for example, if $\varphi = 0$, i.e., the market is stable). Then, club deals occur only in the *H*-equilibrium, which is selected when $\rho \in (\rho_1^c, \rho_2^c)$, and do not occur when ρ lies outside this range. Hence, in this case, the probability of club deals follows an inverted U-shaped pattern in drivers of buyout activity, such as aggregate discount rates and expectations of future deals.

6. Common values

So far, the paper has assumed that valuations of PE firms are private in the sense that information of one bidder about its valuation is irrelevant for the valuation of the other bidder. The assumption of private values is reasonable if operational gains arise due to the unique ability of a PE firm to restructure the target that the rival might not possess. However, when the target is a poorly managed firm, whose inefficiency can be equivalently resolved by any PE firm, the common-value model is a more suitable one (Bulow, Huang, and Klemperer, 1999; Gorbenko and Malenko, 2014a). The two models differ in

the interpretation of where a PE firm's payoff from a transaction comes from. In the private-value setting, it comes from the PE firm's operational skill. In the common-value setting, it comes from the PE firm's informational advantage. In this section, we show how the model can be equivalently set up in the common-value framework.

Consider the same setup as in Section 3, but with the following change. If the target is acquired by any PE firm, its probability of success is given by $\kappa \geq q_T$. The difference $\kappa - q_T$ determines the inefficiency of the incumbent management of the target. Parameter κ comes from two components: $\kappa = \kappa_1 + \kappa_2$, where κ_i is an independent draw from distribution with cumulative distribution function (c.d.f.) $\Phi(\cdot)$ with positive support and mean $\mathbb{E}[\kappa]$. At the beginning of every period, each target is randomly matched to two PE firms, and PE firm $i \in \{1, 2\}$ obtains an imperfect signal s_i about κ_i:

$$s_i = \begin{cases} \kappa_i & \text{with prob. } \pi, \\ \tilde{\kappa}_i & \text{with prob. } 1 - \pi, \end{cases} \tag{16}$$

where $\pi \in [0, 1]$ and $\tilde{\kappa}_i$ is an independent draw from distribution with the same c.d.f. $\Phi(\cdot)$. In other words, the signal of PE firm i is fully informative about κ_i with probability π and completely uninformative with probability $1 - \pi$. While the PE firm observes the signal, it is unaware whether the signal is informative or not. This setup captures common values and can be easily extended to allow differential informational advantage of bidders by making π bidder-specific (see Povel and Singh, 2006). Once the bidders obtain their signals, they compete in an English auction. After that, the game proceeds as before.

In the proof of Proposition 6, we show that the properties of the private-value setting carry over to the common-value setting. First, there is a complementarity between the value that a PE sponsor creates through leverage and its skill, i.e., its ability to get private information about the valuation. Second, if a PE firm never gets any private information about potential value created ($\pi = 0$), then it has no ability to create value through leverage despite repeated deal making.

Notwithstanding the similarities between the two models, they provide very different incentives for building reputation in the debt market. As Proposition 6 shows, a PE firm has greater incentives to invest in reputation for non-diversion in the common-value framework.

Proposition 6. Suppose that the distribution of signals s_i in the common-value model and the distribution of valuations q_i in the private-value model are such that given the same level of debt, the expected payoff of a PE firm from the auction is the same: $\mathbb{E}\left[\pi(s_i - s_{-i})^+\right] = \mathbb{E}\left[(q_i - q_{-i})^+\right]$. Let D^{cv} and D^{pv} denote the level of debt in the most efficient equilibrium in the common-value model and in the private-value model, respectively. Then, $D^{cv} \geq D^{pv}$.

The intuition is as follows. When deciding whether to divert value, the PE firm trades off the benefits from diversion with the costs of more difficult debt financing of its future portfolio companies. These costs are much higher in the common-value framework than in the

private-value framework. In common-value battles, even a small disadvantage of a PE firm compared with its rivals completely destroys its ability to compete and, hence, its surplus. Formally, as we show in the proof of Proposition 6, if one PE firm does not have a reputation for non-diversion and the other PE firm has such a reputation, the first PE firm wins the auction with probability zero. This is not true in private-value battles, when a PE firm with a reputation for expropriating creditors can compensate with its skill to make operational improvements that cannot be replicated by other PE firms.

7. Determinants of LBO activity and leverage

This section discusses the implications of the model for the determinants of buyout activity and leverage and relates these implications to the existing empirical evidence.

First, the analysis implies that buyout leverage is driven by economy-wide factors. It is negatively related to the discount rate r and positively related to expectations of future deal activity γ (see Proposition 6). In contrast to buyout leverage, leverage of non-PE-owned firms is not affected by economy-wide factors and is solely driven by firm-specific characteristics (see Section 2.1). Fig. 4 presents a numerical example, which shows the comparative statics of buyout debt and debt of a non-PE-owned target in $\rho = \frac{\gamma}{r}$.

Second, because lower discount rates and higher expectations of future activity increase debt capacity, PE firms can add more value through financing, so LBO activity increases with these factors as well. In particular, expectations about future deal activity feed back to current deal activity, which can lead to cycles of LBO activity even if other factors stay the same.

These implications occur because of repeated interactions. As Section 2.2 shows, in the single-deal setting, either with or without commitment, buyout leverage and activity are independent of the economy-wide factors r and γ.[22]

These implications are consistent with the existing evidence. Empirically, most of the variation in the discount rate is due to variation in the risk premium. Thus, the negative relation between LBO activity and the discount rate is consistent with Haddad, Loualiche, and Plosser (2014), who find that LBO activity decreases with the market risk premium. Interestingly, they do not find the aggregate credit spread to be a significant predictor of LBO activity when both the credit spread and aggregate discount rates are included in the regression. Their paper also finds that buyout activity is positively related to the risk-

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[22] The fact that buyout activity is independent of the discount rate in the single-deal setting is different from the standard argument about investment, in which a lower discount rate leads to higher investment by increasing the present value of future cash flows from the project. The difference is that while the investment cost of a typical investment project is often assumed fixed, the investment cost in an LBO is the purchase price of the target. A decrease in the discount rate increases the target's value as an independent firm, as well as its valuation by other bidders, which increases the purchase price. Hence, the number of positive NPV deals, and thus buyout activity, is unaffected.

Fig. 4. Comparative statics of buyout debt. The figure shows how buyout debt and debt of a non-PE-owned target change with the discount rate r and expectations of future deal activity γ in the model with identical private equity firms. The x-axis corresponds to $\rho = \frac{\gamma}{r}$, and the y-axis corresponds to the level of debt. The parameters are: $X_B = 1.5$, $X_G = 4.5$, $\lambda = 0.7$, $q_T = 0.3$, $D^* = 0.9$, $g(D) = \frac{1}{2}\left(D^{*2} - (D - D^*)^2\right)$, and q_i is uniform on $[0, 0.8]$.

free rate. This is not inconsistent with the above implication because variation in real risk-free rates is low and periods of high risk-free rates usually coincide with economic booms, when gains from LBOs can be higher (for example, because more firms have excess free cash flow). In general, empirically, it can be difficult to separate the effects of discount rates from the effects of expectations of future activity, because both are likely to co-move with other aggregate economic factors. One approach would be to look at shocks to the availability of LBO targets in other regions. Our model predicts that if a PE firm operates in multiple regions, its LBO activity goes up even in regions not affected by a positive shock because of its higher commitment ability due to the shock.

The implication that buyout leverage is negatively related to discount rates of PE firms (which are combinations of the risk-free rate and the risk premium) is consistent with the findings of Axelson, Jenkinson, Strömberg, and Weisbach (2013). They show that buyout leverage is higher when the matched public company enterprise value multiples (their proxy for economy-wide discount rates) are higher and when aggregate credit spreads are lower.

Our analysis also implies that buyout leverage is positively related to the skill of the PE sponsor (see Propositions 1 and 3 and Lemma 5). This implication is consistent with Demiroglu and James (2010) and De Maeseneire and Brinkhuis (2012), who show that buyout leverage is higher if the PE sponsor is more reputable (older, larger, and more experienced).

Our theory is complementary to the explanation that changes in LBO activity are driven by variation in the supply of credit. Moreover, repeated deal making amplifies the effect of credit supply on LBO activity. Shocks to the availability of credit, such as rapid development of the junk bond market in the 1980s (Kaplan and Stein, 1993) and growth in securitization in 2004–2007 (Shivdasani and Wang, 2011), are amplified: By increasing expectations of future activity (parameter γ), such shocks make it easier for PE firms to commit to not diverting value, leading to a higher willingness to pay for targets and more deals.

8. New empirical predictions

In this section, we outline new empirical predictions of our analysis. We deliberately focus on predictions that, to our knowledge, have not been explored, and discuss other implications in Section 7.

First, the model predicts that the relative importance of different sources of value creation in LBOs will vary over time. Suppose that the driver of the time series variation in buyout activity is variation in the discount rate. In times of low buyout activity (high discount rates), much of the value created in buyouts is due to operational and governance changes. In contrast, in times of high buyout activity (low discount rates), many deals that take place feature small or no operational improvements but have high value from financing. Therefore, conditional on the skill of the PE firm, value added through financing and value added through operational improvements are negatively correlated in the time series, provided that the source of time variation is discount rates. At the same time, if we condition on discount rates and consider variation across PE firms, value added through financing and value added through operational improvements are positively correlated because higher-skill PE firms find it easier to commit to not diverting value from creditors. This leads to Prediction 1.

Prediction 1. (1) *As buyout activity increases (discount rates decrease), more of the value created in an average deal is due to financing decisions and less of the value is due to operational changes.* (2) *Value created through financing and value created through operational changes in an average deal are negatively correlated in the time series, but they are positively correlated in the cross section.*

The analysis of Section 6 implies that incentives to invest in reputation for non-diversion are different depending on whether LBO transactions are closer to the private-value or to the common-value framework. To the extent that the degree of private versus common component of the valuation can be measured, Proposition 6 has the following implication.

Prediction 2. *All else equal, PE firms systematically participating in common-value transactions have cheaper access to debt financing and lever up their targets more than those primarily participating in private-value transactions.*

Various proxies can be used to classify transactions according to whether values are common or private. For example, a PE firm whose general partners have managerial expertise in a given industry is likely to have a substantial private component of the valuation when it acquires targets in this industry, as other PE firms are unlikely to have the ability to make the same operational changes. In contrast, if a target is a standard and well-understood business plagued by agency problems, it is reasonable to expect a significant common component of the valuation.

The analysis of Section 5 has implications for how the probability of club deals changes with drivers of buyout activity. The discussion at the end of that section leads to Prediction 3.

Prediction 3. *All else equal, club deals are unlikely to occur when the discount rate is very low or very high. In particular, in PE markets with little uncertainty about sponsors' skills, the fraction of club deals is an inverted U-shaped function of the discount rate.*

One possible proxy for the degree of uncertainty about PE firms' skills is the extent of entry and exit of PE firms in the market, corresponding to parameter φ in the model. The more stable is the PE market, the lower is the uncertainty about sponsors' skills. Another possible proxy is the extent to which returns on PE firms' investments can be predicted by investors.

As discussed in Section 4, uncertainty about PE firms' skills also affects the sensitivity of buyout activity to discount rates. Other things equal, there are fewer PE firms with a high reputation for skill in an uncertain market. As a consequence, if credit conditions tighten so that only PE firms with a high reputation for skill are able to borrow at favorable rates, buyout activity drops more when uncertainty about PE firms' skills is high.

Prediction 4. *Consider an increase in the discount rate that leads to only PE firms with a high reputation for skill being able to borrow at favorable rates. All else equal, this shock leads to a greater drop in buyout activity if uncertainty about the skill of PE firms is higher.*

Finally, because PE firms compete for targets, the ability of one PE firm to raise cheap debt imposes a negative externality on other PE firms. Proposition 4 shows that this leads to the following implication.

Prediction 5. *All else equal, the fraction of targets acquired by PE firms with a high reputation for skill is an inverted U-shaped function of the discount rate.*

The prediction that the composition of acquirers changes with discount rates is consistent with Demiroglu and James (2010), who show that the fraction of deals done by reputable (more experienced, older, and larger) PE firms is sensitive to aggregate credit spreads. They find that deals involving reputable PE firms are more frequent when aggregate credit spreads are low, which is the downward part of our predicted inverted U-shaped relation. It would be interesting to check for the existence of the upward part. Our paper suggests that a general relation can be non-monotonic: As discount rates decrease significantly enough, low-skill PE firms become stronger competitors for high-skill PE firms because they are now able to raise debt at low costs as well.

9. Concluding remarks

This paper develops a theory of LBO activity that features repeated deal making by PE firms and the ex post conflict between debtholders and shareholders of portfolio companies. The model is based on two building blocks: the idea that PE-owned firms can borrow both against their own assets and against their sponsors' reputation for not expropriating creditors and externalities in PE firms' reputations due to their competition for targets and ability to form clubs.

We show that PE sponsors' ability to add value through operational improvements enhances value creation through financing, and hence differences in PE firms' skills are amplified through access to credit markets. Moreover, the ability to make operational improvements is necessary to

create value through financing: If PE firms never added any operational value, no buyouts would take place. Club deals have a twofold effect on the joint surplus of bidders and the target. On the one hand, they are beneficial ex post due to synergies among club members: Low-reputation bidders with high valuations can borrow reputation from high-reputation bidders with low valuations. On the other hand, they can be detrimental ex ante by reducing bidders' incentives to maintain their reputation for not expropriating creditors, and this negative effect can dominate. The analysis provides implications relating buyout activity, leverage, and other deal characteristics to aggregate economic conditions and PE sponsor characteristics. Unlike leverage of non-PE-owned firms, buyout leverage is determined not only by target characteristics, but also by sponsor-specific and economy-wide factors, and both buyout leverage and aggregate LBO activity are higher when discount rates are lower. Finally, we show that PE firms' incentives to invest in reputation for non-diversion are stronger when operational improvements come from common values, such as poor performance of current management, rather than private values, such as the PE firm's expertise. The model is consistent with much of existing evidence and generates further empirical implications.

For parsimony, the model does not allow for debt covenants. Covenants can alleviate some conflicts between PE firms and creditors. However, covenants also come at a cost of reducing flexibility of the management and costly renegotiations. In addition, not all debt-equity conflicts can be resolved by them. For example, while dividend payouts can be prevented, it is difficult to ensure that a PE firm injects cash when the portfolio company is in distress. Thus, covenants provide a costly resolution of debt-equity conflicts, while PE firms' reputational concerns provide a free, albeit limited, resolution. An extension of the model would lead to implications relating the strictness of covenants in LBOs to aggregate economic conditions and the identity of the PE sponsor. For example, covenants should be less restrictive when discount rates are lower or expectations of future deal activity are higher and when the PE sponsor is of higher skill and has a track record of not diverting value from creditors in the past.

While this paper focuses on LBOs, it can be applied more generally to any setting in which the same agent invests in repeated projects and the capital structure of each project involves significant project-level debt. For example, if a firm or a bank sets up other legal entities that are financed with claims against only the assets of the entities, as opposed to the assets of the parent, then many issues of LBOs are relevant as well. One implication of our model is that aggregate economic conditions and characteristics of the parent company matter for the capital structure of the subsidiary, even if the subsidiary's operations are unrelated to operations of the parent.

Appendix A

Section A.1 presents a microfoundation for the function $g(D)$, representing the benefits of taking debt D. Section A.2 presents the proofs of all propositions. The proofs of all lemmas, corollaries, and supplementary results are presented in the Online Appendix.

A.1. Microfoundation for the benefits of debt

The existing literature emphasizes two important benefits of debt financing in the context of leveraged buyouts: restricting managerial access to free cash flow, advocated by Jensen (1989), and the tax benefits of debt.[23] In this subsection, we microfound our specification of value generated in an LBO with a free cash flow theory of debt augmented by the tax benefits.

There are two states, good and bad, with probability q and $1-q$, respectively. Suppose that if the bad state is realized, the firm's operations generate zero cash flow, and the firm has no good investment opportunities. The firm's assets in place can be sold for a value X_B, the firm's liquidation value. If the good state is realized, the firm's operations generate a free cash flow $C_G > 0$, and the value of its assets in place is A_G. In addition, the firm has access to an investment opportunity that yields the net present value $V(K)$ as a function of the investment amount K. The function $V(K)$ satisfies $V(0) = 0$, $\lim_{K \to 0} V'(K) = \infty$, $V''(K) < 0$, and $\lim_{K \to \infty} V'(K) < 0$. Let $K^* \equiv \operatorname{argmax}_K V(K)$. Intuitively, K^* is the optimal amount of investment, at which the NPV of investing a marginal dollar is zero. The marginal NPV, $V'(K)$, is decreasing in the amount invested, and hence any investment above K^* is wasteful. Suppose that $K^* < C_G$, meaning that the available free cash flow from operations is more than enough to cover the investment needs.

The firm is operated by a manager who is an empire-builder: The manager invests the whole existing free cash flow independently of the profitability of investment. In the bad state, the manager has no free cash flow, so investment equals zero. In the good state, the manager invests $K = C_G - D$, where D is the amount of debt taken during the LBO. The net present value of this investment is $V(C_G - D)$. Concavity of $V(\cdot)$ captures the effects of debt on restricting the free cash flow for investment. If debt is small, an increase in debt increases value by restricting the ability of the manager to waste it on inefficient projects. Indeed, at $D = 0$, the marginal value of debt is $-V'(C_G) > 0$. However, taking too much debt is costly because it leads to underinvestment.

In addition to its effect on investment, debt provides a tax shield. Let τD denote the tax savings created in the good state by repaying D, where $\tau \in (0, 1)$. Because the payoff from liquidation is treated as a capital gain, there are no tax benefits of debt in the bad state.[24] Therefore, the total value to the PE firm and creditors in the bad state is X_B. The total value to the PE firm and creditors in the good state is

$$C_G + A_G + V(C_G - D) + \tau D. \tag{17}$$

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[23] Opler and Titman (1993) and Guo, Hotchkiss, and Song (2011) find evidence consistent with the free cash flow theory of LBOs.

[24] For example, Graham (2000) assumes that tax benefits are lost in bankruptcy in his estimation of tax benefits of debt. More generally, if in the bad state, the firm (rather than its assets) gets acquired, then part of the tax shield can be recovered in what the acquirer pays for the firm. However, this value should be lower, so the tax benefits of debt are likely to be concentrated in the good state in this case, too.

Thus, the unconstrained optimal level of debt D^* is such that $\tau - V'(C_G - D^*) = 0$. By the assumptions on $V(\cdot)$, a unique solution exists. Note that D^* is determined by the amount of free cash flow (C_G), investment opportunities [$V(\cdot)$], and the tax benefits of debt (τ).

To map this payoff into the value specification in the main model, denote $g(D) \equiv V(C_G - D) + \tau D - V(C_G)$ and $X_G \equiv C_G + V(C_G) + A_G$. Then, $X_G + g(D)$ equals (17). Finally, note that $g(D)$ satisfies all the imposed conditions: $g(0) = V(C_G) - V(C_G) = 0$, $\quad g'(D^*) = -V'(C_G - D^*) + \tau = 0$, and $g''(D) = V''(C_G - D) < 0$.

A.2. Proofs

For brevity, it is useful to introduce the following notation: $d_g(q, D) \equiv qg(D) - q_T g_0$.

A.2.1. Proof of Proposition 1
Because Assumption 2 is satisfied for q, it is also satisfied for $q + c$, which is the lowest possible realization for the distribution $q_0 + c$. Thus, all the results, including condition (5), are valid for $q \overset{d}{=} q_0 + c$ for any $c > 0$. The left-hand side of condition (5) does not depend on r, γ, and the distribution of q, while the right-hand side decreases in r and increases in γ and c. To see why it increases in c, let $q \overset{d}{=} q_0 + c$ and $\tilde{q} \overset{d}{=} q_0 + \tilde{c}$ for $\tilde{c} > c$ and denote $\Delta(c) \equiv (\tilde{c} - c)(\Delta_X + g(D)) > 0$. The right-hand side of condition (5) for $\tilde{c}$ equals

$$\frac{\gamma}{r} \mathbb{E}\big[[(\tilde{q}_1 - q_T)\Delta_X + \tilde{q}_1 g(D) - q_T g_0 - ((\tilde{q}_2 - q_T)\Delta_X + \tilde{q}_2 g(D)$$
$$- q_T g_0)^+]_0^{\tilde{q}_1(g(D) - g_0)} \big]$$
$$\geq \frac{\gamma}{r} \mathbb{E}\big[[(q_1 - q_T)\Delta_X + d_g(q_1, D)$$
$$+ \Delta(c) - ((q_2 - q_T)\Delta_X + d_g(q_2, D) + \Delta(c))^+]_0^{q_1(g(D) - g_0)} \big]$$
$$\geq \frac{\gamma}{r} \mathbb{E}\big[[(q_1 - q_T)\Delta_X + d_g(q_1, D) + \Delta(c) - ((q_2 - q_T)\Delta_X$$
$$+ d_g(q_2, D))^+ - \Delta(c)]_0^{q_1(g(D) - g_0)} \big], \tag{18}$$

which equals the right-hand side of condition (5) for c. Therefore, if an equilibrium without diversion and debt $D > (1 - \lambda)X_B$ is sustainable for a given c (r, γ), it is also sustainable for $\tilde{c} > c$ ($\tilde{r} < r$, $\tilde{\gamma} > \gamma$). The statement of the proposition then follows from the fact that the equilibrium with the highest sustainable debt level is selected based on the efficiency refinement.

A.2.2. Proof of Proposition 2
When $\Pr(q = q_0) = 1$, the right-hand side of condition (5) equals zero for any D. Therefore, any $D > (1 - \lambda)X_B$ violates the no diversion constraint. Hence, the only equilibrium is the N-equilibrium, and buyout debt is $D = (1 - \lambda)X_B$.

A.2.3. Proof of Proposition 3
Because the distribution $f(q|H)$ first-order stochastically dominates $f(q|L)$, and because the function $[z_1(q) - z^+]_0^{q\Delta_g/(1+r)}$ is an increasing function of q, (10) implies that $V_R(H) - V_{NR}(H) \geq V_R(L) - V_{NR}(L)$ for any distribution $\eta(z)$. Moreover, $V_R(H) - V_{NR}(H) > V_R(L) - V_{NR}(L)$ for any

distribution $\eta(z)$ satisfying $\Pr\{z_1(q) - z^+ \in \left(0, \frac{q\Delta_g}{1+r}\right) | \theta\} > 0$. The monotone reputation property equilibrium selection then implies that $R(L) \leq R(H)$. Hence, there are three possible cases: (1) $R(L) = R(H) = 1$; (2) $R(L) = R(H) = 0$; and (3) $R(L) = 0$ and $R(H) = 1$. In case 1, (11) simplifies to

$$V_R(U) - V_{NR}(U) = \frac{V_R(H) - V_{NR}(H) + V_R(L) - V_{NR}(L)}{2}. \tag{19}$$

Because $V_R(L) - V_{NR}(L) \leq V_R(H) - V_{NR}(H)$, this implies $V_R(L) - V_{NR}(L) \leq V_R(U) - V_{NR}(U) \leq V_R(H) - V_{NR}(H)$. Because $R(L) = R(H) = 1$, using the monotone reputation property equilibrium selection, we conclude that $R(U) = 1$. In case 2, (11) simplifies to

$$V_R(U) - V_{NR}(U) = \frac{p(1+r)}{\frac{r+\varphi}{\gamma} + (1-\varphi)(1-p)}$$
$$\int \int [z_1(q) - z^+]_0^{q\Delta_g/(1+r)} f(q)\eta(z)\, dq\, dz. \tag{20}$$

Because distribution $f(q|H)$ dominates distribution $f(q)$ in terms of FOSD, and because $\frac{p(1+r)}{\frac{r+\varphi}{\gamma} + (1-\varphi)(1-p)} \leq \frac{\gamma(1+r)}{r+\varphi}$, (20) and (10) imply that $V_R(U) - V_{NR}(U) \leq V_R(H) - V_{NR}(H)$. Because $R(H) = R(L) = 0$, using the monotone reputation property equilibrium selection, we conclude that $R(U) = 0$. Finally, in case 3, because $R(L) = 0$ and $R(H) = 1$, then $R(H) \geq R(U) \geq R(L)$ for any $R(U) \in \{0, 1\}$.

A.2.4. Proof of Proposition 4
Let $\tilde{\mu}_L$, $\tilde{\mu}_U$, and $\tilde{\mu}_H$ denote, respectively, the masses of low, unknown, and high types after realizations of q_i are realized. The probability of a deal taking place is

$$\gamma \sum_{i \in \{H,U,L\}} \sum_{j \in \{H,U,L\}} \tilde{\mu}_i \tilde{\mu}_j \Pr(\max(z_{R(i)}(q_1), z_{R(j)}(q_2)) > 0). \tag{21}$$

Because $z_1(q) > z_0(q)$, it follows that buyout activity monotonically increases from the N-equilibrium to the H-equilibrium, to the HU-equilibrium, and to the HUL-equilibrium.

The fraction of deals done by types known to be high-skill after the realization of q is $\pi_\varrho = N_\varrho / D_\varrho$ for equilibrium $\varrho \in \{HUL, HU, L, N\}$, where

$$D_\varrho = \sum_{i \in \{H,U,L\}} \sum_{j \in \{H,U,L\}} \tilde{\mu}_i \tilde{\mu}_j \Pr(\max(z_{R(i)}(q_1), z_{R(j)}(q_2)) > 0),$$
$$N_\varrho = \tilde{\mu}_H [\tilde{\mu}_H \Pr(\max(z_{R(H)}(q_1), z_{R(H)}(q_2)) > 0 | H, H)$$
$$+ 2\tilde{\mu}_U \Pr\left(z_{R(H)}(q_1) > z_{R(U)}(q_2)^+ | H, U\right)$$
$$+ 2\tilde{\mu}_L \Pr\left(z_{R(H)}(q_1) > z_{R(L)}(q_2)^+ | H, L\right)]. \tag{22}$$

Because $z_1(q_2) > z_0(q_2)$, $\Pr\left(z_1(q_1) > z_0(q_2)^+ | H, \theta_2\right) \geq \Pr\left(z_1(q_1) > z_1(q_2)^+ | H, \theta_2\right)$. Hence, the first two terms of N_{HUL} and N_{HU} are the same, and the third term is greater for N_{HU}, so $N_{HUL} \leq N_{HU}$. By the same argument, $N_{HU} \leq N_H$. Because $z_1(q) > z_0(q)$, we also have $D_{HUL} > D_{HU}$ and $D_{HU} > D_H$, and hence $\pi_{HUL} < \pi_{HU}$ and $\pi_{HU} < \pi_H$. To show that $\pi_N < \pi_H$, note that $\pi_N = 1 - \frac{M_N}{D_N}$ and $\pi_H = 1 - \frac{M_H}{D_H}$, where

$$M_N = \tilde{\mu}_U^2 \Pr(\max(z_0(q_1), z_0(q_2)) > 0 | U, U)$$
$$+ \tilde{\mu}_L^2 \Pr(\max(z_0(q_1), z_0(q_2)) > 0 | L, L)$$
$$+ 2\tilde{\mu}_U \tilde{\mu}_L \Pr(\max(z_0(q_1), z_0(q_2)) > 0 | U, L)$$
$$+ 2\tilde{\mu}_U \tilde{\mu}_H \Pr\left(z_0(q_1) > z_0(q_2)^+ | U, H\right)$$

$$+2\tilde{\mu}_L\tilde{\mu}_H \Pr\left(z_0(q_1) > z_0(q_2)^+ |L,H\right), \tag{23}$$

$$\begin{aligned}
M_H = &\tilde{\mu}_U^2 \Pr(\max(z_0(q_1), z_0(q_2)) > 0|U,U) \\
&+ \tilde{\mu}_L^2 \Pr(\max(z_0(q_1), z_0(q_2)) > 0|L,L) \\
&+ 2\tilde{\mu}_U\tilde{\mu}_L \Pr(\max(z_0(q_1), z_0(q_2)) > 0|U,L) \\
&+ 2\tilde{\mu}_U\tilde{\mu}_H \Pr\left(z_0(q_1) > z_1(q_2)^+ |U,H\right) \\
&+ 2\tilde{\mu}_L\tilde{\mu}_H \Pr\left(z_0(q_1) > z_1(q_2)^+ |L,H\right).
\end{aligned} \tag{24}$$

Because $z_1(q_2) > z_0(q_2)$, $\Pr\left(z_0(q_1) > z_0(q_2)^+ |\theta_1,H\right) \geq \Pr\left(z_0(q_1) > z_1(q_2)^+ |\theta_1,H\right)$ for $\theta_1 \in \{L,U\}$. Therefore, $M_H \leq M_N$. Combining this with $D_H > D_N$ implies $\pi_H > \pi_N$.

A.2.5. Proof of Proposition 5

We first prove Part 1. Comparing conditions (13) and (15) with condition (9) for the case without club deals automatically implies that the *HUL-* and the *HU*-equilibria are less likely to exist when club deals are allowed. Consider condition (14). First, suppose that φ is close to one and p is large enough. As φ converges to one, the right-hand side of condition (14) converges to the sum of $V_R^H(H) - V_{NR}^H(H)$ and

$$\begin{aligned}
&\frac{\gamma}{2}\mathbb{E}\left[\frac{1}{2}S_{club}\Big|\chi_1 = L, \chi_2 = H\right] - \frac{\gamma(1-p)}{2}\frac{p}{2}\mathbb{E}\left[\frac{1}{2}S_{club}\Big|\chi_1 = H, q_2 \in \left[\frac{1}{2}+d, \overline{q}\right]\right] \\
&= \frac{\gamma}{2}p^2\mathbb{E}\left[\frac{1}{2}S_{club}\Big|q_1 \in Q_M, \right. \\
&\left. q_2 \in Q_M\right] - \frac{\gamma}{2}\frac{(1-p)^2}{2}\mathbb{E}\left[\frac{1}{2}S_{club}\Big|q_1 \in Q_H, q_2 \in Q_H\right].
\end{aligned} \tag{25}$$

If p is large enough, this term is positive, implying that the H-equilibrium is easier to sustain when club deals are allowed. On the other hand, as Part 2 of Proposition 5 shows, the H-equilibrium is harder to sustain under club deals if $\varphi = 0$. Thus, the effect of club deals on sustainability of the H-equilibrium is ambiguous and depends on φ and p.

We next prove Part 2. Suppose that $\varphi = 0$. Then, there are only two types, H and L, so the right-hand side of condition (14) equals the sum of $V_R^H(H) - V_{NR}^H(H)$ and

$$\frac{\gamma(1+r)}{4r}\left(\mathbb{E}[S_{club}|\chi_1 = L, \chi_2 = H] - \mathbb{E}[S_{club}|\chi_1 = H, \chi_2 = H]\right). \tag{26}$$

According to (12), S_{club} is increasing in q_1. Because $F(\cdot|H)$ first-order stochastically dominates $F(\cdot|L)$, $E[S_{club}|\chi_1 = L, \chi_2 = H] < E[S_{club}|\chi_1 = H, \chi_2 = H]$, so the negative effect of club deals on the sustainability of the H-equilibrium dominates. According to condition (13), the *HL*-equilibrium is less likely to be sustained either, which completes the proof.

A.2.6. Proof of Proposition 6

We start by deriving the equilibrium at the auction stage.

1. First, consider the equilibrium at the auction stage in the environment in which each PE firm has the target raise debt with face value D and does not divert value. Because all PE firms are symmetric, we look for equilibria in symmetric bidding strategies. Let $b(s; D)$ denote the bidding strategy of the rival bidder with signal s. If a bidder wins at price p, at which the rival bidder drops out, the bidder infers that the signal of the rival bidder is $b^{-1}(p; D)$. The value of the target to the bidder with signal s in this case is

$$V_0 + \frac{\left(\pi s + \pi b^{-1}(p;D) + 2(1-\pi)\mathbb{E}[\kappa]\right)(\Delta_X + g(D)) - q_T(\Delta_X + g_0)}{1+r}. \tag{27}$$

The bidder is willing to increase its bid up to point b at which it is indifferent between acquiring the target for b and losing it to the rival. Acquiring the target in this marginal event means that the signal of the other bidder equals $b^{-1}(b(s; D), D) = s$. Therefore, there exists a unique symmetric equilibrium and, in this equilibrium, a PE firm with signal s bids up to

$$b(s; D) = V_0 + \frac{(2\pi s + 2(1-\pi)\mathbb{E}[\kappa])(\Delta_X + g(D)) - q_T(\Delta_X + g_0)}{1+r}. \tag{28}$$

Thus, the expected surplus of PE firm i conditional on realizations s_i and s_j is the maximum between zero and the difference between the value of the target and the acquisition price:

$$\begin{aligned}
&\left[\frac{(\pi s_i + \pi s_j + 2(1-\pi)\mathbb{E}[\kappa])(\Delta_X + g(D)) - q_T(\Delta_X + g_0)}{1+r}\right. \\
&\left. - \frac{(2\pi s_j + 2(1-\pi)\mathbb{E}[\kappa])(\Delta_X + g(D)) - q_T(\Delta_X + g_0)}{1+r}\right]^+ \\
&= \frac{\pi(s_i - s_j)^+}{1+r}(\Delta_X + g(D)).
\end{aligned} \tag{29}$$

2. Second, consider the equilibrium at the auction stage in the environment in which PE firm i does not have a reputation for non-diversion and hence has the target raise debt with face value $(1-\lambda)X_B$, while PE firm j has a reputation for non-diversion and hence has the target raise debt with face value $D > (1-\lambda)X_B$ and does not divert value. In the Online Appendix, we prove that, in this case, no equilibrium exists in which PE firm i wins with positive probability, and there exist infinitely many equilibria in which PE firm i wins with probability zero. Because PE firm i loses in any equilibrium, its expected surplus from the auction is zero.

3. Given the analysis of the equilibrium at the auction stage, consider a symmetric equilibrium with debt D and no diversion, and consider PE firm i contemplating diversion upon a realization of the bad state. If it diverts value, it gets λX_B in the current deal and zero in all future deals. Therefore, the deviation is not beneficial if and only if

$$\lambda X_B - (X_B - D)^+ \leq \frac{\gamma}{r}\pi\mathbb{E}\left[(s_i - s_{-i})^+\right](\Delta_X + g(D)). \tag{30}$$

The level of debt in the most efficient equilibrium, D^{cv}, is the maximum between D^* and the highest level of debt satisfying (30). Note, first, that if (30) is satisfied for debt $D > (1-\lambda)X_B$ and a given π, then it is also satisfied for $\pi' > \pi$. Because the equilibrium with the highest sustainable debt level is selected based on the efficiency

refinement, the equilibrium level of debt weakly increases in π, implying a complementarity between the value that a PE sponsor creates through leverage and its ability to get private information about the valuation. Second, if $\pi = 0$, i.e., the PE firm never gets any private information about potential value created, then it has no ability to create value through leverage despite repeated deal making. This shows that the results for the private-value model continue to hold in the common-value model.

We next prove that $D^{cv} \geq D^{pv}$. From derivations in Section 3, D^{pv} is the highest level up to D^* satisfying

$$\lambda X_B - (X_B - D)^+ \leq \frac{\gamma}{r}\mathbb{E}[(q_1 - q_2)(\Delta_X + g(D))]_0^{q_1(g(D) - g_0)}. \quad (31)$$

The right-hand side of condition (31) is smaller than $\frac{\gamma}{r}\mathbb{E}[(q_1 - q_2)]^+(\Delta_X + g(D))$, which equals the right-hand side of condition (30) because $E[\pi(s_i - s_{-i})^+] = E[(q_i - q_{-i})^+]$. Therefore, if debt D satisfies the no diversion condition (31) in the private-value model, it also satisfies the no diversion condition (30) in the common-value model. Hence, $D^{cv} \geq D^{pv}$.

Appendix B. Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jfineco.2015.06.007.

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