

Private Equity Acquisitions and Strategic Buyers: Information Discounts versus Synergies*

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Abstract Strategic buyers integrate with targets to obtain synergy gains and private benefits. Private equity funds cut projects generating private benefits, thereby gaining an ex ante information advantage for understanding value creation. This ex ante advantage can dominate to give private equity funds a competitive advantage over strategic buyers in acquisitions, albeit the strategic buyer's ex post value is uniformly superior. Private equity funds are more likely to win takeover competitions when their information advantage is greater, their required return premium is smaller, and strategic buyers' synergy gains are smaller. Such takeovers by private equity funds can improve economic welfare.

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1 Introduction

The amount of capital allocated to private equity funds is substantial and the resulting activities by such funds are impressive (e.g., Strömberg, 2008; Sørensen et al., 2014; Norbäck et al., 2013). For example, U.S. private equity funds raised about \$88 billion in Q1-2021 with a total of \$213 billion in 2020 and European funds raised about €101 billion in 2021.¹ The persistent and substantial amount of capital allocated to private equity funds indicates that such funds are perceived to generate value to investors.² Still, the economic value to society of private equity funds' equity reallocation is debated among academics as well as in the media.³ While there is an increasing amount of empirical literature analyzing the role of private equity funds, the theoretical literature on the subject remains thin, although theory is needed to address the question of social value.

The present paper provides a theoretical framework to capture realistic determinants of private equity fund activity, and to serve as a foundation for a normative assessment of these activities. A key ingredient in this framework is that private equity funds compete with strategic buyers to acquire target firms. The differences among these investors in both skills and objective functions deliver a realistic characterization of the key determinants of private equity fund success in acquisitions. Competition with a strategic buyer raises the bar for the private equity fund, and for the normative assessment it is crucial whether the winner relies on relative strengths that benefit or harm society. For instance, a strategic buyer may be motivated by anti-competitive conduct in product markets, against society's interests. The theory allows us to address how private equity acquisitions may generate value to society and not only to investors.

Some stylized facts on private equity funds must be incorporated in our model. First,

¹Statistics from the American Investment Council 2021 Q1 Private Equity Trends report and the Invest Europe 2020 European Private Equity Activity report, respectively. Available at <https://www.investmentcouncil.org/> and <https://www.investeurope.eu/>, respectively. Accessed July 2021.

²Kaplan and Sensoy (2015) provide a survey focusing on private equity performance. Sørensen et al. (2014) propose a method to evaluate the performance of illiquid, non-listed private equity investments. Stucke (2011) argues that estimates in Lerner and Schoar (2004) and Phalippou and Gottschalg (2009) of buyout performance are downward biased and Harris et al. (2014) find that the funds likely outperformed the S&P 500 index. Harris et al. (2020) address the persistence of private equity performance.

³See, e.g., "Amid Attacks on Private Equity, Efforts to Study Its Value", The New York Times (January 24, 2012), "Private equity adds value to investors as well as businesses", Financial Times (June 14, 2013), and "Private Equity – Adding Value?", The Economist (February 8, 2013), as well as Zingales (2015) for a broader perspective on the social value of finance.

private equity funds typically undertake major changes to their acquired firms, delisting them from the stock exchange while assets are restructured and investments in growth options take place. Second, funds have restrictive requirements for generating high returns to the partners. Third, their investments must pay off on a shorter horizon, typically within six years, see, e.g., Kaplan and Strömberg (2009) and supporting evidence regarding value creation in Gompers et al. (2016, 2020) and Biesinger et al. (2020). We take these features for granted, as exogenously given arrangements among limited and general partners (e.g., Axelson et al., 2009).

Our core idea to explain a private equity fund's role is that the wider financial market's valuation of the target firm is distorted due to frictions. In general, private benefits can distort investment decisions. Specifically, the model allows the firm to keep some legacy assets which convey benefits to most types of owners and managers, but not to the profit-oriented private equity owners. Legacy assets complicate the owner's ability to understand the firm, and they reduce the incentive to acquire information about potential new investments.⁴ Such information frictions prevent the firm from following a pure value improving investment policy. To the contrary, private equity funds have special skill and special motivation to mitigate information frictions of this kind. These skills create value to investors and society as soon as the growth option pays off in the restructured target firm.⁵ In successful outcomes, the private equity fund can sell again within its limited time horizon.

We pay attention to the fact that private equity funds, target firms, and other operating firms (strategic buyers) considering a takeover are pitted in a contest, and therefore need to outbid each other. This provides an analysis of bidding incentives that is richer than in frictionless financial markets, but our focus is precisely on the role of private equity funds in markets with frictions. Strategic buyers desire to take over the target company in order to obtain a competitive advantage over other operating firms. However, like the target firm, a strategic buyer can be subject to an information friction which limits its ability to

⁴Frictions stemming from private benefits and information asymmetries also inefficiently restricts the firm's access to outside financing.

⁵Lerner et al. (2011) find no evidence that levered buyouts sacrifice long-term investments. Gompers et al. (2016) find that investors rely on internal rate of return and multiples to evaluate performance and that private equity investors expect to add value due to increase in growth rather than reducing costs. Biesinger et al. (2020) analyze a sample of funds' value creation plans. Among other actions, buyout funds frequently plan to modify the asset structure and to replace management while reducing costs.

bid for the target.

A somewhat similar game between private equity funds and strategic buyers is considered in a few recent papers, e.g., Hege et al. (2018) and Martos-Vila et al. (2019). The latter rests on the assumption that the financial market evaluates debt incorrectly because uninformed investors have a wrong perception of the success probabilities. Their paper is related to ours in the sense that valuation and decision making is distorted by a lack of information. However, in contrast to the more behavioral approach in Martos-Vila et al. (2019), we assume that a private equity fund's information advantage is due to its skills to obtain information and to its credible commitment to a loss-cutting strategy. This may reconcile the view that funds sell loss-making parts of firms with the evidence that average portfolio firms exhibit growth in economic activity and employment (e.g., Acharya et al. (2013) find that top, mature private equity houses create economic value through operational improvements).

Our main framework involves three players: the manager (target), a strategic buyer, and a private equity fund; we include outside investors in an extension. Therefore, we need to be very specific about these players and to make assumptions which yield a parsimonious and tractable, yet insightful, model. If the strategic buyer or private equity fund will pay more than a reservation value for the target firm, the firm is sold to the party with the highest value.

The strategic buyer's incentive to take over the manager's firm depends on the synergy gains which can be created by combining the strategic buyer's assets and those of the target. Furthermore, the strategic buyer can potentially obtain private benefits from expanding to a larger firm. However, managing more assets makes inference regarding growth options more opaque; that is, the strategic buyer is more easily subject to information frictions and hence incurs an information discount in valuation. In contrast, the private equity fund does not enjoy private benefits as the fund has a limited time to deliver a return to its investors. Thus, it has a narrow focus on restructuring the target to make value-maximizing decisions. In making such decisions, the private equity fund in parallel aims to only undertake value-improving investments in any embedded growth option. It is precisely this difference in incentives for obtaining precise information which we analyze as a foundation for private equity funds playing a role as mitigating information frictions. In an extension to the model, we analyze a private equity fund's incentives to acquire several firms and

restructuring them into one merged firm either sequentially or simultaneously. We also argue that strategic buyers are further disadvantaged when it comes to understanding information about growth options in multiple target firms, and hence attach even greater information discounts to their valuations.

Our analysis shows under which conditions private equity funds have a competitive advantage in acquiring target firms with a potential. The private equity fund wins the takeover competition if its information advantage is sufficiently important. The private equity fund cannot win the target unless it is able to employ its assets for a gain that is at least comparable to the synergy gain obtained by the strategic buyer. It handicaps the private equity fund that it is constrained to deals that offer a return premium over the market rate. Private benefits explain why the target manager and the strategic buyer keep the legacy asset and accept an information cost, but they also directly contribute to the strategic buyer's valuation for the target, so they do not necessarily pave the way for a private equity takeover.

Since the activities of private equity funds are highly debated, we also consider welfare effects for the broader economy. Most forces that enable the private equity fund to win the takeover in our model also improve the efficiency of investment, thereby improving society's welfare. It is then more likely that the absence of a private equity takeover indicates a loss, as the other owners maintain private benefits and possess inferior information. The exact welfare assessment of the takeover depends on the relative economic benefit of the gains obtained by the different owner types using the target's assets. A part of the strategic buyer's synergy gain naturally stems from anti-competitive conduct, reducing efficiency. On the other hand, another part of the private equity fund's competitive advantage may come from tax avoidance skills, of no benefit to society unless the tax system is flawed.

The remainder of the paper is organized as follows. Section 2 sets up the model and we solve it in Section 3. Section 4 analyses welfare implications and discussion, and we consider various extensions in Section 5. Finally, we conclude in Section 6. Proofs are postponed to the appendix.

2 Model and Valuations

We model the potential sale of a target firm to a private equity (PE) fund. This section introduces our model involving the firm's original owner, competitive strategic buyers, and

the PE fund. For now, we assume that all three player types have sufficient funds, allowing us to ignore any differences arising when they rely on outside investors. To simplify the exposition, we set the risk-free interest rate to zero, and suppose that all parties are risk neutral.

2.1 Possible Transactions

The owner-manager (henceforth, manager) of the target firm has three opportunities. Opportunity 1 is to make no transaction, keeping the firm as it is. Opportunity 2 is selling the firm to a strategic buyer. Opportunity 3 is selling the firm to the PE fund.

We will assume that the manager takes the opportunity among the three which allocates the target firm to the investor who values it the most. Essentially, the strategic buyer and the PE fund bid for the firm, and the firm goes to the bidder willing to pay the most, provided this value exceeds the manager's stand-alone value. The calculations of the precise values of the three opportunities depend on some frictions specified below. The relative strengths of these frictions determine the allocation. The frictions also have implications for the welfare efficiency of any particular outcome.

We assume the manager has all the bargaining power vis-a-vis competitive strategic buyers, and that a strategic buyer pays in cash to take over the entire target firm.⁶ The manager then relies on the most efficient of opportunities 1 and 2 to define the reservation value of the firm in negotiations with the PE fund. When the PE fund creates most value for investors and thus takes over the firm, the resulting terms of the transaction are determined by bilateral bargaining between the fund and the manager. We assume that also the PE fund pays in cash.

2.2 Information and Investment in the Target Firm

The target firm has productive assets in place which can be viewed as the union of asset A_1 and asset A_2 . The target firm has no liquid funds. Asset A_1 provides the target's valuable opportunities through a two-stage growth option, while A_2 is a bad legacy asset. Both assets offer private benefits which is a source of frictions. The size of private benefits depends on who is in control of the firm and on which investments are made, and we will

⁶This assumption is relaxed in an extension. Full strength of the manager isolates the hardest case for the PE fund to be able to beat its competition for a takeover of the target.

specify these private benefits in the subsections below.

If no investment is made, A_1 returns zero cash-flow (beyond private benefits). More importantly, if an initial investment of amount $I_1 > 0$ in asset A_1 is made, it generates an observable signal s . The signal is informative about the random state $\theta \in \{0, 1\}$ which will indicate whether investment results in success. Upon observation of this signal's outcome, it is possible to follow up with a second investment of size $I_2 > 0$. If the second investment is not made, the asset returns zero cash flow. If both rounds of investment are carried out, asset A_1 returns cash θV_{A_1} at time $t = 3$, thus depending on the random state θ . All players in the model share a prior belief $p = \Pr(\theta = 1)$, where $0 < p < 1$. The success value $V_{A_1} > 0$ is an exogenous parameter. Figure 1 illustrates the timing of the model.

The bad asset A_2 always returns zero cash-flow (beyond private benefits). The most important friction stemming from A_2 is that it complicates inference regarding A_1 . Initial divestment of A_2 will improve transparency in the firm, and simplify information generation regarding the potential in A_1 . If the owners first divest A_2 , the signal is clear — for simplicity, $s = \theta$ in this case. If instead A_2 is kept, we let $s \in \{0, 1\}$ satisfy $\Pr(s = 1|\theta = 1) = 1/\eta$ and $\Pr(s = 1|\theta = 0) = 0$. Here $\eta \geq 1$ may depend on who owns the asset.⁷ The greater is η , the greater is the information friction induced by legacy asset A_2 . We can think of divestment of A_2 as implying the special case $\eta = 1$.

Upon observation of s , Bayes' rule provides the posterior belief. Specifically, $\Pr(\theta = 1|s = 1) = 1$ and $\Pr(\theta = 1|s = 0) = (p\eta - p)/(\eta - p)$. The posterior belief after $s = 0$ is lower than after $s = 1$, but less so when η is greater. Moreover, $\Pr(\theta = 1|s = 0)$ increases from 0 to p as the information friction tends to infinity. Note that $\Pr(s = 1) = p/\eta$. The greater is η , the lower the chance that $s = 1$ is observed.

Being closer to the specific line of business of the target firm, it might at first seem natural to assume that the manager and the strategic buyer have a lower η than a PE fund — they find it easier to acquire information about the business. However, closeness to the business also implies that strategic buyers are less motivated to dispense of legacy asset A_2 which creates noise that clouds the picture of the target's situation. This channel de facto gives the PE fund an information advantage, because it reduces the fund's effective η to 1. To put it differently, the strategic buyer is subject to an information disadvantage and, as

⁷We could choose other specifications of the signal structure, but this model already captures our main idea. We could also assume that the three player types have different costs (I_1) of acquiring information, but this would not add to the story.

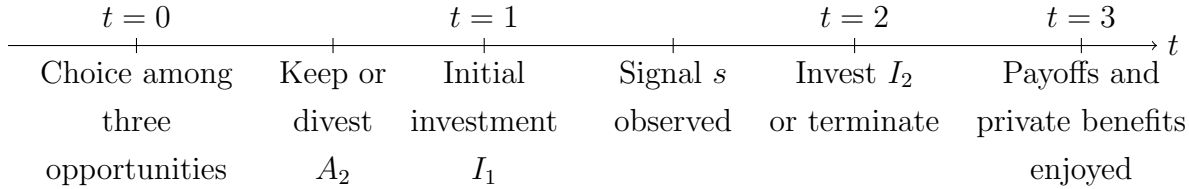


Figure 1: **Timeline of the model.** At time $t = 0$ the target firm’s manager decides whether to continue without a transaction, to sell the firm to a strategic buyer, or to sell it to a PE fund. Subsequently, the (potentially new) firm owner decides whether to keep the bad legacy asset and whether to invest in the two-stage growth option. A signal is observed before the second-stage investment decision is made.

will become clear below, the strategic buyer thus discounts the target’s value. Therefore, we will henceforth talk about the information discount induced by η .

More generally, for any specification of the signal, Bayes’ rule allows computation of the posterior belief π . This is a random variable that satisfies $\mathbb{E}[\pi] = \Pr(\theta = 1)$. A better informed decision maker obtains a distribution of π that is more variable in the sense of a mean-preserving spread, or equivalently in the sense of second-order stochastic dominance, or the convex order: for any convex function h , $\mathbb{E}[h(\pi)]$ is greater (see Rothschild and Stiglitz, 1970). The PE fund’s informational advantage, a lower η , benefits the fund’s valuation through this effect.

It remains to fully specify the private benefits, which depend on the owner type. In the following, we complete this specification for each owner type. For each given owner type, we will also derive the valuation of the firm given optimal decisions after time 0. However, our assumptions imply that the strategic buyer generates more value than the manager for any fixed course of action, and hence we will skip precise valuation for the manager.

2.3 Manager in Control

Suppose the firm is not sold, but stands alone. We will proceed here under the assumption that the manager has sufficient capital available to make both investments.⁸ If both investments are made, asset A_1 provides the manager a private benefit of $U_{A_1} \geq 0$, independent

⁸We assume that the manager, like the strategic buyer considered below, has frictionless access to financing of these investments. The alternative is discussed in Section 5.1.5.

of the realization of the state θ . Otherwise, the private benefit from A_1 is reduced to zero. If asset A_2 is kept, it provides the manager private benefit $U_{A_2} \geq 0$. Let $\eta_m > 1$ denote the manager's information friction if A_2 is kept.

Suppose, at time 2, the manager's posterior belief is π . Focusing on the contribution from asset A_1 , this stage's expected net payoff from undertaking investment I_2 is then $U_{A_1} + \pi V_{A_1} - I_2$. The alternative provides net payoff zero. The optimal subgame payoff as a function of belief π is thus

$$\max\{0, U_{A_1} + \pi V_{A_1} - I_2\}. \quad (1)$$

2.4 Strategic Buyer's Valuation

A strategic buyer aims to integrate with the target firm. The strategic buyer operates in the same business as the target firm, and hence shares the manager's ability to extract private benefits from A_1 , worth U_{A_1} if both investments are made. If A_2 is kept, a strategic buyer likewise obtains the private benefit U_{A_2} , and the information-friction parameter becomes $\eta_{sb} > 1$. We assume that the information friction for the strategic buyer is no greater than that for the manager.

Assumption 1 *Information frictions satisfy $\eta_m \geq \eta_{sb} > 1$.*

In combination with the synergy gain and additional private benefits that we describe below, assumption 1 implies that the strategic buyer can always generate more value than the manager, as we will observe after expression (2).

Acquisition of the target also unleashes synergy gains in two forms that matter for the welfare analysis in Section 4. A welfare-enhancing synergy gain comes in the form of cash value $G_{SB} > 0$ if both investments are made, and the good state $\theta = 1$ is realized. This gain arises from more efficient use of the firms' pooled resources. In addition, the strategic buyer obtains private synergy gain $U_Q \geq 0$ if both investments are made — like U_{A_1} , we suppose this gain is independent of the realization of the state θ . Such private synergy gains can arise, for example, through increased market power. They may also arise from private benefits from control.⁹

⁹See e.g. Barclay and Holderness (1989); Doidge et al. (2009); Wang and Wu (2018). Furthermore, the strategic buyer depends less on outside investors, and hence is under less outside pressure to reduce private benefits.

Suppose, at time 2, the strategic buyer's posterior belief is π . The expected net payoff, at this stage, from undertaking investment I_2 is then $U_{A_1} + U_Q + \pi(V_{A_1} + G_{SB}) - I_2$. The optimal subgame payoff as a function of belief π is then

$$\max\{0, U_{A_1} + U_Q + \pi(V_{A_1} + G_{SB}) - I_2\}. \quad (2)$$

Observe that, at any given posterior belief π , the strategic buyer expects higher payoff than the manager at this stage. The payoff expression in (2) is no smaller than (1), and they are equal only if (2) is zero. Since the strategic buyer provides additional private benefits, and also has better information by Assumption 1, the strategic buyer's valuation of the target firm dominates the stand-alone option.

While not crucial for the analysis, we find it natural to assume that the optimal investment decision at time 2 depends in a non-trivial way on information. More precisely, the zero payoff prevails in (2) when $\pi = 0$, but not when $\pi = 1$.

Assumption 2 *Ex post, the strategic buyer gains from investing I_2 if and only if $\theta = 1$: $U_{A_1} + U_Q + V_{A_1} + G_{SB} > I_2 > U_{A_1} + U_Q$.*

Thus, private benefits alone are not a sufficient reason for the strategic buyer to undertake the second stage investment.

At time 1, the strategic buyer decides whether to make the initial investment. If the initial investment is not made, the project is terminated, for overall payoff U_{A_2} or 0, depending on whether A_2 was previously kept or divested.

As described above, the initial investment generates signal s , and thus defines the distribution over the random posterior belief π . When A_2 is divested, so the information friction is eliminated, the strategic buyer's expected net gain from undertaking this investment is W_1 , defined by

$$W_1 = p(U_{A_1} + U_Q + V_{A_1} + G_{SB} - I_2) - I_1. \quad (3)$$

When A_2 is kept, the information friction is $\eta_{sb} > 1$, and assumption 2 does not suffice to predict the optimal choice at signal $s = 0$. Recall that the strategic buyer's probability of obtaining signal $s = 1$ is p/η_{sb} . The strategic buyer's expected net gain from undertaking the investment is thus W_2 , defined by

$$W_2 = \frac{p}{\eta_{sb}} (U_{A_1} + U_Q + V_{A_1} + G_{SB} - I_2) + \frac{\eta_{sb} - p}{\eta_{sb}} \max\{0, U_{A_1} + U_Q + \frac{p\eta_{sb} - p}{\eta_{sb} - p} (V_{A_1} + G_{SB}) - I_2\} - I_1, \quad (4)$$

where we recall that $(p\eta_{sb} - p)/(\eta_{sb} - p)$ is the probability the random state is good conditional on $s = 0$. It is a relatively simple exercise to verify that $W_1 > W_2$ when $\eta_{sb} > 1$. More generally, (4) is a non-increasing function of η_{sb} . That is, the greater the strategic buyer's information friction is, the lower is its expected net gain from investing.

Lemma 1 *If $\eta_{sb} > 1$ then $W_1 > W_2$, and (4) is non-increasing in η_{sb} .*

Before time 1, the strategic buyer chooses whether to keep A_2 . The utility from keeping it is $U_{A_2} + \max\{0, W_2\}$, and we impose the assumption that the strategic buyer prefers to keep A_2 . Since $U_{A_2} > 0$, this can be written as follows:

Assumption 3 *A strategic buyer prefers to keep A_2 : $\max\{U_{A_2}, U_{A_2} + W_2\} > W_1$.*

The strategic buyer's expected gain from the takeover is thus

$$U_{A_2} + \max\{0, W_2\}. \quad (5)$$

Lemma 2 *The strategic buyer's willingness to pay (5) is increasing in G_{SB} without bound, decreasing in η_{sb} , and increasing in private benefits.*

We have assumed that the manager has all the bargaining power against the strategic buyer. Therefore, (5) is the most the strategic buyer is willing to offer, also denoted the maximum willingness to pay. This offer is attractive to the manager by assumption.

The formulations above allow us to formalize the information discount. If the strategic buyer is not subject to an information disadvantage, there is no reason for divesting asset A_2 since this allows for private benefits. In this case the strategic buyer evaluates the target as $U_{A_2} + W_1$. Therefore, we define the information discount induced by η_{sb} as the difference between the no-information-disadvantage value with the one in (5); that is:

$$U_{A_2} + W_1 - (U_{A_2} + \max\{0, W_2\}) = W_1 - \max\{0, W_2\}. \quad (6)$$

We have already noticed that this is always positive unless $\eta_{sb} = 1$. As will become clear later, it is instructive to intuitively think of the PE fund as one who is not able to outbid the value W_1 as long as its synergy gain is not larger than the strategic buyer's. This is due to the fact that we deliberately let the PE fund's added value be tied up on an information advantage. However, it is possible that the PE fund has a valuation of the target which is higher than the strategic buyer's valuation in (5), albeit the strategic buyer has private benefits of keeping asset A_2 . This possibility becomes more likely when the information discount gets larger.

2.5 Private Equity Fund's Valuation

Due to the internal contractual structure and the methods employed by the PE fund, we assume that it annihilates private benefits. It is a stylized feature that this investor type does not enjoy private benefits in the same way as other owner types do.¹⁰ Without private benefits from A_2 , in particular, the exact value of $\eta_{pe} > 1$ for the PE fund will be irrelevant to the analysis.

The PE fund has the potential to create a welfare-enhancing gain $G_{PE} \geq 0$. This gain is unleashed only if investment in the target's A_1 results in a successful outcome, $\theta = 1$. The gain most naturally stems from, for example, merging the target firm with another firm of independent value in the PE fund's portfolio. This other firm would create additional value, which we assume independent of investment or success in A_1 . In this case, G_{PE} is a synergy gain. Alternatively, G_{PE} could be obtained from operational improvements that the PE fund is capable of undertaking.¹¹ As we are not endogenizing the specifics of the gain, we will for simplicity henceforth interchangeably talk about G_{PE} as the PE fund's synergy or direct gain.

The PE fund has promised its partners a higher risk-neutral return $r \geq 0$ on capital. The higher return is effectively a rent accruing to the PE fund from its ability to create value in target firms. This ability is not priced in the market except through this very channel that higher returns can be earned on projects where the PE fund provides financing. This required return represents a friction in our model. It naturally stems from the agency problem between the general and limited partners of the fund, which puts a constraint on the available capital, see Axelson et al. (2009).

Suppose, at time 2, the PE fund's posterior belief is π . The expected net payoff, at this stage, from undertaking investment I_2 is then $\frac{\pi}{1+r}(V_{A_1} + G_{PE}) - I_2$. The optimal subgame payoff as a function of belief π is

$$\max\{0, \frac{\pi}{1+r}(V_{A_1} + G_{PE}) - I_2\}. \quad (7)$$

Comparing (2) with (7), observe that the strategic buyer has an ex post advantage over the PE fund if $G_{PE} < U_{A_1} + U_Q + G_{SB}$. In this case, for any given posterior belief π and any $r \geq 0$, we observe that (2) exceeds (7), identical only when (2) is zero.

¹⁰For indirect empirical evidence, see e.g., Gorbenco and Malenko (2014).

¹¹For evidence on both of these possibilities, see e.g., Hammer et al. (2017) and Malenko and Malenko (2015). An extension in Section 5 addresses the issue of acquiring the initial firm in the PE fund's portfolio.

In analogy with Assumption 2, we assume that the PE fund's final investment decision depends on the belief π .

Assumption 4 *Ex post, the PE fund gains from investment 2 if and only if $\theta = 1$: $V_{A_1} + G_{PE} > (1 + r) I_2 > 0$.*

The PE fund obtains no private benefit from A_2 , so keeping it is weakly dominated. On the other hand, we assume the PE fund actually gains from the better signal obtained from divesting A_2 .

Assumption 5 *The PE fund invests at $t = 1$ if A_2 is divested: $p(V_{A_1} + G_{PE} - (1 + r) I_2) > (1 + r)^2 I_1$.*

Consequently, to acquire the target, the PE fund is at most willing to offer its net gain,

$$\frac{p}{1 + r} \left(\frac{1}{1 + r} (G_{PE} + V_{A_1}) - I_2 \right) - I_1. \quad (8)$$

Lemma 3 *The PE fund's maximal offer (8) decreases in r , and increases without bound in G_{PE} .*

3 Analysis of the Outcome

We analyze the manager's choice between the PE fund (Opportunity 3) and the two outside opportunities, i.e., the manager considers which ownership is efficient from the viewpoint of investors.

Intuitively, the PE fund creates less value by killing the private benefits that can be enjoyed by other owners. Depending on the size of synergy gain G_{PE} , this may even imply that for any posterior belief π of the owner, the PE fund can expect lower value from any given investment strategy in the firm. It adds to this disadvantage that the PE fund requires a higher return on investments, r .

However, we analyze the situation where the private benefits are such that the strategic buyer prefers to keep the legacy asset A_2 , cf. Assumption 3. This implies that the PE fund obtains a more precise signal before choosing to invest I_2 , as the information friction parameters satisfy $\eta_{sb} > \eta_{pe} = 1$. Consequently, the distribution of the PE fund's posterior belief is more variable than that of the strategic buyer. Assumption 4 implies that the PE fund lets the second investment decision depend on the signal's realization. This

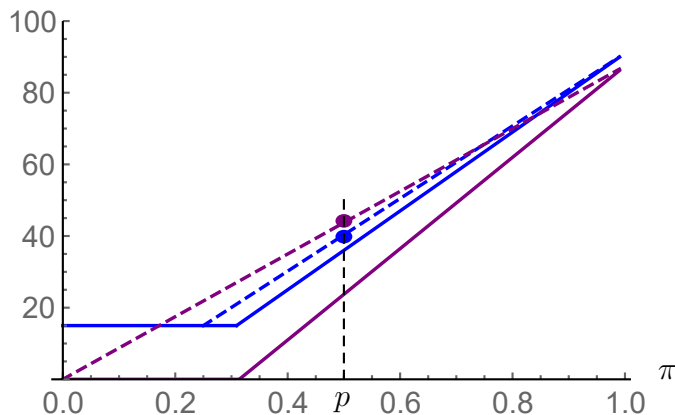


Figure 2: **Value of Information.** The purple solid lines illustrates the subgame payoff (7) to a PE fund as a function of the belief π about the investment's viability, $\theta = 1$. The purple dashed line shows the expected payoff to a fully informed fund at prior belief, $p \in [0, 1]$; the circle shows the expected payoff at prior belief $p = 0.5$ (black dashed line). Blue lines likewise illustrate the payoff (2) plus U_{A_2} to a strategic buyer who keeps A_2 (solid line), with the blue circle indicating the expected payoff at prior belief $p = 0.5$. Base case parameters from Section 3.4 are used.

optionality creates a convexity in the PE fund's expected payoffs as a function of posterior belief π .

We illustrate this value of information in Figure 2. At any given posterior belief, due to private benefits, the strategic buyer places a higher value (solid blue curve) on the target than the private equity fund (solid purple curve). The optionality of the second investment makes both solid curves convex. The expected value of this, before receiving the signal realization, is illustrated by the dashed lines. The figure illustrates that the PE fund's lower information friction implies that the signal gives more extreme posterior beliefs for the fund, allowing it to better exploit the convexity in the payoff function. Once the PE fund's information advantage is sufficiently large, its expected value at stage 0 can exceed that of the other owner types. The PE fund can, therefore, have a higher ex ante expected value even if it has an ex post lower payoff function. Phrasing this same finding differently, the strategic buyer enjoys greater private benefits, but includes an information discount in its valuation of the target firm.

We now derive the parameter condition for the manager to prefer a takeover by the PE

fund. Since bargaining is efficient among the investors, such a takeover occurs whenever the fund is willing to pay more than the strategic buyer. Comparing (8) to (5), we can find the owner predicted by our analysis. In particular, the PE fund will take over if the synergy G_{PE} created by the PE fund and the information discount faced by the strategic buyer are sufficiently large.

Proposition 1 *A takeover by the PE fund occurs if the information friction η_{sb} is large enough, the return premium r is not too big, the synergy gain G_{PE} from a PE-takeover is sufficiently larger than the alternative synergy gain G_{SB} , and the private benefits U_{A_1}, U_{A_2}, U_Q are not too large. Specifically, the PE-takeover condition, that (8) exceeds (5), can be typed out as*

$$\begin{aligned} & \frac{p}{1+r} \left(\frac{1}{1+r} (G_{PE} + V_{A_1}) - I_2 \right) - I_1 \\ & \geq U_{A_2} + \max \left\{ 0, \frac{p}{\eta_{sb}} (U_{A_1} + U_Q + V_{A_1} + G_{SB} - I_2) \right. \\ & \quad \left. + \frac{\eta_{sb} - p}{\eta_{sb}} \max \{ 0, U_{A_1} + U_Q + \frac{p\eta_{sb} - p}{\eta_{sb} - p} (V_{A_1} + G_{SB}) - I_2 \} - I_1 \right\}. \end{aligned} \quad (9)$$

As noted after (7), the strategic buyer has an ex post advantage over the PE fund if $G_{PE} < U_{A_1} + U_Q + G_{SB}$, particularly if $G_{PE} < G_{SB}$. It follows from condition (9) that such an ex post advantage implies an ex ante advantage. By (3), the strategic buyer's optional W_1 strictly exceeds the PE fund's left-hand-side of (9) under this parameter condition. On the other hand, by Assumption 3, the strategic buyer's right-hand-side of (9) is at least W_1 . Note also from (9) that the direct effect of higher legacy asset value U_{A_2} is a competitive advantage to the strategic buyer, although its indirect effect of keeping the asset is a loss of information (so $\eta_{sb} > 1$). Conversely, if the PE fund's gain G_{PE} is sufficiently great, and the strategic buyer's information discount is sufficiently large (so W_1 is small), it will instead be the PE fund who has the ex ante advantage.

Going forward, it is convenient to analyze this general condition in the three possible cases for the strategic buyer's investment policy which are possible under our assumptions.

3.1 Strategic Buyer Invests like the PE Fund

Assume that the strategic buyer prefers to behave like the PE fund: investing at time 1, and terminating the project at time 2 if $s = 0$. Then the parameter condition for a PE

takeover becomes

$$\frac{p}{1+r} \left(\frac{1}{1+r} (G_{PE} + V_{A_1}) - I_2 \right) \geq U_{A_2} + \frac{p}{\eta_{sb}} (U_{A_1} + U_Q + G_{SB}) + \frac{p}{\eta_{sb}} (V_{A_1} - I_2). \quad (10)$$

This is simply a comparison of the present values of A_1 for the PE fund and strategic buyer with the addition of private benefit U_{A_2} to the strategic buyer's valuation.

Interpreting (10), recall that the terms G_{PE} and G_{SB} capture the synergy gains from a takeover. On the right-hand-side, there also appear private benefits that are annihilated by the PE fund. The term $V_{A_1} - I_2$ on both sides is the second-period gain from undertaking the project: with the better information technology, the PE fund obtains this gain with a greater likelihood.

3.2 Strategic Buyer Always Invests

Alternatively, suppose that the strategic buyer does not behave like the PE fund. Instead it invests if it gets a low signal and investment yields a positive net payoff at stage two. By Assumption 2 this cannot occur if η_{sb} is sufficiently small. On the other hand, if η_{sb} is large and p is not too small, it can be understood from Figure 2 that both posteriors of the strategic buyer (after signals 0 and 1) are so close to p that investing I_2 is best. The PE-takeover condition (9) becomes

$$\frac{p}{1+r} \left(\frac{1}{1+r} (G_{PE} + V_{A_1}) - I_2 \right) \geq U_{A_2} + (U_{A_1} + U_Q + pG_{SB}) + (pV_{A_1} - I_2). \quad (11)$$

Intuitively, compared to (10), the strategic buyer no longer takes advantage of the convexity in payoffs in Figure 2, so the dashed blue line is dragged down to the solid blue line. This eases the condition for the PE fund to offer the highest bid. Still, if $G_{PE} < G_{SB}$, the PE fund cannot win the takeover contest.

3.3 Strategic Buyer Never Invests

Finally, suppose that I_1 or I_2 are relatively large, such that the strategic buyer would not invest at time 1 regardless of optimal continuation behaviour at time 2. The PE-takeover condition (9) then becomes

$$\frac{p}{1+r} \left(\frac{1}{1+r} (G_{PE} + V_{A_1}) - I_2 \right) - I_1 \geq U_{A_2}. \quad (12)$$

The strategic buyer is not acquiring information and hence cannot use convexity. This again eases the condition for the PE fund to take over. In this instance, G_{SB} plays no direct role.

3.4 Comparison

Our analysis is useful for eliciting under which conditions PE funds have a competitive advantage over strategic buyers in acquiring information-constrained firms with a potential. The mathematical condition can be seen from Proposition 1 and, in particular cases, conditions (10), (11), or (12). We now elaborate on the trade-offs associated with the key determinants through a numerical analysis. We ensure that Assumptions 2–5 are satisfied in the parameterizations we consider.

This analysis starts from a base case parametrization with ex ante success probability $p = 0.5$ and successful investment payoff $V_{A_1} = 100$. The initial investment cost is $I_1 = 20$ and the second stage investment cost is $I_2 = 40$. Hence, the project yields a net present value of 10, if there are no frictions. The informational frictions induced by keeping the legacy asset A_2 are captured by $\eta_m = 3.5$ and $\eta_{sb} = 1.5$. This implies that the strategic buyer’s probability of a high signal is $p/\eta_{sb} = 1/3$, while a low signal gives posterior $\Pr(\theta = 1|s = 0) = (p\eta_{sb} - p)/(\eta_{sb} - p) = 1/4$. For the PE fund the latter posterior is 0. We assume that the private benefits are primarily present in the legacy assets and also present, but to a smaller extent, when the strategic buyer combines assets. Specifically, $U_{A_1} = 0, U_{A_2} = 15$, and $U_Q = 6$.¹² Furthermore, the direct gain of a takeover by the strategic buyer is $G_{SB} = 10$.¹³ Similarly, we let the direct gain of a takeover by the PE fund be $G_{PE} = 30$. Clearly, the strategic buyer’s direct gain is less than that of the PE fund which, as argued earlier, is necessary for the PE fund to win the takeover contest. On the other hand, there is no higher gain in terms of return realization for the PE fund compared to the strategic buyer; i.e., $G_{PE} = 30 < 31 = U_{A_1} + U_{A_2} + U_Q + G_{SB}$. Finally, the PE fund’s return requirement is $r = 0.02$. The base case parametrization is summarized in Table 1.

¹²For this part of the analysis, U_{A_1} and U_Q play a similar role through the sum $U_{A_1} + U_Q$, so we normalize U_{A_1} to zero. In the extension with outside investors, U_{A_1} plays a role independent of U_Q .

¹³The base case parameters are such that the strategic buyer invests like the PE fund, so (10) is the relevant condition for a PE takeover. For some of the variations to come, the strategic buyer follows another strategy. This shows up as kinks in the figures.

Table 1: Base case parametrization

Target firm		Strategic buyer		Private equity fund	
$\Pr(\theta = 1)$	0.5	U_{A_1}	0		
V_{A_1}	100	U_{A_2}	15		
I_1	20	U_Q	6		
I_2	40	G_{SB}	10	G_{PE}	30
η_m	3.5	η_{sb}	1.5	r	0.02

The base case is used to illustrate the subgame payoffs (2) and (7) to the strategic buyer and the PE fund in Figure 2 as functions of the posterior belief (note that I_1 is not subtracted from the value in that figure). For any given posterior belief, the strategic buyer's payoff dominates that of the PE fund. However, the two competitors do not obtain equally informative signals implying that at the time of the takeover, the strategic buyer in (5) evaluates the takeover to be worth about 20.3, whereas the PE fund in (8) evaluates the takeover to be worth about 22.9. As a consequence the PE fund's bid will be dominating and the PE fund takes over. In contrast, if the strategic buyer has no information disadvantage, $\eta_{sb} = 1$, then the strategic buyer evaluates the target to 33. The information discount is thus $33 - 20.3 = 13.3$ and large enough to let the PE fund make a dominating offer.

Figures 3 and 4 illustrate how the PE fund's valuation advantage, founded by the strategic buyer's information discount, depends on some key parameters. By definition, this valuation advantage is the amount by which the left-hand side of (9) exceeds its right-hand side.

The trade-off between the strategic buyer's information friction η_{sb} and the PE fund's required return premium r is illustrated in Figure 3 panel (a). If the information friction is sufficiently low, the features of a PE fund are not valuable enough to compensate for the higher return requirement. As the purple curve illustrates, when the return premium is higher, the slack for the information friction is smaller. This makes good sense. A lower information friction makes an acquisition by the strategic buyer more attractive, while a higher return premium puts pressure on the PE fund's maximum willingness to pay. As a result, a private equity takeover is less likely.

Similarly, a takeover by the PE fund is less likely to occur when the private benefits from a strategic buyer's takeover, U_Q , increases because the strategic buyer is willing to

pay a higher price for the manager’s firm. As seen in panel (b), a higher return requirement to the PE fund amplifies this effect. When U_Q gets high enough a second effect enters and makes the takeover even more valuable for the strategic buyer. The reason is that the strategic buyer finds it optimal to invest albeit a low signal is obtained, see (4). Given the other base case parameters this happens when $U_Q = 12.5$, and (11) is then the relevant condition for a takeover by the PE fund. This explains the kink in panel 3(b).

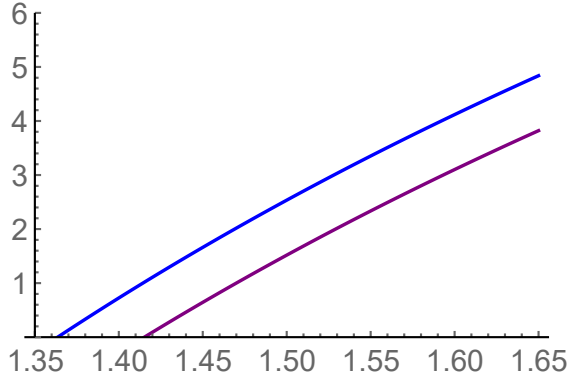
Panel 3(c) considers how the direct gain by a private equity takeover influences the outcome. Naturally, G_{PE} and G_{SB} are important determinants for who takes over and for welfare. The outcome of a takeover game is highly sensitive in G_{PE} and G_{SB} , and these gains are difficult to estimate in practice. However, the important issue is how uncertain the gain difference $G_{PE} - G_{SB}$ is. If the difficulty of estimating G_{PE} is similar to the difficulties when estimating G_{SB} , and if both components are affected similarly by estimation difficulties, then $G_{PE} - G_{SB}$ can be relatively robust. Therefore, we only consider variations in G_{PE} . Intuitively, a higher gain makes it easier for the PE fund to undertake a takeover, and it also provides more leeway for a high return premium. Recall that the PE fund can only play a role if its direct gain is larger than the strategic buyer’s. In our base case this occurs as long as G_{PE} is at least 25. This is higher than G_{SB} , but about 19% lower than the strategic buyer’s highest possible gain (that is, $U_{A_1} + U_{A_2} + U_Q + G_{SB} = 31$).¹⁴

Panel 3(d) shows the direct effect of the required return premium r . The purple line corresponds to a case with lower information friction $\eta_{sb} = 1.4$. For a given level of information friction, a higher return requirement makes a private equity acquisition more difficult and, eventually, impossible. Hence, the higher the return requirement, the larger must the information friction be, before the PE fund plays a role.

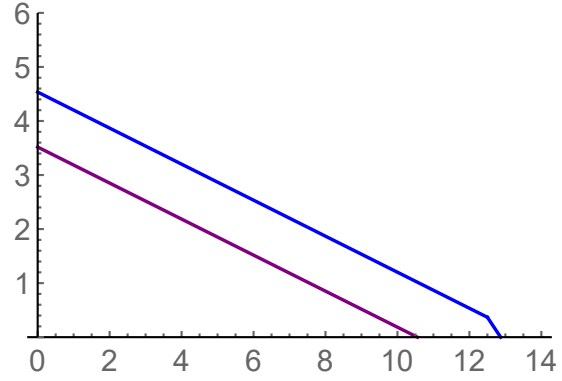
The initial investment cost, I_1 , is usually not decisive in terms of which type of firm takes over the target, cf. (10) and (11).¹⁵ However, Figure 4(a) shows that the second

¹⁴This observation is important when we later evaluate the welfare of PE fund takeovers. Although the PE fund may apparently yield a lower ex post gain than the strategic buyer, and in addition require a return premium, the PE fund can actually be the preferred one to acquire the manager’s firm due to better informed investment. The welfare weight on the strategic buyer’s private benefits plays an important role in this comparison.

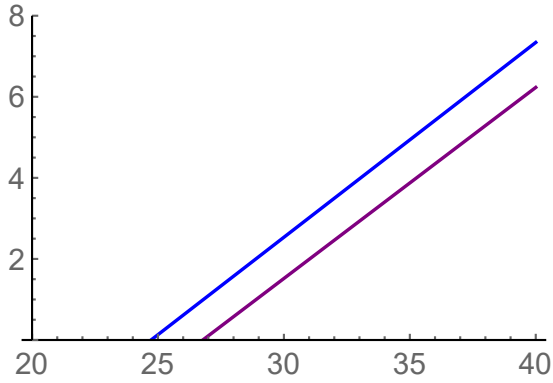
¹⁵The initial investment cost does matter for the firms, cf. (5) and (8), but increasing it will either exclude the firm with the lowest valuation or both firms. Notice that in one case, captured by (12), the strategic buyer does not acquire information, and hence a greater I_1 reduces the advantage of the PE fund.



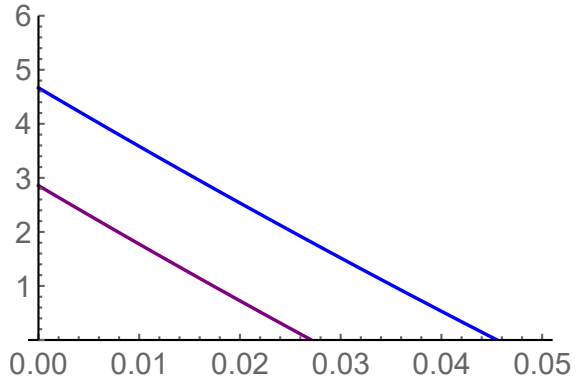
(a) Information friction, η_{sb} . Variation with high return premium, $r = 0.03$.



(b) Private benefits to SB, U_Q . Variation with high return premium, $r = 0.03$.

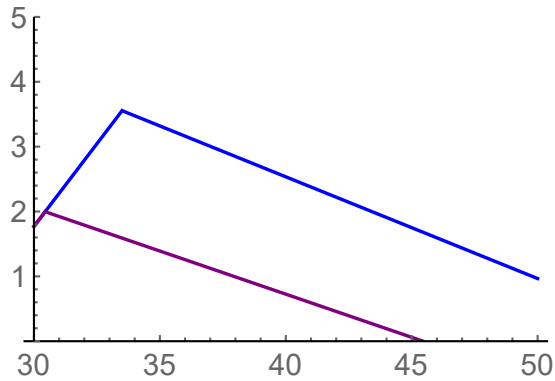


(c) Direct gain of private equity acquisition, G_{PE} . Variation with high return premium, $r = 0.03$.

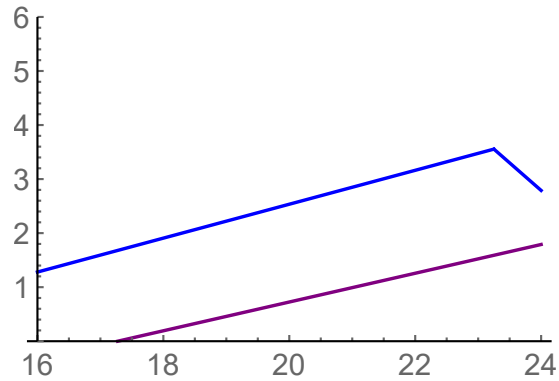


(d) Return premium, r . Variation with low information friction, $\eta_{sb} = 1.4$.

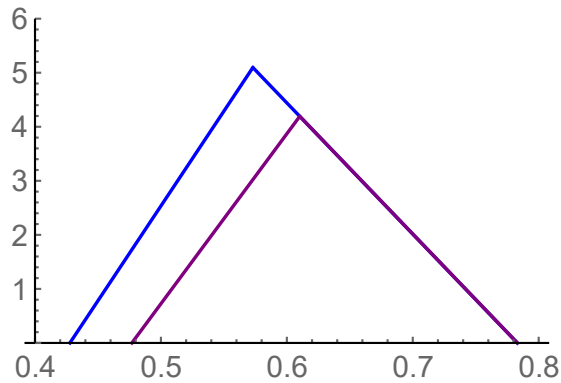
Figure 3: **Condition for a private equity takeover.** The plotted lines show by how much the left-hand side exceeds the right-hand side in (10)–(12), as a function of changing the parameter mentioned in each panel. The PE fund is predicted to take over whenever this valuation difference is positive. The blue lines depict the base case parametrization from Table 1, the purple lines depict the variations detailed in the panel.



(a) Investment cost of second stage, I_2 . Variation with low information friction, $\eta_{sb} = 1.4$.



(b) Investment cost in first stage, I_1 , for fixed $I_1 + pI_2$. Variation with low information friction, $\eta_{sb} = 1.4$.



(c) Prior belief, p . Variation with low information friction, $\eta_{sb} = 1.4$.

Figure 4: **Condition for a private equity takeover.** The plotted lines show by how much the left-hand side exceeds the right-hand side in (10)–(12), as a function of changing the parameter mentioned in each panel. The PE fund is predicted to take over whenever this valuation difference is positive. The blue lines depict the base case parametrization from Table 1, the purple lines depict the variations detailed in the panel.

stage investment, I_2 , impacts the PE fund to a larger extent. This is due to the fact that the information friction reduces the sensitivity of the investment cost's present value, see (10), unless the strategic buyer decides to invest even after observing a bad signal. The PE fund's required rate, r , mitigates this effect, but—as long as the PE fund realistically can play a role—the required rate is typically too small to impact the outcome. The reason for the kink is similar to the reason for the kink when U_Q gets high. When the second stage investment cost gets low enough, the strategic buyer prefers always to invest albeit a low signal is revealed.

To better understand the implications of dynamic investment costs, we perform an analysis in which we keep the PE fund's expected investment sum $I_1 + pI_2$ constant, and vary distribution of investment costs over time, I_1 and I_2 . Figure 4(b) depicts the effect of this exercise. We now see that a higher stage one investment cost makes it more likely that the PE fund undertakes the takeover. This is due to the fact that as I_2 decreases the present value after making the first investment increases. Since the PE fund has an informational advantage in the second stage, as discussed in relation to Figure 4(a), this advantage thus increases as the initial investment cost accounts for a larger share of the total investment costs. Of course, the PE fund has less to say if the information friction is lower. Indeed, if $\eta_{sb} = 1.4$ the PE fund loses the takeover contest unless the initial investment cost is at least about 17.

The effect of a higher probability of a good signal, prior belief p , is analyzed in Panel 4(c). In the base case, there is kink at $p = 0.57$; for lower information friction at $p = 0.61$. The kink again arises where the strategic buyer changes behavior to always invest. Since the PE fund's key advantage derives from the convexity of payoffs, it is intuitive that the advantage is greater for a somewhat uncertain prior near 50%. This is where information is most valuable.

4 Welfare Implications and Discussions

Our model is useful for shedding light on the circumstances under which PE funds are beneficial to society. For this application of the model, it is crucial how society evaluates private benefits and synergies. This depends on the economic meaning embodied in these elements of our theory. Different private benefits clearly incentivize the PE fund and

strategic buyer to invest differently, but to which extent does society agree to these private incentives? If private benefits are essentially saved efforts which are costly to provide, the PE fund's elimination of them is a cost borne by the manager—such a private benefit would naturally be considered as part of welfare. If instead private benefits are perks accruing to the strategic buyer, they would often be regarded as excessive and wasteful, with low benefit to society. Likewise, synergy benefits may come from efficiency-enhancing coordination of technological possibilities in a merged firm, or they may arise from anti-competitive conduct or from profit-shifting tax avoidance with overall loss of welfare.

Thus, how society evaluates private benefits and synergies in practice is specific to the case at hand and, therefore, we cannot perform merely one comparison. Rather, we introduce three parameters $u_U, u_{gsb}, u_{gpe} \in [0, 1]$ to represent the weight society puts on private benefits and synergies. While u_U is the weight attached to private benefits, u_{gsb} is the weight attached to a strategic buyer's synergy gain, and u_{gpe} is the weight attached to a PE fund's synergy gain.

Given the value of the various strategies we can address which strategy is efficient from society's point of view. Recall from Section 3 that there are three relevant cases to consider with respect to the strategic buyer's investment policy. In the first case this policy is identical to the PE fund's, in the second case the strategic buyer invests in both periods regardless of information, and in the third case the strategic buyer abstains from any investment. Then we have, in parallel with the valuation expressions (4), (5), and (8):

Proposition 2 *If the PE fund takes over, society's value is*

$$p(u_{gpe}G_{PE} + V_{A_1} - I_2) - I_1. \quad (13)$$

If the strategic buyer takes over, and invests like the PE fund, society's value is

$$u_U U_{A_2} + \frac{p}{\eta_{sb}} (u_U U_{A_1} + u_U U_Q + u_{gsb} G_{SB} + V_{A_1} - I_2) - I_1. \quad (14)$$

If the strategic buyer takes over, and always invests, society's value is

$$u_U U_{A_2} + (u_U U_{A_1} + u_U U_Q + p u_{gsb} G_{SB} + p V_{A_1} - I_2) - I_1. \quad (15)$$

If the strategic buyer takes over, but never invests, society's value is

$$u_U U_{A_2}. \quad (16)$$

The special characteristic of private equity funding is highlighted in (13); that is, private benefits play no direct role. Moreover, the return premium—which the PE fund has to

satisfy—is from society’s perspective merely a redistribution among investors and does thus not influence our welfare measure directly. However, we will highlight below that the return premium can have indirect welfare implications through its influence on the takeover outcome. For a full discussion of society’s benefits, we will soon look closer at the three cases for the strategic buyer’s investment policy. But first, it is useful to inspect the benchmark where the strategic buyer has no information friction, so that differences are entirely determined by society’s weights on private benefits and synergies.

4.1 No information friction

To illustrate some key forces for the welfare comparison, suppose first that the strategic buyer has no information friction, setting $\eta_{sb} = 1$. By Assumption 2, the strategic buyer follows the PE fund’s investment policy at time 2. In the interesting case, the strategic buyer also invests at time 1.¹⁶

The gain to society from a PE takeover instead of acquisition by the strategic buyer, is given by the difference of (13) and (14) with $\eta_{sb} = 1$. This becomes

$$G_{soc} = p(u_{gpe}G_{PE} - u_U U_{A_1} - u_U U_Q - u_{gsb}G_{SB}) - u_U U_{A_2}. \quad (17)$$

This highlights how society’s evaluation depends on the synergy gains and private benefits which can be less valuable to society.

For an extreme case, suppose $u_U = 0$. Then society finds a takeover by a PE fund welfare improving if $u_{gpe}G_{PE} > u_{gsb}G_{SB}$. It is plausible that the PE fund is less anti-competitive, so $u_{gpe} > u_{gsb}$. From the discussion of Proposition 1 we know that $G_{PE} > G_{SB}$ is a necessary condition for a PE fund to take over. Thus, a PE fund takeover is necessarily good for welfare when it takes place. Still, private benefits can privately induce the strategic buyer to have a higher maximum willingness to pay, suboptimally from a welfare perspective.

At another extreme case, suppose $u_{gpe} = 0$; for example, because the value gain enjoyed by the PE fund derives from tax avoidance. Clearly, the welfare gain (17) is negative, but G_{PE} might be so large that the outcome is a takeover by the PE fund.

Instead of setting $\eta_{sb} = 1$, we could change parameters so that Assumption 3 fails. This also eliminates the information friction because the strategic buyer chooses to sell

¹⁶Comparing (13) to (16) is simpler than comparing (13) to (14) as we do in the following.

the legacy asset A_2 . Then the last term, $u_U U_{A_2}$ is dropped from society's gain (17), generally making the strategic buyer a more attractive owner from a welfare perspective.

4.2 Strategic Buyer Invests like the PE fund

We now return to the main specification of our model with information frictions for the strategic buyer, $\eta_{sb} > 1$. Suppose the strategic buyer optimally adopts the same investment policy as the PE fund, to invest with the outcome of the signal. The PE fund takes over the target when condition (10) is satisfied. Society's gain from a PE fund's takeover over a strategic buyer's takeover is the difference between (13) and (14), simplifying to

$$G_{soc} = p(u_{gpe}G_{PE} + V_{A_1} - I_2) - u_U U_{A_2} - \frac{p}{\eta_{sb}} (u_U U_{A_1} + u_U U_Q + u_{gsb}G_{SB} + V_{A_1} - I_2). \quad (18)$$

Since $\eta_{sb} > 1$, society generally gains less from the strategic buyer's takeover—the information friction reduces the expected value generated by A_1 . Aside from this effect, the remaining terms are those already discussed in connection with (17). Thus, we see that the PE fund's superior processing of information about the target firm's growth option confers a welfare benefit: the fund invests more efficiently.

4.3 Strategic Buyer Always Invests

In contrast, suppose a bad signal implies a high enough conditional probability of a successful second-stage investment for the strategic buyer, so it is optimal to always invest. The condition for the PE fund to take over is given in (11) and society's gain is

$$G_{soc} = p(u_{gpe}G_{PE} - I_2) - (u_U(U_{A_2} + U_{A_1} + U_Q) + pu_{gsb}G_{SB} - I_2). \quad (19)$$

As the strategic buyer invests suboptimally due to the information friction, it would too often spend I_2 to no avail. On the other hand, we have assumed that private benefits U_{A_1} and U_Q accrue regardless of success. In total, G_{soc} in (19) exceeds that in (17) by $(1-p)(I_2 - u_U(U_{A_1} + U_Q))$. This is positive since $I_2 > U_{A_1} + U_Q$ by Assumption 2, so the strategic buyer's inefficient investment policy again renders it less helpful to society.

4.4 Strategic Buyer Never Invests

The remaining possibility is that the strategic buyer prefers never to invest. The PE fund takes over if it can dominate the strategic buyer's valuation of the private benefits, see (12).

The gain to society from this is

$$G_{soc} = p(u_{gpe}G_{PE} - I_2) - I_1 - u_U U_{A_2}. \quad (20)$$

If the direct gain from the PE fund fully improves welfare, $u_{gpe} = 1$, then a takeover by a PE fund is clearly welfare improving for society. This occurs even if a strategic buyer's private benefits are also seen to fully improve welfare. However, the higher the return premium, r , is, the more difficult it is for the PE fund to satisfy (12). Hence, as we discuss below, handicapping the PE industry by regulating the takeover market leading to increases in r can make takeovers less welfare improving for society.

4.5 Comparison – PE gains valuable to society

We turn to a broader comparison of a PE fund and a strategic buyer from a welfare perspective, beyond the specifics of the three regimes above. To simplify the exposition, suppose that the direct gain obtained when the PE fund takes over is fully valuable to society; that is $u_{gpe} = 1$.

The trade-off in our model between a takeover by a PE fund or by a strategic buyer depends on four central elements. A direct channel is the difference in the synergy gain, $G_{PE} - G_{SB}$. Intuitively, if this synergy gain to a PE fund exceeds that to a strategic buyer, then society has reasons to prefer a takeover by the PE fund. However, such an outcome can be obstructed by the second element, the (excess) return requirement r . Thus, the PE fund's internal contractual arrangement that leads to $r > 0$ can result in a friction for society. A third element is the information friction η_{sb} . This measures the information advantage the PE fund has over the strategic buyer, and the gain to society of a takeover by the PE fund is larger, the larger is the information friction. The final element is the weight society puts on the private benefits, also playing a central role in evaluating the efficiency of a takeover by the PE fund. When u_U is close to one, private benefits are assessed as being beneficial for society as well; just as the direct gain the PE fund can provide. Since private benefits are distorted by a PE fund's takeover, a higher u_U makes such a takeover less efficient. We collect the analysis of the various trade-offs below.

Corollary 1 *Assume the direct gain from a PE fund's takeover is fully welfare improving, $u_{gpe} = 1$. Then Proposition 2 gives us*

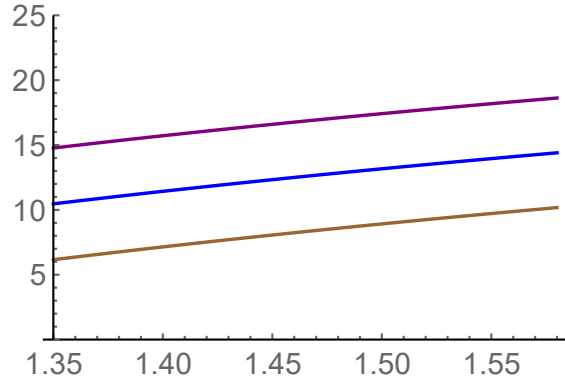
1. If a takeover by the PE fund is possible, i.e., (9) holds, then such a takeover is efficient from society's point of view.
2. If society has no value of private benefits, $u_U = 0$, and if the excess takeover gain $G_{PE} - G_{SB}$ and information friction η_{sb} are only moderate, then society incurs a loss due to an inefficient takeover by a strategic buyer.

Figure 5 illustrates a number of trade-offs. The effects that a higher information friction and a lower value for society of private benefits increases society's gain of a private equity takeover are intuitive (panels 5(a) and 5(b)). We observe that the sensitivity is fairly high for both parameters, but the impact of the information cost and society's weight on private benefits relies on different channels. This is most easily seen from (18). If the private benefit of the legacy asset is relatively large, which in turn makes the strategic buyer keep that asset, then society's weighting is more important. On the other hand, if the strategic buyer's value to a larger extent stems from combining assets through U_Q and, in particular, G_{SB} , then the information cost is relatively more important.

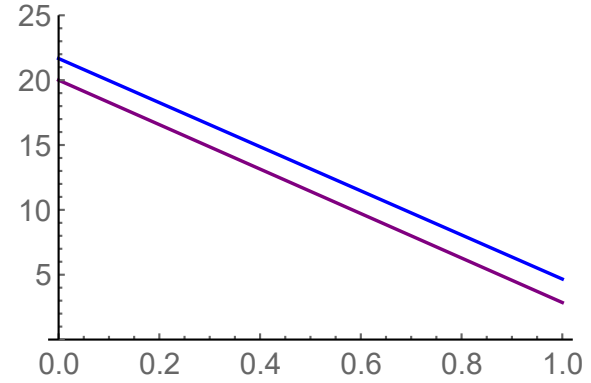
We know from Figure 3(b) that higher private benefits to the strategic buyer makes it more difficult for the PE fund to take over the target. Figure 5(c) shows (blue curve) that society's valuation is aligned with this. However, as discussed, for U_Q higher than about 13 in this parametrization, the strategic buyer wins and will, in fact, always invest. This is not good from society's perspective and the gain to society of a private equity takeover consequently jumps upwards.¹⁷ Intuitively, these effects are amplified if society attaches lower weight to the strategic buyer's private benefits ($u_U = 0.25$, purple curve) or synergy gains ($u_{gsb} = 0.5$, olive curve). That is, private benefits eventually distort the alignment between the strategic buyer and society.

The PE fund's direct gain, G_{PE} , and return premium, r , play a major role in the PE fund's ability to attain a higher valuation than the strategic buyer. As discussed above, society can have reasons to prefer the PE fund's direct gain compared to the strategic buyer's combined private benefits and synergies. However, this need not be aligned with who acquires the target. For example, for the benchmark parameters the PE fund loses the takeover bid to the strategic buyer when $G_{PE} < 25$. Yet, if $G_{PE} = 20$, a takeover by a PE fund is welfare improving unless society puts very little weight on the PE fund's

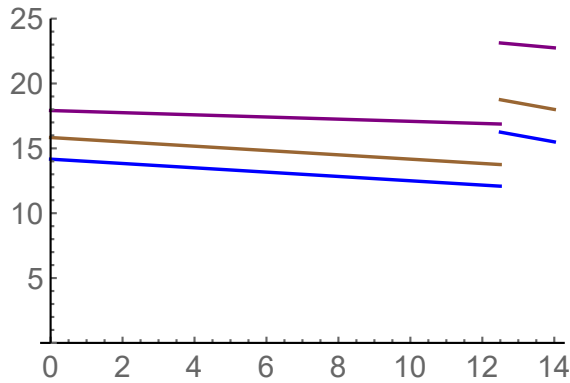
¹⁷While curves in Figures 3 and 4 exhibited kinks where the strategic buyer changes behavior, in Figures 5 and 6 the curves exhibit jumps. This is because the former figures involved the strategic buyer's own evaluation, while the latter figures involve society's evaluation of the strategic buyer's behavior.



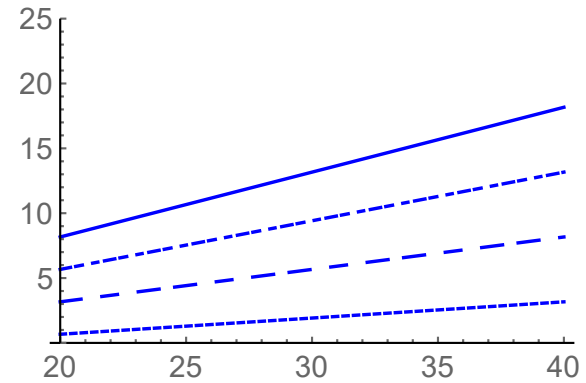
(a) Information cost, η_{sb} . Variation with society's weight on private benefits, $u_U \in \{0.25, 0.50, 0.75\}$ (olive, blue, purple curve). $u_{gpe} = u_{gsb} = 1$.



(b) Society's weight on private benefits, u_U with $u_{gpe} = u_{gsb} = 1$. Variation with low information cost, $\eta_{sb} = 1.4$ (purple curve).

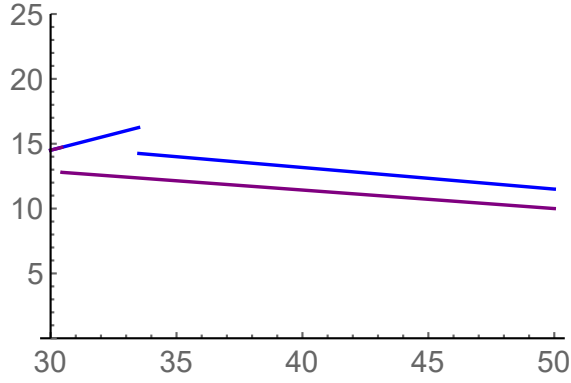


(c) Private benefits to SB, U_Q , with $u_{gpe} = 1$. Variation with society's weight on SB's benefits, $u_U = 0.5, u_{gsb} = 1$ (blue), $u_U = 0.25, u_{gsb} = 1$ (purple), $u_U = 0.5, u_{gsb} = 0.5$ (olive).

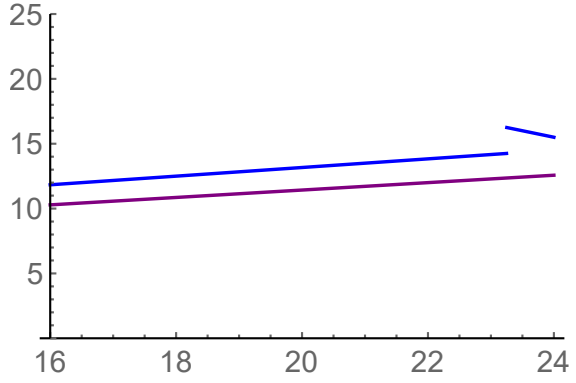


(d) Direct gain of PE acquisition, G_{PE} . Variation with weights $u_{gpe} \in \{0.25, 0.50, 0.75, 1.00\}$ (dotted, wide dashed, dashed, solid). $u_U = 0.5, u_{gsb} = 1$.

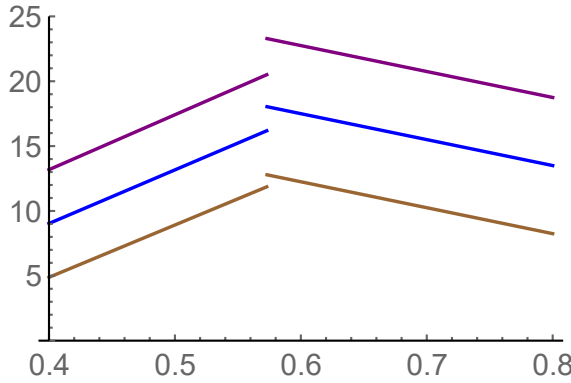
Figure 5: **Gain to society of a private equity takeover**, (18)–(20). The base case parametrization from Table 1 is used, while social weights u are specified in each panel.



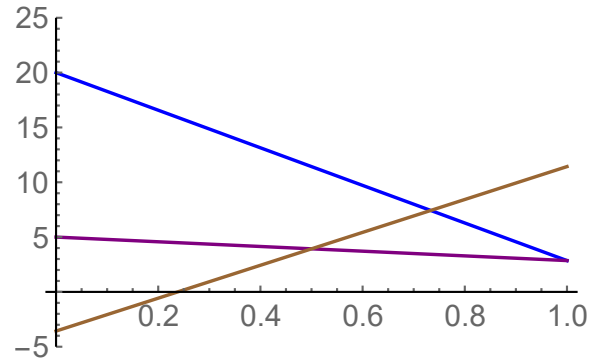
(a) Investment cost of second stage, I_2 , with $u_U = 0.5$ and $u_{gpe} = u_{gsb} = 1$. Variation with low information friction, $\eta_{sb} = 1.4$ (purple curve).



(b) Investment cost in first stage, I_1 , for fixed $I_1 + pI_2$, with $u_U = 0.5$ and $u_{gpe} = u_{gsb} = 1$. Variation with low information friction, $\eta_{sb} = 1.4$.



(c) Prior belief, p . Variation of society's weight on private benefits, $u_U \in \{0.25, 0.50, 0.75\}$ (purple, blue, olive curve). $u_{gpe} = u_{gsb} = 1$.



(d) Social weights, with low information cost $\eta_{sb} = 1.4$. u_U varies, $u_{gpe} = u_{gsb} = 1$, blue curve. $u_U = u_{gpe} = u_{gsb}$ vary, purple curve. u_{gpe} varies with $u_U = 0.5, u_{gsb} = 1$, olive curve.

Figure 6: **Gain to society of a private equity takeover**, (18)–(20). The base case parametrization from Table 1 is used, while social weights u are specified in each panel.

direct gain, see Figure 5(d).¹⁸ Furthermore, from Proposition 2 we see that the return premium does not directly impact welfare. However, recall from Figure 3(d) that the PE fund loses the takeover bid if $r > 0.045$ ($r > 0.027$ if $\eta_{sb} = 1.4$). Thus, internal contract issues or regulatory initiatives which in effect increase the return requirement makes a takeover from a PE fund less likely and can, as in this case, decrease society’s welfare.

Figures 6(a) and 6(b) provide the welfare analysis of the dependence on investment costs that we analyzed in Figures 4(a) and 4(b). Jumps again occur where the strategic buyer switches from following the signal to always investing because I_2 is low—this is inefficient behavior, so society’s gain from a private equity takeover jumps up. On the other hand, as long as both parties follow the same investment policy, the direct effect of raising I_2 is worse for private equity ownership, since the PE fund’s signal leads it to (efficiently) invest more often.

Changing the prior probability of success again has a non-monotonic effect, see Figure 6(c). As discussed in relation to Figure 4(c), the value of information is greater for intermediate values of this prior, and society shares this point of view. Thus, when there is greater prior uncertainty, as the prior is neither near 0 nor near 1, information creates more value. Information contributes to welfare, and society therefore finds the private equity fund a more attractive buyer.

The final Figure 6(d) emphasises the point that the welfare evaluation is highly dependent on our specification of social weights, and we elaborate on this in the next section.

4.6 PE Fund’s Takeover Decreases Welfare

Our framework is rich enough to also demonstrate cases in which a PE fund’s takeover decreases welfare. The worst case for society is if the PE fund’s gain is only due to welfare distorting actions. Depending on the situation at hand, the buy-and-build strategy can be such a case because the creation of a dominating market player can distort competition. Furthermore, PE funds typically create their takeovers with highly levered project-only funding, increasing the scope for tax shields. Tax shields may be regarded as a matter of redistribution and need not directly impact our welfare measure, although tax avoidance

¹⁸Alternatively, if the strategic buyer’s private benefits are highly valuable in terms of welfare, $u_U = u_{gsb} = 1$, then even with moderate weight on the PE fund’s gain, $u_{gpe} = 0.5$, society is indifferent between a takeover by a PE fund or a strategic buyer when $G_{PE} = 25$. This straightforward case is not depicted in the figure.

may raise society’s cost of raising funds for public expenditure. More obviously, consider a cross-border context. If the PE fund can redistribute income from a higher-tax country to a country with lower tax burden, then the higher-tax country experiences negative welfare effects from a PE takeover.

To consider such examples we analyze the effects of changing u_{gpe} in Figure 6(d). In the benchmark case the PE fund’s gain is highly valuable to society (blue curve, $u_{gpe} = 1$). We compare this to the case in which society equally weights private benefits and indirect gains ($u_{gpe} = u_U = u_{gsb}$). When this common weight increases, a takeover by the PE fund becomes less welfare improving to society. This is because we assume that the direct gain caused by a strategic buyer’s takeover does not depend on investment success. Interestingly, in the extreme case in which society’s weighting is zero on all private benefits and synergies ($u_{gpe} = u_U = u_{gsb} = 0$), society prefers a takeover by the PE fund. This follows from (18):

$$G_{soc} = p \frac{\eta_{sb} - 1}{\eta_{sb}} (V_{A_1} - I_2). \quad (21)$$

As long as there is an information friction, society prefers the investment decision is undertaken by the PE fund.

At another extreme, if we allow the strategic buyer’s private benefits to contribute to welfare by 50% and the synergies by 100% ($u_U = 0.5, u_{gsb} = 1$), then a PE fund’s takeover can be welfare decreasing. This is seen with the olive curve in Figure 6(d), when u_{gpe} is low. An example of this is if the PE fund is improving profits only by undermining competition.

5 Extensions

To make the analysis as transparent as possible, we have made a number of assumptions. This section explores the robustness of our results under relevant alterations to the model.

5.1 Outside Investors

Our analysis so far has assumed that all three main player types possess sufficient funds to make both investments if they own the firm. We now relax this assumption, and assume some players need to approach outside investors. As we explain in greater detail below, we

do not consider this relevant for PE funds in our model—they make efficient investment from outside investors’ point of view, and furthermore, the return requirement $r \geq 0$ might be seen as capturing a friction cost of funding. For the other two players, the effect of needing outside investors is more comparable. We will elaborate on the simplest case, where the manager needs outside funding, but similar analysis applies if the strategic buyer needs it. In section 5.1.5 below, we will return to discuss the overall implications for our takeover game and welfare.

5.1.1 Contracting

Suppose that the manager has no liquid funds for the purpose of developing asset A_1 . We assume that outside investors are willing to inject capital as long as their net present value of doing so is at least zero. The manager can offer a contract to the investors, specifying the payments made by the investors and the cash flow to return. The manager has limited liability, so there is no stage in which the manager earns less than zero. This normalization to zero plays no qualitative role for our results. Also, private benefits U_{A_1} and U_{A_2} are truly private, so they cannot be pledged for repayments to outside investors.

We can imagine three relevant cases regarding how contracts can be enforced. In all cases, it must be a contractible outcome whether asset A_1 provides the successful cash flow V_{A_1} , implying that both investments have been made in both stages and $\theta = 1$. This is the only positive cash flow that can be promised for repayment. In the first case, the manager’s investment choices and signal are all contractible—this allows for a trivial, frictionless contract where the manager behaves precisely as if the funds were privately available. In the second case, which we will analyze in detail, the contract can only depend on whether each of the two investments have been made. In the final case, the contract cannot depend on all investments or signal realizations—we consider this less realistic, and its effect would only be to exacerbate the frictions that we already obtain in the second case. So, we continue with the assumptions of the second case.

Note that the manager will offer a contract only if the project provides some gain. This implies that both investments must be made under some contingencies. Further analysis depends on whether the manager keeps A_2 , thereby incurring the information friction $\eta_m > 1$.

5.1.2 Both Assets Kept

Assume thus that the manager keeps A_2 and contracts with outside investors. The manager's signal is not contractible, but both the initial investment in the growth option and the decision to continue are contractible. Value can be generated only with successful investment, so a contract requires the investors to provide the initial I_1 as well as the additional I_2 if the manager decides to continue.¹⁹

Since the manager's signal is private there is an incentive constraint. The manager obtains private benefits U_{A_1} from continuation regardless of the true state, but the chance of obtaining the pledgable V_{A_1} from continuation depends on the signal. The contract needs to incentivize the manager to drop investment I_2 if investment has too low a chance to compensate investors. The contract therefore specifies that investors provide compensation $C \geq 0$ to the manager in case the project is terminated.²⁰ This creates an information rent that can be the root cause of frictions in the contracting relationship.

The only cash flow going back to investors is a fraction $\alpha \in [0, 1]$ of the final cash-flow θV_{A_1} . The outside investors accept any contract where their present expected net cash flow is non-negative. The manager designs contract parameters α and C to maximize own expected utility, subject to investor participation. If the contract specifies termination at signal $s = 0$, the incentive constraint is

$$\frac{p\eta_m - p}{\eta_m - p} (1 - \alpha) V_{A_1} + U_{A_1} \leq C. \quad (22)$$

Lemma 4 *The optimal contract depends on whether termination is efficient after receiving a low signal.*

Case a: If $U_{A_1} + \frac{p\eta_m - p}{\eta_m - p} V_{A_1} - I_2 \leq 0$, it is inefficient to invest if $s = 0$. It is possible to obtain financing from outside investors if and only if

$$\frac{p}{\eta_m} (V_{A_1} - I_2 + U_{A_1}) \geq I_1 + U_{A_1}. \quad (23)$$

Case b: If instead it is efficient to continue when $s = 0$, then the manager contracts with the outside investors if and only if

$$pV_{A_1} - I_1 - I_2 \geq 0. \quad (24)$$

If (24) does not hold, the manager cannot make a contract with the outside investors, but the target firm continues as a stand-alone.

¹⁹If the manager does not undertake the first investment, amount I_1 must be returned to investors and the relationship ends. We deal with the second investment in the following.

²⁰The manager thus returns $I_2 - C$ to investors if the second investment is not made.

Since outside investors obtain zero expected profit, it is easy to calculate the manager's expected utility. When outside financing is impossible, it is U_{A_2} . When possible, and the efficient contract induces termination if $s = 0$, the manager's expected utility is

$$\frac{p}{\eta_m} (V_{A_1} - I_2 + U_{A_1}) - I_1 + U_{A_2}. \quad (25)$$

If it is efficient to continue when $s = 0$, then the manager's expected utility is

$$U_{A_1} + U_{A_2} + pV_{A_1} - I_1 - I_2. \quad (26)$$

5.1.3 Initial Asset Sale

We also consider the possibility that the manager initially sells A_2 for the value of 0. The manager loses the benefit U_{A_2} , but gains that inference regarding A_1 is easier. Lemma 4 carries over, by setting $U_{A_2} = 0$ and $\eta_m = 1$ in the Lemma. Since the manager now receives a precise signal regarding the random state, only the case with termination with $s = 0$ is relevant. The exact condition for the possibility of outside-investor funding with one asset is thus

$$p(V_{A_1} + I_2 + U_{A_1}) \geq I_1 + U_{A_1}. \quad (27)$$

Since (23) implies (27), this financing condition is easier to satisfy. If contracting is possible in this case, the manager's utility becomes

$$p(V_{A_1} - I_2 + U_{A_1}) - I_1. \quad (28)$$

5.1.4 Comparison

To conclude, outside funding is feasible when (27) holds. If also (23) holds (or (24) if η_m is high enough), the manager can choose between selling or keeping the additional asset A_2 . Assuming it is efficient to terminate the contract when $s = 0$, a comparison of (25) to (28) yields that the manager prefers to sell the additional asset A_2 precisely when

$$U_{A_2} \leq (\eta_m - 1)(V_{A_1} - I_2 + U_{A_1}). \quad (29)$$

Intuitively, if the private benefits of keeping the legacy asset are small relative to the information cost, then the manager prefers to sell the legacy asset. If it is not efficient to

terminate the contract after a low signal, a comparison of (26) to (28) reveals that the manager never prefers to sell the asset A_2 .

In practice, it can be difficult to write a contract with the outside investors which rewards the manager a compensation if he terminates at an intermediary stage. To consider this, suppose the contract can only return a share α to the investors; that is, $C = 0$. This can be thought of as equity (or debt which in our setup is similar to equity). The case corresponds to case b in Lemma 4 and the manager's expected utility is as in (26). Note that if case a in Lemma 4 prevails, then the manager is better off with the contract having $C = U_{A_1} + U_{A_2}$. If the information friction is sufficiently high so that the signal is irrelevant for the investment decision, then having $C = 0$ is efficient.

5.1.5 Discussion

To summarize, if the outside investors are restricted in terms of offering compensation, C , then the manager can be worse off compared to the analysis in Section 3. However, since the manager's access to outside investors does not affect neither the strategic buyer's valuation nor the private equity fund's valuation, extending the analysis to include outside investors does not have any direct effect on our previous analysis of the outcome and efficiency of the takeover game between a strategic buyer and a PE fund.²¹

A similar concern deals with the matter of the private equity fund's options as well as the strategic buyer's options to fund the takeover and subsequent investments. With respect to the private equity fund we have assumed that the return requirement r proxies for the cost of setting up an efficient contract within the fund; that is, between the general partner and the limited partners. The subsequent funding is in practice most often done with a minor share consisting of equity from the fund's committed capital and a major share consisting of newly issued debt based on the assets in the acquired firm; that is, a levered buyout. In our analysis we assume that the PE fund's debt can be issued without frictions due to reputation costs for the PE fund, if investors subsequently infer that the PE fund misbehaved when issuing debt (e.g., Demiroglu and James, 2010). Thus, absent from tax effects, outside investors have already been implicitly considered with respect to the PE fund.

²¹There would potentially be an effect if these two parties were in a more complex bargaining situation with the manager, and their bargaining strengths were unequal.

The need to fund with outside investors is a more delicate concern when it comes to the strategic buyer. Restricting the strategic buyer to fund with outside investors would imply a trade-off involving private benefits as well as cross-subsidization with the strategic buyer’s pre-takeover assets. If an investment-efficient contract with outside investors—from the strategic buyer’s point of view—can be obtained, then the analysis is as in Section 3. If not, the strategic buyer would be limited in the contest with the private equity fund; that is, the intrinsic maximum willingness to pay can be larger than what can be supported by funding from outside investors. Thus, in this case private benefits can make it more challenging for the strategic buyer to win over the private equity fund, whereas with private benefits for a deep-pocket strategic buyer makes it more likely that such a firm acquires the manager’s firm.

5.2 Private Equity Fund’s Acquisition of Two Firms

Arguably, the information advantage of PE funds is particularly pronounced when they handle investment-relevant information in a portfolio of firms. Those strategic buyers who likewise engage in multiple takeovers are more likely to focus on issues of integration than on the separate possibilities arising from the various acquired firms. In this extension we illuminate this logic in a formal model. As before, this information-based competitive advantage for PE funds also improves welfare.

5.2.1 Model

We consider two target firms, A and B . To avoid unnecessary analytical complexity, we let each firm be a copy of the target firm considered earlier. Initially, firm A has assets A_1 and A_2 , and firm B has assets B_1 and B_2 . Only asset A_1 (B_1) can eventually provide a profitable return. Each firm has a growth option whose eventual success depends on states θ_A and θ_B . Let these states be independently and identically distributed as in the one-firm model.

The PE fund is interested in taking over both firms. Upon making the first-stage investments in each firm, as before, the PE fund receives signals s_A and s_B . We take the signals to be independently distributed, conditionally on state pair (θ_A, θ_B) . Copying all specifications and assumptions from the one-firm model, the PE fund will always shed the legacy assets in each acquired firm, and make the first-stage investment to obtain the

signals. As before, these signals s_i are then separately perfectly informative about the separate firm's state θ_i . Finally, the PE fund makes the second-stage investment in each high-state firm.

Since the PE fund's behavior in each case is identical to that with one firm, the valuation for each target firm continues to be given by (8). Society's value from PE acquisition of each target firm continues to be given by (13).

Let us now turn to model the strategic buyer dimension. Sometimes, a PE fund faces two independent strategic buyers for the separate target firms. In this case, the outcome of each takeover battle is exactly as in the one-firm model. The earlier model can very easily accommodate a portfolio-driven informational advantage of PE funds in the setting with multiple strategic buyers: let the informational friction (η_{sb}) of each strategic buyer be greater than before. The results of the model are then two copies of all the results from the one-firm case, only with informationally weaker strategic buyers.

We focus on the more challenging case when a single strategic buyer is likewise interested in the acquisition of both targets. This case is particularly relevant in times when firms engage in M&A activities to strengthen their market power. If the strategic buyer acquires only one firm, again, everything will be an exact copy of the one-firm analysis. In the remaining case, the strategic buyer bids to take over both targets. For each target, then, it first has to decide whether to sell the legacy assets, A_2 and B_2 . Extending our analysis from before, we will focus on parameters where both of these assets are kept. Private benefits and synergy gains are produced in each firm as before.

In order to capture the relative informational weakness of the strategic buyer in the two-firm model, we analyze a form of information overload. After making the first-stage investment I_1 in each firm, two "hidden" signals are produced. The hidden signals are independent, conditionally on state pair (θ_A, θ_B) . They are also distributed as in the one-firm model, with the same information friction parameter η_{sb} . However, the strategic buyer does not observe a signal s_i specific to state θ_i . Instead it actually receives a signal pair which has garbled the two hidden signals. With probability $\zeta \in (0, 1/2)$, the two coordinates from the hidden signal are swapped, while with probability $1 - \zeta$ the strategic buyer sees the true hidden signal. The strategic buyer does not know whether the coordinates were swapped or not, but knows that swapping happens with probability ζ . Table 2 displays the simultaneous distribution of signals and state. When both hidden

		(θ_A, θ_B)				$\Pr(s_A, s_B)$
		(1, 1)	(1, 0)	(0, 1)	(0, 0)	
(s_A, s_B)	(1, 1)	$p^2 \frac{1}{\eta^2}$	0	0	0	$\left(\frac{p}{\eta}\right)^2$
	(1, 0)	$p^2 \frac{\eta-1}{\eta^2}$	$p(1-p) \frac{1-\zeta}{\eta}$	$p(1-p) \frac{\zeta}{\eta}$	0	$\frac{p}{\eta} \left(1 - \frac{p}{\eta}\right)$
	(0, 1)	$p^2 \frac{\eta-1}{\eta^2}$	$p(1-p) \frac{\zeta}{\eta}$	$p(1-p) \frac{1-\zeta}{\eta}$	0	$\frac{p}{\eta} \left(1 - \frac{p}{\eta}\right)$
	(0, 0)	$p^2 \frac{(\eta-1)^2}{\eta^2}$	$p(1-p) \frac{\eta-1}{\eta}$	$p(1-p) \frac{\eta-1}{\eta}$	$(1-p)^2$	$\left(1 - \frac{p}{\eta}\right)^2$
$\Pr(\theta_A, \theta_B)$		p^2	$p(1-p)$	$p(1-p)$	$(1-p)^2$	1

Table 2: Simultaneous distribution $\Pr(s, \theta)$ of states and signals, as well as marginal distributions in the last row and column, respectively. To improve legibility, we have written η where the meaning is η_{sb} everywhere.

signals have identical realizations (both at zero, or both at one), swapping makes no difference. When the two signal realizations differ, however, it is harder for the strategic buyer to infer the true state. When $\zeta = 0$, there is no information overload, but the greater is $\zeta \in (0, 1/2)$, the greater is this information friction. Once $\zeta = 1/2$, signal pairs (0, 1) and (1, 0) are at their least informative level, arising as frequently in state pair (θ_A, θ_B) as in the permuted state pair (θ_B, θ_A) .²²

The main effect of information overload is that the strategic buyer is going to make investment decisions that are ex post less valuable, the greater is the information-overload friction ζ . The greater risk of swapping the two signals implies that the signal pair is less informative about each firm's state.²³

By implication, each firm is less valuable to the strategic buyer, so it is less competitive at the ex ante stage. Similarly, if the strategic buyer takes over a firm, its investment policy is less efficient, and welfare is lost. These effects are strict if the strategic buyer really relies on using the signal for the investment decision at stage 2, i.e., investing like the PE fund.

Proposition 3 *The greater is the information-overload friction ζ , the higher is the information discount, and the lower is welfare in case the strategic buyer wins. Each of these two effects is strict if and only if the strategic buyer invests like the PE fund in the one-firm setting.*

²²Alternatively, we can model this as the strategic buyer receiving the signal $s = s_A s_B$. It is also possible to model the two-firm case with correlated signals; this only affects the case when the two signal realizations differ—results are qualitatively the same, after a more complicated analysis.

²³The strategic buyer with swap risk ζ is able to replicate the outcome after optimal behavior with swap risk $\zeta' > \zeta$. Namely, start by further swapping the two signals with chance ζ'' such that $\zeta' = \zeta(1 - \zeta'') + (1 - \zeta)\zeta''$. The requisite ζ'' exists since $\zeta < \zeta' < 1/2 < 1 - \zeta$.

5.2.2 Discussion

In the battle for two firms, it is also plausible that the synergy gains are different from before. In particular, the synergy gains could materialize precisely when a buyer takes over both firms. The analysis of the model extension follows direction from our earlier analysis of synergy gains.²⁴ If one type of buyer expects greater synergy gains, it will be more competitive at the bidding stage. Depending on the nature of the synergy gains, the welfare difference among PE funds and strategic buyers may go either way, exactly along the lines discussed before. The main insight from the two-firm analysis is that it effectively corresponds to considering the information-overload friction as an additional information friction which can play a role different than η_{sb} . Even if there is no information friction in the one-firm case, $\eta_{sb} = 1$, then a strategic buyer with two-firms is subject to an informational distortion when $\zeta > 0$. In this case, an information discount still prevails and, importantly, a takeover by a strategic buyer does not improve welfare.

5.3 Information Regarding Takeover Gains

We have assumed that there is perfect information regarding the gains G_{PE} and G_{SB} . A classical issue in takeovers is how to convince the incumbent shareholders to sell their shares to a raider who can improve the value (e.g., Grossman and Hart, 1980; Shleifer and Vishny, 1986). Clearly, we could consider a more complex model in which the bargaining game between the manager and the PE fund is more elaborate, or we could introduce asymmetric information regarding the size of the gains. In the latter case, the expected gains would be the central ingredient (perhaps conditional on the takeover offer being profitable to the PE fund), and we would get some further conditions for when a private equity takeover is possible. However, we do not see that these conditions change the first-order effects elicited in our model, and thus we leave out this more complex setting in order to preserve tractability of our model.

²⁴That is, we can add synergy gains G_{PE}^{AB} and G_{SB}^{AB} for the PE fund and the strategic buyer, respectively, which are only effective when investing in two firms. However, this is qualitatively similar to adjusting G_{PE} or G_{SB} in the one-firm case.

6 Conclusion

Firms with a potential for value creation are limited in exploiting their growth opportunities, if they are subject to information frictions. Private equity funds and strategic buyers compete about acquiring such firms. Following an acquisition, the two types of buyers vary in their ex post strategies. Due to the framework in which private equity funds are set up, they have a relatively short time horizon for getting verifiable signals supporting improvements. This leads to immediate termination of loss-making projects and potentially mergers with similarly restructured constrained firms. This provides a specific role for private equity funds in realizing gains. In contrast, a strategic buyer focuses on integrating the acquired firm into the existing business plan. This difference leads to different incentives.

We show under which conditions private equity funds have a competitive advantage in acquiring constrained firms with a potential. Private equity funds are well poised to acquire the target, unless the competing strategic buyers can avoid information costs and are able to obtain synergy gains of a magnitude that is at least comparable to the potential value unleashed by private equity funds.

Since the activities of private equity funds are highly debated, we also consider welfare effects from a broader societal perspective. We find that when takeovers by private equity funds take place, then they can in most cases be expected to improve society's welfare. A notable exception is when the funds excel at tax avoidance. We also highlight that high return requirements within private equity funds can crowd out takeover opportunities pointing towards a potential loss for society. Thus, private equity funds may serve as a means to mitigate information frictions and by that contribute to welfare.

A Appendix

A.1 Proof of Lemma 1

Proof. If the maximum in the second term is zero, it follows from Assumption 2 that W_2 locally decreases in η_{sb} . If the maximum is positive, then $W_2 = U_{A_1} + U_Q - I_2 + p(V_{A_1} + G_{SB}) - I_1$ which is locally constant in η_{sb} . If η_{sb} is a critical point where the maximum switches from zero to positive as η_{sb} increases, then we note that W_2 switches continuously from the decreasing to constant part, establishing the desired monotonicity of W_2 . Thus, W_2 is never greater than its limit for $\eta_{sb} \rightarrow 1$, where W_2 converges to W_1 . ■

A.2 Proof of Proposition 1

Proof. The result follows directly from analysis of condition (9). All mentioned parameters enter on one side of the condition only, so the claims are simple to verify. Only changes of parameters consistent with the assumptions should be considered. ■

A.3 Proof of Corollary 1

Proof. When $u_{gpe} = 1$, comparison of (8) with (13) shows that society places no smaller value on the PE fund's ownership than it does privately. On the other hand, comparison of (5) to (14)–(16) shows that society places no greater social value on the strategic buyer's ownership than it does privately. It follows that society prefers PE fund ownership whenever its private value exceeds that of the strategic buyer, i.e., whenever it wins the takeover competition. For part 2, notice that with $u_U = 0$, the strategic buyer values its ownership of the target discretely higher than society does. For parameter constellations where the strategic buyer narrowly wins the takeover competition, society incurs a loss. ■

A.4 Proof of Lemma 4

Proof. Case a. Since it is inefficient to invest if $s = 0$, the manager will choose C to satisfy incentive constraint (22) with equality. Then α must be determined by the outside

		(θ_A, θ_B)			
		(1, 1)	(1, 0)	(0, 1)	(0, 0)
(s_A, s_B)	(1, 1)	1	0	0	0
	(1, 0)	$p \frac{\eta-1}{\eta-p}$	$(1-p)(1-\zeta) \frac{\eta}{\eta-p}$	$(1-p)\zeta \frac{\eta}{\eta-p}$	0
	(0, 1)	$p \frac{\eta-1}{\eta-p}$	$(1-p)\zeta \frac{\eta}{\eta-p}$	$(1-p)(1-\zeta) \frac{\eta}{\eta-p}$	0
	(0, 0)	$\left(p \frac{\eta-1}{\eta-p}\right)^2$	$p(1-p) \frac{\eta(\eta-1)}{(\eta-p)^2}$	$p(1-p) \frac{\eta(\eta-1)}{(\eta-p)^2}$	$\left((1-p) \frac{\eta}{(\eta-p)}\right)^2$

Table 3: Conditional distribution $\Pr(\theta|s)$, where $\theta = (\theta_A, \theta_B)$, $s = (s_A, s_B)$. To improve legibility, we have written η where the meaning is η_{sb} everywhere.

investors' zero-profit condition,

$$\begin{aligned}
0 &= \frac{p}{\eta_m} (\alpha V_{A_1} - I_2) - \frac{\eta_m - p}{\eta_m} C - I_1 \\
&= \frac{p}{\eta_m} (\alpha V_{A_1} - I_2) - \frac{p\eta_m - p}{\eta_m} (1 - \alpha) V_{A_1} - \frac{\eta_m - p}{\eta_m} U_{A_1} - I_1 \\
&= p\alpha V_{A_1} - \frac{p}{\eta_m} I_2 - \frac{p\eta_m - p}{\eta_m} V_{A_1} - \frac{\eta_m - p}{\eta_m} U_{A_1} - I_1, \tag{30}
\end{aligned}$$

where the first equality follows from replacing C from the binding constraint (22), and the second equality collects terms. Obviously, $\alpha > 0$ is necessary to satisfy (30). On the other hand, (30) can be solved with $\alpha \leq 1$ if and only if

$$pV_{A_1} \geq \frac{p}{\eta_m} I_2 + \frac{p\eta_m - p}{\eta_m} V_{A_1} + \frac{\eta_m - p}{\eta_m} U_{A_1} + I_1, \tag{31}$$

equivalent to (23).

Case b. There is no incentive constraint, and $C = 0$, so the outside investors' zero-profit condition becomes

$$0 = p(\alpha V_{A_1} - I_2) - I_1, \tag{32}$$

which can be solved for $\alpha \in [0, 1]$ if and only if (24) holds. ■

A.5 Proof of Proposition 3

Proof. We record the posterior distributions that follow from Table 2 in Table 3.

When the strategic buyer needs to value firm A , it relies on computing the marginal probability $\Pr(\theta_A = 1|s)$. When the signal pair is (1, 1) or (0, 0), this posterior probability is exactly the same as in the single-firm model, namely 1 and $(p\eta_{sb} - p)/(\eta_{sb} - p)$,

respectively. Summing entries for state pairs $(1, 1)$ and $(1, 0)$ from Table 3, we obtain $\Pr(\theta_A = 1|s = (1, 0)) = 1 - \zeta(1 - p)\eta_{sb}/(\eta_{sb} - p)$. On the other hand, $\Pr(\theta_A = 1|s = (0, 1)) = 1 - (1 - \zeta)(1 - p)\eta_{sb}/(\eta_{sb} - p)$. Note that, $\Pr(\theta_A = 1|s = (1, 0))$ strictly falls below $\Pr(\theta_A = 1|s = (1, 1)) = 1$ as ζ rises. Likewise, $\Pr(\theta_A = 1|s = (0, 1))$ strictly rises above $\Pr(\theta_A = 1|s = (0, 0))$ as ζ rises. As long as $\zeta < 1/2$, as we have assumed, it remains true that $\Pr(\theta_A = 1|s = (1, 0)) > \Pr(\theta_A = 1|s = (0, 1))$.

Consider the case where the strategic buyer always invests in the one-firm model. All signal pair realizations provide $\Pr(\theta_A = 1|s) \geq \Pr(\theta_A = 1|s = (0, 0))$. So, in the two-firm case, the buyer still always invests. Since the signal pair does not influence any decision, modifying its distribution via ζ has zero effect on the outcome.

Likewise, in the case where the strategic buyer never invests. All signal pair realizations provide $\Pr(\theta_A = 1|s) \leq \Pr(\theta_A = 1|s = (1, 1))$, and therefore the strategic buyer still never invests.

Finally, when the strategic buyer invests like the PE fund, it will suffer a loss that is strictly rising in ζ . The distribution over the strategic buyer's posterior beliefs is strictly worse, being less spread out in the mean-preserving spread sense. Indeed, from Table 2, the probability of each signal realization pair is constant with respect to ζ . As recorded above, the effect of greater ζ is to move $\Pr(\theta_A = 1|s = (1, 0))$ and $\Pr(\theta_A = 1|s = (0, 1))$ to less extreme positions.

It follows that the strategic buyer's expected value of beliefs is strictly lower (recalling the value of information illustrated in Figure 2). As long as the strategic buyer remains interested in investing I_1 , it is evident from (4) that the strategic buyer's valuation for firm A is strictly decreasing in ζ . It is constant in ζ once the strategic buyer no longer desires to invest I_1 . The same analysis applies to firm B . That is, the information discount is non-decreasing in ζ for either firm.

Finally, the equivalent of welfare expression (14) strictly decreases when the probability of matching investment I_2 to a good state decreases. ■

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