Event Study Analysis: Is Cooperating with Rivals a Good idea?

by

Man Wan Lai

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Honours Degree of

BACHELOR OF SCIENCE

in the Department of Economics

Supervised by:

Dr. Pascal Courty

Abstract

The practice of simultaneously competing and cooperating with competitors (co-opetition) has been very prevalent for high technology firms in recent years. Nevertheless, academia has yet to come to a consensus on how to explain the formation of this paradoxical behavior. This research applies the event study approach to examine announcement effects of co-opetition on firms' valuation with the intention of providing insight to the paradox. Based on the sample 96 firm announcements involving 35 firms listed on the US stock market during 2002-2012, the results suggest that co-opetition generally does not produce any significant effect on the value of the firm. However, smaller subsample estimations suggest that joint research & development and patent licensing announcements increase firms' value by 0.90% and 1.67% respectively, while the announcements of collaboration decrease the value by 1.70% to 1.82%.

Keywords: co-opetition, event study, announcement effect

Introduction[1]

Over the past decade, news of fierce competition among high technology enterprises has frequently topped headlines. From the game console battle between Sony and Microsoft to the smart electronics contest between Apple and Samsung, these companies were not merely competing, but also working together to achieve common goals. Brandenburger and Nalebuff (1996) define this phenomenon as "co-opetition". Why do firms in the industry of high technological consumer products engage in such paradoxical relationship? Is making friends with the enemy really a good idea? The objective of this paper is to find concrete empirical evidence and give insight into this question.

The discussion surrounding co-opetition is intensive and divergent. Some scholars claim that the cost of co-opetition can be tremendous in terms of the loss of inside information and the creation of more aggressive competitors (Cohen & Levinthal, 1990; Hamel, 1991). On the other hand, some argue that co-opetitive practice prompts various advantages such as faster sharing knowledge and greater economic and market growth (Lado, Boyd and Hanlon, 1997). Jorde and Teece (1989) affirm that the careful balance between simultaneous cooperation and competition plays a key role in a business' success and value creation. An empirical investigation

[1] I would like to thank Dr. Pascal Courty and Dr. Herbert Schuetze for their advice and guidance. Special thanks to Dr. Pascal Courty for his endless encouragement. I also want to acknowledge the support from my classmates in the Honours Program 2012-2013

in multiple industries by McConnell & Nantell (1985) establishes that the stock market responds positively to joint ventures among competing firms. Das, Sen and Sengupta (1998) find economically small but significant positive returns from marketing alliances. Despite the abundance of studies on technology co-opetition, most have been theoretical. Moreover, empirical research puts emphasis on a specific type of co-opetitive arrangements rather than a variety of cooperation agreements. Therefore, I conduct this research using a broader group of co-opetitive activities in a bid to support or repudiate the theoretical views on co-opetition with solid real world evidence.

In this paper, I investigate whether co-opetitive behavior creates value for the shareholders of firms that specialize in producing high technological consumer products. An event study approach is employed to inspect any significant abnormal returns on stock prices due to the announcements of cooperating with rival firms.

Based on a sample of 96 co-opetitive announcements, I find that the cooperation announcements do not generate significant cumulative average abnormal returns for the participant companies. Yet, subsample estimations suggest that firms engaging in joint research and product development as well as patent licensing agreements enjoy positive and significant effects on security returns. Furthermore, firms taking part in both joint research and development and marketing experience significant negative

impacts on value creation.

This paper is organized as follows: Section 2 reviews theories about co-opetition and summarizes findings from past empirical research on co-opetitive announcements. Section 3 explains data collection procedures and event study methodology. Section 4 describes the study's findings and Section 5 discusses the limitations of the study and provides summary comments.

Section 2 Literature Review

Co-opetition is a strategy in which a firm decides to cooperate with rivaling players to achieve a common target and gain mutual benefits, while simultaneously competing with each other on the product market (Brandenburger & Nalebuff, 1996). The theories about this paradoxical behavior are quite fruitful. Hamel, Doz and Prahalad (1989) argue that building a close relationship with rivals helps predict partners' future actions. Park & Russo (1996) assert that establishing cooperative agreements with competitors incubate effective firm-to-firm knowledge transfer especially when the transaction cost of keeping a specific know-how secret from rivals is remarkably high. It is also suggested that an all-round and complemental cooperation among firms may foster general advantages of strategic alliance such as scale economies, risk sharing, and product innovation (Bengtsson & Kock, 2000). Brandenburger & Nalebuff (1996) conclude that co-opetition is a win-win strategy to

obtain non-negative benefits and avoid destructive competition.

Although co-opetition appears to be positive in most theoretical perspective, empirical analysts have diverse ideas. Past research show that the formation of joint ventures with competing firms result in around a 0.73% to 0.80% increase in returns on the stock market (McConnell & Nantell, 1985; Woolridge & Snow, 1990). Koh & Venkatraman (1991), who examined 175 joint venture announcements involving 239 companies during 1972-1986 periods, further confirm the positive average effects of joint venture on security returns; in addition, their study suggests that smaller firms in the joint ventures earn higher abnormal returns than larger firms. Chan et al. (1997), in their study of non-equity alliance, looked at 345 announcements made by 460 firms; their results exhibit that non-equity cooperation with competitors significantly raises the value of a firm by 0.64% on the announcement day. However, two notable works come up with a contrary conclusion. Reuer & Koza (2000), based on a sample containing 297 domestic and international joint ventures, find a significantly greater market response to joint ventures where information asymmetry is expected to be stronger; hence, they point out that investors see joint ventures as a way to diminish asymmetric information as opposed to a way to create value for the firm. Finally, McGahan & Villalonga (2005) used the sample consisted of 9276 deals made by 86 members of the Fortune 100 between 1990 and 2000 to show that the impact of

working with rivals is trivial in terms of creating abnormal security returns.

In light of the mixed findings brought by prior empirical research and the focus on particular forms of co-opetitive practice such as joint ventures, I intend to draw a solid conclusion regarding the theories of co-opetition by investigating a more comprehensive dataset.

Section 3: Data Collection & Methodology

3.1 Identification of Companies and Competitors

Instead of collecting samples by searching cooperation announcements from various databases, I made a list comprised of enterprises that are well-known and active in producing high technological devices. First, I selected several high technology industries from *The Industry Center* by *Yahoo!Finance*[2]. These industries cover the majority of hi-tech products on the market for general consumers. I then added the leading firms to the list based on their market capitalizations[3]. If the common stocks of a leading firm were not publicly traded on the U.S. stock market, I would drop the firm from out of my list. The last step was identifying key competitors for each firm in a bid to avoid sampling non-rival cooperation announcements. For

[2] To be specific, I choose the following industries: Application Software, Communication Equipment, Data Storage Devices, Diversified Computer Systems, Diversified Electronics, Electronic Equipment, Information Technology Services, Internet Information Providers, Multimedia & Graphics Software, Networking & Communication Devices, Personal Computers, Photographic Equipment & Supplies, Semiconductor - Broad Line, Semiconductor – Specialized, Semiconductor Equipment & Materials, Semiconductor- Memory Chips, and Wireless Communications.

[3] *The Industry Center* identifies the leaders and laggards in terms of market capitalization for each industry.

each company on the list, I entered its ticker on both *LexisNexis Academic* and *NASDAQ* to obtain information about competing firms[4]. This gave me a record of competitors for each firm. I was then able to determine whether a firm cooperated with its "true" rivals by checking the corresponding record of competitors. After all of this preparatory work, I was ready to build a dataset.

3.2 Sample of Rival-based Cooperation Announcements

To obtain the sample of rival-based cooperation announcements, I searched my listed companies' News Release Center[5] for the 2002-2012 period. I used different combinations of keywords for the search in hope that the results would cover all possible cooperative activities. Specifically, the following keywords were used: alliance, joint research, joint develop, collaborate, team up, patent licensing, marketing, supply, and joint manufacturing. Below is an example of co-opetition announcement identified by searching firm's News Release Center:

> Sony Corporation and Panasonic Corporation today announced that they have signed an agreement regarding the joint development of next-generation OLED (organic light-emitting diode) panels and modules for TVs and large-sized displays…Sony and Panasonic aim to establish mass-production technology during 2013, by integrating their unique technologies to improve the overall efficiency of development…
> (Sony Global – News Release, 25 June 2012, Search Keywords: Joint develop)

Since the accuracy of event dates play a vital role in capturing announcement effects, I double checked the event dates against PR Newswire and Business Wire using

[4] I used *LexisNexis Academic* and *NASDAQ* because they provide a more comprehensive list of firms' competitors.

[5] It is also called Newsroom. The news release center can be easily found by typing "company's name" and "news release" on any search engine.

LexisNexis Academic. In the case that different event dates were reported, I picked the earlier date as an event date. To further improve the test results and to prevent the "confounding issue[6]" of event study analysis, I selected an announcement to be a sample of this research if it meets all the following requirements:

(1) All participating firms are competitors to each other.

(2) There is sufficient data of daily stock prices for all participating firms.

(3) Securities are publicly traded and listed on NYSE/NASDAQ/S&P 500.

(4) The firm is not a subsidiary from another company involved in the same cooperative announcement.

(5) The announcement is related to the initiation of cooperation rather than ongoing alliance activities.

(6) There is no other cooperative announcement for the same firm in the 120 calendar days prior to the event date.

(7) There is no earnings announcement five days before or after the event date.

The cooperation news between Sony and Panasonic met all criteria, so it was a "valid" announcement. The unit of observation was a firm-announcement on a given date. Using the above case as an example, I considered two cooperating firms – Sony and Panasonic – as two individual observations with the same form of cooperation and the

[6] This is the situation where the stock prices are "contaminated" by the occurrence of other unrelated events around the event date, resulting in a failure to capture the real impact of the event of interest.

same announcement date. Therefore, the sample size was increased by two. Similarly, the unit of observation at which cooperation with three or more firms were measured by the number of firm-announcement. The final remark is that I allowed multiple announcements made by a single firm as long as the announcements did not overlapped in 120 days. Originally, I collected 204 firm announcements. By checking each requirement, I deleted 49 samples because the stocks of the firms were traded in foreign markets; 23 samples were found to be overlapping other related announcements in 120 days; 19 samples were excluded since they were dealing with ongoing alliance agreements; 12 samples were subtracted as there were earnings announcements around the event date; two samples concerned the co-opetition with non-rivaling firms; two more were deducted due to the scarcity of daily stock prices data, and finally one announcement was deleted because it related to cooperation between subsidiary and parent companies. Table 1 summarizes the sample filtering process. (See next page)

Table 1 Samples Filtering Process	
	Total
Available firm announcements	204
Less:Participating firms are not competitors.	(2)
No sufficient daily stock data.	(2)
No securities are traded on NYSE/NASDAQ/S&P500.	(49)
Cooperative announcement between subsidiary and parent.	(1)
Announcement relating to ongoing alliance expansion.	(19)
Overlapping other cooperative announcements in 120 days.	(23)
Earnings announcement was made 5 days before and after the event date.	(12)
Final Sample Size (N)	96

Table1

Notes to Table 1. Announcements of co-opetition by NYSE, NASDAQ and S&P500 firms, 2002-2012. Announcements were identified using the news release centers by pre-selected firms. I searched keywords such as alliance, joint research, joint develop, collaborate, team up, patent licensing, marketing, supply, and joint manufacturing.

Eventually, the search identified 96 clean co-opetition announcements made by 35 firms. There are four cases that the announcement involved cooperation among three or more firms. Table 2 shows the distribution of announcements according to the types of cooperation. Nearly 70% of co-opetitive announcements concern technological agreements; particularly, around 34% and 26% of technological cooperation are related to joint research & development and patent licensing & pooling, respectively. Collaboration[7] accounts for 20.83% of the total number of announcements. Non-technological cooperation is relatively rare and accounts for only about 10% of the total sample.

[7] I defined collaboration as an agreement of joint research and development along with joint marketing.

Table 2 Distribution of Sample by the Type		
Types of Cooperation	Number of Announcements	Percentage
Technological Activities		
Joint Research & Development[#]	33	34.38%
Patent Licensing & Pooling[#]	25	26.04%
Joint Ventures	6	6.25%
New Technology Standard	3	3.13%
Non-Technological Activities		
Joint Marketing	7	7.29%
Supply Agreement	3	3.13%
Mixed Activities[+]		
Collaboration	20	20.83%
Full Sample Size (N)	96	≈100%

Table 2

Notes to Table 2. [#] There is one sample included in both joint research & development and patent licensing & pooling. [+] Mixed activities represent the agreement involves both technological and non-technological cooperation. Announcements of co-opetition made by NYSE, NASDAQ and S&P500 firms, 2002-2012. Announcements were identified using the news release centers by pre-selected firms. I searched keywords such as alliance, joint research, joint develop, collaborate, team up, patent licensing, marketing, supply, and joint manufacturing.

3.3 Stock Prices Data

The event study analysis in this research required a market index. I chose a value-weighted S&P 500 Index for the market portfolio suggested by MacKinlay (1997). All daily stock prices data and daily market price indexs were obtained from *Yahoo!Finance*[8].

3.4 Event Study Methodology

Event study is a way to measure the effect of new information on the value of a firm. The underlying assumption in the event study methodology is the efficient

[8] Only the adjusted closing prices were used to compute stock returns. Please refer to Appendix B for the calculation of the adjusted closing prices.

market hypothesis. When the capital market is efficient, the stock price responds instantaneously to any newly released information (Fama, 1991). In other words, event studies provide a convenient way to determine what variables change the firm's security price and how significant the variables make that change. With the help of the event study, I am able to detect the market's reaction and investors' valuation of the firm when the announcement of joint cooperation with rivals was made. This paper follows the standard procedures of conducting event study analysis outlined by MacKinlay(1997).

Due to its simplicity and popularity, a simple market model is employed to estimate normal returns on stock price:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

where R_{it} and R_{mt} are, respectively, the daily rate of return for firm i and value-weighted S&P 500 over period t. The returns are computed as:

$$R_{it} = \ln\left(\frac{P_{it}}{P_{it-1}}\right) \quad (2)$$

where P_{it} is the adjusted daily closing price for firm i. α_i and β_i are the average return and market risk of firm i, respectively. Under the market model, it is assumed that the disturbance term (ε_{it}) has a zero mean and that the returns are jointly normally distributed.

The next step is setting up event period and estimation period. Figure 1 illustrates the timeline of the event study approach for this paper. Announcement date are

defined as the event date occurring at T=0. Let's denote $[-T_2, {}_+T_3]$ as the event window, where T_2 is the number of days before the announcement date and T_3 is the number of days after the announcement date. Similarly, $[-T_{0,} {}_-T_1]$ represents the estimation window with T_0 and T_1 denoting the "earliest" day and the "latest" day of the estimation, respectively. For this research, 120-day long estimation window with different lengths of event windows are taken into account considering the fact that information leakage before the event and a longer "digestion" period after the event are possible[9].

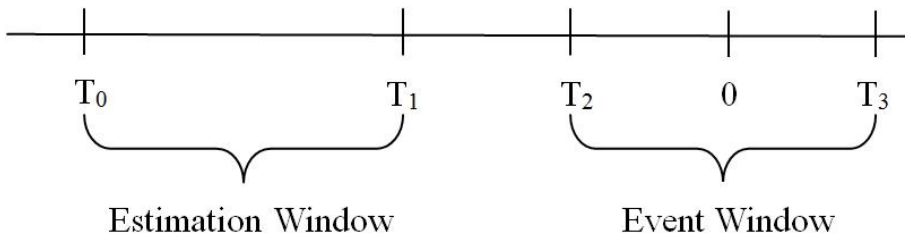

Figure 1: Timeline for the event study. The length of the estimation window is fixed at 120 days, and multiple event windows, specifically 3-day, 7-day, and 11-day event periods are applied. Each event window implies a particular estimation window interval. For example, 3-day event window [-1,+1] is associated with [-122,-2] estimation window, while 7-day event windows [-3,+3] is associated with [-124,-4] estimation window.

To predict the returns, I run an OLS regression on equation (1) to get the parameter estimates. Given the estimated coefficients, the abnormal returns (AR) for each firm i on each day of an event window can be calculated:

$$\widehat{\varepsilon_{it}} = AR_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \quad (3)$$

Then, cumulative average abnormal returns (CAAR) over event windows were computed as:

[9] I used 3-day, 7-day, and 11-day time horizons for the test. Their corresponding event window intervals are: [-1,+1], [-3,+3], [-5,+5].

$$\mathrm{CAAR}_{(t_2,t_3)} = \frac{1}{N}\sum_{i=1}^{N}\left(\sum_{i=T_2}^{T_3} AR_i\right) \quad (4)$$

Since my research consists of multiple observations of individual types of events, CAAR is a suitable measurement to examine the impact of a particular type of cooperation announcement in the period of interest.

The final step is to perform a significance test. The null hypothesis states that cooperating with rivals has no impact on stock returns, or CAAR is not different from zero. The parametric t-test was used for statistical inference:

$$t - \text{statistic} = \frac{\mathrm{CAAR}_{(t_2,t_3)}}{\sqrt{\frac{1}{N^2}\sum_{i=1}^{N}\hat{\sigma}_{AR_i}^2}} \quad (3)$$

Section 4 - Test Results

This section presents major numerical findings along with the interpretation of the results. (See next page)

Table 3
Cumulative Average Abnormal Returns (CAAR) under Market Model

Event	Overall Events (96 obs.)		Joint R&D (33 obs.)		Patent Related (25 obs.)		Collaboration (20 obs.)	
Window	CAAR	t	CAAR	t	CAAR	t	CAAR	t
[-5,+5]	0.35	1.48	0.90	2.36*	1.67	3.08**	-1.70	-3.32**
[-3,+3]	0.30	1.26	1.08	2.85**	0.32	0.60	-1.82	-3.58**
[-1,+1]	0.10	0.42	0.60	1.57	0.81	1.51	-1.77	-3.49**

Table 3

Notes to Table 3. Cumulative average abnormal returns (CAAR) are in percentage. The *t*-test is two-sided. A *t*-statistic attached with ** or * indicates that the estimated CAAR is statistically significant at 1% and 5% levels respectively. Detailed calculations for CAAR and t-statistics are written in "Event Study Methodology" in Section 3. "Overall Events" represents full sample of 96 co-opetitive firm-announcement involving 35 firms traded on NYSE, NASDAQ or S&P500 with available stock return data on *Yahoo!Finance* during the period 2002-2012. Joint research and development (Joint R&D), patent licensing/pooling (Patent Related), and collaboration are subsample tests for the announcement effect. Collaboration refers to a situation where firms team up in joint research and development together with joint marketing.

Table 3 illustrates the full sample test outcome under the column of "Overall Events", and subsample test outcomes for joint research and development, patent licensing or pooling, and collaboration. Tests for the other forms of co-opetition including joint ventures, co-marketing and distribution, supply agreement and new technology standard are not examined due to small sample size.

The main results are the following: (1) co-opetition announcements do not create significant value for the shareholders in full sample test. Although positive CAARs

are recorded in all different event windows, I find none of those CAARs are statistically significant; (2) firms announced to work together on research and product development are estimated to increase the returns by 1.08% for the 7-day event window and 0.90% for the 11-day event window, and the effects are statistically significant at 1% and 5% respectively; (3) the announcement of patent licensing or pooling generates additional 1.67% cumulative returns on average for the 11-day event window. The effect is highly significant and the strongest in terms of producing positive abnormal returns, which suggests that patent-related co-opetition plays a key role in stimulating a firm's stock market valuation; (4) collaboration announcements report, surprisingly, significant negative CAARs ranging from -1.70% to -1.82% for all the event windows. The implication is that investors regard collaboration as a bad move for the firm, but that although the abnormal returns are statistically significant it may not be precisely estimated because of the limited sample size. Appendix C presents a robustness test on the above findings. The test result confirms that the findings in Table 3 are reliable. In what follows, I propose possible elucidations for aforementioned results.

Result (1) supports the finding carried out by McGahan & Villalonga (2005), who find no significant announcements effect of establishing alliances or joint ventures with rivals on stock market trends. One similarity between McGahan &

Villalonga's research and my research is that we both study the cooperative activities among giant companies. As McGahan & Villalonga suggest, they ascribe the finding to the idea that the degree of gain is disproportionally related to the market value of the firms; that is, the alliance among large companies get the least benefits whereas the small firms gain the most when they partner with sizable firms. Although the full sample test result maintains that co-opetition has no impact on firms' valuation, the individual subsample test tells a different story.

Result (2) and (3) are consistent with value-maximizing hypothesis, which predicts that the share prices response positively to announcement of cooperating with competitors. Similar findings are also shown in many event study analyses of strategic alliance (Chan et al., 1997; Das, Sen and Sengupta, 1998; Anand & Khanna, 2000)[10]. In particular, result (2) implies that the source of abnormal returns may come from beneficent knowledge transfer. According to the theory of information sharing within organizations (Jensen & Meckling, 1991), working with enemies can be an effective way to learn general or specific know-how (Chan et al. 1997). Result (4) indicates that firms are expected to experience returns deduction when they collaborate in both R&D and marketing. Since result (3) has already proved that the stock market favors joint R&D, joint marketing is a highly suspicious factor causing significant negative

[10] For more examples, please see McConnell & Nantell (1985); Crutchley, Guo, & Hansen (1991), and Kale, Dyer & Singh (2002).

returns. I conjecture that the cost of marketing alliance outweighs the benefits of joint R&D in collaboration announcement. There are a few studies which support my point: Hagedoorn (1993) argues that joint marketing strategy may give investors a signal that the product is entering the mature or declining stage of life cycles, so markets react negatively to lower future profitability; Das, Sen & Sengupta (1998) provide empirical evidence showing that investors tend to have larger uncertainty about marketing agreements than technological agreements. They further argue that the substantially small 0.002% cumulative abnormal returns they found on marketing alliance might be a consequence of natural risk-return tradeoff, although the result is statistically significant at 5%.

In sum, despite the absence of significant results in the full sample test, technological co-opetition announcements such as joint R&D and patent licensing are estimated to yield significant and positive impacts on firms' security returns. On the other hand, a mix of non-technological and technological co-opetition such as collaboration is predicted to generate significantly negative effects on firms' share prices.

Section 5 - Limitation of the Study and Conclusion

The biggest limitation of this study comes from small sample size estimation and lack of a comprehensive test of robustness. I could only identify 96

firm-announcement observations, whereas similar researches such as Woolridge & Snow's (1990) and Chan et al.'s (1997) used a sample size comprised of 345 to 767 strategic alliance announcements. It is clear that the preciseness of my estimation is arguable. My findings thus should be interpreted with caution because of the problem of small sample size. Besides, the significance test adopted in this study grounds on a single parametric *t*-test, which assumes that the returns from an individual firm are normally distributed. In the case where the normality of abnormal returns is violated, the parametric test plays a negligible role in detecting false null hypotheses (Fama, 1976; Brown & Warner, 1985; Dombrow et al., 2000). Scholars hence recommend using non-parametric tests such as the generalized sign test and generalized rank test to verify the research findings (Campbell & Wasley, 1993; Kolari & Pynnonen, 2010). However, I did not run a complete set of non-parametric tests on my results due to complex programming and limited time of doing the research. The robustness of the main estimates remains questionable. To improve the analysis, a more extensive sample collection and more powerful test statistics are needed.

In conclusion, this paper addresses the question of whether co-opetition announcements significantly impacted the value of the firm. The aim of the research is to disclose empirical evidence in the hope to testify the validness of co-opetition theories. Using the event study approach, I inspected the fluctuation of firms' security

returns when the firm announced to cooperate with competitors. Based on the full sample estimation, the result suggests that co-opetition announcement plays no vital role in boosting extra firms' value. This seems to refute the general standpoint in favor of co-opetition. However, the subsample estimation demonstrates that different types of co-opetitive behavior significantly affect the valuation in different ways. The formation of technological co-opetition such as joint research and development and patent pooling yields significantly positive effects through, possibly, effective inter-firm knowledge exchange. The co-opetition involving both research and development and marketing produces significant negative impacts by sending unfavorable signal towards investors. Therefore, the subsample estimation partially supports the theories of co-opetition. The contradiction between the full sample test result and the subsample test result implies future developments of this research. A more thorough examination for each type of co-opetitive strategy is required to confirm the results.

Appendix A

Sample Description of Co-opetition

There are seven types of co-opetitive activities in this research. This section provides a brief description for each type of co-opetition. The description is directly copied from the firm announcement found in the News Release Center.

1. *Joint Research & Development*
Sony Corporation ("Sony") and Panasonic Corporation ("Panasonic") today announced that they have signed an agreement regarding the joint development of next-generation OLED (organic light-emitting diode) panels and modules for TVs and large-sized displays. Sony and Panasonic plan to jointly develop next-generation OLED panels and modules by each utilizing their core and printing technologies. They plan to jointly develop printing method-based next-generation OLED technology, which will be suitable for low-cost mass production of large, high resolution OLED panels and modules. Sony and Panasonic aim to establish mass-production technology during 2013, by integrating their unique technologies to improve the overall efficiency of development. (Sony News Releases, 2012-06-25)

2. *Patent Licensing/Pooling*
To accelerate the widespread adoption and deployment of WiMAX technology and products, Alcatel-Lucent, Cisco, Clearwire, Intel Corporation, Samsung Electronics and Sprint today announced the formation of the Open Patent Alliance (OPA). The OPA will advance a competitive and open intellectual property rights model, thus stimulating a larger WiMAX industry that supports innovation through broader choice and lower equipment and service costs for WiMAX technology, devices and applications globally. To accomplish its goals, the OPA will form a WiMAX patent pool to help participating companies obtain access to patent licenses from patent owners at a predictable cost. (Intel News Releases, 2008-06-09)

3. *Collaboration*
Today, Microsoft Business Division President Stephen Elop and Nokia's Executive Vice President for Devices Kai Ö istämö announced the agreement, outlining a shared vision for the future of mobile productivity. This is the first time that either company has embarked on an alliance of this scope and nature. Under the terms of the agreement, the two companies will begin collaborating immediately on the design, development and marketing of productivity solutions for the mobile professional, bringing Microsoft Office Mobile and Microsoft business communications, collaboration and device management software to Nokia's Symbian devices. (Microsoft News Center, 2009-08-12)

4. *Co-marketing*
Working to provide consumers with the most compelling digital content whenever and wherever they desire, HP and Apple® today announced a strategic alliance to deliver an HP-branded digital music player based on Apple's iPod™, the number one digital music player in the world, and Apple's award-winning iTunes digital music jukebox and pioneering online music store to HP's customers. As part of the alliance, HP consumer PCs and notebooks will come preinstalled with Apple's iTunes® jukebox software and an easy-reference desktop icon to point consumers directly to the iTunes Music Store, ensuring a simple, seamless music experience. This offering is yet another way that HP is helping consumers enjoy more from their personal digital entertainment content.(Apple Press Info, 2004-01-08)

5. *Joint Ventures*
STMicroelectronics, Intel and Francisco Partners today announced they have entered into a definitive agreement to create a new independent semiconductor company from the key assets of businesses which last year generated approximately $3.6 billion in combined annual revenue. The new company's strategic focus will be on supplying flash memory solutions for a variety of consumer and industrial devices, including cellular phones, MP3 players, digital cameras, computers and other high-tech equipment. The new company will combine key research and development, manufacturing and sales and marketing assets of Intel and STMicroelectronics into a streamlined worldwide structure with the scale to produce cost-effective and innovative non-volatile memory solutions. (Intel News Releases, 2007-05-22)

6. *Supply Agreement*
Apple® today announced that it has reached long-term supply agreements with Hynix, Intel, Micron, Samsung Electronics and Toshiba to secure the supply of NAND flash memory through 2010. As part of these agreements, Apple intends to prepay a total of $1.25 billion for flash memory components during the next three months. (Apple Press Info, 2005-11-21)

6. *New Standard*
LG, Philips and Sharp have agreed to work together to define common technical requirements for their Smart TVs, based upon open standards such as HTML5, CE-HTML and HbbTV. The group's first step will be to introduce the first beta version of a common Software Development Kit (SDK), which highlights the need to define the technical requirements that would allow content developers to create a single application that can run on Smart TVs from LG, Philips and Sharp Aquos Net+. (LG News Room, 2011-09-01)

Appendix B

Calculation of the Adjusted Closing Prices

Using adjusted closing prices to compute daily security returns is more accurate because closing prices are adjusted for dividends and splits. The adjustment factors used in *Yahoo!Finance* follow the standard of the Center for Research in Security Prices (CRSP). Please check the link below for additional information:

http://help.yahoo.com/kb/index?page=content&y=PROD_FIN&locale=en_US&id=SLN2311&pir=wDJ8S3FibUlXCBwZUE9vbtPeZbEjdxCBF1zXsumcsV2hgD_2wepLNWAZdyC_evrAzwg-

For your convenience, I excerpt an example of calculating adjusted closing prices directly from the webpage above:

Adjusted close calculation example

This example shows how split and dividend multipliers are calculated and applied, to determine adjusted close prices:

Date	Close, Dividend, or Split
2/13/03	Close = 46.99
2/14/03	Close = 48.30
2/18/03	Split = 2:1
2/18/03	Close = 24.96
2/19/03	Cash Dividend = 0.08 (ex-date)
2/19/03	Close = 24.53

1. The multipliers are determined using the split and dividend:

- Split Multiplier = 0.5
- Dividend Multiplier = 1 - (0.08/24.96) = 0.9968

2. Using these split and dividend multipliers, the adjusted close prices are calculated:

Date	Adjusted close calculation
2/13/03	0.5 * 0.9968 * 46.99 = 23.42
2/14/03	0.5 * 0.9968 * 48.30 = 24.07
2/18/03	0.9968 * 24.96 = 24.88
2/19/03	24.53

Appendix C

Robustness Test for Market Model

Under the market model, the estimated results may suffer an endogeneity problem when the sample contains companies that are large enough to influence the prices of a stock market index (Luca, Langus and Motta, 2012). Hence, scholars recommend using the mean-adjusted model to reproduce estimation and make a comparison with the results in the market model (Luca, Langus and Motta, 2012; MacKinlay, 1997). Since the mean-adjusted model does not allow for general market movements, its estimation is immune to endogenous effect. Given the fact that many large enterprises are included in my sample, applying the mean-adjusted model gives a quick and direct test of robustness for the main results presented in Section 4.

Under the mean-adjusted model, it is assumed that the actual return of a security is equal to its historical mean:

$$AR_{it} = R_{it} - \alpha_i \quad \text{(A1)}$$

where α_i equals to the mean value of the stock return over the estimation window and is assumed constant over time. Table A1 and A2 illustrate different estimates generated by the market model and the mean-adjusted model. As a simple robustness test, I am only interested in checking the robustness of the significant estimates produced in the market model. By making a comparison between two models, I

discover that the significant cumulative average abnormal return estimates from the market model and the corresponding estimates from the mean-adjusted model share the same sign and hence go with the same direction; moreover, all estimates under the mean-adjusted model are smaller than the market models'. Therefore, the impact of endogeneity on the market model estimates is insignificant and the results and inferences discussed in Section 4 remain valid.

Table A1
Cumulative Average Abnormal Returns (CAAR) under Market Model

Event	Full Sample (96 obs.)	Joint R&D (33 obs.)	Patent Related (25 obs.)	Collaboration (20 obs.)
Window	CAAR %	CAAR %	CAAR %	CAAR %
(-5;+5)	0.35	**0.90***	**1.67****	**-1.70****
(-3;+3)	0.30	**1.08****	0.32	**-1.82****
(-1;+1)	0.10	0.60	0.81	**-1.77****

Two-sided test, significant levels **1% *5%

Table A2
Cumulative Average Abnormal Returns (CAAR) under Mean-adjusted Model

Event	Full Sample (96 obs.)	Joint R&D (33 obs.)	Patent Related (25 obs.)	Collaboration (20 obs.)
Window	CAAR %	CAAR %	CAAR %	CAAR %
(-5;+5)	-0.08	**0.16**	**1.51**	**-2.70**
(-3;+3)	-0.14	**0.68**	-0.27	**-3.59**
(-1;+1)	-0.32	0.24	-0.30	**-1.84**

Bold numbers are used to compare the sign and magnitude with significant estimates found in market model.

References

Anand, B. and T. Khanna,. 2000, “Do companies learn to create value?” *Strategic Management Journal* 21: 295-316.

Bengtsson, M. and Kock, S., 2000: "‘Coopetition’ in Business Networks-to Cooperate and Compete Simultaneously". *Industrial Marketing Management*, 29(5): 411-426.

Brandenburger, A.M. and Nalebuff, B.J., 1996: *Co-optetition.* New York: Doubleday.

Brown, Stephen J., Warner, Jerold B., 1985. Using daily stock returns: The case of event studies. *Journal of Financial Economics* 14, 3–31.

Campbell, C. J. and Wasley, C. E. 1993. 'Measuring security performance using daily NASDAQ returns'. *Journal of Financial Economics*, 33(1): 73-92

Chan, S.H., J.W. Kensinger, A.J.Keown, and J.D. Marin., 1997, “Do strategic alliances create value? *Journal of Financial Economics 46*: 199-221

Cohen, W.M. y Levinthal, D.A., 1990, "Absorptive Capacity: A New Perspective on Learning and Innovation". *Administrative Science Quarterly*, 35(1): 128-152.

Crutchley, C.E., E. Guo & R.S. Hansen., 1991, “Stockholder benefits from Japanese-U.S. joint ventures,” *Financial Management,* 20 (4): 22-30.

Das, S., P.K. Sen & S. Sengupta, 1998, “Impact of strategic alliances on firm valuation,” *Academy of Management Journal* 41: 27-41

Dombrow, J., M. Rodriguez, and C. F. Sirmans, 2000. A complete nonparametric event study approach. *Review of Quantitative Finance and Accounting* 14 (4), 361.80.

Fama, Eugene F., 1976. Foundations of Finance. Basic Books, New York, NY.

Fama, Eugene F., 1991. Efficient capital markets:II. *The Journal of Finance*, Vol. 46, No. 5. (Dec., 1991), pp. 1575-1617..

Hagedoorn, J., 1993. Understanding the rationale of strategic technology partnering: Interorganizational modes of cooperation and sectoral differences. Strategic Management Journal, 14: 371-385.

Hamel, G., 1991. "Competition for Competence and Interpartner Learning Within International Strategic Alliances". *Strategic Management Journal*, 12: 83-103.

Hamel, G.; Doz, Y.L. and Prahalad, C.K., 1989: "Collaborate with Your Competitors-and Win". *Harvard Business Review*, 67(1): 133-139.

Jensen, M., Meckling, W., 1991. Specific and general knowledge, and organizational structure. In: Werin, L., Wijkander, H. (Eds.), *Contract Economics*. Blackwell Publishers, Oxford.

Jorde, J.M. and Teece, D.J., 1989: "Competition and cooperation: Striking the right balance". *California Management Review*, 31(3): 25-37.

Kale, P., J.H. Dyer, and H. Singh, 2002, "Alliance capability, stock market response, and long-term alliance success: The role of the alliance function," *Strategic Management Journal* 23: 317-43.

Koh J. & N. Venkatraman, 1991, "Joint venture formations and stock market reactions: an assessment in the information technology sector," *Academy of Management Journal 34:* 869-892.

Kolari, J. W. and Pynnonen, S., 2010. 'Event study testing with cross-sectional correlation of abnormal returns'. *Review of Financial Studies*, 23(11): 3996-4025.

Lado, A.A.; Boyd, N.G. and Hanlon, S.C., 1997: "Competition, cooperation, and the search for economic rents: A syncretic model". *Academy of Management Review*,22(1):110-141.

Luca, A, Langus G. and Motta M., 2012: The effect of EU antitrust investigation and fines on a firm's valuation, EUI Working Paper.

MacKinlay, A.C., 1997. "Event studies in economics and finance." *Journal of Economic Literature*, 35 (1): 13-39

McConnell, J., and T. Nantell, 1985, "Corporate combinations and common stock returns: The case of joint ventures," *Journal of Finance* 40: 519-36.

McGahan, A.M. and B. Villalonga, 2005, "Does the value created by acquisitions, alliances and divestitures differ?" Working paper.

Park, S.H. and Russo, M.V., 1996: "When Competition Eclipses Cooperation: An Event History Analysis of Joint Venture Failure". *Management Science,* 42(6): 875-890.

Reuer, J.J. and M.P. Koza., 2000. Asymmetric information and joint venture performance: Theory and evidence for domestic and international joint ventures. *Strategic Management Journal,* 21(1): 81-88

Woolridge, J.R. & C.C. Snow, 1990, "Stock market reaction to strategic investment decisions," *Strategic Management Journal*, 11: 353-363.