# "E.U. sponsored" versus "spontaneous" R&D collaborations
# Towards a micro-analysis

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Paper to be presented to the conference
"Evaluation of government funded R&D activities", 15th-16th May, Vienna

Preliminary draft
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## 1. Introduction

The aim of our paper is to examine and characterize E.U. sponsored R&D collaborations at a micro-analytical level, and to derive some policy implications. Most often existing literature about European framework research programmes relies on quantitative, statistical and rather agregate information. We think that the relevance and the efficiency of such programmes may well require a deeper understanding of the cooperative practices adopted by the companies which participate to government sponsored collaborations. Our contribution can be considered as an attempt at opening this specific "inter-organizational black box" from the – micro – point of view of the firm. More precisely, we shall explore the internal mechanisms of governement-sponsored collaboration by comparing them to those of spontaneous, privately funded research collaborations[1]. Our work is based on existing literature concerning interfirm alliances, as well qualitative, empirical information obtained through numerous interviews about some R&D projects of the BRITE-EURAM framework programme.

In terms of conceptual framework, we propose to consider inter-firm technological collaborations as particular forms of organisations, that aim at creating new knowledge via the association of the resources of two or more independent firms[2]. Following March & Simon (1993), organisations - in general - are "systems of co-ordinated actions among individuals and groups whose preferences, information, interests, or knowledge differ". Thus a distinctive property of an organisation is that it coordinates the actions of agents with different knowledge and different interests. As a consequence, we suggest that any organisational mode - interfirm collaboration in particular - can be usefully decomposed into the three following dimensions: coordination, incentive, and cognition functions. Our paper uses and applies this three-dimensional grid in order to apprehend the micro-mechanisms of inter-firm technological collaborations.

The paper will be organized as follows. In a first part we shall synthetize some relevant and interesting results of the literature about strategic management of technological alliances (focusing mainly, although not exclusively, on spontaneous research collaborations). Important issues generally concern : the motivations of the partners in connection to potentially opportunistic behaviors; the mechanisms of inter-organizational learning and value creation ; the influence of contractual terms and other coordination devices of alliances. This allows us to use our previously mentioned, three-dimensional, analytical grid (in terms of incentives, learning and coordination) for explaining some important aspects of the micro-rationale of inter-firm collaboratione emerging from the literature.

In the second part of the paper, we use this grid to identify the specificities of "our" BRITE-EURAM research projects, and we try to compare them with ideal spontaneous collaborations. We find that the two types of collaborations show rather contrasted rationales : government-sponsored collaborations most often concern peripheral activities, submit to predefined rules and favour exploratory, unilateral learning ; by contrast spontaneous collaborations concern more critical activities (i.e. closer to core competencies), create their

[1] Except for Hagedoorn & Schakenraad's article comparing private versus subsidized R&D partnerships of big, information technology firms [[1]], we could not find explicit mention of similar issues in the literature about inter-firm alliances. Although Hagedoorn & Schakenraad did not identify substantial differences between the two kinds of agreements in terms of the number and/or intensity of the inter-firm linkages (i.e. the general shape of the networks), we shall contend that sharp differences may appear when opening the "organizational black box" of inter-firm relationships.

[2] Independance means here that the partners are legal entities with separate identities, that enjoy some autonomy in economic and strategic terms.

own operating rules and may trigger an interactive learning process which generates valuable collective specific assets. Evolution pathways also differ : government-sponsored collaborations seem to be more stable in the short run (no premature end), but less persistent in the long run in case of success.

The concluding section of the paper synthetizes our main theoretical propositions and suggests some policy implications resulting from the identification of two different collaborative patterns.

## 2. The micro rationale of inter-firm technological alliances according to the litterature : some important issues concerning motivations, coordination, learning and their dynamic implications

In this section we shall briefly present some important issues concerning the micro-mecanisms of interfirm technological alliances[3], that can be found in the literature in strategic management, in sociology of organization, in the resource-based view of the firm, in transaction cost economics and, to a lesser degree, in industrial organization. We will do so by using a three-dimensional analytical grid in terms of incentive, learning and coordination.

The first of these issues, which we call the "incentive issue", is about the motivations and the rationale behind such inter-organizational strategies. As we shall insist upon, it seems that rather exploratory learning and/or combining core competences with external, complementary resources represent key motives for collaborating with another (non affiliate) company. Consequently and unsurprisingly, learning mecanisms, and especially interactive learning mecanisms, are a major topic in the literature about technological alliances (and, which is a bit more puzzling, about non technological alliances also). We will discuss this "cognitive issue" further in section 2.2. The way the work of the partners is defined and effectively organised, via contractual terms and/or informal coordination procedures, is also a recurrent focus in scholars' attention, probably because the coordination devices are supposed to condition heavily the efficiency, the outcomes (success versus failure), and more generally the evolution (stability, durability,…) of the collaboration. This "coordination issue" and the subsequent dynamic considerations will be developed respectively in section 2.3 and 2.4. Needless to say, although we will present them separately for clarity 's sake, the three building blocs of our micro-analysis – that is to say incentive, learning and coordination mecanisms – are generally interdependant.

### 2.1 The incentive issue : the motivations of inter-firm technological cooperation

Puzzled by the dramatic increase of technological inter-firm collaborations that started in the end of the 70's[4], numerous scholars in economics and management have tried to explain the motivations of the firms entering collaborative strategies. Why should independant firms cooperate in a competitive world ?

A first possible answer, presenting some analogy with the traditional explanation of collusions and cartels, is based on a "power" argument. Some authors consider technological alliances just as another way to compete, to eliminate rivals and to obtain market power. For instance, an alliance may create entry barriers and exclude competitors through the specification of a technical standard shared by only a few, privileged companies. Or it may hold the hidden strategic intent to absorb the core competences of the partner[5] without giving any counterpart. These free riding, opportunistic behaviours with guile are very well analysed

[3] An extensive overview of the literature would be well beyond the scope of the present paper.
[4] Cf. Hagedoorn (2002) for a recent and up-dated statistical analysis of the phenomenon.
[5] Cf. the growing literature about learning races (Hamel, 1991) .

through game-theoretic finite game like prisoner dilemma. While we recognise the existence of such one shot, short term, opportunistic actions in this paper, we won't place them at the heart of alliances rationale : systematic nul-sum games do not seem consistent with the longevity of the observed phenomenon at the macro - and sometimes at the micro - level. Rather, we shall consider "opportunism and power" as a second order motive in the case of technological collaboration, located far behind a first order motive consisting in a quick access to external resources and/or competences.

Actually, some preliminary empirical work has revealed that the phenomenon was much more pronounced in industries characterized by rapid technological change, rising R&D costs, increasing complexity and demand variety : computer and telecommunication industries, biotechnologies, new materials, aeronautics… Thus technological innovation - in its broadest sense – is probably at the center of most cooperative strategies. More precisely, the turbulence of the environment lead high tech companies to find a quick access to external competences and/or to pool some critical resources. "Access to external competence" is a rather broad motivation that can be split into - at least - three categories :

- to reach a critical mass via the pooling of similar resources ;
- to combine complementary, dissimilar resources in order to create value ;
- to acquire reputation and other "network" assets.

*2.1.1 Reach a critical mass via the pooling of similar resources*

Sharing of R&D costs and other cost minimizing concern (avoidance of wasteful R&D duplication), realizing economies of scale in R&D, agreement on a common technical norm to impose a de facto standard, enlarging commercial outlet via an access to partners' market… All these "scale-based" motivations are central in the traditional economic analysis of cooperative R&D, as proposed by scholars in industrial organization (Katz, 1993 ; Geroski, 1993). Note that in this type of literature the partner firms are usually considered as symetric (they hold homogeneous capabilities) and that the underlying economic rationale is primarily a cost minimizing one.

*2.1.2 Combine complementary resources to create value*[6]

Early empirical analysis about alliances motives, like the pioneering work of Mariti & Smiley (1983), or Hagedoorn (1992) in the information technology industry, already insisted on the fact that one of the main motivations of alliances was technological complementarity. Access to complementary assets and knowledge are often a necessary - but not sufficient - condition for exploiting and benefitting from a technological innovation (Teece, 1986).

In his seminal contribution about the organization of industry, Richardson (1972) also suggested that complementarity was the essence of inter-firm cooperation. Observing that cooperation (and not market) was the dominant mode of organizing economic activities, he proposed that similar activities (i.e. activities requiring the same skills, human capabilities,...) tended to be assembled inside the firm, whereas dissimilar but closely complementary activities had to be articulated via explicit, ex ante cooperative mechanisms between firms (not closely complementary and dissimilar activities were supposed to be coordinated by the market).

Richardson's vision, according to which the frontier of the firm depends partly on the capabilities and know how of its human resources, can be considered as a precursor work of

[6] Cf the seminal contribution of GB Richardson (1972) about the organization of industry, insisting on the idea that cooperation is the dominant mode of industrial organization, especially when the coordination of dissimilar and closely complementary activities is at stake.

recent approaches in strategic management and evolutionary economics, called the "competence-based view of the firm". The firm is seen as a portfolio of strategic, distinctive core competences (Prahalad & Hamel, 1990), i.e. pieces of collective knowledge which are the main source of its competitive advantage, but which are built through a time-consuming, cumulative process. What has been done in the past influences heavily what can be done in the future. Hence current competences constrain the scope of the future activities of the firm. In this perspective, the distance from the core determines the type of external growth to be chosen : a core activity is highly strategic and critical, it is not tradable on the market and has to be quasi-internalized, whereas a peripheral activity can be out-sourced. According to Amesse & Cohendet, 2001), between the zone of core competences and peripheral knowledge, lies an intermediary zone "where the firm holds significant pieces of knowledge but needs access to complementary forms of knowledge held by other firms to be able to develop and use the knowledge efficiently. This zone is characterized by networks" (Amesse & Cohendet, 2001, p.1470).

However the notion of complementarity is even more interesting in an explicit dynamic perspective. Alliances may be used as coordination devices, not only for exploiting existing complementary activities, but also for exploring new technological options (future core competences). If we go beyond the idea of a static exploitation of well-defined complementary assets and consider the opportunity to actually associate competences, learning mecanisms appear to play a central role in alliance rationale. Sharing the skills of heterogeneous firms can provoke a new combination in the sense of Schumpeter, i.e. it may create new valuable knowledge for one or for all the partners[7]. Exploration learning appears essential in a turbulent environment. But learning is a rather blurred notion. It entails many meanings and has important implications upon alliance dynamics. A deeper analysis of inter-organizational learning through alliances is conducted in section 2.2.

*2.1.3 Acquire reputation and other "network" assets*

By network we mean a microcosm of several (more than two) interacting organisations[8]. In some cases R&D collaboration is an admission ticket to a broader collaborative, information network. Entering such a network might be desirable *per se* because it provides one or a combination of the following advantages :

- "internal" reputation and more generally specific relational abilities vis-à-vis the other members of the network ;
- "external" reputation, credibility and visibility vis-à-vis agents located outside the network. This motivation deserves specific consideration since it is a particular kind of intangible collective asset ;
- quick access to numerous and scattered resources, potentially all the resources of all the partners. These resources can be partly similar (human resources, funds, information...) and dissimilar (a variety of complementary specific competences). No matter if the main "network advantage" relates more to the leveraging effect than to the presumably high connectiveness and variety of the network. The point we want to stress is that the network

[7] Numerous authors insists on this "learning rationale". See for instance Koza & Lewin (1998), Doz (1996),…

[8] Alliances and networks have to be distinguished. Except for consortia (with more than two partners), single alliances should not be considered as networks. Conversely, numerous networks do not exhibit the formal, contractual links between all the participants that are a typical feature of alliances . In our view, alliances should be better considered as sub-components of networks.

dimension is much more than a sum of individual advantages. Network has to be considered as a locus for learning and as such it deserves particular attention[9].

Probably, the three categories of motives just described are not mutually exclusive and the distinction might not be so clearcut in practice. But a dominant, prioritary motive seems to emerge from previous analysis. Namely, we contend that access to complementary resources in order to create knowledge are the main motivations of firms entering collaborative technological agreements. Power and cost minimizing motives, though not marginal, should not be seen as a priority for firms. In circumstances where a "learning motive" actually prevails, power and cost minimization dimensions would probably even exert a counter productive effect. But learning does not only refer to an incentive dimension. It also exert a strong influence on alliance's dynamics. This is the reason why we further develop this cognitive and knowledge dimension in the following sub-section.

**2.2 The cognitive dimension : different types of learning processes**

It is worth noting first that the importance and impact of learning on collaboration dynamics are strongly emphasized in the literature and that this observation goes well beyond the case of pure research collaborations. Learning matters for any type of alliances as well, even those with no technological dimension. At least four types of knowledge appear relevant in this respect :

- the increase in information about the firm environment,
- the creation of new technological and/or commercial competences,
- the acquisition of knowledge about the partner(s) (strategic prospects, reliability, actual competences but also organizational routines and interpretative framework), with the possible emergence of trust between the parties,
- the accumulation of experience about the management of agreements in general.

Even when the creation of knowledge is not intentional (i.e. it does not explicitly belong to the set of agreement initial objectives), the activation – or not - of learning processes can exert a strong influence on the collaboration evolution, stability and success. This has probably to be connected with the distinctive properties of learning. On the one side, learning may bring novelty and considerably change the initial conditions of an alliance. On the other hand it is also a costly, time-consuming process entailing strong irreversibility features (it generates high sunk costs). Although a kind of consensus seems to have emerged in the literature about the connection between learning and agreement evolution, ideas do not converge if we consider the direction or exact impact of learning upon the durability of the relationship : does learning favor or not the stablity of agreements ?

In addition to a more precise specification of the meaning of "stability" (cf. section 2.4), it seems to us that answering this question requires a clear recognition of the variety of the types of learning at stake. Learning is not a homogeneous process. In its broader sense it may refer to the maintenance of existing knowledge as well as the incremental improvement of previous know-how or the creation of totally new knowledge. Some qualifications are needed in order to derive dynamic considerations. Economic and/or organizational theories

[9] For a deeper analysis of the specific value of collaborative networks, namely of their "learning advantages", see the very interesting contribution of Powell & alii (1996) in the case of biotechnology.

distinguish between different types of learning [10] depending for instance on the nature of knowledge at stake (tacit versus codified [11] ), the configurations of the learning agents (individual versus collective), the degree of novelty of the process (the level of learning) and the origin of knowledge (external versus internal). In the case of inter-firm agreements, we find it relevant to elaborate a distinction between unilateral and interactive learning, that combine several of the previously mentioned criteria.

### *2.2.1 Unilateral learning*

Unilateral learning corresponds to a situation where one party individually acquires and uses knowledge thanks to the cooperative process. Ciborra (1991) mentions a type of unilateral learning particularly relevant in the case of technological alliances : radical and exploratory learning (i.e. learning to learn abilities). This kind of high level, double loop learning may concern for instance the best way to manage agreements in general, or more generally provide some guideline to cope with a turbulent, highly competitive environment.
In other situations the agreement may lead to the genesis of new, valuable, technological knowledge that is largely redeployable individually by a given partner. This supposes that this partner absorbs[12] some kind of – rather - generic knowledge and is able to adapt it to another field of application than was initially specified in the collaborative agreement (ne pas oublier de faire le lien avec les effets indirects de Brite).

The impact of unilateral learning on agreement stability is rather ambiguous. If the acquisition/internalization of a specific competence is the main objective of the collaborating firm(s), then there is a high probability that the alliance loses its "raison d'être" as soon as learning is achieved – if such an ending point do make sense in the case of a cumulative process. In this respect, whereas a minimum of durability might be necessary for (time-consuming) learning to occur, long term perennity of the collaborative relationship is – a priori - not warranted. Olk & Young (1997) show for instance that learning by an organization member of an R&D consortium increases the likelihood of leaving the alliance.

Unilateral learning may also be operated by one party to the detriment of the other, in the frame of a "learning race" (Hamel, 1991 ; see also Hamel, Doz & Prahalad,1989). The type of learning emphasized in these papers does generally not concern the creation of entirely new knowledge but the transfer of existing competence from one organization to the other. Moree precisely, asymetric learning can modify the relative bargaining power of the partners, thus transforming a situation of bilateral interdependance into a situation of unilateral, non viable dependance. Cooperative agreements make it thus possible to internalize opportunistically the technological skills and even the core competences of the partner. The effectiveness of such technological "hold ups" depends on the transparency and receptivity of the partners, as well as on the appropriability regime (Teece, 1986) of the technological

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[10] Well known definitions of different types of knowledge and/or learning can be found for instance in : Malerba F. (1992) “Learning by firms and incremental technical change”, *The Economic Journal*, vol. 102, July, pp. 845-859 ; Arrow K.J. (1962) : “The economic implication of learning by doing”, *Review of Economic Studies*, vol.29(80), pp. 155-173 ; Rosenberg N. (1982) : *Inside the black box*, Cambridge University Press ; Nelson R.R. & Winter S. (1982): *An evolutionary theory of economic change*, Harvard University Press, Cambridge ; Dosi G. (1988): “Sources, procedures and microeconomic effects of innovation”, *Journal of Economic Literature*, 26, September, pp. 1120-1171 ; Argyris C & Schön D.A. (1978) : *Organizational Learning : a theory of action perspectives*, Addison Wesley, Reading.

[11] Ancori B., Bureth A. & Cohendet P. (2000) : “The economics of knowledge : the debate about codification and tacit knowledge”, Industrial and Corporate Change, vol. 9(2), pp. 255-288.

[12] Cf the notion of absorptive capacity developed by Cohen & Levinthal (1994).

competences considered.[13]. If the critical core knowledge of a company (needing an access to complementary assets) has a weak appropriability regime, i.e. if it is easily imitable because it is well codified (not tacit) and moreover if it cannot be efficiently protected by property rights or by secrecy, then this company would be well advised to avoid cooperation and to integrate/absorb the complementary partner.

On the one hand, asymmetric learning, opportunistic behaviors linked to the search for power and/or for weakening the partner, lead unsurprisingly to highly unstable alliances, characterized by conflicts, failure for at least one of the partners, or premature end of the collaboration. On the other hand, learning is a time-consuming process that requires a minimal durability. In sum, the impact of unilateral learning on agreement stability can be negative as well as positive.

*2.2.2 Interactive collective learning*

Interactive learning "*à la* Lundvall" (1988) refers *stricto sensu* to a real reciprocal learning, agreed by the actors. We talk then of learning "with" partner(s), i.e. learning together on the tasks to be carried out within the partnership and on the cooperative process as such. The knowledge thus created is often largely tacit - which favours a strong appropriability regime in the sense of Teece's (1986, cf § 2.2.1). Moreover it may entail a strong collective dimension. Actually, one of the possible outcomes of interactive learning - if it effectively occurs - is the emergence of new, collective and indivisible competencies and other specific assets, endogenous to the agreement itself. According to Williamson's definition (1989), asset specificity refers to the degree to which an asset cannot be redeployed to alternative uses and by alternative users without sacrificing productive value. According to us, asset specificity should not be considered as a once for all and well specified, exogenous factor. Instead, it is an endogenous, dynamic factor, which evolves and grows as the interaction goes on. More precisely, it is the outcome of a cumulative process of collective knowledge creation, of the progressive specification of a common language and also of the emergence of trust between the parties.

Here the word "trust" requires some qualification. Trust acts as a cumulative process of investment in "transactional capital" (Palay, 1984) based on a "reciprocity of favor" principle. It thus leads to the creation of a particular kind of valuable, intangible assets resulting from past behaviors. Unlike reputation, transactional capital is highly specific to the partners, and cannot be easily transferred to other agents (Ouchi, 1980 ; Butler & Carney, 1983).

The positive influence of asset specificity on agreement durability is twofold. First, the newly created assets may generate a highly valuable, "relational quasi-rent" (Aoki, 1988 ; Dyer & Singh, 1998), such that if the relationship broke off, most of the benefits from learning would be definitely lost. Second, if the newly created asset consists mainly in collective, indivisible, tacit knowledge, most of it is incorporated in human resources via a progressive encoding in the organizational memory of the agreement. Such a process of routine creation, because it is associated with a kind of lock-in phenomenon, usually favors the continuity of the relationship between the partners (Wolff, 1992; Ring & Van de Ven, 1994).

[13] Observing the troubles beared by the companies trying to launch a technological innovation, especially when critical core know-how and access to complementary assets are required, Teece (1986) also insist on the danger caused by opportunistic partners and knowledge leakages. But he adds an important conceptual tool : the appropriability regime of technological innovation.

More generally, we contend that the articulation and the respective weight of different types of learning (unilateral versus interactive) may have a decisive influence on each partner's willingness to pursue the cooperation or not. Many authors stress the influence of different types of learning and/or their combination on the dynamics of agreements [14]. Our main assertion in this respect is that the effective implementation of interactive learning is a factor favoring the continuity of the inter-firm relation, whereas unilateral learning may, in some cases, lead to breaking down the cooperation (Bureth, Wolff & Zanfei, 1997).

### 2.3 The coordination dimension : flexibility, formal and informal mechanisms

External knowledge, assets and competences may be obtained through other means than technological agreements, for instance mergers or company acquisitions. A full understanding of the micro rationale underlying interfirm cooperation supposes to explain why and when such coordination devices are preferred to full integration (section 2.3.1). It also requires to explore the possible implications of coordination upon alliances evolution (section 2.3.2).

#### *2.3.1 Transaction costs versus flexibility*

We will present two alternative views :

- the transaction cost approach (Williamson 1979, 1991) put emphasis on static efficiency, i.e. (transaction) cost minimization. Note that an important source of cost resides in the search for power via opportunistic behavior ;
- - the second approach insists on the flexibility of agreements compared to full acquisition, i.e. it emphasizes dynamic efficiency : augmenting information and knowledge while simultaneously preserving adaptation and scope of action in a very uncertain environment.

According to Williamson's comparative institutional analysis (1991, 1979) , there are three broad modes of coordination of economic activities (i.e. three modes of governance) : market, hybrid modes (including inter-firm alliances), and hierarchies, each corresponding to a given law doctrine (Macneil, 1974). The first law doctrine is the classical contract law, based on complete presentiation in formal documents , that fits well with anonymous market transactions and contingent claims contracting. It minimizes transaction costs, i.e. the cost of negociating and adaptating the contract, only when environment is stable and asset specificity is weak. In oher words it is especially efficient when uncertainty is low and (intermediate) products are standardized.

The second law doctrine is the neo-classical contract law, that corresponds to incomplete long term contracts designed to preserve flexiblity. Third party assistance, or in other words arbitration, is often used to resolve disputes among the parties. Such a trilateral governance is supposed to be efficient for occasional transactions or medium to high levels of asset specificity. An important advantage of arbitration compared to litigation is that it preserves continuity of the relation.

Last but not least, the third law doctrine is the relational contract law, which relies on norms and past behaviors to provide efficient adaptation mechanims in the case of very complex, uncertain and recurrent transactions (Williamson, 1979). Two sub-categories of governance modes may be distinguished here. Hierarchy (unified governance) is the most common type of relational contracting and it offers distinctive adaptive properties (through

[14] See for instance Parkhe (1991), Doz (1996), Child (1997) Larsson & alii (2002).

fiat) when assets are idiosyncratic ; relational bilateral governance (between autonomous parties) is most efficient in the case of intermediate asset specificity.

Because it focuses on a cost minimization criterion and neglects learning and knowledge properties, transaction costs economics might not provide an ideal conceptual framework for analysing technological alliances in quickly changing environments[15]. In accordance with our "learning and knowledge creation" perspective, we prefer to emphasize their dynamic efficiency qualities : we suggest that alliances are better considered as exploratory tools, that preserve or even expand the scope of strategic and technological options in the future. Kogut (1991) shows for instance than joint ventures can play the role of (real) options, leading to full integration in case they are validated. In fact we suggest that technological collaborative agreements help to cope with uncertainty in at least two respects. First, when quick access to external competences and knowledge creation are considered, alliances make it possible to explore new technological options without bearing the high sunk costs of a 100% internal development and/or internalisation. Second, when coordination modes are considered, an alliance makes it possible to preserve two governance options in the future : maintaining the alliance or expand it via a full acquisition.

In sum, alliances may be considered as transitory devices, some kinds of "wait and see" positions which are valuable as such until uncertainty (about technological success, about partner's intend,…) is resolved. However, we recognize that alliances are by no way pure, perfectly reversible waiting positions. Learning cannot occur without a minimum level of commitment i.e. of irreversible, tangible as well as intangible investments (Bureth & al., 1997). Conversely, too much rigidity can impede and block exploratory learning. This leads to the idea that the more or less detailed way the coordination of the collaborative work is specified may exert a strong influence upon leaning effectiveness and hence upon alliance dynamics. Here it seems to us that transaction costs economics provides interesting insights again, which are discussed in the next paragraph.

*2.3.2 Contractual safeguard versus informal mechanisms*

While we might question the theoretical proposition that technological alliances are selected because they minimize transaction costs, Williamson's distinction between classical contracting and relational contracting is especially interesting as far as the flexibility of interfirm agreements is concerned. To put it briefly, there seems to exist a dilemma between the necessity to formalize written contractual terms and to promote the creation of informal, tacit rules and routines.

On the one hand the coordination and division of labour can be obtained through formal, detailed contractual terms and safegards specified through a costly negociation process. But this formal specification of the allocation of the tasks, obligations, and outcomes for each party can be very inflexible and thus inefficient in a quickly changing context.

On the other hand, relational or psycho-sociological contracts based on routines, trust and informal coordination processes make less necessary the filling of the "contractual gaps". In this sense they can better preserve the flexibility of the tasks to be achieved. The problem is that they need time to emerge since they are built on past behavior. As a consequence, a first step of reciprocal commitment, formal contractual safegards and/or exchange of hostages

[15] The presumed superior adaptive properties of hierarchies should lead to a multiplication of mergers and acquisitions in the turbulent context of high technology industries. Moreover hybrid form's efficiency implies that asset specificity is located at an intermediate level. But we may emit some serious doubts about the non idiosyncratic nature of core competences and closely complementary assets in the case of technological alliances.

(Williamson 1985) can be necessary in order to provide a stable window of the future (Bureth & al. , 1997). Reference to the formal document will be less and less necessary as and when the collaboration evolves and grows through time. Informal rules often substitute for formal explicit contractual terms.

The emergence of relational capital and tacit collective routines, as well as learning in general, requires also relatively frequent direct interactions between the participants, like the implementation of specific communication channels. The implementation of an effective interaction process is an especially important prerequisite if collective, indivisible competences and specific assets have to be created. The creation of a joint facility may have to be programmed in this perspective (as opposed to an ex ante division of the tasks between the partners and a subsequent separate execution inside each member firm).

Finally, as mentioned in the previous section, relational capital introduces the possibility of inertia and lock-in phenomenon in the long run. In sum, a cautious balance between formal and informal mechanisms has to be maintained during the whole life of the collaborative relationship (Ring & Van de Ven, 1994).

### 2.4 Implication on the evolution of alliances

Before going any further, it appears necessary to specify our concept(s) of stability. In fact we will define two types of stability: short term versus long term stability. By "short term stability", we mean the absence of a premature end of a cooperative agreement. Usually connected to the notion of success, this notion of stability applies to contracts with an *ex ante* precise time horizon as well as to agreements with no limited duration. Thus it can be clearly distinguished from the notion of duration. Actually a short duration does not mean instability or failure, it may simply be the direct outcome of an *ex ante* contractual specification.

Beyond the short term stability of a single collaborative agreement, it is relevant to take the continuity of the global relationship into account, that is to say the whole set or sequence of formal and informal agreements between the parties. In this case we will talk about "long term stability", defined as the persistance of an interfirm relationship beyond the initial agreement.

Keeping in mind both definitions of stability (short run stability of a single alliance versus long run stability of a global relationship), our main propositions about alliances dynamics may be summerized as follows. As emphasized in the literature, the rate of failure of collaborative agreements is generally high, because of high internal and external uncertainty and because of the dangers associated with a potentially opportunistic partner. In other words, technological collaborations are not characterized by short term stability.

But if short term stability occurs, more precisely if and when valuable specific assets are created, a kind of virtuous circle of success and increasing commitment may arise. In this perspective, a research agreement is seen as a kind of real option that will be exercised only in case of success, by way of further specific commitments, for instance a second research agreement or an investment in a more formal structure, or an equity agreement such as a joint venture. This idea of an escalation of commitment and satisfaction is mentioned by several authors in the literature [16]. It represents a good example of what is called "long term stability" of an inter-firm relationship.

Section 2 was devoted to an extraction of interesting theoretical results from the rich and diverse literature about strategic inter-firm alliances and technological collaboration in

[16] Cf. Doz (1996) ; Doz, Olk& Ring (2000) ; Bureth, Wolff & Zanfei (1997) ; Ring & Van de Ven (1994) ; Wolff (1992).

general. Most cited papers focus implicitely on spontaneous collaborations, i.e. collaborations which are not fostered by government policies. Section 3 is an attempt at confronting those theoretical propositions with empirical information concerning the particular case of E.U-sponsored R&D collaborations.

## 3. The specificities of EU sponsored collaborative projects

The conceptual framework elaborated in the previous section will help us to locate and characterize a particular case of collaboration : the R&D collaboration sponsored in the framework of a European research program. More precisely, section 3 tries to identify the specific incentive, learning and coordination properties of the BRITE-EURAM projects, and to confront them with the main analytical results of section 2.

Our empirical material consists basically in qualitative information obtained through official information channels and through numerous in-depth interviews[17] about a representative sample of 50 BRITE-EURAM projects (cf. Bach & alii, 1995). Interviews were achieved in the beginning of the 90's. Although they were not conducted for the specific purpose of the present paper, they contain a lot of relevant information, for instance about the stability of collaboration, the creation of new technological assets, and so on. Anyway we do not have the ambition to use our empirical information to provide any statistical support of some theoretical hypothesis. We simply use it to infer and to elaborate several theoretical propositions, or stylized facts, according to an inductive research process.

Our intention, and actually our main result, is to emphasize some outstanding, specific features of the E.U. sponsored collaborative projects at the individual level. We proceed to this characterization by contrasting two collaborative patterns : the pattern of a typical E.U. sponsored RD collaboration versus the pattern of an idealized, pure form of spontaneous collaboration. We develop the idea that the two collaborative patterns exhibit sharp differences. Some of these differences are due to the presence of imposed rules and characteristics in the case of framework European programmes. Other differences relate to the systematic occurrence (or non occurrence) of a given incentive, learning or coordination property in in the government sponsored case. We suggest that the main determinant of these differences has to do with the strategic importance of the collaborative research from the point of view of the firm : a fundamental assumption is that the research undertaken in a spontaneous collaboration is presumably closer to the firm's core competence than research undertaken in a government sponsored RD project.

### 3.1 Incentives to form E.U. sponsored R&D collaboration

The general motives or incentives for entering collaboration described in the literature are probably the same for E.U.-sponsored and spontaneous collaborations. The cost sharing motives are often emphasized by the policy makers. Nevertheless, our observations reveal that complementary, dissimilar partners are much more frequent, in the case of BRITE-EURAM projects , than similar partners looking exclusively for a critical mass. So the skill sharing motive probably prevails in the BRITE-EURAM case. Sakakibara (1997) in his study about Japanese R&D consortia also stresses the importance of the "skill-sharing" motive as opposed to the "cost-sharing" motive.

If we go deeper into the analysis of motives, and incorporate also the reputation/network motive, some specificities of E.U. sponsored collaborations immediately

[17] A representant in each partner firm has been interviewed.

appear. The strategic importance of the project, that is to say its distance from the "core competences" of the firm, is a relevant development in this respect.

*3.1.1 Public information vs. secrecy*

Participating in a public program supposes that part of the project becomes public information. In the case of BRITE-EURAM and of other European programs, the E.U. Cordis database provides free access to a list of the funded projects, including a summary of the research objectives and information about the partners. From the strategic point of view of a given company, several hypotheses about this information disclosure can be assumed :

- The firm does not mind revealing this kind of information because the project is not critical for it, in the sense that it belongs to the peripheral activities of the company,
- The firm wants deliberately to reveal this information in a signaling strategy. It wants to signal to the external world a specific technical competence, its willingness to cooperate or its intention of entering a new research area, etc. The signaling strategy is *a priori* compatible with the hypothesis that the project is connected to peripheral activities of the company. The core activities of the firm should be known by the competitors, the clients and the suppliers. Thus the need for the company to signal its activity in its core domain seems to be less important than signaling other domains of interests that can attract new partners.
- The signaling strategy may also be linked to reputation effects. The diffusion of information – about one's reliability - to the entire microcosm of firms participating to a public program will play an important role in creating and/or maintaining a good reputation. A good reputation can be considered as a strategic asset, making allowance for new "public" research contracts, for instance.

So government-sponsored collaboration supposes disclosure (about research topic, partners,…). By contrast spontaneous research collaborations represent an alternative means to access to external complementary knowledge, but without necessarily disclosing publicly this strategy. Of course the partners will share and exchange knowledge with each other, but they will have the choice to advertise or not the existence of their collaboration. If the R&D project is closely connected to the core activity of the firm, then the partners may be incited to keep the cooperation secret [18]. In sum the spontaneous agreements are more compatible with the preservation of secrecy that is often required for strategic activities.

*3.1.2 Subsidies vs. private funds*

Government-sponsored agreements benefit from public subsidies[19], which, from a social point of view, should not represent a substitution for private funds, but a complement [20]. Let us consider that firms, at least big ones, generally do not pursue a single research project but manage a portfolio of projects. With a portfolio perspective in mind, the opportunity to benefit from external subsidies can be analyzed from the point of view of the company in different ways:

[18] We do not mean that all spontaneous agreements imply secrecy. At a development stage or after obtaining some promising preliminary results, firms may have an interest to disclose the cooperation for competitive reasons : to be the first to innovate, to advertise their comparative advantage, etc.

[19] In the fifth E.U. framework programme for instance, the financial contribution of the Community represents 50% of the eligible project costs.

[20] Cf. David P.A., Hall B.H., Toole A.A. (2000) ; see also Bozeman B. & Dietz J.S. (2001).

- the company "free rides" and uses public money to do what it would have done without it. This corresponds to a case of pure substitution where the policy is *a priori* useless. Nevertheless, note that the company can allocate the money saved to an other research project. In this sense, the subsidy allows indirectly the firm either to open up a new research project or to expand an existing one ;
- the company takes advantage of the subsidy to carry out a project it would not have undertaken, or not to that extent. The subsidy allows directly the company to open up a new research project or to carry it out in a more ambitious way (broader objectives, with more partners, time-sparing, etc.).

In sum the subsidy can be considered as a direct or indirect means to open up new technological options, that is to say to broaden the scope of exploration [21]. The new options are presumably located at the periphery of the firms' activities. They might of course become central in the long run.

The decision to finance research collaboration with public versus internal private funds is connected to the way companies manage their knowledge. The more strategic (i.e. close to the core competencies) the knowledge, and the more the company will be induced to invest on its own. Here again we find the idea that the spontaneous strategy is more likely to be related to the management of critical, "close to core" knowledge.

To put it briefly, the subsidy can be considered as a way for firms to open up new options, which are not necessarily considered as central for the company at the moment of application. By contrast the private funding opens previously selected options, considered as having strategic priority and connected to the - future - core activities of the company. To some extent, the government-sponsored collaboration is more "exploration" oriented and the private funded partnerships more "exploitation" oriented. Sakakibara shows for Japan [22] that "support for R&D consortia by the Japanese government is modest and declining, and there is no clear link between the existence of R&D consortia and industry competitiveness. R&D consortia participants perceive sharing complementary knowledge to be the single most important objective of R&D consortia. […] R&D consortia work as a complement of private R&D. The overall subjective evaluation of the typical project's success is modest, and participants do not perceive R&D consortia to be critical to the establishment of their competitive position" .

### 3.2 Learning via E.U. sponsored R&D collaboration

Although exploration learning processes obviously concern both types of agreements - private versus government sponsored -, we suggest some distinctive features of the "public" partnerships.

As discussed in the previous paragraph about "incentives", we propose first that the object of the publicly funded joint research is usually rather distant from the current core competencies of the participating firms, so that learning is of a – slightly - more exploratory nature than in the case of private collaboration in general. . If we except a few cases of (very) small companies with restricted amounts of resources, the strategic intend behind BRITE-EURAM sponsored collaboration was generally not to create or to move towards new core competencies. It seems to us that companies cooperated mainly in order to explore some possible options and to see "what was going on" in a given technological area.

[21] Exploration in the sense of March J.G. (1991)
[22] cf. Sakakibara M. (1997b) p.449.

Section 2.2 developed two notions of learning relevant in the case of technological collaboration: unilateral and interactive learning. Actually, we found that the BRITE-EURAM projects exhibited important effects in terms of unilateral, individual learning, but almost no effects in terms of interactive collective learning. Let us develop those points.

One of the prevailing indirect effects identified in Bach & alii (1995) are "technological effects"[23]. By definition, indirect technological effects result from the partial redeployement – by each individual party - of the technology acquired through the european collaboration. Such effects arise specifically when the new technological knowledge are applied to a new domain, i.e. outside the initial field of cooperation. They typically correspond to the creation of individually redeployable knowledge assets and may be considered as a manifestation of unilateral learning.

Another type of unilateral learning was also identified. Participating in a BRITE-EURAM program was found to improve subtantially the learning to learn abilities of the participants. The latter often recognized to have gained considerable experience in the management of multipartite, E.U.-sponsored R&D collaborations. Subsequent contributions to such programs were perceived as facilitated.

As far as opportunistic learning is concerned, we found no obvious cases of learning races leading to effective hold ups of the partner's competences. Nevertheless, free riding behaviors, in the sense of pure"wait and see" positions and lacks of true commitment, may sometimes happen.

We may turn now to the role of interactive learning, i.e. the creation of collective competences and specific indivisible assets which cannot be individually appropriated and redeployed by one party. Whereas spontaneous R&D collaborations are sometimes concluded with an explicit intention of creating such specific collective assets – in the perspective of a long run relationship, this does never seem to be the case of BRITE-EURAM projects (at least in our representative sample of 50 projects).

In sum, we suggest that most of the assets created through publicly funded projects are largely redeployable, separable and appropriable individually by each partner. They are generally not of the collective, non-redeployable kind described in subsection 2.2.2. As a consequence we may advance that long run stability, and particularly the rationale of increasing commitment emphasized by several authors (cf section 2.4) should not be a typical characteristics of government sponsored agreements. This idea is partly supported by our empirical material : none of our selected BRITE-EURAM projects gave rise to a subsequent deeper collaboration (a joint venture) in the same field and/or with the same partner(s).

We do not mean that spontaneous interfirm collaborations always exhibit long term stability : effective genesis of specific assets requires short term stability and is typically difficult to obtain. Instead, we simply assert that, if and once specific assets have been created, private partnerships tend to promote longer run relationships (through a sequence of increasing commitment) than government-sponsored agreements.

It is worth mentioning that the specificities of learning through spontaneous, versus E.U.-sponsored collaborations are consistent with our propositions concerning the incentive dimension of section 3.1. In order to create valuable, collective, specific assets, the partners of a spontaneous collaboration must have strong motivations (clear prospect of developing pieces of knowledge which are relatively close to the core competences) and a long run

[23] In the frame of the particular evaluation methodology usedby the authors, technological effects represent 50% of all indirect effects (the latter include technological, but also network, organisational and critical mass effects).

horizon. Weaker motivations – obtaining peripheral knowledge - are consistent with the fact that government-sponsored collaborations are triggered by an external organization (a government agency) and not due to an "internal" awareness of environmental pressures or opportunities[24].

### 3.3 The coordination of activities in E.U. sponsored collaboration

In this section we will take for granted the idea (developped in section 2.3.1) that inter-firm technological collaborations are governance modes that hold decisive flexibility advantages compared to hierarchical governance structures (mergers). We will focus on the rules of coordination operating inside a given collaboration. The aim of coordination is to provide compatibility and coherence to individual actions as well as to decentralized learning processes in order to reach a global objective. Moreover any collaborative agreement has to solve the problem of the distribution of the roles and tasks of the partners, as well as their articulation.

Here again our BRITE-EURAM collaborative projects show strong peculiarities. Some of them are imposed by the design of the policy instrument, i.e. the European program itself.

#### *3.3.1 Pre-defined rules vs. rules to be created*

Very often in the framework of a technological policy, the public organization in charge of the management and the control of the program requires some information and fixes some minimum rules that have to be respected by the partners.

For instance, the research contracts signed by partners in the BRITE-EURAM Programme must contain terms about the allocation of funds and budget between the partners, the duration and milestones of the agreement, the contribution of each partner and the objectives of the project. European programs also impose some minimal inter-partner coordination rules in terms of allocation of work : ex ante definition of working packages, organization of a limited number of meetings,.... Moreover this kind of program usually requires that the partners agree on the results and/or property rights. Ham & Mowery (1998) describe very well the problem of defining the sharing of intellectual property rights in the case of the CRADAs program (Cooperative Research And Development Agreements).

This pre-defined framework eases the coordination of the partners in terms of allocation of resources (money, competences, tasks, property rights) and contributes to build the channels used to communicate and exchange research results. In other words, it helps to fix the initial conditions of the collaboration and constitutes certainly an important stabilizing element.

Nevertheless such an ex ante specification of rules also entails potential rigidities. More importantly, it may confine learning into specific zones and types. We propose that it favours primarily unilateral learning to the detriment of true interactive learning. Just to illustrate briefly this point, we observed that in most cases of BRITE-EURAM partnerships, the organization of work between the partner often consisted in a clear ex ante separation of the tasks between the parties. Actual organisation of work seems to correspond more or less to the minimal E.U. requirements and/or guidelines (in terms of defining workpackages and only few meetings). Those rules, when strictly applied, constitue a very poor framework for stimulating interactive learning. More intensive exchanges, or even the creation of a common

[24] For interesting development concerning "triggering entities" in cnnection with "engineered networks" of collaborations, see Doz, Olk & Ring (2000).

research facility, might be necessary in order to stimulate effective processes of collective knowledge creation.

In a spontaneous collaboration strategy, the partners have first to elaborate and agree upon the kind of rules to be used before specifying their content. So the spontaneous agreements have to overcome an additional problem, which is to define the boarder of the contract. In the negociation phase, the partners will learn which rules should be created, but also how to implement them and how to cope with them. This first step confers on the partners of a spontaneous R&D collaboration a higher degree of freedom and flexibility, compared to the case of a European sponsored partnership. To maintain of even enlarge this flexibility, the partners may well be induced to formalize and codify fewer rules and contractual safegards than in a government-sponsored agreement.

But flexibility and informal coordination has a counterpart. This additional degree of freedom may of course induce more hazards and misunderstandings. It thus leads to the high, well documented, failure rate i.e. premature termination of cooperation. In other words it leads to what can be called "short term instability" (section 2.4).

Both spontaneous and sponsored collaborations will in most instances specify the duration of the partnership. Respecting the planned time duration may represent an indicator of the stability of the relationship. We saw in section 2.4 that a high rate of failure characterizes most spontaneous technological collaboration. Interestingly enough, our own experience acquired during the evaluation of BRITE-EURAM agreements [25] does not mach this point. On the contrary it suggests that the rate of break-up is very small : among 50 statistically representative selected agreements only one failed at the beginning. It might be derived that short term stability seems to be a relevant characteristics of E.U. sponsored collaborations. The observation is consistant with the assumed stabilizing properties of the pre-defined coordination rules imposed by European framework R&D programs. The "stabillity" argument is further reinforced by the discussion in the next subsection.

*3.3.2 The existence of an arbitrator vs. self-resolution of conflicts*

This point is of course linked to the previous one. In a public policy, the agent in charge of the management and control of the program can play the role of an arbitrator, in the sense of Williamson (1979, cf. section 2.3) when a conflict arises. For instance, in case of non-enforcement of the agreed rules by one of the partners, the public supervisor can solve the problem by using some credible threat (no more subsidies, no reimbursement). The supervisor can exclude one of the partners and help the remaining group to stabilize[26]. Moreover the presence of a “principal” may be a good way to coordinate “a group of agents”[27].

In spontaneous agreements, there is no official arbitrator and the partners have to define their own solution to solve the conflict. Asking a third person (very often lawyers) to intervene is usually an expensive solution that does not preserve the continuity of the relationship and that will be used only if damages are important for the partner(s).

[25] Cf. Bach L., Ledoux M.J., Matt M., Schaeffer V. (1995)

[26] For a more general discussion about the role of government agency in discouraging opportunistic behavior in collaorative R&D, see Tripsas & alii, 1995.

[27] Cf. Picard P. & Rey P. (1988)

The absence of an arbitrator may constitute another argument explaining the relative higher percentage of failure of the spontaneous agreements compared to the government-sponsored ones.

### 3.4 Two contrasted scenarios of evolution

The bi-polar characterization of inter-firm research agreement in the previous section leads us to assemble incentive, coordination and cognition features in such a way as to exhibit a strong internal coherence between the characteristics of one given configuration, be it the configuration of the government-sponsored or the one of the "pure" spontaneous private agreement. For instance the secrecy aspect put forward as a characteristic of private R&D cooperation is consistent with the idea of a close connection to the core activity of the partners, which in turn seems to be highly compatible with the fact that partners prefer to preserve their scope of action in terms of specification of the cooperative rules.

According to us, internal organizational coherence is critical for understanding agreement dynamics too, in particular the stability, success and overall logic of a given relationship.

Keeping our two definitions of stability in mind, we are now able to combine the incentive, learning and coordination features of agreements identified in the previous section in order to build two contrasted scenarios of evolution. Our main propositions can be formulated as follows. Government sponsored R&D agreements are most often associated with rather strong "short term" stability but they do not necessarily favor longer-term relationships. By contrast, spontaneous research agreements seem to be characterized by a much higher degree of instability and failure in the short run, whereas they promote long-term relationships in case of a first success.

Let us consider the case of publicly funded agreement first. As was previously mentioned, the mere existence of pre-defined coordination rules in the case of government-sponsored agreements, combined with the presence of a third party able to arbitrate conflicts, should favor the stability of the research project. This "short term stability" argument is still reinforced by the reduced strategic weight linked to a peripheral activity (as compared to a core business). Most importantly, the signaling strategy associated with potentially strong reputation effects inside the whole network of firms participating in the government program may exert very strong, despite indirect, incentive pressures : they should impede or at least discourage opportunistic behaviors ; they add pressure to get things done, that is to say, to complete previously announced R&D projects.

In the long run, it may happen that experience gained in the management of government-sponsored projects leads to subsequent contracting in the same type of R&D programs (networking dynamics). But the highly exploratory nature of motivations and learning, and the probable absence of inter-firm specific assets do not favour "long term stability" of the relationship between all the participants in the initial project. Specifically, it does not seem to favour increasing commitment in a given relationship.

Let us turn now to our pattern of idealized spontaneous collaboration. Such collaborations, because of their proximity to the partners' core businesses, because they are perceived as critical for companies' survival, or more generally because of the strong motivations and expectations that triggered them off, are unsurprisingly submitted to more hazardous pressures in the short run. Failure rate is thus high.

But if specific, non appropriable assets are generated thanks to an effective interactive learning process, then a virtuous escalation of commitment and success can occur. These are the reasons why we - somewhat paradoxically - stress the short term instability of spontaneous collaborations simultaneously with their "long term stability". Needless to say, we recognize that short term stability is an obvious prerequisite for long term stability. But it does not constitute a sufficient condition.

Our bipolar characterization and our evolution scenarios are synthesized in Table 1.

| | **Government sponsored agreement** | **Spontaneous agreement** |
|---|---|---|
| **Incentives** | Subsidies<br>Public info / signaling strategy<br>Reputation effects<br>Develop peripheral competences | Private funding<br>Secrecy<br>Trust<br>Develop future core competences |
| **Coordination** | Predefined rules<br>Arbitration by a third party | Rules to be created / flexibility<br>Self resolution of conflicts |
| **Learning** | Individual learning<br>and creation of redeployable assets | Towards interactive learning<br>and creation of endogenous specific asset (technological or relational) |
| **Evolution** | Short term stability<br>No long term duration of the global relationship between the partners<br><br>"Networking" rationale | Short term unstability<br>Long term duration of the relationship in case of success<br>i.e. increasing commitment and success<br>"Increasing specificity" rationale |

**Table 1 Government sponsored versus spontaneous agreements : two idealized collaborative patterns**

## 4. Conclusion

In this paper we have tried to characterize the organisational properties and the micro-mechanisms of a particular case of inter-firm technological collaboration : the E.U. sponsored collaborative projects. In order to achieve this goal, we used a three dimensional analytical grid in terms of incentive to cooperate, learnng via collaboration and coordination devices. A first application of this grid lead us to extracted some relevant issues from the literature about strategic alliances in general. We then confronted them with empirical material issued from numerous BRITE-EURAM projects.

Our main results are of a theoretical nature. They consists in the elaboration of stylized facts, more precisely two contrasted, idealized collaborative patterns : E.U.- sponsored and spontaneous research collaborations. They can be summurized in the following terms :

- government-sponsored collaborations are generally about peripheral competences, submit to predefined rules and favour exploratory, unilateral learning ;
- by contrast spontaneous collaborations can also concern the creation of more critical knowledge (i.e. closer to core competencies) ; they have first to define their own operating

rules and they sometimes trigger an interactive learning process that generates valuable collective specific assets.
- evolution pathways also differ : government-sponsored collaborations seem to be more stable in the short run (no premature end), but less persistent in the long run in case of success.

The next steps of this exploratory reseach would be :
- To realize a survey in order to provide some empirical support for our theoretical hypothesis. We would like to test the following proposition : Do E.U. sponsored partnerships actually differ from spontaneous collaboration from the point of view of the strategy of the firm ? This could be done for example by sending a questionnaire to companies using both types of collaborations.
- To explore the policy implications of such a distinction between two collaborative rationales. If the government-sponsored collaborations actually obey to specific motivation, learning, coordination and evolution features, compared to spontaneous collaborations, then it could become necessary to revisit the rationales behind technology policy instruments like European research framework programmes.

In order to give general ideas about some possible policy implications, let us suggest two paths for future research.

First, the discussion of section 3.3 identified possible rigidities associated with the ex ante specification of coordination rules case of participation to a European framework program. Namely, the structure and rules of coordination may influence heavily the learning mechanism learning. We suggest that they can even impede or block the emergence of interactive learning. As a consequence, a deeper understanding of the imposed coordination rules and their impact is required.

Second, we hope that our distinction can throw new light on the neo-classical, "market failure" policy rationale. According to this rationale, the justification of public intervention, i.e. subsidies of collaborative R&D, generally relates to spillovers in R&D, appropriability problems and other market failure sources that lead to under-investment in collaborative R&D. In other words the level of spontaneous collaboration is supposed to be located below a socially desirable optimum, so it is necessary to stimulate interfirm R&D collaboration. Note that this rationale implicitely assumes that government sponsored collaboration are equivalent to spontaneous ones. We might question the validity of such a market failure justification as soon as sponsored partnerships intrinsically differ from spontaneous collaborations.

More generally, we think that opening the inter-organizational black box of R&D collaborations is necessary for the purpose of elaborating and improving the effectiveness and efficiency of technology policy instruments like the European framework R&D programs.

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