The Problem of the Hold Up problem: Outside options, Irreversible Investments and Entry Deterrence

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Abstract

We discuss a simple incomplete contractmodel between a buyer and a seller with third party externality. We outline the conditions under which an equilibrium with entry deterrence and non-contractible specific (over)investment occurs. Our result contrasts with standard incomplete contract theory conclusions in three respects: it outlines first, how equilibrium with overinvestment rather than with underinvestment may apply; second, how overinvestment may act as an endogenous enforcement device for incomplete contracts; third, that a trade-off may emerge between ex-post efficient entry and ex-ante efficient specific investments. We finally apply our result to revisit the debate on 'fundamental transformation' in incomplete contracts.

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1 Introduction

Irreversible investments play two opposite roles in two different streams of literature. When they deter ex-post competition they might sustain long term monopolistic rents and thus bring to overinvestment by an incumbent firm. When they are not contractible and occur in a bilateral monopoly framework they expose investors to counterparty's hold-up, thus generating incentives to under-investments. While the literature on incomplete contracts depicts irreversible investments as an action that exposes investors to the risk of counterparty's ex-post appropriation (hold-up), even in a context of bilateral monopoly, the literature on strategic entry deterrence outlines the conditions under which long-term monopolistic rents might be sustaied by irreversible investments.

This comparison brings to a puzzle concerning the role played by irreversible investment in generating or destroying investor's monopolistic rents, depending on the degree of contractual incompleteness from one side and the on degree of ex-post competition from the other.

On the one hand the standard literature on incomplete contracts (Hart and Hölmstrom, 1987; Milgrom and Roberts, 1990; Hart, 1995; Tirole, 1999), shows how contractual incompleteness may constitute a source of inefficiency when it inhibits Pareto-relevant exchanges. When specific assets are involved in incomplete contracts, the owner of specific assets is locked-in by the fact that the degree of asset specificity acts as a 'fundamental transformation' which reduces the ex-post value of employing the assets in alternative uses (Williamson, 1985). This lock-in effect generates in turn the risk of opportunistic behaviour by contractual counterparties who may want to renegotiate contractual terms in order to extract additional rents with respect to those ex-ante contracted (the so-called hold-up problem). The main consequence is that, under this framework, contractual parties have strong incentives to under-invest in asset specificity and the risk of counterparty's opportunistic behaviour implies the renounce to generate potential quasi-rents. Another stream of articles in the incomplete contracts literature shows how applying the outside option principle, hold-up occurs mostly when ex-post renegotiation is due to a change in parties' outside options. In this case one agent is induced to ask for contractual renegotiation when her *ex-post* outside option turns to be binding (MacLeod and Malcomson, 1993; Lyon and Rasmussen, 2004).

On the other hand, the literature on strategic entry deterrence (Bain, 1956; Dixit, 1980), traditionally outlined the strategic role played by irreversible investments, such as investments in 'capacity', in deterring efficient entry, especially when entry is subject to a given amount of fixed costs. Whenever entrant's profits are adversely affected by incubent's capacity, anticipating that, the incumbent firm might decide to increase strategically her capacit, before entry, through irreversible investments. Overinvestments in capacity might be rational if the resulting long term profit turns to be higher than that associated with the accomodating equilibrium.

In a nutshell, these two approaches may be reformulated in the following way:

- Industrial Organization's (hereinafter IO's) statement: strategic over-investment might deter efficient entry and maintain future monopolistic rents.
- New Institutional Economics' (hereinafter NIE's) statement: post-contractual opportunism induces inefficient underinvestment, destroying future bilateral monopoly quasi-rents.

In this paper we analyze the interdependence between the two statments above by studying an incomplete contract framework with one-sided specific investment and third party externality. Our intuition is that, when the *outside option principle*[1] is applicable to incomplete contracts, post-contractual efficient entry by third party on the investor'side, when anticipated by the investor, may induce underinvestment, as in the standard hold-up problem. Since contracts are incomplete and investments non contractible, parties may not internalize the effects of potential competition in the original contract

[1] See section 1.1

(as in Aghion and Bolton, 1988). However, when entrant's payoffs are adversely affected by the specificity degree of the investment previously made by the competitor in the contractual relationship, then the investor might have a strong incentive to overinvest in specific assets up to a level that deters entry. In this case inefficient entry deterrence might constitute a powerful enforcement device for the original incomplete contract. This result depends on the costs of overinvestments, on the level of breach penalties and on the level of fixed entry costs. Our conclusion contrasts with standard incomplete contract theory results in three respects: first, it outlines how equilibrium with overinvestment rather than with underinvestment may apply; second, it envisages how overinvestment may act as an enfoorcement device; third it outlines the emergence of a neglected trade-off between ex-post efficient entry and ex-ante efficient specific investment.
The general lesson we derive from this simple model is that standard underinvestment results in the incomplete contracts framework strictly depend on the assumptions made on the impact of specific investments on parties' outside options. This result allows us to revisit the notion of 'fundamental transformation' (Williamson, 1985) in incomplete transactions and, consequently, to discuss the efficiency features of bilateral monopoly sustained by noncontractible specific investments.

1.1 Hold Up Problem and the Outside Option Principle

The standard hold-up problem is actually based on the simple idea that noninvestors always maintain strong incentives to renegotiate contractual terms in order to extract, entirely or partially, investor's quasi-rent. That is to say, that noninvestors[2] can always engage in a credible threat in the form of take-it-or-leave-it proposal in the renegotiation game. This case only occur in a one shot renegotiation game in which noninvestor has all the bargaining power.

As generally agreed in the literature[3], that is a very strong assumption.

[2]The same apply for investors who delay their decision to make specific investments to the date in which they have observed counterparts' ones.

[3]See for instance Gul (2001): "This result is very extreme form of the hold-up problem"

We will first show that relaxing this assumption and applying the *outside option principle*[4], even in a very simple case, dramatically reduces the case for hold-up in the renegotiation game. Our starting point is a rather simple one. Let us assume a simple setting with unilateral investment, in which a seller has to make specific investments observable to a buyer but unverifiable:we contend that as long as there are quasi-rents to gain ex-post, each party is specific to some extent to the contractual relationship independently of the ex-ante level of specific investments made. In other terms, any potential quasi-rent the buyer can extract from counterpart is a measure of its specificity to the contract. As a consequence exit by rational buyer is never a credible threat as long as her ex-post outside option coincides with ex-ante values. Now, if the renegotiation game takes the form of an ultimatum game where the buyer has all the bargainig power, hold-up may occur if seller accepts a surplus sharing offer. This in turns depends on the buyer's credible threat to end the game, should the seller refuses. The question is whether buyer's threat is credible at that stage. If we acknowledge that also noninvestor is somewhat specific to the relation (as long as she incurs in a loss by choosing outide option), any threat is far to be credible and indefinite renegotiation may lead to several equilibria (and hold-up is only one of them). We thus turn our attention into another renegotiation game which applies the outside option principle and gives the investing party with the power of making a take-it-or-leave-it offer. It is easy to show that, in this case, the renegotiation game assumes the form of an *ultimatum game* in which the buyer has strong incentives to accept any transfer ($\varepsilon > 0$) greater than her outside option. When this happens the amount of quasi-rents ex-post appropriable by buyer is virtually zero ($\varepsilon > 0$), thus restoring ex-ante seller's incentives to invest. Consider that the seller's specific investments to produce a widget costs 60 and generates a gain from trade of 100, paid by the buyer, who has a value of 120 from the widget sold by the seller. Suppose also that an alternative widget produce through generic investment has a price of 90 and gives to the buyer a benefit of 100. Then, seller's quasi-rent

[4]The outside option principle asserts that the outside option of noninvestor acts as a constraint on the equilibrium division.

is equal to 40=100-60, while buyer's quasi-rent is equal to 20=120-100. Once the seller's has made specific investment, standard hold-up theory suggests that the buyer could be induced to renegotiate on the agreed upon price, asking a discount up to 40 to the seller, thus leaving him just enough money to cover investments[5]. This result would apply even if buyer's outside option is maintained constant over time and equal to 100. What happens in this setting if the seller refuses to renegotiate the price? The seller will obtain a loss of 60 and the buyer will obtain 10 from her outside option. However, that also means that the buyer will have a loss of 10, equal to the difference between expected quasi-rent at the agreed upon price of 100 with the seller and the value of the outside option. Thus, if we claim that it is not rationale for the seller to breach the contract under renegotiation, once specific investments are made, we should also conclude that it would be rationale for the buyer to accept seller's offer of 10 in the renegotiation game[6]. Let us assume that the renegotiation game takes the form of an ultimatum game in which the seller's makes an offer (delivery of the widget) asking a price of 100 to the buyer, thus leaving her a surplus of 10 with respect to her outside option. If the buyer accepts the game end with reciprocal gains from trade, if he refuses the game ends with joint losses. In this setting, it is easy to see that the game as a unique equilibrium with rational buyer accepting seller's offer (Osborne and Rubinstein, 1988).

As a consequence, when outside option priciple applies and investor makes first offer in the renegotiation game, hold-up seems to occur whenever noninvestor's *ex-post* outside option turns to be binding. To see this, consider the case in which, once investment is made by seller, buyer's outside option exogenously raises for some unexpected reason up to 150. In this case, the only way to minimize losses for the seller is forcing the buyer to stay in the contract offering a price of 150+ε. In this case, renegotiation by buyer would reduce seller's share of gains from trade to an extent which inhibits covering

[5]To the sake of simplicity we are assuming the best scenario for the investor, while the worst will inhibit any capacity to cover irreversible investments

[6]We are awaiving here any fairness consideration. For a different approach see Tore Ellingsen & Magnus Johannesson, 2004

investment costs. By anticipating this outcome then the seller could be induced to underinvest in the first instance. This example shows how hold-up strategies could emerge only when noninvestor's outside option raise ex-post up to a binding level. However, also in this case, within the informational setting generally assumed by incomplete contracts literature, i.e. under the assumption that all the variables relevant to the contract are observable by parties, it is easy to show that the seller may alway implement an efficient contractual scheme (MacLeod and Malcomson, 1993).

We thus focus here out attention only to cases in which (as in session 2.4.1) hold-up occurs due to buyer's binding ex-post outside option, i.e. due to entry by a more efficient seller.Our conclusion suggests further explanations, based on investors' ability to control counterparts' outside options, of existing solutions to hold-up and of the meaning that horizontal as vertical integration decision have in assuring contractual enforcement.

2 Incomplete Contract with Third Party's Entry: a Simple Model

2.1 The Standard Hold-Up Problem with One-Sided Specific Investment

Let us consider a simple contract between a buyer B and a seller S concerning the delivery of a widget. For simplicity's sake, let us assume that at the starting date of the contract, $t = 0$, the buyer is a monopsonist, while there is competition on seller's side for a *generic* widget at market prices. Let us further assume that by making a specific investment, x^1, the seller produces a a widget for the buyer, which has a higher *net* value (because it increases buyer's value or reduces buyer's price). In particular we assume that the specific investments, x^1, reduces the total costs of the seller, generating a bilateral monopoly and higher joint surplus from the contract, from which eventually also the buyer can partially benefit through lower price. Timeline is as following: at $t = 0$ parties contract upon investments, prices and quantities, at $t = 1$ investments are made and at $t = 2$ quantities are delivered

and prices paid.
Let us assume that buyer's demand is given by $p = 1 - q$, where q is the quantity of the widget delivered, while seller's total costs are given by $C(x^1, q) = (c_S - x^1)q$, showing how specific investments increase efficiency with $\partial C/\partial x^1 < 0$. In particular, let us assume a quadratic cost function $f(x^1) = \left(x^1\right)^2$. Let us define with $I(x^0, q)$ the surplus associated with generic widget and generic investment $x^0 \Rightarrow x^1 = 0$, while the joint surplus is $[I(x^1, q) - I(x^0, q)] > 0$ when there are specific investments. Let us furthermore define x^{1*} as the value of specific inevstment which maximes quasi-rents:

$$x^{1*} = argmaxI(x^1, q) \tag{1}$$

When contracts are complete, the value of specific invetsments that maximizes equation [1] is the same that maximizes seller's profits $\prod^S = pq - c_S q$, with $c_S = (c - x^1)$; that is, seller's incentives are perfectly aligned with social surplus. In particular, these are the values associated with FOCs when contracts are complete:

$$q^M = \frac{1 - c_S}{2}; p^M = \frac{1 + c_S}{2}; \prod^M = \frac{(1 - c_S)^2}{4} \tag{2}$$

where M stands for 'monopolist'.
On the contrary, when contracts are incomplete, after specific investments are made in $t = 1$, according to standard hold-up problem (Klein *et a*l (1978), Williamson, (1985), Osborne, (2004)), the buyer has strong incentives to renegotiate on contractul terms, in order to extract seller's quasi-rent. When this standard form hold-up occurs parties will share the surplus $I(x^S, q)$ according to their respective ex-post bargaining power $(1 - a)$ instead that to ex-ante agreed surplus sharing. That means that ex-post seller will obtain only a fraction of the marginal surplus he contributed to generate through specific investment:

$$(1 - \alpha) \prod^S = (1 - \alpha)[pq - (c - x^1)q] \tag{3}$$

where q^M and p^Mderive from [2].
Anticipating this outcome at $t = 0$, the seller is thus induced to underivest,

i.e., by [3], to select the value of $x^{1H} = argmax\left\{(1-\alpha)[pq-(c-x^1)q]\right\}$, with $x^0 \leq x^{1H} < x^{1*}$, as suggested by the standard literature on incomplete contracts (Hart, 1995).

2.2 The case of Noninvestor's Binding Outside Option

Let us now extend this setting by introducing two new main assumptions.
First we assume that hold-up (i.e. renegotiation by the buyer) will occur in this setting only when buyer's outside options are binding, according to the so-called *outside option principle* (Sutton, 1980; Osborne and Rubistein, 1988; MacLeod and Malcomson, 1993; Lyon and Rasmussen, 2004) mentio in section 1.1. This means designing the renegotiation game as one in which seller is the first mover making an offer to noninvestor. In this setting, buyer's hold-up is sustainable only when exit is a credible threat, i.e. only when an efficient seller's competitor comes in after having observed in $t = 1$ seller's investment and proposes a new price to the buyer. At $t = 2$, then, the renegotiation game is as follows: the seller offers a price and the buyer may accept or propose a renegotiation to the original seller. In particular the buyer may buy at the new price p^R only from the original seller, either she can split her demand at the new price between the old and the new seller or she can buy entirely from the new seller. According to Osborne and Rubinstein (1980), when buyer's outside option is not binding, this game has a unique immediate equilibrium in which buyer accepts seller's offer, even if it is played with alternative offers for an infinite horizon. An important result outlined by Osborne and Rubinstein is that when buyer's outside option is binding the original seller will offer the value of buyer's next best alternative (plus a transfer ε, with $\varepsilon \simeq 0$), the buyer will accept and the game ends. According to the outside option principle, renegotiation (hold-up) will occurs only should buyer's outside option be binding.
Second, we assume that the new seller is as efficient as the incumbent seller[7], entering at the marginal cost c and has to sustain some fixed cost $F > 0$. As

[7]We will also analyze in next sessions the case of a more efficient entrant

with the standard assumption in incomplete contracts literature we further assume that all the payoffs are observable by parties (the seller, the buyer and the entrant), while specific investments are observable but non-contractible (un-verifiable).

2.2.1 Hold-up by Competition

In this section we examine the conditions under which entry at $t = 2$ induces hold-up. Let first consider what happens at $t = 2$ if entry occurs and buyer splits her demand equally between the two sellers, Then, by backwards induction, we will analyze seller's ex-ante incentives to make specific investment under the threat of ex-post entry. At $t = 2$ a duopoly occurs[8] and firm 1 and 2 (respectively, the incumbent seller and the new entrant) will decide the production of widget by maximizing the following:

$$\prod_i (1 - q_i - q_j - c_i) q_i$$

$\forall\ i, j = 1, 2$ with$i \neq j$ where $c_1 = c - x_1$ while $c_2 = c - x_2$. Here, x_2 is the specific investment for new entrant, as defined for incumbent. The first order conditions for seller 1 and seller 2 bring to the following reaction functions:

$$R_1 : q_2 = 1 - 2q_1 - c + x^1 = 1 - 2q_1 - c_1$$

$$R_2 : q_2 = \frac{1 - q_1 - c + x^2}{2} = \frac{1 - q_1 - c_2}{2}$$

The intersection between the two reaction curves gives the standard Cournot equilibrium with $q_i^C = \frac{1-2c_i-c_j}{2}; p^C = \frac{1+c_i+c_j}{3}$ and

$$\prod_i^C = \frac{(1 - 2c_i + c_j)^2}{9} = \frac{\left(1 - c + 2x^i - x^j\right)^2}{9} \tag{4}$$

Proposition 1: When an efficient seller enters in the market at $t = 2$, seller 1 obtains a lower profit level with respect to the value obtained in the case of no-entry and contractual completeness.

Proof.

[8] Notation is derived by Motta (2004), pp. 457-9

From [2] and [4] it is evident that $p^{\mathrm{M}} > p^{C}; \leq \prod_i^C < \prod^{\mathrm{M}}$. See also Equilibrium III below.

Proposition 2: If at $t = 2$ efficient entry determines a duopoly, ex-post competition determines buyer's hold-up, then at $t = 1$ seller 1 (the incumbent) is induced to underinvest, when contracts are incomplete.
Proof.

When an as efficient seller enters the market at $t = 2$, seller 1 by backward induction anticipates this entry and will underinvest choosing a level of investment x^{1C} such that[9]:

$$x^{1C} = argmax[\prod_i^C = \frac{(1 - 2c_1 + c_2)^2}{9}] \tag{5}$$

with $x^0 \leq x^{1C} < x^{1H} < x^{1*}$.

2.2.2 Efficient Specific Investment as a Barrier to Entry

Observing equation [4] one can notice that firm's 2 profit decrease with the investment of firm 1. Call strategic investment $x^{1\#}$ the level of investment such that

$$\prod_2^C \left(x^{1\#}\right) \leq 0 \tag{6}$$

it may represent the set of practices made by the firm 1 which endogenously discourages the entry of firm 2. We have the following propositions.

Proposition 3: strategic investment $x^{1\#}$ may be a profitable and anti-competitive[10]

[9] By [5], from $\partial \prod^C / \partial x^1 = 0$ and further substitutions we have that $x^{1C} = \frac{c - x^2 - 1}{2} = \frac{c_2 - 1}{2}$

[10] The basic argumentation as anti-competitive behaviour is similar to predatory pricing: an action is taken that involves the sacrifice of current profits, to be outweighted by future profits. In other words, for a period, the incumbent invests more than is profitable in the short-run, with the expectation of increasing profits in the long-run, when the rival has left (or a potential competitor abandons plans of entering the market.

practice if it is profitable and directed mainly to "drive competitors out of the industry, or to persuade them not to enter all" (Motta, 2004:454).

Proof.
In order to see whether or not the level of investment that deterres the entry is anti-competitive, we have to find whether or not a level different from x^{1C} is profitable for the firm 1. Indeed, if $x^{1C} < x^{1\#}$ then the firm 1's behaviour is anti-competitive because she is not maximizing her short-run profit [5] in order to deter firm 2's entry [6]. Now, the question is whether by behaving strategically (and therefore by preserving future monopoly rent) seller 1 will obtain higher profits than by accomodating the firm 2 as a Cournotean duopolist). with $\prod_1^C \left(x^{1C}\right) < \prod_1^M \left(x^{1\#}\right)$. If it is verified, $x^{1\#}$ is at once profitable and anti-competitive conduct.

Proposition 4: The incumbent's strategic investment is inversely proportional to the level of entry fixed costs F.

Proof.
By [4] we have that new entrant's profit is: $\prod_2^C = \frac{(1-c-x^1+2x_2)^2}{9} - F$. It is easy to see that, in order to deter entry,

$$x^{1\#} \geq 1 - c + 2x_2 - 3\sqrt{F} \tag{7}$$

Similarly, we can find the deterring level of fixed costs F with null strategic investments (namely, $x^1 = x^{1C} = x^{1\#}$). Denoting this deterrence level by $F*$, by equations [4] and [6], and further substitutions we have that $q_2 = \frac{3(1-c)+5x_2}{6}$, $p = \frac{3(1+c)-2x_2}{6}$ and

$$\prod_2 = \frac{3 + 3x_2 + c\,(7x_2 - 3c)}{12} - \frac{5\,(x_2)^2}{18} - F \tag{8}$$

.

Then, the firm 2 would enter the market as long as $F \leq \frac{3+3x_2+c(7x_2-3c)}{12} - \frac{5(x_2)^2}{18}$. Instead, using words of Bain (1956), with $F* = F > \frac{3+3x_2+c(7x_2-3c)}{12} -$

$\frac{5(x_2)^2}{18}$, entry would be bloackaded, that is, there would no need for the firm 1 to behave strategically beyond her short-run profitable conduct.

Proposition 5: When $F = F*$, the incumbent has no incentive to make strategic conduct.

Proof.
$F*$is obtained properly by [4] and by assumption that $x^1 = x^{1C} = x^{1\#}$.

Corollary: The strategic investment of incumbent is directly proportional to new entrant's level of investment.

Proof.
See equation [7].

2.3 Strategic-Specific Investment

Now, let's deeply analyze the renegotiation gameunder the framewok of the outside option principle. At $t = 2$: the seller offers a price and the buyer may accept, exit or propose a renegotiation p^R . When buyer's outside option is not binding, this game has a unique equilibrium in which buyer accepts seller's offer, then renegotiation does not occur; instead, when buyer's outside option is binding the original seller will offer the value of buyer's next best alternative, the buyer will acccept and the game ends. In this latter case there is an actual renegotiation such that price will be the least among sellers'supply (Osborne and Rubinstein, 1988). We can distinguish the following equilibria.

Equilibria I: Efficient investment or Unnderinvestment (Standard Hold-up problem)

At $t = 2$, seller 2 will not enter the market, if exogenous barrier entry is such that $F = F*$. Then seller 1 will invest her profitable level of investment x^{1H}, which will depends on credible hold-up by buyer. In this case, two equilibria are possible: efficient investment with no renegotiation (when seller is the first mover) or hold-up (when buyer is first mover and no trade is a credible threat by buyer). In the hold-up case the price p is in accordance with parties' contractual power, would be p^H. Anticipating this result at $t = 0$,a standard underinvestment equilibrium will emerge.

Equilirium II: Hold Up Deterrence

If $0 < F < F*$ and $x^1 = x^{1\#} > x^{1C}$ is profitable, then the firm 1's investment decision rests on strategic-based rationale. Incentives in investing are higher thanwhat we should expect under standard bilateral monopoly configuration. The price here is p^M and outside options are not binding, since deterrence has occurrred.

Equilirium III: Hold-up by Competition

If $0 < F < F*$ and $x^1 = x^{1\#} > x^{1C}$ is not profitable, then the firm 2 entries. Here buyer has a binding outside option and thus may make a credible threat to exit unless renegotiation occurs. Indeed, buyer may renegotiate the price p^R unitl is equal to the least price among sellers, obtaining, however, the same high quality of widget. In this case ex-post buyer's contractual power is increased $a^R > a$ thus reduccing expected gains for seller 1. Equation [3] becomes

$$x^R = argmax \left\{ \left(1 - a^R\right) [pq - (c - x^1)q] \right\}$$

with $x^0 < x^R \leq x^{1H} < x^{1*}$.

Let's briefly consider the effects on price of widget. Both "Hold Up Deterrence equilibrium" and "Hold-Up by Competition equilibrium" imply that the price of widget is equal or even lower than in the standard hold up case.

2.4 Strategic Specific Investments with Breach Penalties

The analysis above allows us to show that even when parties may implement some verifiable rules to enforce incomplete contracts, such as imposing breach penalties on observable exit, there are cases in which these rules play a countervailling effect on strategic specific over-investment as well as there cases in which breach penalties are uneffective in deterring entry (and then hold-up), while specific overinvestment still are effective in enforcing contracts. Let us introduce in the previous setting a breach penalty like p^S to be paid by buyer upon exit. As a breach penalty p^S has the aim to act as a safeguard of sellers' specific investments when exit is the only way for buyer to enact hold-up. Breach penalty has the immediate effect of raising barriers to entry (Aghion and Bolton, 1988). In particular, the equation 7 becomes:

$$x^{1\#} \geq 1 - c + 2x_2 - 3\sqrt{F - p^s} \tag{9}$$

This implies following results.

Proposition 6: Strategic investment is inversely proportional to breach penalties.

Proof.
By [9].

Proposition 7: Denote by p^{s*} the optimal value of breach penalty, i.e. the value that deters entry. Then seller 1 will invest x^{1H} when $0 \leq p^s < p^{s*}$ and will select the efficient level x^{1*} when $p^s = p^{s*}$.

Proof.
Seller 2's profit function with breach penalty is by [8]: $\prod_2 = \frac{3+3x_2+c(7x_2-3c)}{12} - \frac{5(x_2)^2}{18} - F - p^S$. As a result $p^{S*} : \prod_2 (p^s) = 0$. With $p^s = p^{s*}$ will not be rational for the seller 1 to spend extra resources in strategic over-investments.

An interesting consequence of proposition 7, is that breach penalties, in our framework, restore efficient specific investment with respect to inefficient over-investment rather than with respect to inefficient underinvestment, as in the standard hold-up case. With 'optimal' breach penalties p^{s*}, however, competition is reduced and, under contractual incompleteness, equilbrium II - with at least partial compensation of under-investement level - may be not reached. This holds also even if new entrant may be more efficient (see proposition 9 below) and/or equilibrium II may be preferred in the Pareto sense. For these reasons, a judge[11] may impose a *cap* to sanction, say a maximum value p^{cap}, in order to favour competition and entry by more efficient sellers.

Under the assumption of an upper limit to enforceable breach penalties, we can distinguish three level of penalties: $p^0 < p^{cap} \leq p^{s*}$.

That is, sanctions may be null if contract is unenforceable at all, is p^{cap} if contract is enforceable against exit to a given extent, and finally is equal to p^{s*} if there are no legal constraints on breach penalties. In particular, let us denote p^{cap*} when $p^{cap} \geq p^{S*}$and $p^{\widetilde{cap}}$ when $p^{cap} < p^{S*}$.

We can now chematize the specific-strategic consequences as in following table.

	$0 < F < F*$	$F*$
p^0	case 1: $x^{1H} + x^{1\#}$ or x^{1R}	case 2: x^{1H} or x^{1*}
$p^{\widetilde{cap}}$	case 3: $x^{1H} + x^{1\#}$ or x^{1R}	case 4: x^{1H} or x^{1*}
$p^{S*} = p^{cap*}$	case 5: x^{1H} or x^{1*}	case 6: x^{1H} or x^{1*}

Tab. 1

In Tab. 1 is evident the fact that when entry costs are lower than the exogenous deterrence level $F*$, and breach penalties are null or lower than the deterring level (case 1 and case 3) entry wil occur unless the level of investments of incumbent seller is higher than the efficient one (overinvestment). On the contrary, when entry cost are at their deterrence level and/or breach penalties are applicable (cases 2, 4, 5 and 6), efficient investment are

[11] A common feature in both common law and civil law traditions is that Courts are generally reluctant to enforce privately liquidated damages

made. The table thus outlines the interdependence between exogenous and endogenous barriers to entry which have the effect of enforcing incomplete contracts.

Let's define as EXD the function that envisages exogenous barrier to entry (thus treating breach penalties as 'exogenous' and specific investments as endogenous). By [9] this function is equal to $EXD\left(F,p^s\right) = 1-c+2x_2-3\sqrt{F-p^S}-x^1$. Then, EXD will be optimal , in the sense that it induces efficient investment by seller 1, if the combination of tecnological fixed costs and legal punishment deters the entry of firm 2, without the firm 1's engaging in strategic overinvestment. .Similarly we denote as endogenous deterrence the function which obtain deterrence through specific overinvestment: $END\left(x^1\right) = 1-c+2x_2-3\sqrt{F-p^S}-x^1$ where F, p^s and c are given.

Proposition 8: When exogenous entry costs are not optimal, the incumbent seller will be stimulated to make strategic overinvestments..

Proof.

Denoted by x^{1+} the level of investments selected both for specific purposes and for strategic ones, it will be: $x^{1+} = argmax\left\{(1-\alpha)[pq-(c-x^1)q]\right\} + END\left(x^1, q, EXD\right)$. It implies that $x^{1+} > argmax\left\{(1-\alpha)[pq-(c-x^1)q]\right\} = x^{1H}$. Moreover, for certain specific and strategic conditions such that $x^{1\#} \geq x^{1*} - x^{1H}$, an over-investment level may occur, $x^{1+} \geq x^{1*}$.

Proposition 8 outlines an important result, almost neglected in the literature on incomplete contracts. When seller's specific investment adversely affects the entrant's payoff, there is an equilibrium in which overinvestment in specificity generates a deterrence effect. Moreover, when renegotiation occurs crucially in the case in which noninvestor's outside option is binding, as we have assumed in our framework, then the deterrence effect generates also an enforcement effect on the incomplete contract. The higher is the level F of entry costs that entrants has to face upon entry, the lower is the critical threshold that specific investments have to satisfy in order to deter hold-up.

2.4.1 Specific overinvestment against a more efficient entrant

So far, we have assumed identical marginal costs c for both sellers. Now, we relax this assumption. In particular, we suppose that the seller 2 is technologically more efficient than seller 1. Denoting by $\underline{c_i}$ the marginal costs of firm more efficient and by $\overline{c_j}$ ones of lower efficient, we have that: $END\left(x^1\right) = 1 - 2\left(\underline{c_2} - x_2\right) + \overline{c_1} - x_1 - 3\sqrt{F - p^S}$. Then we have the following proposition.

Proposition 9: Higher exogenous barriers may deter also the entry of more efficient new entrants.

Proof.

By [6] we can reformulate the function of endogenous deterrence in the following terms: $END\left(x^1\right) = 1 - 2c_2 + c_1 - 3\sqrt{F - p^S}$. Remind that $c_i = c - x_1$. It is easy to see that if: $x_1 = 1 - 2\left(\underline{c_2} - x_2\right) + \overline{c_1} - 3\sqrt{F - p^S}$ the entry of a more efficient firm is deterred for any given value of F and legal sanctions p^S.

Proposition 9 outlines another important effect of specific investments in our framework. By using the deterrence effect of specific overinvestment as an enforcement device for the incomplete contract, seller one may strategically overinvest in noncontractible specific investments in order to deter a more efficient entrant[12].

[12] An example for that could be the case in which an incumbent monopolist who has to decide how much to invest in R&D, knowing that a firm is considering entry into the industry. Facing competition, it makes sense that the incumbent wants to improve its technology and abate its production costs. Indeed, we would all say that such an investment in R&D is one of the welcome effects of increased competition. However, on the contrary, the incumbent might act strategically, and try to discourage the new firm from entering at all. For instance, it might choose to invest in a particularly costly and efficient technology, so costly and efficient that the new entrant would not expect to be sufficiently profitable (also because new entrant should face with fixed costs). Therefore, this firm may invest in R&D in order to realize and to impose in the market the best technological standard given the incumbent's inputs, independently from how it influences the new entrant's profit, or a technological standard that maximises the (positive) difference between her profit and

3 Analysis

In the NIE's approach, once made, a specific investment locks the investors into the contractual relationship, by raising their ex-post exit costs. As a result, economic resources spent to make specific investments will be fully dissipated in the case of a counterparty's hold up. When agents make specific investments, they are thus vulnerable to counterparty's post-contractual opportunism and may require ex-ante appropriate safeguards. Agents in order to align parties' incentives and thus to maximize their joint rent should then build endogenous enforcement arrangements, defined by Williamson as "private orderings". As it is normally assumed by the New Institutional Economics literature, incomplete contracts characterized by specific investments cause, at least for one party in a contract, the Williamsonian "fundamental transformation", for which an ex-ante competitive transaction is transformed ex-post into a monopolistic one. Thus, contractual rivalry is mainly directed to the analysis of ex-post surplus sharing between 'actual' contractual parties, neglecting rent sharing 'outside' the contract, among contractual parties and their competitors. In this respect, the standard literature assumes that exogenous outside options and the agents involved in incomplete contracts do not bear competition costs in excess with respect to those sustained by agents in the case of perfect competition. On the opposite, in raising rivals' costs theory, strategic invesrment may be assested by some agents in order to deter competitors. Even in efficient external enforcement structure, contractual enforcement is guaranteed by efficient breach penalties. However, economic agents have to face competition extra costs to exclude competitors

new entrant's one. Surely, these two occurrences may coincide, but more likely they imply different investments choices. The former stems from specific-based logic, whilst the latter rests on strategic-based motivations. These two rationales may be formally distinguished by analyzing the decisional process as deriving from self-regarded choice and as resting on relative-regarding effects. However, as we shown in this paper, the level of investmens may derive from both motivations.

and enhance their contractual power or market share. The resulting institutional context will thus be characterized by positive 'competition costs', as it is generally assumed in the strategic competition literature and the analyses of strategic sunk costs to deter rivals' entry or raise rivals' costs. For instance, this literature explains the entry deterrence effect that the buyer investment generates on ex-post competitors: if any amount of extra-investments determines a deterrence effect on competitors so as to induce them to exit the market and/or to inhibit their entry by raising their costs to compete (Salop and Scheffman, 1983), then it would be rational for the buyer to select that amount, since this strategy will increase her ex-post gains from trade (Chatterjee and Chiu, 1999; Nicita, 2004). Similarly, models of "naked exclusion" illustrate the case in which scale economies allow an incumbent to exclude a rival by signing up customers to deny rival the necessary scale to profitably enter (Rasmusen et al., 1991; Segal and Whinston, 2000). In this respect, the pioneer model of Dixit (1980) and Spence (1977) depicts an incumbent investing in capacity to gain a strategic advantage at the stage of market competition, but many other investment possibilities are possible: R&D, brand image and advertising, initial production or sales in the presence of a learning curve or switching costs, product compatibility decisions, product positioning, facilitating practices like price protection provisions, etc (Vives. 1999). The rationale may be described in the following terms. Suppose that the investment reduces marginal costs in a Cournot-like market with downward-sloping best response function (namely, with strategic substitutes). The incumbent by investing pushes his best response function to the right and therefore, in equilibrium, the entrant produces less and the incumbent more (see, Vives, 1999). This is a 'top dog' strategy by the incumbent in the terminology of Fudenberg and Tirole (1984). The incumbent has a strategic incentive to over-invest to improve his position at the market stage. However, here we refer to the wide range of deterrence actions outlined by a huge scholarly literature on the commitment effect of sunk costs, the inducement of exit, product-differentiation advantages, limit pricing behaviours, most-favoured-customer clause, target rebates, tying arrangements, systems and product compatibility and so on. Under such a configuration, competition induces economic agents to make actions or investments which deter the competitors' entry, by sustaining positive competition costs, in excess with respect to those sustained by agents in the case of perfect competition, whereas they do not bear any enforcement cost.

Bilateral enforcement mechanisms are thus affected by the actions selected by agents in order to deter a competitor's entry, and vice versa, competition strategies are affected by the economic incentives promoted by the parties for the enforcement of contractual obligations[13].

Propositions 9 shows a very important result despite the simplicity of the model. In a sense, it reverses the main conclusion of incomplete contracts theory: here, asset specificity rather than being a contractual weakness turns to be the strategic devise to endogenously obtain contractual enforcement, due to deterrence effect exterted by specificity on competitors' entry. Moreover, specific over-investment rather than underinvestment could be the emerging equilibrium (i.e. equilibrium II), when entry costs are fairly high in the market. Of course our result depends on a number of assumptions. Our result differs from those of Edlin and Reichelstein (1996), and Spier and Whinston (1995) given that we obtain a 'real' overinvestiment result. i.e. a level of investment higher than the ex-ante efficient one (rather than alevel higher than the underinvestment level), even when contracts are partially complete (breach penalties with a cap), but entry costs are lower enough to encourage entry.

The first and most important is our assumption on the form of the renegotition game. We have assumed that buyer will ask for renegotiation only when her outside option turns to be binding. This means assuming that buyer will never renegotiate when exit is not an option and accepts initial offer by the

[13]We defined such a complex institutional context as cross competition to indicate an institutional order in which the outcome of a transaction – even when specific assets are involved – is always a complex interaction among four representative agents, the two parties involved in a transactional exchange and the best competitor of each (Nicita, 1999). Therefore, with respect to contractual rivalry configuration, cross competition rejects the implicit assumption of perfect competition markets, stressing the role of enforcement strategies acting on parties' outside options, i.e. the role of market-contract interactions along the original notion of transaction provided by Commons. On this point see also Nicita and Vatiero (2007)

seller (see Osborne and Rubinstein, Ch.3). For the economic rationale of this assumption we refer to Osborne and Rubinstein (1980). The intuition behind that is that if the seller has the right to make the first offer in the renegotiation game, he can gain his expected payoff minus a small amount ($\epsilon > 0$) so as to induce the buyer to accept. Under this renegotiation game ths it is easy to see why renegotiation will be credible only when buyer's outside option is binding at $t = 2$.
The second assumption, as outlined above, is that the transaction will take place in a market characterized by high entry costs $F > 0$. This is a reasonable assumption in our setting since we describe a transaction for which the idget to be produce requires costly specific investments by original seller, and thus the idea that even entrant have to face relevant entry costs in order to exchange with the buyer captures the idea that the transaction requires - at least initially - a relevat economic effort also on new entrants ' side.
Let us notice that our result would also easily obtain in a context of bilateral specific investments.
Another important consequence, implied by our analysis, is that our argument provides an alternative explanation to what Williamson (1985) defines as 'fundamental transformation'. Williamson (1985) introduces this notion in order to show how an initial transaction between exchange partners, which requires bilateral specific investments, creates a "transaction residual" that aligns parties' incentives to continue the initial trading relationship over other potential traders, given that specificity endogeously accrues quasi-rents. Williamson's argument is mainly based on the idea that parties involved in an incomplete contract sustained by bilateral specific investments will prefer to continue to trade rather than switch to an alternative partner, so that contractual partis' identity matters. Our argument shows an alternative explanation: parties create a bilateral monopoly as long as, due to the high value of competitors' entry costs, the level of their specific investments generate a deterrence effect over competitors at each stage. In other words, the 'fundamental transformation' is not only a transformation in the contract but also in the market. And it is generated not only by parties preferences towards counterparts' identity (what Klein defines the 'reputational

capital') but also by the deterrence effect played by specific investments. This conclusion has important consequences in terms of policy approaches towards legal or *de facto* exlcusivity in incomplete contracts involving parties operating, respectively, in markets characterized by relevant entry costs. The trivial result is that we would expect bilateral monopoly emerging in those markets where noncontractible specific investments are coupled with relevant entry costs, exactly because specificity is an effective enforcment device for icomplete relationship in those markets. A trade-off thus emerges between assuring, through specific investments, an enforcement safeguard to investors vulnerable to counterpart's hold-up and the subsequent market monopolization which would occur, when entry costs are relevant.

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