Transitions in Agbiotech: Economics of Strategy and Policy

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28. Collaborative Agreements in the Ag-Biotechnology Industry: The Importance of Transaction Costs and Investment Strategy

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Chapter 28

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Introduction

With the emergence of a new cycle of business acquisitions, divestitures and strategic partnerships, the process of consolidation in the field of ag-biotechnology continues its course during the nineties. Competition has become not only an issue of rivalry among firms, but also an issue of rivalry among inter-organizational networks and contending technological fronts. Today, in addition to learning how to deal with uncertainty, ag-biotechnology firms need to learn how to partner with other companies. Collaborative agreements of biotech-biotech, seed-biotech, biotech-agchemical and other multiple combinations of inter-organizational arrangements abound both in domestic and international markets.

The purpose of this chapter is to identify factors affecting business investment decisions in the formation of collaborative agreements in the ag-biotechnology industry. Transaction costs economics is an appropriate perspective that relates business investment commitment (e.g., business acquisition, equity investment and non-equity investment, spot market transaction) to factors associated with uncertainty, asset specificity, opportunistic behavior, etc. The research domain of strategic alliances examines the strategic motives for investing in new inter-firm relationships. This study combines both views to analyze collaborative agreements in the ag-biotechnology sector.

The next section describes relevant theoretical arguments on transaction costs economics and strategic alliances associated with investment commitment. The data and methodology to conduct our empirical test are summarized in section three. Section four provides the main findings of our study and the last section completes the chapter with a brief summary of conclusions and implications.

Investment Decision: Transaction Cost and Strategic Alliance Perspectives

The ag-biotechnology market is characterized by numerous and complex inter-firm relationships which result from spot market failures and transactional difficulties in many instances. Transaction cost economics is a research stream that draws on organization theory and takes the transaction, rather than the firm or market, as the basic unit of analysis. Within this conceptual framework, the governance form may range from markets to internal organization (i.e., ownership). According to Williamson (1975), factors

such as asset specificity (i.e., human, physical, site specific assets), uncertainty, opportunism, product complexity and constraints of repeated purchase activity will determine the optimum governance form to consummate a transaction.

Organizational integration is viewed as a method for overcoming some of the problems associated with imperfect long-term contracts (Shane, 1994). The main objective advocated by the transaction cost rationale is to overcome the problem of market failure and find among different contracting modes the one that minimizes transaction costs.

This line of thinking suggests an inverse relationship between uncertainty and a hierarchical governance form. That is, as uncertainty increases less committing transactional arrangements will be preferred (Pisano, 1989). It is noteworthy to mention that in this study organizational integration (i.e., business acquisition) is assumed to be a more committing business investment transaction than any other transactional arrangement such as an equity or licensing agreement (i.e., agreements which involve a lower investment commitment). One can classify uncertainty sources in three groups: technological uncertainty, extrinsic uncertainty and resource uncertainty (McGrath and MacMillan, 1998).

Technological uncertainty comes from the lack of knowledge about the viability of a technological project. The firm does not know whether or not the technology can be developed, and even less, whether or not it can reach the market. Technological uncertainty will be reduced once the project is undertaken. For highly uncertain technological projects, lower sunk costs would be preferred to higher sunk costs by risk averse agents.

Extrinsic uncertainty comes from forces external to a firm. Such exogenous factors may include unexpected government regulation, unpredictable climatic conditions, pest damage, customers' financial problems, and so on. In contrast to technological uncertainty, undertaking investment in the project cannot reduce extrinsic uncertainty. For a risk averse agent, higher extrinsic uncertainty will be associated with lower investment commitment (Long and Ravenscraft, 1993).

Resource uncertainty can come from the conflict arisen due to asymmetric information about the adequacy of the resources owned by the potential partner. One way to reduce resource uncertainty is by developing a long-term relationship with a partner where investment in the technological project is completed gradually (Kogut, 1994). As common knowledge about each partner's capabilities is gained over time, a firm is in a better position to commit further in the investment project. Once resource uncertainty is reduced, a firm may decide to culminate the prior relationship by completing an acquisition of the partner firm.

Transaction cost theory seems to be an important, but yet incomplete framework to examine inter-firm relationships in agricultural markets. Many of the empirical findings agree that more committing governance forms help in reducing transaction costs, but they also agree that transaction cost theory ignores the strategic motives driving collaborative agreements.

Instead of reducing transaction costs, strategic alliances can be understood as cooperative agreements carried out among firms with the aim to extend their own pool of resources and capabilities, or alternatively, to position themselves strategically in the marketplace. In fact, transaction cost savings may not be as critical as gains in technical capability, tacit knowledge, or understanding of rapidly changing markets in some instances (Osborn and Hagedoorn, 1997).

Horizontal mergers and acquisitions could be an example of capturing a larger portion of the market in order to regain technological rents. A firm may wish to join efforts with another company in the same industry (i.e., horizontal inter-firm agreement) and create a new entity either to reduce costs through synergy effects or to improve bargaining power through increasing industry concentration, which would allow it not only to appropriate technological rents but also to consolidate a new technology in the marketplace. The trend towards a higher industry concentration in agricultural sectors may force firms inclined to enhance market share (i.e., so that firms are able appropriate technological rents and exploit their technological products) to further pursue inter-firm horizontal alliances (Hitt et al., 1998: p.240). The seed and fertilizer agricultural sectors may serve as examples of such an industry trend (i.e., to commercialize Roundup Ready or Liberty Link technologies).

In summary, we expect that in addition to transaction cost arguments such as increased uncertainty (i.e., technological, resource and extrinsic uncertainty), strategic alliance arguments (i.e., market positioning, access to innovation, etc.) serve also to explain the investment commitment embedded in collaborative agreements among ag-biotechnology firms.

Data and Methodology

Secondary data for the 1994-1997 period have been collected primarily for major US and European companies operating in different industry sectors such as agricultural chemicals, organic chemicals, biotechnology, seed commodity, agricultural wholesale and food manufacturing (see Appendix for the description of variables). The selection of this timeframe (i.e., 1994-1997) is appropriate, as many of the business investment transactions completed in this decade have taken place during this period. All the companies studied are public and completed at least one business investment transaction during the 1994-97 period in order to acquire, develop or commercialize agricultural biotechnology or food technology products. The diverse sources consulted for collecting the data are: Merger and Acquisitions, *Bioscan*, US Patent and Trademark Library database, Agricultural Statistics, Statistical Abstract and individual companies' annual reports.

Cox regression is a method for modeling time-to-event data. Survival analysis is concerned with the time to occurrence of a critical event such as the acquisition of a firm (i.e. death of the other party). The Cox regression test is conducted on a sample of 467 business investment transactions completed in the agricultural biotechnology and food technology markets during the 1994-97 time period. The dependent variables STATUS and TIME indicate, respectively, whether or not an acquisition took place between 1994

and 1997 (i.e., death of the target company), and the time elapsed until the moment when the acquisition occurred. To check the reliability of these results a discriminant analysis, is conducted on the same sample. The discriminant analysis will help us to better understand which forces contribute most in differentiating among the three levels of commitment for individual business transactions (i.e., non-equity, controlling equity and acquisition).

Results

Factors that determine a business acquisition (i.e., death of a target company) and a majority equity-based agreement (i.e., controlling equity of 51% of target-firm's capital) are identified by using a Cox regression method. Results are displayed in Tables 1 and 2. Results from Cox regression analysis show some support for transaction cost theory arguments.

TABLE 1 Cox Regression Results for Business Acquisition Transactions

Dependent Variable:	STATUS						
Method:	Cox Regression Analysis						
Variable	**b**	**df**	**S.E.**	**Wald**	**R**	**Sign.**	**Exp(b)**
AGE	0.01***	1	0.00	6.01	0.04	0.01	1.01
CPALLNC	-0.06***	1	0.03	5.41	-0.04	0.01	0.93
CPAP94	0.00***	1	0.00	10.28	-0.06	0.00	0.99
DD	0.44***	1	0.17	6.46	0.04	0.01	1.54
DEBTRAT	0.00	1	0.00	0.08	0.00	0.77	0.99
DV	0.01	1	0.01	2.17	0.00	0.14	0.10
EXPAC	-0.02	1	0.03	0.34	0.00	0.53	0.97
INTSALE	0.01	1	0.00	1.54	0.00	0.21	1.01
MD	0.94***	1	0.21	19.96	0.09	0.00	2.57
RD	-0.08	1	0.20	0.13	0.00	0.71	0.92
RELD	0.43**	1	0.18	5.20	0.04	0.02	1.53
SD	0.94***	1	0.36	7.90	0.05	0.01	2.55
SIC200	1.63***	1	0.58	7.66	0.05	0.01	5.11
SIC286	0.72	1	0.57	1.58	0.00	0.20	2.07
SIC519	1.46***	1	0.57	11.90	0.07	0.00	7.16
SIC873	-1.52***	1	0.53	6.24	-0.02	0.01	0.32
SICR4	1.01	1	0.34	9.67	0.01	0.43	1.27
SIM	-0.15	1	0.18	0.40	0.00	0.40	0.85
TOTA	0.00***	1	0.00	8.50	0.05	0.00	1.00

a) Results are significant at the .05 level.
b) Results are significant at the .01 level.

Our findings indicate that an acquisition was more likely to occur in a transaction dealing with either product supply (i.e., SD), manufacturing (i.e., MD) or commercialization (i.e., DD) type of agreement. Compared to product supply, manufacturing or commercialization agreements, technological uncertainty seems to be larger in business transactions where the motive of the agreement is to enhance R&D capabilities. Not surprisingly, a business acquisition is less likely to happen in a research and development type of agreement.

Uncertainty involved in the transaction regarding the value and usefulness of a technology might be a factor to explain this result. When the viability of a particular technology is not noticeably favorable, a firm does not seem to commit completely into the R&D investment project (Osborn and Baughn, 1990). This finding confirms the proposition that as technological uncertainty increases, a business investment transaction with lower commitment would be preferred.

The industry in which the transaction takes place may also have certain influence on the commitment level embedded in the agreement. For instance, results suggest that an acquisition was more likely to take place in the food manufacturing industry or food wholesaling industry (i.e., SIC200 and SIC519 respectively) and less likely in the biotechnology sector (i.e., SIC873). The exemplar consolidation process of the food manufacturing and wholesale sectors during the last decade could have driven companies to pursue acquisition type of agreements, rather than other type of investment arrangements. For instance, the acquisition investment approach during this period is common among food manufacturing companies like Nabisco, AgriNutrition, Tyson Foods, or Universal Food Corporation and among wholesaling firms such as Terra Industries, Fresh America or Delta Pine Land.

Another plausible explanation for this result is that the food manufacturing and wholesale industry sectors are more mature and companies in these industries do not face high extrinsic uncertainty like in the biotechnology sector, where regulation about new products is not fully developed, markets are more volatile, and rivals' strategic moves are unpredictable.

As suggested by the control variable SIC873, the result about the lack of acquisitions in the biotechnology industry is not surprising. In addition to facing higher uncertainty, many of the companies operating in this sector do not show enough financial assets to acquire other companies. In fact, many of these companies seem to be in a financially precarious situation, which makes the acquisition outcome very unlikely.

Results also indicate that the variable CPALLNC (i.e., larger number of prior business transactions of acquirer firm) shows a negative effect on the event of a business acquisition. Firms with more experience in completing alliances, rather than acquisitions, develop skills to better evaluate and control their partners. These skills may contribute to lowering potential transactional hazards (i.e., anticipating the risk of opportunistic behavior by the owners of the target company) or transactional costs (i.e., monitoring costs). Consequently, one could interpret that the choice of business integration (i.e.,

highest investment commitment level) would not become *a sin e qua non* condition to minimize transactional opportunism or costs, since other preventive alternatives seem to exist to avoid transactional conflicts. The negative relationship found between CPALLNC and a business acquisition transaction could serve to show one of such alternatives.

Results from the Cox regression analysis also indicate that there are three additional control variables that seem to be important in predicting a business acquisition type of transaction. These variables are the age of the acquirer firm (i.e., AGE variable), firm size (i.e., TOTA; although this variable has a low coefficient) and the relatedness among the products being marketed by the acquirer (i.e., RELD). In view of this result, one can consider that business experience gained in the industry over time, firm resources and the development of firm core competencies are positively associated with the likelihood of completing a business acquisition. Perhaps the target companies being acquired bring in new resources and capabilities that help to sharpen (i.e., exploitation approach), rather than to diversify (i.e., exploration approach), the pool of assets of the acquirer.

Results for the Cox model when the dependent variable is a majority-based equity investment transaction (i.e., MAJCON) are displayed in Table 2. Most of the significant explanatory variables match the variables of the acquisition model depicted in Table 1. It seems that variables such as CPALLNC, SD, MD, SIC200, SIC519, SIC873, RELD, and AGE serve to equally explain acquisitions and controlling majority investments. However, there is one result (i.e., variable SIC286) that merits some attention.

The positive coefficient for the variable SIC286 suggests that the arrangement of a controlling business investment (i.e., majority equity investment agreement), but not a business acquisition, seems to be very likely among organic chemical companies. Organic chemical companies in the sample represent major chemical companies with business units operating in the agricultural biotechnology and food technology markets. Although some of these companies have fully committed themselves by pursuing business acquisitions, many of them seem to be more conservative and have taken a real option like approach by investing gradually and buying partner-firm's equity. Thus, the results suggest that organic chemical companies rarely fall among the firms pursuing extreme commitment levels (i.e., business acquisition or non-equity investment) and an interest of controlling the partner seems to influence their investment decision.

Noticeably, in addition to avoiding business acquisitions, agricultural biotechnology firms do not pursue majority equity agreements. The low exponential-β values for SIC 873 exhibited in Tables 1 and 2 suggest that agricultural biotechnology firms do not highly commit in their business investment projects. Their agreements seem to be more in line with licensing or cross licensing types of contractual arrangements.

According to these results one can conclude that findings to some extent support conventional transaction cost arguments. Overall, our results suggest that as technological uncertainty increases, extrinsic uncertainty increases, and transactional hazards

decrease firms prefer to commit less in a single business investment transaction. These results are supported in both types of transactions (i.e., acquisitions and controlling investments). Besides factors associated with the individual transaction (i.e., type of transaction: R&D, manufacturing, commercialization), industry and firm factors also seem to be important in influencing the investment decision for an individual business transaction. More experienced firms with a larger pool of resources operating in mature or stable industries motivate a larger investment commitment level.

TABLE 2 Cox Regression Results for Majority Equity-based Transactions

Dependent Variable:	MAJCON						
Method:	Cox Regression						
Variable	**b**	**df**	**S.E.**	**Wald**	**R**	**Sign.**	**Exp(b)**
AGE	0.01**	1	0.00	5.10	0.03	0.02	1.01
CPALLNC	-0.06***	1	0.02	6.30	-0.04	0.01	0.93
CPAP94	0.00	1	0.00	1.21	0.00	0.27	0.99
DD	0.34**	1	0.02	4.47	0.04	0.03	1.40
DEBTRAT	0.00	1	0.00	0.12	0.00	0.72	0.99
DV	0.01	1	0.01	2.47	0.01	0.11	0.10
EXPAC	-0.02	1	0.03	0.35	0.00	0.55	0.97
INTSALE	0.01	1	0.00	2.30	0.01	0.12	1.00
MD	0.88***	1	0.19	21.49	0.09	0.00	2.42
RD	-0.07	1	0.18	0.16	0.00	0.68	0.92
RELD	0.28*	1	0.17	2.59	0.01	0.10	1.32
SD	0.70**	1	0.31	4.92	0.03	0.02	2.02
SIC200	1.54***	1	0.49	9.69	0.05	0.00	4.70
SIC286	0.82*	1	0.48	2.89	0.03	0.08	2.27
SIC519	1.72***	1	0.48	12.83	0.07	0.00	5.59
SIC873	-1.42***	1	0.51	6.89	0.04	0.01	0.91
SICR4	0.96	1	0.39	5.17	0.01	0.39	2.54
SIM	-0.13	1	0.2	0.42	0.00	0.51	0.87
TOTA	0.00	1	0.00	1.15	0.00	0.28	1.01

a) Results are significant at the .1 level.
b) Results are significant at the .05 level.
c) Results are significant at the .01 level.

A discriminant analysis has been conducted to test the robustness of these results and to find differences between three types of agreements: business acquisitions, majority equity investment and non-equity investment. The variables that contribute most in differentiating the three levels of investment commitment are shown in Table 3.

The discriminant analysis suggests that the most significant variables are EXPAC, MD, CPAP94 and SIC286. Nevertheless, all the variables (i.e., including DD, SIC519, TOTA, and DEBTRAT) are important in separating the three groups. Acquisition agreements are more common in manufacturing and commercialization types of business transactions. Uncertainty involved in this type of transaction is lower than in R&D agreements (i.e., high technological uncertainty), therefore, high commitment business investments are made. Acquisitions are more popular among agricultural wholesaling companies (i.e., SIC519). During this period 1994-97, hostile investment strategies of companies like Delta Pine Land, Agribiotech Inc., Agway or Fresh America seemed to be mostly oriented towards the manufacturing and commercialization of their patented and trademarked products resulting from technological innovations created or developed in the past.

TABLE 3 Discriminant Analysis Results for Individual Business Transactions

Dependent Variable: TRIO
Method: Discriminant Analysis

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	0.65	86.01	86.01	0.63
2	0.11	13.99	100.00	0.31

First 2 canonical discriminant functions were used in the analysis.

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	0.55	276.25	16	0
2	0.90	46.17	7	8.112E-08

Standardized Canonical Discriminant Function Coefficients

Function	1	2
MD	0.48	0.35
DD	0.29	0.00
SIC286	-0.22	0.54
SIC519	0.41	-0.14
CPAP94	-0.30	1.65
TOTA	0.38	-1.39
DEBTRAT	0.30	0.20
EXPAC	0.51	0.15

	Non-equity Agreements		Equity Agreements		Acquisitions	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
RD	0.46	0.50	0.30	0.47	0.19	0.39
SD	0.08	0.27	0.03	0.18	0.08	0.27
MD	0.35*	0.47*	0.63*	0.49*	0.74*	0.43*
DD	0.21*	0.41*	0.2*	0.41*	0.41*	0.49*
SIC287	0.11	0.32	0.17	0.38	0.08	0.28
SIC200	0.14	0.35	0.10	0.31	0.27	0.45
SIC286	0.46*	0.5*	0.63*	0.49*	0.33*	0.47*
SIC519	0.05*	0.22*	0.03*	0.18*	0.28*	0.45*
SIC873	0.23	0.42	0.07	0.25	0.02	0.15
CPAP94	87.08*	1105.17*	1018.67*	1767.49*	109.86*	787.02*
CPALLNC	2.17	3.82	1.68	3.75	1.46	3.03
DV	9.86	9.39	14.61	8.64	9.03	9.60
TOTA	5,031,327*	9,317,924*	8,990,229*	11,412,302*	6,960,576*	8,891,274*
DEBTRAT	38.41*	26.67*	42.88*	20.82*	54.56*	15.41*
EXPAC	0.44*	1.03*	0.86*	1.61*	2.38*	2.78*
AGE	29.76	29.76	42.50	29.33	47.64	34.23
RELD	0.60	0.49	0.47	0.51	0.66	0.48
INTSALE	28.41	23.79	32.28	20.78	28.09	21.07
SICR4	50.25	21.55	47.57	19.99	43.69	21.12
SIM	0.62	0.49	0.63	0.49	0.64	0.48

a) Significant at the .05 level.

It appears that a greater experience of firms in completing business acquisitions (i.e., EXPAC) increases the likelihood of pursuing a new business acquisition. That is, results show that business acquisitions are more popular in firms with a larger number of acquisitions conducted in the past. The financial condition of acquirer companies is not as sound compared to the companies that pursue less aggressive investment strategies. On average, the debt ratio of acquirer companies is over 50%.

According to the results, a particular feature of acquisitions is that they are arranged mostly between companies operating in the same industry sector. Therefore, the main motive of acquisitions might be to benefit from horizontal synergy effects. In these agreements, resource uncertainty seems to be lower and rather than showing an exploratory behavior (i.e., assessment of new technologies), the parties seem to exploit their respective technological capabilities in a common front (i.e., new operating system of established plants or new management of distribution channels). To some extent this would support the arguments by Hitt et al. (1998) and Osborn and Hagedoorn (1997) in the strategic alliance literature.

Companies pursuing equity agreements portray different firm attributes. On the one hand, they seem to be larger as indicated by the average total asset amount. On the other hand, they are better endowed with research and learning skills. Prior to 1994, these companies owned a larger number of patents relative to firms pursuing non-equity or acquisition agreements. Companies operating in the organic chemical industry sector primarily adopt investment strategies based on equity agreements. Considering the results in the Cox model, one may suspect that these agreements are majority equity-

based, motivated by an exploratory investment conduct but having control of new technologies. Companies such as Dow Chemical, Hoechst, Merck, Zeneca or DuPont are examples of firms pursuing investment transactions with lower commitment levels than business acquisitions, an approach which is more in line with what is advocated by real option theory.

Finally, non-equity agreements seem to be associated with smaller firms conducting mostly R&D agreements, with an inferior competitive advantage regarding research and technological learning skills, and almost no experience in pursuing business acquisitions. Apparently, these are firms that lack the pool of tangible and intangible assets owned by firms classified in the rest of the groups. The risk at which they seem to be exposed appears to be higher relative to other firms (i.e., higher technological and resource uncertainty) and it is not surprising to notice a low investment commitment in their business transactions.

Conclusion and Implications

Higher technological and extrinsic uncertainty seem to be related to a lower commitment level in a single business investment transaction, and lower transactional hazards appear to have the same impact. Findings in this study also suggest that in addition to transaction-specific factors, firm and industry factors are relevant in determining the choice of investment commitment level in a business exchange.

Results of this study should be interpreted with caution. Findings are derived from a reduced sample, which includes primarily major North American and European companies. However, these major companies are representative of all the companies that have completed a large number of business investment agreements. The study sample represented a specific period of time, 1994-97. A larger sample with more companies and an extended time framework would improve the reliability of our results.

This study provides several implications about how corporate managers may plan and implement their business investment projects. The first implication for corporate managers is that the choice of an optimum business investment strategy (i.e., level of investment commitment) seems to be influenced, at least partially, by a goal of minimizing transactional costs.

Corporate managers competing in the agricultural biotechnology and food technology markets should expect an acquisition-type of transaction to be more likely to occur when the exchange involves a product supply, manufacturing or commercialization agreement as opposed to a R&D agreement. The acquisition investment outcome is also more likely when the acquirer has been operating for a long period in the industry, and has experience and resources for acquiring companies. Managers should expect that industries where little extrinsic uncertainty prevails, like the mature food manufacturing or wholesale industries, are very appropriate to complete business acquisitions.

Business investment decision-makers in general appear to value high managerial flexibility; particularly in companies operating in uncertain industry environments (i.e., agricultural biotechnology, and agricultural chemicals). When business agreements involve the transfer of R&D capabilities, companies seem to adopt an exploratory approach by undertaking gradual investment instead of a punctual full-investment commitment.

This study also offers some implications for policy makers. Recent works in the literature suggest that not only inter-firm competition, but also cooperation seems to be critical for the development of new technologies in agricultural biotechnology and food technology markets. Our work suggests that most agreements in agricultural biotechnology and food technology markets are equity-based agreements instead of business acquisitions. How these non-acquisition linkages will be treated by antitrust authorities is unclear. The propensity towards business acquisitions seems to be higher in more mature industries. Results suggest that regarding concentration and antitrust issues, government authorities should be less concerned with unstable industry sectors (i.e., industries with higher uncertainty such as agricultural biotechnology and chemical industries) and more concerned with more stable industries (i.e., like the agricultural wholesaling and manufacturing sectors).

Appendix A

Description of Variables:

SIM: It takes the value 1 = transacting companies share same SIC code, and 0 otherwise.

TRIO: This categorical variable takes three values: 0 for a non-equity agreement (0% equity), 1 for a majority-equity agreement (>51% and <100% of the target firm's equity), and 2 for an acquisition (100% of the target firm's equity).

DV: It represents the variance in sales during the 1994-97 time period for the industry of the dominant party in a business transaction.

CPALLNC: It represents the difference between the number of business investment transactions of a firm (i.e., dominant party) and the average number of business investment transactions completed by the rest of the rivals included in the sample classified under the same SIC code. This variable is expected to capture the relative experience of a firm with respect to immediate rivals regarding the formation of strategic alliances.

CPAP94: It represents the difference between the total number of patents before 1994 owned by a firm and the average total number of patents before 1994 owned by the rest of the rivals included in the sample classified under the same SIC code. This variable is expected to capture the competitive position of a firm with respect to immediate rivals regarding the learning and research skills acquired in the past.

AGE: It represents the number of years of a firm since inception until 1997.

RELD: It represents whether a firm possesses related diversified products (i.e., products being sold in the same SIC code industry): 1= yes, 0= no. This variable is expected to capture the existence of inter-product synergy effects within a firm.

DEBTRAT: It represents the percentage of financial liabilities over total assets in a firm. This variable is expected to capture the financial constraints faced by a company.

INTSALE (year 1997): It represents the percentage of sales to foreign markets over total sales for a dominant firm.

EXPAC: It represents the number of previous acquisitions completed by the dominant party before each investment transaction during the 1994-97 time period.

SICX: It is a dummy variable and represents whether a firm belongs to the X industry (200 food manufacturing, 286 organic chemicals, 287 agricultural chemicals, 519 agricultural wholesaling, 873 ag-biotechnology firms).

RD: The type of the business investment transaction is an R&D agreement: 1 = yes, 0 = no.

SD: The type of the business investment transaction is a product or commodity supply agreement: 1 = yes, 0 = no.

MD: Type of the business investment transaction is a manufacturing agreement: 1 = yes, 0 = no.

DD: The type of the business investment transaction is a commercialization agreement: 1 = yes, 0 = no.

TOTA: It represents a firm's total assets in thousand US dollars in 1997.

SICR4: The four-firm concentration ratio in the industry of the dominant party.

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