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MARKET VALUATION OF STRATEGIC RESPONSES TO OPEN SOURCE NEWS AND ANNOUNCEMENTS

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Abstract

This paper examines the disruptive impact that open source (OS) software has on the mainstream software market within the period 2001 - 2003. The findings indicate that the stock market reacted negatively when the strategic responses of closed source incumbents were antagonistic to open source despite their relentless effort and investment in product and service enhancement. Whereas their counterparts that embraced open source were most likely to perform well on the stock market and successfully enter into the emerging new markets.

Keywords: Disruptive Technology, Strategic Responses, Cumulative Abnormal Return.

1 INTRODUCTION

As the press and the media have portrayed open source (OS) software as the next big disruptive technology, the market punters and investors will have to closely study the reaction from the affected closed source (CS) incumbents, specifically their respective strategic responses to any major OS news and announcements such as the set up of Opengroupware.org, and the recent launch of Open Office. The strategic responses grow out form the CS incumbents' assessment of the situation, and represent CS core strategies to ensure continuous success in the market by either building or defending their competitive advantages, and by improving its market position (Chen, 1996). Although the literature has focused on strategic responses to disruptive technologies (e.g. Christensen & Overdorf, 2000), most of the evidence is anecdotal and the theorizing remains at extending the motivation-ability framework (Markides & Charitou, 2004), and notably the empirical investigations of the effectiveness of different strategic responses to disruptive technologies have been lacking (Christensen, Suarez & Utterback, 1998).

This paper intends to fill this void in research by examining the types of strategic responses that CS incumbents used to mitigate the potential disruptive impact following a major OS news and announcement, and empirically evaluate the effectiveness of CS strategic responses in swaying the market to boost their share price. The rest of the paper is organized to address the following objectives: first, to examine whether OS software bears any significant hallmarks of a disruptive technology; second, to identify the core strategic responses based on a qualitative analysis of the exchanges of news and announcements between OS and the affected CS incumbents in the period 2001-2003; third, to posit and empirically test the impact that each strategic response has on the market; and lastly to discuss the implications of the present findings to both theory and practice.

1.1 Disruptive Characteristics of OS

Within the literature of innovations, scholars make the distinction between incremental and radical innovations (Utterback, 1994; Afuah & Bahram, 1995). Incremental innovations rely on improving the existing production methods to produce better products with performance attributes that the mainstream customers find appealing. The underlying rationale is to build upon the previous successes and enhance what firms have acquired in terms of dynamic capabilities, know-how and competencies. Whereas radical innovations come about as a result of scientific and technological breakthroughs that do not require and/or build on the firms' current capabilities, and importantly have the effect of devaluating the existing products. In many respects, OS products are similar to their CS counterparts despite the differences in terms of the design processes (Bonaccorsi & Rossi, 2003; Scacchi, 2004), and the underlying drivers for innovation and technological development (von Hippel and von Krogh, 2003). The major similarities include: that both OS and CS rely on processes of incremental improvement; and that they both offer a general and similar set of functionalities and performance attributes. Hence, at least with respect to innovations, OS is not radically different from CS.

So is OS a disruptive technology? According to Bower and Christensen (1995), technological changes that damage incumbents or established companies are usually not radically new or different from a technological point of view. The new technology, however, introduces a new package of features, which have the potential of changing the nature of competition in the market. These technologies typically present a different package of performance and product attributes, which initially do not appeal to the mainstream customers. Yet as the attributes improve, the product will eventually enter the market as a "good-enough" alternative to allure the mainstream customers to switch. A significant tipping point for product switching is when the mainstream products overshoot the customers' needs, and customers find themselves not only being over-served technologically by their vendors but also at the same time paying higher licence fees.

Specific to OS software, the release of source codes to its users is an attribute that not only results in greater flexibility for users to tailor and modify applications to suit their unique requirements[1] but also generates a degree of freedom from dependencies on a single provider (Kaufman, Tucci & Brumer, 2003). CS creates and increases the dependence of its users on the CS developer for support, installation and problem fixing. Occasionally, these dependencies force the users to upgrade their products even when the added benefit is not needed or obvious to them[2]. Another significant attribute is that disruptive technologies offer a lower cost alternative to the established players. Licensing costs, for example, can be zero with OS software. With Linux, non-corporate users simply download and install the software from the Internet. Netproject (2003) reported that the total cost of ownership with Linux on the desktop was 35% that of Microsoft Windows resulting in a 65% savings. These savings came from the elimination of license fees for both the system software and office software, elimination of vendor churn that forces unnecessary software updates, reduction in the number of software security updates and reduction in the number of support staff.

OS products are increasingly being seen as a viable product substitute and potentially a category killer to the mainstream software products. Its properties of being cheaper, more flexible, and its development process that taps into communities of developers, provide the needed incentives for companies to depart from the prevailing technology. In the last decade, OS products have captured a large share of the established market. One indication of this growth is the prevalence of adoption and usage of OS products, among the high profile ones in the market including Apache for web servers, Linux for the server operating systems, and MySQL for the databases.

The growth of OS products is evident and CS vendors are sitting up and taking notice. The Goliath amongst them, Microsoft, acknowledges OS products as a threat, and in January 2001, its CEO Steve Ballmer publicly announced, "Linux the biggest threat to Microsoft." Other CS vendors are also aware of this and have taken actions such as openly denouncing OS on issues of security and support or taken a more collaborative approach such as modifying its product to run on OS software and/or offering support for OS products at a fee.

As a result of the inherent differences in organizational assets (Srivastava, Shervani and Fahey, 1999; Wernerfelt, 1984), the CS incumbents are expected to differ in their strategic responses to OS products. Most of the current frameworks are derived from a defender perspective with two key considerations: the motivation and the ability to defend (e.g. Christensen & Raynor, 2003; Charitou & Markides, 2003). But in the 1990s as OS has become more amenable to commercial investors[3], the landscape of the software industry has changed dramatically from an antagonistic stance to a more neutral and benign one which provides the opportunity for cooperation between the OS developers and the CS vendors. In the following section, we report the types of strategic responses identified on the basis of a qualitative analysis of the competitive interaction between CS and OS in their exchanges of news and announcements (examples are included in the Appendix; and for a detailed description of the procedures for data collection and analysis, see the method section), and posit the effectiveness of

[1] A case in point, operating systems and word processing software support only a limited range of languages. Iceland, in order to help preserve its language, wanted Icelandic support added to Microsoft Windows and was willing to pay for its modification. Microsoft, however, was not prepared to translate or localize Windows into the Icelandic language as the market was too small to justify the effort (Vermeer, 1999). In such an instance, OS software provided a more attractive option as the source code of the operating system is available and can be freely modified, and developers were able to add support for the language of their choice.

[2] When Microsoft decided to end its volume licensing in 2001 and support by 2002 for Windows 95, the existing users were forced to switch to the more expensive Windows 2000 if they wish to continue running those applications (Foley, 2000).

[3] During this period, Debian, an organization established to disseminate Linux, introduced a licensing agreement to bundle OS developed codes with proprietary code.

each strategic response in combating the potential disruptive impact following a major OS news and announcement.

Table 1. Strategic Responses to Open Source Announcement

Strategic Response	Definition	Illustrative Example
Associative Product Enhancement	Enhanced the existing bundle of services and functionalities through incorporating open source capabilities	Sun Microsystems announced its plan in enhancing its instant messaging (IM) service by releasing a standalone IM server in response to the latest sign of booming demand for corporate IM services. This appeared to be a prospector's move to the greater acceptance of Linux in the high-end server market.
Associative Collaboration	Embraced Open Source through strategic alignment, new business venture and source code	RealNetworks announced in its plan in following the open source trend by releasing the source code of its audio and video player to run on the Linux operating system.
Associative Price (Lower Tier Market)	Targeted lower tier of the market by using competitive pricing and offering lower-cost alternatives	Red Hat announced its plan in releasing database software to target small and medium sized businesses. As an early investor in Red Hat, Oracle was counting on offering a more attractive pricing plan to coincide with the release of new 9i for capturing more market share.
Antagonistic Product Enhancement	Provided additional functionalities and services to counteract similar offerings by open source products and/or partnerships	In response to the challenge of OpenGroupware.org, Microsoft announced its plan in allowing Mac OSX users to access corporate e-mail and calendar information stored on a Microsoft Exchange server. This was regarded by the market as a move to capture the new Mac OSX users and notably to retain its existing Exchange users.
Antagonistic New Product	Offered new products as a defensive move to retain market share	Oracle released a new portal software to drive sales of its database and application server, and of its business software. This was a reaction to the collaboration between IBM and MySQL, and was seen as a move to defend its market share.
Antagonistic Price (Upper Tier Market)	Targeted upper tier of the market by charging according to the customers' unique requirement	MS announced its Office bundling plans to help volume licensing businesses to manage cost by tailoring the productivity tools to needs. This was a reaction to the developments in StarOffice and was a move to defend its market share.

1.2 Strategic Responses

Table 1 shows the strategic responses with their respective definitions and illustrative examples. The six strategic responses dovetail with the motivation-ability framework, but also include the opportunity the OS brings to the CS vendors. For the first three strategic responses, the nature and the extent of cooperation vary. The associative product enhancement characterizes the opportunistic move by CS vendors in improving their product capabilities and compatibilities by bundling and incorporating OS with their proprietary products and/or codes. For the associative collaboration, CS vendors go further by releasing their source codes to the OS developers, and often pump prime resources to sponsor further code development. And for the third strategic response, as the market for OS products is small and low margin business, competitive pricing offers a lower-cost alternative to encourage the mainstream customers to switch form their existing more higher-cost products.

The three associative strategies signify a more neutral and benign stance taken by CS vendors. The first two strategic responses in particular, not only substantially reduce the potential high cost related to R&D but also shorten the product life cycle. Kaufman et al. (2003) advocated that firms (suppliers/manufacturers) often co-specialize their assets to gain efficiencies, and collaborate in long-term relationships to optimize on transaction costs. These relationships allow firms in the supply chain to engage in joint product design and concurrent engineering, to share personnel and equipment, and importantly to leverage financial and marketing resources strategically and speedily. In effect, although the OS market is a small and low profit margin business, this is compensated by the associative strategic responses that serve to increase adoption and to facilitate CS vendors to enter the emerging OS market.

A primary decision criterion in creating collaborative efforts and alliances is the potential impact on shareholders' wealth (Das, Sen & Sengupta, 1998). If investors perceive the move as increasing the returns or decrease risks, stock prices will increase. Conversely, deals that jeopardize the health of the firm will result in a significant drop in stock prices. Other studies examine the effect of reputation as informational signal to the marketplace regarding future cash flows of the firms. An alliance and collaboration with a reputed partner can send a credible signal to the market about a firm's true level of quality. Taken together, we formulate the following three hypotheses:

H1a: The market will react positively towards the strategic responses that take the stance of associative product enhancement

H1b: The market will react positively towards the strategic responses that take the stance of associative collaboration

H1c. The market will react positively towards the strategic responses that take the stance of associative pricing.

With respect to the antagonistic strategic responses, the underlying strategic intent is in defending market share by expanding effort and investment in product and service enhancement (Antagonistic Product Enhancement); by introducing a new product aimed at competing with its OS equivalent (Antagonistic New Product); and by pricing in accordance with the unique requirements of the upper tier of the market (Antagonistic Pricing).

Although there is some evidence that the stock market generally reacted positively in the first few days after the new products launch and announcement (Chaney, Devinney & Winer, 1991), research in the market valuation of emerging and competing technologies suggests the opposite. Pardue, Higgns and Biggart (2000) studied the relationship between new IT product and announcement during the two eras of technical advance in the period 1981 to 1994. The era of incremental technical change was characterized by a period where there was a dominant design in the marketplace and incremental changes were made to the dominant design. New designs would have a hard time winning a market share. The era of ferment, on the other hand, was a period when several new designs are introduced and challenged the old design. Using the event study methodology, they classified the announcements as either competing with the emerging technology or competing with existing dominant design. The findings indicate that the market reacted negatively to new product announcements during an era of ferment whereas the results were not significant for new product announcements during an era of incremental technical change; and that during the era of incremental technical change, the market reacted negatively to announcements on new product that competed with emerging technology whereas announcements that competed with the emerging technology was found to be non-significant. There are two plausible factors that led to the negative market valuation. First, investors interpret the information conveyed in new product announcements as signalling negative future cash flows for the announcing firms. Second, the investors' expectations rise with new products launch to a point when the product enhancements and new products failed to meet the investors' expectation. Here, we offer a third plausible factor that further technological advancement will exacerbate the ready over-servicing impact that the current CS products have had on the mainstream customers. Taken together, we formulate the following hypotheses:

H2a: The market will react negatively towards announcement that takes the stance of antagonistic product enhancement.

H2b: The market will respond negatively towards announcement that takes the stance of antagonistic new product.

The last strategic response taken by CS incumbents was to cut the price of their products and services or create alternate cheaper pricing packages for their customer base. OS products are often available without a fee and with low maintenance and support cost. This poses a threat to the CS incumbents, and as a result they have to use strategic tactics on the basis of pricing such as offering different product and service packages at varying prices to different consumer segments. Price adjustments are

not costless (Sheshinki & Weiss, 1992). There are real costs associated with the transmission of the price information to customers and with the decision process itself. However, price changes may be required either because of structural shifts in demands or due to a change in the general price level.

Price has often been used as an indicator of quality. Verma and Gupta (2004) investigated the perception of price on durable and non-durable goods, and found that consumers perceive higher price to mean higher quality. They noted that consumers are more likely to use price as an indicator of quality when the products in questions are expensive. As price increases, the risk of an incorrect decision increases as the buyer is often less familiar with the product due to infrequent purchase. In such situations, simple rules such as "getting what you pay for" determine consumers' decisions. The perception that price is an indicator of quality was also found to be true under conditions of extreme market volatility for tangible goods (Esposto, 1998). However, consumers also have lower and upper price thresholds (Ofir, 2004). Low prices falling outside of this threshold will be perceived by consumers as a signal for suspect product and therefore be unacceptable; and high prices above the threshold for the product will be considered too expensive and deter purchase.

The use of price promotion, defined as a short-term price cut, is well documented. Inman (1990, 1993) has shown that even without an actual decrease in price, promotion signal will result in an increase of sales. Promotion signal refers to any sign, marker, or other indicator of a price promotion to draw consumers' attention to a special offer. Over time, some consumers interpret a promotion marker as a proxy for a price cut so the simple presence of a promotion signal leads the consumers to presume that the price of the promoted brand has been discounted.

Pricing decisions are often made by the incumbents to defend their market share (Hauser, 1988). As the literature has shown, this strategy is effective to increase sales, at least in the short term, if the new price falls within the consumers' price threshold. Here the CS incumbents adopt a differential pricing model to appeal across different consumer segments, specifically the upper tier market with a higher profit margin where consumers are more demanding in their software needs and requirement. The strategic tactic is to reinforce the notion of "getting what you pay for". Taken together, we formulate the following hypothesis:

H2c: The market will respond positively towards announcement that takes the stance of antagonistic pricing

Table 2. Key Determinants of the Relationship between Strategic Responses and Market Valuation

Strategic Response	Strategic Intent	Profit Margin	Resource Implications	Technology Development Model	Lead Time	Over-Serving	Market Valuation
Associative Product Enhancement (AsPrEn)	Increase adoption	Mainly low	Low	Emphasizing "plug & play" and "component-based" solutions	Short	No	+
Associative Collaboration (AsCo)	Enter new markets	Mainly low	Medium	Moving towards a modular architecture	Short	No	+
Associative Price: Lower Tier Market (AsPr)	Increase adoption	Low	Low	Emphasizing "plug & play" and "component-based" solutions	Short	No	+
Antagonistic Product Enhancement (AnPrEn)	Retain existing customers	Medium to High	Medium	Remaining within the integrated architecture	Moderate	Yes	-
Antagonistic New Product (AnNePr)	Compete with new entrants	Low to Medium	High	Ranging from modular to integrated architectures	Long	Yes	-
Antagonistic Price: Upper Tier Market (AnPr)	Retain existing customers	High	Low	Remaining within the integrated architecture	Short	No	+

Note : Resource implications in terms of co-specialized assets, project management, re-structuring, etc.

Table 2 provides a summary of the underlying key determinants between the six strategic responses and the market valuation.

2 METHODS

Considering that the present research focus was on the CS incumbents' strategic responses to major OS news and announcements within the period 2001 to 2003, we adopted the "competitive-interaction" framework (Chen & MacMillan, 1992) to guide our data collection. As the previous classification (which was derived from the motivation-ability model) might limit the scope of strategic responses, we opted for an inductive approach (Glaser and Strauss, 1967; Strauss and Corbin, 1990) to analyze the exchanges of news and announcements between OS and CS, and followed by an independent coding procedure to establish the inter-coder reliability of the induced classification. And to gauge the impact of strategic responses on the market valuation of the CS incumbents, we used and implemented the event study methodology strictly adhered to the guidelines advocated by McWilliams and Siegel (1997).

2.1 Description of Data

The data were collected using the Internet as the primary source of information. We first obtained a listing of all CS firms that were traded on the American stock exchanges including NASDAQ and NYSE. The initial list comprised of 549 firms, and was then sorted according to their market capitalization. Because we were interested in firms that would be primarily featured in the news, we limited our firm selection to the top 30 firms. We then analyzed the firms individually based on the Reuters Internet database (www.investor.reuters.com). The purpose was to understand the types of CS products, and importantly to exclude firms if there were no OS equivalents available in the marketplace. This exercise reduced the number of firms to 13.

The next step was to obtain a listing of well-known OS projects. Instead of using the official open source website (www.opensource.org) which might provide biased information, we used the Wikipedia website (http://en.wikipedia.org/wiki/Opensource) to identify all the prominent OS products and projects. At the initial count, there were 416. We then carried out a cursory review of each OS project by visiting its respective website. OS projects that were not in stages of development were discarded as any of their respective news and announcements were unlikely to elicit a response from the CS incumbents. We further screened for OS projects and products that directly challenged the five most commercially profitable applications including databases, document editing, media, networking and Internet, and lastly operating systems. The final number of OS products and projects were 165.

Next, we searched for the OS news and announcements on the CNET (a leading Internet based technology news source) within the study period from January 1, 2001 through December 31, 2003. This search generated 1671 hits. As we were interested in OS projects and products within the five most profit applications, we discarded all the unrelated OS news and announcements. This resulted in 45 announcements. To ensure that we did not accidentally eliminate or overlook any significant announcements, we repeated the above procedure using another weekly Internet technology news service, Computer Hope (www.computerhope.com/newslet.htm). The second search generated 47 announcements. This resulted in a 4.3% margin of error for the process of identifying major OS news and announcements.

Regarding CS news and announcements, we again used the CNET to search for all major news of the 13 CS firms. The initial search resulted in 116 CS announcements. We then eliminated all announcements where there existed the possibilities of contamination by other confounding effects (such as dividend announcement, law suits and so forth) that had an inevitable impact on the firms'

stock price. A listing of all the confounding effect was provided in the Appendix. The final number of CS announcements was 72.

We next consolidated the news and announcements of OS and CS into a single Excel file, chronologically arranging OS in one column and CS in another. First, we attempted to identify the number of "competitive-interaction" pairs where each pair was characterized by the actions triggered by OS and the reactions from CS counterparts. This resulted in 31 pairs comprised of 59 (27 OS and 32 CS) announcements. Second, in studying the contents of the announcements, we adopted an open coding methodology (Glaser and Strauss, 1967; Strauss and Corbin, 1990). This approach required an iterative process of theoretical sampling, which amounted to compare and contrast the news and announcements exchanged between OS and CS. The aim was to build a series of theoretical categories, which were then compared and interrelated to gauge the strategic intent of each firm. The coding stopped once there were no more emergences of new theoretical categories. This happened around the coding of 60% of the news and announcements. Here the theoretical categories took the form of the six strategic responses (reported earlier). Two researchers then coded the contents of the exchanges of the 31 competitive- interaction pairs independently. The coding yielded an inter-coder reliability of 87%. The third party then resolved any disagreement.

2.2 Method of Analysis

We applied the event study methodology to assess the stock market valuation of strategic responses to OS news and announcements. The methodology was used here to measure any significant abnormal returns in stock prices following the strategic responses announced by CS firms, assuming that the information content contained in the announcement would be rapidly and rationally reflected in traded stock prices (Wells, 2004). The use of abnormal returns is common in the accounting and finance literature to represent a risk-adjusted return in excess of the average stock market return around the announcement date. Briefly, the method begins by gauging the actual stock returns over the period of interest (comprised of estimation and event windows), and followed by computing the difference between the returns that were predicted and the returns that actually occurred. If the difference between the actual results and the predicted results is determined to be statistically different from zero, it may be concluded that the event (in this case, the CS strategic response) triggered the stock market to adjust the market value of the firm following the announcement.

For this research, the CS announcement date was defined as day 0, and the estimation period from day -49 to day -2. The event of window of interest began on day -1 and ended on day +5. Following the suggestion by McWilliams and Siegel (1997), we used a shorter event window considering that the software development is a high velocity industry where events occurred at a rapid rate and news may be of little significance a short period after the announcement. The inclusion of day -1 in the event window aimed to capture any information leakage pertaining to the knowledge of when an OSS application was to be released. Hence, to ensure our sampling framework was reliable and to authenticate the exact date of the news and announcement, we checked the announcement date with other Internet technology news sources. This yielded a 1% margin of error.

Finally, as there were only 31 competitive-interaction pairs, the non-parametric Corrado rank test was used to assess the impact of each strategic response on the market valuation, and for the overall effect of antagonistic and associative strategic responses, the parametric Corrado T-test was used. Both tests are generally well specified and robust (Corrado, 1989; Corrado & Zivney, 1992), and particularly suited to the event clustering among observations when using the market model as a return generating process (as in the present study). Traditional non-parametric tests such as the signed-rank and sign tests, assume that the Central Limit Theorem holds, and that the analyzed sample is large enough for the theorem to be applied. Corrado rank test, however, was based on the computation of ranks of abnormal returns, which were independent of the degree of skewness commonly observed in the distribution of abnormal returns. For each firm in our present sample, the rank test first merged the

abnormal returns observed in both the estimation and the event window, and then ranked them accordingly. The detailed computation can be found in Campbell and Wasley (1993).

Table 3: Cumulative Abnormal Returns and Corrado Rank Test (in parenthesis) for Associative and Antagonistic Strategic Responses

	Associative Strategic Response			*Antagonistic Strategic Response*		
Trading Day Relative to Strategic Response	Product Enhancement	Collaboration	Pricing: Lower Tier Market	Product Enhancement	New Product	Pricing: Upper Tier Market
	n = 4	n = 5	n =2	n = 6	n = 9	n = 5
-1	0.016 (1.000) *	0.013 (2.161)	-0.016 (1.696)	-0.008 (4.286)	0.002 (4.857)	0.013 (1.946)
0	0.028 (1.089) †	0.016 (2.536)	-0.020 (1.161)	-0.009 (3.286)	-0.005 (4.571)	0.030 (1.982)
1	0.015 (2.607)	0.048 (1.964)	-0.013 (0.714)	-0.014 (3.250)	0.009 (3.286) †	0.036 (2.464)
2	0.028 (1.393)	0.044 (2.625)	-0.013 (0.929)	-0.011 (2.321)	0.011 (3.946)	0.041 (2.571)
3	0.036 (1.304)	0.062 (1.268) *	0.003 (0.304) **	-0.008 (2.214)	-0.049 (3.607)	0.066 (1.536) †
4	0.032 (2.161)	0.054 (3.304)	0.004 (0.982)	-0.004 (2.500)	-0.060 (5.536)	0.072 (2.375)
5	0.035 (1.964)	0.061 (1.893)	-0.007 (1.464)	-0.009 (4.071)	-0.051 (3.946)	0.080 (2.804)

Note: † $p \leq 0.1$, * $p \leq 0.05$, ** $p \leq 0.01$.

3 RESULTS

Table 3 gives the cumulative abnormal returns a day before and five days after the CS strategic response announcement. It can be seen from Table 3 that abnormal returns were positive with the announcement of strategic responses that took the stance of associative product enhancement and collaboration, and antagonistic pricing whereas the abnormal returns for the associative pricing, and the antagonistic product enhancement and new product were somewhat mixed.

For the associative product enhancement, abnormal returns on a day before and a day after the announcement were statistically significant at the level of 0.05 and 0.1 respectively. This provides support for H1a. And the results also support H1b and H1c as the abnormal returns on day 3 after the announcements of the associative collaboration and pricing were also found to be statistically significant. To illustrate the above results graphically, we use Figure 1a to provide a plot of the cumulated abnormal returns of the 11 days surrounding the announcement day 0 for each strategic response.

Figure 1a. Cumulative Abnormal Returns for Associative Strategic Responses

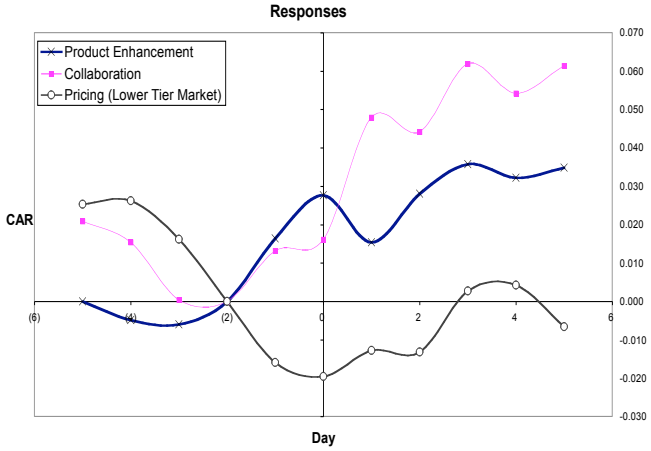
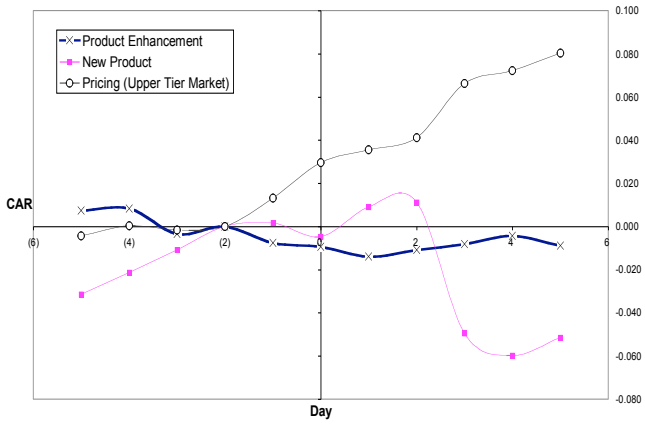


Figure 1b. Cumulative Abnormal Returns for Antagonistic Strategic Responses



The patterns of the impacts of associative product enhancement and collaboration on the market valuation displayed an upward trend, which is consistent with the view that the market's responding slowly over the event window. For the associative pricing, there was a delay in the market's reaction. To test the overall effect of associative strategic responses, we merged all the data, and then subject the data to the parametric Corrado T-Test. As shown in Table 4, the overall associative strategic responses earned significant and positive abnormal returns on day 3.

With regard to the impact of antagonistic strategic responses on the market valuation, Table 3 provides a somewhat mixed picture. For the antagonistic product enhancement, H2a was not supported as the market did not respond and the cumulative abnormal returns over the 11 days surrounding the announcement were flat (as shown in Figure 1b). For the antagonistic new product, contrary to the prediction of H2b that the market would react negatively, on day 1 after the announcement, the abnormal return was positive and moderately significant. Further inspection of the trend (as displayed in Figure 1b) suggests that the market started to adjust on day 2, and the overall trend was negative. And for the antagonistic pricing, we find partial support for H2c as the abnormal returns on day 3 after the announcement was positive and moderately significant. As for the overall effect of antagonistic responses, Table 4 indicates the market reacted negatively on day 3 after the announcement. In contrast to the associative responses, which yielded a significant increase of 1.37% of the market value, the antagonistic responses decreased the market value of the CS incumbents significantly by 2.02%.

Table 4. Average Daily Abnormal Returns (in %) and Cumulative Average Daily Returns (in %) from 1 Day before through 5 days after the Strategic Response Announcements

	Associative Strategic Response			*Antagonistic Strategic Response*		
Trading Day Relative to Strategic Response	Average Daily Abnormal Return	Corrado T-Statistic	Cumulative Average Daily Returns (in %)	Average Daily Abnormal Return	Corrado T-Statistic	Cumulative Average Daily Returns (in %)
-1	0.9	-0.63	0.9	0.17	0.86	0.17
0	0.48	-0.7	1.38	0.07	-0.13	0.24
1	1.12	-0.21	2.5	0.64	-0.79	0.88
2	0.29	-0.55	2.79	0.33	-0.92	1.21
3	1.37	**-2.59**	4.16	-2.02	**-2.09**	-0.81
4	-0.45	0.93	3.71	-0.19	0.32	-1.01
5	0.22	-0.18	3.94	0.44	0.65	-0.57

Note. Corrado T-statistic in bold is statistically significant at the 5% level.

4 DISCUSSION

As OS software and products continue to proliferate, CS incumbents increasingly must respond. Future competitive advantage and continuous success in the market rests on the ability of the CS incumbents to initiate and implement the right strategy (Markides & Charitou, 2004). To address this important research issue, we empirically investigate the influence of strategic responses on the market valuation of CS incumbents. Our results, in which stock prices serve as the market value of the CS incumbents, suggest that as a whole the stock market reacted negatively towards the antagonistic but positively towards the associative strategic responses. Among the strategic responses that led to positive and significant abnormal returns, CS incumbents that embraced OS were more likely to perform well in the stock market and successfully enter the newly emerging OS/CS markets than their counterparts that strongly opposed OS. It seems that with a neutral and benign stance towards OS, CS incumbents can easily absorb OS either by incorporating OS into their products or by entering into new business ventures and partnership with OS. Both strategies present a positive signal to the market

that newly bundled CS products with enhanced OS capabilities not only satisfying the existing consumers but also appealing across different consumer segments including those who are currently using both OS and CS, and possibly those who are strictly OS users. In general, the above results agree with the literature that technological alliances benefit firms not only in terms of cost advantage through savings in product development but also in terms of entry to the new markets (Das et al., 1998).

With the three antagonistic responses, the overall effects were negative although there were moderate significant and positive abnormal returns relating to new product and pricing. For the antagonistic product enhancement, the market did not seem to react at all. There are two plausible reasons including that the market investors failed to understand the newly released product information to an already complicated product; and that the market investors failed to appreciate the significance of the incremental changes or improvement made to the existing products (Pardue et al., 2000). For the antagonistic new products, the market reaction was somewhat mixed. The trend followed an inverted U relationship with the initial moderate significant upsurge quickly corrected by the market. A plausible explanation is that because our sample comprised only the top 13 firms in the computing and software industry, the market was likely to initially equate firm reputation to profitable products, and the quick adjustment might be due to the product reviews and the actual sales of the new product (Chaney et al., 1991). And lastly, the market seems to regard the antagonistic pricing as the most effective and aggressive way of defending market share and of retaining the existing customers within the same industry (Shankar, 1999). However, the overall negative effect indicates that the market perceived the antagonistic responses as a signal of weakness and evoked a lower investor enthusiasm than the associative responses. In effect, the deployment of antagonistic strategic responses incurred an opportunity cost on the CS incumbents as a result of the lost opportunity in reaping the potential benefits presented by OS.

4.1 Limitations and future research implications

The present study relies on secondary data for the empirical tests, and thus our investigation is limited to the variables that we could obtain. For example, the data sampling relies heavily on announcements that were prominently featured on the news; hence to increase the likelihood of media coverage, our sample is limited to the top CS companies. In so doing, this precludes many of the smaller software companies in this research. Furthermore, as the present study was situated in a high velocity environment characterized by high market and technological turbulence, the stock prices of the CS companies were likely to be subjected to a wide range of multiple confounding variables (see Appendix). Whilst there are suggestions of how to control the confounding variables statistically, the possibility of contamination is still high and may render difficulties in the analysis and subsequent interpretation (Meznar, Nigh & Kwok, 1998; McWilliams & Siegel, 1997). In choosing between contamination and limited generabilizability, we decided to discard all the contaminated announcements with the intention that future research can use the present findings as an exploratory guide to collect more data.

In formulating our present hypotheses, we assumed that the announcements of OS would have zero impacts on the CS stock prices. To test the validity of this assumption, we used the OS announcement date to gauge any changes on the CS stock prices, and no significant findings were then found. Also, we suggest that strategic responses determine the market valuation, however, it is possible that market valuation drives strategic responses. In our present sample, only one case had a follow-up announcement and yet this bore no significant impact on the abnormal return. Future research should consider this possibility in the analysis. Lastly, our inductive approach in the derivation of the strategic responses is by no means exhaustive. For example, within the study period 2001 – 2003, there was no incident whereby two CS competitors entered into collaboration and/or strategic alliances. But again with a larger sampling time frame, CS competitors might decide to collaborate as a way to destruct the OS disruptive impact (Kaufman et al., 2003).

4.2 Theoretical Implications

The two primary theoretical contributions of this research are the extension of the motivation-ability framework and the linking of the influence of strategic responses to the market valuation of the CS incumbents. First, contrary to most disruptive technologies that threatened the survival of the incumbents, the OS presents an opportunity for CS incumbents not only to diversify their product offerings but also to enable entering the newly emerging OS/CS markets. The contrast of the impact on the market valuation between the associative and the antagonistic strategic responses clearly demonstrates the significance of opportunity that the motivation-ability framework failed to address. Second, in an area when theory lags behind practice, the linking of strategic responses to shareholder wealth not only allows a direct testing of the most advanced thinking regarding the right strategic responses to disruptive technologies but also serves the basis for any further theorizing. For example, as the associative strategic responses are opportunistic and in effect, indirectly exploiting the public collective actions that successfully fuel the development of pure OS projects (von Hippel & von Krogh, 2003), the sustainability of this new OS/CS arrangement, and importantly the market valuations of both short- and long-term impact of different commercially sponsored OS projects, provide new avenues for further theorizing and empirical testing. Finally, in terms of methodology, as most of the past research relies heavily upon questionnaire design and hence suffers from common method bias; by collecting secondary data longitudinally, the present study provides useful insight in the relationship between strategic responses and the market value of the CS incumbents.

4.3 Managerial Implications

This research has shed light on two important strategic issues for managers: the value of various strategic responses to OS and their immediate impact on the market valuation of the firm. The present findings suggest that a neutral and benign strategy to OS not only ensures CS firms to gain a foothold in the newly OS/CS market but also results in a short-term gain in the market valuation. Whereas the strategic responses that oppose OS can backfire and undermine the stock market confidence despite the relentless effort and investment in product and service enhancement. It might seem that the significant abnormal returns is only a small fraction of the market value of the firms (1.37% increase and 2.02% decrease for associative and antagonistic respectively), depending on the trading volumes of the respective stocks, the respective dollar values can be millions. Against this, CS incumbents might want to adopt a thinking-outside-the-box attitude: first, by considering outside the "motivation-ability" stance by realizing the opportunity cost as the result of acceptance of a defensive strategy; second, by taking OS as an opportunity to induce states of non-equilibrium needed for organizational self-renewal and creativity; and lastly, by expanding the dynamic capabilities to develop their lateral capabilities in integrating technologies and market opportunities.

REFERENCES

Afuah, A.N., Bahram, K. 1995. The hypercube of innovation. *Research Policy*, 24: 51–76.

Bonaccorsi, A., & Rossi, C. (2003). Why open source software can succeed? *Research Policy*, 32: 1243-1258.

Bower, J. L., & Christensen, C. M. 1995. Disruptive technologies: catching the wave. *Harvard Business Review*, Jan-Feb: 43-53.

Campbell, J. C., & Wasley, C. E. 1993. Measuring security price performance using daily Nasdaq return. *Journal of Financial Economics*, 33: 73-92.

Chaney, P. K., Devinney, T. M., & Winer, R. 1991. The impact of new product introductions on the market value of firms. *Journal of Business*, 64: 573-610.

Charitou, C., & Markides, C. C. 2003. Responses to disruptive strategic innovation. *MIT Sloan Management Review*, Winter: 55-63.

Chen, M-J. 1996. Competitor analysis and interfirm rivalry: toward a theoretical integration. *Academy of Management Review*, 21: 100-134.
Christensen, C. M., & Overdorf, M. 2000. Meeting the challenges of disruptive change. *Harvard Business Review*, Mar-Apr: 67-76.
Christensen, C. M., & Raynor, M. E. 2003. *The innovator's solution: Creating and sustaining successful growth*. Boston: Harvard Business School Press.
Christensen, C. M., Suarez, F. F., & Utterback, J. M. 1998. Strategies for survival in fast-changing industries. *Management Science*, 44: 202-220.
Corrado, C. 1989. A nonparametric test for abnormal security-price performance in event studies. *Journal of Financial Economics*, 23: 385-395.
Corrado, C. J., & Zivney T. L. 1992. The specification and power of the sign test in event study hypothesis using daily stock returns. *Journal of Financial and Quantitative Analysis*, 27: 465-478.
Das, S., Sen, P., K., Sengupta, S. 1998. Impact of strategic alliances on firm valuation. *Academy of Management Journal*, 41: 27-41.
Esposto, A. G. 1998. Price, quality, and smoke signal. *Applied Economics Letters*, 5: 801 – 803.
Foley, M. 2000. Microsoft ends volume pricing for consumer Windows. CNet Article published December 15, available at: (http://news.com.com/Microsoft+ends+volume+pricing+for+consumer+Windows/2009-1001_3-250005.html) access on March 15, 2005.
Glaser, B., G., & Strauss, A. K. 1967. *The discovery of grounded theory: strategies for qualitative research*. New York: Aldine De Gruyter.
Hauser, J. R. 1988. Competitive price and positioning strategies. *Marketing Science*, 7: 76-91.
Inman, J. J., & McAlister, L. 1993. A retailer promotion policy model considering promotion signal sensitivity. *Marketing Science*, 12: 339-356.
Inman, J. J., McAlister, L., & Hoyer, W. D. 1990. Promotion signal: proxy for a price cut? *Journal Of Consumer Research*, 17: 143-148.
Kaufman, A., Tucci, C., & Brumer, M. 2003. Can creative destruction be destroyed? Military IR&D and destruction along the value-added chain. *Research Policy*, 32: 1537-1554.
Markides, C., & Charitou, C. D. 2004. Competing with dual business models: a contingency approach. *Academy of Management Executive*, 18: 22-36.
McWilliams, A., & Siegel, D. 1997. Event studies in management research: Theoretical and empirical issues. *Academy of Management Journal*, 40: 626-657.
Meznar, M. B., Nigh, D., & Kwok, C. C.Y. 1998. Announcements of withdrawal from South Africa revisited: making sense of contradictory event study findings. *Academy of Management Journal*, 41: 715-730.
Netproject's statistics on total cost of ownership from http://www.netproject.com/opensource/coo.html accessed on March 16th, 2005
Ofir, C. 2004. Reexamining latitude of price acceptability and price thresholds: predicting basic consumer reaction to price. *Journal Of Consumer Research*, 30: 612-621.
Pardue, J. H., Higgins, E., & Biggart, T. 2000. The impact of new product announcements on firm value in information technology producing industries: an examination of industry-level evolutionary eras. *The Engineering Economist*, 42: 144-157.
Scacchi, W. 2004. Free and open source development practices in the game community. *IEEE Software,* 59-66.
Shankar, V. 1999. New product introduction and incumbent response strategies: Their interrelationship and the role of multimarket contact. *Journal of Marketing Research*, 36: 327-344.
Sheshinski, E., & Weiss, Y. 1992. Staggered and synchronized price policies under inflation: the multiproduct monopoly case. *Review Of Economic Studies*, 59: 331-359.
Srivastava, R. K., Shervani, T. A., & Fahey, L. 1998. Market-based assets and shareholder value: A framework for analysis. *Journal of Marketing*, 63: 2-18.
Strauss, A. K., & Corbin, J. 1990. *Basics of qualitative research: grounded theory procedures and techniques*. Newbury Park, CA: Sage Publications.
Utterback, J.M. 1994. *Mastering the dynamics of innovation*. Boston: Harvard Business School Press.

Verma, D. P. S., & Gupta, S. S. 2004. Does higher price signal better quality? *The Journal for Decision Makers*, 29: 67-77.
Vermeer, M. 1999. Linux and ethnodiversity' from Linux today. Available at: (http://linuxtoday.com/news_story.php3?ltsn=1999-01-21-007-05-OP) access on March 15, 2005.
von Hippel, E., & von Krogh, G. 2003. The private-collective innovative model in open source software development. *Organizational Science*, 14: 209-233.
Wells, W. 2004. A beginner's guide to event studies. Journal *of* Insurance Regulation, 22: 61-70.
Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5, 171-180.

APPENDIX

Summary of the Number of Confounding Effects between 2001 and 2003

	Restructuring	Dividend/ Earnings	Acquisition	Litigation/ Labour	Executive Changes	Forecasted Changes in Earnings	Layoffs	Debt or Equity Related	Contract Awards
Adobe Systems Inc		3				3	2		
Apple Computers		5		4	1	11	1		
BEA					2				1
Borland					1	1			1
Computer Assoc				2	1	2			
Cisco Systems	1	3			3	7			
IBM	4		5	6		5	2		3
Microsoft		7		15	3		3		
Novell				3			7		
Oracle		9		7					
SCO Group				13					
RealNetworks				1	1				
Sun Microsystem		3	2	2			6		

Examples of Reactions by CS developers to OSS Announcements

OSS Announcements	Reaction by CS

2-Oct-01	Sun releases beta of StarOffice 6.0: Sun Microsystems unveiled the beta of StarOffice 6.0, a streamlined version of the company's free office software that's aimed to gain ground against Microsoft's Office	14-Jan-02	Microsoft releases new Office XP tools: MS launched new tools for linking its Office desktop software into its growing .Net Web services plan
10-May-02	OpenOffice released to 'pre-alpha' version to Mac OS: OpenOffice.org released its software in version 1.0 which includes the key desktop applications, such as a word processor, spreadsheet, presentation manager, and drawing program, with a user interface and feature set similar to other office suites	2-Jun-02	Microsoft polishes Office for Apple: MS plans to release on Monday the first significant update to the Mac OS X version of Office and will also introduce a version of its instant messaging program designed for the latest Mac operating system
7-Mar-03	Sun working on StarOffice update: Sun Microsystems next week will begin offering a trial edition of the next version of its StarOffice software	9-Mar-03	Microsoft rebrands Office for enterprises: Microsoft on Monday plans to rebrand its flagship productivity suite as "Office System," in an attempt to reposition the software as a base on which businesses can custom-build products
15-Mar-01	Linux standardisation effort goes ahead: The effort to standardize the way Linux works has moved several steps closer to reality in the last two weeks through Linux Standard Base with involvement from IBM, Intel, Oracle, Red Hat, Caldera, SuSE and others	24-Mar-01	Mac enthusiasts test drive OS X: Macintosh launches OS X and users get to try OS X
28-Mar-01	SuSE Linux announces upcoming release of SuSE Linux 7.1 PowerPC Edition	9-Apr-01	MS introduces Windows XP to 500 testers: MS announced the second test version of its Windows XP operating system and the first version that shows off the new look and feel of the software
19-Jun-01	Red Hat to play in Oracle's arena by announcing database software	26-Jun-01	Oracle software users getting more options: Oracle outlined a list of new delivery options for its hosted software Tuesday and signed partnerships to support its newly revamped strategy via Oracle.com
14-Jan-03	Mainframes get open-source database: MySQL has released a version of its software for IBM's mainframe line	17-Jan-03	Oracle polishes portal software: Oracle will release software designed to make it easier for business users to access data through a Web browser