EXAMINING VALUE CREATION IN TECHNOLOGY DEVELOPMENT ALLIANCES

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ABSTRACT

Inter-firm alliance activity in the area of technology has increasingly become a vital strategic tool over the last twenty years. The present study assesses the degree to which technology alliances create value. Using Porter's (1985) value-chain as the foundation for evaluating the issue of value creation, it is hypothesized that pure technology and technology related alliances do create value for the firm. Porter's value chain framework (1985) was employed to categorize the announcements of alliances by U.S. based manufacturing multinationals from 1987 through 1993. Employing an event study, the value creating effects of technology alliances and technology related alliances was investigated. Event study results indicate that there were no wealth effects associated with pure technology alliances, however there was some support for technology-related alliances which involved value-adding activities in production operations and marketing. Future direction in research and implications are discussed

INTRODUCTION and LITERATURE REVIEW

There is an extensive body of work that has evolved over the last forty years, both theoretical and empirical in nature, that have been instrumental in highlighting the growth and evolution of alliances[1] The early works by Fusfeld (1959), Dixon (1962), Pate (1969), Mead (1968), Boyle (1968), Williamson (1975), Contractor & Lorange (1988) Harrigan (1985, 1988), Kogut, (1988), Buckley & Casson (1988) Porter & Rawlinson (1986) and Beamish (1988), have been instrumental in highlighting the growing importance of alliances as a critical medium to undertake strategic action.

Alliances take a range of structural forms. These different structures affect the pattern of decision-making, responsibilities, and the control of capabilities. Jointly owned ventures, licensing relationships, joint R&D programs, co-marketing programs, and partial equity investments would tend to qualify as alliances by this definition.

Alliances also differ according to the operational relationship between the partners. Some alliances represent "vertical" relationships (i.e., between suppliers and buyers) and other represent "horizontal" relationships (i.e., between companies selling the same or similar products). Some alliances combine one firm's technological capabilities with another firm's marketing organization; other alliances pool similar capabilities from different companies.

While there are these differences among alliances, because various forms of alliances share many behavioral characteristics, they are often grouped together for analytical purposes. In two earlier papers (Ramaya & Khayum, 2002; Ramaya, Khayum and Rhim 2001; Ramaya, Hall & Rhim, 2000) alliances are grouped according to the types of activities that form the basis for the inter-firm cooperation. In particular, alliances segments are based on whether the firms are involved in activities at similar or different stages of the value-added chain. Such an approach, although not new (see Porter & Rawlinson, 1986; Murray, 1995), focuses on the underlying purpose of the alliance as opposed to its legal structure

Using the value chain (Porter & Rawlinson; Ghemawat, Porter & Rawlinson, 1986) allows the systematic disaggregation of various alliances into classifiable categories. Why would firms want to cooperate on R&D activities? Porter and Rawlinson (1986) provides two primary reasons for the logic of cooperation; role of high costs and risk reduction.

In R&D[2] activities, fixed costs and the resulting importance of global scale are very high. In a number of industries, such as pharmaceuticals, electronics, computers, telecommunications, aircraft, the absolute size of technological development costs has been increasing rapidly. In the case of pharmaceutical products, the average cost of developing drugs runs in the $250-300 million range (Economist, 1993). In the case of aircraft manufacturing, the cost of developing a new passenger aircraft can cost $2 billion dollars (Economist, 1994). No one firm is prepared to bear the costs and associated risks of undertaking such a costly venture alone. Increasingly as a result of such high costs, firms consider alliances as a viable option. Despite transaction and coordination difficulties alliances can lead to increased cooperation for pooling R&D resources to reduce attendant risks (Porter & Fuller, 1986). Where the component of R&D has large, fixed costs, and one firm has advanced far beyond others in R&D, alliances can provide access to technology. An advanced R&D firm has often been prepared to transfer its technology through cross-

[1]Ramaya & Khayum (2002), provide a more extensivediscussion of the literature on alliances.

[2] Porter and Rawlinson (1986) uses the term Technology Development to classify R&D activities.

licensing in exchange for products and processes. Through various alliance arrangements technological leaders can transfer to followers technology that would be prohibitively expensive to develop in-house. Such sharing is indicative of the leader's long term focus and expectation that the recipient firms will reciprocate in the future.

R&D costs are an important consideration. However, frequently alliances are a quick way to access innovations that are hard to replicate in-house despite substantial R&D spending. R&D alliances could also be viewed as a means to reduce the high risks inherent in missing out on major innovations. In a study on global technology, Howells (1990) found that the assessment of the potential in a R&D venture by the external collaborating partner was critical in providing the strategic direction for the alliance. Furthermore, R&D alliances provide a means to increase the technological avenues to pursue and in the process shape industry structure and markets through technological standardization[3] (Porter & Fuller, 1986).

The formation of technology-based alliances has become an important vehicle for increasing the technology capabilities of multinational firms. There is growing evidence that R&D has become a key cornerstone of corporate and business strategy and acquiring technology from external sources is common (Edler, Frieder & Reger, 2002). Although the study of alliances including R&D alliances is not new, understanding the wealth effects of R&D[4] alliances is still an emerging area of inquiry. The results to date on wealth effects of R&D alliances (Neill, Pfeiffer & Young-Ybarra, 2001) and positive effects of overall R&D activities on profitability (Del Canto & Gonzalez, 1999) are mixed.

Our paper investigates the wealth effects of R&D alliances from the standpoint of R&D pure versus R&D mixed alliances. A pure R&D alliances is one where the underlying purpose of the arrangements is deemed to focus primarily on activities that fall under the domain of technology. A R&D related alliance is one which includes other functional activities such as production and marketing.

Data and Methods

The data for this study was drawn from an earlier database on alliance activity of firms in the U.S. manufacturing sector (SIC Code 2000-3999) during the time period of 1987 to 1993 (Ramaya, 1997). It was during this period that a number of the significant and major developments discussed above were increasingly evident. The manufacturing sector was chosen because multinationals in this sector account for approximately 75% of the world trade in manufactured goods (Stopford, 1994). Furthermore, a significant number of these firms are U.S.-based firms. The initial population of firms for this study consisted of approximately 7,000 publicly held firms and was drawn from the *Compustat* database. Adding the criteria that at least 10% of the firm's revenues be drawn from international operations (Stopford, 1994) and that the firm had to be in operations continuously during the study period (1987-1993), reduced the population to 270 of the largest U.S. firms, operating primarily in the manufacturing sector. It should be noted that although the focus exclusively on manufacturing firms results in a biased sample, a large sample size mitigates the problem of bias.

Data on the announcements of alliances was drawn from archival sources through content analysis. Announcements and the respective dates of announcements of cooperative arrangements were identified from the *Wall Street Journal Corporate Index*. The full text of the articles was obtained for each of the identified announcements. In addition, other published indexes such as *Predicasts F&S Index of Corporate Change, US. Companies and International Companies,* were reviewed to identify any announcements that were not mentioned in the *Wall Street Index*. The approach for identifying these ICAs was through "literature based alliance counting" (Hagedoorn & Schakenraad, 1992, 1994), a form of content analysis. The method includes both a "definitional" and "inclusionary" criteria. The criteria that was employed is based upon Porter's original definition of the constituent elements of the value chain (Porter, 1985).

Under the "definitional" criterion, information identified as ICAs was matched to the criteria of what constitutes an ICA from a value chain perspective. Porter (1985) articulated that cooperation could involve any activity or set of activities along the value chain. However, his focus was primarily on the simplified value chain as the basis for cooperation. Porter did not provide a rationale about why cooperation in the other areas, such as the support activities, was less likely. In order to maintain a high degree of consistency and comparability with past studies, only alliances that met the following conditions were included:

1) The common stock of the firm making the alliance announcement is traded on either the New York Stock Exchange, American Stock Exchange or the NASDAQ Exchange and was available in the daily returns file of the Center for Research in Security Prices (CRSP).

2) Only alliances of publicly held firms that were part of manufacturing industries (between SIC codes of 2000 - 3999) were considered. Industries such as

[3]For example, Kodak introduced a new generation of cameras in early 1996. The new camera was supposed to be a major technological breakthrough. The development of the camera resulted from a joint collaboration between Kodak and its arch rival Fuji. In addition, Canon, Nikon, and Minolta also became part of the joint effort in an effort to establish industry standardization and eventual product acceptance.

4

mining, banking, retailing and other service-oriented industries were not included.

3) For those alliances that were equity based, only those that are less than 90% were considered, since anything above 90% is considered a wholly-owned subsidiary (Department of Commerce Benchmark Survey, 1989).

In addition to the above alliances were subsequently classified into domestic and international. The primary reason is because of systemic differences that exist between markets. We achieved an inter-rater reliability of 91 percent which compares favorably with past studies reporting reliability measures that ranged from 60 to 97 percent (Kolbe & Burnett, 1991).

Event Study Analysis

The event study method is employed to calculate the degree to which the change in the stock price is influenced by the occurrence of an event. In this study the event will be the announcement of the technology alliance. If the event is unanticipated, the abnormal change in the stock price when the event becomes public knowledge measures the impact on the wealth of the firm stockholders (Fama, Fisher, Jensen & Roll, 1969). To determine if a price change is abnormal, it must be evaluated against the expected normal change in the price of the stock.

Model Specification and Selection of Time Frame

A market model assumes that part of the return on a stock is caused by market-wide factors that simultaneously affect all stocks in the market, and the influence of these market-wide factors is captured in the rate of return of the market (Carter, 1994). The market model is:

$$R_{jt} = \alpha_j + \beta j R_{mt} + \varepsilon_{jt}$$

where

R_{jt} = rate of return on security j on day t, j = 1,...n.

R_{mt} = rate of return on the value weighted market portfolio of assets

$\alpha_j \& \beta j$ = ordinary least squares estimates of firm j s market model parameters.

ε_{jt} = residual returns on security in period

The day that the announcement of the alliance is made is defined as the announcement date. Pre-event estimates of the model's parameters intercept (a) and beta (P) are calculated over a period of 120 days before and 61 days prior to the alliance announcement. Past research on joint venture announcements have typically used pre-event periods ranging from 60 to 180 days (Hu, Chen & Shieh, 1992; McConnell & Nantell, 1985).

Average abnormal returns will be calculated as follows:

$$AR_{jt} = AR_t = (1/N)\ \Sigma\ AR_{jt}$$

where N_t = number of firms with an abnormal return defined in day t. The cumulative average abnormal return over the interval t_1 to t_2 is:

$$CAR_{jt} = \sum_{t=1}^{t=2} AR_{jt}$$

One of the most important steps in estimating the valuation impact is determining the relevant time frame. A significant number of studies to date have employed the two-day window (-1,0). In the two-day window, t=O is the day of the first public announcement and t= -1 is the trading day preceding the announcement. The two-day window is used to identify the immediate market reaction to the occurrence of an event, based upon the assumption that in a relatively efficient market, investors adjust to the new information regarding an event on the day of the announcement. Despite its wide usage, some researchers have questioned the sufficiency of the two-day window, because it may not capture the full market evaluation of an event (Lubatkin & Shrieves, 1986; Reinganum, 1985). In a recent study examining the wealth effects of cross border acquisitions Datta and Puia (1995) suggested that a five-day window would be adequate in providing a realistic picture of wealth effects. For the purposes of this study, in addition to a two-day event period (-1, 0), six additional windows were examined: (-1,1) (-5,5), (-10,10), (-15,15), (-20,20), (-30,30). Since the focused event is the announcement of a DCA or an ICA, all alliance announcements that occurred within two weeks of other types of announcements were excluded.

Results

Descriptive statistics and event study results are provided in Tables 1 through Table 5. Pure technology alliance announcements were clearly the most frequently occurring type (29%). When classified by location, pure technology alliances were clearly the preferred type, accounting for almost 41% of total domestic alliances. From a value chain standpoint there is some empirical support (*p=0.1*) that alliances, domestic and international, in aggregate do provide positive wealth effects. However, despite the preponderance of technology arrangements there were no wealth effects associated with the pure technology arrangements. With respect to technology-related announcements, there was some support for positive wealth effects when the alliance involved all three types of functional activities (*p=0.05* for the first window). When considering broader windows, the wealth effects of technology-related arrangements are negative.

Discussion

The lack of empirical support for pure technology arrangements does not mitigate the importance or relevance of technology alliances, both pure and related. With the exception of domestic alliances that involved all functional activities there is some evidence that technology alliances both domestic and international adversely affect wealth of firms. Longer time horizons typical of R&D endeavors is perceived as risky and markets may view such alliances with skepticism. However, we suggest caution about making inferences from relatively small samples especially in the case of technology related arrangements Notwithstanding these results, wealth creation of alliances both pure and related merit further study. The current study which is a logical extension of our earlier studies (Ramaya & Khayum, 2002; Ramaya, Khayum and Rhim 2001; Ramaya, Hall & Rhim, 2000) is an ongoing attempt to better understand the nature of value created by alliances. A logical extension of these studies would be to undertake a longitudinal examination of alliances that would hopefully provide a better understanding of the nature and evolution of alliances.

Table 1: Type and Number of Cooperative Arrangement Announcements by Origin

Value Chain Category	**INTL**	**DOM**	**TOTAL**	**%**
Logistics & Operations (LO)	126	41	167	18%
Technology Development (TD)	74	193	267	29%
Marketing Sales & Service (MSS)	77	93	170	18%
Logistics & Operations - Technology Development (LO-TD)	17	23	40	4%
Logistics & Operations-Marketing, Sales & Service (LO-MSS)	54	19	73	8%
Technology Development - Marketing, Sales & Service (TD-MSS)	22	35	57	6%
Logistics & Operations-Technology Development-Marketing, Sales & Service(LO-TD-MSS)	23	20	43	5%
Unclassifiable	68	47	115	12%
TOTAL	461	471	932	100%

Table 2: Cumulative Average Abnormal Returns for Domestic and International Arrangements

Windows	**DCA**	**ICA**
(-1,0)	0.24%$	0.19%$
(-1,+1)	0.17%	0.26%$
(-5,+5)	0.06%	0.04%
(-10,+10)	0.09%	0.09%
(-15,+15)	0.05%	0.17%
(-20,+20)	0.20%	-0.19%
(-30,+30)	0.83%	0.15%
$ = p<0.10		

Table 3: Cumulative Average Abnormal Returns For Domestic versus International Pure R&D Arrangements

Windows	**D-TD**	**I-TD**
(-1,0)	0.29%	0.42%

(-1,+1)	0.37%	0.58%
(-5,+5)	0.35%	0.00%
(-10,+10)	0.21%	-0.77%
(-15,+15)	-0.09%	-0.34%
(-20,+20)	-0.33%	-1.46%
(-30,+30)	0.88%	-0.39%

Table 4: Cumulative Average Abnormal Returns for Domestic versus International R&D related Arrangements

Windows	**D-TDMSS**	**D-LOTD**	**D-LOTDMSS**	**I-TDMSS**	**I-LOTD**	**I-LOTDMSS**
(-1,0)	-0.25%	0.03%	***1.30%*****	0.29%	-0.07%	-0.03%
(-1,+1)	-0.69%	-0.25%	***0.87%$***	0.17%	0.59%	-0.11%
(-5,+5)	***-2.69%*****	***2.21%$***	***2.10%****	-0.03%	0.51%	***2.17%$***
(-10,+10)	***-3.48%*****	***5.60%*****	***2.65%****	-0.82%	0.27%	2.07%
(-15,+15)	***-5.85%******	***6.19%*****	1.84%	***-3.59%****	-1.00%	1.50%
(-20,+20)	***-5.96%*****	***5.74%****	***3.85%****	***-4.60%****	-2.54%	0.35%
(-30,+30)	***-3.46%$***	***4.97%$***	***3.87%$***	***-8.68%*****	-2.17%	0.85%

$ = p<0.10
**** = p<0.05***
*****= p<0.01***
******=p<0.001***

Table 5: Cumulative Average Abnormal Returns for
International Multiple-Activity Arrangements Mixed Arrangements

Windows	**I-LOMSS**
(-1,0)	***-0.45%$***
(-1,+1)	-0.20%
(-5,+5)	-0.70%
(-10,+10)	-1.01%
(-15,+15)	-0.88%
(-20,+20)	-0.36%
(-30,+30)	-1.83%

$ = p<0.

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