# Entry Decisions and the Governance Form of Strategic Alliances

by

Stefano Comino

Submitted to the Departament d'Economia i d'Historia Economica
in partial ful...llment of the requirements for the degree of

Ph.D in Economic Analysis

at the

UNIVERSITAT AUTONOMA DE BARCELONA

degreemonth unde...ned 2001

© Universitat Autonoma de Barcelona 2001

Signature of Author .....
Departament d'Economia i d'Historia Economica
July 23, 2001

Certi...ed by .....
David Pérez-Castrillo
Director, Sound and Furry Laboratory
Research Head

Accepted by .....
kk
¤f

Entry Decisions and the Governance Form of Strategic Alliances

by

Stefano Comino

Submitted to the Departament d'Economia i d'Historia Economica
on July 23, 2001, in partial ful...llment of the
requirements for the degree of
Ph.D in Economic Analysis

## Abstract

Replace with the thesis abstract

Research Head: David Pérez-Castrillo
Title: Director, Sound and Furry Laboratory

# Chapter 1

# Introduction

This thesis is composed of two distinct parts. In the …rst one (chapter 2), I present an extension of an entry model "à la Dixit". I consider a setting in which the investment decisions of the …rst mover might reveal information to a second entrant. In this context, I characterize the …rst mover's strategic behavior.

In the second part (chapters 3,4,5,6), I consider the issue of the governance form of strategic alliances. That is, I study the way in which …rms organize their cooperative arrangements. In chapter 3, there is a brief introduction to the topic. In chapters 4 and 5, I present two theoretical models. In the …rst one, I employ an incomplete contracts setting and I analyze the role of learning the partner's know-how on the performances of two typical modes of organizing strategic alliances, namely Joint Ventures and Contractual Agreements. The model of chapter 5 combines the tools and methods of two strands of economic literature: investment under uncertainty and search theory. The main objective of the model is that of relating the form of governance that partners choose for their alliance to the typology of the project undertaken and to the characteristics of the sector in which the alliance takes place. The last chapter is devoted to an empirical assessment of the topic. I test some of the predictions that can be derived from the models of chapters 4 and 5 as well as those that have been put forward by other theoretical studies dealing with the same issue.

# Chapter 2

# Entry and Preemption When the Competitor Can Wait and See[1]

## 2.1 Introduction

Market entry is a decision that typically involves uncertainty. Variables in question might be production costs, demand conditions, the suitability of the supplied products to the consumers' tastes or the level of competition that a …rm is going to experience. One strategy that a …rm can use is to enter in a sequential way. It can start with a small scale and then increase it if market conditions have been favorable. However, this behavior might reveal information. Observing that a …rm is increasing the size of its investment, other companies can infer that markets are pro…table and, therefore, they can follow the …rst entrant. That is, a sequential entry pattern might induce other …rms to follow the leader.

In this chapter, I introduce these features in a simpli…ed version of an entry model "à la Dixit" (1980). Two …rms (a …st and a second movers) decide about entry into two markets of unknown but correlated pro…tability. The two …rms have common priors about the state of the markets. The …rst mover can enter both markets at the same time or sequentially, that is, it enters the …rst, observes the state of the markets and it conditions entry in the second

[1]This paper has bene…tted from the helpful suggestions and remarks of David Pérez-Castrillo, Inés Macho-Stadler, Pierre Regibeau and Konrad Stahl.

upon this new information. However, this latter choice reveals information to the competitor. Choosing a wait and see strategy, the second entrant observes whether the …rst mover enters the second market and therefore it infers the market conditions.

The explicit consideration that the …rst mover's behavior might reveal information to the competitor is the novel aspect of my analysis. Indeed, the literature about entry usually extends the two-periods two-…rms Dixit model to allow for uncertainty but not for learning among …rms.[2] In Somma (1999) and Brander and Spencer (1992), uncertainty resolves as time goes by. That is, it is assumed that between the …rst and the second period both …rms learn the market conditions. In McGahan (1993), uncertainty is resolved just after …rms have invested. This author compares the equilibrium under two regimes. In the …rst, both …rms learn the market conditions as soon as the …rst mover invests. In the second, it is only the investing …rm that learns the state of demand. In this chapter, in a sense, I endogenize these two regimes. The …rst mover decides whether to enter sequentially, revealing information to the competitor, or to enter both markets at the same time to avoid any information disclosure.

Inferring information by observing the behavior of informed agents is an issue that has been extensively addressed within contexts di¤erent from entry or investment decisions.[3] Typically, these models consider scenarios in which the link among agents is purely informational. That is, each agent can learn valuable information by observing the behavior of the other players, but her pay-o¤ does not depend on their actual choices. Each player would prefer the others to move …rst in order to learn their private information, but once she decides to move, she will not act in a strategic way since her pay-o¤ does not depend on what the others will do. However, when uncertainty is related to variables that are speci…c to the …rm's business, it is only the observation of the behavior of companies belonging to the same industry that is relevant to acquire information. In this case, the assumption that the …rm's pay-o¤ is una¤ected by what the other companies do is no longer acceptable.

Another strand of literature to which my paper is related is the so-called market experimentation.[4] In these studies, competing …rms, in order to improve their information about an

[2] Maggi (1996) considers a framework where the …rst and the second movers are endogenously determined. However, he assumes that uncertainty resolves exogenously between the …rst and the second period.

[3] See, among others, Chamley and Gale (1994), Gul and Lundholm (1995).

[4] See Harrington (1995) and Mirman et al. (1994).

unknown variable, distort their choices from the ones that maximize the short-run pro…ts. The main di¤erence with my model relies on the nature of information. While I consider it as being privately acquired, in the market experimentation literature information is public so that …rms are always symmetrically informed.

As a reference, in section 3, I characterize the equilibrium of the game in a benchmark in which the link among agents is purely informational. The second entrant can learn the state of markets by observing the …rst mover's behavior. However, the pay-o¤ of each …rm does not depend on the other's choices; that is, …rms are not rivals. In this context, there is no role for strategic behavior and …rms face a simple trade-o¤ between higher potential pro…tability (enter both markets as soon as possible) and additional information (enter markets sequentially or play a wait and see strategy to observe the …rst mover's behavior before acting).

In section 4, I analyze what changes when …rms are rivals. In particular, by comparing the equilibrium outcome with the one obtained in the benchmark, I focus on the strategic behavior of the …rst mover. This …rm tries to preempt or to postpone the entry of the competitor and it knows that entering markets sequentially it reveals information, while entering them at the same time it does not. When the priors are such that …rms believe that markets are likely to be pro…table, then the …rst mover has no chance to preempt the competitor. In this case, the best it can do is to enter markets sequentially, reveal information trying to delay the competitor's entry. Indeed, when information is going to be revealed, the second mover plays the wait and see strategy and, therefore, di¤ers entry in any market until it has observed the complete entry pattern of the …rst mover. On the contrary, when the priors are such that …rms believe that markets are likely to be unpro…table, the …rst entrant strategically chooses to enter both markets at the same time, reveal no information and preempt the competitor.

In section 5, I brie‡y consider the case of complementarities. That is, the case in which revenues are higher when both …rms are simultaneously present in the same market. This time, the …rst mover's aim is to encourage the other …rm to enter as soon as possible. I …nd that the …rst mover might strategically choose to enter both markets at the same time rather than enter them sequentially. Indeed, this last strategy might induce the second …rm to play wait and see and thus to postpone entry.

The model I present is better suited to scenarios in which …rms are deciding about entry into

"new" and yet unknown markets. Indeed, the assumption that …rms have the same priors about markets pro…tability seems to be more likely to be met in these circumstances. However, this observation poses the question of whether in such cases it is sensible to assume a structure with exogenous …rst and second movers. In section 6, I tackle this issue considering an extension of the model. The question I address is when a …rst-second mover structure arises as an equilibrium outcome. That is, if both …rms were free to move from the very beginning of the game, when would it happen that one …rm enters as …rst and, some time later, the other follows? I …nd that the results crucially depend on the level of competition among …rms and on the prior probabilities. However, interestingly enough, when priors are su¢ciently good and competition not too harsh, then, with respect to the benchmark, the fact that …rms are rivals increases the likelihood that a …st-second mover structure arises in equilibrium.

## 2.2 The Model

I consider two …rms (…rm A and …rm B) that are deciding about entry into two markets. The investment required is I for each of the two sites. This is paid at the entry time and it is irreversible. Consumers' tastes are uncertain but perfectly correlated between markets. Before entering, …rms expect their products to suit the consumers' tastes, $s = 1$ in both markets, with probability p and not to, $s = 0$, with complementary probability $(1 ¡ p)$: At each period, if a …rm is the only one active in the market it collects monopoly revenues. These are normalized to $s(1 ¡ ±)$; where $± 2 (0; 1)$ is the discount factor. When both …rms are simultaneously active in the same market, then competition reduces the revenues that each …rm collects. The per-period duopoly pro…ts that a …rm obtains in a market are $s((1 ¡ ±) ¡ r)$; where $r ¸ 0$ is a reduced form for the e¤ects of competition.[5]

I assume that once entered a market a …rm stays active forever.[6] The present value of the ‡ow of revenues that it collects from the period of entry on is s in case of monopoly and it

[5] The form $r ¸ 0$ encompasses any kind of rivalry between the two …rms from Bertrand competition in homogeneous goods $(r = 1 ¡ ±)$ to the case of independent products $(r = 0)$.

[6] This assumption might seem extreme when $s = 0$: Indeed, in this case, a …rm does not earn any revenue but still it stays active in the market. However, one should think to $s = 0$ just as a simplifying assumption. When the product does not suit the consumers' tastes, then revenues are low. Therefore, no …rm would pay I to enter a market, but once the investment is sunk is optimal no to exit.

is $s(1 - R)$ in the duopoly case, where $R = \frac{r}{1+r}$. In expected terms these are $p$ and $p(1 - R)$ respectively.

Clearly, when $s = 0$ entry in a market is not profitable: the investment $I$ has to be paid and no revenues will be earned. On the contrary, I assume that when $s = 1$, entry is profitable regardless of whether the other firm enters or not that market. In other words, in this case, the flow of revenues that a firm earns from the period of entry on is always sufficient to cover $I$. That is:

$$1 - R \geq I. \tag{2.1}$$

For future reference, I define $\overline{R} \equiv 1 - I$ so that condition (2.1) can be re-written as $R \leq \overline{R}$. I assume that (2.1) holds throughout the whole paper.

Firms just choose their entry patterns. Firm A moves in periods $t = 1, 2$, while B moves in periods $t = 2, 3$. Firm A can locate in the two markets at $t = 1$ and with the only knowledge of the priors, $p$ and $(1 - p)$. Alternatively, A can enter markets in sequence and take advantage of the correlation of consumers' tastes. In this case, at $t = 1$, it locates in one market, observes $s$ and, the next period, it conditions entry in the second upon this new information. The last option is to enter no market at all.[7]

Formally, the same choices are available to B. However, this firm can also take advantage of the information that A's behavior reveals. When, at $t = 1$, firm A has entered only one market, then, at $t = 2$, it decides whether to locate in the second having perfect knowledge of $s$. Choosing to enter no market at $t = 2$, B observes A's choice and it infers information about $s$. In this case, I say that firm B chooses to wait and see. The advantage of this strategy is that firm B will decide about entry with a better knowledge about markets' profitability. The disadvantage is that entry in any site is postponed till $t = 3$.

[7] Waiting for one period and then entering one or two markets is a dominated strategy for firm A.

## 2.3 The Benchmark: Independent Firms

I consider a non-strategic framework in which …rms' pay-o¤ are independent; that is, I consider the case in which $r = 0$: Still, I assume $s$ to be the same for the two …rms, so that B can infer the market conditions when A enters markets in a sequential way.

In this setting, …rms face a trade-o¤ between higher potential pro…tability and additional information. Entering the two markets as soon as it can, a …rm collects revenues from the very beginning but it locates in both markets with the only knowledge of priors. The expected pay-o¤ associated with this strategy is $2(p - I)$: Choosing a sequential entry pattern, a …rm enters just one market and, the next period, it will enter the second if and only if it observes $s = 1$: When choosing this strategy a …rm expects a pay-o¤ $p - I + \pm p(1 - I)$: Finally, for …rm B, when A has located in one market and, therefore, it is going to reveal the true state of $s$ at $t = 2$, then by choosing to wait and see it postpones to collect revenues in both markets but it decides about entry with perfect knowledge about $s$: The expected pay-o¤ associated with the strategy wait and see is $2\pm p(1 - I)$:

Next proposition characterizes the equilibrium of the game for the case under analysis:

Proposition 1 When $r = 0$ , then:

(i) A enters both markets at $t = 1$ and B enters both markets at $t = 2$ if $p \geq p^{both}_{r=0}$;

(ii) A enters markets sequentially and B chooses to wait and see if $p \in \left[p^{pre}_{r=0}; p^{both}_{r=0}\right)$;

(iii) no entry takes place if $p < p^{pre}_{r=0}$.

The above proposition shows that when markets are likely to be pro…table (case i)), …rms enter them as soon as they can. For intermediate values of $p$ (case ii)) they prefer to collect information. Firm A chooses a sequential pattern, while …rm B chooses to wait and see. When the priors are so low that negative pro…ts are expected (case iii)), then no …rm enters any market.

The bounds $p^{both}_{r=0}$ and $p^{pre}_{r=0}$ in the statement of proposition 1 as well as all the other bounds for $p$ that I will use later are de…ned in the appendix.[8]

[8] The superscripts both; pre refer to the rivalry case. When $p > p^{both}$; …rm B prefers to enter both markets as soon as it can and independently of A's choices. When $p < p^{pre}$; then …rm B is preempted when …rm …rm A enters the two markets at the same time.

## 2.4 Rival Firms

Under rivalry ($r > 0$), …rm A prefers …rm B not to enter or to postpone entry in the markets. Consequently, when taking its decisions, …rm A has incentives to behave in a strategic way.

I start the analysis of the case in which $r > 0$ by characterizing the equilibrium of the signaling game that takes place at $t = 2$ once A has entered one market:

### 2.4.1 The Signaling Game played at $t = 2$

Entering one market at $t = 1$; …rm A has observed the true state of consumers' tastes. When $s = 0$; it is a dominant strategy not to enter the remaining market. When $s = 1$; then A trades o¤ two e¤ects. From condition (2.1), entry in the second market is per se pro…table. However, this choice has also the e¤ect of revealing that $s = 1$ and, therefore, of attracting the competitor in the markets when the latter chooses to wait and see. The optimal choice depends on the level of rivalry. As I check in the appendix, there is a cut-o¤ value, $R^{harsh}$: [9] If $R \cdot R^{harsh}$; then the bene…ts entering the second market are greater than the costs due to the increase in rivalry. On the contrary, when $R > R^{harsh}$, the competition e¤ect is dominant.

I will say that rivalry is harsh when $R > R^{harsh}$; otherwise I will say that rivalry is not harsh. Next two lemmas characterize the equilibrium of the signaling game for these two cases. Given that it is dominant not to enter the second market when $s = 0$; I only characterize A's choices when $s = 1$. Moreover, I de…ne the equilibrium of signaling game as separating, semi-separating or pooling depending on whether A enters, randomizes or does not enter the second market once it has observed $s = 1$:

Lemma 1 When $R \cdot R^{harsh}$, then the Bayesian equilibrium of the signaling game played at $t = 2$ once A has entered the …rst market is separating. In equilibrium, if $s = 1$ A enters the second market; while B enters both markets at $t = 2$ if $p \geq p^{both}$ and it chooses to wait and see if $p < p^{both}$: When waiting, …rm B updates its beliefs in this way: if A has entered the second market, then B believes that $s = 1$ with probability 1; if A has not entered the second market, then B believes that $s = 0$ with probability 1:

[9] The cut-o¤ value $R^{harsh}$ as well as all the other bounds for R that I will use later are de…ned in the Appendix.

When competition is not harsh, …rm A always separates thus revealing the true state of s: When priors are high $[p \geq p^{both}]$; then B enters both markets as soon as it can. When priors are lower $[p < p^{both}]$; then B prefers to wait and see and take advantage of the information that A's behavior reveals.

The equilibrium in the case of harsh competition is characterized by the following lemma:

Lemma 2 When $R > R^{harsh}$, then the Bayesian equilibrium of the signaling game played at t = 2 once A has entered the …rst market:

(i) is separating if $p \geq p^{both}(R)$: In equilibrium, if s = 1 A enters the second market, while B enters both markets at t = 2;

(ii) is semi-separating if $p \in [p^{pool}; p^{both})$: In equilibrium, if s = 1 A enters the second market with probability $y^{\alpha}$ and does not with probability $(1 - y^{\alpha})$: Firm B enters the second market with probability $x^{\alpha}$ and does not enter any market with probability $(1 - x^{\alpha})$;

(iii) is pooling if $p < p^{pool}$: In equilibrium, A does not enter the second market and B does not enter any market:

When, at t = 2; it does not enter any market; …rm B updates its beliefs in this way: if A has entered the second market, then B believes that s = 1 with probability 1; if A has not entered the second market, then B believes that s = 1 with probability 0 if $p \geq p^{both}$, with probability $\frac{(1-y^{\alpha})p}{(1-y^{\alpha})p+(1-p)}$ when $p \in [p^{pool}; p^{both})$ and with probability p when $p < p^{pool}$: Where $y^{\alpha} = \frac{p^{both}}{p}\,\frac{p - p^{pool}}{p^{both} - p^{pool}}$, $x^{\alpha} = \frac{1+2\pi-R}{R(2\pi-1)}$:

When rivalry is harsh, B's entry is particularly harmful. Firm A is willing to forgo the pro…ts available in the second market and, therefore, to play a pooling strategy according to which it does not enter the second market independently of the observed s; if this choice preempts B's entry. This happens when priors are su¢ciently low: $p < p^{pool}$: On the contrary, when priors are high $(p \geq p^{both})$, …rm B enters both markets as soon as it can, the decision of A has no in‡uence on B's actions, so that the best A can do is to locate in the second market if s = 1: For intermediate values of priors, $p \in [p^{pool}; p^{both})$; the equilibrium is in mixed strategies. Firm A randomizes between entering or not entering the second market, while B randomizes between

entering one market or not:[10] The probabilities according to which A and B randomize satisfy another condition. If the result of the randomization is that no …rm enters any market at t = 2, then the beliefs of …rm B are so worsened that, the next period, it will choose not to enter any market: That is, B is preempted.

Simple di¤erentiation leads to the following result.

Lemma 3 The probability according to which B chooses not to enter any market in the semi-separating equilibrium of the signaling game, $(1 - x^{\alpha})$, is a decreasing function of the level of rivalry, r:

In the semi-separating equilibrium, …rm A is indi¤erent between entering the second market or not. The latter choice is valuable since with probability $(1 - x^{\alpha})$ it preempts B. Clearly, the stronger the e¤ect of rivalry (the higher r), the greater the advantage of preempting the competitor and then the greater the advantage of choosing not to enter the second market. Therefore, to keep …rm A indi¤erent between entering and not in the second market a decrease in $(1 - x^{\alpha})$ has to be associated with an increase in r.

### 2.4.2 The Results

Unfortunately, determining the equilibrium of the game turns out to be particularly cumbersome. Several cases should be considered to completely characterize the optimal choices of …rms A and B. These cases do not signi…cantly di¤er from each other. In what follows I just present two of them (one for the non-harsh and one for of harsh rivalry cases) and I focus on the strategic behavior of …rm A.[11] I say that A behaves strategically when its entry pattern di¤ers from the one it chooses in the benchmark for the same values of the priors.

In case of rivalry the strategic aim of …rm A is that of preempting or postponing entry of its competitor. Preemption is possible only in the case priors are low enough: $p < p^{pre}$: In this case, entering the two markets at the same time, …rm A does not reveal any information and

[10] Note that the mixed strategy equilibrium "approaches" the pure strategy ones. That is, when $p = p^{pool}$ then $y^{\alpha}$ is equal to 0 so that A chooses not to enter the second market with probability 1: When $p = p^{both}$; then $y^{\alpha}$ is equal to 1 and so A chooses to enter the second market with probability 1:

[11] The results and proofs for the cases I omit in this version of the paper are available upon request.

this choice induces …rm B to stay out from any market. When priors are larger that $p^{pre}$; this kind of strategic behavior is not possible. As I check, in this case, the typology of strategic actions chosen by …rm A depends on the equilibrium of the signaling game.

### Rivalry is not harsh: $R \cdot R^{harsh}$

In this subsection, I characterize the equilibrium choices of …rm A and …rm B for the case in which $R \in \left[R^c; \min\left\{R^{harsh}; R^d\right\}\right)$.[12]

**Proposition 2** When $R \in \left[R^c; \min\left\{R^{harsh}; R^d\right\}\right)$, then:

(i) A enters both markets at t = 1 and B enters both markets at t = 2 if $p \geq p^{both}$;

(ii) A enters both markets at t = 1 and B enters markets sequentially if $p \in \left[p^d; p^{both}\right)$;

(iii) A enters markets sequentially and B chooses to wait and see if $p \in \left[p^{pre}; p^d\right)$;

(iv) A enters both markets at t = 1and B does not enter any market if $p \in [p^e; p^{pre})$;

(v) A enters markets sequentially and B chooses to wait and see if $p \in \left[p^f; p^e\right)$;

(vi) A does not enter any market and B enters markets sequentially if $p \in \left[p^{pre}_{r=0}; p^f\right)$;

(vii) no entry takes place if $p < p^{pre}_{r=0}$.

As it was the case in the benchmark, …rms face a trade-o¤ between higher potential profitability and additional information. When priors are high, …rms enter markets as soon as they can. As the probability that s = 1 decreases, then …rms try to collect additional information before entering.

### Firm A's Strategic Behavior

When priors are high, $p \geq p^{both}$, there is no room for strategic behavior. Firm B enters both markets at t = 2 and this independently of A's choices. For intermediate values of p,

[12] To characterize the equilibrium of the game when $R \in \left[R^{harsh}; \min\left\{R^c; R^d\right\}\right)$, I should consider four cases: $R \in \left[R^{harsh}; R^c\right)$; $R \in \left[R^c; \min\left\{R^{harsh}; R^d\right\}\right)$; $R \in \left[R^d; \min\left\{R^{harsh}; R^f\right\}\right)$ or $R \in \left[R^f; R^{harsh}\right)$: The relation among $R^{harsh}$; $R^d$ and $R^f$ is not established a priori. E.g. when $\pm < \left(\frac{1}{3}; \frac{1}{2}\right)$; then $R^c \cdot R^d \cdot R^f$ so that the third of the four cases is not de…ned.

$p \in [p^{pre}; p^{both})$, …rm A is able to in‡uence B's behavior. Entering the two markets at the same time, A reveals no information and induces B to enter markets in a sequential way, starting at $t = 2$: On the contrary, when entering just one market, …rm A is implicitly "promising" B to reveal the true state of s: Indeed, when $R \cdot R^{harsh}$; the equilibrium of the signaling game is always separating. In this case, the optimal response of B is to wait and see and then to decide about entry in both markets only at time $t = 3$: Therefore, by choosing a sequential entry pattern, …rm A is able to delay the competitor's entry. This implies that there is a strategic incentive to choose this entry pattern. In the appendix I check that for intermediate values of the priors, …rm A prefers to enter markets sequentially rather than both at the same time for any $p < p^d$:

A comparison with the benchmark leads to the following result.

Corollary 1 When $R \in [R^c; \min\{R^{harsh}; R^d\})$, then for any $p \in [p^{both}_{r=0}; p^d)$ …rm A enters markets sequentially for strategic reasons. The interval where the strategic behavior takes place enlarges as the level of rivalry, r; increases.

Corollary 1 points out the interval of priors for which this strategic behavior arises. That is, …rm A enters both markets at the same time in the benchmark, while it chooses a sequential pattern in case of rivalry. Clearly, the higher r, the more pro…table is to act strategically and, consistently, the larger the set of priors for which this behavior arises. This result can be easily checked observing that $p^d$ is increasing in r: A direct implication of the corollary above is captured in the following remark:

Remark 1 For any $p \in [p^{both}_{r=0}; p^d)$; …rm A reveals the true s under rivalry, while it does not reveal any information in the benchmark.

In other words, under the previous conditions, rivalry among …rms increases the cases where there is revelation of information.

When priors are low, $p < p^{pre}$, …rm A is able to preempt its competitor by entering the two markets at $t = 1$: On the contrary, by condition (2.1), a sequential entry pattern is never preemptive when the equilibrium of the signaling game is separating. This time, strategic reasons induce …rm A to enter the two markets at $t = 1$. In the appendix I check that A prefers

this strategy whenever $p \geq p^e$: Firm A's strategic behavior when priors are low is summarized in the corollary below:

Corollary 2 When $R \in \left[R^c; \min\left\{R^{harsh}; R^d\right\}\right)$, then for any $p \in [p^e; p^{pre})$ firm A enters both markets at $t = 1$ for strategic reasons. The interval where the strategic behavior takes place enlarges as the level of rivalry, $r$, increases.

When $p \in [p^e; p^{pre})$, under rivalry, firm A enters both markets at $t = 1$ while, in the benchmark, it enters them sequentially. As said this change is due to strategic motives. Moreover, as $r$ increases, the interval where the strategic behavior arises enlarges. This happens because of two reasons. On the one hand, as competition becomes stronger it is more advantageous to preempt B; that is, $p^e$ decreases in $r$. On the other hand, the stronger the effects of competition, the larger the set of priors for which B is preempted; that is, $p^{pre}$ increases in $r$.

Rivalry is harsh: $R > R^{harsh}$

Even when $R > R^{harsh}$, the complete characterization of the equilibrium requires distinguishing among several cases.[13] Here, I present just one of them. The results for the other cases are similar.

Proposition 3 When $R \in \left[\max\left\{R^{harsh}; R^d\right\}; R^e\right]$, then:

(i) A enters both markets at $t = 1$ and B enters both markets at $t = 2$ if $p \geq p^{both}$;

(ii) A enters both markets at $t = 1$ and B enters markets sequentially if $p \in \left[p^h; p^{both}\right]$;

(iii) A enters one market at $t = 1$ and, at $t = 2$, the semi-separating equilibrium of the signaling game is played if $p \in \left[p^{pre}; p^h\right]$;

(iv) A enters both markets at $t = 1$ and B does not enter any market if $p \in [p^g; p^{pre})$;

(v) A does not enter any market and B enters markets sequentially if $p \in \left[p^{pre}_{r=0}; p^g\right)$;

(vi) no entry takes place if $p < p^{pre}_{r=0}$.

[13] Three cases should be considered: $R \in \left[R^{harsh}; R^d\right]$; $R \in \left[\max\left\{R^{harsh}; R^d\right\}; R^e\right]$ and $R > \max\left\{R^{harsh}; R^e\right\}$.

When competition is harsh, …rm A chooses to enter one market at t = 1 only for limited range of priors. In other words, when $R > R^{harsh}$, A tends either to locate into both markets at the same time or to enter no market at all. Recalling the analysis done in lemma 2, we know that after locating into the …rst market …rm A does not always enter the second even once s = 1 has been observed. When $p < p^{both}$; the equilibrium of the signaling game is either semi-separating or pooling. This means that, in an attempt of preempting the competitor, …rm A does not take advantage of the information that it has collected. For this reason, locating in one market at t = 1 tends to be non-optimal.

### Firm A's Strategic Behavior

Similarly to the previous case, …rm A is able to in‡uence B's behavior and, therefore, it can act strategically only when priors are intermediate or low. However, when $p \in [p^{pre}; p^{both}]$; the reasons that induce …rm A to behave strategically are di¤erent from above. Entering just one market at t = 1 and playing the semi-separating equilibrium of the signaling game[14] is the only chance to preempt the competitor. Indeed, as pointed out in lemma 2, if the result of the randomization is such that no …rm enters any market at t = 2; then B's beliefs are so worsened that it does not enter any market at t = 3 neither. In the appendix I check that given B's responses, A prefers to enter one market rather than both for any $p < p^h$:

A comparison with proposition 1 leads to the following result:

Corollary 3 When $R \in \left[\max\{R^{harsh}; R^d\}; R^e\right]$, then for any $p \in [p^{pre}; p^h]$ …rm A enters only one market at t = 1 for strategic reasons. The interval where the strategic behavior takes place shrinks as the level of rivalry, r; increases.

Corollary 3 highlights the range of priors for which this strategic behavior arises. In particular, for any $p \in [p^{pre}; p^h]$; …rm A enters one market at t = 1 under rivalry and both markets in the benchmark. However, this range shrinks as r increases. This last result is due to two e¤ects. On the one hand, as pointed out in lemma 3, as r increases the probability that B enters no market at t = 2, $(1 - x^*)$; and, then, the probability of preempting B decreases. That is,

[14] In the appendix I check that $p^{pool} < p^{pre}$ and then for any $p \in [p^{pre}; p^{both}]$; the equilibrium of the signaling game is the semi-separating.

the stronger the degree of competition the less likely that entering one market at t = 1 leads to the preemption of the competitor and, therefore, the less advantageous for A to play this strategy. This result, is re‡ected in the fact that $p^h$ is decreasing in r. On the other hand, an increase in the level of rivalry enlarges the set of priors for which entering both markets at t = 1 preempts B. That is, an increase in r increases $p^{pre}$: As I argue below, when entry in both markets is preemptive, then entering one market at t = 1 is a dominated choice.

For the case of low priors ($p < p^{pre}$) I obtain a result similar to corollary 2. Firm A, in order to preempt the competitor, chooses to locate in both markets at t = 1 more often under rivalry than in the benchmark.

Corollary 4 When $R \geq \max\{R^{harsh}; R^d; R^e\}$, then for any $p \in [p^g; p^{both}_{r=0}]$ …rm A chooses to enter both markets at t = 1 for strategic reasons. The interval where the strategic behavior takes place does not depend on the level of rivalry, r:

Di¤erently from corollary 2, this time, the interval where the strategic behavior arises does not depend on r: The reason for this result is that the choice of entering one market at t = 1 is dominated.[15] Indeed, in the semi-separating equilibrium that follows it is optimal for …rm A not to take advantage of the information that it has learned.[16] That is, it is optimal not to enter the second market even if s = 1: Therefore, when the expected revenues are larger then the investment costs, p ¡ I > 0; the optimal entry pattern is to enter both markets at t = 1; in this way …rm A collects pro…ts from both markets rather than from just one. When p ¡ I < 0; any entry mode assures a negative expected pay-o¤ so that …rm A is better-o¤ entering no market at all. The pay-o¤s of entering the two markets at t = 1 or not to enter any market do not depend on r, then neither the set where A behaves strategically does.

[15] In the case analyzed in corollary 3, when $p \in [p^{pre}; p^{both}]$, entering one market is not a dominated strategy. Indeed, doing so and then playing the semi-separating equilibrium of the signaling game is the only way to preempt B with positive probability.

[16] In the appendix I check that $p^{pool} < p^g < p^{both}_{r=0}$; therefore for $p \in [p^g; p^{pool}_{r=0}]$ the semi-separating is the equilibrium of the signaling game. In this equilibrium, …rm A once it has observed s = 1 is indi¤erent between entering and not the second market. This means that, independently to the observed s; it is optimal to stay out from the second market.

## 2.5 Complementarities

To complete the analysis of the …rst mover's strategic behavior, it is worth considering the case in which $r < 0$; that is, the case in which there are complementarities between the two …rms. Various are the scenarios in which this condition is likely to be met. For instance, if the goods that the two …rms sell are perceived as complements, then their simultaneous presence in the market increases the willingness to pay of the consumers. Another case could be that of two …rms that are vertically related with one of them being the supplier of the other.

I do not characterize the equilibrium of the game for this case. Indeed, this would require particularly cumbersome calculations. The reason is that, contrarily to the previous frameworks, under complementarities, choosing to enter both markets at $t = 2$ is not a dominated strategy for …rm A. Given that entering both markets either at $t = 1$ or at $t = 2$ induces the same response by …rm B, then, both in the benchmark and rivalry cases, the former choice is preferred to the second or, if not, then they both assure a negative pay-o¤. One can check that this does not occur in the case of complementarities. Indeed, when $r < 0$; …rm A gets low pro…ts in the early periods when it is the only active …rm in the markets.

With complementarities., the aim of the …rst mover is to induce B to enter as soon as possible. Choosing a sequential entry pattern,[17] …rm A might encourage B to wait and see and then to postpone entry. Entering the two markets at the same time, A induces B to starting entering at $t = 2$: Therefore, strategic reasons might induce the …rst mover to enter both markets at the same time thus not revealing any information to B. In the appendix, I provide an example in which this happens. That is, in the example, …rm A chooses to enter both markets at time $t = 2$ only because of strategic reasons; if its behavior were not to a¤ect B's choices, then A would prefer to enter markets sequentially: In the example, parameter R is su¢ciently negative (i.e. the level of complementarities is su¢ciently high) that inducing …rm B to enter earlier is particularly valuable.

The choice of entering both markets at the same time rather than sequentially is the only case in which, when $r < 0$, the strategic behavior of …rm A might arise. Indeed, the other two ways of strategically inducing …rm B to enter do not play any role in equilibrium. First,

[17] Once entered the …rst market, …rm A enters also the second i¤ $s = 1$:

…rm A attracts B by being present in both markets, thus assuring it an extra ¡sr per period. However, independently of the entry pattern, by time t = 2; that is, by the time in which B moves, …rm A is located in both markets in the relevant case; that is, when s = 1: Second, when priors are so low that B expects a negative pay-o¤, …rm A could induce it to enter by choosing a sequential pattern and then revealing that s = 1: However, when r < 0, it is the …rst mover's non-negativity constraint which is binding. That is, if ignoring the true value of s, …rm B expects a negative pay-o¤, then …rm A, when deciding about entry, anticipates a negative pay-o¤ too. Therefore, neither …rm A enters.

## 2.6 Extensions: Endogenous First and Second Movers

In the analysis made so far, I have employed the standard assumption of the entry models "à la Dixit": there are an exogenous …rst and second movers. One might question whether this structure arises as an equilibrium outcome. That is, if both …rms can move from the beginning of the game, when will it happen that, in equilibrium, one …rm enters as …rst and, some time later, the other follows?

Allowing both …rms to move at any $t = 1; 2::: 1$; it is possible to address this question within the model presented in the previous sections.

In this setting, the only rationale to postpone entry and to be the endogenous second mover arises when the other …rm chooses an entry pattern that reveals the true state of the markets. This means that a …rst-second mover structure arises only when one …rm enters markets sequentially and the other chooses to wait and see.

Before starting the analysis, some remarks are in order. First, the identity of the …rst and of the second mover is not determined That is, it is only possible to …nd conditions that assure that one …rm enters as …rst and the other as second. As a convention, I consider …rm A as being the …rst entrant. Second, the expected pay-o¤ of each …rm depends on its information about s and on the markets already entered by the two …rms, but it is independent of the time index, t. Thus, I concentrate the analysis on Markov perfect equilibria in which the strategies of each …rm are not conditional on t. Third, when …rm A has entered the …rst market and …rm B the second, two equilibria might follow. In the …rst, "non-collusive", equilibrium, whenever s = 1

each …rm enters the other market too. This equilibrium exists for any values of the parameters. The second possible equilibrium is a "collusive" one. When $s = 1$; …rm A (B) does not enter the second (…rst) market unless B (A) enters the …rst (second). One can check that this equilibrium exists only for a limited range of the parameters.[18] In the analysis that follows, I assume that when each …rm has entered one market, then they always play the "non-collusive" equilibrium. Finally, in what follows, I do not solve for the equilibrium of the whole game but I just check when a structure with a …rst and a second movers arises.

### 2.6.1 The Benchmark: Independent Firms

In the benchmark, the next result holds:

**Proposition 4** When A and B can play at any $t = 1; 2::: 1$; then when $r = 0$; a …rst-second mover structure arises in equilibrium for any $p \in \left[p^{pre}_{r=0}; p^{I}_{r=0}\right)$:

When …rm B chooses to wait and see, A faces the same scenario as in proposition 1. Therefore, analogously, it enters markets sequentially for any $p \in \left[p^{pre}(R = 0); p^{both}(R = 0)\right)$: The set of priors for which B is willing to play wait and see, $p < p^{I}_{r=0}$; is smaller than that of proposition 1, i.e. $p^{I}_{r=0} \cdot p^{both}_{r=0}$. Indeed, in this setting this strategy requires to wait for two periods and not just for one before learning the true value of s:

### 2.6.2 Rival Firms

#### Rivalry is not harsh $R \cdot R^{harsh}$

The analysis of section 4 is largely applicable to this case. In particular, the equilibrium of the signaling game is unchanged.

When prior probabilities about markets pro…tability are at an intermediate level, $p \in \left(p^{pre}; p^{both}\right)$; then the following result holds:[19]

[18] In the model of section 2, the "collusive" equilibrium does not arise. Indeed, B always enters the …rst market as soon as $s = 1$:

[19] For high values of priors the two …rms enter the both markets at $t = 1$:

Proposition 5 When A and B can play at any $t = 1; 2::: 1$, then when $R \cdot R^{harsh}$ for intermediate values of p; $p \; 2 \; \pounds p^{pre}; p^{both} ¢$; the set of priors for which a …rst-second mover structure arises in equilibrium is larger in the case of rivalry than in the benchmark.

Proposition 5 provides an interesting prediction. When rivalry is not harsh and priors are at an intermediate level, then it is more likely to observe the emergence of a market structure with a …rst and a second movers when there is rivalry. The intuition for this result is the following. The emergence of this structure requires two conditions: one …rm enters markets sequentially and the other chooses wait and see. As proved in section 4, when priors are intermediate, the …rst entrant is more willing to choose a sequential entry pattern under rivalry; in this way, it postpones the competitor's entry. Therefore, strategic reasons favor the appearance of a structure with a …rst and a second movers. Moreover, the opportunity cost of being an endogenous second mover is represented by the pro…ts that this …rm forgoes by postponing entry. In the benchmark, a second mover forgoes monopoly pro…ts, while, under rivalry, only duopoly pro…ts. Therefore, it is "less costly" to wait and see under rivalry.

For low values of the priors ($p < p^{pre}$), the e¤ects due to the strategic behavior of the …rst mover and to the lower opportunity cost of waiting, work in opposite direction. Indeed, from section 4, we know that the …rst mover is less willing to enter markets sequentially because in this way it gives up the opportunity of preempting the competitor. This fact is detrimental for the emergence of a structure with a …rst and a second movers.

Proposition 6 When A and B can play at any $t = 1; 2::: 1$, then when $R \cdot R^{harsh}$ for low values of p; $p < p^{pre}$; the set of priors for which a …rst-second mover structure arises in equilibrium is smaller in the case of rivalry than in the benchmark, provided that either $R \; 2 \; \pounds R^{g}; R^{harsh} ¤$ or $R \cdot \min © R^{harsh}; R^{i} ª$: In all the other cases the two sets are not comparable.

According to proposition 6, when p is low, the set of priors for which a …rst-second mover structure arises in equilibrium is larger in the benchmark than under rivalry provided that the lower cost of waiting that characterizes the latter framework plays no role in the comparison. Indeed, one can check in the appendix that conditions $R \; ¸ \; R^{g}$ or $R \cdot R^{i}$ that appear in proposition 6 have the e¤ect of neutralizing the lower cost of waiting. In all the cases that do

not satisfy one of these two conditions the sets where a …rst-second mover structure arises are not comparable.

Rivalry is harsh: $R > R^{harsh}$

When rivalry is harsh, a …rst-second mover structure never emerges as an equilibrium outcome. The formal proof of this statement is not presented in this chapter.[20] On the contrary, in what follows, I o¤er an informal and intuitive argumentation. As said, a structure with a …rst and a second entrants arises when …rm A enters one market, B chooses a wait and see strategy and, in the signaling game, it receives information about s: The equilibrium of the signaling game has the same features as the one characterized in lemma 2. In particular, for high values of the priors, the equilibrium is separating and …rm B enters both markets without waiting for more information: However, in this case, B is better-o¤ entering both markets the previous period rather than waiting. Therefore, for high values of the priors both …rms enter markets enter markets immediately. For low values of the priors, the equilibrium of the signaling game is pooling and …rm B is preempted. Therefore, neither in this case a …rst-second mover structure arises. For intermediate values of p; the signaling game has a semi-separating equilibrium where it is optimal for …rm B to enter one market.[21] However, if this is the case, then B is better-o¤ entering that market the previous period rather than waiting. Therefore, neither for intermediate values of the priors a …rst-second mover structure arises.

## 2.7 Conclusions

In this chapter, I have focused on investment decisions as means of transmitting information. Various are the sources of information from which a …rm can bene…t when deciding about entry in the markets: industry reviews, accounting data, stock market evaluations ... . However, observing that a competitor is increasing the size of its investment is certainly a de…nitive signal of pro…tability. I have introduced these features in a simpli…ed version of an entry model "à la Dixit". In particular, I have considered a …rst and a second mover that have the opportunity to

[20] The formal proof of the result is available from the author upon request.
[21] In the semi-separating equilibrium, B randomizes between entering one market or not.

enter into two markets of unknown but correlated pro…tability. The …rst mover can enter the two markets at the same time and just knowing the prior probabilities about pro…tability, or it can enter them sequentially; that is, enter one market, observe the correlated pro…tability and, the next period, condition entry in the second upon this new information. The second mover has an additional possibility. When the …rst mover enters market sequentially, it can choose a wait and see strategy. It observes whether the …rst mover enters the second market, infers information about the markets conditions and decides about entry with a superior knowledge regarding pro…tability.

In this context, I have characterized the …rst mover strategic behavior in the cases of rivalry and of complementarities. In the former case , I have shown that when priors are such that …rms believe that markets are likely to be pro…table, then the …rst mover cannot preempt the competitor and the best it can do is to enter markets sequentially. This induces the second mover to play wait and see thus postponing entry. On the contrary, when priors are such that markets are likely to be unpro…table, then the …rst mover strategically enters the two markets at the same time, reveals no information attempting to preempt the competitor.

In case of complementarities, that is, in case revenues are larger when both …rms are active in the same market, the aim of the …rst mover is to encourage the other …rm to enter as soon as possible. In this case, the …rst mover might strategically choose to enter both markets at the same time because otherwise it induces the second …rm to wait and see.

In the last section of this chapter, I have analyzed whether a structure with a …rst and a second movers can arise as an equilibrium outcome. That is, if both …rms had the opportunity to play from the very beginning of the game, when would it be that a …rst-second mover structure arises? The answer is shown to crucially depend on the level of competition among …rms and on the prior probabilities about pro…tability. However, interestingly enough, I have shown that when priors are su¢ciently good and competition not too harsh, then, with respect to a benchmark, the fact that …rms are rivals increases the likelihood that a …st-second mover structure arises in equilibrium.

## 2.8 Appendix

List of de…nitions for $R$:

$\overline{R} \equiv 1 - I$;

$R^{harsh} \equiv \frac{(1-I)}{2\pi}$;

$R^{c} \equiv \frac{2\pi(1-I)}{1+\pi+2\pi^2}$;

$R^{d} \equiv \frac{2\pi(1-I)}{1+\pi}$;

$R^{e} \equiv \frac{\pi(1-3\pi)(1-I)}{(1-2\pi-\pi^2)}$;

$R^{f} \equiv \frac{2\pi(1-I)}{1+\pi^2}$;

$R^{g} \equiv \frac{\pi(1-I)}{1-\pi}$;

$R^{i} \equiv \frac{2\pi^2(1-I)}{1+\pi}$:

List of de…nitions for $p$:

$p^{both} \equiv \frac{I}{(1-R)(1-\pi)+\pi I}$;

$p^{pre} \equiv \frac{I}{(1-R)(1+\pi)-\pi I}$;

$p^{pool} = \frac{I}{1+\pi(1-R)-\pi I}$;

$p^{d} \equiv \frac{I}{(1-\pi R)(1-\pi)+\pi I}$;

$p^{e} \equiv \frac{I}{(1-\pi)+2\pi^2 R+\pi I}$;

$p^{f} \equiv \frac{I}{(1+\pi)-2\pi^2 R-\pi I}$;

$p^{g} \equiv I$;

$p^{h} \equiv \frac{I(2\pi-1)}{\pi R(1-\pi)-(1-\pi)^2+\pi^2 I}$;

$p^{i} = \frac{I(1-2\pi)}{(1+\pi R)(1-\pi)-\pi I}$;

$p^{j} = \frac{2I}{2I-R(1+\pi)}$;

$p^{l} = \frac{I}{(1+2\pi(1-R))(1-\pi)+2\pi^2 I-\pi I}$:

Proof of Proposition 1

It follows immediately considering the pay-o¤s de…ned in the text.

Proof of Lemma 1

In equilibrium, …rm B expects $2(p(1-R)-I)$ when entering both markets and $p(1-R)-I+\pi p((1-R)-I)$ when entering one market at $t=2$ and the other at $t=3$ i¤ $s=1$. Playing wait and see, B learns the true $s$ and, at $t=3$; it enters the two markets i¤ $s=1$. The expected pay-o¤ of this last strategy is $2\pi p((1-R)-I)$:

wait and see when A enters sequentially: When A does not locate into any market then B faces the same scenario as in the benchmark and it enters sequentially for any $p \in [p^{pre}_{r=0}; p^{pre})$ and it does not locate into any marker when $p < p^{pre}_{r=0}$: Firm A enters both markets at $t = 1$, pay-o¤ $2(p - I)$, if $p \in [p^e; p^{pre})$; it enters sequentially, pay-o¤ $p\left[(1-\pm) + \pm(1-\pm) + \pm^2(1-R)\right] - I + \pm p((1-\pm) + \pm(1-R) - I)$, if $p \in \left[p^f; p^e\right)$ and it locates into no market, pay-o¤ 0, if $p < p^f$:[25] Recall that $p^{pre}_{r=0} \cdot p^f \cdot p^e \cdot p^{pre}$:Q:E:D

Proof of Corollaries 1 and 2

One can check that

- $p^{both}_{r=0} \cdot p^d$, since $R \geq 0$:

- $p^{pre} \cdot p^{both}_{r=0}$; since $R \cdot R^d$:

Therefore, combining these relations with the ones used in the proof of proposition 5:

$p^{pre}_{r=0} \cdot p^f \cdot p^e \cdot p^{pre} \cdot p^{both}_{r=0} \cdot p^d \cdot p^{both}$:

Propositions 2 and 1 assure that:

- for any $p \in \left[p^{both}_{r=0}; p^d\right)$ …rm A: enters sequentially under rivalry, while it locates into the two markets at $t = 1$ in the benchmark;

- for any $p \in [p^e; p^{pre})$ …rm A: enters the two markets at $t = 1$ under rivalry, while it enters sequentially in the benchmark.Q:E:D:

Proof of Proposition 3

In proposition 3, $R \in \max\left\{R^{harsh}; R^d\right\}; R^e\right)$ and by (2.1) it has to be $R \cdot \overline{R}$: These conditions are simultaneously veri…ed for any $R \in \left(R^{harsh}; R^e\right)$ when $\pm \in \left(\frac{1}{3}; \frac{1}{8} + \frac{1}{8}\sqrt{17}\right)$ and for any $R \in \left(R^d; R^e\right)$ when $\pm \geq \frac{1}{8} + \frac{1}{8}\sqrt{17}$: For $\pm < \frac{1}{3}$ the above conditions cannot be simultaneously veri…ed.

The following inequalities hold:

- $p^h \cdot p^{both}$; since $R \geq R^{harsh}$ and $\pm > \frac{1}{3}$;

- $p^{pre} \cdot p^h$; since $R \cdot R^e$ and $\pm > \frac{1}{3}$;

- $p^g \cdot p^{pre}$; since $R \geq R^{harsh}$;

- $p^{pool} \cdot p^g$; since $R \cdot \overline{R}$;

- $p^{pre}_{r=0} \cdot p^{pool}$; since $R \geq 0$:

[25] Note that $p \geq p^f$ assures that A gets a positive pay-o¤ by entering one market at $t = 1$, while B plays wait and see:

Overall:

$p^{pre}_{r=0} \cdot p^{pool} \cdot p^{g} \cdot p^{pre} \cdot p^{h} \cdot p^{both}$:

- If $p \geq p^{both}$; the proof is the same as in proposition 2.

- If $p \in [p^{pre}; p^{both})$; firm B enters sequentially if A has entered both markets at t = 1: If A has entered only one market at t = 1then the semi-separating equilibrium of the signaling game is played: Firm A prefers to enter both markets, pay-off $p\left[2(1-\pm) + \pm(1-\pm) + \pm((1-\pm) - r) + 2\pm^{2}(1-R)\right] - 2I$, rather then just one, pay-off

$p((1-\pm) + \pm(x^{\alpha}((1-\pm) + ((1-\pm) - r) - I + 2\pm(1-R)) + (1-x^{\alpha})(2(1-\pm) - I + 2\pm(1-R)))) - I$, whenever $p \geq p^{h}$: Given that $p^{pre} \cdot p^{h} \cdot p^{both}$ the equilibrium is easily checked.

- If $p \in [p^{pool}; p^{pre})$; firm B is preempted when A enters the two markets at the same time, while, as above, the semi-separating equilibrium follows when A has entered just one market. When doesn't locate in any market firm B enters sequentially. Firm A enters the two markets at t = 1, pay-off $2(p - I)$, for $p \in [p^{g}; p^{pre})$ while it doesn't locate into any market, pay-off 0, for $p \in [p^{pool}; p^{g})$:

- If $p < p^{pool}$, firm B is preempted when at t = 1 firm A enter either one or two markets. However, since $p < p^{g}$ firm A doesn't enter any market since negative pay-offs are expected: In this case, firm B is the only possible entrant and it chooses to enter sequentially if $p \in [p^{pre}_{r=0}; p^{pool})$ while it doesn't enter any market for $p < p^{pre}_{r=0}$:Q:E:D

Proof of Corollaries 3,4

One can check that:

- $p^{g} \cdot p^{both}_{r=0}$; since $R \cdot \overline{R}$;

- $p^{both}_{r=0} \cdot p^{pre}$; since $R \geq R^{d}$:

Therefore, combining these with the inequalities used in proposition 3:

$p^{pre}_{r=0} \cdot p^{pool} \cdot p^{g} \cdot p^{both}_{r=0} \cdot p^{pre} \cdot p^{h} \cdot p^{both}$:

Propositions 3 and 1 assure that:

- for any $p \in [p^{pre}; p^{h})$; firm A: enters one market at t = 1under rivalry, while it enters both markets in the benchmark;

- for any $p \in [p^{g}; p^{both}_{r=0})$; firm A: enters both markets at t = 1 under rivalry and only one in the benchmark.Q:E:D:

Example for the case of Complementarities

Assuming that $1 \geq \frac{\pm l}{1-\pm}$; $\pm \geq \left[\frac{1}{3}, \frac{1}{2}\right)$ and that the level of complementarities is sufficiently high (that is, R is sufficiently negative), then:

* when $\pm \in \left[\frac{1}{3}, \frac{1}{2}\right)$; $\frac{1}{8} + \frac{1}{8}\sqrt{17}$; in equilibrium, for any $p \in (p^i; p^{both})$, firm A enters both markets at $t = 2$ only because of strategic reasons;

* when $\pm \in (\frac{1}{8} + \frac{1}{8}\sqrt{17}; 1)$; in equilibrium, for any $p \in (p^j; p^{both})$, firm A enters both markets at $t = 2$ only because of strategic reasons:

Proof

Define $R^k \equiv \frac{\pm l - (1-\pm)}{\pm(1-\pm)}$: Condition $R \leq R^k$ assures that the denominator of $p^i$ is negative.

One can check that:

$p^{both} \leq p^g$; when $R \leq \frac{\pm(l-1)}{1-\pm}$;

$p^i \leq p^{both}$; when $R \leq \min\left\{\frac{2\pm(l-1)}{1-\pm}; R^k\right\}$;

$p^j \leq p^i$; when $R \leq R^k$ and $\pm \geq \frac{1}{8} + \frac{1}{8}\sqrt{17}$;

$p^i \leq p^j$; when $R \leq \min\left\{\frac{2\pm(l-1)}{1+\pm-4\pm^2}; R^k\right\}$ and $\pm \in \left[\frac{1}{3}, \frac{1}{2}\right)$; $\frac{1}{8} + \frac{1}{8}\sqrt{17}$;

$p^j \leq p^{both}(R)$; when $R \leq 0$ and $\pm \geq \frac{1}{3}$;

$p^{pre} \leq p^i$; when $R \leq 0$ and $\pm \geq \left[\frac{1}{3}, \frac{1}{2}\right)$;

$p^{pre} \leq p^j$; when $R \leq 0$:

Therefore when R is sufficiently negative and $\pm \in (\frac{1}{8} + \frac{1}{8}\sqrt{17}; 1)$:

$p^{pre} \leq p^j \leq p^i \leq p^{both} \leq p^g$; when R is sufficiently negative and $\pm \in \left[\frac{1}{3}, \frac{1}{2}\right); \frac{1}{8} + \frac{1}{8}\sqrt{17}$:

$p^{pre} \leq p^i \leq p^j \leq p^{both} \leq p^g$

Given that $p \in (p^{pre}; p^{both})$; then B enters sequentially when A enters the two markets at the same time either at $t = 1$ or at $t = 2$: When A enters sequentially, B chooses wait and see: Therefore, firm A expects $p[2(1-\pm) + \pm(1-\pm) + \pm((1-\pm) - r) + 2\pm^2(1-R)] - 2I$ when locating into the two markets at $t = 1$; $\pm(p((1-\pm) + ((1-\pm) - r) + 2\pm(1-R)) - 2I)$ when entering them at $t = 2$ and $p[(1-\pm) + \pm(1-\pm) + \pm^2(1-R)] - I + \pm p((1-\pm) + \pm(1-R) - I)$ when choosing the sequential entry pattern. The second strategy (entering both markets at $t = 2$) is preferred to the first for any $p < p^g$ and to the third for any $p \geq p^i$:[26] Moreover, for any $p \geq p^j$ A expects a non-negative pay-off when entering both markets at $t = 2$::

[26] Note that this last condition requires $R \leq R^j$:

This implies that in equilibrium, when $\pm \in \left[\frac{1}{8} + \frac{1}{8}\sqrt{17}; 1\right)$; then for every $p \in [p^j; p^{both})$ firm A enters the two markets at t = 2. The same choice is made when $\pm \in \left[\frac{1}{3}; \frac{1}{8} + \frac{1}{8}\sqrt{17}\right)$ for any $p \in [p^j; p^{both})$:

Note that these decisions are only due to firm A's strategic behavior. Indeed, if A's behavior were not to affect that of B, then firm A would prefer to enter both markets at t = 2 rather than sequentially if $p(\pm I + (1 - \pm)) + I(1 - 2\pm) \geq 0$; this last inequality does not hold if $1 \geq \frac{\pm I}{1-\pm}$ and $\pm \geq \left[\frac{1}{3}; \frac{1}{2}\right)$:Q:E:D

Proof of Proposition 4

When firm B plays wait and see then A faces the same scenario as in proposition 1. Therefore, it enters markets sequentially for any

$p \in [p^{pre}_{r=0}; p^{both}_{r=0})$: In turn, firm B prefers wait and see, pay–off $2\pm^2 p(1 - I)$,[27] rather than enter markets sequentially, pay-off $p - I + \pm p(1 - I)$; for any $p < p^I_{r=0}$: Condition (2.1) assures that: $p^{pre}_{r=0} \leq p^I_{r=0} \leq p^{both}_{r=0}$:Q:E:D:

Proof of Proposition 5

Under rivalry, when A enters markets sequentially, then B prefers wait and see, pay-off $2\pm^2 p(1 - R - I)$, rather then sequential entry, pay-off $p((1 - \pm) + \pm(1 - R)) - I + \pm p(1 - R - I)$, for any $p < p^I$: When B waits and sees, then for $p \in [p^{pre}; p^{both})$; A face the same situation as in proposition 2 and it prefers to enter markets sequentially for any $p < p^d$: When $R \geq 0$; $p^I \leq p^d \leq p^{both}$ and then a first-second mover structure arises in equilibrium for any $p \in I_R = [\min\{p^{pre}; p^I\}; p^I)$:[28] In the benchmark, focusing on $p \in [p^{pre}; p^{both})$; a first and a second mover arise for any $p \in I_B = [\min\{p^{pre}; p^I_{r=0}\}; p^I_{r=0})$: Since $p^I_{r=0} \leq p^I$ for any $R \geq 0$; then $I_B \mu I_R$:Q:E:D:

Proof of Proposition 6

Under rivalry, as in the previous proposition, when A enters markets sequentially, B chooses wait and see for any $p < p^I$: When B plays according to this strategy, then for $p < p^{pre}$; A face the same scenario as in proposition 5 and enters markets sequentially for any $p \in [p^f; p^e)$: One can check that $p^f \leq p^{pre}$; by $R \geq 0$; $p^f \leq p^e$ by $R \leq R^{harsh}$ and $p^f \leq p^I$

[27] Note that in this case a wait and see strategy requires not to enter any market for two periods: t = 1 and t = 2:

[28] Note that when $\min\{x; y\} = y$; then $[\min\{x; y\}; y)$ represents the empty set.

by $R \geq 0$ and $R \leq \overline{R}$: Therefore, when $p < p^{pre}$; a …rst-second mover structure arises in equilibrium for any $p \in I_R \equiv \left[p^f; \min\left\{p^{pre}; p^e; p^l\right\}\right)$: In the benchmark, focusing on $p < p^{pre}$ and since $p^{pre}_{r=0} \leq p^{pre}$ for any $R \geq 0$: then a …rst-second mover structure arises in equilibrium for any $p \in I_B = \left[p^{pre}_{r=0}; \min\left\{p^{pre}; p^l_{r=0}\right\}\right)$: Since $p^{pre}_{r=0} \leq p^f$ for any $R \geq 0$; then $I_R \mu I_B$ provided that $\min\left\{p^{pre}; p^e; p^l\right\} \leq \min\left\{p^{pre}; p^l_{r=0}\right\}$: If the last inequality does not hold then $I_R$ and $I_B$ are not comparable. When $R \geq 0$ then $p^l_{r=0} \leq p^l$ and then the inequality holds i¤ either $p^e \leq p^l_{r=0}$ or $p^{pre} \leq p^l_{r=0}$: Condition $p^e \leq p^l_{r=0}$ holds i¤ $R \geq R^g$: Therefore, the existence of this case requires $R \geq R^g$; $R \leq \overline{R}$ and $R \leq R^{harsh}$. These conditions are simultaneously veri…ed for any $R \in \left[R^g; R^{harsh}\right]$ i¤ $\pm \geq \frac{1}{2}$: Condition $p^{pre} \leq p^l_{r=0}$ holds i¤ $R \leq R^i$: Therefore, the existence of this case requires $R \leq R^i$; $R \leq \overline{R}$ and $R \leq R^{harsh}$: These conditions are simultaneously veri…ed for any $R \leq R^i$ when $\pm \leq 0{:}76$ and for any $R \leq R^{harsh}$ for $\pm > 0{:}76$:Q:E:D:

# Bibliography


[1] Brander, J. and B. Spencer (1992), "Pre-Commitment and Flexibility", European Economic Review, 36, 1601-1626.

[2] Chamley, C. and D. Gale (1994), "Information Revelation and Strategic Delay in a Model of Investment", Econometrica, 62, 1065-1085.

[3] Dixit, A. (1980), "The Role of Investment in Entry Deterrence" The Economic Journal, 90, 95-106.

[4] Harrington, J. (1995), "Experimentation and Learning in Di¤erentiated-Products Duopoly", Journal of Economic Theory, 66, 275-288.

[5] Gul, F. and R. Lundholm (1995), "Endogenous Timing and Clustering of Agents' Decisions", Journal of Political Economy, 103, 1039-1066.

[6] Maggi, G. (1996), "Endogenous leadership in a new market" Rand Journal of Economics, 27, 641-659.

[7] McGahan, A. (1993), "The E¤ect of Incomplete Information about Demand on Preemption", International Journal of Industrial Organization, 11, 327-346.

[8] Mirman, L., L. Samuelson and E. Schlee (1994), "Strategic Information Manipulation in Duopolies", Journal of Economic Theory, 62, 363-384.

[9] Somma, E. (1999), "The E¤ect of Incomplete Information about Future Technological Opportunities on Preemption", International Journal of Industrial Organization, 17, 765-799.

# Chapter 3

# The Governance Form of Strategic Alliances: an Introduction

The next chapters deal with the issue of the governance form of strategic alliances. That is, the subject under analysis is the way in which …rms organize their cooperative arrangements.

Various de…nitions of strategic alliances have been put forward. For instance, Hagedoorn (1996) de…nes them as "... inter-…rm agreements aimed at improving the long-term prospects of the involved companies ...". Similarly, Root (1988) in a study on international alliances de…nes "...an international cooperative arrangement as any form of long-term cooperation between two or more independent …rms ... that undertakes or supports a business activity for mutual economic gain". The idea behind these de…nitions is that strategic alliances are hybrid forms of businesses that lie between arm's length transactions and mergers and acquisitions. That is, in principle, they are mid-long term relationships that go beyond spot market transactions, that require the continuous collaboration of the participating …rms but that leave them independent. This means that, contrarily to mergers or acquisition, the involved …rms continue being separated and distinct entities.

Several are the reasons that might induce …rms to cooperate. According to Contractor and Lorange (1988) these range from cost and risk sharing to the possibility of reaching an e¢cient scale of production and from strategic motives to government mandated requirements. Starting from the study of d'Aspremont and Jacquemin (1988) a number of theoretical papers have

focused on cooperation in Research and Development activities pointing out that alliances are bene…cial since they allow the internalization of externalities and to capture larger spillovers.[1] Hagedoorn (1993) in an accurate analysis on the rationales for cooperation stresses that besides these classical arguments two major reasons that induce …rms to collaborate are the need of complementary capabilities and the possibility of capturing some of the skills, knowledge or technologies of partners.

In spite of these advantages, cooperation among …rms is not easily managed. For instance, Business Week (1986) reports that according to two independent studies by McKinsey & Co and by Coopers & Lybrand, seven out of ten strategic alliances fall short of expectations or are disbanded. Likewise, Kogut (1989), underlies that there is strong evidence that alliances are highly unstable.[2]

These di¢culties in the management of alliances emphasize the role of the governance form.[3] That is, the way in which alliances are structured plays a primary role in conditioning their probability of success and of failure. The traditional approach when studying this issue is the one o¤ered by the Transaction Costs Theory.[4] According to this literature, the governance form of alliances can be classi…ed into two broad categories, namely equity and non-equity. The former group is composed of Joint Ventures and minority equity participations. In case of a Joint Venture, partners create and jointly own a new and separated entity (called, indeed, the Joint Venture) in whose structures the cooperative activities are undertaken. In case of minority participations, the agreement involves the acquisition of minority positions in the capital of the partner.[5] The label "non-equity arrangements" includes a bunch of di¤erent organizational forms that range from simple networking to more structured forms of governance such as technology exchange agreements, joint research agreements, co-production, co-development, ... .

[1] For a recent survey both on theoretical and on empirical aspects of R&D cooperation see Veugelers (1998).

[2] Similar conclusions are found in other studies, for instance Bleeke and Ernst (1992) and Doz et al. (1989).

[3] See Hagedoorn and Narula (1996), Osborn and Baughn (1990) and Pérez-Castrillo and Sandonís (1996). Kesteloot and Veugelers (1994) and Eaton and Eswaran (1997) make a di¤erent point. They employ a repeated game framework to analyze whether the threat of no future cooperation can induce partners not to behave opportunistically

[4] Among others, see Gulati (1995), Hennart (1988) and Kogut (1988).

[5] According to Gulati (1995) treating Joint Ventures and minority equity participations as a single category can be justi…ed in terms of "...a direct equity investment by one …rm into another essentially creates an equity Joint Venture between one …rm's existing shareholders and the new corporate investor".

The common features of these arrangements are that they do not involve the sharing of equity (that is, the relationship is purely contractual) and usually do not entail the creation of a new and separated entity. The di¤erence between equity and non-equity arrangements on which the Transactions Costs Theory focuses is the type of control that partners have over the cooperative activities and over the assets that are used. Equity arrangements are closer to the case of full ownership, while non-equity ones are more akin to arm's length transactions. Therefore, the comparison between these to categories resembles the classical one between hierarchical and market (that is, contractual) types of control. The governance form employed will be closer to either the hierarchy or the market extreme, depending on the amount of transaction costs. The greater these latter are the better hierarchical organizations perform. In particular, according to Gulati (1995) "The possibility of opportunistic behavior by a partner generates the most salient transaction costs in the alliance context".

Other studies claim that the discriminating feature relies on whether a separated entity is created or not. Therefore, the relevant distinction is between Joint Ventures in which a new …rm is created and Contractual Agreements where this does not happen. Pastor and Sandonís (2001) point out that this di¤erence has important implications in terms of incentives,[6] while Tao and Wu stress that it has consequences on the ownership structure.[7]

The main advantages attributed to Joint Ventures or, more generally, to equity types of arrangements can be summarized in two major points. On the one hand, partners obtain a better alignment of their interests. Sharing the costs and the revenues of the jointly owned venture they also share the same objectives. On the other hand, working together in a structure that is devoted to the joint project has advantages in terms of better monitoring of the partner's behavior, larger synergies and easier transfer of knowledge between partners. The disadvantages associated with these organizational forms are related the long negotiations that are usually required for their establishment and to the di¢culties and costs of modifying the terms of the arrangements or to exit the alliance. Indeed, it is widely accepted that equity

[6] In their model a Joint Venture is a structure with two principals (the partners) and one agent (the common laboratory i.e. the Joint Venture), while a Contractual Agreement is a structure with two principal (the partners) each having its own agent (its own laboratory).

[7] In a Joint Venture partners are co-owners of the innovation they obtain, while in a Contractual Agreements each of them is an individual owner of the innovation; that is, it can freely use it without the consensus of the other partner.

agreements require a larger commitment both in …nancial as well as in organizational terms and therefore any amendment of the initial agreement comes at di¢culties. The advantages and disadvantages usually ascribed to non-equity agreements are the reverse of the medal. They are more rapidly arranged, require less commitment and are more ‡exible both in terms of modifying the objectives and scope of the alliance as well as in terms of exiting it. However, these organizational forms are considered to be more vulnerable to the opportunistic behavior of the partner and also the possibilities of learning from each other as well as the creation of synergies are reduced.

In chapter 4, I present a theoretical model in which I consider the e¤ect of learning one partner's know-how on the performances of a Joint Venture and a Contractual Agreement. Hagedoorn (1993) stresses that sometimes alliances are "...merely a cover-up for an attempt to quickly absorb some innovative capabilities from others". Similarly, Baughn et al. (1997) warn against the costs of unintended informational leaks and state that "Uncontrolled information disclosure may allow one's partner increased bargaining power in the relationship, or possibly help to create a future competitor". I concentrate on the link between learning and the bargaining power of the partners. In particular, I claim that this link has a di¤erent impact on a Joint Venture and on a Contractual Agreement and, therefore, on their optimality. [8]

As pointed out above, the need of complementary capabilities has been recognized as one of the leading rationales for cooperation. In chapter 5, I focus on this kind of alliances. The main objective is to relate the governance form to the typology of the project that partners are pursuing and to the characteristics of the sector in which the alliance takes place. I assume that, ex-ante, each …rm is uncertain about some of the characteristics of the partner and I show that uncertainty has a detrimental e¤ect on the incentives to invest. Interpreting this result in terms of the governance form, I expect that the larger the uncertainty the more arrangements that require low levels of commitment tend to prevail.

In the last chapter of the thesis, I present an empirical assessment. This analysis is based on Comino, Mariel, Sandonís (2001) and uses a database on alliances that has been created at the Katolieke Universiteit of Leuven. The objective is to test the principal predictions of

[8] The issue of the creation of a stronger competitor through the dissemination of kow-how has already been addressed in a series of studies. Pérez-Castrillo and Sandonís (1996) and Pastor and Sandonís (2001) present a theoretical approach to this issue, while Contractor and Lorange (1988) o¤er a more anecdotal analysis.

the theoretical literature as well as some of the main hypotheses that can be derived from the models of chapters 4 and 5.

# Bibliography

[1] d'Aspremont C. and A. Jacquemin (1988), "Cooperative and Non-cooperative R&D in Duopoly with Spillovers", American Economic Review, 78, 1133-1137.

[2] Baughn, C., J. Denekamp, J. Stevens and R. Osborn (1997), "Protecting Intellectual Capital in International Alliances", Journal of World Business, 32(2), 103-117.

[3] Bleeke, J. and D. Ernst (1992), "The Way to Win in Cross-Border Alliances", The McKinsey Quarterly, 1, 113- 133.

[4] Business Week, (1986) "Corporate Odd Couples: Beware the Wrong Partner", July, 21, 98-103.

[5] Comino, S., P. Mariel and J. Sandonís (2001) "Empirical Aspects of the Governance Form of Strategic Alliances", mimeo, Universidad del Pais Vasco.

[6] Contractor, F. and P. Lorange (1988), "Why Should Firms Cooperate? The Strategy and Economics Basis for Cooperative Ventures", in "Cooperative Strategies in International Business", F. Contractor and P. Lorange eds., Lexington books..

[7] Doz, Y., G. Hamel and C. Prahlad (1989), "Collaborate with Your Competitors and Win", Harvard Business Review, January-February, 133-139.

[8] Eaton B. and M. Eswaran (1997), "Technology Trading Coalitions in Supergames", Rand Journal of Economics, 28(1), 317-38.

[9] Gulati, R. (1995), "Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances", Academy Management Journal, 38(1), 85-112.

[10] Hagedoorn, J. (1993), "Understanding the Rationale of Strategic Technological Partnering: Interorganizational Modes of Cooperation and Sectoral Di¤erences", Strategic Management Journal, 14, 371-385.

[11] Hagedoorn, J. (1996), "Trends and Patterns in Strategic Technology Partnering since the Early Seventies", Review of Industrial Organization, 1,; 601-616.

[12] Hagedoorn, J. and Narula, R. (1996), "Choosing Organizational Modes of Strategic Technology Partnering: International and Sectoral Di¤erences", Journal of International Business Studies, 27, 265-284.

[13] Hennart, J. (1988), "A Transactions Costs Theory of Equity Joint Ventures", Strategic Management Journal, 9, 361-374.

[14] Kesteloot, K. and R. Veugelers (1994), "Stable R&D Cooperation with Spillovers", Journal of Economics and Management Strategy, 4, 651-672.

[15] Kogut, B. (1988), "A Study of the Life Cycle of Joint Ventures", in "Cooperative Strategies in International Business", F. Contractor and P. Lorange eds., Lexington books.

[16] Kogut, B. (1989), "The Stability of Joint Ventures: Reciprocity and Competitive Rivalry", The Journal of Industrial Economics, 28(2), 183-198.

[17] Osborn, R. and C. Baughn (1990), "Forms of Interorganizational Governance for Multinational Alliances", Academy of Management Journal, 33 (3), 503-519.

[18] Pastor, M. and J. Sandonís (2001), "Research Joint Ventures vs Cross Licensing Agreements: An Agency Approach", International Journal of Industrial Organization, forthcoming.

[19] Pérez-Castrillo, D. and J. Sandonís (1996), "Disclosure of Know-How in Research Joint Ventures", International Journal of Industrial Organization, 15, 51-75.

[20] Pisano, G. (1989), "Using Equity Participation to Support Exchange: Evidence from Biotechnology Industry", Journal of Law, Economics and Organization, 5(1),109-126.

[21] Root, F. (1988), "Some Taxonomies of International Cooperative Arrangements", in "Cooperative Strategies in International Business", F. Contractor and P. Lorange eds., Lexington books.

[22] Tao, Z. and C. Wu (1997), "On the Organization of Cooperative Research and Development: Theory and Evidence", International Journal of Industrial Organization, 15, 573-596.

[23] Veugelers, R. (1998), "Collaboration in R&D: An Assessment of Theoretical and Empirical Findings", De Economist, 146 (3), 419-443.

# Chapter 4

# On the Governance Form of R&D Alliances: Joint Ventures and Contractual Agreements[1]

## 4.1 Introduction

In the literature about partnerships, a commonly remarked aspect is that an alliance is a way of disseminating existing knowledge. While collaborating, …rms not only pursue a targeted project but they also learn from each other. Pérez-Castrillo and Sandonís (1996) and Pastor and Sandonís (2001) show that when partners are rivals there are little incentives to share know-how. An increase in the know-how that a …rm provides to the alliance has two e¤ects: it increases the expected pay-o¤ of the project undertaken but it also enlarges the amount of knowledge that the partner learns, making it a stronger competitor in the market in which …rms are rivals. In particular, Pérez-Castrillo and Sandonís (1996) prove that the joint e¤ect of moral hazard, learning and rivalry may prevent the formation of pro…table alliances.

In this chapter, I focus on the e¤ects of learning the partner's knowledge on the perfor-

[1] I would like to thank my advisor David Peréz-Castrillo, Inés Macho-Stadler, Joel Sandonís and Reinhilde Veugelers for helpful comments on earlier versions of the paper. I am also grateful to the partecipants at the workshops at the Universitat Autonoma de Barcelona, Katolieke Universiteit of Leuven, Jornadas de Economia Industrial (Madrid) and Simposio de Analisis Economico (Barcelona).

mances of two typical modes of organizing an alliance: Joint Ventures (JVs) and Contractual Agreements (CAs).[2] While at the very beginning of a relationship each …rm lacks some basic input[3] and, therefore, it completely depends on its partner for the project's completion, as cooperation carries on, learning one's other capabilities alters this dependence. When a …rm has learned a su¢cient amount of the partner's know-how it could complete the project on its own and, therefore, the level of dependence from the partner is reduced. This means that the process of learning alters the bargaining positions that …rms have within an alliance. The link between learning and bargaining power has been pointed out in a number of studies. For instance, Hamel (1991) stresses that power within an alliance crucially depends on the ability to outlearn one's partner and that "successful learning at each stage obsolesced existing bargain ...". Similarly, Prahalad and Hamel (1990) state that "when collaborating with a competitor, failure to outlearn one's partner could render a …rm …rst dependent and then redundant within the partnership". I claim that the link between learning and bargaining power has a di¤erent impact on a JV and a CA and, therefore, on their optimality.

In the model, I consider an R&D alliance between two …rms possessing complementary technologies. Partners choose whether to organize it as a JV or as a CA. Once they have reached an agreement, they provide their know-how to the relationship. Their contributions, i.e. the know-how provided, have asymmetric e¤ects on the value of the project. At an intermediate step of the alliance, partners obtain a prototype that determines whether project's completion is pro…table. Ex-ante, partners ignore what prototype they will obtain and are unable to contract on it. Therefore, they can decide about project's completion only after they have the prototype in hand. However, by this time each …rm has learned part of the know-how provided by the partner and this fact might a¤ect the …rms' bargaining positions. The larger the know-how that a …rm has learned the stronger its bargaining position. The ability to learn depends on the absorptive capacity of a …rm. I assume the absorptive capacity to be exogenous. [4]

[2] As I said in chapter 3, it is typical to classify the governance form of alliances into these two broad categories.

[3] In chapter 3, I have pointed out that the need of complementary capabilities is one of the principal rationales for cooperation.

[4] This assumption has been implicitly employed in other studies dealing with the e¤ect of learning on the alliance's organization (Pérez-Castrillo and Sandonís (1996) and Pastor and Sandonís (2001)). On the contrary, a series of papers originated by Cohen and Levinthal (1989) consider the absorptive capacity of a …rm as an endogenous variable. The more in-house R&D a …rm is doing the more it can absorb from the R&D projects that other …rms are independently carrying out. However, in my paper I am not considering …rms undertaking

The feature that mainly distinguishes a JV from a CA is that in the former case a new and separated …rm (the so-called Joint Venture) is established and devoted to undertake the partners' project.[5] On the contrary, in a CA, joint activities take place in structures that already exist[6] and in which other projects are possibly run at the same time. I claim that this di¤erence results, de facto, in a distinct distribution of property rights on the prototype. In a JV, a …rm cannot threaten the partner to use the prototype on its own. Indeed, a structure devoted to the project was employed and the partner can prove that the prototype is due to the joint activities and, then, that it owns it too. That is, in a JV partners are, de facto, co-owners of the prototype. This fact does not occur in a CA. In this case, the fruits of the joint activities are not easily singled out. No structure devoted to the common project was employed and, then, the results of cooperative e¤orts might be confused with those of other projects that were simultaneously run within the same buildings. Therefore, de facto, each …rm is entitled to use the prototype on its own (i.e. it is a private owner) and it can threaten the partner to do so. This di¤erence implies that only in a CA an eventual change in the bargaining positions caused by the dissemination of know-how plays a role. When partners get to know that the project is pro…table, then its joint completion is automatic in case of a JV, while it is achieved after bargaining in a CA. I assume that the bargaining process is done "à la Nash". In the threat point, each partner completes the project on its own.

This distinction between a JV and a CA is in line with the prediction made by other studies tackling the same issue. Tao and Wu (1997) quote evidence that, indeed, the di¤erence between these two organizational modes relies on the distinct ownership rights structure on the fruits of the alliance. Similarly to what I claim, in a JV partners are co-owners while in a CA they are individual owners.[7] In the same vein, also the Transaction Costs Theory argues that the main

independent R&D projects. Conversely, I study the case of two …rms contributing (i.e. providing know-how) to a joint R&D project.

[5] A typical example of a Joint Venture is the one o¤ered by the alliance between Rhone-Poulenc and Snia. In february 1994 the two companies agreed to set up a 50-50 JV to carry out engineering plastics projects. According to the agreement, the new company, called Nyltech, was based in Lyon and "All of the production sites and technical centers will be included in the Joint Venture" (Financial Times, 23rd of february 1994).

[6] For instance, in september 1996 Mitsubishi and Hindustan Motors agreed on technical collaboration. According to the agreement "Production will start at an Hindustan Motors plant ..." (Financial Times, 26th of september 1996).

[7] Likewise, Osborn and Baughn (1990) de…ne "...a Joint Venture as a new legal entity with full status as a corporate entity ... Joint Ventures provide joint ownership and control over the use and fruits of assets".

advantage of a JV relies on the superior control over joint activities that it assures to partners. A CA, being more akin to market transactions, is more ‡exible but it assures less protection against opportunistic behavior. In this paper, I interpret the fact that only in a CA a …rm can threaten the partner to complete the project on its own as evidence of opportunistic behavior.[8]

In the model, the only di¤erence between the two forms of governance is due to the bargaining process that takes place in a CA. During this phase the …rm with the largest absorptive capacity tends to be in a stronger bargaining position and to receive a transfer. This fact increases the e¢ciency of the alliance whenever the …rm with the largest absorptive capacity is also the one whose know-how is most relevant for the project. That is, a CA is superior when the transfer stimulates a larger contribution from the …rm that has the most valuable know-how. If the contrary happens, a JV is more e¢cient. This is the main result of the model. Making some comparative static analysis, I check that the more asymmetric partners' absorptive capacities are the worse a CA performs. Even in the case in which the most relevant partner receives a transfer, this might be excessive. Indeed, the magnitude of the transfer is closely linked with the partners' absorptive capacities and not with the relevance of their contributions. This observation implies that when partners have very asymmetric absorptive capacities choosing a CA might be hazardous . Finally, when the bene…ts that partners get from the project become very asymmetric, then a CA tends to perform better. Indeed, during the bargaining process there is a redistribution that has the e¤ect of equalizing the partners' pay-o¤s.

This chapter is organized as follows. In section 2, the assumptions and the structure of the model are outlined. In section 3, the model is solved and the principal results are derived. The last section is devoted to the …nal remarks.

## 4.2 The Model

Two …rms (…rm A and …rm B) form an alliance to undertake an R&D project. Ex-ante they ignore whether the project is feasible. That is, they know that only in some of the many possible future contingencies project's completion will be pro…table, but they ignore which

[8] In terms of the literature on incomplete contracts, only in a CA partners face a hold-up problem.

contingency will occur. For ease of exposition, I only consider two possible contingencies. I say that some time after starting the project …rms obtain a prototype. Ex-ante, they expect that the prototype will be of a good type with probability p, of a bad type with probability $(1 - p)$; being pro…table only in the former case.

The project requires two pieces of complementary know-how. These are provided by the partners before learning about the prototype. Firm $i = A; B$ only possesses the technology to provide know-how $K_i$ at a cost $\frac{K_i^2}{2}$: This is the cost necessary to adapt the technology to the project or to convey it to the partners' technicians. The levels of know-how are unveri…able and partners choose them non-cooperatively. Once the prototype has been obtained partners decide about project's completion. When the prototype is of a bad type, then it is not pro…table to ultimate the project. On the contrary, completing the project after a good type has been obtained pays o¤ $s_A K_A^{1-\gamma} K_B^{\gamma}$ and $s_B K_A^{1-\gamma} K_B^{\gamma}$ to …rms A and …rm B respectively.[9] I assume the pay-o¤s to be private and the previous expressions represent their reduced forms. For instance, if the R&D project aims at reducing partners' production costs, then the pay-o¤s might be interpreted as the increased pro…ts due to the cost abatement. Parameter $s_i$ is a measure of the bene…ts obtained by …rm i. Parameters $(1 - \gamma)$ and $\gamma$ weight the relevance of the know-how provided by …rms A and B for the value of the project; $\gamma \in (0; 1)$ and the larger it is the more (less) relevant B's (A's) know-how is. Clearly, the expected pay-o¤s are increasing functions of the amount of know-how provided. However, there is another e¤ect. By working together each partner learns part of the know-how delivered by the other …rm. The e¤ects and the way in which learning takes place are speci…ed below.

Partners cannot contract on $K_A$ and $K_B$; on the type of the prototype and on the private pay-o¤s. However, they can choose the governance form for their alliance. That is, they can choose either to set-up a Joint Venture (JV) or to sign a Contractual Agreement (CA). This decision is taken at the very beginning of the relationship, before choosing $K_A$ and $K_B$ and before learning about the prototype. As said in the introduction, the di¤erence between a JV and a CA is the resulting distribution of property rights on the prototype. I claim that a JV stands for the case in which partners are, de facto, co-owners, while a CA represents the case in

[9] I assume that the know-how that partners provide a¤ects the value of the project but not the probability of obtaining a good prototype. This is a simplifying assumption. However, assuming that p and $(1 - p)$ depend on $K_A$ and $K_B$ would not signi…cantly alter the results at the cost of complicating the analysis.

which they own the prototype individually. Once a good type of prototype has been obtained, then in a JV, the only option that partners have is that of completing the project within the partnership. On the contrary, in a CA each partner is entitled to complete the project on its own. In this latter case, …rms decide about completion via a Nash bargaining process. In case they fail to reach an agreement, each of them completes the project on its own obtaining $s_A K_A^{1\,i} - \pm_A K_B$ and $s_B - \pm_B K_A^{1\,i} - K_B$ respectively. Since they have been working together, each …rm has learned part of the know-how provided by the partner. Therefore, by the time in which the prototype has been obtained each …rm is able to complete the project on its own. Clearly, …rm i is perfectly able to handle its own know-how, $K_i$; but not the one provided by the partner, $K_{i\,i}$: The parameter $\pm_i \in [0;1]$ represents the absorptive capacity of …rm i: That is, it indicates how e¤ective is …rm i in handling the knowledge provided by the partner:

Figure 1: the time line

The timing of the game is summarized in the Figure 1. At the beginning partners choose either a JV or a CA. Subsequently, they choose $K_A$ and $K_B$ in a non-cooperative way. Then, they learn about the prototype and decide whether to complete the project or not. Finally, pay-o¤s are realized.

## 4.3 Solving the Model

I look for the Subgame Perfect Nash Equilibrium of the game. In the analysis the parameter that measures the bene…ts of …rm A is normalized to 1; that is, $s_A = 1$: Moreover, I denote $s_B$´s with $s \geq 0$:

### 4.3.1 Project's completion

In case of a bad prototype partners dismiss the project. In case of a good prototype, joint completion (i.e. the two partners ultimating the project together) is the e¢cient choice. Indeed, $K_A$ and $K_B$ can be perfectly handled only when both partners are simultaneously involved in the project. In case of a JV, joint completion is the only option that partners have and, therefore, it follows automatically. In a CA each …rm can threaten the partner to complete the project individually. Thus they agree on joint completion through a bargaining process. This process is done "à la Nash", partners have the same bargaining power and the threat point is determined by what partners would obtain by completing the project individually. The Nash bargaining solution is de…ned by the transfer, T; that solves the following program:

$$\max_T \left[ K_A^{1-\bar{}} K_B^{\bar{}} - T - K_A^{1-\bar{}} - \pm_A K_B^{\bar{}} \right]^{\prime\prime} \left[ sK_A^{1-\bar{}} K_B^{\bar{}} + T - s \pm_B K_A^{1-\bar{}} - K_B^{\bar{}} \right]^{\prime} :$$

When $T > 0$, then …rm A pays a transfer to B, while $T < 0$ implies that it is B the one which pays. Next lemma characterizes T the solution:

**Lemma 4** *In the case of a CA, the transfer in the bargaining process is:*

$T^{\alpha}(K_A; K_B) = \frac{1}{2} K_A^{1-\bar{}} K_B^{\bar{}} (1 - \pm_A - s(1 - \pm_B))$:

$T^{\alpha}(K_A; K_B) > 0$ *i¤* $s < \frac{1-\pm_A}{1-\pm_B}$ *and it is increasing in* $\pm_B$ *and decreasing in both s and* $\pm_A$:

*Proof.* It follows immediately ■

The sign, that is the identity of the …rm that pays the transfer, depends on both the relative absorptive capacities of the two partners and on the bene…ts that they obtain from the project. The transfer is positive (i.e. A pays B) when B's absorptive capacity is high relative to that of A and/or when the bene…ts that …rm B obtains from the project are low (i.e. s is low). In particular, $T^{\alpha}(K_A; K_B) > 0$ implies that at least one of the following conditions holds: $\pm_B > \pm_A$ or $s < 1$:

The absorptive capacity of a …rm positively a¤ects its pay-o¤ in the threat point. Therefore, an increase in $\pm_i$ strengthens …rm i's bargaining position and, in general, the partner whose

absorptive capacity is the largest is the one that obtains the transfer. The same reasoning explains why $T^{¤}(K_A; K_B)$ is increasing in $±_B$ and decreasing in $±_A$: That is, the higher $±_B$ or the lower $±_A$, the higher the transfer that …rm B receives (or the lower the transfer that it pays).

At the same time, failure of the bargaining process has an opportunity cost: the project is not completed in the e¢cient way and …rms only obtain the pay-o¤s of the threat point. Clearly, the larger the bene…t a …rm obtains from the project (i.e. the larger s in case of …rm B), the more a …rm is penalized by this event. Thus, the …rm that bene…ts most from the project tends to be the one that pays the transfer. By the same reason, the larger s, the lower the transfer that B receives (or the higher the transfer it pays). That is, $T^{¤}(K_A; K_B)$ is decreasing in s:

Clearly, as long as $s = \frac{1 ¡ ±_A}{1 ¡ ±_B}$ the transfer equals zero and a JV and a CA are equivalent.

### 4.3.2 The Choice of $K_A$ and $K_B$

Before learning about the prototype partners choose the levels of know-how to provide. They do it in a noncooperative way. In case of a CA, …rms A and B solve respectively:

$$\max_{K_A} p\left[K_A^{1¡\bar{}} K_B^{\bar{}} ¡ T^{¤}(K_A; K_B)\right] ¡ \frac{(K_A)^2}{2}$$
$$\max_{K_B} p\left[sK_A^{1¡\bar{}} K_B^{\bar{}} + T^{¤}(K_A; K_B)\right] ¡ \frac{(K_B)^2}{2}:$$

With probability p the prototype will be of a good type, the private pay-o¤s will be obtained and the transfer paid.

Manipulating the F.O.C., the equilibrium levels of $K_A$ and $K_B$ can be written as:

$$\begin{aligned} K_A^{CA} &= p(\bar{R})^{\frac{\bar{}}{2}}((1 ¡ \bar{})Q)^{\frac{2¡\bar{}}{2}} \\ K_B^{CA} &= p(\bar{R})^{\frac{1+\bar{}}{2}}((1 ¡ \bar{})Q)^{\frac{1¡\bar{}}{2}} \end{aligned} \tag{4.1}$$

where $Q = \frac{1}{2}(1 + ±_A + s(1 ¡ ±_B))$ and $R = \frac{1}{2}(s(1 + ±_B) + 1 ¡ ±_A)$:

In case of a JV …rms face a similar problem. The only di¤erence is that no transfer arises. Therefore, …rms solve respectively:

$$\max_{K_A} p\left[K_A^{1-\mu} K_B^{\mu}\right] - \frac{(K_A)^2}{2}$$
$$\max_{K_B} p\left[sK_A^{1-\mu} K_B^{\mu}\right] - \frac{(K_B)^2}{2}.$$

The equilibrium values for $K_A$ and $K_B$ are:

$$\begin{aligned} K_A^{JV} &= p(\mu s)^{\frac{\mu}{2}} (1-\mu)^{\frac{2-\mu}{2}} \\ K_B^{JV} &= p(\mu s)^{\frac{1+\mu}{2}} (1-\mu)^{\frac{1-\mu}{2}}. \end{aligned} \tag{4.2}$$

Comparing the equilibrium values of $K_A$ and $K_B$

To simplify the presentation of the results, from now on I will focus on the case in which the parameters satisfy the following condition:

$$(A1)\ s < \frac{1+\pi_A}{1+\pi_B}.$$

From lemma 4, this implies that in the bargaining process of a CA …rm B receives the transfer from …rm A. This restriction causes no loss of generality. Indeed, if (A1) is not satis…ed, then one obtains the same qualitative results as those I will present.

The optimal level of know-how that …rm i adapts in case of a JV depends on the pay-o¤ it gets but also on $K_{-i}$ which determines the marginal productivity of $K_i$. In particular, as s increases …rm B adapts a larger level of know-how, which has a positive e¤ect on the marginal productivity of $K_A$. On top of these e¤ects, in case of a CA, the transfer that B obtains alters the distribution of the pay-o¤s. This fact a¤ects …rms' choices in two ways. Firstly, …rm B gets a larger share of pay-o¤s. This fact, accounts for a larger $K_B$ and a smaller $K_A$. Secondly, there is an indirect e¤ect that works in an opposite direction and that can compensate the …rst one.

The increase in $K_B$ enlarges the marginal productivity of $K_A$ and thus it induces …rm A to adapt an higher level of technology. Conversely, the lower $K_A$ caused by the transfer decreases the marginal productivity of $K_B$; thus, …rm B tends to reduce the amount of know-how it provides. The magnitude of this indirect e¤ect depends on $\bar{}$ and $(1 ¡ \bar{})$: The larger $\bar{}$ the higher the magnitude of the indirect e¤ect caused by an increase of $K_B$ and the smaller that caused by a reduction of $K_A$:

Next lemma formally compares the equilibrium values of $K_i^{JV}$ and $K_i^{CA}$; $i = ; B$:

Lemma 5 Assuming that (A1) holds, then the equilibrium values of $K_A$ and $K_B$ chosen in a JV and in a CA satisfy the following conditions:

i) when $s \cdot \min\left\{\frac{1¡\pm_A}{1¡\pm_B}; \frac{1+\pm_A}{1+\pm_B}\right\}$ ; then $K_A^{CA} ¸ K_A^{JV}$ i¤ $\bar{} ¸ \bar{}_A$; moreover $K_B^{CA} ¸ K_B^{JV}$;

ii) in the other cases, $K_A^{JV} ¸ K_A^{CA}$; moreover $K_B^{CA} ¸ K_B^{JV}$ i¤ $\bar{} ¸ \bar{}_B$;

where $\bar{}_A = 2 \ln Q \quad \ln\frac{Qs}{R}\Big)^{¡1}$; $\bar{}_B = \ln\frac{s}{QR} \quad \ln\frac{R}{Qs}\Big)^{¡1}$ and $\lim_{s!0} \bar{}_A = 0$.

When s is low (case i)), in a JV …rm B obtains a negligible pay-o¤ and, therefore, it provides a low level of know-how. This fact has a detrimental e¤ect on the marginal productivity of $K_A$. The transfer to …rm B realized in a CA leads always to a larger level of $K_B$; while it induces an increase in $K_A$ whenever the indirect e¤ect caused by a larger $K_B$ is su¢ciently high (i.e. provided that $\bar{} ¸ \bar{}_A$). Note that when s is very small, then $K_A$ and $K_B$ are always larger in a CA; that is, $\lim_{s!0} \bar{}_A = 0$ .

When s is not low (case ii)), $K_B^{JV}$ is not negligible. In this case …rm A adapts always a larger know-how in a JV, while …rm B chooses a larger $K_B$ in a CA whenever that the indirect e¤ect caused by the reduced $K_A$ is low enough; that is, provided that $\bar{} ¸ \bar{}_B$:

### 4.3.3 The Optimal Governance Form

At the very beginning of their relationship, partners choose whether to structure the alliance as a CA or as a JV. I assume that they select the governance form that maximizes the sum of their expected pay-o¤s. That is, I assume that partners agree on choosing the most e¢cient mode. Note that to guarantee that both A and B agree on this choice a transfer might be required before starting. Next proposition characterizes the optimal choice:

Proposition 7 Assuming that (A1) holds, then

² there exists a unique $\bar{\theta}(s;\pm_A;\pm_B) \in (0;1)$ such that:

- if $\theta \geq \bar{\theta}(s;\pm_A;\pm_B)$; then partners choose a CA;
- if $\theta < \bar{\theta}(s;\pm_A;\pm_B)$; then partners choose a JV.

The message of proposition 7 is quite intuitive. In a CA, …rm B receives a transfer and this fact increases the e¢ciency of the alliance provided that $K_B$ is su¢ciently relevant for the project. That is, provided that $\theta \geq \bar{\theta}(s;\pm_A;\pm_B)$: Indeed, as checked in lemma 5 for large values of $\theta$; then both …rms tend to adapt higher levels of technology in the case of a CA. In particular, …rm B always adapts a larger $K_B$: On the contrary, when $\theta$ is low, then a JV is superior. Indeed, in a CA …rm B obtains the transfer even if its know-how is not the most relevant.

### 4.3.4 Comparative static analysis

In a context in which it is not possible to contract on the know-how to be provided, the optimal levels of $K_A$ and $K_B$ have to be stimulated through the pay-o¤s that partners get. Moreover, the relevance of $K_A$ and $K_B$ for the project is not homogeneous as it is parameterized by $(1 - \theta)$ and $\theta$: Therefore, in order to maximize e¢ciency, the total pay-o¤ of the alliance should be shared between the partners in a way which is consistent with these parameters: However, this is not possible in the framework under analysis. In a JV the distribution of the pay-o¤ is …xed: …rm A obtains a share $\frac{1}{1+s}$ of the total pay-o¤, while B obtains $\frac{s}{1+s}$: In a CA this distribution is altered because of the transfer. However, the sign (i.e. the identity of the …rm which pays) and the amount of the transfer are in‡uenced by $s;\pm_A;\pm_B$ and, therefore, they are not necessarily consistent with $\theta$ and $(1 - \theta)$:

For reasons of tractability, I use numerical examples to point out the e¤ects of changes in $s;\pm_A;\pm_B$ on the cut-o¤ point $\bar{\theta}(s;\pm_A;\pm_B)$ and, therefore, on the likelihood that a CA or a JV is chosen.

The effect of $\pm_B$

In Table 1, I fix $s = 1$, $\pm_A = 0{:}5$ and consider values of $\pm_B$ larger than $\pm_A$: [10] As shown, $\bar{=}(s;\pm_A;\pm_B)$ is always larger than 0:5. This means that a JV can be superior because of two reasons. When $\bar{} < 0{:}5$; $K_A$ is the most relevant know-how and, therefore, the transfer that A pays in case of a CA has always a detrimental effect on efficiency. When $\bar{} > 0{:}5$; the transfer has a correct sign ($K_B$ is the most relevant know-how) but it might be "too large". Indeed, the magnitude of T is influenced by $s;\pm_A;\pm_B$ and it might be excessive when $\bar{}$ is just slightly larger than 0:5. As an extreme example, consider $\bar{} = 0{:}5$: In this case, partners are perfectly alike and efficiency would require that they equally split the total pay-off; this occurs in a JV while in a CA firm B receives a positive transfer.[11] Closely linked with this, is the other result I want to stress. The cut-off point $\bar{=}(s;\pm_A;\pm_B)$ increases with $\pm_B$: That is, the more $\pm_B$ increases beyond $\pm_A$ the smaller the set of $\bar{}$s for which a CA is superior. From lemma 4, the transfer increases in $\pm_B$: Therefore, the greater the difference between $\pm_B$ and $\pm_A$ the more likely that the transfer is "too large" in the sense stressed above.

Table 1: the effect of $\pm_B$

| | |
|---|---|
| $\pm_B = 0{:}6$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}518$ |
| $\pm_B = 0{:}7$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}537$ |
| $\pm_B = 0{:}8$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}556$ |
| $\pm_B = 0{:}9$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}575$ |

The effect of $\pm_A$

Changes in $\pm_A$ have a similar effect as those of $\pm_B$ and the intuition is alike. In Table 2, I fix $s = 1$, $\pm_B = 0{:}5$ consider values of $\pm_A$ lower than $\pm_B$: Similarly to the previous case $\bar{=}(s;\pm_A;\pm_B)$ is slightly greater than 0:5: However, $\bar{=}(s;\pm_A;\pm_B)$ is a decreasing function of $\pm_A$: That is, as $\pm_A$

[10] Recall that I am considering the case where $s < \frac{1-\pm_A}{1-\pm_B}$ and when $s = 1$ this implies $\pm_B > \pm_A$:

[11] For instance, B receives a $T = 0{:}024$ when $\pm_B = 0{:}6$:

becomes closer to $\pm_B$; then a CA is preferred for a larger set of $\bar{}$s. Indeed, from lemma 4, the transfer is decreasing in $\pm_A$

Table 2: the e¤ect of $\pm_A$

| | |
|---|---|
| $\pm_A = 0{:}1$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}575$ |
| $\pm_A = 0{:}2$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}556$ |
| $\pm_A = 0{:}3$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}537$ |
| $\pm_A = 0{:}4$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}518$ |

The e¤ect of s

Lastly, I consider the e¤ect of changes in s: Discussing lemma 5, I have pointed out that when s is very small then in a CA the equilibrium levels of $K_A$ and $K_B$ are larger and, therefore, this organizational mode is superior. Indeed, in this case, the only way to induce …rm B to provide its know-how is that of redistributing the overall pay-o¤ through a transfer to this …rm. This result is con…rmed when considering some numerical examples. In Table 3, I …x $\pm_A = \pm_B = 0{:}5$ and consider values of s lower than 1:

Table 3: the e¤ect of s

| | |
|---|---|
| $s = 0{:}1$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}081$ |
| $s = 0{:}2$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}146$ |
| $s = 0{:}3$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}207$ |
| $s = 0{:}4$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}264$ |
| $s = 0{:}5$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}314$ |
| $s = 0{:}6$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}360$ |
| $s = 0{:}7$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}401$ |
| $s = 0{:}8$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}437$ |
| $s = 0{:}9$ | $\bar{=}(s;\pm_A;\pm_B) = 0{:}470$ |

When s is very low, then a CA is nearly always preferred. That is, a JV is superior only in the cases in which $K_A$ is basically the only relevant know-how for the project. For instance when

$s = 0{:}1$ a JV is preferred only when $\bar{} < 0{:}081$: As s increases then the need of redistributing the pay-o¤s in favor of …rm B becomes less important. Therefore, as s enlarges, the set of $\bar{}$s for which a CA is preferred shrinks. That is, $^{=}(s; \pm_A; \pm_B)$ increases with s:

## 4.4 Concluding Remarks

In this chapter, I have compared the performances of two typical modes of organizing alliances in a context in which the di¤erent absorptive capabilities of the partners may alter their bargaining positions. The formal di¤erence on which I have focused is the resulting ownership rights structure on a prototype. I claim that a Joint Venture (JV) stands for the case in which partners are, de facto, co-owners of the prototype, while a Contractual Agreement (CA) represents the case in which each partner owns it individually. This di¤erence implies that, when partners decide about project's completion, then only in the CA case a bargaining process takes place. During this phase the …rm with the largest absorptive capacity bene…ts from a transfer. I have proved that a CA tends to be superior when the partner whose contribution is most valuable for the project is the one that obtains the transfer. On the contrary, a JV performs better. Moreover, since the transfer is closely linked with the partners' absorptive capacities and not with the relevance of their contributions, I have checked that choosing a CA might be particularly hazardous when partners have asymmetric abilities to absorb know-how.

Before concluding, let me stress a couple of remarks. Firstly, the model is better suited for the case of non-rival partners. Indeed, in the model, it is always dominant for …rms to complete the project jointly. Were the …rms rivals, each of them would bene…t from the partner not completing the project.[12] Secondly, the model is very stylized. The only di¤erence between a JV and a CA on which I have focused is the resulting distribution of property rights on a prototype. In this way, I have neglected some of the alleged di¤erences between these two forms of governance as pointed out in chapter 3.

[12] See Kesteloot and Veugelers (1994) on this point.

## 4.5 Appendix

Proof of Lemma 5

Call $diff^A \equiv \left[K_A^{CA} - K_A^{JV}\right]$ where $K_A^{CA}$ and $K_A^{JV}$ are de…ned by (4.1) and (4.2) respectively. Condition $diff^A \geq 0$ holds if $(2-\gamma)\ln Q + \gamma \ln \frac{R}{s} \geq 0$:

Condition (A1) assures that $\frac{\partial diff^A}{\partial} > 0$ and $diff^A|_{\gamma=0} < 0$: Moreover, $diff^A|_{\gamma=1} > 0$ if $\left[1-\pi_B^2\right]s^2 + 2(\pi_A\pi_B - 1)s + 1 - \pi_A^2 > 0$: This last expression is convex in s with roots $\frac{1-\pi_A}{1-\pi_B}$ and $\frac{1+\pi_A}{1+\pi_B}$:

Similarly, call $diff^B \equiv \left[K_B^{CA} - K_B^{JV}\right]$ where $K_B^{CA}$ and $K_B^{JV}$ are de…ned by (4.1) and (4.2) respectively. Condition $diff^B \geq 0$ holds if $(1-\gamma)\ln Q + (1-\gamma)\ln \frac{R}{s} \geq 0$:

Condition (A1) assures that $\frac{\partial diff^B}{\partial \gamma} > 0$ and $diff^B|_{\gamma=1} > 0$: Moreover, $diff^B|_{\gamma=0} > 0$ if $\left[1-\pi_B^2\right]s^2 + 2(\pi_A\pi_B - 1)s + 1 - \pi_A^2 > 0$: This last expression is convex in s with roots $\frac{1-\pi_A}{1-\pi_B}$ and $\frac{1+\pi_A}{1+\pi_B}$:Q:E:D.

Proof of Proposition 7

Let $\pi_i^m$ denote the equilibrium pay-o¤ of …rm $i = A, B$ when the organizational mode of the partnership is $m = CA, JV$: a CA is chosen if $\left[\pi_A^{CA} + \pi_B^{CA}\right] - \left[\pi_A^{JV} + \pi_B^{JV}\right] \geq 0$: Manipulating the equilibrium pay-o¤s, one can check that this condition implies that a CA is selected if $\gamma \ln \frac{R}{s} + (1-\gamma)\ln Q + \ln \frac{Q(1+\gamma)+R(2-\gamma)}{(1+\gamma)+s(2-\gamma)} \geq 0$: I denote $Diff$ this last expression; that is $Diff \equiv \gamma \ln \frac{R}{s} + (1-\gamma)\ln Q + \ln \frac{Q(1+\gamma)+R(2-\gamma)}{(1+\gamma)+s(2-\gamma)}$: Next I will prove that there exists a unique $\bar{\gamma}(s;\pi_A;\pi_B) \in (0;1)$ such that $Diff = 0$ and that $Diff > 0$ if $\gamma > \bar{\gamma}(s;\pi_A;\pi_B)$:

Condition (A1) assures that: $\lim_{\gamma \to 0} Diff < 0$ and $\lim_{\gamma \to 1} Diff > 0$. Therefore, to end the proof I need to check that $\frac{\partial Diff}{\partial \gamma} > 0$ for any $\gamma \in (0;1)$ and for all the relevant values of the parameters: $\pi_A \in [0;1]$; $\pi_B \in [0;1]$; $s \geq 0$; $s < \frac{1-\pi_A}{1-\pi_B}$. Two helpful results are the following: $\frac{\partial\left(\frac{\partial Diff}{\partial \gamma}\right)}{\partial \pi_A} < 0$ and $\frac{\partial\left(\frac{\partial Diff}{\partial \gamma}\right)}{\partial \pi_B} \geq 0$ with equality holding if $s = 0$:[13]

Manipulating the expressions, then conditions $s \geq 0; s < \frac{1-\pi_A}{1-\pi_B}$ imply that $\pi_A < 0$; while, $s < \frac{1-\pi_A}{1-\pi_B}$ can be re-written as $\pi_B > 1 - \frac{1-\pi_A}{s}$: Therefore, I need to check that $\frac{\partial Diff}{\partial \gamma} > 0$ for

[13] The derivation of these results is long and tedious, therefore I skip it. However, a complete proof is available upon request.

any $\bar{} \in (0;1)$ and for $\pm_A \in [0;1]; \pm_B \in [0;1]; s \geq 0; s < \frac{1 \dot{} \pm_A}{1 \dot{} \pm_B}$. Moreover note that $1 \dot{} \frac{1 \dot{} \pm_A}{s} < 1$ for any $\pm_A \in [0;1)$ while $1 \dot{} \frac{1 \dot{} \pm_A}{s} \geq 0$ i¤ $\pm_A \geq 1 \dot{} s$: Consider two cases:

- $\pm_A \geq 1 \dot{} s$; note that since $\pm_A \in [0;1)$; then it has to be $s > 0$: Therefore, I need to check that $\frac{@Diff}{@\bar{}} > 0$; for $\pm_A [1 \dot{} s;1); \pm_B \in \left[1 \dot{} \frac{1 \dot{} \pm_A}{s}; 1\right]$ and $s > 0$: One can check that $\frac{@Diff}{@\bar{}} c_{\pm_B = \left(1 \dot{} \frac{1 \dot{} \pm_A}{s}\right)} = 0$ and therefore using the fact that $\frac{@\frac{@Diff}{@\bar{}}}{@\pm_B} > 0$ for any $s > 0$; then $\frac{@Diff}{@\bar{}} > 0$ in this case;

- $\pm_A < 1 \dot{} s$; note that since $\pm_A \in [0;1)$; then it has to be $s < 1$: Therefore, I need to check that $\frac{@Diff}{@\bar{}} > 0$; for $\pm_A \in [0;1 \dot{} s); \pm_B \in [0;1]$ and $s \in [0;1)$: One can check that $\frac{@Diff}{@\bar{}} c_{\pm_A = (1 \dot{} s); \pm_B = 0} = 0$; and therefore using $\frac{@\frac{@Diff}{@\bar{}}}{@\pm_A} < 0$ and $\frac{@\frac{@Diff}{@\bar{}}}{@\pm_B} \leq 0$ for $s \geq 0$; then $\frac{@Diff}{@\bar{}} > 0$ in this case. Q:E:D:

# Bibliography

[1] Cohen, W. and D. Levinthal (1989), “Innovation and Learning: the Two faces of R&D”, Economic Journal, 99, 569-596.

[2] Gulati, R. (1995), “Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances”, Academy Management Journal, 38(1), 85-112.

[3] Hamel, G. (1991), “Competition for Competence and Interpartner Learning within International Strategic Alliances”, Strategic Management Review, 12, 83-103.

[4] Hagedoorn, J. (1993), “Understanding the Rationale of Strategic Technological Partnering: Interorganizational Modes of Cooperation and Sectoral Di¤erences”, Strategic Management Journal, 14, 371-385.

[5] Hagedoorn, J and R. Narula (1996), “Choosing Organizational Modes of Strategic Technology Partnering: International and Sectoral Di¤erences”, Journal of International Business Studies, 27, 265-284.

[6] Kesteloot, K. and R. Veugelers (1994) “Stable R&D Cooperation with Spillovers”, Journal of Economics and Management Strategy, 4, 651-672.

[7] Osborn, R. and C. Baughn (1990), “Forms of Interorganizational Governance for Multinational Alliances”, Academy of Management Journal, 33 (3), 503-519.

[8] Pérez-Castrillo, D. and J. Sandonís (1996), “Disclosure of Know-How in Research Joint Ventures”, International Journal of Industrial Organization, 15, 51-75.

[9] Pastor, M. and J. Sandonís (2001), “Research Joint Ventures vs Cross Licensing Agreements: An Agency Approach”, International Journal of Industrial Organization, forthcoming.

[10] Pisano, G. (1989), “Using Equity Participation to Support Exchange: Evidence from the Biotechnology Industry”, Journal of Law, Economics and Organization, 1, 109-126.

[11] Prahalad, C. and G. Hamel (1990), “The Core Competence and the Corporation”, Harvard Business Review, May-June, 71-91.

[12] Tao, Z. and C. Wu (1997), “On the Organization of Cooperative Research and Development: Theory and Evidence”, International Journal of Industrial Organization, 15, 573-596.

# Chapter 5

# Flexibility and Commitment When Searching a Partner[1]

## 5.1 Introduction

As reported in chapter 3, one of the principal motives that induces …rms to cooperate is the need of complementary capabilities. Hagedoorn (1993) points out that faced with "...the increased complexity and intersectoral nature of new technologies and the cross-fertilization of scienti…c disciplines ... even very large and diversi…ed …rms may lack some competence". In this chapter, I focus on this type of alliances and I relate the governance form that partners choose to the typology of the project that they are pursuing and to the characteristics of the sector in which the alliance takes place.

As already pointed out, the typical approach employed by the economic theory when dealing with the governance form of alliances is that of distinguishing two broad categories: Joint Ventures and Contractual Agreements. According to Chiesa and Manzini (1998) and Contractor and Lorange (1988) the comparison between these two forms is nothing but a comparison between commitment and ‡exibility.[2] In case of a Joint Venture, partners create a new structure

[1]I would like to thank my advisor David Perèz-Castrillo, Petr Mariel, Michele Moretto, Antonio Nicolò, Joel Sandonìs and the participants to the workshops at Universidad del Pais Vasco, Bilbao and Università di Padova for helpful comments. I acknowledge Reinhilde Veugelers and the project FWO spillovers 6.0131.98 at the Katolieke Universiteit of Leuven for the use of the K.U. database.

[2]Similar considerations are found in other studies such as Hagedoorn and Narula (1996), Hagedoorn (1996)

where they jointly work at the common project. This solution requires a substantial commitment both in organizational as well as in …nancial terms. Conversely, Contractual Agreements have a more limited impact on the partners' organizations, they usually require a smaller investment and are more easily amended both in terms of modifying the initial objectives and scope of the alliance as well as in terms of exiting it. However, it is claimed that these arrangements are characterized by a lower capacity of creating synergies between partners and by a more limited possibility of monitoring each other's behavior.

In section 2, I consider a pool of …rms willing to form alliances. Ex-ante, all …rms look alike and each of them ignores some of the characteristics of the others. In particular, it ignores whether the potential partners possess the technological and organizational characteristics required to undertake a common project. I say that each …rm is uncertain about the …t level it has with any of the other companies. I interpret the …t level just as the technological or organizational quality of the match between a couple of …rms; that is, I assume that it is not related to the ability or e¢ciency of the companies. Partners decide about two things. At the very beginning of the relationship, they choose the governance form for their alliance. I say that partners decide how many assets to invest. One can interpret this choice as an investment in organization. In this way, in light of what claimed by Chiesa and Manzini (1998) and Contractor and Lorange (1988), large investment can be thought as Joint Ventures and small ones as Contractual Agreements. The invested assets are assumed to be alliance-speci…c and, therefore, irreversible. Uncertainty about the …t level resolves while cooperating. That is, I assume that after cooperating for some time, a couple of …rms learns the quality of the match. Conditional on this information, partners decide whether to continue together or to separate and search better matches. Clearly, the latter choice prevails when the observed …t level is particularly low. However, when separating, partners lose the invested assets.

The model combines the tools of two strands of economic literature: irreversible investment under uncertainty and search theory. The objective of the …rst literature is that of studying the optimal investment behavior in changing and uncertain environments.[3] The peculiar aspect of an alliance that these studies do not capture is that it is a match between two (or more)

and Osborn and Baughn (1990).

[3]See Dixit (1989) and Dixit and Pindyck (1994).

…rms. Therefore, even if, in general, many are the possible sources of uncertainty what is typical of an alliance is that there is an extra one due to the unknown quality of the match among the participating …rms. Search theory has been applied to many …elds of research and, in particular, to labor economics. The paper that is closest to mine is the one of Jovanovic (1979). This author considers a worker-…rm relationship in a context where both agents ignore the worker's productivity within the …rm. As time goes by, they observe a distorted signal of the productivity and it is proved that the probability of separating decreases with tenure. The main di¤erence with Jovanovic's paper is that I also consider an investment decision. That is, in my model, agents do not only decide if and when to separate but they also choose how many assets to devote to their relationship. The interpretation I give to the …t level of a couple of …rms is analogous to the one given to the worker's productivity by Jovanovic. As said, this is not related to the ability of the …rms but it is just a measure of the technological or organizational quality of the match. This assumption greatly simpli…es the analysis since it allows not considering any kind of reputation or adverse selection e¤ects. Indeed, the only information that can be inferred when two …rms separate is that their technological or organizational …t is not high enough.

The main result of the model is that the larger the uncertainty over the …t level the lower the incentives to invest in irreversible assets. Therefore, I expect that in contexts in which uncertainty is substantial, …rms relatively prefer Contractual Agreements to Joint Ventures. The intuition for this result is rather simple. The larger the uncertainty, the higher the probability of matching a partner with a low …t level. This means that, in more uncertain contexts, the probability of separation and, thus, the probability of losing the investment is larger. This fact has clearly a detrimental e¤ect on the incentives to invest.

In section 3, I test this prediction using a database on alliances that has been created at the Katolieke Universiteit of Leuven. In particular, I consider that uncertainty relates to two variables: the typology of the project pursued by the alliance and the characteristics of the sector in which this takes place. The empirical tests give a …rst and rough con…rmation to the results of the model. Indeed, the proportion of Contractual Agreements that is chosen is signi…cantly larger in cases where uncertainty is supposed to be higher; that is, when the alliance is formed to pursue an R&D rather than a production or distribution and marketing project

and when it takes place in an high tech rather than in a more mature sector. With respect to this second point, I need to stress that a similar result has already been presented in a series of empirical studies. For instance, according to Hagedoorn and Narula (1996) "Joint Ventures are disproportionately represented in relatively mature industries. Contractual alliances dominate strategic technology partnering in so-called high-tech industries".[4]

The model I present shares some features with the one proposed by Rauch and Watson (1999). These authors …nd that the higher the riskiness associated with a partner the more the …rm prefers to start small; that is, run a pilot project that reveals additional information so that the investment in the large project can be conditioned upon this news. However, it is not possible to directly infer from this result that for riskier types of projects or in riskier sectors …rms prefer to start small. Indeed, the analysis of Rauch and Watson is done by comparing the optimal decision when facing two partners characterized by di¤erent levels of riskiness under the assumption that, in case of separation, the …rm will look for a new allied by searching in a common pool of potential partners. That is, the value of searching is common in the two cases. My claim is that the value of searching depends on the context (i.e. the typology of the project or the sector) in which this process takes place.[5] If the value of searching depends positively on the riskiness of the sector, the result of Rauch and Watson could even be reversed. Indeed, the alternatives to starting small (run directly the large project or search a new partner right away) bene…t more of an increase of the value of search.

This chapter is organized as follows. In section 2, the model and the main results are presented. In section 3, an empirical evaluation of the principal prediction of the model is o¤ered. The last section is devoted to the concluding remarks.

## 5.2 The Model

I consider a continuum of …rms willing to form alliances. Ex-ante, all …rms look alike and each of them ignores some of the characteristics of the others. In particular, when forming an alliance each …rm is uncertain about the …t level it has with the partner. The only available

[4]On this point, see also Hagedoorn (1996), Narula and Hagedoorn (1997) and Osborn and Baughn (1990).

[5]Note, however, that the relation between the investment level and the typology of the project or the sector in which partners operate is not in the agenda of Rauch and Watson.

information is that this is a random variable $\mu \sim U(1-\varepsilon;1)$; with $\varepsilon \in (0;1)$ being a known constant. Clearly, the higher $\varepsilon$ the larger the uncertainty about the …t level.[6]

Firms play an in…nite periods game in discrete time. At each period, the sequence of moves is as follows. At the beginning, …rms form alliances by randomly matching in couples. Just after matching, and still ignoring the realization of $\mu$; each couple (alliance) chooses how many assets, $a$; to invest; that is, it chooses the governance form. The investment is assumed to be alliance speci…c and, therefore, irreversible.[7] The cost of the investment is $\frac{c}{2}a^2$: At the end of the period, …rms observe $\mu$ and, conditional upon this information, they decide whether to continue together or to separate. In this latter case, $a$ is lost and …rms pay a search cost, $s$; to be re-matched to other partners and form new alliances. Changing partner involves drawing a new $\mu \sim U(1-\varepsilon;1)$: This implies that the …t level just relates to the technological or organizational …t of a couple of …rms. Therefore, learning the $\mu$ that characterizes the match with the current partner is uninformative with respect to the …t level with any other …rm. Formally, this means that the …t level of a couple of …rms, say $i$ and $j$; is assumed to be independent of that characterizing any other couple, say $i$ and $z$:

The pay-o¤ that partners obtain depends on their …t level an on the amount of assets invested. In particular, at each period, partners earn an overall pay-o¤ $\theta\mu + a$, where parameter $\theta$ is a measure of the impact of the …t level. Using a separable pay-o¤ function allows concentrating on the e¤ects of uncertainty (as measured by $\varepsilon$) and irreversibility of the assets on the incentives to invest. In this way, I rule out any "technological" aspect that might a¤ect the choice of $a$: That is, with a separable pay-o¤ function, the marginal productivity of $a$ does not depend on $\varepsilon$.[8]

Throughout the paper, I assume that the partners of an alliance equally split earnings and costs, that the investment $a$ is perfectly contractible and no asymmetry of information about $\mu$

[6] An increase in $\varepsilon$ also implies a lower expected …t level. Indeed, $E[\mu] = \frac{2+\varepsilon}{2}$: I will comment more about this point in subsection 2.2.

[7] Complete irreversibility of the investment is an extreme assumption but it greatly simpli…es the analysis. Moreover, any degree of alliance speci…city of the investment (i.e. any degree of irreversibility) would let the argument of the paper go through.

[8] Moreover, this functional form can be thought as a reduced form of the supposed advantages of investing in organization. The larger the commitment (i.e. the larger $a$), the larger the pay-o¤ given the synergies and the enhanced monitoring capabilities. As said in chapter 3, these are the supposed advantages that Joint Ventures have with respect to Contranctual Agreements.

exists. Under these assumptions the objectives of the …rms involved in an alliance are perfectly aligned and, therefore, considering the optimal decision at the …rm or at the alliance level is analogous. I will focus on the alliance level.

### 5.2.1 Solving the Model

To characterize the equilibrium of the game, one needs to determine the optimal behavior of an alliance both when choosing the investment level and when deciding about continuation or separation. Let $V$ denote the value of an alliance when partners are about to choose $a$ and still ignore the realization of $\mu$. I will also refer to $V$ as the value of searching, that is how worthy (gross of the search costs) it is to look for new partners. Moreover, let $V(a;\mu)$ denote the value of an alliance when …rms choose about continuation or separation. That is, $V(a;\mu)$ says how worthy an alliance is once $a$ has been sunk, $\mu$ has been observed and partners can decide whether to continue together or to separate.

Continuing together, …rms earn $\bar{\mu} + a$ per period, discounting future pay-o¤s at a rate $\pm \in (0;1)$: Therefore, the pay-o¤ of this strategy is $\frac{\bar{\mu}+a}{1-\pm}$: If they separate, then each of them pays half of the search costs, and, with one period of delay, it is matched with a new …rm with …t level $\mu \sim U(1-\varepsilon;1)$: This means that, by separating, each …rm pays $\frac{s}{2}$ and obtains $\frac{\pm V}{2}$: Therefore, the value of an alliance when choosing about continuation or separation is:

$$V(a;\mu) = \max\left\{\frac{\bar{\mu}+a}{1-\pm}; -s + \pm V\right\} \tag{5.1}$$

The pay-o¤ when continuing together is an increasing function of the observed …t level, while the pay-o¤ from separating is not a¤ected by the current value of $\mu$: Therefore, the decision about continuation or separation is characterized by a trigger value of $\mu$: More formally:

$$V(a;\mu) = \begin{cases} \frac{\bar{\mu}+a}{1-\pm} & \text{if } \mu > \bar{\mu}(a) \\ -s + \pm V & \text{if } \mu \leq \bar{\mu}(a) \end{cases};$$

$$\text{where } \bar{\mu}(a) = \begin{cases} 1 \text{ if } \frac{(\iota s+\pm V)(1\iota\pm)\iota a}{} \geq 1 \\ \frac{(\iota s+\pm V)(1\iota\pm)\iota a}{} \text{ if } \frac{(\iota s+\pm V)(1\iota\pm)\iota a}{} \in (1\iota";1) \\ 1\iota" \text{ if } \frac{(\iota s+\pm V)(1\iota\pm)\iota a}{} \leq 1\iota" \end{cases}$$

If the observed …t level is large enough ($\mu > \bar{\mu}(a)$), then it is optimal for partners to continue together. On the contrary, when $\mu$ is lower than the trigger value $\bar{\mu}(a)$, they separate and look for new partners. As highlighted in expression (5.1), the larger s and a the less likely that separation occurs.[9] The e¤ect of search costs is straightforward. The larger the cost of looking for new partners the lower the willingness to do so. The e¤ect of the invested assets is due to its irreversible nature. Separating has an opportunity cost since partners give up the bene…ts that the investment is going to generate. The larger a the costlier to separate. These arguments imply that s and a are both sources of lock-in for the partners.

The value of an alliance when partners are about to choose a is:

$$V = \max_{\tilde{A}} \bar{E}[\mu] + a\iota\frac{c}{2}a^2 + \pm\left[\text{prob}\left(\mu \leq \bar{\mu}(a)\right)(\iota s + \pm V) + \text{prob}\left(\mu > \bar{\mu}(a)\right)\frac{a + \bar{E}\left[\mu/\mu > \bar{\mu}(a)\right]}{1\iota\pm}\right] \tag{5.2}$$

The function V is composed of two parts. The …rst is the current period expected pay-o¤ net of the investment costs. The second, displayed into brackets, is the pay-o¤ that partners expect from next period on. From (5.1), they know that whenever the observed $\mu$ is lower than the trigger value $\bar{\mu}(a)$; then they will separate. On the contrary, for values of $\mu$ larger than $\bar{\mu}(a)$; the partnership will last forever.

Note that, V stays constant over time and, therefore, (5.1), (5.2) correctly de…ne the maximization problems faced a couple of …rms, if, at the end of each period, a continuum of alliances chooses to separate. In this way, the probability of being re-matched with the current partner is zero. This occurs provided that the following conditions hold:

$$^2 \text{ (A1): } s < \frac{(\iota 2(1\iota\pm)+"(2\iota\pm))\bar{}}{2(1\iota\pm)};$$

[9] This argument is some imprecise in that V depends on s and, therefore, it is not exogenous.

² (A2): $c > \frac{\pm}{¡\ ^{-}"\pm^2+2s\pm^2+2^{-}\pm^2+^{-}"\pm+^{-}"}$:

It would be easy to check that in case that either (A1) and/or (A2) are violated, then the optimal investment is such that no alliance chooses to separate. When (A1) does not hold, then search costs are so high that it is too costly to change partner. When it is (A2) not to hold, then the cost of the investment is so low that a is the only relevant component of the pay-o¤. Therefore, restricting the analysis to the cases in which both (A1) and (A2) are satis…ed means getting rid of the situations in which μ and the inherent uncertainty plays no substantial role.[10]

Next proposition characterizes the equilibrium of the game under (A1) and (A2).[11]

Proposition 8 Assuming that (A1) and (A2) are satis…ed, then, at any period, the equilibrium of the game is characterized by the following sequence of events:

i) at the beginning of the period, …rms match in couples and form alliances;

ii) each alliance chooses a¤ as de…ned in the appendix;

iii) at the end of the period, a continuum of i.i.d. random variables μ is realized and a proportion equal to $\text{prob}\left(\mu \cdot \bar{\mu}(a^{¤})\right)$ has a value lower than $\bar{\mu}(a^{¤})$;

iv) all the alliances with a μ larger than $\bar{\mu}(a^{¤})$ continue together, while all the alliances with a μ lower than $\bar{\mu}(a^{¤})$ separate and the involved …rms restart the game.

Proposition 8 states that, in equilibrium, at each period, a proportion of alliances continues together while another proportion separates. Firms involved in the alliances that separate re-start the game, that is, they look for new partners.

In the following corollary, I qualify the e¤ect of " on the optimal investment.

Corollary 5 The optimal level of investment a¤ is decreasing in ":

Corollary 5 points out that the larger the uncertainty over the …t level, the lower the incentives to invest in an alliance. The intuition of this result is quite simple. The probability

[10] When (A1) and (A2) do not hold the optimal investment is $\frac{1}{c(1¡\pm)}$ and no alliance ever separates. Therefore, any of the partners' choices is una¤ected by μ and ":

[11] Note that all alliances choosing $a = \frac{1}{c(1¡\pm)}$ and none of them separating is another equilibrium. However, under (A1) and (A2) one would get rid of this equilibrium just by assuming that at each period some new …rms enter the pool of potential partners.

that $\mu$ turns out to be low increases with $\varepsilon$: Therefore, when $\varepsilon$ is high the probability of separation and, then, the probability of losing the alliance speci…c investment at the end of the current period is large.

Corollary 6 stresses other two properties of $a^{\alpha}$:

Corollary 6 The optimal level of investment $a^{\alpha}$ is:

i) increasing in $s$;

ii) decreasing in $\bar{\ }$:

As mentioned when discussing (5.1), search costs lock partners into the alliance thus reducing their willingness to separate. This fact implies that an high $s$ stimulates large investments. Indeed, with an high probability partners will stay together even after observing $\mu$ and the invested assets will be productive beyond the current period (part i) of corollary 6).[12] A small $\bar{\ }$ lowers the incentives to search new partners with a larger $\mu$: Therefore, its e¤ect is that of lowering the likelihood of separation. This implies that the willingness to invest in an alliance enlarges as $\bar{\ }$ decreases (part ii) of corollary 6).

### 5.2.2 A Generalization of the Results

In the analysis made so far, I have neglected the fact that an increase in $\varepsilon$ does not only enlarge uncertainty about $\mu$ but it also decreases its expected value. Thus, implicitly, I have assumed that more uncertain contexts are also less pro…table ones. However, in this subsection, I prove that this implicit assumption does not a¤ect the qualitative results of corollary 5. I assume that the impact of the …t level on the pay-o¤ is a function of the level of $\varepsilon$; that is, $\bar{\ }(\varepsilon)$: Considering the case in which $\bar{\ }(\varepsilon)$ is increasing, in more uncertain contexts the lower expect value of $\mu$ is compensated by a larger $\bar{\ }(\varepsilon)$ : Therefore, when making comparative static analysis with respect to $\varepsilon$ ,one would consider scenarios in which alliances have similar pro…tability. For instance, when $\bar{\ }(\varepsilon) = \frac{1}{2i\varepsilon}$; the expected value of the …t level for the alliance, $E[\bar{\ }(\varepsilon)\mu]$; is equal to $\frac{1}{2}$ independently of $\varepsilon$:

[12] Rauch and Watson (1999) obtain an opposite result. That is, in their model, the larger the search costs the more likely it is that …rms start small. This di¤erence in the results stems from the fact that in their set up the investment is not productive but it is just a kind of "entry fee" that has to be paid in order to run the large project.

For sake of generality, I also consider that the search costs might depend on $\varepsilon$; that is, $s(\varepsilon)$: In this case, the result that I obtain is the following:

Corollary 7 When $\bar{\gamma}(\varepsilon)$ and $s(\varepsilon)$ are functions of $\varepsilon$; the optimal level of investment $a^{\alpha}$ decreases in $\varepsilon$ provided that:

$$H > 2G\frac{\partial s(\varepsilon)}{\partial \varepsilon} - F\frac{\partial \bar{\gamma}(\varepsilon)}{\partial \varepsilon}; \tag{5.3}$$

where F, G and H are positive expressions defined in the appendix.

Corollary 7 generalizes the results of corollary 5: in highly uncertain contexts firms have a lower willingness to invest in irreversible assets. Stated in words, condition (5.3) requires both $s(\varepsilon)$ to be "not too increasing" and $\bar{\gamma}(\varepsilon)$ to be "not too decreasing": An intuition of why this condition is required can be derived from corollary 6. As said, larger search costs lock partners into the alliance thus increasing their willingness to invest. Therefore, search costs should be "not too increasing" otherwise their effect might compensate that of uncertainty. Similarly, when $\bar{\gamma}(\varepsilon)$ is low partners have no incentives to look for better matches and this induces them to invest more in the current alliance. Therefore, the requirement that $\bar{\gamma}(\varepsilon)$ is "not too decreasing" is to limit the effect of a lower value of searching. However, this is a mild assumption. Indeed, as said above, if, on the contrary, $\bar{\gamma}(\varepsilon)$ is decreasing projects characterized by a larger $\varepsilon$ are not only more uncertain, but also overall less profitable. Therefore, making comparative static analysis with respect to $\varepsilon$ would mean comparing inherently very different alliances. A more "fair" comparison would be that of considering alliances of similar profitability.

An implication of the analysis above is:

Corollary 8 Assuming that condition (5.3) is satisfied, the proportion of alliances that separate, that is $prob\left[\mu \cdot \bar{\mu}(a^{\alpha})\right]$; increases with $\varepsilon$:

This last result implies that, under the same conditions as in corollary 7, for projects characterized by a larger $\varepsilon$ the turnover is more intense. This is due to two effects that reinforce each other. On the one hand, the probability of separating is per se increasing in $\varepsilon$: Indeed, think about the extreme case in which $\varepsilon = 0$; then, in this situation, separation would never

occur. On top of this, there is the investment e¤ect. The larger " the lower a¤ and therefore the less partners are locked into the alliance.

## 5.3 Empirical Evidence

The main hypothesis that can be derived from the model is contained in corollary 5. In light of what has been stressed by Chiesa and Manzini (1998) and Contractor and Lorange (1988), this result can be interpreted in the following way: the larger " the less partners prefer to invest in organization. Therefore, contexts in which uncertainty is supposed to be substantial are expected to be dominated by Contractual Agreements rather than Joint Ventures.

In this section, I test this prediction using a database on alliances constructed at the Katolieke Universiteit of Leuven. A more accurate analysis is presented in the next chapter of this thesis.

### 5.3.1 Description of the database

The data has been collected by recording the announcements of alliances' formation as they appeared in the Financial Times. Four years have been investigated, from 1993 to 1996, and, overall, information about 1344 alliances has been recorded. Alliances are classi…ed according to the governance form that partners chose: Joint Venture, when the agreement led to the creation of a new …rm, Contractual Agreement, in the other cases. Moreover, a description of the activities undertaken by the alliance is present. These are categorized into three groups: R&D, production and distribution and marketing activities. In addition, a sectoral classi…cation of both the activities of the alliance and the core businesses of the participating …rms is included. These are based on the Nace codes at the 3-digits level.

### 5.3.2 Testing procedure

I test the hypothesis of the model considering two di¤erent variables. Firstly, I consider that " relates to the typology of the project that the alliance undertakes. In this case, I check whether

there is a signi…cant di¤erence across projects' typologies and the proportion of Joint Ventures and Contractual Agreements that partners have chosen. Secondly, focusing just on the alliances that carry out R&D activities, I concentrate on the characteristics of the sector in which the alliance takes place. In particular, I consider that " is related to the "level of sophistication" of the sector. In this case, I test whether there is a signi…cant di¤erence across sectors and the proportions of Joint Ventures and Contractual Agreements. In both cases I apply the $\hat{A}^2$ test of non-parametric statistic.

### Type of activities carried out in the alliance

The database categorizes the activities undertaken by the alliances into three groups: R&D, production and distribution and marketing. In this case, I test whether the proportions of Joint Ventures and Contractual Agreements that have been established varies in a signi…cant way in these three groups. In the analysis, I drop those alliances in which more than one activity was simultaneously carried out and, obviously, those for which the type of activity was unknown.[13]

It is commonly accepted that R&D activities are characterized by an high level of uncertainty. Consistently, I expect " to be higher for R&D alliances. Therefore, based on the theoretical model, I expect the proportion of Contractual Agreements being signi…cantly larger when R&D rather than production or distribution and marketing activities are carried out.

Table 1: Alliances classi…ed in terms of the activity undertaken

| | Joint Ventures | Contractual Ag. | Total |
|---|---|---|---|
| R&D activities | 37 | 95 | 132 |
| Production activities | 415 | 164 | 579 |
| Dist-Mark activities | 96 | 105 | 201 |
| Total | 548 | 365 | 912 |

From Table 1 it is immediate to check that this is the case. When R&D activities are in the agenda of the alliance, the number of Contractual Agreements (95) is nearly three times

[13]Overall, there are 381 alliances that carried out at least two between R&D, production and distribution and marketing activities. Moreover, for 51 alliances there was no information about the type of activity.

that of Joint Ventures (37). The contrary is true in case the alliance is formed to carry out production activities. At an intermediate place rests the case of distribution and marketing activities. Obviously the $\hat{A}^2$ test con…rms this di¤erence. The null hypothesis is that the relative proportion of Joint Ventures and Contractual Agreements do not vary across the three categories in a signi…cant way. The value of the test is 101:7 which means that the null hypothesis can be rejected with 99:5% con…dence.

However, some caution should be used when interpreting these results. Indeed, even if the di¤erence among R&D, production and distribution and marketing is evident, this might not only be caused by the argument given in the theoretical model. On the one hand, other factors could play a primary role. As an example, production alliances could require to set up a new plant and this might be more easily managed through a Joint Venture. On the other hand, as said in the introduction, that about the …t level is not the only source of uncertainty for the partners. Therefore, one should keep in mind that also other sources of uncertainty might be important determinants of the empirical …nding.

### Level of sophistication of the sector

The second exercise I want to perform is that of relating some features of the sector in which the alliance takes place to the form of governance. As said in the introduction, in a series of empirical studies it has been shown that Contractual Agreements tend to prevail in high tech sectors, while Joint Ventures in more mature ones. High tech or sophisticated are considered those sectors for which the ratio R&D expenditures to sales is high relative to the others. The intuition derived from the model I have presented goes in the direction of con…rming this empirical …nding. High tech sectors are typically those in which …rms having “distinct backgrounds” and endowed with very di¤erent capabilities ally. As Hagedoorn (1993) stresses “Here it is the growing interrelationship between ... computer science and process technologies; material science, electronics and chemistry ...”. Therefore, uncertainty over the …t level should be at its maximum levels (i.e. " should be largest) when the alliance takes place in high tech sectors.

To test the hypothesis that Contractual Agreements are signi…cantly more present in high

tech industries, I restrict the attention to R&D alliances and I classify them in high, mid and low tech using the same classi…cation as in Hagedoorn and Duyster (1999).[14] In high tech I include those alliances whose 3-digits Nace codes belong to sectors characterized by the largest levels of the R&D to sales ratio.

Table 2: R&D alliances classi…ed in terms of the level of sophistication of the sector

| | Joint Ventures | Contractual Ag. | Total |
|---|---|---|---|
| High-tech | 15 | 61 | 76 |
| Mid-tech | 11 | 26 | 37 |
| Low-tech | 11 | 8 | 19 |
| Total | 37 | 95 | 132 |

As one can check from Table 2, the prevalence of Contractual Agreements is clear in case of high tech sectors, while in low tech sectors there is a slight prevalence of Joint Venture. The $\hat{A}^2$ square test con…rms that there is a signi…cant di¤erence between the three groups. The value of the test is 11:04 which implies that the null hypothesis (the proportion between Joint Ventures and Contractual Agreements does not vary signi…cantly among the three groups) can be rejected with 99:5% con…dence.

## 5.4 Concluding Remarks

In this chapter, I have considered a stylized model of alliance formation in a context in which …rms are uncertain about their technological or organizational …t level. Partners decide about two things. Firstly, they decide how many assets to invest. Secondly, once they have learned their …t level they decide whether to continue together or to separate. I have proved that the larger the uncertainty the lower the incentives to invest in the alliance. I interpret this result in terms of the governance form that partners choose for their alliance. Therefore, I expect that the larger the uncertainty the more …rms prefer kinds of agreements that require lower levels of commitment. In the last part of the paper, I have tested the main prediction of the theoretical model using a database on alliances created at the Katolieke Universiteit of Leuven.

[14] See appendix for more details.

In particular, I have concentrated on two variables: the typology of project that the alliance undertakes and the characteristics of the sector in which this takes place. The empirical findings give a first and rough support to the prediction of the model. In cases in which uncertainty is likely to be large, partners have a stronger preference towards governance forms that require less commitment.

## 5.5 Appendix

### 5.5.1 Mathematical Appendix

Proof of Proposition 8.

I characterize the equilibrium of the game for the general case in which $\bar{\mu}(\varepsilon)$ and $s(\varepsilon)$ are functions of $\varepsilon$: Consider the optimal behavior of an alliance. Using backward induction:

iv) suppose that all the other alliances have invested a while the alliance under consideration has invested $a^0$ with $a^0$ possibly different from a: If $\bar{\mu}(a) < (1 - \varepsilon)$; then no other alliance separates and therefore neither the one under consideration will. If $\bar{\mu}(a) \geq (1 - \varepsilon)$; then (by iii)) a proportion $prob\left\{\mu < \bar{\mu}(a)\right\}$ of alliances has …t level lower than $\bar{\mu}(a)$: In equilibrium all these alliances separate. If the alliance under consideration separates then the involved partners will face a continuum of potential partners. Therefore, for each partner the value of dismissing the alliance is $\frac{1}{2}(-s(\varepsilon) + \pm V)$ and they will do it if $\mu < \bar{\mu}(a^0)$;

iii) given that all the …t levels are i.i.d. random variables, then the law of large numbers applies. When all the alliances have invested the same a; then a proportion $prob\left\{\mu \leq \bar{\mu}(a)\right\}$ have a …t level lower than $\bar{\mu}(a)$;

ii) in equilibrium all the other alliances invest the optimal a; $a^*$: Therefore, the alliance under consideration knows that at the end of this period a continuum of partnerships will be dismissed (a proportion $prob\left\{\mu \leq \bar{\mu}(a^*)\right\}$) so that (5.2) correctly de…nes its maximization problem. To characterize $a^*$ recall that: $E[\mu] = \frac{2-\varepsilon}{2}$; $prob\left\{\mu \leq \bar{\mu}(a)\right\} = \frac{\bar{\mu}(a)-(1-\varepsilon)}{\varepsilon}$; $E\left\{\mu | \mu \geq \bar{\mu}(a)\right\} = \frac{1+\bar{\mu}(a)}{2}$: For the probabilities to be well de…ned a has to belong to the interval

$((-s(\varepsilon) + \pm V)(1 - \pm) - \bar{c}(\varepsilon); (-s + \pm V)(1 - \pm) - (1 - \varepsilon)\bar{c}(\varepsilon))$: I …rst compute the optimal a and then check that indeed it belongs to the above interval.

The F.O.C of the maximization problem shown in (5.2) de…ne the optimal a given V: That is, $a(V) = \frac{\bar{c}(\varepsilon)\varepsilon - \bar{c}(\varepsilon)\varepsilon\pm + s(\varepsilon)\pm - s\pm^2 + \pm\bar{c}(\varepsilon) - \pm^2(1-\pm)V}{c\bar{c}(\varepsilon)\varepsilon(1-\pm)-\pm}$: Conditions (A1) and (A2) assure the concavity of the problem. Using $a(V)$; the optimal value of V becomes:

$V^* = \frac{-s(\varepsilon)\pm^3 c + c\bar{c}(\varepsilon)\pm^2 + s(\varepsilon)\pm^2 c - c\bar{c}(\varepsilon)\varepsilon\pm^2 - \pm + c\bar{c}(\varepsilon)\varepsilon - \sqrt{A}}{c\pm^3(1-\pm)}$; where

$A \equiv c^2\bar{c}(\varepsilon)^2\varepsilon^2 + \pm^2 + 2s(\varepsilon)\pm^2 c^2\bar{c}(\varepsilon)\varepsilon + 2c^2\bar{c}(\varepsilon)^2\pm^2\varepsilon - 2s(\varepsilon)\pm^3 c^2\bar{c}(\varepsilon)\varepsilon$

$+c^2\pm^3\bar{c}(\varepsilon)^2\varepsilon^2 - 2c^2\bar{c}(\varepsilon)^2\varepsilon^2\pm^2 - 2c^2\pm^3\bar{c}(\varepsilon)^2\varepsilon - 2c\bar{c}(\varepsilon)\varepsilon\pm - 2c\bar{c}(\varepsilon)\pm^3 - 2s(\varepsilon)\pm^3 c + c\bar{c}(\varepsilon)\varepsilon\pm^3$:

and A it is positive by conditions (A1) and (A2). Substituting $V^*$ in $a(V)$ it is possible to

de…ne the optimal investment level: $a^{\alpha} = -\frac{1}{c\pm} + \frac{\sqrt{A}}{c\pm(c^{-}(\varepsilon)\varepsilon(1-\pm)-\pm)}$: Using (A1) and (A2) one can check that indeed

$a^{\alpha} \; 2 \; ((-s(\varepsilon)+\pm V)(1-\pm) - {}^{-}(\varepsilon); (-s(\varepsilon)+\pm V)(1-\pm) - (1-\varepsilon){}^{-}(\varepsilon))$:Q:E:D:

Proof of Corollary 5, 6, 7

Di¤erentiating $a^{\alpha}$ with respect to $\varepsilon$ :

$$\frac{@a^{\alpha}}{@\varepsilon} = -\frac{\pm}{2}\frac{F\frac{@^{-}(\varepsilon)}{@\varepsilon} - 2G\frac{@s(\varepsilon)}{@\varepsilon} + H}{G\sqrt{A}}$$

where:

$F \acute{} (2\varepsilon + \pm(2-\varepsilon) + 2\varepsilon s(\varepsilon) c(1-\pm))$

$G \acute{} (c^{-}(\varepsilon)\varepsilon(1-\pm) - \pm)$

$H \acute{} {}^{-}(\varepsilon)(2c(1-\pm)(s(\varepsilon) + {}^{-}(\varepsilon)) + (2-\pm))$

Note that F, G and H are positive under (A1) and (A2) and, therefore, $\frac{@a^{\alpha}}{@\varepsilon} < 0$ under the condition highlighted in corollary 2. This proves corollary 7.

When $s(\varepsilon) = s$ and ${}^{-}(\varepsilon) = {}^{-}$; then simple di¤erentiation of $a^{\alpha}$; leads to:

$$-\frac{@a^{\alpha}}{@\varepsilon} = -\frac{\pm}{2}\frac{H}{G\sqrt{A}} < 0;$$

$$-\frac{@a^{\alpha}}{@s} = \frac{\pm}{\sqrt{A}} > 0;$$

$$-\frac{@a^{\alpha}}{@^{-}} = -\frac{F\pm}{2G\sqrt{A}} < 0:$$

therefore, corollaries 5 and 7 are demonstrated.Q:E:D:

Proof of Corollary 8

$$-\frac{@(prob(\mu<\bar{\mu}(a^{\alpha})))}{@\varepsilon} = \frac{@\left(\frac{1}{\pm} - \frac{(1-\pm)c}{\pm}a^{\alpha}\right)}{@\varepsilon} > 0:$$

this derivative is negative by the previous proof.Q:E:D:

### 5.5.2 Industry Classi…cation

Industry classi…cation in high, mid, low tech. Table taken from Hagedoorn and Duyster (1999); the classi…cation is based on a comparison of the R&D expenditures to sales ratio at the industry level. Data from OECD 1997 “Revision of the high technology sector and product classi…cation”, Paris, OECD.

Table 3: industry classi…cation

| | Industry |
|---|---|
| High tech | |
| | Drugs |
| | Information technology |
| | Aerospace / Defense |
| Mid tech | |
| | Instrumentation |
| | Automotive |
| | Chemicals[17] / Plastics |
| Low tech | |
| | Food and beverages |
| | Metals |
| | Oil and Gas |

# Bibliography

[1] Chiesa, V. and R. Manzini (1998), "Organizing for Technological Collaborations: a Managerial Perspective", R&D Management, 28 (3), 199-212.

[2] Contractor, F. and P. Lorange (1988), "Competition vs. Cooperation: A Bene…t/Cost Framework for Choosing Between Fully-Owned Investments and Cooperative Relationships", Management International Review, Special Issue, 5-19.

[3] Dixit, A. (1989), "Entry and Exit Decisions Under Uncertainty", Journal of Political Economy, 97, 620-638.

[4] Dixit, A. and R. Pindyck (1994), "Investment Under Uncertainty", Princeton, Princeton University Press.

[5] Gulati, R. (1995), "Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances", Academy of Management Journal, 38(1), 85-112.

[6] Hagedoorn, J. (1993), "Understanding Strategic Technological Partnering", Strategic Management Review, 14, 371-385

[7] Hagedoorn, J. (1996), "Trends and Patterns in Strategic Technology Partnering Since the early Seventies", Review of Industrial Organization, 11, 601-616.

[8] Hagedoorn, J. and R. Narula (1996), "Choosing Organizational Modes of Strategic Technology Partnering: International and Sectoral Di¤erences", Journal of International Business Studies, 2, 265-284.

[9] Hagedoorn, J. and G. Duyster (1999), "External Appropriation of Innovative Capabilities: The Preference for Strategic Alliances or M&As", mimeo, MERIT, University of Maastricht.

[10] Jovanovic, B. (1979), “Job Matching and the Theory of Turnover”, Journal of Political Economy, 87, 972-990.

[11] Osborn, R. and C. Baughn (1990), “Forms of Interorganizational Governance for Multinational Alliances”, Academy of Management Journal, 33 (3), 503-519.

[12] Narula, R. and J. Hagedoorn (1997), “Globalization, Organizational Modes and the Growth of International Technology Alliances”, mimeo MERIT, University of Maastricht, October 1997.

[13] Rauch, J. and J. Watson (1999), “Starting Small in an Unfamiliar Environment”, Discussion Paper 96-28R University of California, San Diego, March 1999.

# Chapter 6

# The Governance Form of Strategic Alliances: an Empirical Analysis[1]

## 6.1 Introduction

In this concluding chapter, I present an empirical analysis of the issue of the governance form of strategic alliances. This part of the thesis is largely based on Comino, Mariel and Sandonís (2001). The objective of this assessment is that of testing the main hypotheses that have been put forward by the economic literature as well as some of the predictions that can be derived from the theoretical models of chapters 4 and 5 of this thesis. In the analysis, a database on strategic alliances that has been created at the Katolieke Universiteit of Leuven is employed.

As said when introducing the topic, the studies that deal with the governance form of strategic alliances have been mainly inspired by the approach of the Transaction Costs Theory. Similarly, a series of empirical papers has tested its principal predictions. In Table 1, there is a list of three of the most known and remarkable among these empirical studies, namely Gulati (1995), Pisano (1989) and Osborn and Baughn (1990). In the table, the principal explanatory variables that have been used, their statistical signi…cance and their e¤ect on the probability that the alliance takes the form of a Joint Venture rather than a Contractual Agreement are

[1] I acknowledge Reinhilde Veugelers and the project FWO spillovers 6.0131.98 at the Katolieke Universiteit of Leuven for the use of the K.U. database.

listed.[2] The sign (+) means that the variable increases the likelihood of a Joint Venture, while the sign (¡) that it decreases it.

Table 1: List of three empirical studies on the governance form of alliances

| | Gulati | Pisano | Osborn and Baughn |
|---|---|---|---|
| R&D | (+) (**) signi…cant | (+) (**) signi…cant | (+) (**) signi…cant |
| INTERNATIONAL | (+) (**) signi…cant | not signi…cant | |
| RIVAL | | not signi…cant | |
| HIGH TECH | | | (-) (**) signi…cant |
| SIZE | | | not signi…cant |
| >2 PARTNERS | not signi…cant | | |
| REPEATED TIES | (-) (**) signi…cant | | |
| (**) | signi…cance at p< 0.01 | | |

The only variable we have not been able to replicate in Comino, Mariel and Sandonís (2001) is REPEATED TIES. This variable counts the number of previous alliances among the partners. According to Gulati (1995), repeated alliances among the same …rms favor the emergence of trust thus reducing the fear of opportunistic behavior. Therefore, the author expects (and empirically tests) that previous alliances favor Contractual Agreements over Joint Ventures.

[2] Gulati (1995) uses a Logit model, Pisano (1989) a Probit model, while Osborn and Baughn (1990) a discriminant function model.

The other variables included in Table 1 are the same as the ones we use. Their description and expected e¤ect are explained below.

This chapter is organized as follows. In section 2, there is a description of the database. In section 3, the principal hypotheses to test are listed. Section 4 describes the method and the variables used in the analysis. The results are presented in section 5, while the concluding remarks in section 6.

## 6.2 The Database

The database used in the analysis is the one created at the Katolieke Universiteit of Leuven. In chapter 5, I have pointed out its principal characteristics.

## 6.3 Testable Conjectures

The main testable hypothesis one can derive from the theoretical model presented in chapter 4 relates the governance form to the absorptive capacities of the partners. In particular, the more asymmetric these latter are the riskier to select a Contractual Agreement. Based on this observation, one would expect Joint Ventures to be more likely to be observed the more asymmetric partners' absorptive capacities are. Unfortunately, it has not been possible to test this hypothesis. Indeed, no good proxy for the absorptive capacity was available. Natural candidates were the number of patents[3] or the R&D expenditures of each partner,[4] but this information was available only for few and huge companies. An attempt has been made by using the …rms' sizes (measured by the number of employees) as proxies for their absorptive capacities. However, when including this variable, the results were not encouraging. In particular, the size variable was not signi…cant. Several could be the reasons of these poor results. The size of the …rm could be not a good approximation of its absorptive capacity. Moreover, the number of observations included in the regressions when using this variable was limited. Indeed, only for

[3] In their empirical analysis, Hagedoorn and Duyster (1999) use the number of patents of a …rm as a proxy for the regime of appropriability. The variable turns out to be non signi…cant. However, the authors still think that this variable plays an important role and that, possibly, the proxy was not good enough.

[4] Several studies stress that the capacity of a …rm to absorb knowledge is closely related to its expenditures in R&D. On this point, see Cohen and Levinthal (1989) and Kamien and Zang (2000).

98 alliances information about the …rms' sizes was available.[5]

The main result of the model of chapter 5 implies that the typology of the project that partners are pursuing as well as the characteristics of the sector in which the alliance takes place are important determinants of the governance form. With reference to the …rst point, we expect that the larger the uncertainty that characterizes a project, the more likely that partners choose a Contractual Agreement. In particular, given that R&D activities are intrinsically more uncertain than production or distribution and marketing ones, it is expected that:

Conjecture 1 Alliances carrying out R&D activities are less likely to be organized as Joint Ventures.

In other words, we expect that the presence of R&D activities in the agenda of the alliance reduces the probability that partners choose to structure it as a Joint Venture. It is important to point out that in other empirical papers the opposite conjecture has been made. The authors of these studies interpret R&D activities as proxies for transaction costs.[6] That is, the large uncertainty that characterizes these activities makes it more di¢cult to write binding contracts and, therefore, the possibilities of opportunistic behavior of the partners are enhanced. As a consequence, in these studies it is predicted that R&D alliances are more likely to be equity based.

The other implication that can be derived from the model of chapter 5 is that in high tech sectors there is a signi…cantly stronger preference towards Contractual Agreements. As said, it is custom to de…ne high tech those sectors in which the ratio R&D expenditures to sales is particularly high.[7] To isolate the e¤ect of the characteristics of the sector in which the alliance takes place, we concentrate on those alliances that pursue R&D projects. The conjecture we want to test is:

[5] In the original database no information on …rms' sizes was included and, therefore, other sources were looked for. However, to use a variable that measures …rms' asymmetry, it was necessary to …nd information about the size of all the partners involved in an alliance. This happened to be possible only in a limited number (98) of cases.

[6] See Gulati (1995), Osborn and Baughn (1990) and Pisano (1989).

[7] On this point see Hagedoorn and Duyster (1999), Osborn and Baughn and Auster (1992).

Conjecture 2 Alliances taking place in high tech sectors are less likely to be organized as Joint Ventures.

According to Pastor and Sandonís (2001) the fact that partners are or are not rivals plays a decisive role when choosing the form of governance. As commonly claimed, these authors assume that Joint Ventures are better vehicles to absorb the partner's know-how. Indeed, working together in a common structure favors the ‡ow of information between partners. However, when they are rivals in an independent market[8] the possibility that the partner learns one's capabilities and, therefore, that it becomes a stronger competitor has detrimental e¤ects on the willingness to reveal know-how. Thus, in these instances, a Contractual Agreement might be superior.[9] Based on this argument we expect that:

Conjecture 3 Alliances between rival …rms are less likely to be organized as Joint Ventures.

The larger the number of partners involved in an alliance, the more di¢cult to monitor each other's behavior. Moreover, as Gulati (1995) says "...the presence of more than two partners heightens the possibility of stalemates and con‡icts". Therefore, when the number of involved …rms is greater than two the possibilities of opportunistic behavior and of con‡icts among partners are enhanced and therefore we predict that:[10]

Conjecture 4 Alliances with more than two partners are more likely to be organized as Joint Ventures

According to the Transaction Costs Theory alliances involving partners coming from di¤erent countries are more likely to be characterized by large transaction costs. Firms may trust

[8] These authors consider the case in which partners are rivals in a market that is di¤erent and independent from the one in which the fruits of the joint project will be used.

[9] One needs to stress that the conclusion reached by Tao and Wu (1997) when analyzing the e¤ect of rivalry between partners is opposite to the one of Pastor and Sandonís (2001). However, Tao and Wu do not analyze the case in which partners compete in an independent market but they consider rivalry in the use of the innovation obtained in the alliance. In their case, the Joint Venture works as a collusive devise. Indeed, with a Contractual Agreements, each partner freely uses the innovation and the total pay-o¤ they obtain is spoiled by competition. In a Joint Venture, partners have to pay a royalty to use the innovation. The royalty is set at a level such that only one of the two partners buys and uses it. In this way, the total pay-o¤ is not reduced because of competition.

[10] The same conjecture is made by Gulati (1995).

more domestic partners and also the information available should be better for companies coming from the same nation. Therefore, the expected costs due to the opportunistic behavior of the partner are larger in case of international alliances. To take into account this e¤ect, we employ a dummy variable that equals 1 when partners are coming from di¤erent countries. This variable has been used in many empirical studies and the expected e¤ect is the following:

Conjecture 5 International alliances are more likely to be organized as Joint Ventures.

## 6.4 Methodology and Variables

We use a Probit model to the test the e¤ect of various independent variables on the probability that the alliance is organized as a Joint Venture. That is, the unit of observation is the alliance and the dependent variable is the form of governance. This variable is equal to 1 in case partners have chosen a Joint Venture, while it is 0 in case of a Contractual Agreement.

Following the discussion made above we have included several variables as determinants of the organizational form of the alliance. In particular:

- R&D: dummy variable that is equal to 1 when some R&D activities are carried out in the alliance;
- PRODUCTION: dummy variable that takes the value 1 when some production activities are carried out in the alliance;
- RIVAL: dummy variable that is equal to 1 if at least two partners are rivals. Rivalry is de…ned on the basis of the Nace codes and two …rms are considered as rivals when the 3-digits codes of their core businesses coincide;
- INTERNATIONAL: dummy variable that takes the value 1 if all the partners are coming from a di¤erent country;
- HIGH TECH: dummy variable which is equal to 1 if the alliance takes place in an high tech sector;[11]

[11] See chapter 5 for a description of this variable as well as for MID TECH.

- MID TECH: dummy variable that is equal to 1 if the alliance takes place in a mid tech sector;
- >2 PARTNERS: dummy variable that takes the value 1 whenever more than two partners are involved in the alliance.

## 6.5 The Results

Firstly, we consider the complete set of alliances, that is 1344. For some observations some values are missing so that the …nal set is composed of 1216 alliances. The main results are listed in Table 2:

Table 2: Probit estimations using all the alliances; dependent variable the governance form (1 if Joint Venture)

| Variables | Model 1 | Model 2 |
|---|---|---|
| | Coe¢cient and (t-statistic) | Coe¢cient and (t-statistic) |
| CONSTANT | -0.267 | -0.267 |
| | (-2.371)¤¤ | (-2.681)¤¤ |
| R&D | -0.438 | -0.439 |
| | (-4.932)¤¤ | (-4.939)¤¤ |
| PRODUCTION | 0.659 | 0.659 |
| | (7.648)¤¤ | (7.646)¤¤ |
| RIVAL | -0.201 | -0.204 |
| | (-2.602)¤¤ | (-2.681)¤¤ |
| INTERNATIONAL | 0.352 | 0.352 |
| | (3.800)¤¤ | (3.795)¤¤ |
| >2 PARTNERS | -0.233 | |
| | (-0.193) | |
| Number of obs. | 1216 | 1216 |
| $\hat{A}^2$ | 132.45 | 132.41 |
| Pseudo $R^2$ | 0.081 | 0.081 |
| Log likelihood | -751.586 | -751.605 |
| (**) | signi…cance at p<0.01 | |
| (*) | signi…cance at p<0.05 | |

One can check that the conjectures 1,3 and 5 are con…rmed, while conjecture 4 is not. In particular, the fact that the alliance undertakes an R&D project decreases the likelihood of a Joint Venture. This result is quite robust in statistical terms. Moreover, also performing analyses for subgroups (e.g. considering separately alliances in high, mid or low tech sectors) the result was con…rmed. However, some caution is needed when interpreting it. In stating conjecture 1, we claimed that one possible explanation is related to the uncertainty that characterizes R&D projects. That is, when uncertainty is large, then partners prefer arrangements that require to commit to a lesser extent. However, some other factors may play an impor-

tant role. For instance, production and distribution and marketing activities may require the construction of new plants or distribution facilities and these might be more easily managed through a Joint Venture. Therefore, if this were the case, in comparative terms, a Contractual Agreement would be better suited to R&D alliances rather than to production and distribution and marketing ones. Moreover, the uncertainty that characterizes an R&D project does not only depend on the unknown …t level between partners (as pointed out in chapter 5) but also it is an intrinsic characteristic of this kind of activities.

On the contrary, in Table 2, it is found that production alliances are more likely to be organized as Joint Ventures.[12] Furthermore, consistently with conjecture 3, rival …rms prefer to organize their ventures as a Contractual Agreements. Following the prediction of Pastor and Sandonís (2001), this means that rivals prefer to keep their businesses separated so that to minimize the risk of unintended informational leakages. The variable >2 PARTNERS does not appear to be statistically signi…cant. Therefore, conjecture 4 is not supported by empirical evidence. One possible justi…cation for this result is that the large majority (around 90%) of the alliances is between two partners so that the number of observations with more than two …rms involved in the alliance is rather limited. Lastly, when the alliance is between …rms coming from di¤erent countries, then it is more likely that it is in the form of a Joint Venture.

To concentrate on the e¤ect of the characteristics of the sector in which the alliance takes place, we consider subgroups of the initial set of alliances. In particular, here I present the results obtained when considering R&D alliances, that is, alliances that are undertaking Research and Development projects. Indeed, the argument of chapter 5 that is behind conjecture 4 is particularly suited for R&D activities in high tech sectors. It is in these instances that companies endowed with very di¤erent capabilities join their forces. The main results when considering R&D alliances are represented in Table 3.

[12] Recall that in the database alliances are classi…ed in three groups according to the activities they carry out: R&D, production and distribution and marketing. Therefore, in Table 2, the reference group is distribution and marketing.

Table 3: Probit estimations using R&D alliances; dependent variable the governance form (1 if Joint Venture)

| Variables | Model 1 | Model 2 |
|---|---|---|
| | Coe¢cient and (t-statistic) | Coe¢cient and (t-statistic) |
| CONSTANT | 0.172 | 0.197 |
| | (0.623) | (0.735) |
| HIGH TECH | -0.767 | -0.767 |
| | (-3.142)¤¤ | (-3.141)¤¤ |
| MID TECH | -0.579 | -0.582 |
| | (-2.245)¤¤ | (-2.259)¤¤ |
| INTERNATIONAL | 0.338 | 0.343 |
| | (1.919) | (1.956)¤ |
| >2 PARTNERS | -0.394 | -0.379 |
| | (-1.677) | (-1.634) |
| RIVAL | 0.593 | |
| | (0.397) | |
| Number of obs. | 306 | 306 |
| $\hat{A}^2$ | 16.81 | 16.66 |
| Pseudo $R^2$ | 0.040 | 0.040 |
| Log likelihood | -199.593 | -199.672 |
| (**) | signi…cance at p<0.01 | |
| (*) | signi…cance at p<0.05 | |

The variables HIGH TECH and MID TECH have the expected sign[13] and are statistically signi…cant. Therefore, we found evidence that in developing sectors there is a signi…cantly larger presence of Contractual Agreements. This result held even when estimating the model for the pool of production alliances (i.e. when concentrating the analysis on the alliances that carried out production rather than R&D activities), while it was less clear for the distribution

[13]Note that the sectors in which the alliances take place are classi…ed as high, mid and low tech. Therefore, in Table 3, the reference group is that of the alliances active in low tech sectors.

and marketing one.[14] Comparing the results of Table 3 with those of Table 2, one can check that INTERNATIONAL keeps its correct sign even if its statistical signi…cance has decreased. Considering the pool of production alliances, the variable was signi…cant at a level $p < 0:01$; while it was not when considering distribution and marketing alliances. Contrarily to the previous analysis RIVAL is not signi…cant. The same happened in case of distribution and marketing alliances,[15] while it was signi…cant and with the expected negative sign for the pool of production alliances. In Table 3, >2 PARTNERS is nearly signi…cant; however, its sign is opposite to the one predicted in conjecture 4. Moreover, when considering either the pool of production or that of distribution and marketing alliances >2 PARTNERS was highly non signi…cant.

## 6.6 Concluding Remarks

The objective of this last chapter of the thesis has been that of empirically testing the principal predictions of the economic literature dealing with the issue of the governance form of strategic alliances as well as some of the hypotheses that can be derived from the models of chapters 4 and 5. The analysis is based on Comino, Mariel and Sandonís (2001) and the database that has been employed is that created at the Katolieke Universiteit of Leuven. In the analysis, we have found evidence that the presence of R&D activities makes it more likely that the alliance is organized as a Contractual Agreement rather than as a Joint Venture. The explanation that we give to this result is that the uncertainty that characterizes these kind of activities induces …rms to choose more ‡exible types of agreements that require to commit to a lesser extent. Moreover, also when …rm are rivals they prefer Contractual Agreements. They do so in order to “keep their businesses separated” thus avoiding unintended informational leakages. International alliances tend to be in the form of Joint Venture. Contrarily to what predicted by the theory, no role seems to play the number of participants to the venture. Relating governance form to the characteristics of the sector in which the alliance takes place, we have found evidence that in highly sophisticated sectors …rms tend to prefer Contractual Agreements. Again, the

[14] In this case the variable MID TECH was not statistically signi…cant while HIGH TECH had a t-statistic of 1.59.

[15] In this case the associated t-statistic is 1.2.

explanation we give to this result is that when partners face highly uncertain contexts they prefer more ‡exible forms of cooperation.

# Bibliography

[1] Auster, E. (1992), "The Relationship of Industry Evolution to Pattern of Technological Linkages, Joint Ventures, and Direct Investment Between US and Japan", Management Science, 6, 778-792.

[2] Cohen, W. and D. Levinthal (1989), "Innovation and Learning: the Two faces of R&D", Economic Journal, 99, 569-596.

[3] Comino, S., P. Mariel and J. Sandonís (2001), "Empirical Aspects of the Governance Form of Strategic Alliances", mimeo, Universidad del Pais Vasco.

[4] Gulati, R. (1995), "Does Familiarity Breed Trust? The Implications of Repeated Ties for Contractual Choice in Alliances", Academy Management Journal, 38(1), 85-112.

[5] Hagedoorn, J. and G. Duyster (1999), "External Appropriation of Innovative Capabilities: The Preference for Strategic Alliances or M&As", mimeo, MERIT, University of Maastricht.

[6] Kamien, M. and I. Zang (2000), "Meet me Halfway: Research Joint Ventures and Absorptive Capacity", International Journal of Industrial Organization, 18(7), 995-1012.

[7] Osborn, R. and C. Baughn (1990), "Forms of Interorganizational Governance for Multinational Alliances", Academy of Management Journal, 33 (3), 503-519.

[8] Pastor, M. and J. Sandonís (2001), "Research Joint Ventures vs Cross Licensing Agreements: An Agency Approach", International Journal of Industrial Organization, forthcoming.

[9] Pisano, G. (1989), "Using Equity Participation to Support Exchange: Evidence from Biotechnology Industry", Journal of Law, Economics and Organization, 5(1),109-126.

[10] Tao, Z. and C. Wu (1997), “On the Organization of Cooperative Research and Development: Theory and Evidence”, International Journal of Industrial Organization, 15, 573-596.