E C O N O M I C S   B U L L E T I N

# Specific investments and coordination failures

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## *Abstract*

This note presents a new result on incomplete contracts. We show that if the different degrees of relation−specificity of the partnerts’ investments determines their ex post bargaining position (what Williamson (1985) calls “the fundamental transformation”), it will appear a potential coordination failure. Under plausible conditions, the parties will coordinate in the more inefficient but less risky equilibrium, that is, in the risk−dominant equilibrium in the sense of Harsanyi and Selten (1988).

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## 1. Introduction

Previous literature on the hold up problem (see, for instance, Grossman and Hart (1986), Hanson (1995), Hart (1995), Hart and Moore (1990)) takes always the *degree* of relation-specificity of the investments as given, focussing on the *level* of ex ante investments and comparing it with the first best solution under complete contracting. Moreover, this literature considers that the parties' bargaining position (for example, the *status quo* point in the Nash solution or the outside options in an alternating offers negotiation) depends on the ownership structure. Namely, a player's bargaining position improves with the property of the assets. Therefore, this literature identifies actually property rights with bargaining power.

By contrast, this note analyses a new aspect of the hold up problem under decentralized property. Many times, the relevant issue is not the level of ex ante investment but the *kind* of investment, that is, its degree of relation specificity. In this situation, a trade-off appears. On the one hand, highly specific investment yields a greater surplus to be divided between the partners but, on the other hand, it reduces the ex post bargaining position of the investor, provided his partner has chosen a less specific type of investment. This is due to the fact that the former has a lower outside option than the latter in the negotiation stage. In other words, the particular pair of investments decided by the players determines their outside options and therefore, their ex post bargaining position (*"the fundamental transformation"* (Williamson (1985)). When the parties face this strategic situation a strong coordination problem would arise caused by a multiplicity of equilibria where both the efficient and the inefficient allocation are Nash equilibrium outcomes. Notice that in the previous literature on incomplete contracts and specific investments the first best cannot be achieved, whereas in our model the first best is a Nash equilibrium, but under plausible conditions it is so risky that the parties will choose the inefficient but the less risky strategy of making general investments. This coordination failure is caused by the fear of getting locked in the relationship with a very weak bargaining position and being exploited by the other party in the negotiation stage.

## 2. The model

We consider the relationship between a player 1 and a player 2 who wish to trade some good. In a first stage, each player has to decide separately and simultaneously whether to make a specific investment (S) or a general investment (G). The pair of investments decided by the players determines the size of the joint surplus, which has to be divided between them at a second stage. In this stage, they negotiate following an alternating-offer game in which the identity of the first proposer is determined by a fair lottery and both players can take their outside options at any time. That is, a player can take his outside option after any rejection even if he has been the proposer. For simplicity, we will assume that players share the same discount factor in this negotiation, $d \in (1/2, 1)$.

We will assume that specific investment entails a higher individual cost than general investment. In particular, let $c > 0$ be the cost of specific investment and we normalize the cost of general investment to zero.

On the other hand, specific investment is more efficient. If both players make specific investments the highest surplus $\overline{v}$ is obtained. If one of them makes a specific investment and the other makes a general investment then they get a smaller but positive surplus $\underline{v}$. And finally, if both players make a general investment they get the lowest possible surplus, which we normalise to zero. We will assume $\overline{v} > \underline{v} > c > 0$.

Each particular pair of investments determines also the bargaining power of the players at the second stage, when the players have to negotiate the division of the surplus. The reason is very intuitive: when a player makes a general investment, this kind of investment will be valuable outside the relationship, that is, he can trade with other potential partner. In other words, the player has an outside option $d$. We will assume $\underline{v} > d > d\,\underline{v}$. Therefore, a player cannot obtain outside the negotiation a higher surplus than the one obtained inside because, at best, his potential partner will make a specific investment but, at worst, his potential partner will make a general investment.

On the other hand, if a player makes a specific investment, he will be locked in the relationship because this kind of investment is not valuable outside. For simplicity, we assume that he has not outside option.

To make the analysis interesting, we shall assume that having both individuals make specific investments is the efficient allocation and hence:

$$\overline{v} - 2c > 2d \qquad \text{(A.1)}$$

## 3. Analysis and results

Let us solve the game described by backward induction. In the second stage, after observing the realized surplus and the possible outside options, players negotiate the division of the surplus following the already described alternating offers negotiation. Firstly, we find the perfect equilibrium of the four possible subgames which results from the four possible pair of investments.

*Subgame 1: both players make specific investments.*

In this case, the highest surplus $\overline{v}$ is obtained and both players have no outside option, that is, neither player 1 nor player 2 can trade with a third party. In other words, they are locked into each other. As it is well-known the unique perfect equilibrium of this game yields an immediate agreement on the Rubinstein's partition: $(\overline{v}/(1+d)$, $d\,\overline{v}/(1+d)$ ). As the identity of the first proposer is decided by a fair lottery, the expected equilibrium payoff for any player would be:

$$\tfrac{1}{2}(\overline{v}/(1+d)) + \tfrac{1}{2}(d\,\overline{v}/(1+d)) = \tfrac{1}{2}\overline{v}\,.$$

*Subgame 2: player i makes a specific investment and player j makes a general investment, where i, $j \in \{1,2\}$.*

In this case, the realized surplus is $\underline{v}$ and only player $j$ has a positive outside option $d$ because his investment is valuable outside, whereas player $i$ is locked in the relationship.

Firstly, suppose player $i$ gets to be the first proposer. As player $j$ can take his outside option as a responder, player $i$ will offer the following division of the surplus: ( $\underline{v} - d$ , $d$ ). Notice that $d > d\,\underline{v} > d\,\underline{v}/(1+d)$ .Therefore, the division of the surplus is accepted in equilibrium because of the *Outside Option Principle* (Sutton (1986)). Secondly, assume that player $j$ gets to be the first proposer and now he can take his outside option after his offer has been rejected. In this case, player $j$ has a substantially stronger bargaining position. Now, he can claim a proportion of the surplus greater than his outside option making a take-it or leave-it offer. In particular, player $j$ will propose the following division of the surplus: ( 0, $\underline{v}$ ). Notice that it is a credible threat that player $j$ leaves the game if this division is rejected by player $i$ because player $j$'s outside option is greater than the size of the surplus in the following period. Therefore, the equilibrium expected payoff is $\frac{1}{2}(\underline{v} - d)$ for player $i$ and $\frac{1}{2}(\underline{v} + d)$ for player $j$. Observe, that player $j$ gets more than a half of the surplus in the equilibrium partition. This is a consequence of his stronger bargaining position. Notice, that if his outside option $d$ approaches to $\underline{v}$, then player $j$ gets almost the whole surplus in the equilibrium partition.

*Subgame 3: both players make general investments.*

In this case, given that the expected surplus is zero, taking the outside options is the best reply for both players and therefore, trade will not take place. Consequently, the equilibrium payoff for any player is given by $d$ .

Summarizing, if both players make specific investments, neither of them has any outside option and they obtain half of the high surplus in the negotiation stage. If one player makes a specific investment and his partner makes a general investment, the latter has an outside option which allows him to claim more than one-half of the low surplus in the negotiation stage. Lastly, if both players make a general investment, they take their outside options and trade will not occur.

*The investments game.*

Let us now analyse the investment stage. Recall, that each player has to decide separately and simultaneously whether to make a specific investment (S) or a general investment (G). Given the negotiation results obtained previously and the backward induction hypotheses, players will face the following simultaneous game in the first period:

(M.1)

| | S | G |
|---|---|---|
| S | $\frac{1}{2}\bar{v}-c \quad , \quad \frac{1}{2}\bar{v}-c$ | $\frac{1}{2}(\underline{v}-d)-c \quad , \quad \frac{1}{2}(\underline{v}+d)$ |
| G | $\frac{1}{2}(\underline{v}+d) \quad , \quad \frac{1}{2}(\underline{v}-d)-c$ | $d \quad , \quad d$ |

where player 1 is the row-player and player 2 is the column-player.

Notice that from assumption (A.1) it follows that: $\frac{1}{2}\bar{v}-c > d$ . That is, (S,S) payoff-dominates (G,G), where the first term in parentheses is the investment chosen by player 1 and the second term is the investment chosen by player 2. On the other hand, given that $\boldsymbol{d} \in (\frac{1}{2},1)$ and $d > \boldsymbol{d}\,\underline{v}$ , then $d > \frac{1}{2}(\underline{v}-d)-c$. That is, to make a general investment is the best reply to a general investment of the partner. In other words, (G,G) is always a Nash equilibrium of the game.

In order to concentrate in the more interesting case, we will assume that (S,S) is also a Nash equilibrium of the investment game (M.1). That is, (M.1) is not a prisoner's dilemma game but a coordination game[1]. Namely, the following condition holds:

$$\frac{1}{2}\bar{v}-c > \frac{1}{2}(\underline{v}+d) \qquad \text{(C)}$$

Denote by $E$ the gains of efficiency, i.e., $E = \bar{v}-(2c+2d)$. Thus, condition (C) can be written as $E > (\underline{v}-d) > 0$.

If players could coordinate their actions by means of a binding contract, they would obviously make specific investments obtaining their best payoffs. But recall that this is impossible because of the incomplete contracting environment. Nevertheless, although (S,S) is the Pareto dominant equilibrium, to play S can be riskier than to play G. If player 1 chooses S and player 2 chooses S, player 1 gets his best payoff but, if player 2 chooses G, player 1 obtains his worst payoff. On the contrary, by making a general investment, although player 2 makes a general investment, player 1 gets, at least, his outside option. Similarly, the same holds for player 2. This notion of "strategic risk" is captured by the concept of risk dominant equilibrium of Harsanyi and Selten (1988). Experimental evidence (see, for example, Fatas, Olcina and Peñarrubia (2001)) and results obtained from evolutionary game theory (see, for example, Kandori, Mailath and Rob (1993)) predicts that, in case of conflict between risk dominance and Pareto efficiency, players tend to coordinate in the risk dominant but inefficient equilibrium.

In order to make a formal analysis of the game (M.1) we use the *Incentive Dominance* notion of Olcina (1997) and Olcina and Urbano (1994), which is equivalent in 2x2 games to the *Risk Dominance* notion of Harsanyi and Selten (1988). Formally, a strategy of a player is incentive dominant in a 2x2 game if the set of beliefs over the

[1] Obviously, if (M.1) has the structure of a prisoner's dilemma to make a general investment is a dominant strategy for both players and, therefore, (G,G) is the unique Nash equilibrium.

strategies of his opponent for which this stategy is a best reply has the largest Lebesgue measure.

**Proposition 1.** *Assume condition (C) holds in game (M.1), if the efficiency gains E are smaller than a critical value,* $\frac{1}{2}\bar{v}$ *, then (G,G) is the risk dominant equilibrium.*

**Proof.** Denote by $p$ the probability that player $i$ assigns to player $j$ making a specific investment, then if player $i$ makes a specific investment, his expected payoff will be:

$$p(\tfrac{1}{2}\bar{v} - c) + (1-p)(\tfrac{1}{2}\underline{v} - \tfrac{1}{2}d - c) \tag{1}$$

On the contrary, if he makes a general investment, his expected payoff is given by:

$$p(\tfrac{1}{2}\underline{v} + \tfrac{1}{2}d) + (1-p)d \tag{2}$$

Hence, to make a general investment is better than to make a specific investment for any $p$ such that:

$$p \le \hat{p} = \frac{\tfrac{3}{2}d - \tfrac{1}{2}\underline{v} + c}{\tfrac{1}{2}\bar{v} - \underline{v} + d} \tag{3}$$

Therefore, to make a general investment is the incentive dominant strategy if $\hat{p} > \tfrac{1}{2}$, that is:

$$\frac{\tfrac{3}{2}d - \tfrac{1}{2}\underline{v} + c}{\tfrac{1}{2}\bar{v} - \underline{v} + d} > \frac{1}{2} \tag{4}$$

This condition can be rewritten as:

$$\tfrac{1}{2}\bar{v} > E \tag{5}$$

■

Therefore, even if there are sufficient gains of efficiency to sustain (S,S) as an equilibrium, if they are smaller than a critical value $\tfrac{1}{2}\bar{v}$, that is, they are not large enough, players will coordinate in the risk dominant, but inefficient, equilibrium. This coordination failure would be caused by the fear of getting trapped in the relationship or, in other words, to be in the hands of the opponent and be exploited by him in the bargaining stage. Only if the gains of efficiency are very large, players will take the strategic risk of making specific investments.

## 4. Conclusions

In this note we have shown that when the differences between player in the degree of specificity of their investments determines their ex post bargaining position, this would result in a multiplicity of equilibria which might yield a coordination failure. In particular, the first best is an equilibrium result in our model but under plausible conditions it is so risky that the parties will choose the safe strategy of making general investments.

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