Hitotsubashi University
Institute of Innovation Research

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The case of the IT industry in the 90's

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ABSTRACT: *In the I.T. industry, which was confronted to a major transition phase during the 90's, partnerships became a strategic component of the new "divided technical leadership" which emerged from the industry vertical disintegration. This paper attempts to evaluate the impact of 1676 partnerships on the financial performance (revenue and profit) and innovative efforts (R&D intensity) of 14 large firms and 725 of their partners. On average, there is a positive impact of collaborative agreements on large incumbents and their partners' financial performance (revenue and income). These results vary according to the type, form and content of the agreement and according to the partner's field of activity. Incumbents get the most benefit from broad scope informal alliances while smaller and more hierarchical forms of partnerships (consortia, joint-ventures) do profit to their partners. For large incumbents, collaborative agreement are more effective when performed with partners from the services industry than with partners from the I.T. industry. The role of partnerships in such an industry transformation phase with heavy cost pressure is confirmed by the negative impact of collaborative agreements on internal R&D spending.*

Keywords: collaborative agreement, R&D intensity, financial performance, alliance, partnership, Information Technology industry.

JEL: C2, L11, L14

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1.Introduction

Due to their proliferation, inter-firm relationships have received increasing attention from the scientific community during the last decade in order to explain their formation process or evaluate their impact on firms' performance. Most empirical investigations attempt to measure the relationship between partnerships and various financial performance indicators. In most cases, such financial indicators are based on short term stock value evolution (in the few days following the partnership agreement) and most empirical investigations focus on cross industry panel data.

The objective of this paper is to evaluate the impact of collaborative agreements in the I.T. industry on firms' financial performances and R&D investment. The contribution to this small but burgeoning literature has several features:

- by adopting business performance indicators such as firms yearly revenue and income, it looks at the impact of collaborative agreements on partners financial performance from a longer term perspective;
- by evaluating the impact of these agreements on both large incumbents and several hundreds of smaller and more specialized firms, it shows the two faces of the economic implications of partnerships;
- by analyzing the impact of these agreements on large firms' propensity to invest in R&D, it also looks et long term innovative efforts of large incumbents;
- by investigating systematically whether the type of agreements, their content, and their importance do affect their impact;
- by focusing on a single industry, the Information Technology (I.T.) sector, confronted to major technology and financial evolutions, it aims at identifying a link between firms partnerships strategy and the evolution of their performance and positioning during industry transformation phases.
- By using an original database composed of about 1700 collaborative agreements between 14 large incumbents and 725 small firms in the IT industry.

Such an approach has been chosen in order to test whether the growth of collaborative agreements formed by I.T. industry leaders in the early 90's can be interpreted as an attempt to absorb a major industry shock characterized by vertical disintegration and the emergence of "divided technical leadership".

The results show that the number of collaborative agreements does affect both financial and R&D performances of large incumbents and their smaller partners. The impact of these agreements depends on their size, type, content, and importance. These results lead to some important policy and managerial implications.

The next section focuses on the review of the literature. We identify six broad hypotheses that are to be validated in our empirical investigations. Section 3 concerns the empirical implementation. It presents the econometric equations, explains the construction of the database and defines the variables that are included in the model. The econometric results are interpreted in section 4 and section 5 concludes.

2. Setting the hypotheses

According to Dussauge and Garette (1995), measuring the performance of an alliance is a complex task. Multiple factors contribute to performance. Among these factors they identified the number of partner firms (suggesting that performance decreases when the number increases), the degree of formalization of the alliance (supporting the idea that performance increases when equity or legal form is involved), the relative position of partners (a strong asymmetry would reduce the probability of a success), or the scope of the alliance (R&D, manufacturing, marketing).

The other dimension of the complexity of measuring the financial performance of alliances resides in the choice of the performance variables: should it be based on short term indicators such as stock price variations in the next days following the partnership or should it be made of longer term parameters such as yearly revenue, gross margins, income, ROE, productivity per employee etc.

Opting for short-term indicators can only be justified in efficient financial markets where the initial stock market response to a key event positively correlates to the long-term performance and value of the event. Kale *et al.* (2002) provide some empirical support for this efficient markets hypothesis by establishing a correlation between both short and long term parameters.

Going to the core subject of measuring the impact of partnerships on the financial performance of firms, most of the authors find a positive relationship between both variables. Based on 345 alliances in the I.T. industry, Chan *et al.* (1997) show that non equity alliances add value to the stocks in the few days after announcement. Baum and Oliver (1991) and Mitchell and Singh (1996) treated firm mortality as the performance variable and showed that alliances raised organizational survival rates. Powell *et al.* (1996) find that companies which had formed many alliances experienced accelerated growth rates. According to Stuart (2000), the greater the revenues of a high-tech firm's alliance partners, the higher the rate of sales growth of that firm.

Sarkar *et al.* (2001) suggest that alliance proactiveness and firm external embeddedness lead to superior market-based performance, and that this effect is stronger for small firms and in unstable market environments. It is during times when environmental changes are threatening to make existing sources of competitive advantage obsolete, when competitive landscapes are being transformed, customer demands are being redefined, and the value of existing competencies being questioned, that proactive alliance formation is likely to create greater value.

The first objective of the present empirical investigation is to test the hypothesis of a positive relationship between partnerships and firms financial performance in the context of the I.T. industry during its transition phase in the 90's.

Hypothesis 1*: Collaborative agreements have globally a positive impact on the financial performance (revenue and income) of large I.T. manufacturers and their partners during the 12 to 24 months following the partnership signature.*

However, some authors find that such a positive effect is not homogenous for all types of partnerships. According to Hagedoorn and Schakenraad (1994) and Berg et al. (1982), short-term negative effects can be expected from knowledge acquisition oriented joint-ventures ("technology partnerships") because of the investments involved, while production and marketing ventures are expected to have short term positive effects.

Meanwhile, the short term impact on the financial performance of firms is not enough to evaluate the final outcome of technology alliances versus sales and marketing partnerships. Anand and Khanna (2000) stress that learning effects should be stronger in R&D partnerships than in other categories (production or marketing) and might therefore counterbalance the short term negative effects.

Hypothesis 2*: When splitting agreements by content (sales, technology and mixed), their impact on large I.T. manufacturers financial performance (revenue and income) might differ substantially.*

Collaborative agreements might also have different impacts in function of the partner industry. Chan *et al.* (1997) and Vanhaverbeke and Duysters (1997) show that partner industries influence the outcome of partnerships differently according to the agreement content: in technology agreements, the outcome is only positive when partners are from the same industry, while in sales it is just the opposite; the outcome is only positive when partner industries differ.

Hypothesis 3*: Agreements with partners from the I.T. industry have a negative impact on the financial performance (revenue and income) of large I.T. manufacturers, while agreements with partners from the services industry have a positive impact.*

Some authors compared the impact of different forms of partnerships on firms' financial performance and identified major differences between informal alliances and more formal forms of partnerships (alliances with equity participation, joint-ventures, mergers and acquisitions).

According to Harrigan (1985), rapidly changing technological developments in sectors of industry induces the formation of somewhat more informal forms of cooperation such as non equity agreements. On the opposite, Allen and Philips Gordon (2000) observe that block equity purchases accompanied by agreements, alliances or joint-ventures result in significantly larger excess stock returns compared to block purchases without partnerships. Target firms increase investments and exhibit gains in operating cash flows after such block purchases. When block purchases are associated with an alliance or joint-venture, those increases in investments and gains in cash flow are even larger. All these effects are bigger when target firms are in industries with high R&D and advertising expenses.

Hagedoorn and Duysters (2000) find that mergers and acquisitions positively influence technological performance. The more the firms are close in size, the worse the increase of technological performance. Restricting their analysis of partnerships impact on firm performance to a single form of collaborative agreement, joint-ventures, many authors underline their negative impact.

Kogut (1989) observes that there is strong evidence that joint-ventures are highly unstable. Among the causes of instability is a lack of reciprocity between partners which are mutual hostages through their equity contribution into the joint-venture. Geringer and Hebert, (1991) showed that international joint-ventures have poor results in general. From 35% to 70% of research joint-ventures have negative results.

In the short term, Finnerty *et al.* (1986) reported that the average stock market reaction to international joint-venture formation announcements was not significantly different from zero. Lee and Wyatt (1990) observed a negative average abnormal return of joint-ventures, which they conjectured was a manifestation of agency problems. Hamel (1991), for instance, views alliances as knowledge appropriation tools and suggest that venture stability can indicate organizational learning dysfunctions rather than success.

Hypothesis 4*: joint ventures, and more formal alliances in general, have a negative impact on the financial performance of firms involved in the partnerships.*

Mortehan (2003) examines a single industry, the Information Technology (I.T.) industry, and suggests that the growth of collaborative agreements formed by industry leaders in the early 90's can be interpreted as an attempt to absorb a major industry shock characterized by vertical disintegration and the emergence of "divided technical leadership". Such incumbent firms have adopted collaborative agreements to maintain their leadership by controlling new entrants in the new industry segments resulting from the disintegration. Partnerships became a strategic component of the new "divided technical leadership" market structure which emerged from the competitive crash of the early 90's.

Based on a case study of the 3 leading firms of the Italian packaging industry, Lorenzoni and Lipparini (1999) showed that the need to match their high standards, in terms of quality and technology, forced firms to concentrate on what they could do best. They studied the process of vertical disintegration and focused on the ability to coordinate competencies and combine knowledge across corporate boundaries arguing that the capability to interact with other companies accelerates the lead firm's knowledge access and transfer with relevant effects on company growth and innovativeness. The ability to integrate knowledge residing both inside and outside the firm's boundaries emerges as a distinctive organizational capability.

Rothaermel (2001 and 2001a) analyzed the phenomenon of extensive cooperation between incumbents and new entrants following radical technological change. Understanding how incumbent firms may take advantage of technological discontinuities is becoming more and more important as the new competitive landscape is characterized by an increasing speed and magnitude of technological change (Bettis and Hitt, 1995). Incumbent survival in the face of radical technological change has been explained by prior collaborative relationships (see Mitchell and Singh, 1996).

According to Rothaermel (2001), more research is needed to understand the phenomenon of inter-firm cooperation and its subsequent impact on incumbent performance. Inter-firm networks can improve an incumbent's access to emerging technologies, increase opportunities for organizational learning, and enable rapid adaptation to market and technology shifts [(Gulati (1998)] .

Mortehan (2003) provides an analysis of the financial evolution of the 14 large I.T. manufacturers during the 1990-2000 decade showing that most of the characteristics of an industry reaching the maturity stage as described by Porter (1980) are met (slower growth of revenue, declining profit margins, cost cuts impact resulting in SG&A reduction and lower internal R&D spending). Bresnahan and Greenstein (1999) showed the structural changes which took place in the computer industry in the early 90's, causing the industry disintegration.

Hypothesis 5*: Firms involved in the agreements (large I.T. manufacturers and their partners) have different outcomes from partnerships in function of their forms and types.*

According to Narula (2000), firms in an industry where a dominant paradigm is established outsource more technologies and make more alliances around niche technologies to be able to follow the rapidity of change and lower costs of innovation. Hagedoorn and Duysters (1997) state that the combination of rising R&D costs and shorter lifecycles cause firms to search for alternatives to internal development. Cooperation is often considered as a viable means to monitor several technological developments at relatively low cost.

Buckley and Casson (1998) observe that by establishing a network of joint-ventures covering alternative technological trajectories, the firm can spread its costs whilst retaining a measure of proprietary control on new technologies. The advantage of joint-ventures is further reinforced by technological convergence. Robertson and Gatignon (1998) suggest that the growth of R&D externalization can be attributed, at least in part, in the United States to Congress's passage of the National Cooperative Research Act in 1984, which eased antitrust laws to permit collaborative research.

Hypothesis 6*: Collaborative agreements contribute to reduce the internal R&D efforts of large I.T. manufacturers.*

3. Empirical implementation

The frame of this analysis being the I.T. industry, the focus is put on the 14 largest firms of the industry in order to keep a degree of homogeneity within the sample (Smaller firms are generally also doing other activities than I.T. (semi conductors, communications, electronics). Matching partnerships made by the I.T. industry leaders during the transition period of the 90's with their financial performance can be very useful in order to test the six hypotheses. We further intend to evaluate the impact of collaborative agreements on smaller firms (most of the incumbents' partners).

Two panel datasets have been constructed. The first one is composed of the 14 large incumbents in the industry. For most firms we have data on financial performances and the number of collaborative agreements over the period 1991-2000. The second panel is composed of smaller firms and recent entrants in the industry. It is composed of 725 firms. For each of the two panels we estimate two types of equations. The first one (see equation 1) attempts to explain financial performances with the number of collaborative agreements (NCA). Since collaborative agreements can take place with firms of different size, we use a second equation that intends to approximate the "size" of the agreement, using the total sales of the partners as weight (see equation 2).

$$Y_{i,t} = \varphi_t + \lambda_i + \alpha\, NCA_{i,t-\theta} + u_{it} \qquad (1)$$

$$Y_{i,t} = \varphi_t + \lambda_i + \alpha\, WCA_{i,t-\theta} + u_{it} \qquad (2)$$

where :

$$NCA_i = \sum_{j=1}^{N} NCA_{ij}$$

$$WCA_i = \sum_{j=1}^{N} S_j \cdot NCA_{ij}$$

Where $Y_{i,t}$ is an indicator of financial performance (total sales or total income) or R&D intensity of firm *i* during the year *t*. NCA_{ij} is the total number of collaborative agreements that a large (small) firm *i* has had with small (large) firm *j*. NCA_i is the total number of agreements that firm *i* has concluded with all other firms. WCA_i is the weighted sum of the agreements performed by firm *i*.

The weights are the total sales value (S_j) of the partner firm. Various time lags (θ) have been tested with values of 0, 1 and 2.

The two equations include time dummies φ_t in order to correct for the cyclicality of the industry, firm dummies λ_i (or within estimates) that allow to correct for firm-specific effects (like size), and an error term u_{it}. All regressions are within panel data estimates performed with the STATA software.

The database includes 1676 collaborative agreements formed by the largest firms of the Information Technology (I.T.) industry between 1986 and 2000. Firms selected for the purpose of this study are the 14 I.T. largest hardware manufacturers (SIC code 357) as of their 1990-2000 rankings by revenue from both Fortune 500 and Gartner Annual Yardstick of top 100 I.T. firms World-Wide. Firms acquired or merged during the period have also been included provided that the company resulting from the merger ranked among the 14 largest firms. The following firms have been screened for their announcements of collaborative agreements: IBM, HP, Sun, Digital, Compaq, Apple, Unisys, NEC, Xerox, Dell, Fujitsu, Siemens, Gateway, and NCR. The database structure is described in detail in Mortehan (2003).

Collaborative agreements have been identified via a Proquest® query searching for a broad range of terms (agreement, partnership, alliance, venture, merger, acquisition, relationship, collaboration) on hundreds of newspapers and periodicals (the list is available on request, including more than 1600 publications covering all regions of the World).

Considering the profile of the I.T. industry, most of the potential biases associated with this approach, and identified by Vonortas (1995), are less relevant.[1] Furthermore, contrary to alternative solutions such as interviewing IT firms management or getting the data from firm's Web sites, this approach also offers the advantage of selecting the agreements with the eyes of neutrality which may increase the homogeneity of the database. From the viewpoint of I.T. practitioners, to this neutrality advantage of the press one can add the positive impact of a considerable improvement of the I.T. press professionalism and technology expertise during the last 20 years. Once the agreements identified with the query on press sources, their contents have been put into the database based on both the contents of press articles and additionally, for the most important and recent agreements, data published on Web sites of partners.

Consolidated statements of income of the 14 largest I.T. firms and 355 out of more than 700 partners have been entered in the database for the purpose of this study. They have been obtained mainly from the US "Securities and Exchange Commission" (http://www.sec.gov/) or from "Investors relations" web sites of firms or, when not available, from Hoover's online (http://www.hoovers.com). Table 1 here under provides a summary of the database contents used in the paper. IBM is by far the company that performed the highest number of agreements. The number of partners is always lower than the number of agreements. Large firms do perform several agreements with similar partners and these agreements involve most of the time single partners.

********** Insert Table 1 around here ***********

[1] small firms being underrepresented (the 14 firms of our target are all large enterprises) , too much English oriented (most of the 14 firms are US based) or announcement requirements varying per country (most I.T. press coming from US)

Table 2 clearly shows that collaborative agreements are differentiated by type, content and importance (weights from 1 -less important agreements- to 6). It clearly shows that informal alliances are the loin's share of all collaborative agreements. In addition, a clear majority of these agreements concern sales performances.

********** Insert Table 2 around here ***********

4. Econometric results

The empirical results can be summarized in five sets of findings: (a) Collaborative agreements have globally a positive impact on the financial performance of firms; (b) the outcome is different for large manufacturers in function of the partnership content; (c) as well as for smaller partners; (d) partner industry is key for large I.T. manufacturers to get a positive return from their partnerships; (e) firms involved in the agreements (large I.T. manufacturers and their partners) have different outcomes from partnerships in function of their forms or types (f) Collaborative agreements contribute to reduce the internal R&D efforts of large I.T. manufacturers.

(a) There is strong empirical evidence that collaborative agreements have globally a positive impact on the financial performance (both in terms of revenue and income) of large I.T. manufacturers and their partners during the 24 months following the partnership signature.

********** Insert Table 3 around here ***********

The first row of results in Table 3 shows that partnerships have generated a positive effect on the evolution of income and sales. This impact occurs during the first two years following the agreements. The larger the partner is, the larger the impact on firms' economic performance. Indeed, the estimates of equation (2), with the weighted sum of the partners' sales as explanatory variables, show a positive and significant impact of collaborative agreements on a large firm's sales or income growth. In other words, the larger the partner, the larger the potential benefit of a collaborative agreement.

Regarding smaller partners, the results presented in the first row of Table 4 also show a positive and significant impact of the number of agreements with large incumbents on their own sales or income performances. The weighted sum model shows less significant results. From the viewpoint of a small firm, all large firms are very large, and therefore the weighted sum of their sales does not yield additional information in our model – what matters is to implement an alliance with a large firm, not the size of the latter.

The fact that both the industry leaders and their partners do benefit from their collaborative agreements confirms that partnerships became a strategic component of the new "divided technical leadership" market structure which emerged during the I.T. industry transformation.

(b) When splitting agreements by content (sales, technology and mixed), their impact on large I.T. manufacturers' financial performance (revenue and income) differs notably. Row 3 of Table 3 shows that agreements that are exclusively oriented towards technology have no impact on revenue and a negative impact on income, whereas both sales and mixed agreements have a positive impact on the two financial performance indicators.

Such result questions the hypothesis formulated by Mortehan (2003) that collaborative agreements are increasingly used by industry incumbents to improve their access to emerging technologies while their partners get the most benefits from sales agreements to get market coverage.

Meanwhile, the fact that mixed partnerships combining both technology and sales/marketing have a significantly positive impact on the revenue and profit of large firms strengthens the above hypothesis. The fact that such mixed agreements have a higher average importance than either technology or sales agreements also reinforces the argument. The poor results of technology partnerships for large firms have three potential explanations. First, many of these agreements are generally considered of minor importance, and would therefore not show up in our model.

Second, since these agreements are exclusively based on technology, it might take longer than two years to reach the market. The short term impact on the financial performance of firms is not enough to evaluate the final outcome of technology alliances versus sales and marketing partnerships. Anand and Khanna (2000) stress that learning effects should be stronger in R&D partnerships than in other categories (production or marketing). Some explanation of these contradictory results can also be found in Hagedoorn and Schakeraad (1994) and Berg et al. (1982) statements that short-term negative effects can be expected from knowledge acquisition oriented joint-ventures ("technology partnerships") because of the investments involved while production and marketing ventures are expected to have short term positive effects.

Third, these poor results might also witness some kind of "innovator's dilemma", whereby a disruptive technology controlled by a smaller firm gradually reaps some market share of an incumbent firm. According to Christensen (2003), in the long run, the incumbent has either to acquire the small firm or adapt its own technology to survive. A related argument is suggested by Mohanram and Nauda (1996) who provide evidence that joint-ventures are announced when the parent firms' performance deteriorates. Firms entering in technology alliances might do so partly because of bad financial performance causing a reversed effect between variables.

********** Insert Table 4 around here ***********

It is difficult to identify which of these three potential explanations is more relevant to explain the negative or insignificant impact of technology alliances on large firms' economic performances. The next results, which concern small firms, might shed some more light on this issue.

(c) When splitting agreements by content (sales, technology and mixed), their impact on smaller I.T. manufacturers' financial performance (revenue and income) differs to some extent: agreements that are exclusively oriented towards technology have an overall positive impact on economic performances and sales or mixed agreements have a positive impact if the size of the large firms is considered.

The third main row of Table 4 shows the impact of collaborative agreement by content on the smaller partner firms. The results clearly show that only the number of technological alliances has a positive impact on total revenue. The number of mixed agreements has a positive impact on the partners' profits whereas the impact of sales agreements shows up in the weighted sum model. In other words, the size of the large incumbent matters more for sales agreements. The positive impact of the number of technology agreements on the total revenue of partners suggests that the third explanation, the disruptive technology effect, might be of importance when attempting to understand the poor results of these agreements on large firms' revenues or profit.

(d) There is evidence that agreements with partners from the I.T. industry have a negative impact on the financial performance (revenue and income) of large I.T. manufacturers, while agreements with partners from the services industry have a positive impact.

Row 5 of Table 3 shows that the number of agreements with partners from the I.T. industry has a negative impact on the financial performance (revenue and income) of large I.T. manufacturers. This result validates the results obtained by Chan *et al.* (1997) and Vanhaverbeke and Duysters (1997). These authors show that in sales partnerships the outcome is positive mainly when partner industries differ.

The fact that the contribution of partnerships with services firms is significantly positive on the financial performance (revenue and income) of large I.T. manufacturers confirms the importance for such market leaders to shift from low margin hardware segments to high-profitability professional services. This has been a well-known strategy for most firms in the 90's and our results confirm its effectiveness.

(e) Firms involved in the agreements (large I.T. manufacturers and their partners) have different outcomes from partnerships in function of their forms or types:

Row 2 of Table 3 and Table 4 show that large I.T. manufacturers do benefit from informal alliances (83% of all observed agreements) while joint ventures and alliances with participations have a rather negative impact on their financial performance; on the opposite, their partners get most of their return from more formal types of partnerships (consortia, acquisitions, alliances with participation and joint ventures,)

One explanation is that large firms do not need hierarchical forms of partnerships to benefit from collaborative agreements as they have a high negotiation power. They are able to control the execution of the deal and therefore get most of the benefits. On the opposite, the fact that their partners, which are mostly small firms and new entrants, do need structured forms of partnerships to get the most benefits from it is quite understandable: hierarchical forms such as joint-ventures or alliances with equity participation protect them against the dominance of the large I.T. firms involved in the partnerships.

The positive impact of consortia for partners sounds logic. By entering into consortia led by large incumbents to promote industry standards, new entrants may get the necessary recognition for their technology and products or services.

Strategic partnerships (weight 3 to 6) contribute to improve large I.T. manufacturers' revenue and have a negative impact on their partners' revenue while less important agreements (weight 1 to 3) have a positive contribution on partners' sales.

Large firms do probably make more use of their power to influence the outcome and get most of the results to them in strategic partnerships than in less important collaborative agreements (see row 4 of Table 3 and Table 4). It must be noticed that in many cases the degree of importance of a partnership is directly linked with the contribution of the large firm involved. As a consequence, small firms may only get control of less important partnerships which probably explains why they benefit mainly from such minor agreements.

********** Insert Table 5 around here ***********

(f) There is strong evidence that collaborative agreements contribute to reduce the internal R&D efforts of large I.T. manufacturers: their negative impact on the R&D intensity (R&D spending/revenue) is particularly visible in the case of acquisitions and/or mixed agreements.

Two complementary reasons can be put forward in order to explain these results (see Table 5):

- On the one hand, the standardization and emergence of a dominant technology in the I.T. industry stimulates the formation of technology agreements (cooperation and exchange of information being easier and less risky). Therefore the aggregate – hence individual- innovative efforts can be reduced through the exploitation of other firms' knowledge. Within the context of an acquisition, the drop of aggregate R&D outlays is straightforward and clearly appears in our results.

- On the other hand, firms confronted to declining profit margins need to cut costs by all means and see partnerships as a way to reduce their internal R&D spending (R&D collaborative agreements allow to share costs and provide more flexibility to adjust R&D efforts in such an unstable technology environment)

7. Conclusions

This paper aimed at quantifying the impact of collaborative agreements on large I.T. manufacturers and their partner's financial performances (revenue and profit). The empirical results provide strong evidence that collaborative agreements played a key role during the I.T. industry transformation phase of the 90's. Firms involved in such partnerships got a positive return from them at three levels:

- they contributed to maintain or improve revenue levels;
- they had a positive impact on income levels which was vital in such a context of negative results;
- they induced firms to reduce their internal R&D spending which was also critical in such a transition period with heavy cost cuts and a clear trend towards standardization.

However, a more in-depth analysis shows that all collaborative agreements are not automatically beneficial to large I.T. manufacturers or their partners. For instance, partnerships which are exclusively technological (as opposed to sales/marketing or mixed agreements) show mainly a weak or negative impact on large I.T. incumbents' revenue and a positive impact on their smaller partners. These results might witness the emergence of some disruptive technologies leading to an innovator's dilemma regarding large I.T. manufacturers.

In addition, collaborative agreements with partners from the services industry were much more fruitful than collaborative agreements with partners from the I.T. industry, suggesting that alliances targeting complementary competencies are more beneficial to large incumbents.

Relative negotiation power and information asymmetry also play an important role in setting up an agreement between a large incumbent and his partner. Formal agreements (alliance with participations, joint venture, acquisition and consortia) benefit more the partner firms, whereas informal partnerships benefit more to the large incumbents.

In a nutshell, and on average, traditional I.T. leader firms successfully used collaborative agreements to keep their leadership and control new entrants in the new segments resulting from

the industry disintegration. Results showing positive outcomes of partnerships for their partners indicate that collaborative agreements are a win-win solution for both firms involved. Partners most probably used collaborative agreements to facilitate their market penetration and get recognition for their technology. Nevertheless, paying a special attention on the type, form and content of a new alliance would significantly improve its potential underlying benefits.

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TABLE 1. Number of collaborative agreements by the 14 largest I.T. firms

Agreements per firm	Nationality	# of partnerships	# of partners
IBM	USA	595	377
HP	USA	271	167
Sun	USA	162	104
Digital	USA	139	102
Compaq	USA	123	80
Apple	USA	98	63
Unisys	USA	67	57
Xerox	USA	49	38
NEC	Japan	44	37
Dell	USA	41	36
Fujitsu	Japan	39	31
Siemens	Germany	23	17
Gateway	USA	16	15
NCR	USA	9	8
Total		1676	
Average per firm		120	81
Average for small firms	nr	**2.16**	**1.46**

Sources: own computation, from 1676 collaborative agreements performed during the period (1986-2000)

TABLE 2. Collaborative agreements by type, content and weights (1986-1999)

# of partnerships/ per content :	Sales	Technology	Mixed	Total
Agreements per type				
Acquisitions	27	5	45	77
Alliances	827	390	191	1408
Alliances with participation	23	19	7	49
Consortia	2	77		79
Joint ventures	17	24	22	63
Agreements per weight				
1	106	11	4	121
2	355	105	41	501
3	320	279	116	715
4	91	111	75	277
5	20	8	22	50
6	4	1	7	12
Agreements per content	896	515	265	1676

Sources: own computation, from 1676 collaborative agreements performed during the period **(1986-2000)**

TABLE 3: PARTNERSHIPS AND FINANCIAL EVOLUTION OF 14 I.T. LARGE FIRMS[1]

	Dummies				*Weighted sum*			
	Sales		Income		Sales		Income[2]	
Dependent variable	*t+1*	*t+2*	*t+1*	*t+2*	*t+1*	*t+2*	*t+1*	*t+2*
1. All partnerships	522.73*	523.78*	-6.22	48.77*	0.28*	0.25*	2.02	8.55*
	(9.78)	*(9.79)*	*(-0.36)*	*(2.73)*	*(4.57)*	*(3.72)*	*(0.79)*	*(3.17)*
R^2	*0.33*	*0.33*	*0.18*	*0.29*	*0.21*	*0.18*	*0.15*	*0.36*
Agreements by type								
Acquisitions	260.31	91.60	91.88	-358.69	0.30	0.43	28.20	44.10
	(0.36)	*(0.12)*	*(0.33)*	*(-1.14)*	*(0.38)*	*(0.53)*	*(0.84)*	*(1.34)*
Alliances	400.64*	358.55*	36.55	97.06*	0.39*	0.33*	2.31	8.18*
	(5.56)	*(4.46)*	*(1.33)*	*(3.06)*	*(4.82)*	*(3.68)*	*(0.67)*	*(2.19)*
Alliances with participation	131.74	235.95	-1,236.6*	-1,258.0*	-0.32	-0.63	-0.58	-8.33
	(0.18)	*(0.30)*	*(-4.36)*	*(-4.00)*	*(-0.48)*	*(-0.93)*	*(-0.02)*	*(-0.30)*
Consortia	176.16	270.37	-135.49	-23.57	0.23	0.50	18.60	12.90
	(0.39)	*(0.56)*	*(-0.79)*	*(-0.12)*	*(0.62)*	*(1.31)*	*(1.18)*	*(0..82)*
Joint ventures	-1090.49*	-1021.21[a]	-753.63*	-59.15	-0.54*	-0.37	-12.70	10.40
	(-2.02)	*(-1.64)*	*(-3.66)*	*(-0.24)*	*(-1.71)*	*(-1.10)*	*(-0.93)*	*(0.75)*
R^2	*0.27*	*0.23*	*0.04*	*0.32*	*0.21*	*0.19*	*0.16*	*0.38*
Agreements by content								
Sales/marketing agreements	243.35*	227.51*	105.01*	122.20*	0.28*	0.16	13.70*	9.30*
	(2.01)	*(1.70)*	*(2.19)*	*(2.20)*	*(2.54)*	*(1.35)*	*(3.11)*	*(1.93)*
Technological agreements	-7.21	-2.43	-399.89*	-174.22*	0.12	0.23*	-19.6*	3.98
	(-0.04)	*(-0.01)*	*(-6.22)*	*(-2.40)*	*(0.90)*	*(1.73)*	*(-3.88)*	*(0.74)*
Mixed agreements	1116.11*	985.57*	239.73*	284.52*	0.69*	0.86*	20.50*	25.70*
	(4.24)	*(3.30)*	*(2.30)*	*(2.30)*	*(3.95)*	*(3.86)*	*(2.94)*	*(2.82)*
R^2	*0.28*	*0.25*	*0.03*	*0.31*	*0.21*	*0.19*	*0.18*	*0.38*
Agreements by importance level								
Weight 1	77.58	26.30	-302.30[a]	-182.93	0.20	0.01	-101*	-71.40*
	(0.17)	*(0.06)*	*(-1.46)*	*(-0.85)*	*(0.37)*	*(0.02)*	*(-5.15)*	*(-3.02)*
Weight 2	275.88*	45.27	-41.68	-32.34	0.25[a]	0.27	21.70*	19.50*
	(1.68)	*(0.24)*	*(-0.58)*	*(-0.38)*	*(1.65)*	*(1.30)*	*(3.94)*	*(2.34)*
Weight 3	257.05*	237.67*	-0.81	114.41*	0.19[a]	0.18	-7.07[a]	8.67*
	(2.04)	*(1.91)*	*(-0.02)*	*(2.03)*	*(1.65)*	*(1.43)*	*(-1.65)*	*(1.77)*
Weight 4	681.90*	997.11*	54.18	134.64	0.60*	0.54*	10.10*	8.47
	(2.11)	*(3.10)*	*(0.38)*	*(0.93)*	*(3.96)*	*(3.48)*	*(1.83)*	*(1.38)*
Weight 5	-1380.01*	-2,499.11*	-263.39	-307.45	-0.74	-1.20*	-77.2*	-28.00
	(-1.72)	*(-3.14)*	*(-0.75)*	*(-0.85)*	*(-1.27)*	*(-2.03)*	*(-3.63)*	*(-1.19)*
Weight 6	3382.76*	4,232.85*	-209.47	-193.72	1.22	1.78*	32.30	45.50
	(1.99)	*(2.51)*	*(-0.28)*	*(-0.25)*	*(1.42)*	*(2.07)*	*(1.03)*	*(1.32)*
R^2	*0.29*	*0.24*	*0.00*	*0.32*	*0.21*	*0.19*	*0.23*	*0.40*
Agreements by partner industry								
Mining, oil extraction	400.52	432.93	1,150.35	1,967.55[a]	-1.25*	385.79	35.70*	54,587
	(0.13)	*(0.14)*	*(1.01)*	*(1.46)*	*(-2.74)*	*(0.50)*	*(1.73)*	*(1.75)*
Construction	10,532.75*	11,460.61*	211.11	-865.25	16.66	11.34	632.70	-912[a]
	(2.51)	*(2.65)*	*(0.14)*	*(-0.48)*	*(1.25)*	*(0.74)*	*(1.05)*	*(-1.47)*
Manufacturing	112.74	389.42	-157.09	-67.10	0.06	0.06	-9.81	2.43
	(0.37)	*(1.22)*	*(-1.39)*	*(-0.50)*	*(0.33)*	*(0.31)*	*(-1.27)*	*(0.31)*
Computers	-362.91[a]	-85.19	-319.07*	-185.81*	0.08	0.09	5.53	16.00*
	(-1.47)	*(-0.33)*	*(-3.46)*	*(-1.70)*	*(0.41)*	*(0.41)*	*(0.61)*	*(1.76)*
Transport, comms oil & gas	520.84	441.88	240.06	55.00	0.41*	0.38*	-6.39	2.07
	(1.00)	*(0.83)*	*(1.24)*	*(0.24)*	*(2.83)*	*(2.38)*	*(-0.98)*	*(0.32)*
Wholesale & retail trade	-305.17	178.34	-1,030.1*	-649.96*	-1.09	-0.40	52.30	35.00
	(-0.42)	*(0.23)*	*(-3.75)*	*(-1.95)*	*(-1.07)*	*(-0.35)*	*(1.14)*	*(0.76)*
Finance, insurance & real est.	117.02	145.31	-679.29[a]	801.00	9.14	26.50	702.70	350.10
	(0.10)	*(0.11)*	*(-1.54)*	*(1.43)*	*(0.34)*	*(0.83)*	*(0.58)*	*(0.27)*
Services	970.81*	745.69*	177.72*	98.12	2.07*	1.16*	10.70	45.70*
	(4.60)	*(3.30)*	*(2.25)*	*(1.02)*	*(5.29)*	*(2.27)*	*(0.61)*	*(2.22)*
R^2	*0.21*	*0.26*	*0.01*	*0.08*	*0.20*	*0.17*	*0.29*	*0.45*
Nobs	*173*	*159*	*173*	*159*	*173*	*159*	*173*	*159*

1. Within estimates, see equations (1) and (2), all equations time dummies.
2: original data x 10^6

TABLE 4: PARTNERSHIPS AND FINANCIAL EVOLUTION OF PARTNER FIRMS[1]

	Dummies				*Weighted sum*[1]			
	Sales		Income		Sales		Income[2]	
Dependent variable: ($m)	*t+1*	*t+2*	*t+1*	*t+2*	*t+1*	*t+2*	*t+1*	*t+2*
1.**All partnerships**	559.16*	593.29*	188.3*	-77.0	5.21*	5.05[a]	0.13	3.05
	(4.59)	*(4.58)*	*(1.97)*	*(-0.96)*	*(1.92)*	*(1.64)*	*(0.06)*	*(1.28)*
R^2	*0.02*	*0.02*	*0.01*	*0.00*	*0.01*	*0.01*	*0.00*	*0.00*
***1.* Agreements by type**								
Acquisitions	799.45	-1158.0	1101.6*	3644.8*	-17.42	-22.20	20.72	42.35*
	(0.99)	*(-1.33)*	*(1.84)*	*(5.42)*	*(-0.75)*	*(-0.94)*	*(1.20)*	*(2.32)*
Alliances	157.94	180.67	-7.98	116.86	3.00	5.36*	-0.23	2.76
	(1.28)	*(1.32)*	*(-0.09)*	*(1.11)*	*(1.07)*	*(1.68)*	*(-0.1)*	*(1.12)*
Alliances with participation	1939.7*	3196.2*	-31.50	293.8	8.38	11.59	-16.02	4.22
	(1.99)	*(3.14)*	*(-0.04)*	*(0.38)*	*(0 .37)*	*(0.42)*	*(-0.9)*	*(0.20)*
Consortia	2658.7*	1816.5*	481.82	390.4	78.79*	11.05	19.69*	6.44
	(3.80)	*(2.39)*	*(0.95)*	*(0.67)*	*(5.48)*	*(0.55)*	*(1.85)*	*(0.41)*
Joint ventures	1302.3*	-994.6	-141.03	-322.4	13.02	0 .64	-0.57	0.28
	(1.83)	*(-1.3)*	*(-0.27)*	*(-0.54)*	*(1.04)*	*(0.05)*	*(-0.0)*	*(0.03)*
R^2	*0.02*	*0.01*	*0.00*	*0.02*	*0.02*	*0.01*	*0.00*	*0.00*
***2.* Agreements by content**								
Sales/marketing agreements	11.57	4.93	-93.99	-156.26	11.61*	17.31*	9.69*	18.97*
	(0.07)	*(0.03)*	*(-0.73)*	*(-1.05)*	*(1.74)*	*(2.40)*	*(1.98)*	*(3.41)*
Technological agreements	837.11*	456.62*	7.59	210.93	-4.17	-2.06	-3.85	-7.03*
	(3.90)	*(2.02)*	*(0.05)*	*(1.21)*	*(-1.02)*	*(-0.42)*	*(-1.3)*	*(-1.9)*
Mixed agreements	34.29	530.83	522.64*	1409*	15.40*	6.90	0.52	6.67[a]
	(0.99)	*(1.33)*	*(2.04)*	*(4.62)*	*(3.17)*	(1.27)	*(0.15)*	*(1.60)*
R^2	*0.02*	*0.02*	*0.00*	*0.01*	*0.02*	*0.01*	*0.00*	*0.01*
***3.* Agreements by importance level**								
Weight 1	699.66	148.86*	203.95	167.48	12.00	25.72[a]	7.21	9.45
	(1.22)	*(2.33)*	*(0.48)*	*(0.34)*	*(0.84)*	*(1.50)*	*(0.68)*	*(0.71)*
Weight 2	-110.36	-326.11	61.66	385.33*	-9.96*	-10.8*	-4.30	1.56
	(-0.48)	*(-1.32)*	*(0.36)*	*(2.01)*	*(-1.8)*	*(-1.7)*	*(-1.1)*	*(0.32)*
Weight 3	640.95*	586.38*	-0.12	-57.21	16.25*	18.05*	2.19	1.23
	(3.28)	*(2.73)*	*(0.00)*	*(-0.35)*	*(4.14)*	*(4.06)*	*(0.75)*	*(0.36)*
Weight 4	-114.40	-476.87	-46.35	376.44	-4.98	-18.2*	-1.09	9.83
	(-0.35)	*(-1.33)*	*(-0.19)*	*(1.36)*	*(-0.7)*	*(-2.4)*	*(-0.2)*	*(1.67)*
Weight 5	1423.8*	1105.3	60.86	777.1	-58.8*	-10.24	7.98	16.29
	(1.78)	*(1.32)*	*(0.10)*	*(1.19)*	*(-1.8)*	*(-0.3)*	*(0.34)*	*(0.64)*
Weight 6	-4014[a]	-2441	422.18	1684.2	-79.6*	-62.2[a]	18.66	33.74
	(-1.56)	*(-0.95)*	*(0.22)*	*(0.85)*	*(-1.9)*	*(-1.5)*	*(0.60)*	*(1.03)*
R^2	*0.01*	*0.01*	0.00	0.01	*0.01*	*0.01*	0.00	0.00
nobs	*1880*	*1742*	*1903*	*1764*	*1609*	*1268*	*1634*	*1293*

1. Within estimates, see equations (1) and (2), all equations include time dummies.
2. original data x 10^9

TABLE 5: PARTNERSHIPS AND INTERNAL R&D OF I.T. LARGE FIRMS[1]

Dependent variable: R&D intensity	Number[2]	Weighted sum[2]
1. All partnerships	-2.80*	-0.30*
	(-1.91)	*(-1.93)*
R^2	*0.11*	*0.13*
2. Agreements by type		
Acquisitions	-87.16*	-7.03*
	(-4.64)	*(-3.49)*
Alliances	-1.70	-0.28
	(-0.92)	*(-1.37)*
Alliances with participation	3.84	-0.22
	(0.20)	*(-0.13)*
Consortia	6.42	0.20
	(0.55)	*(0.21)*
Joint ventures	8.90	-0.84
	(0.64)	*(-1.02)*
R^2	*0.09*	*0.12*
3. Agreements by content		
Sales/marketing agreements	0.40	-0.23
	(0.12)	*(-0.77)*
Technological agreements	-1.59	-0.07
	(-0.36)	*(-0.21)*
Mixed agreements	-15.73*	-1.20*
	(-2.17)	*(-2.58)*
R^2	*0.09*	*0.12*
4. Agreements by importance level		
Weight 1	2.47	0.48
	(0.20)	*(0.33)*
Weight 2	-2.34	-0.08
	(-0.53)	*(-0.20)*
Weight 3	-7.56*	-0.50[a]
	(-2.21)	*(-1.59)*
Weight 4	8.59	-0.32
	(0.98)	*(-0.79)*
Weight 5	-20.92	0.54
	(-0.98)	*(0.34)*
Weight 6	51.28	-1.05
	(1.15)	*(-0.46)*
R^2	*0.10*	*0.12*
nobs	*195*	*195*

1. Within estimates, all equations include time dummies.
2: original data $x10^4$