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Investment incentives in bilateral trading ☆

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ABSTRACT

We characterize the surplus-maximizing trading mechanism under two-sided incomplete information and interim individual rationality, when one party can make a value-enhancing specific investment. This mechanism exhibits a trade-off between providing investment incentives and inducing voluntary participation. We analyze how the trading area of the optimal mechanism is further distorted in order to provide investment incentives. Applications of our main results and the underlying geometric analysis to institutional design issues are also provided.

1. Introduction

The volume of mergers and acquisitions hit a record high just before the current financial crisis. However, the host of successful transactions were usually accompanied by many dead deals in which one party attempted to walk out of its agreement by invoking the "material adverse change" (MAC) clause.[1] The MAC and other similar clauses (such as the "Dow Jones" clause) are common examples of *legally* opting out of a pre-committed agreement when conditions become unfavorable. Indeed, a typical merger or acquisition usually involves complex steps and can take months from the time an agreement is reached until the time the transaction is finally closed. During this long process, additional information regarding the desirability of the deal may be revealed. In the meanwhile, either party may engage in "non-contractible synergy investments" to facilitate the transaction (Gilson and Schwartz, 2005). In this paper, we use a mechanism design approach to analyze a bilateral trading problem under asymmetric information with the following two features: first, it takes into account incentive provision for undertaking non-contractible investments; second, each agent may choose whether to participate in the pre-committed trading mechanism – whether it arises from a written contract or more generally from some existing institution – as more information is revealed between the time that this mechanism is committed and the time that it is executed.

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[1] Some widely cited cases include: Dynegy scrapped its deal to buy the troubled Enron, Johnson and Johnson tried to pull out of its agreement to purchase Guidant (details can be found in various issues of *The Economist*).

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More precisely, we characterize the surplus-maximizing trading mechanism with two-sided incomplete information and interim individual rationality, which provides incentives for the investing party to make an unobservable specific investment. This investment brings about a first-order stochastic dominance shift of the investing party's valuation distribution at the expense of a sunk cost. The resulting optimal mechanism exhibits a trade-off between inducing voluntary participation and providing investment incentives. For the agents to be always willing to take part in the trading mechanism, some mutually beneficial trading opportunities have to be closed down. To encourage the specific investment, in contrast, more trading opportunities must be opened up. These opposing effects imply that whenever the sunk cost is not trivial, both the investment and participation constraints are binding in the surplus-maximizing mechanism. In other words, the investor is exactly compensated for her sunk cost while the worst valuation-type from each side always expects a zero payoff.

To obtain better intuition of our optimal mechanism, it is useful to examine its underlying geometric representation. Consider a two-dimensional space with each axis representing the valuation to the corresponding party. It can be shown that in any incentive compatible trading mechanism, the gains from investment of the investing party are equal to an integral of a weighted difference between her pre-investment and post-investment distributions evaluated at those valuations at which trade occurs. With the additional need to provide investment incentives, trading opportunities are opened up in those regions where the specific investment is rewarded more – as manifested by a higher value of this *weighted distribution difference* – and closed down in others. We show that, for one class of distributions, the overall trading area (i.e., the area in the two-dimensional valuation space where trade takes place) of the optimal mechanism must shrink. However, we also provide a counterexample demonstrating that despite the additional distortion brought about by the investment constraint, there can be more occasions during which trade occurs.

What are the potential institutional implications of this paper? One application lies in the realm of merger or acquisition contracts mentioned in the opening paragraph. Our results shed light on how such a contract should be tailored appropriately to encourage non-contractible synergy investments, as well as on when these transactions are more likely to be closed.

In Appendix A, we provide another application of our theoretical results and the underlying geometric analysis in a different context. We construct an example to demonstrate that, under our incomplete-information setting, having more price-setting power in the ex post bargaining game may actually harm one's ex ante investment incentives. This conclusion is contrary to that drawn from the standard hold-up model in which all the variables of interest – in particular, investments and valuations – are common knowledge.

1.1. Related literature

Our theoretical analysis is closely related to the mechanism design literature. Two classic mechanisms that achieve expost efficiency are the VCG mechanism (Vickrey, 1961; Clarke, 1971; Groves, 1973) and the expected externalities mechanism (d'Aspremont and Gerard-Varet, 1979; Arrow, 1979). It has been long recognized that the former may not balance the budget while the latter may violate interim individual rationality. In a pioneering paper, Myerson and Satterthwaite (1983) prove that budget balance and voluntary participation in general cannot be reconciled in an efficient trading mechanism: some gains from trade have to be given up in the second-best mechanism that balances the budget and induces voluntary participation. The current paper takes this analysis one step further by showing how the second-best mechanism has to be further distorted in order to provide ex ante investment incentives. Rogerson (1992) argues that if interim individual rationality is weakened to ex ante individual rationality, then ex ante and ex post efficiencies need not be compromised: they can be jointly achieved by the expected externalities mechanism. Schmitz (2002b) demonstrates similarly that the first-best is attainable by changing the disagreement point from the usual no-trade outcome to some carefully chosen default outcome.[2] However, their requirements are incompatible with many situations in which participation in the mechanism is voluntary and the default outcome is not contractible.

Our model can also be viewed as a hold-up problem in which both investments and valuations are unobservable. The bulk of the incomplete contract literature has largely ignored the role of asymmetric information; Tirole (1986), Gul (2001) and Lau (2008) are some exceptions.[3] Tirole (1986) shows that the under-investment result in the hold-up problem is robust against the introduction of information asymmetry, as long as its bargaining game satisfies certain conditions. In Gul (2001), the investing party is privately informed about her investment choice and hence her deterministic valuation; the first-best outcome can nevertheless be achieved in the limit by letting the uninformed, non-investing party make infinitely frequent offers. The tension between ex ante investment incentives and ex post bargaining disagreement in the hold-up problem under asymmetric information is analyzed in Lau (2008). The most desirable mix between ex ante and ex post efficiencies can be accomplished by choosing the optimal information flow between the two parties. Yet, unlike the current study, the preceding papers all focus on one-sided incomplete information and/or specific bargaining games. What the optimal bargaining game would be under a more general environment with two-sided asymmetric information remains an unanswered question, and the current study attempts to bridge this gap.

[2] For the former, see also Schmitz (2002a) in the context of cooperative investment; for the latter, see also Cramton et al. (1987) in the context of dissolving a partnership.

[3] See also, for example, the contributions of Farrell and Gibbons (1995), Riordan (1990) for specific applications.