

# Financial vs. Strategic Buyers

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*Within the great oscillations of overall merger activity there is a shifting pattern of activity between strategic (operating firms) and financial (private equity) acquirers. What are the economic factors that drive either financial or strategic buyers to a more dominant position in M&A activity? We introduce the role of debt market misvaluation in M&A activity. Debt market misvaluation might seem limited since both types of acquirer can access misvalued debt markets. However, we demonstrate how moral hazard and insurance effect differences between types of buyers, interact with potential misvaluation of debt, leading to a dominance of financial versus strategic buyers that depends on debt market conditions.*

Mergers and Acquisitions occur in great waves of activity with recent troughs, for example, of only a few thousand deals in 2003 and peaks of over ten thousand deals in 1999 and 2006.<sup>1</sup> Within this oscillation of activity there is another shifting pattern: the percentage of so called financial sponsors (private equity firms) vs. strategic buyers (operating companies) seems to ebb and flow.

Figure 1 examines the financial sponsor vs. strategic proportion of M&A activity of all public targets with values less than \$1 billion recorded in the SDC Platinum

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<sup>1</sup>U.S. merger activity as reported by SDC Platinum data base. See Harford (2005), Rhodes-Kropf and Viswanathan (2004), Mitchell and Mulherin (1996), Andrade et al. (2001), and Holmstrom and Kaplan (2001) for empirical evidence on merger waves.

data base from 1985-2008.<sup>2</sup> It is immediately clear that the fraction of total deal value acquired by financial sponsors has varied dramatically over the last 25 years. This same pattern is true across many industries and geographies.

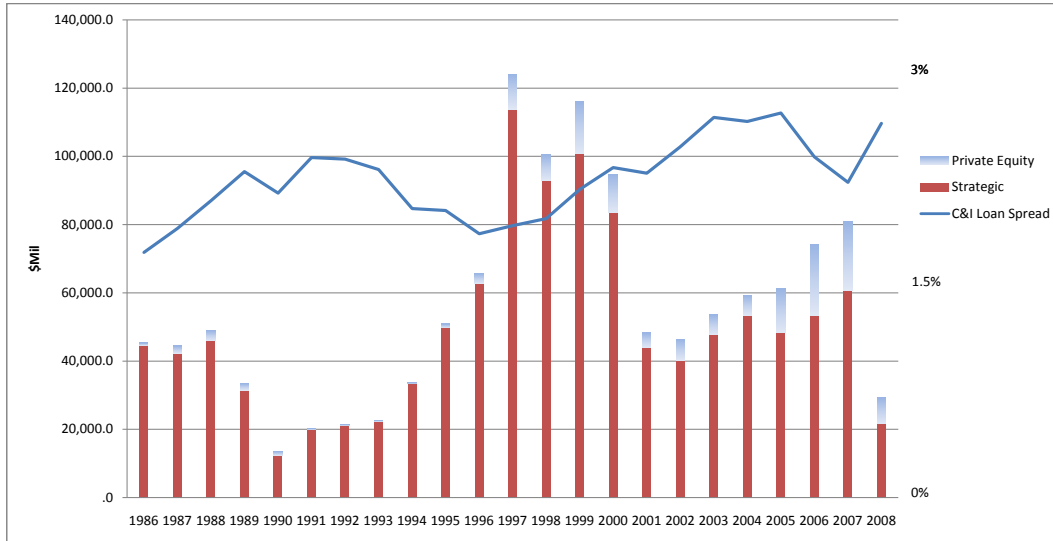


FIGURE 1. US M&A VOLUME (\$10M-\$1B) FINANCIAL VS. STRATEGIC

Any particular transaction has many factors that drive the ultimate acquirer's willingness to pay. And many theories propose reasons why particular firms or industries may be ripe for acquisition activity.<sup>3</sup> However, the broad pattern of financial sponsor activity that spans industries and geographies at a given point in time suggests a broad economic explanation for the coordination. Little research directly considers the competition between financial and strategic buyers. Müller and Panunzi (2004) and Morellec and Zhdanov (2008) examine the leverage of financial buyers but they do not consider potential strategic buyers. Recent working papers by Bargaron et al. (2008), Hege et al. (2010), and Dittmar et al. (2009) focus on bidding behavior and target premiums between strategic and financial acquirers.<sup>4</sup> A

<sup>2</sup>Private equity firms are limited in the size of checks they can write to buy a firm by the amount they have under management and covenants with their investors, called limited partners or LPs. Both strategic and financial buyers can reasonably acquire public targets with values less than \$1 billion. Increasing the target size cutoff dampens the percentage of PE activity in every period, but the increases and decreases in activity are still evident. We also removed deals less than \$10M as a standard screen. The C&I spread is the commercial and industrial loan rates minus the federal funds rate. See William E. Fruhan (2010) for more on the role of PE in acquisitions and the shifting pattern across time.

<sup>3</sup>See Maksimovic and Phillips (2001), Gorton et al. (2009), Jovanovic and Rousseau (2002), Mitchell and Mulherin (1996), Lehn et al. (1990), Mulherin and Boone (2000), and Harford (2005).

<sup>4</sup>Bargaron et al. (2008) report that target shareholders receive a 63% higher premium when the buyer is

recent working paper, Gorbenko and Malenko (2009), considers the bidding behavior of strategic vs financial bidders focusing on how synergies cause different bidding behavior than the search for undervalued assets. Jensen (1986) famously argues that free cash flow determines which firms are taken over by LBOs. And Holmstrom and Kaplan (2001) document and discuss the LBO wave in the late 1980s. However, no research that we know of offers any broad insights into the rising and falling tides of private equity activity through the different merger waves.

What drives either financial or strategic buyers to have a more dominant position in M&A activity at different points in time? This question is important not only because the economic magnitude of this activity is so large, but also because the balance of power between financial vs. strategic acquirers changes the ownership structure of assets and alters the incentives and governance mechanisms that surround the economic engine of our economy.<sup>5</sup>

One potential broad economic mechanism that would imply a shifting willingness to pay by strategic investors stems directly from previous work done on merger waves. The theories of Rhodes-Kropf and Viswanathan (2004) and Shleifer and Vishny (2003) both suggest that overvalued acquirers will bid more than undervalued acquirers and overvalued targets are more willing to accept takeover offers, leading to waves of M&A activity during overvalued markets. Strong support for the misvaluation theory has been found by Rhodes-Kropf et al. (2005), Ang and Cheng (2006), Dong et al. (2006) and others. But clearly, financial buyers who must pay in cash should avoid overvalued targets. This implies that patterns of financial vs. strategic activity could be driven by the same phenomenon. However, a quick look at figure 1 suggests that something else must be at work as the local peaks of financial sponsor activity *relative* to strategic activity correspond with stock market peaks such as the late 90s and 2006-2007, with dips in the early 90s and 2001 recessions.

a strategic vs private equity firm, while Hege et al. (2010) models the decision of private equity firm to bid for corporate assets and report evidence that private equity deals generate greater seller returns, Dittmar et al. (2009) report that when a corporate acquirer competes with a financial rather than a corporate bidder, the acquirer pays a significantly lower premium and earns a significantly higher abnormal return.

<sup>5</sup>Academic work as well as the lay press suggest that there are potentially many different costs and benefits of public vs. private ownership. The difference can alter incentives, promote a long or short run focus, allow for tighter monitoring and less shirking, etc.

Harford (2005) shows that interest rates, specifically the spread between the average interest rate on commercial and industrial loans and the Federal Funds rate, are significantly inversely correlated with merger activity as can be seen in Figure 1. Although Harford (2005) proposes no formal theory of merger activity, he argues that this spread is a proxy for overall liquidity or ease of financing.

In this paper we combine the results from Harford (2005) with the ideas of the misvaluation hypothesis and explore how the possibility of misvalued debt markets can both fuel merger activity and alter the balance between PE and strategic buyers.

While it seems reasonable that if equity markets can be misvalued then so can debt markets, it is much less obvious that “cheap” debt should lead to more acquisition activity. After all, the targets can also access cheap debt and so are more valuable as stand-alone entities when debt is cheap. On top of this, it is not clear how debt misvaluation should alter the interplay between financial and strategic buyers. Just believing that debt markets are overvalued does not imply a benefit to one type of buyer. After all, if both types of acquirers find a misvalued debt market, cannot both take advantage of it? Since it is not ex-ante obvious what misvalued debt might do to the M&A market or how it would differentially impact the participants, our model provides important insights and understanding. We also take our main theoretical implication to the data to help show the strength of the theory.

Our approach is based on a model of private equity (PE) and strategic merger activity in which all players in the model make value maximizing decisions conditional on their information. Misvaluation can stem from asymmetric information between PE firms, managers, and investors à la Myers and Majluf (1984), (see also Greenwald et al. (1984)).<sup>6</sup> And of course, any biases, irrationality, or limited cognitive ability could also cause a miss perception in the probability of success (see Barberis and Thaler (2003), Hirshleifer (2001), and Shleifer (2000) for summaries). In this paper, we take the potential for managers and bondholders to have different viewpoints on valuation as a given and see where that leads, without taking a particular stand on the cause of such difference.

While we assume that each type of buyer and the target can equally access the

<sup>6</sup>Kumar and Langberg (2009) and Goldman and Slezak (2006) also consider the possibility that informed insiders strategically manipulate outside investors beliefs.

debt market, there exist fundamental differences that alter the benefit to each. The fundamental differences between a strategic buyer and a financial buyer are 1) strategic buyers have a current project (or projects) they are considering combining with the target, while financial sponsors evaluate the target as a stand-alone project, and 2) financial buyers have a different governance structure than a strategic buyer.<sup>7</sup> Using these fundamental differences we consider both the co-insurance effect and the monitoring effect.

The co-insurance effect arises anytime less-than-perfectly correlated projects are combined. This effect was first proposed by Lewellen (1971) and then extended by Higgins and Schall (1975) and Galai and Masulis (1976) and has been repeatedly considered in the financial literature both empirically and theoretically. For example, see Kim and McConnell (1977) for an early empirical examination of the co-insurance effect on debt prices after mergers, while Leland (2007) completes an in-depth theoretic examination, and Faure-Grimaud and Inderst (2005) considers the effect of uncorrelated projects in the context of conglomerates and governance. We build on this work to examine how the co-insurance effect interacts with the potential misvaluation of debt claims even when agents are risk neutral.

We show that financial sponsors are better able to take advantage of interest rates that are too low because strategics are diversifying and therefore minimizing the error investors make. While strategics are less hurt by interest rates that are too high because diversification is highly valued when project failure rates are expected to be high. Therefore, while both strategic and financial buyers would like to take advantage of interest rates that are “too low” and avoid borrowing when interest rates are “too high” they are differentially impacted by the errors and are willing to pay *relatively* more or less depending on the sign of the error made on interest rates.

There is also a monitoring effect because PE buyers are often thought to have better oversight and governance than strategics. Better monitoring causes an increase in the use of leverage. Misvaluation will also potentially alter the moral

<sup>7</sup>We will see that it may be beneficial for strategics to acquire targets in a bankruptcy remote way. To the extent this is possible (while still achieving synergies) one prediction from our model is when this is more likely to occur.

hazard problem faced by investors in the firm. In which case the governance of a financial buyer relative to a strategic buyer will potentially create another reason why financial buyers may dominate in overvalued debt markets. To the extent that PE firm oversight is a better governance structure that allows for more debt, and to the extent misvaluation makes the moral hazard problem worse, then PE buyers will be able to create more value in misvalued debt markets than strategic buyers. The joint presence of moral hazard and misvaluation yields interesting insights and allows us to contribute at a methodological level to the literature by analyzing an agency model with asymmetric information between investors and managers.

Overall, the potential for misvalued debt has a number of interesting empirical implications. First and foremost, the possibility of misvalued debt not only changes the likelihood of an acquisition, it also changes the type of buyer and the way the assets are owned. This prediction has empirical content because although the knowledge that the debt market is under or overvalued may be impossible to possess in real time, looking backward we should find that times when credit was particularly easy correspond to increased M&A activity and increased PE activity relative to strategic buyers. Furthermore, the level of activity of financial buyers in aggregate in the economy will correlate with default probabilities. Financial buyers will be more active and take on more debt than strategics when debt is overvalued. Thus a surprisingly large number should end up in financial distress.

We take our central prediction to the data and find that measures of debt market overvaluation strongly correlate with the ratio of private equity (PE) to strategic merger activity. Moreover, debt market overvaluation drives out any relationship between the PE/Strategic merger activity ratio and a number of other variables related including corporate borrowing growth, commercial and industrial credit spread (C&I), the 5-year treasury yield, the high-yield credit spread, the M/B ratio, and the standard deviation of the M/B ratio. We find that debt market misvaluation, as measured by the inaccuracy of Moody's ratings, is the only variable that explains the dominance of PE activity.

Our second empirical prediction relates to PE returns. Although the possibility of overvalued debt may help financial buyers win the target, overvalued debt may

not help financial buyers' returns. Overvalued debt increases all financial buyer's willingness to pay, but competition may cause the gains to go to the target. Since PE firms are more likely to win in overvalued credit markets, they should use more leverage and pay higher prices. Axelson et al. (2010) find support for this idea and report that credit market conditions affect the prices paid and are the main driver of the quantity of debt used in buyouts. Furthermore, Axelson et al. (2010) find that highly levered transactions are associated with lower fund returns. Furthermore, Hege et al. (2010) report that sellers of assets to PE buyers earn positive returns significantly greater than in sales to public operating firms.

Third, our theory suggests that PE firms will tend to dominate strategic buyers during times when the debt markets are overvalued. But the relative dominance of PE firms to strategics should be even greater if the strategic is a conglomerate. Conglomerates are thought to have governance issues (see Scharfstein and Stein (2000) and Rajan et al. (2000)) as well as cross project co-insurance effects. Thus, the effects we propose suggest that overvalued debt markets should lead to greater dominance of financial buyers over conglomerates than over more focused strategic acquirers. Furthermore, conglomerates should increase their divestitures during times of overvalued debt markets.

Fourth, while on average the co-insurance effect of debt suggests that conglomerates should have more debt than stand alone firms, when we consider the potential for time variation in misvaluation we see why this would not necessarily hold in the cross section. Our theory suggests that PE firms will tend to dominate conglomerates during overvalued debt markets. Thus, conglomerates should do relatively more acquiring (and less divesting) during *undervalued* debt markets and thus will use less debt. Therefore, if, as in Baker and Wurgler (2002) the effects on capital structure are persistent then since more stand-alone firms with financial backers and high leverage will be created in overvalued debt markets and conglomerates will tend to make relatively more acquisitions during undervalued debt markets, conglomerates may have lower leverage on average.

Finally, if debt maturities are shorter than the investment horizon of the project, then a PE firm must impound its forecast of the future expected misvaluation of debt

markets into its willingness to pay today. An expectation of future overvaluation may lead a PE firm to pay a higher amount today and borrow more. Then, if debt markets shift from over to undervalued, it may turn out that the financial buyer paid significantly more than the investment is now worth given that it has to be refinanced with undervalued debt. This was not a mistake ex-ante, given debt prices, but will lead to the possibility of sudden collapses ex-post that are not related to a change in the health of the underlying acquired firm. Furthermore, the larger the original debt market misvaluation the larger the resulting financial distress. Therefore, depending on the costs of financial distress, the underlying target firm may be impacted in a way that would not have occurred if debt markets were always correctly valued.

Together these implications and early findings suggest that the possibility of misvalued debt may have important impacts on both firms and investors, on who buys whom, and for default levels in the economy. We hope these ideas guide future work to some interesting findings.

The remainder of the paper is organized as follows. The basic model is developed in Section I. The willingness-to-pay of different organizational forms is determined in Section II. Section III will present the results of comparing the different organizational forms. Section IV contains a discussion of the main ideas in the paper and some extensions. Section V provides some empirical evidence. Section VI concludes.

## I. The Model

### A. *Managers and Private Equity Partners*

The basic set up comes from the workhorse model of Holmstrom and Tirole (1997) with some interesting additions. This model has been used to model the effect of financial intermediaries such as banks and private equity firms on aggregate investment when there are financing constraints. We base it on this model to more easily connect the results to the literature and also because it provides a straight-forward way of modeling governance issues among the different types of organizational forms.

The economy consists of three types of agents: managers, private equity partners, and investors. They differ in both their abilities to generate returns and their information sets, in a way that will be clear shortly. All agents are risk-neutral.



There is a project for sale with a current manager, who owns the project, and there are two potential buyers of the project: a PE firm (who joins with a manager), and a manager with a current project (a merger or strategic acquirer). Whether or not the project is purchased, it requires an investment  $I$  (in period 1) to realize its return (in period 2). In period 2, the investment generates a verifiable return equaling either 0 (failure) or  $R$  (success). The magnitude of the success depends on how the project is managed. A stand-alone project returns  $R$ , a project with a PE partner who monitors the project, returns  $R^{pe}$ , and a project together with another project returns  $R^s$  per project. It is obvious that synergies or increased operating efficiency in an LBO will boost the price a strategic buyer or a financial buyer are willing to pay, respectively. However in this paper we want to focus on the less obvious channels mentioned in the introduction hence we will from now on assume  $R^s = R^{pe} = R$ , bearing in mind the obvious effects of different returns for each of the three organizational forms.

The probability that the project succeeds (and returns  $R$ ) is either  $p_H$  or  $p_L$  ( $\Delta p = p_H - p_L > 0$ ) depending on the manager's project choice (or equivalently effort choice). Projects are run by managers who receive private benefits of 0,  $b$  or  $B$  where  $0 < b < B$ . Projects with a private benefit of  $b$  or  $B$  have a low success probability of  $p_L$  while the 'good', high probability, projects have no private benefits. This can be interpreted either as reduced/increased effort affecting probabilities of success, or as a managerial pet project with higher private benefits but lower expected returns. Thus, without proper incentives managers will choose lower expected return projects with higher private benefits. We assume that investors require a return  $\gamma$  and that only the good projects are economically viable, i.e.,

$$(1) \quad p_H R - \gamma I > 0 > p_L R - \gamma I + B.$$

The potential benefit of including a private equity investor in the project is that PE firms can monitor the project and prevent the manager from choosing the high private benefit,  $B$ , project. However, PE firms must pay a cost,  $c > 0$ , to monitor and will therefore only monitor if they have the incentives to do so. We assume that monitoring is efficient in the sense that  $B - (b + c) > 0$ .

Potential buyers of the project are willing to pay up to a maximum value  $\bar{V}^{pe}$  if they are a PE firm, or  $\bar{V}^s$  if they are a manager with another project (strategic acquisition with synergies). The stand-alone manager values the project at  $\bar{V}$  which is just the highest amount they could extract from the firm if it is not sold. The price paid by a buyer is for the right to invest  $I$  in the project. Therefore, the total amount needed for the project is  $\bar{V}^i + I$ . The buyer may pay for the project and the needed investment with either the cash they possess or by raising money from investors.<sup>8</sup> Managers (with or without another project) have capital  $A_m$  and PE investors may choose to invest capital  $A_{pe}$ .<sup>9</sup> In order to focus on the interesting case when outside investors are needed we will assume that  $A_m + A_{pe} < I$ . We assume that there are infinitely many investors who do not monitor and demand an expected return of  $\gamma$ .<sup>10</sup> Since an optimal contract in this setup pays investors first and gives the residual to those who need incentives, we will often refer to managers as raising debt from investors.

### B. Uninformed Investors

The most interesting addition to the standard modeling assumptions above is the potential for investors to not know and thus estimate with error or miss perceive the probability of success and failure. We assume that all managers (including acquiring managers) and private equity investors know  $p_H$  and  $p_L$ . However, uninformed investors do not know the true probabilities and instead use the probabilities  $p'_H$  and  $p'_L$  in assessing expected values.

A difference between the probabilities used by managers and those used by investors could arise fully rationally due to asymmetric information à la Myers and Majluf (1984).<sup>11</sup> Or, any biases, irrationality, or limited cognitive ability and limits

<sup>8</sup>We assume the selling manager is as informed as potential buyers or requires all cash for exogenous reasons so nothing is learned from the seller's choice to sell or by their decision not to accept contingent claims. See Fishman (1989) and Hansen (1987) for interesting papers on the role of the medium of exchange in acquisitions under asymmetric information between a target and competing bidders.

<sup>9</sup>We will see that if monitoring skill is scarce then PE firms will always want to allocate the minimum to any investment in order to maximize the return to monitoring. Thus,  $A_{pe}$  will be determined endogenously in the model.

<sup>10</sup> $\gamma$  could include a return due to the supply and demand for capital as well as for the equilibrium amount of expected agency costs in the model.

<sup>11</sup>If the investor misvaluation is rational then we must assume that prices are not fully revealing. That is,  $p'_H$  and  $p'_L$  are the probabilities conditional on all available information including the actions of the participants in the know. It seems reasonable that when an acquisition closes the buyer knows more about

to arbitrage could also result in an equilibrium miss perception in the probability of success (see Barberis and Thaler (2003), Hirshleifer (2001), and Shleifer (2000) for summaries). In this paper we take no stand on the source of the mistake only that it is possible for investors to be mistaken. Given the state of the financial markets over the last few years we do not think it is difficult to believe in the possibility that investors misunderstood the potential risk.

The project probabilities can be thought of as having two parts: a firm specific part and a part that relates to the industry/economy as a whole. We focus on a situation in which investors miss perceive the industry/economy-wide component as this alters the opportunity cost for everyone and makes it so that actions by the informed are not revealing and makes arbitrage more challenging and thus the limits to arbitrage argument more plausible.

We assume that uninformed investors still require a return  $\gamma$  and have probability beliefs such that only the good projects are economically viable, i.e.,

$$(2) \quad p'_H R - \gamma I > 0 > p'_L R - \gamma I + B.$$

If debt markets can be under or overvalued then the obvious conclusion is that everyone should issue more debt when it is overvalued by investors and less when investors have too high expectations of default. However, what is interesting about our setup is that it allows us to explore how the misvaluation of debt differentially affects the different types of buyers and the stand-alone firm. It would seem that when debt is misvalued all types of buyers and the stand-alone firm could take advantage of it equally, but we will see that this is not the case. Instead valuation bubbles in the debt market can lead to overall increases in acquisition activity but also to waves of dominance of one type of buyer over another.

the true prospects and the potential market mistakes than the lenders so the price paid does not completely reveal the lenders mistakes. In this paper we will calculate the buyers maximum willingness to pay and show the conditions that make one type of buyer willing to pay more, but we do not model the exact game such that payments do not fully reveal.

## II. Organizational Forms

This section will first determine the reservation price of the stand-alone firm. If either the PE firm or the strategic buyer offer less than this amount then shareholders can expect a larger expected payout if they refuse the offer. Subsequently, subsections B and C will determine the highest amount the PE firm and the strategic buyer would be willing to offer. With these benchmarks established the following section will examine the drivers that give each type of organizational form a higher willingness-to-pay and thus an advantage in the takeover market.

### A. Stand-Alone Firm

We start by examining the reservation price of a stand-alone firm, we denote this amount  $\bar{V}$ . Because of the moral hazard problem, it is potentially constrained by the manager's ability to raise financing from investors as well as the manager's skill. We will see how this is altered by the uninformed investors' potential misvaluation of debt.

The reservation price is the same as the amount that the project is worth to the current investors. Investors that do not sell have effectively invested this amount in the project and must earn a return on  $\bar{V}$ . Thinking of  $\bar{V}$  as an investment will help facilitate comparison to later sections where the buyer must pay the purchase price up-front as they are not endowed with the project. We will then determine the value of this 'investment' to determine the reservation price.

Given the setup described in the previous section, one optimal contract requires the manager to invest  $A_M$ , and the uninformed investors to invest the balance of  $\bar{V} + I - A_m$ .<sup>12</sup> The contract then pays everyone nothing if the project fails and divides the payoff  $R$  into  $R_m > 0$  for the manager and  $R_u > 0$  for the uninformed investor if the project succeeds, where<sup>13</sup>

$$(3) \quad R_m + R_u = R.$$

<sup>12</sup>Thinking of the opportunity cost of not selling from the investors or the manager's point of view is equivalent because if the investor owned the project they could sell part of the project for  $\bar{V} + I - A_m$ .

<sup>13</sup>Since both the manager and the investors get a fixed payoff this could be thought of as inside and outside equity or debt. The notion that our results relate to debt becomes more clear later when projects are combined and the investors get a priority payout if either project succeeds.

First, the manager will only choose the good project if  $p_H R_m \geq p_L R_m + B$ , therefore

$$\text{Manager (IC)} \quad R_m \geq B/\Delta p.$$

This is the true incentive compatibility (IC) constraint for the manager. On the other hand and given equation (1) uninformed investors will only invest if they believe the manager will choose the better project. However, uninformed investors have a different view of the manager's IC constraint. Given the investors' probability beliefs, they think that the following equation is the manager's IC constraint and thus it is only rational for investors to provide debt for the project as long as

$$(4) \quad R_m \geq B/\Delta p'.$$

The notion that there is both a true IC constraint and a different perceived IC constraint is a novel aspect of our model. Only if the *perceived* IC constraint holds will uninformed investors invest  $\bar{V} + I - A_m$ , but only if they expect to earn  $\gamma$  on this investment. Thus, individual rationality on the investor's side requires  $p'_H R_u \geq \gamma(\bar{V} + I - A_m)$ . As is immediate to see, if uninformed investors have overestimated the strength of the good project they require too low a return  $R_u$  and vice versa.

Using equation (3) we can express the manager's payoff if the project is successful as

$$R_m = R - \gamma(\bar{V} + I - A_m)/p'_H.$$

This expression allows us to rewrite (4) as follows,

$$\text{Investor's view of (IC)} \quad R_m = R - \gamma(\bar{V} + I - A_m)/p'_H \geq B/\Delta p'.$$

Finally, the manager's expected return must also be greater than  $\gamma A_m$  otherwise the manager would rather invest  $A_m$  elsewhere. We assume an inelastic supply of projects that earn  $\gamma$ . Therefore, the manager's individual rationality constraint is

$$\text{Manager (IR)} \quad \begin{cases} R_m \geq \gamma A_m/p_H \text{ if Manager IC holds} \\ R_m \geq (\gamma A_m - B)/p_L \text{ if Manager IC does not hold} \end{cases}$$

This is different from a standard model without misvaluation because in a standard model the Manager's IC always holds in equilibrium. However, with misvaluation it is possible that investors believe that the Manager's IC holds and believe that the manager will choose the right project even when he will not. In an equilibrium with misvaluation investors may invest and find that the manager chooses to shirk. Thus, the Manager's IR must ensure that the manager's decision to participate is rational even when his IC does not hold.

Having derived all the relevant constraints of the model, we start by showing a preliminary result that simplifies the optimization program and will help us derive the reservation value  $\bar{V}$  of the project.

LEMMA 1: *The reservation price of the project,  $\bar{V}$ , is the largest  $\bar{V}$  such that the following constraint still holds:*

$$(5) \quad R - \gamma(\bar{V} + I - A_m)/p'_H \geq \max \{B/\Delta p', \min[\gamma A_m/p_H, (\gamma A_m - B)/p_L]\}$$

*PROOF:*

*The shareholders of the project expect to get  $p'_H R_u = \gamma(\bar{V} + I - A_m)$ . Thus, they effectively earn a return on the amount they invest,  $I - A_m$ , and on the opportunity cost of not selling for  $\bar{V}$ . The investor's ability to extract value is constrained by the IC and IR constraints of the manager. Thus, the  $\bar{V}$  is the largest number such that the manager's payoff satisfies the perceived IC constraint,  $B/\Delta p'$  and the relevant IR, which is the minimum of  $\gamma A_m/p_H$  and  $(\gamma A_m - B)/p_L$ .<sup>14</sup>*

The result above will help determine the reservation price of the current manager. It shows that the current manager of the project could only ever extract value from it to the point where investors think the manager will no longer choose high effort or until the manager will no longer participate. We are interested in establishing clear benchmarks about the willingness-to-pay of each type of organizational form in order to understand when one type of buyer is willing to pay more. The stand-alone

<sup>14</sup>To understand the use of the min function it is easy to check that if  $\gamma A_m/p_H < (\gamma A_m - B)/p_L$  then  $\gamma A_m/p_H > B/\Delta p$  and hence  $(\gamma A_m - B)/p_L > B/\Delta p$ . Therefore, if  $R_m > B/\Delta p$  then the IC holds and what matters is  $\max\{B/\Delta p', \gamma A_m/p_H\}$ . If, on the other hand,  $\gamma A_m/p_H > (\gamma A_m - B)/p_L$  then  $(\gamma A_m - B)/p_L < B/\Delta p$  and  $\gamma A_m/p_H < B/\Delta p$ . Therefore, if  $R_m < B/\Delta p$  then the IC does not hold and what matters is  $\max\{B/\Delta p', (\gamma A_m - B)/p_L\}$ . Thus the min function ensures the right IR is holding.

manager's reservation price is the same as their willingness-to-pay. With benchmarks on willingness-to-pay we can determine factors that make deals more or less likely, as we will show in the next section, assuming that a higher willingness-to-pay translates into a higher probability of a deal.

Next we use lemma 1 to derive the minimum value that any potential target would accept. This is the stand-alone value of the firm.

PROPOSITION 1: *The reservation value of the stand-alone firm,  $\bar{V}$ , is defined by*

$$(6) \quad \bar{V} = \frac{p'_H}{\gamma} \left( R - \frac{B}{\Delta p'} \right) - I + A_m$$

*if*  $B/\Delta p' \geq \min[\gamma A_m/p_H, (\gamma A_m - B)/p_L]$

$$(7) \quad \bar{V} = \frac{p'_H}{\gamma} R - I + \left( 1 - \frac{p'_H}{p_H} \right) A_m$$

*if*  $(\gamma A_m - B)/p_L \geq \gamma A_m/p_H > B/\Delta p'$

$$(8) \quad \bar{V} = \frac{p'_H}{\gamma} \left( R + \frac{B}{p_L} \right) - I + \left( 1 - \frac{p'_H}{p_L} \right) A_m$$

*if*  $\gamma A_m/p_H > (\gamma A_m - B)/p_L > B/\Delta p'$

*PROOF:*

*See Appendix.*

The reservation value is defined by which manager constraint binds; his perceived IC or his IR. These will provide a reservation price benchmark to which we will compare the willingness-to-pay of the financial and strategic bidders.

Thus, Proposition 1 shows us that the reservation price of a stand-alone firm is altered by the misperception of uninformed investors. That is, overvaluation in the debt market raises the reservation value of the stand-alone firm. Therefore, it is not even obvious that more acquisitions should occur when debt is cheap, let alone what type of buyer (financial or strategic) should dominate. Thus, the effects of debt misvaluation are neither trivial nor obvious and more work is needed.

Examining Proposition 1 we see that if  $\bar{V}$  is defined by either equation (7) or (8) then the reservation price is increasing with over valuation, since the derivative with respect to  $p'_H$  is strictly positive. Interestingly, the larger  $A_m$  is the lower the impact of overvaluation because less must be borrowed. If  $\bar{V}$  is defined by (6) then the effects

of misvaluation are potentially ambiguous. If investors overvalue the better project,  $p'_H$  increases, then the reservation price clearly increases but if overvaluation causes the low project to be overvalued then depending on relative overvaluation the moral hazard problem may become worse, thus lowering the reservation value – we will come back to this point later.

It is useful here to pause and consider why there are three different pricing equations in Proposition 1 since we will see three regions for each type of organizational form (for which we will solve in the next subsections). One might have expected the stand-alone value of the firm to simply be the discounted net present value of the investment. This is usually the case absent any misvaluation. If  $p'_H = p_H$  and  $p'_L = p_L$  then it can be shown that the reservation value would be  $\bar{V}^* = p_H R / \gamma - I$ , equation (7), the net present value of the project. Both the first and third subcases in Proposition 1 disappear since they both rely on either the difference between  $B/\Delta p'$  and  $B/\Delta p$  or the presence of shirking in equilibrium, as in equation (8). Thus, it is the mispricing directly and through its interaction with the moral hazard problem that leads to the three different equations for the reservation value. The first pricing equation, equation (6) arises because the firm may be constrained by the uninformed investors perception of the IC constraint, i.e., the uninformed investors would not provide any more financing. The third pricing equation, equation (8) arises when the manager shirks in equilibrium. This cannot happen in a standard model but is possible with mispricing.

Proposition 1 demonstrates the reservation value of the stand alone firm. We can also establish the minimum cash the firm must have to even get financing and stay as a stand alone firm. The manager must have a minimum  $A_m$  in order to just attempt to get the firm by ‘paying zero’ but getting investors to provide the investment the project needs. The minimum acceptable cash is<sup>15</sup>

$$(9) \quad A_m \geq \bar{A}_m = I - \frac{p'_H}{\gamma} \left( R - \frac{B}{\Delta p'} \right).$$

Equation (9) demonstrates that as investors overestimate the strength of the good

<sup>15</sup>Note that the minimal acceptable cash ignores the manager’s IR because the minimum acceptable cash needed to attract investors is always larger than the minimum cash needed to meet the IR. See footnote 16.



project (debt is offered “too cheap”) the minimum required manager investment may fall ( $\partial \bar{A}_m / \partial p'_H < 0$ ).<sup>16</sup> Therefore, debt overvaluation can actually mitigate the underinvestment problem caused by the moral hazard problem.

We have established the stand-alone firm benchmarks and will now do the same for financial and then strategic buyers.

### B. Private Equity Buyout

In this section we consider a manager who combines forces with a PE investor as an alternative organizational form to manage the company’s assets. We will denote  $\bar{V}^{pe}$  the maximum amount a manager and a PE investor are willing to pay. This amount will differ from the stand-alone reservation value,  $\bar{V}$ , and from the the amount a strategic acquirer (a manager with another project) might pay,  $\bar{V}^S$ , for several reasons. First, the PE investor can monitor the manager (at a cost,  $c$ ) and eliminate the high private benefit project. Second, the buyout specialist invests his own capital  $A_{pe}$ , in the company. And finally, misvaluation effects PE acquirers differently from stand alone firms. Since we are most interested in the effects of misvaluation we will sometimes assume away the other differences to focus on the misvaluation effects.

Following the same reasoning as in the previous section, one optimal contract requires the manager to invest  $A_m$ , the PE investors to invest  $A_{pe}$  and the uninformed investors to invest the balance of  $\bar{V}^{pe} + I - A_m - A_{pe}$ . The contract then pays everyone nothing if the project fails and if the project succeeds divides the payoff  $R$  into  $R_m^{pe} > 0$  for the manager,  $R_{pe}^{pe} > 0$  for the PE investor and  $R_u^{pe} > 0$  for the uninformed investor, where

$$R_{pe}^{pe} + R_m^{pe} + R_u^{pe} = R.$$

Given equation (1) uninformed investors will only invest if they believe the man-

<sup>16</sup>The minimum acceptable cash is always a function of  $B/\Delta p'$  because if

$$\text{Max}[B/\Delta p', \text{Min}[\gamma A_m/p_H, (\gamma A_m - B)/p_L]] = \gamma A_m/p_H \text{ or } (\gamma A_m - B)/p_L$$

then  $A_m$  could be lower and uninformed investors would still invest. So  $A_m$  can drop until  $\text{Max}[B/\Delta p', \text{Min}[\gamma A_m/p_H, (\gamma A_m - B)/p_L]] = B/\Delta p'$ . Therefore the minimum  $A_m$  is always defined by  $R - \gamma(I - A_m)/p'_H = B/\Delta p'$ .

ager will choose the good project. Now, however, if the PE firm monitors the manager (at a cost  $c \geq 0$ ) investors need only believe that

$$(10) \quad p'_H R_m^{pe} \geq p'_L R_m^{pe} + b.$$

Therefore, the incentive-compatible investor belief requires that the manager is paid at least

$$(11) \quad R_m^{pe} \geq b/\Delta p',$$

and the belief that the PE monitors management requires the investors to believe that

$$(12) \quad p'_H R_{pe}^{pe} \geq p'_L R_{pe}^{pe} + c.$$

Therefore, the incentive-compatible investor belief requires

$$(13) \quad R_{pe}^{pe} \geq c/\Delta p'.$$

If conditions (11) and (13) hold then uninformed investors will invest  $\bar{V}^{pe} + I - A_m - A_{pe}$  as long as they also expect to earn  $\gamma$  on this investment. Thus,  $p'_H R_u = \gamma(\bar{V}^{pe} + I - A_m - A_{pe})$ .

Given the required return to investors, the manager earns

$$R_m^{pe} = R - R_{pe}^{pe} - \gamma(\bar{V}^{pe} + I - A_m - A_{pe})/p'_H$$

if the project is successful. Using the expression above and the PE's IC constraint, the manager will only choose the good project (while the PE investor will monitor) if

$$R_m^{pe} = R - c/\Delta p - \gamma(\bar{V}^{pe} + I - A_m - A_{pe})/p'_H \geq b/\Delta p$$

This is the true IC constraint for the manager.

In equilibrium we can treat the manager and PE investor as one unit because

they are both informed and share surplus. Thus, either the manager will choose the good project and the PE investor will monitor or both will shirk. If there is enough surplus between them that they are better off not shirking then we assume they will divide the surplus in a way that ensures that they both do so and if not they will not. Specifically, we assume that  $R_m^{pe} < B/\Delta p$  otherwise the manager behaves without monitoring and they do not function as a unit.

In summary, investors will only provide funding for the project if they believe the manager will choose the good project and the PE investor will monitor. However, once again uninformed investors potentially have an incorrect view. The investors view of the manager's (and PE's) IC constraint is

$$\text{Investor's view of (IC)} \quad R_m^{pe} = R - c/\Delta p' - \gamma(\bar{V}^{pe} + I - A_m - A_{pe})/p'_H \geq b/\Delta p'$$

Since we are solving for the highest amount that a PE buyout can pay we can assume that the PE's IC binds and use the PE's IR constraint to endogeneize the amount of PE capital,  $A_{pe}$  only if it increases the willingness to pay. If the Manager and PE IC holds then the PE investor is willing to alter his capital in order to raise the price until the point where  $\gamma_{pe}A_{pe} = p_H c/\Delta p'$ , provided this increases the highest bid (otherwise  $A_{pe} = 0$ ). Note that we assume that PE capital is potentially scarce so PE investors require a return of  $\gamma_{pe} \geq \gamma$ . If the Manager and PE IC do not hold, the PE investor is only able to alter his capital in order to raise the price until the point where investors still perceive that he will monitor, i.e.  $\gamma_{pe}A_{pe} = p_L c/\Delta p'$ , again provided that this capital does increase the willingness to pay (otherwise  $A_{pe}$  would be 0).

The manager's expected return must also be greater than  $\gamma A_m$  otherwise the manager would rather invest  $A_m$  elsewhere. Therefore, the manager's individual

rationality constraint is<sup>17</sup>

$$\text{Manager (IR)} \left\{ \begin{array}{l} R_m^{pe} \geq \gamma A_m / p_H \\ \text{if Manager IC holds} \\ R_m^{pe} \geq (\gamma A_m - B) / p_L \\ \text{if Manager IC does not hold} \end{array} \right.$$

Using Lemma 1, we find that the PE team is willing to pay an amount  $\bar{V}^{pe}$  which is defined by the following constraint

$$(14) \quad \begin{aligned} R - c / \Delta p' - \gamma (\bar{V}^{pe} + I - A_m - A_{pe}) / p'_H \\ \geq \max \{ b / \Delta p', \min[\gamma A_m / p_H, (\gamma A_m - B) / p_L] \} \end{aligned}$$

In words, the PE/Manager combination is willing to raise its offer until either the perceived IC or an IR binds.

This result is contained in the following proposition.

PROPOSITION 2: *The highest willingness to pay by a PE firm is given by*

$$(15) \quad \begin{aligned} \bar{V}^{pe} &= \frac{p'_H}{\gamma} \left( R - \frac{b+c}{\Delta p'} \right) - I + A_m + \frac{p_H c}{\gamma_{pe} \Delta p'} \\ &\text{if } b / \Delta p' \geq \min[\gamma A_m / p_H, (\gamma A_m - B) / p_L] \end{aligned}$$

$$(16) \quad \begin{aligned} \bar{V}^{pe} &= \frac{p'_H}{\gamma} R - I + \left( 1 - \frac{p'_H}{p_H} \right) A_m + \left( \frac{p_H}{\gamma_{pe}} - \frac{p'_H}{\gamma} \right) \frac{c}{\Delta p'} \\ &\text{if } (\gamma A_m - B) / p_L \geq \gamma A_m / p_H > b / \Delta p' \end{aligned}$$

$$(17) \quad \begin{aligned} \bar{V}^{pe} &= \frac{p'_H}{\gamma} \left( R + \frac{B}{p_L} \right) - I + \left( 1 - \frac{p'_H}{p_L} \right) A_m + \left( \frac{p_L}{\gamma_{pe}} - \frac{p'_H}{\gamma} \right) \frac{c}{\Delta p'} \\ &\text{if } \gamma A_m / p_H > (\gamma A_m - B) / p_L > b / \Delta p' \end{aligned}$$

PROOF:

See Appendix.

The PE firm's willingness-to-pay depends on misvaluation through different channels. First, it boosts  $\bar{V}^{pe}$  because it makes the expected returns from the investment

<sup>17</sup>Note that  $B$  is not replaced by  $b$  in the second inequality below or in equation (14) because that part of the equation is relevant only when the PE IC does not hold so no one will monitor.

increase (the term  $p'_H R/\gamma$ ). However, a closer look at (15) reveals that the effects of misvaluation are potentially ambiguous. If investors overvalue the better project,  $p'_H$  increases, then the willingness to pay clearly increases but if overvaluation causes the low project to be more overvalued then depending on relative overvaluation the moral hazard problem may become worse, thus lowering the willingness to pay. This ambiguity is present in the other two equations. Interestingly, the larger  $A_m$  the lower the impact of overvaluation because less must be borrowed from investors.

Since a target would only be willing to accept positive offers the manager must have a minimum  $A_m$  in order to be able to access financing from uniformed investors. The minimum acceptable cash is

$$(18) \quad A_m \geq \bar{A}_m^{pe} = I - \frac{p'_H}{\gamma} \left( R - \frac{b+c}{\Delta p'} \right) - \frac{p_H c}{\gamma_{pe} \Delta p'}$$

The equation again demonstrates, as in the case of stand-alone firms, that as investors overestimate the strength of the good project (debt is offered “too cheap” in equilibrium) the minimum required amount of internal funds falls. However, if overvaluation affects  $p_L$  the overall affect is ambiguous since  $\Delta p'$  can either increase or decrease (i.e., the perceived moral hazard problem can get either worse or better).

Thus, we have established the minimum cash needed and the highest willingness-to-pay of a financial buyer. But it is not yet clear how misvaluation will effect the firm. After we establish the benchmark for strategic buyers we will come back to this issue.

### C. Strategic Acquisition

In this section we consider a manager who already has a project and is trying to buy a second project. We will call this manager a strategic acquirer and assume she has access to cash in the amount of twice  $A_m$  to allow proper comparison with alternative organizational forms.

Because our definition of a firm is a pair consisting of a project and a manager, after a strategic acquisition the new entity will have two managers, each with a project. Each project still requires an investment of  $I$  and generates a return  $R$  with the same real and perceived probabilities as the stand-alone case described

above. The payoffs of all claims are based on the outcome of both projects. Thus, we are ruling out project financing as this would be the same as a manager with a single project, which we have already analyzed.<sup>18</sup> Furthermore, we allow the private benefits per project to be different from the stand-alone case, in the amount of  $B^s \gtrless B$ . The interpretation of  $B^s > B$  that we have in mind is that in a larger company agency costs are worse either because the effort cost per project is larger or because it is possible to enjoy larger private benefits per project. One could also conceive the possibility that running the two projects within one company allows the manager to extract less private benefits per project. We, for now, take no stand on the value of  $B^s$ .

With two projects, one optimal contract requires the acquiring manager to invest  $2A_m$ , and the uninformed investors to invest the balance of  $2(\bar{V}^s + I - A_m)$ . An optimal contract then pays the two managers nothing if *both* projects fail, pays the managers nothing if one project fails, and if both projects succeed divides the payoff  $2R$  into  $2R_m^s > 0$  for both managers (each receives  $R_m^s$ ) and  $R_u^s > 0$  for the uninformed investor, where

$$2R_m^s + R_u^s = 2R.$$

Given that the managers and projects are symmetric, incentives will always be such that both managers will choose the good project or both will choose the worse.<sup>19</sup> Furthermore, uninformed investors will always perceive that both managers will choose the same type of project given the incentives.<sup>20</sup> Thus, given equation (2), uninformed investors will only invest if they believe managers will choose the better projects. Now, however, a manager only gets paid if both projects pay off thus

<sup>18</sup>This is equivalent to assuming that the returns from each project cannot be verifiably attached to that project.

<sup>19</sup>If the first manager choosing the good project means the second manager wants to choose the bad project, then  $p_H^2 R_m^s < p_H p_L R_m^s + B^s$ . But this implies  $p_H p_L R_m^s < p_L^2 R_m^s + B^s$  because  $p_L/p_H < 1$ . Which means that if the second manager chooses the bad project then so will the first. So it is a Nash equilibrium for both to choose the high private benefit project. If the first manager choosing the bad project means the second manager wants to choose the good project, then  $p_H p_L R_m^s \geq p_L^2 R_m^s + B^s$ . But this implies  $p_H^2 R_m^s \geq p_H p_L R_m^s + B^s$  because  $p_H/p_L > 1$ . Which means that if the second manager chooses the good project then so will the first. So it is then a Nash equilibrium for both to choose the good project.

<sup>20</sup>The math in the last footnote holds with primes on each probability.

investors need to believe that<sup>21</sup>

$$p_H'^2 R_m^s \geq p_H' p_L' R_m^s + B^s.$$

Therefore, the incentive compatible investor belief requires that the manager is paid at least

$$(19) \quad \text{Investor's view of (IC)} \quad R_m^s \geq B^s / p_H' \Delta p'$$

However, since  $p_H' \Delta p' \neq p_H \Delta p$  the manager will not actually choose the good project unless  $R_m^s \geq B^s / p_H \Delta p$  - we must account for this when we consider the manager's individual rationality constraint.

If condition (19) holds then uninformed investors will invest  $2(\bar{V}^s + I - A_m)$  if they expect to earn  $\gamma$  on this investment. Thus,

$$p_H'^2 R_u^s + 2p_H'(1 - p_H')R = 2\gamma(\bar{V}^s + I - A_m).$$

Note that in the equation above we use the fact that in case only one of the projects is successful the payoff to the investor is the entire cash flow available,  $R$ , thus investors retain a debt-like priority. Hence the only unknown variable is  $R_u^s$ .<sup>22</sup>

Given the required return to investors, both managers earn

$$\begin{aligned} 2R_m^s &= 2R - R_u^s \\ &= 2R - \frac{2\gamma(\bar{V}^s + I - A_m) - 2p_H'(1 - p_H')R}{p_H'^2} \end{aligned}$$

if both projects are successful and thus they will only choose the better projects if

$$\text{Manager (IC)} \quad R_m^s = R - \gamma(\bar{V}^s + I - A_m)/p_H'^2 + (1 - p_H')R/p_H' \geq B^s/p_H \Delta p.$$

And investors will only provide debt for the project if they believe managers will

<sup>21</sup>We assume investors focus on the pareto-dominating equilibrium where both managers choose the good project as long as it is incentive compatible.

<sup>22</sup>Section IVIV.F explores the situation when this is not the case and shows that the main result still holds.

choose the better projects.

The manager's expected return must also be greater than  $\gamma A_m$  otherwise she would rather invest  $A_m$  elsewhere. As before, we assume an inelastic supply of projects that earn  $\gamma$ . Therefore, the manager's individual rationality constraint is

$$\text{Manager (IR)} \begin{cases} R_m^s \geq \gamma A_m / p_H^2 \text{ if Manager IC holds} \\ R_m^s \geq (\gamma A_m - B^s) / p_{HPL} \text{ if Manager IC does not hold} \end{cases}$$

Thus, using lemma 1 the acquirer manager raises  $\bar{V}^s$  as high as possible subject to the following constraint:<sup>23</sup>

$$(20) \quad \begin{aligned} R/p_H' & - \gamma(\bar{V}^s + I - A_m)/p_H'^2 \\ & \geq \max \{ B^s/p_H' \Delta p', \min[\gamma A_m/p_H^2, (\gamma A_m - B^s)/p_{HPL}] \}. \end{aligned}$$

In words, a strategic acquirer is willing to pay more up to the point where the manager no longer chooses high effort even though uninformed investors think that she will, but then her IR changes to include her private benefits and the lower probability of success. Which IR is relevant depends on whether or not the IC holds at the highest price the manager is willing to pay.

**PROPOSITION 3:** *The highest  $\bar{V}^s$  a strategic acquirer is willing to pay is defined by*

$$(21) \quad \begin{aligned} \bar{V}^s & = \frac{p_H'}{\gamma} \left( R - \frac{B^s}{\Delta p'} \right) - I + A_m \\ \text{if } & B^s/p_H' \Delta p' \geq \min[\gamma A_m/p_H^2, (\gamma A_m - B^s)/p_{HPL}] \end{aligned}$$

$$(22) \quad \begin{aligned} \bar{V}^s & = \frac{p_H'}{\gamma} R - I + \left( 1 - \frac{p_H'^2}{p_H^2} \right) A_m \\ \text{if } & (\gamma A_m - B^s)/p_{HPL} \geq \gamma A_m/p_H^2 > B^s/p_H' \Delta p' \end{aligned}$$

$$(23) \quad \begin{aligned} \bar{V}^s & = \frac{p_H'}{\gamma} \left( R + \frac{p_H'}{p_{HPL}} B^s \right) - I + \left( 1 - \frac{p_H'^2}{p_{HPL}} \right) A_m \\ \text{if } & \gamma A_m/p_H^2 > (\gamma A_m - B^s)/p_{HPL} > B^s/p_H' \Delta p' \end{aligned}$$

<sup>23</sup>To understand the use of the min function in this case note that if  $\gamma A_m/p_H^2 < (\gamma A_m - B^s)/p_{HPL}$  then  $\gamma A_m/p_H^2 > B^s/p_H \Delta p$  and hence  $(\gamma A_m - B^s)/p_{HPL} > B^s/p_H \Delta p$ . Therefore, if  $R_m^s > B^s/p_H \Delta p$  (IC holds) what matters is  $\max \{ B^s/p_H' \Delta p', \gamma A_m/p_H^2 \}$ . If  $\gamma A_m/p_H^2 > (\gamma A_m - B^s)/p_{HPL}$  then  $(\gamma A_m - B^s)/p_{HPL} < B^s/p_H \Delta p$  and  $\gamma A_m/p_H^2 < B^s/p_H \Delta p$ . Therefore, if  $R_m^s < B^s/p_H \Delta p$  (IC does not hold) what matters is  $\max \{ B^s/p_H' \Delta p', (\gamma A_m - B^s)/p_{HPL} \}$ . Thus the min function ensures the right IR is holding.



*PROOF:*

*See Appendix.*

If  $\bar{V}^s$  is defined by either equation (22) or (23) then the strategic firm's willingness-to-pay is increasing with over valuation,  $p'_H$ . Furthermore, the larger  $A_m$  is the lower the impact of overvaluation because less must be borrowed. If  $\bar{V}^s$  is defined by (21) then the effects of misvaluation are potentially ambiguous. If investors overvalue the better project,  $p'_H$  increases, then the willingness to pay clearly increases but if overvaluation causes the low project to be more overvalued then depending on relative overvaluation the moral hazard problem may become worse, thus lowering the willingness to pay.

Following the same procedure as before it is easy to show that for a strategic acquisition the minimum  $A_m$  is defined by

$$(24) \quad A_m \geq \bar{A}_m^s = I - \frac{p'_H}{\gamma} \left( R - \frac{B^s}{\Delta p'} \right).$$

This completes the characterization of a strategic acquisition where two projects are organized under the same firm. Having examined the three possible organizational forms we next compare them and derive the main results and predictions of the paper.

### III. Comparing Different Organizational Forms

We split this section into two parts. The first analyzes the relative ability of the different organizational forms in creating value and thus bidding higher for a given target. The second moves away from prices and looks at the aggregate amount of acquiring firms that are more likely to be of one or another organizational form. Essentially, we first consider the effect on 'price' and then the effect on 'quantity'.

The first section separates out the main interactions between the drivers of the model, namely diversification and co-insurance, misvaluation and corporate governance. First, we look at the co-insurance effect that arises from combining the asymmetry of information (misvaluation) with the diversification of cash flows in debt contracts. We show that the difference in information between debtholders

and managers creates a gap in the willingness to pay of strategic buyers compared to stand-alone managers and financial buyers that has to do with the diversification of cash flows. Second, we analyze the effects of corporate governance by comparing the willingness-to-pay of PE firms and a stand-alone manager. This provides insights on how misvaluation affects the governance of the firm, in the sense of its interaction with agency costs that come from the moral hazard problem. Finally we compare strategic and financial buyers the bidding behavior of which comes from aggregating all the effects previously dissected.

In the second part of the section we focus on the predictions of the model in terms of the aggregate number of firms that we expect could be acquired under one or another organization form, further implying dominance in acquisition activity by one type of buyer or another. We call this the “quantities effect”. The results further analyze the effects of the interaction between misvaluation and corporate governance.

#### A. The Maximum Bidding Price

We start by adding some additional structure to our existing model. In particular, we will think of  $p'_H$  and  $p'_L$  not just as parameters but functions of an underlying variable that measures the extent of asymmetric information or misvaluation,  $\mu$ . That is, with a slight abuse of notation let us define  $p'_H \equiv p'_H(\mu)$  and  $p'_L \equiv p'_L(\mu)$ , where  $p'$  is a continuous, differentiable and strictly increasing function of  $\mu$  over its domain:  $(-\infty, +\infty)$ , it is bounded between 0 and 1 and  $\Delta p' \equiv p'_H - p'_L > 0, \forall \mu$ . Moreover we shall note that  $p'_H(0) = p_H$  and  $p'_L(0) = p_L$ ; namely, in the absence of misvaluation ( $\mu = 0$ ) the perceived probability  $p'$  coincides with the true probability,  $p$ , and  $\mu > 0$  results in overvaluation while  $\mu < 0$  results in undervaluation.<sup>24</sup>

#### THE CO-INSURANCE EFFECT ON PRICES

In order to highlight the effect that results from diversification in markets with asymmetric information we first abstract away from the moral hazard part of our set-up. We do so without loss of generality in the sense that this effect does not depend

<sup>24</sup>Moreover since  $p' < 1$ , we also require that  $\lim_{\mu \rightarrow \infty} p'(\mu) = 1$ .

on the extent or existence of moral hazard between investors and management, we choose to isolate it only for expositional reasons. To do so, we assume that  $B = B^s = 0$  to isolate the diversification effect from any other. The following proposition contains an important result of this paper.

**PROPOSITION 4** (The Co-insurance Effect): *Absent moral hazard, if debt is overvalued ( $\mu > 0$ ) then  $\bar{V} = \bar{V}^{pe} > \bar{V}^s$ . The opposite is true when debt is undervalued, that is, if  $\mu < 0$  then  $\bar{V} = \bar{V}^{pe} < \bar{V}^s$ . Moreover, the difference in willingness to pay  $\bar{V}^{pe} - \bar{V}^s$  increases (decreases) with overvaluation (undervaluation).*

*PROOF:*

*First, using the results in proposition 1 and 2, it is easy to see that the relevant equations become (7) and (22) since  $A_m/p_{HPL} \geq A_m/p_H^2 > 0$ . The difference between  $\bar{V}$  and  $\bar{V}^s$  is, after some algebra,*

$$\left( \left( \frac{p'_H}{p_H} \right)^2 - \frac{p'_H}{p_H} \right) A_m.$$

*The term is positive if and only if  $p'_H > p_H$ , that is, when debt is overvalued. By taking the derivative with respect to  $p'_H$  it is immediate to see that the derivative is positive.*

This proposition shows us that one effect of overvaluation always helps non-diversified companies (stand-alone but also financial buyers) outbidding strategic buyers, and more generally, the more diversified the merged company becomes the larger the disadvantage when debt is overvalued. This occurs because the combination of projects effectively reduces the valuation mistake being made by the investors. That is, they underestimate the default probability, but that makes them underestimate the co-insurance benefit. The mistakes offset and thus an overvalued debt market cannot be as exploited by a strategic buyer as it can be by a stand-alone or PE buyer.

The co-insurance effect penalizing strategics does not mean that stand-alone managers and/or financial buyers will always beat strategics in overvalued markets. In general, there are other effects that will also influence who is willing to pay more,

such as potential synergies, and, of course, governance effects that we will explore in the next section.

Overall this important result tells us that overvalued debt tends to help bidders that do not bring diversification to the table, namely, stand-alone managers or financial buyers, more than strategic buyers. Thus, the ratio of deals completed by financial buyers relative to strategic buyers should tend to increase during overvalued debt markets, as we will explain further later on.

While the interaction effect of diversification and asymmetric information on the willingness to pay of strategic buyers (price/co-insurance effect) is of first order, the more general setting with moral hazard and the remaining fundamental differences between strategics and PE sponsor also have interesting implications regarding the willingness to pay of financial vs. strategic buyers. We discuss this next.

#### THE MONITORING EFFECT ON PRICES

To understand the monitoring effect we will first establish the following relationship between the relative impact of misvaluation in the probability of success of the better project versus the worse project:

CONDITION 1:  $\frac{\partial p'_H}{\partial \mu} < \frac{\partial p'_L}{\partial \mu}, \forall \mu.$

In words the condition above states that the first derivative of the investor-perceived probability function with respect to  $\mu$  is lower for a sound project (high probability of success/high effort) than for the project that generates more private benefits but lower probability of success. This condition suggests the notion that those investments that generate more private benefits to management are also more prone to being misperceived or estimated with more error by investors. If misvaluation functions as in condition one then greater misvaluation makes the moral hazard problem worse. We think that this is plausible and it is in line with work that argues that overvaluation is an important driver of managerial misbehavior such as Jensen (2005), Bolton et al. (2006) and Bolton et al. (2005).<sup>25</sup> However, this is ultimately an empirical question. Therefore, going forward we do not assume this condition holds, but rather we establish results that depend on whether or not it does.

<sup>25</sup>See Kindleberger (1978) for a discussion of bubbles and fraud.

We now compare the willingness to pay by financial buyers and that of a stand-alone manager. In doing so we wish to isolate and focus on the governance problem and how it is affected by the difference in information between managers and debtholders. As explained, the main difference between PE buyers and a stand-alone firm is that the monitoring role of PE sponsors might alleviate the agency cost caused by the moral hazard problem. To simplify the exposition we initially set the cost of monitoring to zero and then corollary 1 demonstrates the effect of monitoring costs.

**PROPOSITION 5 (Monitoring Effect):** *Assume that condition 1 holds and  $c = 0$ . If debt is overvalued ( $\mu > 0$ ) then the PE firm highest bid dominates the stand-alone's highest willingness to pay,  $\bar{V}^{pe} \geq \bar{V}$ . Moreover, the difference in highest bids  $\bar{V}^{pe} - \bar{V}$  increases with overvaluation.*

*PROOF:*

*See Appendix.*

This result lays down the times when we would expect PE sponsors to be willing to pay more for a target compared to the stand-alone value. First, since financial sponsors alleviate the moral hazard problem compared to the stand-alone firm this could give them an advantage (recall that agency costs are reflected in prices via the first pricing equation for each type of bidder). If condition 1 holds, then increased mispricing increases the moral hazard problem. This makes the provision of incentives harder. Thus, PE firms, with greater oversight, have a higher willingness-to-pay relative to a stand alone firm. This implies that the PE price is never below the stand-alone value with overvaluation.

**COROLLARY 1:** *If  $c > 0$ , the PE firm highest bid dominates the stand-alone's highest willingness to pay if overvaluation is high enough, that is,  $\exists \mu^*$  such that  $\forall \mu \geq \mu^*$ ,  $\bar{V}^{pe} \geq \bar{V}$  and the difference in highest bids increases with overvaluation.*

When monitoring costs are strictly positive we need overvaluation to be large enough. The reason is that when either overvaluation is not large or when the firm's own internal funds  $A_m$  are large the maximum willingness to pay is set by the NPV (the second equation in propositions 1 and 2) except that in the PE case

the remuneration to the PE manager necessary for monitoring lowers the price and puts them at a disadvantage compared to the stand-alone case. This is why some overvaluation is needed. In other words, there is trade-off between the misvaluation benefits and its costs (to financial buyers): the benefit is that to the extent that monitoring is efficient and misvaluation makes the moral hazard problem worse the PE firm's skill as monitor becomes more valuable through alleviating the moral hazard cost (and they can bid more). However, the PE firm needs to be provided with incentives as well, and this cost dominates for low levels of overvaluation or high levels of internal funds. This prediction is intuitive in the sense that cash rich firms with no financial frictions stemming from moral hazard should not be at a disadvantage against financial buyers whose value consists in alleviating such financial friction.

#### THE BIDDING CAPACITY OF FINANCIAL AND STRATEGIC BUYERS

We now use the insights from the two previous results and compare the bidding capabilities of both financial and strategic buyers.

**PROPOSITION 6** (PE buyer and Strategic buyer): *Assume that condition 1 holds and  $c = 0$ . If debt is overvalued ( $\mu \geq 0$ ) then the PE firm highest bid dominates the strategic buyer's highest willingness to pay,  $\bar{V}^{pe} \geq \bar{V}^s$ . Moreover, the difference in highest bids  $\bar{V}^{pe} - \bar{V}^s$  increases with overvaluation. Furthermore, in this case, financial buyers leverage more than strategic acquirers.*

*PROOF:*

*See appendix.*

Comparing financial and strategic buyers boils down to a combination of the co-insurance effect and the monitoring effect. Overvalued debt gives an advantage to financial buyers because diversified acquisitions are not able to extract information rents to the extent that financial buyers do. Moreover, a manager needs less cash when joining with a PE buyer so we would expect to see higher leverage in PE deals. This prediction, although not obvious, is also economically intuitive.

**COROLLARY 2:** *If  $c > 0$  then the PE firm highest bid dominates the strategic buyer's highest willingness to pay if overvaluation is high enough, that is,  $\exists \mu^{**} < \mu^*$*

such that  $\forall \mu \geq \mu^{**}$ ,  $\bar{V}^{pe} \geq \bar{V}^s$  and the difference in highest bids  $\bar{V}^{pe} - \bar{V}^s$  increases with overvaluation.

As in proposition 5, with strictly positive monitoring costs we need overvaluation to be large enough so that the benefits of monitoring surpass the cost of providing incentives to the PE manager. However when comparing strategics and financial buyers we need *less* overvaluation ( $\mu^{**} < \mu^*$ ) because the co-insurance effect provides an added benefit to financial buyers.

The main two drivers of our analysis differ from past work: the co-insurance effect and the monitoring effect. As noted above, the strategic buyer is unable to take full advantage of the overvaluation because he has a current project that partially offsets the lenders valuation mistake. At the same time, if overvaluation makes the moral hazard problem worse then the governance advantage of the PE firm becomes more relevant allowing them to pay more. These two effect working together suggest a potential mechanism for a changing ratio of strategic to financial acquirers that depends on the level of overvaluation in the debt market.

### B. The Quantities Effect and Aggregate Acquisition Activity

We noted in the model setup that the asymmetry of information between debtholders and managers has implications that come from an interaction with the hidden-action agency problem. As explained in section I, this problem creates an ex-ante financing constraint and establishes a minimum amount of internal funds  $A_m$  such that financing will be available. This cutoff determines whether a particular firm will be able to sell a debt instrument in order to finance the investment in the context of an acquisition. A changing cutoff, therefore, will increase or decrease the number of potential PE or strategic buyers and further explain the shifting type of acquirer (financial and/or strategic).

In this section we examine, among other things, when overvaluation allows more companies to raise financing under the sponsorship of a PE firm versus a strategic deal. This effect, which we sometimes refer as quantity effect, should be added to the price effects discussed in the previous section in order to have a complete picture of the determinants of merger activity.

We start by comparing  $\bar{A}_m$  and  $\bar{A}_m^{pe}$ . We do so because such comparison will throw light on the determinants of aggregate buyout activity in general. If and when  $\bar{A}_m^{pe} < \bar{A}_m$  all firms with  $A_m \in [\bar{A}_m^{pe}, \bar{A}_m)$  would only obtain financing in a PE deal, making a leverage buyout the only possible organizational form. Moreover, because such mass of firms possess the smallest amount of internal funds, they would also be the most leveraged deals in the economy since the amount borrowed from uninformed investors would be the largest, other things equal. This is precisely a key feature of PE buyouts that our model helps explain. The following result establishes this comparison.

**PROPOSITION 7:**  $\bar{A}_m^{pe} < \bar{A}_m$ . *The difference  $\bar{A}_m^{pe} - \bar{A}_m$  (capturing those firms which are only funded under a PE sponsorship) becomes more negative with increases in  $B$  and less negative with increases in  $b$  and  $\gamma$ . The effect of  $c$  is positive if there is overvaluation. Moreover, if also condition 1 holds, overvaluation (undervaluation) makes this difference more (less) negative, that is,*

$$\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m)}{\partial \mu} < 0.$$

*PROOF:*

*See Appendix.*

Essentially the result above states that a PE deal provides more access to financing and hence unlocks value compared to the stand-alone scenario. This condition is however only sufficient since there is another effect that can explain  $\bar{A}_m^{pe} < \bar{A}_m$ . A PE firm provides additional equity ( $A_{pe}$ ), which alleviates the financial constraint as well.

Apart from these fundamental drivers perhaps a more relevant question in the context of this paper is how does asymmetric information affect the firm's financial constraint by way of either reinforcing or alleviating the moral hazard cost. In general this effect is ambiguous. Overvaluation *lowers* the expected perceived agency cost since  $p'_H$  affects the term  $p'_H B / \Delta p'$  negatively. However it *increases* such cost by raising  $p'_L$ . So when it comes to comparing a stand-alone firm and a PE buyout, we need a low productivity project to react more to asymmetric information in the



credit market (same notion as above). Thus, if overvaluation makes things “worse” in terms of the moral hazard problem, then, intuitively, overvaluation will benefit financial buyers given their ability to lower ex-post agency costs - this is the point of condition 1.

Thus, what we have shown here is if overvaluation makes the moral hazard problem “worse” (condition 1 holds) then overvaluation increases the “quantity” of PE acquirers relative to stand-alone firms. As we have noted this is ultimately an empirical question. However, the idea that overvaluation increases moral hazard is argued by many authors. For example, Jensen (2005), Bolton et al. (2006) and Bolton et al. (2005) all argue that overvaluation is the root cause of much managerial misbehavior. Our point is, if true, then overvalued debt markets should result in more financial acquisitions.

The next proposition considers how strategic acquirers are affected relative to stand-alone firms with respect to the amount of internal funds required by credit markets and finds conditions under which a strategic acquirer does worse than a stand-alone in terms of their ability to raise funds externally.

**PROPOSITION 8:** *If  $B^s \geq B$  then  $\bar{A}_m \leq \bar{A}_m^s$ . The difference  $\bar{A}_m - \bar{A}_m^s$  becomes more negative with increases in  $B$  and less negative with increases in  $B^s$  and  $\gamma$ ; and if also condition 1 holds, then overvaluation (undervaluation) makes this difference larger (smaller), that is,*

$$\frac{\partial (\bar{A}_m - \bar{A}_m^s)}{\partial \mu} < 0.$$

*PROOF:*

*See Appendix*

This proposition highlights the fact that conglomerates mergers will be less likely to occur with overvaluation for two reasons. First, it is often argued that conglomeration comes with potentially higher agency costs. This is reflected with the condition  $B^s \geq B$ . The effect of worse moral hazard is further exacerbated with the presence of overvaluation, since when condition 1 holds, overvaluation makes the moral hazard problem worse, making conglomerates look even worse.

At the same time, the proposition can be interpreted differently. If synergies are

important and the acquisition does not imply worse agency problems then such a strategic buyer should be able to bid highly for a target.

Finally, the most relevant comparison is that of  $\bar{A}_m^s$  with  $\bar{A}_m^{pe}$ . This will establish when and why one organizational form is more likely to show up in a potential auction for a target. Therefore, we next demonstrate what conditions make financial buyers the only organizational form possible for the lower end of the distribution of  $A$ .

**PROPOSITION 9:**  $\bar{A}_m^{pe} < \bar{A}_m^s$ . *The difference  $\bar{A}_m^{pe} - \bar{A}_m^s$  becomes more negative with increases in  $B^s$  and less negative with increases in  $b$  and  $\gamma$ , while the effect of  $c$  is positive if there is overvaluation. Moreover, if also condition 1 holds, overvaluation (undervaluation) makes this difference more (less) negative, that is,*

$$\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \mu} < 0.$$

*PROOF:*

*See Appendix*

This proposition tells us, among other things, that to the extent that one believes that a PE monitor is a more efficient form of governance than a conglomerate, overvaluation in the debt market should lead to more financial sponsor activity relative to strategic activity, if overvaluation makes the moral hazard problem worse. This lets us understand what we need to believe in order to think that overvalued debt markets increase financial activity relative to strategic activity, and why we should see more highly leveraged PE transactions in the data. This is because a lower  $\bar{A}_m^{pe}$  means managers with less cash are only able to finance a deal with a PE partner.

Building on the three results in this subsection, we have shown that with overvaluation there exists a mass of firms with  $A_m \in (\bar{A}_m^{pe}, \bar{A}_m^s)$  which only financial bidders can buy and hence a PE buyout is the optimal organizational form. While for firms such that  $A_m > \max\{\bar{A}_m^s, \bar{A}_m^{pe}\}$  both types of buyers are likely to be present in an auction for the company. And furthermore depending on the relative private benefits of a strategic or stand alone manager then  $\bar{A}_m$  may be larger or smaller

than  $\bar{A}_m^s$ ). However, for firms with enough capital all three organizational forms are possible. The figure below illustrates an example when  $(\bar{A}_m > \bar{A}_m^s)$ .

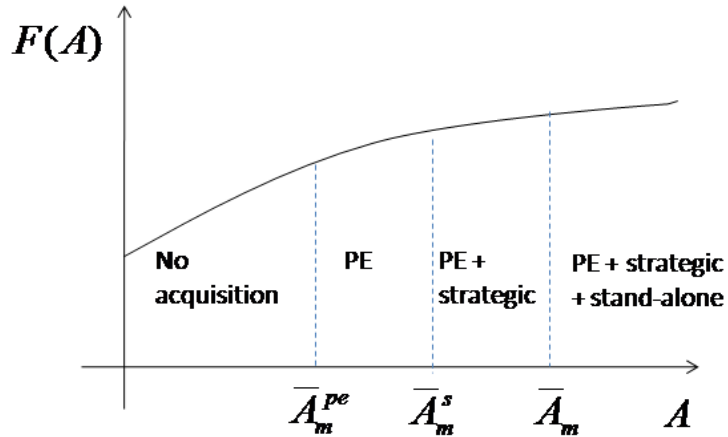


FIGURE 2. MINIMUM REQUIRED CAPITAL.

Overall we have shown how debt overvaluation can have an effect both on the acquirer willingness-to-pay and on the acquirer ability to finance the deal that could explain why we see increased financial sponsor activity that correlates with high liquidity and low yields in the debt market.

#### IV. Predictions and Discussion

##### A. The Merger Wave of 2005-07

The starting point of this paper was the observation that the one thing that seemed to characterize the last wave of acquisition activity of 2005-2007 was the relatively more predominant role of financial buyers. It has been argued by both industry practitioners and some academics that this period was characterized as a period of potentially overvalued debt and hence “too low” yields. This casual observation is consistent with, and predicted by, our model. According to our results a period with overvalued debt should have several effects. Provided monitoring is efficient, overvaluation allows relatively more external financing to both financial and strategic buyers, hence more firms are susceptible to being acquired either by a PE group or a strategic acquirer. This speaks about increased acquisition activity.

Our central proposition, however, also proves that because of the interaction between misvaluation and cash flow diversification, periods with overvalued debt should cause an increase in the number of financial buyers compared to strategics. Our model provides a characterization of this last merger wave as one potentially caused by, or at least magnified by, the misvaluation of debt (either because of asymmetric information or behavioral factors).

### *B. The Collapse of the PE Market*

Our static setup can also be taken a little further, in a more dynamic thought experiment. Let us assume that debt maturities are shorter than the investment horizon: in this case a PE firm must impound their forecast of future expected misvaluation in debt markets into their willingness to pay today. If debt markets shift from “over” to “undervaluation” it may turn out that a financial buyer paid significantly more than the investment is now worth given that it has to be refinanced with “underpriced” debt. To be clear, this was not a mistake *ex-ante* but will lead to the possibility of sudden collapses *ex-post* that are not related to a change in the health of the underlying target. Furthermore, the larger the original debt market mispricing the larger the resulting financial distress situation. Therefore, depending on the costs of financial distress, the underlying target firm may be impacted in a way that would not have occurred had debt markets been correctly priced at all times. This reasoning explains the possibility of financial distress related purely to misvalued debt and not to negative shocks to the firm’s underlying asset value.

### *C. Divestitures and Asset Sales*

Even though we have motivated this paper in the context of acquisition activity, its predictions and implications go beyond asset expansion and can be more generally related to overall restructuring activity. One example of this broader interpretation can be made in the context of optimal asset sale policies. When debt is overvalued a diversified company can potentially unlock value by getting rid of a division. This is so because as a stand-alone entity the division should be better able to extract information rents from lesser informed investors. However, a divestiture will only

be an optimal strategy provided, of course, that there are no significant synergies between the division to be divested and the rest of the divisions that comprise the original firm. Hence in terms of overvalued debt markets, our paper suggests not only more acquisition activity (with potentially more financial buyers) but also more divestitures or asset sales undertaken by diversified companies or conglomerates. The reason for this prediction is the same driving our acquisition results, namely, the interaction of information asymmetries and diversification of cash flows.

*D. Enhancing Diversification: Increasing the Number of Projects*

One important dimension in which one might want to check the robustness of our result is by increasing the number of projects beyond two, which was initially assumed for simplicity. Let us assume instead that a strategic buyer consists of  $n$  projects if it buys the target. As the following proposition shows, when the number of projects increases the advantage of financial buyers with overvalued debt increases as well. This is because the cost created by diversification in a strategic acquisition becomes greater. The intuition is simple. As  $n$  goes to infinity the firm should be so diversified that debt would be riskless: no mispricing should exist at all. This is bad news for a strategic buyer when debt is overvalued and rents can be extracted from investors. At the limit with  $n$  approaching infinity, a diversified (strategic) buyer is unable to counterbid any financial or stand-alone buyer.

PROPOSITION 10: *Assume w.l.o.g. that the IC constraint holds, that is,  $\forall n \in \mathbb{N}$ ,  $(\gamma A_m - B)/p_H p_L^n \geq \gamma A_m/p_H^n > B/p_H'(p_H^n - p_L^n)$ . Then*

$$\begin{aligned} \bar{V}_n^s &= \frac{p_H'}{\gamma} R - I + \left(1 - \left(\frac{p_H'}{p_H}\right)^n\right) A_m \text{ and} \\ \lim_{n \rightarrow \infty} \bar{V}_n^s &= \begin{cases} 0 & \text{if } p_H' > p_H \\ p_H' R/\gamma - I + A_m & \text{if } p_H' < p_H \\ p_H' R/\gamma - I & \text{if } p_H' = p_H \end{cases} \end{aligned}$$

*PROOF:*

*See Appendix.*

It is immediate to see, from the proposition above, that the marginal impact of an additional project on a strategic buyer's willingness-to-pay is negative,  $\partial \bar{V}^s / \partial n < 0$  and larger when debt is overvalued. The proposition also shows that in the limit when the number of projects is arbitrarily large, the highest willingness-to-pay becomes closer to zero in the case of overvalued debt financing, making the difference between strategics and financial buyers the largest.

#### *E. Correlated Projects*

A limiting force on the co-insurance/misvaluation effect occurs when firm's cash flows are positively correlated, as opposed to independent. In this case, the price effect shown in Proposition 4 is diminished and financial buyers enjoy a lower advantage, compared to strategics. An extreme example is the case of perfectly correlated projects. If the two projects are perfectly positively correlated, then the possibility of diversification disappears. The strategic acquirer scenario then becomes equal to the stand-alone case. The relevant comparison becomes the stand-alone and the private equity cases, where the differences mainly arise from the different agency costs and there is no interaction between diversification and asymmetric information. We highlight this observation because it has empirical content: we should observe strategic acquirers whose cash flows are more correlated with the target's being more able to outbid financial buyers.

#### *F. When the Equilibrium Contract is not a Debt Contract*

In this subsection we perform another robustness check by looking at an alternative equilibrium contract, one that could arise if  $R$  is large enough so that the optimal contract that pays the manager only in the case of success in both projects is not feasible. We refer to the appendix for a full explanation of this scenario, but this alternative contract could arise whenever

$$2p'_H(1 - p'_H)R > 2\gamma(\bar{V}^s + I - A_m).$$

In this case, the equilibrium contract must be of the form  $(R_u^s, R_{ui}^s)$ , where the pair denotes payments to uninformed investors whenever both projects are successful or

only one is, respectively (compared to the optimal debt contract where  $R_{ui}^s = R$  and the manager does not receive any payoff in the intermediate cash flow realizations).

We are interested in analyzing the implications of this alternative contract, which clearly affects the diversification power of the contract that investors sign, by shifting more payoffs to the investors away from the intermediate case (only one project is successful) to the best state (two projects are successful).

Following the same logic behind proposition 4 in trying to isolate the interaction effect between diversification and asymmetric information we assume  $B = 0$ . When we compare the result in proposition 4 with this alternative contract, the following result arises.

**PROPOSITION 11:** *If there is overvaluation, the financial acquirer's willingness to pay with the alternative contract issued to investors, compared to an optimal debt contract, is lower. A financial buyer is able to pay more than a strategic buyer to the extent that  $\Delta < \left( \left( \frac{p'_H}{p_H} \right)^2 - \frac{p'_H}{p_H} \right) A_m$ , where  $\Delta \equiv \left( \frac{p_H'^2}{p_H} - p'_H \right) R + R_{ui}^s \left[ (1 - p'_H)p'_H - \frac{(1-p_H)p_H'^2}{p_H} \right]$ .*

*PROOF:*

*See Appendix.*

This proposition essentially confirms that as the diversification power decreases the relative disadvantage of strategic buyers does so as well. Note that this alternative contract – which is not quite a debt contract – offers less diversification (in the sense that the payoff structure brings more payoffs to the “extreme” case where both projects are successful) hence the disadvantage of a strategic buyer with respect to a financial buyer is reduced by an amount  $\Delta$  derived in the appendix. This is similar to the case of correlated projects, explained in the previous section.

## V. Evidence

In order to test the key thesis of our paper, we measure overvaluation in the bond market using the 5-year Average Position from Moody's. The average position for a cohort is calculated from that cohort's accuracy ratio, which is a summary measure of Moody's cumulative accuracy profile. According to Moody's, “the cumulative

accuracy profile is constructed by plotting, for each rating category, the proportion of defaults accounted for by firms with the same or a lower rating against the proportion of all firms with the same or a lower rating.” The accuracy ratio is then is the ratio of the area between the cumulative accuracy profile and the 45-degree line to the total area above the 45-degree line.<sup>26</sup> We reproduce an exhibit from Moody’s below (Our Figure 3, Moody’s Exhibit 4). The accuracy ratio (henceforth  $AR$ ) is the ratio of the area of A to the sum of areas A and B. Moody’s has provided us with quarterly cohort 5-year average position ( $AP$ ) measures, which are related to the accuracy ratio through the following expression:  $AR = 2AP - 1$ . A higher  $AR$  (and hence  $AP$ ) reflects better ex-post accuracy of Moody’s ratings, so misvaluation in the bond market will be captured by lower average positions.

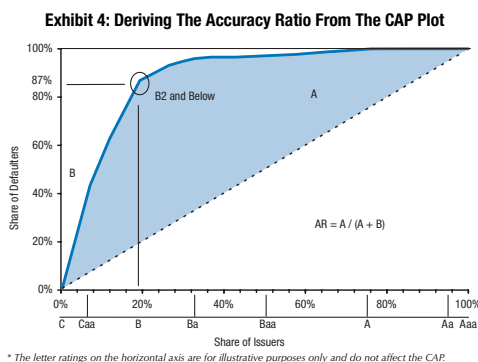


FIGURE 3. EXHIBIT FROM MOODY’S SPECIAL COMMENT *Measuring The Performance of Corporate Bond Rating* [HTTP://WWW.MOODYS.COM/SITES/PRODUCTS/DEFAULTRESEARCH/2001900000426576.PDF](http://www.moody.com/sites/products/defaultresearch/2001900000426576.pdf)

We use other measures of bond market activity and conditions, such as the growth in corporate borrowing from the Federal Reserve’s Flow of Funds Statement, the 5-year Treasury rate, the high-yield credit spread, and the average spread over the Federal Funds rate for commercial and industrial loans. As a general measure of valuations, we also control for the median market to book ratio (based on the Compustat population) and the standard deviation of the market to book ratio.

Our measure of private equity activity is the fraction of the value of all deals for public targets accounted for by financial sponsors (also know as private equity or



leveraged-buy-outs (LBOs). We calculate this on a quarterly basis. For M&A data, quarterly time series can be highly variable, so we smooth all of our time series by taking the two quarter average. In our regression tests, we use only non-overlapping periods. Figure 4 plots the average position and the percentage of PE activity. We define a high PE period as a two-quarter period where the average fraction of activity accounted for by PE activity is more than 10%.

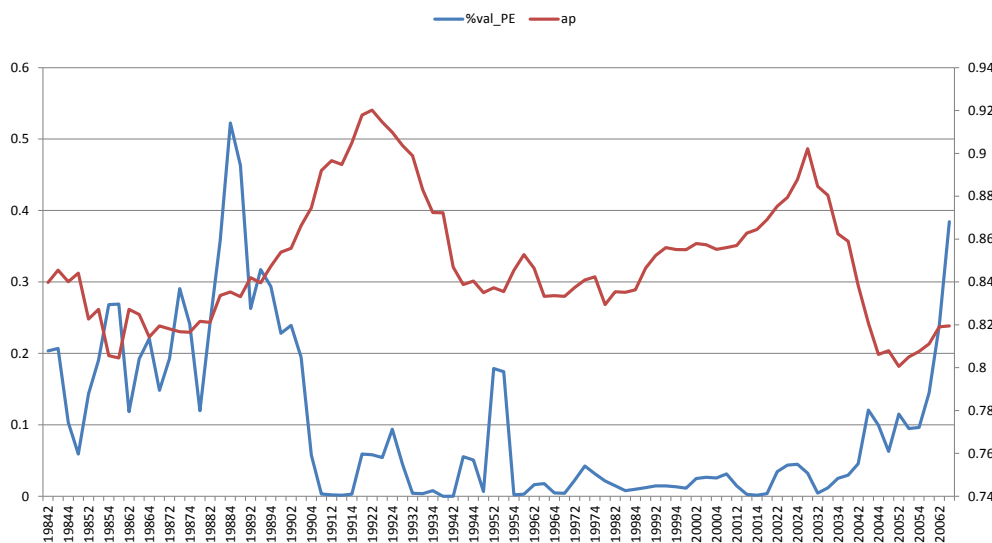


FIGURE 4. MOODY'S AVERAGE POSITION (AP) AND THE PERCENTAGE OF LBO ACTIVITY (*%val\_lbo*)

Table 1 presents summary statistics for the variables used in our estimation. The average fraction of activity accounted for by PE acquirers is 11% and about 38% of our two-quarter periods are high PE periods. The average position fluctuates within a relative tight range (between 80% and 92%), so even relatively small changes in the average position reflect large changes in bond market misvaluation.

[Table 1]

We estimate a logit predicting whether a given two-quarter period will have high PE activity. We present the results as marginal effects in Table 2, where the first row contains average position, our measure of bond market pricing accuracy. It is consistently significantly negative, confirming that in periods where current bond ratings are a poor measure of future defaults, PE activity is higher as a fraction of

total activity. The effect is economically large as well. A one standard deviation decrease in average position increases the fraction of activity by LBOs by between 18% and 35%, depending on the coefficient. Interestingly, none of the other credit market variables correlate with PE activity when debt mispricing (average position) is included. Thus, high PE activity does not seem to be just about changing economic conditions but rather highly related ratings mistakes. In some specifications, the average M/B is negative, indicating that when valuations are particularly high, LBOs are a smaller fraction of activity, which is sensible because strategic acquirers can use overvalued stock to dominate PE firms.

[Table 2]

We have estimated the specification at the annual and quarterly level as well, finding consistent results. We have also repeated the annual estimation using the fraction of deals by count with consistent results. We have also used an alternative measure of misvaluation—the ratio of ratings downgrades to upgrades three years after the quarter of interest. We get similar inferences in that a higher ratio of future downgrades to upgrades is associated with a greater PE share of activity today. In head-to-head tests, the downgrade-to-upgrade ratio loses significance in the presence of average position. Since they are both proxy for the degree of overpricing in the bond market, we choose average position as our primary variable.

Our conclusions from the data must be tempered by the limited number of observations we have for a single time series due to the data availability. However, the evidence is consistent with the idea that misvaluation in the debt market is driving the relative dominance of PE activity.

## VI. Concluding Remarks

We highlight and then set out to explain the oscillating pattern of financial vs. strategic acquirers within overall merger activity. The wave like increases and decreases in financial sponsor activity relative to strategic activity suggests that a broad economic explanation is driving the shifting dominance of one over the other.

Initially it would seem that current theories of waves of merger activity by Rhodes-Kropf and Viswanathan (2004) and Shleifer and Vishny (2003) would easily explain

the shifting dominance of strategic acquirers – when strategic acquirers have overvalued stock they dominate financial buyers. However, Figure 1 dispels this notion as a driving force because the relative fraction of financial buyers seems to peak with the stock market. Logically an overvalued stock market correlates with an overvalued debt market.

We demonstrate that misvaluation in the debt market that can explain increased activity and the relative dominance of financial buyers. This is non-obvious because an overvalued debt market should raise the value of stand alone firms as well as the willingness-to-pay of both financial and strategic acquirers as they can all access cheap debt. We model how misvaluation interacts with both the co-insurance effect (Lewellen (1971)) of mergers on debt and the moral hazard problem, to give financial firms a relative advantage when debt markets are overvalued.

Strategic acquirers by definition have a current project that they combine with the target project. This has a well known co-insurance effect on the debt. The magnitude of this co-insurance effect depends on the independence of the projects that the probability either project has a bad outcome. When debt holders underestimate the probability of the bad outcome they both overvalue the debt and undervalue the co-insurance effect. At these times strategic acquirers suffer relative to financial buyers. Alternatively, when debt investors overestimate the probability of a bad outcome they both undervalue the debt and overvalue the co-insurance effect of combining projects. At these times financial acquirers on average cannot pay as much as strategic acquirers.

Furthermore, if misvaluation makes the moral hazard problem worse and PE firms are better at countering the moral hazard problem, then when debt markets are misvalued PE firms will be able to lever more and extract more value from the project than a strategic acquirer, or firms that operate on a stand-alone basis. Thus, misvalued debt markets should lead to more PE activity.

The central empirical prediction from our model is that debt market misvaluation should drive the dominance of PE acquirers over strategics. We find in the data a strong correlation between measures of debt market misvaluation and the fraction of acquisition activity due to PE acquirers. This is consistent with our

theory, which provides a possible explanation for this correlation.

Overall, by combining the idea of the co-insurance effect of strategic M&A with the ideas of misvaluation we gain considerable insights into a previously unexplored pattern. We hope that future work will further examine the impact of potentially misvalued debt markets and show its relevance to M&A activity in the same way that so much has followed from the ideas of equity misvaluation.

## REFERENCES

- Andrade, Gregor, Mark Mitchell, and Erik Stafford. "New Evidence and Perspectives on Mergers." *Journal of Economic Perspectives* 15 (2001), pp. 103–120.
- Ang, James S., and Yingmei Cheng. "Direct evidence on the market-driven acquisitions theory." *Journal of Financial Research* 29 (2006), pp. 199–216.
- Axelson, Ulf, Tim Jenkinson, Per Stromberg, and Michael S. Weisbach. "Borrow Cheap, Buy High? The Determinants of Leverage and Pricing in Buyouts." *NBER working paper* (2010).
- Baker, Malcolm, and Jeff Wurgler. "Market timing and capital structure." *Journal of Finance* 57 (2002), pp. 1–32.
- Barberis, Nicholas, and Richard H. Thaler. "A Survey of Behavioral Finance." In George Constantinides, Milton Harris, and Rene M. Stulz, editors, "Handbook of the Economics of Finance," Amsterdam, North Holland: MacMillan (2003).
- Bargeron, Leonce L., Frederik P. Schlingemann, Rene M. Stulz, and Chad J. Zutter. "Why do private acquirers pay so little compared to public acquirers?" *Journal of Financial Economics* 89 (2008), pp. 375–390.
- Bolton, Patrick, Jose Scheinkman, and Wei Xiong. "Pay for Short-Term Performance: Executive Compensation in Speculative Markets." *Journal of Corporation Law* (2005).
- Bolton, Patrick, Jose Scheinkman, and Wei Xiong. "Executive Compensation and Short-termist Behavior in Speculative Markets." *Review of Economic Studies* 73 (2006), pp. 577–610.
- Dittmar, Amy, Di Li, and Amrita Nain. "The Bright Side of Bidder Competition." *University of Michigan working paper* (2009).
- Dong, Ming, David Hirshleifer, Scott Richardson, and Siew Hong Teoh. "Does Investor Misvaluation Drive the Takeover Market?" *Journal of Finance* 61 (2006), pp. 725–762.

- Faure-Grimaud, Antoine, and Roman Inderst. "Conglomerate entrenchment under optimal financial contracting." *American Economic Review* 95 (2005), pp. 850–861.
- Fishman, Michael J. "Preemptive Bidding and the Role of the Medium of Exchange in Acquisitions." *Journal of Finance* 44 (1989), pp. 41–57.
- Galai, D., and Ronald W. Masulis. "The Option Pricing Model and the Risk Factor of Stock." *Journal of Financial Economics* (1976).
- Goldman, Eitan, and Steve Slezak. "An Equilibrium Model of Incentive Contracts in the Presence of Information Manipulation." *Journal of Financial Economics* 80 (2006), pp. 603–626.
- Gorbenko, Alexander S., and Andrei Malenko. "Strategic and Financial Bidders in Takeover Auctions." *Stanford University working paper* (2009).
- Gorton, Gary, Matthias Kahl, and Richard Rosen. "Eat or be eaten: A theory of mergers and merger waves." *Journal of Finance* 64 (2009), pp. 1291–1344.
- Greenwald, Bruce, Joseph Stiglitz, and A. Weiss. "Informational Imperfections in the Capital Market and Macroeconomic Fluctuations." *American Economic Review* 74 (1984), pp. 194–199.
- Hansen, R.G. "A Theory for the Choice of Exchange Medium in Mergers and Acquisitions." *Journal of Business* 60 (1987), pp. 75–95.
- Harford, Jarrad. "What Drives Merger Waves." *Journal of Financial Economics* 77 (2005), pp. 529–560.
- Hege, Ulrich, Stefano Lovo, Myron B. Slovin, and Marie E. Sushka. "The Role of Private Equity in Corporate Asset Sales: Theory and Evidence." *HEC Paris working paper* (2010).
- Higgins, Robert, and Lawrence Schall. "Corporate bankruptcy and conglomerate merger." *Journal of Finance* 30 (1975), pp. 93–113.
- Hirshleifer, David. "Investor psychology and asset pricing." *The Journal of Finance* 56 (2001), pp. 1533–1597.

- Holmstrom, Bengt, and Steven N. Kaplan. "Corporate Governance and Merger Activity in the United States: Making Sense of the 1980s and 1990s." *Journal of Economic Perspectives* 15 (2001), pp. 121–144.
- Holmstrom, Bengt, and Jean Tirole. "Financial Intermediation, Loanable Funds, and the Real Sector." *The Quarterly Journal of Economics* 112 (1997), pp. 663–691.
- Jensen, Michael. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *American Economic Review* 76 (1986), pp. 323–329.
- Jensen, Michael. "Agency Costs of Overvalued Equity." *Financial Management* 34 (2005), pp. 5–19.
- Jovanovic, Boyan, and Peter Rousseau. "The Q-Theory of Mergers." *The American Economic Review, Papers and Proceedings* 92 (2002), pp. 198–204.
- Kim, E. Han, and John McConnell. "Corporate mergers and the co-insurance of corporate debt." *Journal of Finance* 32 (1977), pp. 349–365.
- Kindleberger, Charles P. *Manias, Panics, and Crashes*. New York: Basic Books (1978).
- Kumar, Praveen, and Nisan Langberg. "Corporate fraud and investment distortions in efficient capital markets." *RAND Journal of Economics* 40 (2009), pp. 144172.
- Lehn, Kenneth, Jeffrey Netter, and Annette Poulsen. "Consolidating Corporate Control: Dual-Class Recapitalization versus Leveraged Buyouts." *Journal of Financial Economics* 27 (1990), pp. 557–580.
- Leland, Hane. "On purely financial synergies and the optimal scope of the firm: implications for mergers, spin-offs, and structured finance." *Journal of Finance* 62 (2007), pp. 765–807.
- Lewellen, W. G. "A Pure Financial Rationale for the Conglomerate Merger." *Journal of Finance* (1971).

- Maksimovic, Vojislav, and Gordon Phillips. "The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains?" *The Journal of Finance* LVI (2001), pp. 2019–2065.
- Mitchell, Mark L., and J. Harold Mulherin. "The impact of industry shocks on takeover and restructuring activity." *Journal of Financial Economics* 41 (1996), pp. 193–229.
- Morellec, Erwan, and Alexei Zhdanov. "Financing and Takeovers." *Journal of Financial Economics* 87 (2008), pp. 556–581.
- Mulherin, J. Harold, and Audra L. Boone. "Comparing acquisitions and divestitures." *Journal of Corporate Finance* 6 (2000), pp. 117–139.
- Müller, Holger M., and Fausto Panunzi. "Tender Offers and Leverage." *Quarterly Journal of Economics* 119 (2004), pp. 1217–1248.
- Myers, Stewart C., and N. S. Majluf. "Corporate financing and investment decisions when firms have information that investors do not have." *Journal of Financial Economics* 13 (1984), pp. 187–221.
- Rajan, Raghuram, Henri Servaes, and Luigi Zingales. "The Cost of Diversity: The Diversification Discount and Inefficient Investment." *The Journal of Finance* 55 (2000), pp. 35–80.
- Rhodes-Kropf, Matthew, David Robinson, and S. Viswanathan. "Valuation Waves and Merger Activity: The Empirical Evidence." *Journal of Finance* 77 (2005), pp. 561–603.
- Rhodes-Kropf, Matthew, and S. Viswanathan. "Market Valuation and Merger Waves." *Journal of Finance* 59 (2004), pp. 2685–2718.
- Scharfstein, David S., and Jeremy C. Stein. "The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment." *The Journal of Finance* 55 (2000), pp. 2537–64.
- Shleifer, Andrei. *Inefficient Markets—An Introduction to Behavioral Finance*. Oxford: Oxford University Press, 1 edition (2000).



Shleifer, Andrei, and Robert W. Vishny. "Stock Market Driven Acquisitions." *Journal of Financial Economics* 70 (2003), pp. 295–311.

William E. Fruhan, Jr. "The Role of Private Equity Firms in Merger and Acquisition Transactions." *Harvard Business School Case 9-206-101* (2010).

Table 1. Summary Statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Min</i>	<i>Max</i>
Value by LBO (%)	45	0.110	0.149	0.000	0.703
High LBO	45	0.378	0.490	0.000	1.000
AP	45	0.849	0.029	0.803	0.917
Corp. Borrowing Growth (%)	45	6.771	4.639	-2.800	16.000
5-year Treasury Yield (%)	45	6.425	2.240	2.525	12.750
High-yield Credit Spread (%)	45	2.445	0.703	1.450	4.440
C&I Spread (%)	40	1.614	0.251	1.220	2.120
M/B	45	1.340	0.132	1.145	1.662
Std Dev (M/B)	45	3.794	1.717	1.954	7.023

Table 2. Financial Buyers Activity

This table shows logistic regressions of *highlbo*, where *highlbo* is a dummy variable that takes the value of 1 if lbo participation as a % of total deal value is above 10% and 0 otherwise. Standard errors are in parenthesis. All variables are averages over two non-overlapping quarters.

<i>Variables</i>	(1)	(2)	(3)	(4)	(5)	(6)
<i>AP</i>	-9.918*** (1.939)	-12.276*** (2.150)	-11.971*** (1.772)	-10.505** (2.720)	-10.609** (3.213)	-6.256* (2.308)
Borr Growth			0.005 (0.016)	0.000 (0.017)	0.001 (0.019)	0.020 (0.025)
Treasury Yield				0.133* (0.057)	0.141 (0.089)	0.179 (0.107)
C&I Sprd					0.026 (0.216)	0.246 (0.283)
H-Y Sprd						1.086 (0.900)
M/B		-1.249** (0.467)	-1.220** (0.468)	-0.412 (0.572)	-0.343 (0.804)	1.608 (1.761)
Std Dev M/B		-0.046 (0.036)	-0.043 (0.037)	0.028 (0.039)	0.026 (0.041)	-0.203 (0.198)
Observations	45	45	45	45	45	40

TECHNICAL APPENDIX

**Proof of Proposition 1 (Highest willingness to pay, stand-alone case).**

The proof of this proposition uses the preliminary result contained in Lemma 1. We will show that in fact the maximum willingness to pay can take on three different values depending on the parameter values.

Subcase 1:  $B/\Delta p' \geq \min[\gamma A_m/p_H, (\gamma A_m - B)/p_L]$ .

In this case the R.H.S. of the constraint in Lemma 1

$$(R - \gamma(\bar{V} + I - A_m))/p'_H \geq \max\{B/\Delta p', \min[\gamma A_m/p_H, (\gamma A_m - B)/p_L]\}$$

becomes  $B/\Delta p'$ , therefore the maximum willingness to pay is defined by making the constraint  $R - \gamma(\bar{V} + I - A_m)/p'_H \geq B/\Delta p'$  bind since the larger  $\bar{V}$  is the less likely the constraint will be satisfied. Rearranging terms, we find that

$$\bar{V} = \frac{p'_H}{\gamma}(R - B/\Delta p') - I + A_m.$$

Subcase 2:  $(\gamma A_m - B)/p_L \geq \gamma A_m/p_H > B/\Delta p'$ .

If the condition above holds then the RHS of the constraint in Lemma 1 becomes  $\gamma A_m/p_H$ . Therefore the constraint can now be written as  $R - \gamma(\bar{V} + I - A_m)/p'_H \geq \gamma A_m/p_H$ . The highest willingness to pay is defined by the maximum amount of  $\bar{V}$  that still satisfies the constraint, therefore

$$\bar{V} = \frac{p'_H}{\gamma}R - I + (1 - \frac{p'_H}{p_H})A_m.$$

Subcase 3:  $\gamma A_m/p_H > (\gamma A_m - B)/p_L > B/\Delta p'$ .

In the last subset of parameter values the RHS of the constraint in Lemma 1 is simplified to  $(\gamma A_m - B)/p_L$ . Following the same logic as in the preceding subcases we find that

$$\bar{V} = \frac{p'_H}{\gamma}(R + \frac{B}{p_L}) - I + (1 - \frac{p'_H}{p_L})A_m. \blacksquare$$

**Derivation of results in the scenario without asymmetric information.**

Absent any information asymmetry between external investors and management

only firms with

$$A \geq \bar{A}_m^* \equiv I - p_H (R - B/\Delta p) / \gamma$$

would receive funding, this is the standard result from Tirole (2005). This implies that  $\gamma A_m / p_H > B / \Delta p$  since the NPV of the firm is strictly positive by assumption. Equation (5) can then be rewritten as

$$R - \gamma(\bar{V} + I - A_m) / p_H \geq \gamma A_m / p_H.$$

This is so because now investors coincide with managers in assessing the probability of success and the right hand side of the equation simplifies to a single case, while the investor's IR reads  $p_H R_u = \gamma(\bar{V} + I - A_m)$ . We can rewrite the constraint as

$$R - \gamma(V^* + I - A_m) / p_H \geq B / \Delta p,$$

which gives us a reservation value of  $\bar{V}^* = p_H R / \gamma - I$ , the net present value of the project. ■

**Proof of Proposition 2 (Highest willingness to pay, PE case).** The proof is parallel to the proof of Proposition 1. It also uses the equivalent of Lemma 1 in the case of a PE firm, that is,

$$\begin{aligned} & R - c / \Delta p' - \gamma(\bar{V}^{pe} + I - A_m - A_{pe}) / p'_H \\ & \geq \max \{ b / \Delta p', \min[\gamma A_m / p_H, (\gamma A_m - B) / p_L] \}. \end{aligned}$$

We again divide the parameter space in three subcases.

Subcase 1:  $b / \Delta p' \geq \min[\gamma A_m / p_H, (\gamma A_m - B) / p_L]$ .

In this case  $\max \{ b / \Delta p', \min[\gamma A_m / p_H, (\gamma A_m - B) / p_L] \} = b / \Delta p'$ . So the maximum  $\bar{V}^{pe}$  is defined by

$$R - c / \Delta p' - \gamma(\bar{V}^{pe} + I - A_m - A_{pe}) / p'_H = b / \Delta p',$$

which gives

$$\bar{V}^{pe} = \frac{p'_H}{\gamma} (R - (b + c) / \Delta p') - I + A_m + A_{pe}.$$

Subcase 2:  $(\gamma A_m - B)/p_L \geq \gamma A_m/p_H > b/\Delta p'$ .

In this case it is easy to see that  $\max[b/\Delta p', \min[\gamma A_m/p_H, (\gamma A_m - B)/p_L]] = \gamma A_m/p_H$ . Therefore following the same logic we arrive at

$$\bar{V}^{pe} = \frac{p'_H}{\gamma} R - I + (1 - \frac{p'_H}{p_H}) A_m + (A_{pe} - \frac{p'_H}{\gamma} \frac{c}{\Delta p'}),$$

but then  $A_{pe} = p_H c / \gamma_{pe} \Delta p'$ , so

$$\begin{aligned} \bar{V}^{pe} &= \frac{p'_H}{\gamma} R - I + (1 - \frac{p'_H}{p_H}) A_m + (\frac{p_H}{\gamma_{pe}} \frac{c}{\Delta p'} - \frac{p'_H}{\gamma} \frac{c}{\Delta p'}), \\ \bar{V}^{pe} &= \frac{p'_H}{\gamma} R - I + (1 - \frac{p'_H}{p_H}) A_m + (\frac{p_H}{\gamma_{pe}} - \frac{p'_H}{\gamma}) \frac{c}{\Delta p'}. \end{aligned}$$

Subcase 3:  $\gamma A_m/p_H > (\gamma A_m - B)/p_L > b/\Delta p'$ .

Finally, in this case  $\max[b/\Delta p', \min[\gamma A_m/p_H, (\gamma A_m - B)/p_L]] = (\gamma A_m - B)/p_L$ .

Therefore and by simply rearranging terms, the expression for the highest amount the buyout team is willing to pay is defined by

$$R - c/\Delta p' - \gamma(\bar{V}^{pe} + I - A_m - A_{pe})/p'_H = (\gamma A_m - B)/p_L$$

which, after rearranging, implies

$$\bar{V}^{pe} = \frac{p'_H}{\gamma} (R + \frac{B}{p_L}) - I + (1 - \frac{p'_H}{p_L}) A_m + (A_{pe} - \frac{p'_H}{\gamma} \frac{c}{\Delta p'}),$$

but then  $A_{pe} = p_L c / \gamma_{pe} \Delta p'$ , so

$$\bar{V}^{pe} = \frac{p'_H}{\gamma} (R + \frac{B}{p_L}) - I + (1 - \frac{p'_H}{p_L}) A_m + (\frac{p_L}{\gamma_{pe}} - \frac{p'_H}{\gamma}) \frac{c}{\Delta p'}.$$

■

### **Proof of Proposition 3 (Highest willingness to pay, strategic acquirer).**

The proof of this proposition uses the preliminary result contained in Lemma 1 but adapted to the case of a strategic buyer, as explained in equation (20). We will show that in fact the maximum willingness to pay can take on three different values depending on the parameter values.

Subcase 1:  $B^s/p'_H\Delta p' \geq \min[\gamma A_m/p_H^2, (\gamma A_m - B^s)/p_{HPL}]$

In this case the R.H.S. of the constraint in (20) becomes  $B^s/p'_H\Delta p'$ , therefore the maximum willingness to pay is defined by making that constraint,  $R/p'_H - \gamma(\bar{V}^s + I - A_m)/p_H^2 \geq B^s/p'_H\Delta p'$ , bind since the larger  $\bar{V}$  is the less likely the constraint will be satisfied. Rearranging terms, we find that

$$\bar{V}^s = \frac{p'_H}{\gamma} \left( R - \frac{B^s}{\Delta p'} \right) - I + A_m.$$

Subcase 2:  $(\gamma A_m - B^s)/p_{HPL} \geq \gamma A_m/p_H^2 > B^s/p'_H\Delta p'$ .

If the condition above holds then the RHS of equation (20) becomes  $\gamma A_m/p_H^2$ . Therefore the constraint can now be written as  $R - \gamma(\bar{V}^s + I - A_m)/p'_H \geq \gamma A_m/p_H^2$ . The highest willingness to pay is defined by the maximum amount of  $\bar{V}$  that still satisfies the constraint, therefore

$$\bar{V}^s = \frac{p'_H}{\gamma} R - I + \left( 1 - \frac{p_H^2}{p_H^2} \right) A_m.$$

Subcase 3:  $\gamma A_m/p_H^2 > (\gamma A_m - B^s)/p_{HPL} > B^s/p'_H\Delta p'$ .

In the last subset of parameter values the RHS of equation (20) is simplified to  $(\gamma A_m - B^s)/p_{HPL}$ . Following the same logic as in the preceding subcases we find that

$$\bar{V}^s = \frac{p'_H}{\gamma} \left( R + \frac{p'_H}{p_{HPL}} B^s \right) - I + \left( 1 - \frac{p_H^2}{p_{HPL}} \right) A_m. \blacksquare$$

### **Proof of Proposition 5 (Conditions under which $\bar{V}^{pe} \geq \bar{V}$ ) and Corollary 1**

To proof this result first note that we need to deal with pricing equations that have at least one discontinuity, hence comparison is a priori not trivial. We will assume that  $c > 0$  hence the proof is that of corollary 1 which is more general than proposition 5.

We first assume that the IC holds in equilibrium, this is without loss of generality. Let us from now on rewrite  $\bar{V}$  as  $\bar{V}_i^j(\mu)$  to denote the  $i$ -th equation for the willingness-to-pay of type  $j$  ( $j \in \{\emptyset, pe, s\}$ ), as a function of the misvaluation parameter  $\mu$ . Let us also define  $\bar{\mu}^j$  as the value of misvaluation such that  $\bar{V}_1^j(\bar{\mu}^j) = \bar{V}_2^j(\bar{\mu}^j)$ ,

that is,

$$\bar{\mu}^j : \bar{V}_1^j(\bar{\mu}^j) = \bar{V}_2^j(\bar{\mu}^j) \quad \forall j \in \{\emptyset, pe, s\}.$$

Recall that this happens We start with a series of preliminary results.

In fact we will show that the stand-alone cutoff  $\bar{\mu} > \bar{\mu}^{pe}$ , the cutoff for the PE firm. One way to prove it is by showing the difference in derivatives  $\partial\bar{V}_2^{pe}/\partial\mu - \partial\bar{V}_1^{pe}/\partial\mu < \partial\bar{V}_2/\partial\mu - \partial\bar{V}_1/\partial\mu$ , which implies that the cutoff where both equations  $V_1$  and  $V_2$  meet occurs sooner for the stand-alone case.

**Claim 1.**  $\lim_{\mu \rightarrow 0} \bar{V}^j = \bar{V}_2^j$ . *Proof.* When  $\mu = 0$ ,  $B/\Delta p' = B/\Delta p$  and  $b/\Delta p' = b/\Delta p$  so  $\gamma A_m/p_H > B/\Delta p$  and  $\gamma A_m/p_H > b/\Delta p$ , in which case the relevant equation is the second one, (16) and (7) for the PE firm and stand-alone firm respectively. ■

**Claim 2.** Assume condition 1 holds. Then  $\exists \bar{\mu}^j \equiv \bar{\mu}^j : \bar{V}_1^j(\bar{\mu}^j) = \bar{V}_2^j(\bar{\mu}^j) \quad \forall j \in \{\emptyset, pe, s\}$ . *Proof.* By condition 1, as  $\mu$  increases so does  $b/\Delta p'$  and  $B/\Delta p'$  hence by continuity there exists a value of  $\mu \equiv \bar{\mu}^j$  such that for  $\mu \leq \bar{\mu}^j : \bar{V}^j = \bar{V}_2^j(\mu) \leq \bar{V}_1^j(\mu)$  and  $\mu > \bar{\mu}^j : \bar{V}^j = \bar{V}_1^j(\mu) < \bar{V}_2^j(\mu), \forall j = \{\emptyset, pe\}$ . ■

**Claim 3.**  $\bar{\mu} < \bar{\mu}^{pe}$ . *Proof.* Using the Intermediate Value Theorem we will show that the cutoff, defined by the point where the two functions  $V_1$  and  $V_2$  meet, occurs earlier in the stand-alone case. This is shown by proving that  $V_1^{pe} - V_2^{pe}$  has a higher value at  $\mu = 0$  and a smaller slope than  $V_1 - V_2$ . First, note that

$$\bar{V}_1^{pe} - \bar{V}_2^{pe} = -\frac{p'_H b}{\gamma \Delta p'} + \frac{p'_H}{p_H} A_m \quad \text{and} \quad \bar{V}_1 - \bar{V}_2 = -\frac{p'_H B}{\gamma \Delta p'} + \frac{p'_H}{p_H} A_m.$$

At  $\mu = 0$ :

$$\begin{aligned} \bar{V}_1^{pe}(0) - \bar{V}_2^{pe}(0) &= -\frac{p_H b}{\gamma \Delta p} + A_m > 0, \\ \bar{V}_1(0) - \bar{V}_2(0) &= -\frac{p_H B}{\gamma \Delta p} + A_m > 0 \end{aligned}$$

Moreover, since  $-\frac{p_H b}{\gamma \Delta p} > -\frac{p_H B}{\gamma \Delta p}$ ,  $\bar{V}_1^{pe}(0) - \bar{V}_2^{pe}(0) > \bar{V}_1(0) - \bar{V}_2(0)$ . We now differ-



entiate the previous differences with respect to  $\mu$  and evaluate at  $\mu = 0$ :

$$\begin{aligned}\frac{\partial [\bar{V}_1^{pe}(0) - \bar{V}_2^{pe}(0)]}{\partial \mu} &= -\frac{b}{\gamma \Delta p'^2} \left[ -p'_L \frac{\partial p'_H}{\partial \mu} + p'_H \frac{\partial p'_L}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu}, \\ \frac{\partial [\bar{V}_1(0) - \bar{V}_2(0)]}{\partial \mu} &= -\frac{B}{\gamma \Delta p'^2} \left[ -p'_L \frac{\partial p'_H}{\partial \mu} + p'_H \frac{\partial p'_L}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu}.\end{aligned}$$

It is immediate to see that the PE derivative is less negative because  $b < B$ . This implies that  $\bar{\mu} < \bar{\mu}^{pe}$ . ■

We are now ready to prove the first part of the proposition.

First, if  $0 \leq \mu \leq \bar{\mu}$  by claim 1, 2 and 3 (claim 3 implies that it is also true that  $\mu < \bar{\mu}^{pe}$ ) we need to compare (7) and (16). By comparing the two equations we see that  $\bar{V}_2^{pe} - \bar{V}_2$  is given by

$$-\left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} \leq 0,$$

since  $p'_H - p_H \geq 0$  and  $\gamma_{pe} \geq \gamma$ . Hence if  $c = 0$  then  $\bar{V}_2^{pe} = \bar{V}_2$ .

Second, if  $\bar{\mu} < \mu \leq \bar{\mu}^{pe}$  then we need to compare (6) and (16). The difference  $\bar{V}_2^{pe} - \bar{V}_1$  is given by

$$-\frac{p'_H}{p_H} A_m - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} + \frac{p'_H}{\gamma \Delta p'} B.$$

Note that as  $\mu \rightarrow \bar{\mu}$ ,  $\frac{\gamma A_m}{p_H} \rightarrow \frac{B}{\Delta p'}$  and the difference above is negative (0 if  $c = 0$ ), whereas as  $\mu \rightarrow \bar{\mu}^{pe}$ ,  $\frac{\gamma A_m}{p_H} \rightarrow \frac{b}{\Delta p'}$  the difference above tends to

$$\frac{p'_H}{\gamma \Delta p'} (B - b - c) + \frac{p_H c}{\gamma_{pe} \Delta p'} > 0,$$

therefore there exists a  $\mu^*$  such that if  $\mu \geq \mu^*$  then  $\bar{V}_2^{pe} - \bar{V}_1 \geq 0$ . If  $c = 0$ ,  $\bar{V}_2^{pe} - \bar{V}_1 \geq 0$  for all  $\bar{\mu} < \mu \leq \bar{\mu}^{pe}$ .

Third, if  $\mu > \bar{\mu}^{pe}$  then we must compare (15) and (6) so  $\bar{V}_1^{pe} - \bar{V}_1$  is given by

$$\frac{p'_H}{\gamma \Delta p'} (B - b - c) + \frac{p_H c}{\gamma_{pe} \Delta p'} > 0.$$

This concludes the proof of the first part of the proposition.

Next we need to proof that an increase in  $\mu$  will lead to an increase in the difference  $\bar{V}^{pe} - \bar{V}$  for a high enough value of  $\mu$ . The proof is complicated by the fact that as we know,  $\bar{V}$  is a function with three parts and therefore it is not continuously differentiable everywhere.

By differentiating with respect to  $\mu$  we find that

$$\begin{aligned}\frac{\partial \bar{V}_1}{\partial \mu} &= \frac{R}{\gamma} \frac{\partial p'_H}{\partial \mu} - \frac{B}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right], \\ \frac{\partial \bar{V}_2}{\partial \mu} &= \left[ \frac{R}{\gamma} - \frac{A_m}{p_H} \right] \frac{\partial p'_H}{\partial \mu}, \\ \frac{\partial \bar{V}_1^{pe}}{\partial \mu} &= \frac{R}{\gamma} \frac{\partial p'_H}{\partial \mu} - \frac{b+c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right], \\ \frac{\partial \bar{V}_2^{pe}}{\partial \mu} &= \left[ \frac{R}{\gamma} - \frac{A_m}{p_H} \right] \frac{\partial p'_H}{\partial \mu} - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right].\end{aligned}$$

By direct inspection we can see that

$$\frac{\partial \bar{V}_1^{pe}}{\partial \mu} > \frac{\partial \bar{V}_1}{\partial \mu},$$

so when  $\mu > \bar{\mu}^{pe}$  the result is just been shown. For  $\bar{\mu}^* < \mu \leq \bar{\mu}^{pe}$  we must compare  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu}$  with  $\frac{\partial \bar{V}_1}{\partial \mu}$ . Note that if  $\mu \leq \bar{\mu}^{pe}$  then  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu} - \frac{\partial \bar{V}_1}{\partial \mu} > 0$  since

$$\begin{aligned}& -\frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ & > \left[ -\frac{B}{\gamma \Delta p'} + \left( \frac{1}{\gamma} - \frac{p_H}{p'_H \gamma_{pe}} \right) \frac{c}{\Delta p'} \right] \frac{\partial p'_H}{\partial \mu} - \frac{p'_H c}{\gamma \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{p'_H} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ & > \left[ -\frac{B}{\gamma \Delta p'} + \left( \frac{1}{\gamma} - \frac{p_H}{p'_H \gamma_{pe}} \right) \frac{c}{\Delta p'} \right] \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ & = \left[ -\frac{B}{\gamma \Delta p'} - \frac{p_H c}{p'_H \gamma_{pe} \Delta p'} \right] \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ & = -\frac{B}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'} \left[ -\frac{1}{\Delta p'} \frac{\partial p'_H}{\partial \mu} + \frac{p'_L}{p'_H \Delta p'} \frac{\partial p'_H}{\partial \mu} \right] \\ & > -\frac{B}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right].\end{aligned}$$

where the first inequality follows from  $\mu \geq \bar{\mu}^*$  and the second from  $\frac{\partial p'_H}{\partial \mu} < \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu}$  by condition 1. The last inequality follows from the fact that  $-\frac{1}{\Delta p'} \frac{\partial p'_H}{\partial \mu} + \frac{p'_L}{p'_H \Delta p'} \frac{\partial p'_H}{\partial \mu} > 0$  since  $p'_H > p'_L$  and condition 1. If  $c = 0$ ,  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu} - \frac{\partial \bar{V}_1^{pe}}{\partial \mu} > 0$  since

$$-\frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} > -\frac{B}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right],$$

the equality above holds because  $\frac{\partial p'_H}{\partial \mu} < \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu}$  and  $\frac{A_m}{p_H} < \frac{B}{\gamma \Delta p'}$  when  $\mu \geq \bar{\mu}$ . ■

**Proof of Proposition 6 and Corollary 26 (Conditions under which  $\bar{V}^{pe} \geq \bar{V}^s$ )**

We first assume that the IC holds in equilibrium, this is without loss of generality. Let us use the same notation introduced in the proof of proposition 5, namely, rewrite  $\bar{V}$  as  $\bar{V}_i^j(\mu)$  to denote the  $i$ -th equation for the willingness-to-pay of type  $j$  ( $j \in \{\emptyset, pe, s\}$ ), as a function of the misvaluation parameter  $\mu$ . Let us also define  $\bar{\mu}^j$  as the value of misvaluation such that  $\bar{V}_1^j(\bar{\mu}^j) = \bar{V}_2^j(\bar{\mu}^j)$ , that is,

$$\bar{\mu}^j : \bar{V}_1^j(\bar{\mu}^j) = \bar{V}_2^j(\bar{\mu}^j) \forall j \in \{\emptyset, pe, s\}.$$

We start with a series of preliminary results.

We first show if the strategic cutoff  $\bar{\mu}^s > \bar{\mu}^{pe}$ , the cutoff for the PE firm. One way to prove it is by showing the difference in derivatives  $\partial \bar{V}_2^{pe} / \partial \mu - \partial \bar{V}_1^{pe} / \partial \mu < \partial \bar{V}_2^s / \partial \mu - \partial \bar{V}_1^s / \partial \mu$ , which implies that the cutoff where both equations  $V_1$  and  $V_2$  meet occurs sooner for the strategic acquisition case. Claim 1 and 2 from the proof of proposition 5 are valid since they apply to all cases, hence we do not reproduce them here.

First, note that

$$\bar{V}_1^{pe} - \bar{V}_2^{pe} = -\frac{p'_H b}{\gamma \Delta p'} + \frac{p'_H}{p_H} A_m \text{ and } \bar{V}_1^s - \bar{V}_2^s = -\frac{p'_H B^s}{\gamma \Delta p'} + \left(\frac{p'_H}{p_H}\right)^2 A_m.$$

At  $\mu = 0$ :

$$\bar{V}_1^{pe}(0) - \bar{V}_2^{pe}(0) = -\frac{p_H b}{\gamma \Delta p} + A_m > 0, \quad \bar{V}_1^s(0) - \bar{V}_2^s(0) = -\frac{p_H B^s}{\gamma \Delta p} + A_m > 0.$$

Moreover, since  $-\frac{p_H b}{\gamma \Delta p} > -\frac{p_H B^s}{\gamma \Delta p}$ ,  $\bar{V}_1^{pe}(0) - \bar{V}_2^{pe}(0) > \bar{V}_1^s(0) - \bar{V}_2^s(0)$ . We now differentiate the previous differences with respect to  $\mu$  and evaluate at  $\mu = 0$ :

$$\begin{aligned} \frac{\partial [\bar{V}_1^{pe} - \bar{V}_2^{pe}]}{\partial \mu} &= -\frac{b}{\gamma \Delta p^2} \left[ p'_H \frac{\partial p'_L}{\partial \mu} - p'_L \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} \\ \frac{\partial [\bar{V}_1^s - \bar{V}_2^s]}{\partial \mu} &= -\frac{B^s}{\gamma \Delta p^2} \left[ p'_H \frac{\partial p'_L}{\partial \mu} - p'_L \frac{\partial p'_H}{\partial \mu} \right] + 2p'_H \frac{A_m}{p_H^2} \frac{\partial p'_H}{\partial \mu} \\ \frac{\partial [\bar{V}_1^{pe}(0) - \bar{V}_2^{pe}(0)]}{\partial \mu} &= -\frac{b}{\gamma \Delta p^2} \left[ p'_H \frac{\partial p'_L}{\partial \mu} - p'_L \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu}, \\ \frac{\partial [\bar{V}_1^s(0) - \bar{V}_2^s(0)]}{\partial \mu} &= -\frac{B^s}{\gamma \Delta p^2} \left[ p'_H \frac{\partial p'_L}{\partial \mu} - p'_L \frac{\partial p'_H}{\partial \mu} \right] + 2 \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} \\ &= -\frac{B^s}{\gamma \Delta p^2} \left[ p'_H \frac{\partial p'_L}{\partial \mu} - p'_L \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} + \frac{b}{\gamma \Delta p'} \frac{\partial p'_H}{\partial \mu}. \end{aligned}$$

It is immediate to see that the PE derivative might not be less negative. We will assess both possibilities.

Assume first that  $\bar{\mu}^s < \bar{\mu}^{pe}$ .

First, if  $0 \leq \mu \leq \bar{\mu}^s$  by claim 1 and 2 we need to compare (22) and (16). By comparing the two equations we see that  $\bar{V}_2^{pe} - \bar{V}_2^s$  is given by

$$\left( \frac{p'_H}{p_H} - 1 \right) \frac{p'_H A_m}{p_H} - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} \leq 0$$

since the first term is positive if  $p'_H - p_H \geq 0$  but the second is negative since  $p'_H - p_H \geq 0$  and  $\gamma_{pe} \geq \gamma$ . If  $c = 0$  the expression above is greater than or equal to 0 so  $\bar{V}_2^{pe} - \bar{V}_2^s \geq 0$ . If  $c > 0$ , for  $\mu = 0$  the difference is negative and for  $\mu = \bar{\mu}^s$  the difference is given by

$$\left( \frac{p'_H}{p_H} - 1 \right) \frac{p_H B^s}{\gamma \Delta p'} - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'},$$

If the expression above is positive then there exists a  $\mu^{**}$  such that for  $\mu \geq \mu^{**}$ ,  $\bar{V}_2^{pe} - \bar{V}_2^s \geq 0$ . If it is negative then  $\bar{V}_2^{pe} - \bar{V}_2^s \leq 0$  for all  $0 \leq \mu \leq \bar{\mu}^s$ .

Second, if  $\bar{\mu}^s < \mu \leq \bar{\mu}^{pe}$  then we need to compare (21) and (16). The difference

$\bar{V}_2^{pe} - \bar{V}_1^s$  is given by

$$-\frac{p'_H}{p_H} A_m - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} + \frac{p'_H}{\gamma \Delta p'} B^s.$$

For  $\mu = \bar{\mu}^s$  the expression above is

$$-\frac{p_H B^s}{\gamma \Delta p'} - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} + \frac{p'_H}{\gamma \Delta p'} B^s$$

and for  $\mu = \bar{\mu}^{pe}$  the expression becomes

$$\begin{aligned} & -\frac{p'_H b}{\gamma \Delta p'} - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} + \frac{p'_H}{\gamma \Delta p'} B^s \\ & = \frac{p'_H}{\gamma \Delta p'} (B^s - b - c) + \frac{p_H}{\gamma_{pe}} \frac{c}{\Delta p'} > 0, \end{aligned}$$

since  $B^s > b + c$  and  $p'_H > p_H$ . Therefore if  $\mu^{**}$  exists,  $\bar{V}_2^{pe} - \bar{V}_1^s > 0$  for all  $\bar{\mu}^s < \mu \leq \bar{\mu}^{pe}$ , and if  $\mu^{**}$  does not exist then there exists a  $\mu^{***} \geq \bar{\mu}^s$  such that

$$-\frac{p'_H}{p_H} A_m - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} + \frac{p'_H}{\gamma \Delta p'} B^s = 0,$$

and for all  $\bar{\mu}^{***} < \mu \leq \bar{\mu}^{pe}$ ,  $\bar{V}_2^{pe} - \bar{V}_1^s > 0$ . Again if  $c = 0$  then  $\bar{V}_2^{pe} - \bar{V}_1^s \geq 0$  for  $\bar{\mu}^s < \mu \leq \bar{\mu}^{pe}$ .

Third, if  $\mu > \bar{\mu}^{pe}$  then we must compare (15) and (21);  $\bar{V}_1^{pe} - \bar{V}_1^s$  is given by

$$\frac{p'_H}{\gamma \Delta p'} (B^s - (b + c)) + \frac{p_H c}{\gamma_{pe} \Delta p'} > 0.$$

Next we need to prove that an increase in  $\mu$  will lead to an increase in the difference  $\bar{V}^{pe} - \bar{V}^s$  for a high enough value of  $\mu$ . The proof is complicated by the fact that as we know,  $\bar{V}$  is a function with two parts and therefore it is not continuously differentiable everywhere.

By differentiating with respect to  $\mu$  we find that

$$\begin{aligned}\frac{\partial \bar{V}_1^s}{\partial \mu} &= \frac{R}{\gamma} \frac{\partial p'_H}{\partial \mu} - \frac{B^s}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right], \\ \frac{\partial \bar{V}_2^s}{\partial \mu} &= \left[ \frac{R}{\gamma} - 2 \frac{p'_H}{p_H^2} A_m \right] \frac{\partial p'_H}{\partial \mu}, \\ \frac{\partial \bar{V}_1^{pe}}{\partial \mu} &= \frac{R}{\gamma} \frac{\partial p'_H}{\partial \mu} - \frac{b+c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right], \\ \frac{\partial \bar{V}_2^{pe}}{\partial \mu} &= \left[ \frac{R}{\gamma} - \frac{A_m}{p_H} \right] \frac{\partial p'_H}{\partial \mu} - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right].\end{aligned}$$

By direct inspection and monitoring efficiency we can see that

$$\frac{\partial \bar{V}_1^{pe}}{\partial \mu} > \frac{\partial \bar{V}_1^s}{\partial \mu},$$

so when  $\mu > \bar{\mu}^{pe}$  the result is just been shown. For  $\bar{\mu}^{***} < \mu \leq \bar{\mu}^{pe}$  we must compare  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu}$  with  $\frac{\partial \bar{V}_1^s}{\partial \mu}$ . We know that if  $\mu \leq \bar{\mu}^{pe}$  then  $b/\gamma \Delta p' \leq A_m/p_H$  and  $\mu \geq \bar{\mu}^{***}$  then  $-\frac{p'_H}{p_H} A_m - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} + \frac{p'_H}{\gamma \Delta p'} B^s \geq 0$  so

$$\begin{aligned}& -\frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{c}{\gamma_{pe} \Delta p'} \left[ \frac{p_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p_H}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] \\ &= \left( -\frac{A_m}{p_H} - \frac{c}{\gamma \Delta p'} \right) \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] - \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} \\ & \quad + \frac{c}{\gamma_{pe} \Delta p'} \left[ \frac{p_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p_H}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] \\ &= \left( -\frac{A_m}{p_H} - \frac{c}{\gamma \Delta p'} \right) \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{p'_H}{\Delta p'} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ &> \left( -\frac{B^s}{\gamma \Delta p'} - \frac{p_H}{p'_H \gamma_{pe}} \frac{c}{\Delta p'} \right) \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{p'_H}{\Delta p'} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ & \quad + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ &= -\frac{B^s}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{A_m}{p_H} \frac{p'_H}{\Delta p'} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] - \frac{p_H}{p'_H \gamma_{pe}} \frac{c}{\Delta p'} \left[ \frac{\partial p'_H}{\partial \mu} \right] \\ &> -\frac{B^s}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H B^s}{p'_H \gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_H}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] - \frac{p_H}{p'_H \gamma_{pe}} \frac{c}{\Delta p'} \left[ \frac{\partial p'_H}{\partial \mu} \right] \\ &> -\frac{B^s}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right]\end{aligned}$$

since the first inequality follows from  $\mu \geq \mu^{***}$ , the second from  $\mu \geq \bar{\mu}^s$  and the third from  $\frac{B^s}{\gamma \Delta p'} \geq \frac{c}{\gamma_{pe} \Delta p'}$  and  $\frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_H}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \geq \frac{\partial p'_H}{\partial \mu}$ . This proves that  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu} > \frac{\partial \bar{V}_1^s}{\partial \mu}$ . Note that if  $c = 0$ , then  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu} \geq \frac{\partial \bar{V}_1^s}{\partial \mu}$  because if  $\mu \geq \mu^{***}$  then  $-\frac{p'_H}{p_H} A_m + \frac{p'_H}{\gamma \Delta p'} B^s \geq 0$ .

If  $\mu^{**} < \mu^s$  we also need to compare  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu}$  with  $\frac{\partial \bar{V}_2^s}{\partial \mu}$  for  $\mu \geq \mu^{**}$ . First  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu} > \frac{\partial \bar{V}_2^s}{\partial \mu}$  since

$$\begin{aligned} & -\frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ > & \left[ -\frac{p'_H}{p_H} \frac{A_m}{p_H} + \left( \frac{1}{\gamma} - \frac{p_H}{p'_H \gamma_{pe}} \right) \frac{c}{\Delta p'} \right] \frac{\partial p'_H}{\partial \mu} \\ & - \frac{c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_H c}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\ > & -\frac{p'_H}{p_H} \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} \\ > & -2 \frac{p'_H A_m}{p_H^2} \frac{\partial p'_H}{\partial \mu} \end{aligned}$$

where the first inequality uses  $\frac{\partial p'_H}{\partial \mu} < \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_L}{\Delta p'} \frac{\partial p'_H}{\partial \mu}$  and  $\mu > \mu^{**}$ . For  $c = 0$ ,  $\frac{\partial \bar{V}_2^{pe}}{\partial \mu} > \frac{\partial \bar{V}_1^s}{\partial \mu}$  because  $-\frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} > -2 \frac{p'_H A_m}{p_H^2} \frac{\partial p'_H}{\partial \mu}$  if debt is overvalued.

If  $\mu^{pe} < \mu^s$  then for  $0 \leq \mu \leq \bar{\mu}^{pe}$  we again need to compare (22) and (16). The difference  $\bar{V}_2^{pe} - \bar{V}_2^s$  is given by

$$\frac{p'_H}{p_H} \left( \frac{p'_H}{p_H} - 1 \right) A_m - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} \leq 0,$$

since the first term is positive if  $p'_H - p_H \geq 0$  but the second is negative since  $p'_H - p_H \geq 0$  and  $\gamma_{pe} \geq \gamma$ . For  $\mu = 0$  the expression above is negative whereas for  $\mu = \bar{\mu}^{pe}$  it is

$$\left( \frac{p'_H}{p_H} - 1 \right) \frac{p'_H b}{\gamma \Delta p'} - \left( \frac{p'_H}{\gamma} - \frac{p_H}{\gamma_{pe}} \right) \frac{c}{\Delta p'} \leq 0$$

If the expression above is positive then there exists a  $\mu^{**}$  such that for  $\mu \geq \mu^{**}$ ,  $\bar{V}_2^{pe} - \bar{V}_2^s \geq 0$ . If it is negative then  $\bar{V}_2^{pe} - \bar{V}_2^s \leq 0$  for all  $0 \leq \mu \leq \bar{\mu}^{pe}$ . If on the other hand  $c = 0$  then  $\bar{V}_2^{pe} \geq \bar{V}_2^s$  since  $p'_H > p_H$ .

Second, if  $\bar{\mu}^{pe} < \mu \leq \bar{\mu}^s$  then we need to compare (22) and (15). The difference

$\bar{V}_1^{pe} - \bar{V}_2^s$  is given by

$$\begin{aligned}
& \left(\frac{p'_H}{p_H}\right)^2 A_m - \frac{p'_H(b+c)}{\gamma\Delta p'} + \frac{p_H c}{\gamma_{pe}\Delta p'} \\
> & \left(\frac{p'_H}{p_H}\right)^2 \frac{p_H B^s}{\gamma\Delta p'} - \frac{p'_H(b+c)}{\gamma\Delta p'} + \frac{p_H c}{\gamma_{pe}\Delta p'} \\
> & \frac{p'_H B^s}{\gamma\Delta p'} - \frac{p'_H(b+c)}{\gamma\Delta p'} + \frac{p_H c}{\gamma_{pe}\Delta p'} \\
> & 0
\end{aligned}$$

where the first inequality follows from  $\mu \leq \bar{\mu}^s$ ,  $\frac{\gamma A_m}{p_H} \geq \frac{B^s}{\Delta p'}$  and the last from monitoring efficiency. If  $c = 0$  then it is immediate to see that  $\bar{V}_1^{pe} \geq \bar{V}_2^s$  since  $B^s > b$ .

Third, if  $\mu > \bar{\mu}^s$  then we must compare (15) and (21) so  $\bar{V}_1^{pe} - \bar{V}_1^s$  is given by

$$\frac{p'_H}{\gamma\Delta p'} (B^s - (b+c)) + \frac{p_H c}{\gamma_{pe}\Delta p'} > 0,$$

as previously shown. It is obvious to see that this holds also for  $c = 0$ .

Next we again need to prove that an increase in  $\mu$  will lead to an increase in the difference  $\bar{V}^{pe} - \bar{V}^s$  for a high enough value of  $\mu$ .

By direct inspection we can see that

$$\frac{\partial \bar{V}_1^{pe}}{\partial \mu} > \frac{\partial \bar{V}_1^s}{\partial \mu},$$

so when  $\mu > \bar{\mu}^s$  the result is just been shown. For  $\bar{\mu}^{pe} < \mu \leq \bar{\mu}^s$  we must



compare  $\frac{\partial \bar{V}_1^{pe}}{\partial \mu}$  with  $\frac{\partial \bar{V}_2^s}{\partial \mu}$ . We can show that  $\frac{\partial \bar{V}_1^{pe}}{\partial \mu} > \frac{\partial \bar{V}_2^s}{\partial \mu}$  because

$$\begin{aligned}
& -\frac{b+c}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_{HC}}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\
> & -\frac{B^s}{\gamma \Delta p'} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_{HC}}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\
> & -\frac{A_m}{p_H} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] + \frac{p_{HC}}{\gamma_{pe} \Delta p'^2} \left[ \frac{\partial p'_L}{\partial \mu} - \frac{\partial p'_H}{\partial \mu} \right] \\
> & -\frac{A_m}{p_H} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} \right] \\
> & -\frac{A_m}{p_H} \left[ \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu} - \frac{p'_H}{\Delta p'} \frac{\partial p'_H}{\partial \mu} \right] - \frac{A_m}{p_H} \frac{\partial p'_H}{\partial \mu} \\
> & -2 \frac{p'_H A_m}{p_H^2} \frac{\partial p'_H}{\partial \mu}.
\end{aligned}$$

■

### Proof of Proposition 7 (Comparative Statics for $\bar{A}_m^{pe} - \bar{A}_m$ )

First, from (18) and (9) we can express  $\bar{A}_m^{pe} - \bar{A}_m$  as

$$\begin{aligned}
(25) \quad \bar{A}_m^{pe} - \bar{A}_m &= \frac{p'_H}{\gamma} \left( \frac{b+c-B}{\Delta p'} \right) - \frac{p_{HC}}{\gamma_{pe} \Delta p'}, \\
&= -\frac{p'_H}{\gamma} \left( \frac{B-b-c}{\Delta p'} \right) - \frac{p_{HC}}{\gamma_{pe} \Delta p'}.
\end{aligned}$$

By inspection of the equation above it is direct to see that a sufficient condition for  $\bar{A}_m^{pe} - \bar{A}_m < 0$  is  $b+c-B < 0$ , that is, efficient monitoring. This guarantees that all the summands in (25) are negative. The necessary conditions are as follows. We need

$$\begin{aligned}
\frac{p'_H}{\gamma} \left( \frac{B-b-c}{\Delta p'} \right) &> \frac{p_{HC}}{\gamma_{pe} \Delta p'} > 0, \\
B-b-c &> \frac{\gamma p_H}{\gamma_{pe} p'_H} c.
\end{aligned}$$

Second, by differentiating (25) we find that

$$\begin{aligned}\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \gamma} &= p'_H \left( \frac{B - b - c}{\Delta p'} \right) \left( \frac{1}{\gamma^2} \right) > 0 \\ \frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial B} &= -\frac{p'_H}{\gamma} \frac{1}{\Delta p'} < 0, \\ \frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial b} &= \frac{p'_H}{\gamma} \frac{1}{\Delta p'} > 0 \\ \frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial c} &= \frac{p'_H}{\gamma \Delta p'} - \frac{p_H}{\gamma_{pe} \Delta p'} > 0.\end{aligned}$$

Lastly, we need to show how  $\mu$  affects the difference in cutoffs. By differentiating equation (25) with respect to  $\mu$  we obtain

$$\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \mu} = \frac{1}{\gamma} \left[ -\frac{B - b - c}{\Delta p'} \left( 1 - \frac{p'_H}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} - \frac{p'_H}{\gamma} \left( \frac{B - b - c}{\Delta p'^2} \right) \frac{\partial p'_L}{\partial \mu}$$

If we impose  $\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \mu} < 0$ , this requires

$$\left[ -\frac{B - b - c}{\Delta p'} \left( 1 - \frac{p'_H}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} < p'_H \left( \frac{B - b - c}{\Delta p'^2} \right) \frac{\partial p'_L}{\partial \mu}.$$

Since  $1 - \frac{p'_H}{\Delta p'} < 0$  a sufficient condition is

$$\begin{aligned}\frac{B - b - c}{\Delta p'} \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} &< \frac{p'_H}{\Delta p'} \left( \frac{B - b - c}{\Delta p'} \right) \frac{\partial p'_L}{\partial \mu}, \\ \left( \frac{p'_H}{\Delta p'} - 1 \right) \frac{\partial p'_H}{\partial \mu} &< \frac{p'_H}{\Delta p'} \frac{\partial p'_L}{\partial \mu}, \\ \frac{\partial p'_H}{\partial \mu} / p'_H &< \frac{\partial p'_L}{\partial \mu} / p'_L,\end{aligned}$$

which is precisely condition 1. ■

### Proof of Proposition 8 (Comparative Statics for $\bar{A}_m - \bar{A}_m^s$ )

Note that using expressions (9) and (24)  $\bar{A}_m < \bar{A}_m^s$  requires  $(B - B^s)/\Delta p' > 0$ . Therefore, we need  $B^s \geq B$ .

The difference  $\bar{A}_m - \bar{A}_m^s$  can be simplified to

$$-\frac{p'_H}{\gamma} \left[ \frac{B - B^s}{\Delta p'} \right].$$

The comparative statics are as follows:

$$\begin{aligned} \frac{\partial (\bar{A}_m - \bar{A}_m^s)}{\partial B} &= -\frac{p'_H}{\gamma \Delta p'} < 0 \\ \frac{\partial (\bar{A}_m - \bar{A}_m^s)}{\partial B^s} &= \frac{p'_H}{\gamma \Delta p'} > 0 \\ \frac{\partial (\bar{A}_m - \bar{A}_m^s)}{\partial \gamma} &= p'_H \left[ \frac{B - B^s}{\Delta p'} \right] \frac{1}{\gamma^2} > 0 \end{aligned}$$

With a bit of algebra we can differentiate with respect to  $\mu$  to obtain the misvaluation marginal effect.

$$\frac{\partial (\bar{A}_m - \bar{A}_m^s)}{\partial \mu} = \frac{1}{\gamma} \left[ -\frac{B^s - B}{\Delta p'} \left( 1 - \frac{p'_H}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} - \frac{p'_H}{\gamma} \left( \frac{B^s - B}{\Delta p'^2} \right) \frac{\partial p'_L}{\partial \mu}.$$

Imposing  $\partial (\bar{A}_m - \bar{A}_m^s) / \partial \mu < 0$  requires

$$\left[ -\frac{B^s - B}{\Delta p'} \left( 1 - \frac{p'_H}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} < p'_H \left[ \frac{B^s - B}{\Delta p'^2} \right] \frac{\partial p'_L}{\partial \mu}.$$

Note that a sufficient condition is

$$\begin{aligned} \left[ \frac{B^s - B}{\Delta p'} \left( \frac{p'_L}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} &< p'_H \left[ \frac{B^s - B}{\Delta p'^2} \right] \frac{\partial p'_L}{\partial \mu}, \\ \left[ \frac{B^s - B}{\Delta p'^2} \right] \frac{\partial p'_H}{\partial \mu} p'_L &< p'_H \left[ \frac{B^s - B}{\Delta p'^2} \right] \frac{\partial p'_L}{\partial \mu} \\ \frac{\partial p'_H}{\partial \mu} / p'_H &\leq \frac{\partial p'_L}{\partial \mu} / p'_L, \end{aligned}$$

where that the second step uses  $B^s - B \geq 0$  and the last inequality is satisfied if condition 1 holds. ■

**Proof of Proposition 9 (Comparative Statics for  $\bar{A}_m^{pe} - \bar{A}_m^s$ )**

The difference between  $\bar{A}_m^{pe}$  and  $\bar{A}_m^s$  can be obtained using (18) and (24):

$$\begin{aligned}\bar{A}_m^{pe} - \bar{A}_m^s &= -\frac{p'_H}{\gamma} \left( R - \frac{b+c}{\Delta p'} \right) - \frac{p_H c}{\gamma_{pe} \Delta p'} + \frac{p'_H}{\gamma} \left( R - \frac{B^s}{\Delta p'} \right) \\ &= -\frac{p'_H}{\gamma} \frac{B^s - b - c}{\Delta p'} - \frac{p_H c}{\gamma_{pe} \Delta p'}.\end{aligned}$$

As before, it is direct to see that a sufficient condition for  $\bar{A}_m^{pe} < \bar{A}_m^s$  is  $B^s - b - c > 0$ ; this makes all the summands in the expression above negative.

Secondly, the comparative statics are as follows:

$$\begin{aligned}\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial B^s} &= -\frac{p'_H}{\gamma} \frac{1}{\Delta p'} < 0, \\ \frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial b} &= \frac{p'_H}{\gamma} \frac{1}{\Delta p'} > 0, \\ \frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial c} &= \frac{p'_H}{\gamma \Delta p'} - \frac{p_H}{\gamma_{pe} \Delta p'} > 0, \\ \frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \gamma} &= p'_H \frac{B^s - b - c}{\Delta p'} \frac{1}{\gamma^2} > 0.\end{aligned}$$

Lastly, by differentiating the expression above with respect to the misvaluation measure  $\mu$  (which affects  $p'_H$  and  $p'_L$ ) we obtain

$$\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \mu} = \frac{1}{\gamma} \left[ \frac{b+c-B^s}{\Delta p'} \left( 1 - \frac{p'_H}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} - \frac{p'_H}{\gamma} \left( \frac{B^s - b - c}{\Delta p'^2} \right) \frac{\partial p'_L}{\partial \mu}.$$

We impose  $\frac{\partial (\bar{A}_m^{pe} - \bar{A}_m^s)}{\partial \mu} < 0$  which requires

$$\left[ \frac{b+c-B^s}{\Delta p'} \left( 1 - \frac{p'_H}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} < p'_H \left[ \frac{B^s - b - c}{\Delta p'^2} \right] \frac{\partial p'_L}{\partial \mu}.$$

Note that a sufficient condition is

$$\begin{aligned}\left[ \frac{B^s - b - c}{\Delta p'} \left( \frac{p'_L}{\Delta p'} \right) \right] \frac{\partial p'_H}{\partial \mu} &< p'_H \left[ \frac{B^s - b - c}{\Delta p'^2} \right] \frac{\partial p'_L}{\partial \mu}, \\ \left[ \frac{B^s - b - c}{\Delta p'^2} \right] \frac{\partial p'_H}{\partial \mu} p'_L &< p'_H \left[ \frac{B^s - b - c}{\Delta p'^2} \right] \frac{\partial p'_L}{\partial \mu}, \\ \frac{\partial p'_H}{\partial \mu} / p'_H &< \frac{\partial p'_L}{\partial \mu} / p'_L,\end{aligned}$$

where the last step uses  $B^s - (b + c) > 0$  and the last inequality is true if condition 1 holds. ■

**Proof of Proposition 10 (n projects).** First, note that because we assume  $(\gamma A_m - B)/p_H p_L^{n-1} \geq \gamma A_m/p_H^n > B/p'_H(p_H^{n-1} - p_L^{n-1})$ ,  $\forall n = \{1, 2, 3, \dots\}$ , we fall in the case where the IC constraint holds and the maximum bid amount is determined by the IR constraint binding. This is the equation of interest. We follow the same reasoning as with two projects. For  $n = 3$ , the incentive compatible investor belief requires that the manager is paid at least

$$(26) \quad \text{Investor's view of (IC)} \quad R_m^s \geq 2B/p'_H(p_H'^2 - p_L'^2)$$

If this condition holds then uninformed investors will invest  $3(\bar{V}^s + I - A_m)$  if they expect to earn  $\gamma$  on this investment. Thus,

$$(27) \quad p_H'^3 R_u^s + 3p'_H(1 - p'_H)^2 R + 6p_H'^2(1 - p'_H)R = 3\gamma(\bar{V}^s + I - A_m).$$

This equation can be further simplified since  $3p'_H(1 - p'_H)^2 R + 6p_H'^2(1 - p'_H)R = 3p'_H(1 - p_H'^2)R$ . Note that in the equation above we use the fact that in case only one of the projects is successful the payoff to the investor is the entire cash flow available,  $R$ . Hence the only unknown variable is  $R_u^s$ .

Given the required return to investors, then manager earns

$$\begin{aligned} R_m^s &= 3R - R_u^s = \\ &= 3R - \frac{3\gamma(\bar{V}^s + I - A_m) - 3p'_H(1 - p_H'^2)R}{p_H'^3} \end{aligned}$$

The manager's expected return must also be greater than  $3\gamma A_m$  if the incentive compatibility holds otherwise the manager would rather invest  $A_m$  elsewhere. Given the assumption we have made the constraint determining  $\bar{V}_n^s$  is

Thus, the manager raises  $\bar{V}^s$  as high as possible subject to the following constraint,

$$3R - 3\gamma(\bar{V}^s + I - A_m)/p_H'^3 + 3p'_H(1 - p_H'^2)R/p_H'^3 \geq 3\gamma A_m/p_H'^3.$$

Rearranging terms we obtain

$$\bar{V}^s = \frac{p'_H}{\gamma} R - I + A_m - \left( \frac{p'_H}{p_H} \right)^3 A_m.$$

It is easy to realize that for  $n$  projects this becomes

$$\bar{V}_n^s = \frac{p'_H}{\gamma} R - I + A_m - \left( \frac{p'_H}{p_H} \right)^n A_m.$$

The limit expression in the proposition is direct, except for the first limit. Note that when  $p'_H > p_H$ ,  $\lim \bar{V}_n^s = -\infty$ . Since the maximum price can only be non-negative, the well-defined maximum willingness to pay in the case of overvalued debt would be 0, hence  $\lim \bar{V}_n^s = 0$ . ■

### Model of Section III.F

Recall that with two projects, one optimal contract requires the manager to invest  $2A_m$ , and the uninformed investors to invest the balance of  $2(\bar{V}^s + I - A_m)$ . The contract then pays everyone nothing if *both* projects fail, pays the manager nothing if one project fails, and if both projects succeed divides the payoff  $2R$  into  $2R_m^s > 0$  for the managers and  $R_u^s > 0$  for the uninformed investor, such that  $2R_m^s + R_u^s = 2R$ .

Uninformed investors will only invest if they believe the manager will choose the good projects. The manager is only remunerated if both projects pay off thus investors need only believe that  $p_H'^2 R_m^s \geq p'_H p'_L R_m^s + B$ . Therefore, the incentive compatible investor belief requires that the manager is paid at least  $R_m^s \geq B/p'_H(p'_H - p'_L)$ .

Even though this is an optimal contract it could be that the parameter values are such that there exists no  $R_u^s \geq 0$  such that

$$(28) \quad p_H'^2 R_u^s + 2p'_H(1 - p'_H)R > 2\gamma(\bar{V}^s + I - A_m).$$

This can happen whenever

$$2p'_H(1 - p'_H)R > 2\gamma(\bar{V}^s + I - A_m).$$

In that case, and given that  $R_u^s$  must be non-negative, the optimal contract which pays nothing to the manager if only one project is successful, is not feasible. Therefore, the equilibrium contract is of the form  $(R_u^s, R_{ui}^s)$  where the pair denotes payments to uninformed investors whenever both projects are successful or only one is, respectively. Hence the investor's IR becomes

$$p_H'^2 R_u^s + 2p_H'(1 - p_H')R_{ui}^s = 2\gamma(\bar{V}^s + I - A_m)$$

Given the required return to investors, each manager earns  $(R_m^s, R_{mi}^s)$  where the vector of payoffs refers to the payoff in case both projects are successful and only one is, respectively; that is,

$$(29) \quad \begin{aligned} 2R_m^s &= 2R - R_u^s \\ &= 2R - \frac{2\gamma(\bar{V}^s + I - A_m) - 2p_H'(1 - p_H')R_{ui}^s}{p_H'^2} \end{aligned}$$

if both projects are successful and

$$2R_{mi}^s = R - R_{ui}^s$$

if only one is. Given the required uninformed investor returns the manager will only choose the better projects if

$$\begin{aligned} \text{Manager (IC)} \quad R_m^s &= R - \gamma(\bar{V}^s + I - A_m)/p_H'^2 + (1 - p_H')R_{ui}^s/p_H' \\ &\geq B/p_H \Delta p + (p_L(1 - p_H) + p_H(1 - p_L) - 2p_H(1 - p_H)) R_{mi}^s/p_H \Delta p. \end{aligned}$$

And investors will only provide funding for the project if they believe the manager will choose the good projects.

The manager's expected return must also be greater than  $2\gamma A_m$  if the incentive compatibility holds, otherwise the manager would rather invest  $A_m$  elsewhere. We assume an inelastic supply of projects that earn  $\gamma$ . Therefore, the manager's indi-

vidual rationality constraint is

$$(30) \text{ Manager (IR)} \begin{cases} R_m + 2\frac{1-p_H}{p_H} R_{mi}^s \geq \gamma A_m/p_H^2 \text{ if Manager IC holds} \\ R_m + 2\frac{1-p_L}{p_L} R_{mi}^s \geq (\gamma A_m - B)/p_H p_L \text{ if IC doesn't hold} \end{cases}$$

Thus, the manager raises  $\bar{V}^s$  as high as possible subject to the following constraint,

$$\begin{aligned} & R - \gamma(\bar{V}^s + I - A_m)/p_H^2 + (1 - p'_H)R_{ui}^s/p'_H \\ \geq & \max \left\{ \begin{array}{l} B/p'_H \Delta p' - (p'_L(1 - p'_H) + p'_H(1 - p'_L) - 2p'_H(1 - p'_H)) R_{mi}^s/p'_H \Delta p', \\ \min[\gamma A_m/p_H^2 - 2\frac{1-p_H}{p_H} R_{mi}^s, (\gamma A_m - B)/p_H p_L - 2\frac{1-p_L}{p_L} R_{mi}^s] \end{array} \right\}. \end{aligned}$$

We will from now on focus on the case where the IC holds, without loss of generality.

LEMMA 2: *The highest  $\bar{V}^s$  a manager in a strategic acquisition is willing to pay is defined by*

$$\begin{aligned} \bar{V}^s &= \frac{p_H^2}{\gamma} \left( \frac{R}{p'_H} - \frac{B}{p'_H \Delta p'} \right) - R_{ui}^s \left( \frac{p_H^2}{p'_H} - p'_H \right) - I + A_m \\ &\quad \text{if } B/p'_H \Delta p' - (p'_L(1 - p'_H) + p'_H(1 - p'_L) - 2p'_H(1 - p'_H)) R_{mi}^s/p'_H \Delta p' \\ &\quad \geq \gamma A_m/p_H^2 - 2\frac{1-p_H}{p_H} R_{mi}^s \end{aligned}$$

$$\begin{aligned} \bar{V}^s &= \frac{p_H^2}{\gamma p_H} R - I + \frac{R_{ui}^s}{\gamma} \left[ (1 - p'_H)p'_H - \frac{(1 - p_H)p_H^2}{p_H} \right] + \left( 1 - \frac{p_H^2}{p_H^2} \right) A_m \\ &\quad \text{if } \gamma A_m/p_H^2 - 2\frac{1-p_H}{p_H} R_{mi}^s \\ &\quad > B/p'_H \Delta p' - (p'_L(1 - p'_H) + p'_H(1 - p'_L) - 2p'_H(1 - p'_H)) R_{mi}^s/p'_H \Delta p' \end{aligned}$$

### Proof of proposition 11 (Non-debt equilibrium contract)

To prove the result we need to show that

$$\Delta \equiv \left( \frac{p_H^2}{p_H} - p'_H \right) R + R_{ui}^s \left[ (1 - p'_H)p'_H - \frac{(1 - p_H)p_H^2}{p_H} \right] \geq 0.$$

This is the difference between the two pricing equations (debt and alternative contract). We will prove this claim with an *a fortiori* argument. That is, we know that  $R_{ui}^s \leq R$ . Also,  $(1 - p'_H)p'_H - \frac{(1-p_H)p_H^2}{p_H} < 0$  and  $\frac{p_H^2}{\gamma p_H} - \frac{p'_H}{\gamma} > 0$  with overvaluation



$(p'_H > p_H)$ . Assume that  $R_{ui}^s = R$ . Then it is easy to obtain that  $\Delta = 0$ . This is what we expect since  $R_{ui}^s = R$  is the optimal debt contract. If we lower  $R_{ui}^s$  by  $dx$  the total change to  $\Delta$  is  $-dx \left[ (1 - p'_H)p'_H - \frac{(1 - p_H)p_H^2}{p_H} \right] > 0$ . Because  $\Delta$  is linearly decreasing in  $R_{ui}^s$ ,  $\Delta \geq 0 \forall R_{ui}^s \leq R$ . ■