The Impact of Alliance Formation on Firm Value in an Emerging Industry: The Case of Organic Light Electric Diode in Japan

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1. Introduction

The last decade has witnessed the replacement of tube-based televisions and monitors with flat panel display (FPD) monitors. Now the competition has shifted from tube-vs.-FPD to the different set technologies for FPDs. Major FPD technologies include liquid crystal display technology, plasma display technology and organic light electric diode (OLED) technology. This study focuses on OLED technology...
since it is still in its infancy but rapidly advancing and
has the largest market potential, as it has applications
not only in conventional monitors but also in new
products such as electric papers, which would be
unattainable with other competing technologies.

An OLED is a film made of organic compounds
and a structure that is fabricated with lithography
technology from the semiconductor industry. The idea
of the OLED was conceived in the 1960s and has been
studied since then. However, it was Ching W. Tang
and Steven Van Slyke at Eastman Kodak who made
a breakthrough in 1979, leading to the first diode
device, which was based on low-molecular polymers.
In the 1980s, Kodak launched an in-house research
and development (R&D) project to move toward
commercialization of the technology. However, the
company could not overcome technical problems and
decided not to proceed with commercialization. Tang
and Van Slyke reported their seminal work in Applied
Physics Letters in 1987. Their study was the impetus
for the current OLED R&D. Soon after the publication
of Tang and Van Slyke’s work, a research group at
Cambridge University that had been independently
pursuing development of an OLED using high-
molecular polymers published a paper about its
accomplishments, which later led to the founding
of Cambridge Display Technology (CDT), a major
developer of OLED technology (Johnstone, 2001;
Kido, 2003).

The OLED technology is a combination of a
wide range of knowledge and technologies, such as
organic chemistry, semiconductor devices, and
the semiconductor lithography manufacturing
process, which opens a window for alliances and
collaborations among firms, universities, and other
organizations. In fact, Kodak decided not to continue
the product development in-house in the mid-1980s,
but it licensed its technologies to or collaborated with
other firms, the majority of which were Japanese
firms such as Pioneer, NEC, TDK, Sanyo, and Idemitsu
Kosan Co. CDT also licensed its technologies to or
collaborated with Sumitomo Chemical and Panasonic.
Accordingly, many alliances have been formed among
firms and other organizations in the OLED industry
in the past twenty years or so, which provides a
research opportunity to examine the impact of
alliances on firm performance in an emerging
industry.

The industry has been growing rapidly. The global
OLED market was expected to grow to 109 billion yen
(1.4% share of the whole FPD industry) in 2010 from
54 billion yen in 2008 (0.56%), and it is projected to
grow to 470 billion yen (5.5%) in 2016 (New Energy
and Industrial Technology Development Organization,
2010). The industrial structure has changed during
the past 10 years. Japanese firms were major players
in the OLED industry 10 years ago, but they have
been replaced by Korean firms today. Tohoku Pioneer
had a 91% share of the 7.6 billion-yen worldwide
OLED module market in 2002, and Samsung Mobile
Display captured 92% of the 50 billion-yen market in
2007 (Fuji Chimera Research Institute, 2003, 2010).

This study applies a standard event study methodology (Inoue & Kato, 2006; Mitsui, 2009),
which uses the market response to an event as an
indicator of the impact of the event on firms and on
alliance formation in the OLED industry. Specifically,
this study examines whether alliances have an impact
on firm performance in an emerging industry and
what kinds of alliances influence firm performance,
either positively or negatively.

We found that an alliance is, all in all, a valuable
strategy in an emerging industry. The market favors
manufacturing over R&D and marketing alliances,
suggesting that the OLED industry is still in its
infancy. In contrast, the complexity level of the focal
products does not have a significant impact on the
market. Instead, the focus on manufacturing matters.
Although the market has an attitude unfavorable
to R&D in general, it shows high expectations with
potential large market such as OLED TV and lighting.

The rest of the paper is structured as follows.
Section 2 reviews the extant literature on alliances
with an emphasis on the relationship between
alliance characteristics and firm performance.
Section 3 describes the data and methodology, and
this is followed by the empirical results in Section
4. Finally, Section 5 concludes by discussing the
results and draws connections to R&D managers and
policymakers.

2. Literature Review

Today’s firms recognize that they cannot innovate
alone as technology becomes more advanced and
complex. They need to collaborate with others to
bring their technologies to the marketplace. This is
particularly true concerning the development of the
OLED, as discussed in the introduction. There exists
a voluminous literature explaining firms’ incentives to enter into alliances, which are voluntarily and independently initiated interfirm links that involves exchange, sharing, or co-development of new products and technologies (Contractor and Lorange, 1988; Gulati, 1995; Harrigan, 1986). Explanations for alliance formation include risk and/or cost sharing, gaining access to complementary resources, and learning and developing new competencies from the partners (Hagedoorn, Link, & Vonortas, 2000). Firms can enjoy these benefits in various forms of alliance while avoiding the rigidity associated with mergers and acquisitions, gaining access to resources not available in market transactions. An alliance isn’t a panacea, however. Transaction cost theory, for example, pointed out that an alliance involves costs for negotiating, monitoring, and controlling exchange transactions (Brockhoff, 1992; Williamson, 1989).

A related issue is appropriation concerns associated with knowledge specificity, which is exacerbated particularly in an R&D alliance (Gulati &Singh, 1998; Oxley, 1997). Nevertheless, many alliances are formed annually. The Strategic Alliance database from the Security Data Company (SDC), one of most commonly used in empirical studies of alliances (Schilling, 2009), recorded approximately 4,800 alliance formations worldwide in 2005 and a peak of 10,500 alliances in 2000.

This study uses the standard event study method, which has been widely used in management research, to assess the impact of alliances on firm value. The method, in short, uses financial market data to assess the impact of an event on firm value, with the assumption that rationality and efficiency exist in the market. Putting it differently, the method assumes that the effect of an event on firms is processed by the market and reflected in a firm’s stock price immediately. An abnormal stock price is inferred as reflecting the significance of the focal event. If it is higher than the trend projection, for example, the event is understood to have had a positive impact on the firm. The method has been widely applied in the alliance studies. The overall finding is a positive and significant abnormal return as summarized in Table 1.

Some researchers paid attention to the influence of the nature of alliances on firm value (Campart & Pfister, 2007; Chan et al., 1997; Das et al., 1998; Koh & Venkataraman, 1991). Their common finding was that alliances that focused on R&D and technology performed better than those that did not as summarized in Table 2. This was because the uncertainty and high costs associated with new technologies, coupled with the public-good nature of knowledge and technology, which characterize R&D and technological alliances, made them more valuable than other kinds of alliances. In addition, they had a longer horizon of benefits and were thus perceived to increase firm value more. Those studies analyzed alliances in multiple industries or the biotechnology-pharmaceutical industry, which is more mature and stable than the OLED industry.

In a mature industry, manufacturing alliances face only relatively minor technological difficulties in the product manufacturing process because they use proven and well-established technologies to avoid costly manufacturing mistakes. In an emerging

<table>
<thead>
<tr>
<th>Study</th>
<th>Alliance of interest</th>
<th>Sample period</th>
<th>Abnormal return at the event day (%)</th>
<th>Cumulative abnormal return (%)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anand &amp; Khanna (2000)</td>
<td>Multi-sector alliances</td>
<td>1990-1993</td>
<td>0.675**</td>
<td>0.866†</td>
</tr>
<tr>
<td>Brooke and Oliver (2005)</td>
<td>Technology-oriented alliances</td>
<td>1994-2001</td>
<td>0.014</td>
<td>0.016</td>
</tr>
<tr>
<td>Chan, Kensinger, Keown &amp; Martin (1997)</td>
<td>Multi-sector alliances</td>
<td>1983-1992</td>
<td>0.64***</td>
<td>0.85*</td>
</tr>
<tr>
<td>Das, Sen &amp; Sengupta (1998)</td>
<td>Information technology alliances</td>
<td>1987-1991</td>
<td>n/a</td>
<td>0.065**&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Koh &amp; Venkataraman (1991)</td>
<td>Information technology alliances</td>
<td>1972-1986</td>
<td>0.876***&lt;sup&gt;d&lt;/sup&gt;</td>
<td>n/a</td>
</tr>
<tr>
<td>McNonnell &amp; Nantel (1985)</td>
<td>Multi-sector alliances</td>
<td>1972-1979</td>
<td>0.73***&lt;sup&gt;c&lt;/sup&gt;</td>
<td>n/a</td>
</tr>
<tr>
<td>Mitsui (2009)</td>
<td>Fuel cell alliances in Japan</td>
<td>1980-2008</td>
<td>0.20</td>
<td>n/a</td>
</tr>
<tr>
<td>Neill, Pfeiffer &amp; Young-Ybarra (2001)</td>
<td>Information technology R&amp;D alliances</td>
<td>1987-1994</td>
<td>0.568**</td>
<td>n/a</td>
</tr>
</tbody>
</table>

† 3-day return around the event day.

<sup>a</sup> Our calculation from Table 2; significance level is not available.  
<sup>b</sup> Our calculation from Table 3; significance level is not available.  
<sup>c</sup> Two-day return (days -1, 0).  
<sup>d</sup> Two-day average (days -1, 0).  
<sup>e</sup> Our calculation from Table 3; significance level is not available.  
<sup>f</sup> Three-day return (days -1, 0).  

***significant at 1% level; **significant at 5% level; *significant at 10% level.
industry, in contrast, the manufacturing itself is likely to be challenging since the products are new and the manufacturing process is not yet established or standardized to a sufficient degree. Putting it differently, manufacturing alliances in an emerging industry are likely to perform like quasi-R&D alliances in mature industries. In a similar vein, R&D alliances in an emerging industry are likely to engage in research activity that is close to the basic research stage, which inherently suffers more severely from the public-good nature of knowledge and technology and is characterized by quite high uncertainties and costs (Arrow, 1962). Therefore, it is expected that the impact of alliances on firm value is most positive for manufacturing alliances and lower for R&D and marketing alliances in an emerging industry.

Industry technologies advance and become more mature as an industry grows. Products that are more complex and sophisticated are introduced in the market. Rycroft & Kash (1999) analyzed the relationship between the level of complexity of technologies and their importance in the international trade and found that many technologies becomes more complex and that complex technologies become increasingly more valuable than simple technologies. The OLED is a typical example. The first generation of OLED products was a display panel for car-audio or other applications that did not demand a color display or a wide display area, which thus required a relatively low level of technology maturation (low-complexity). As firms learned from their own R&D activities or the manufacturing process, the technology matured. More sophisticated OLED products were introduced, such as display panels for digital cameras and cell phones, which need to be high-resolution color displays (medium-complexity). The market is also larger than before. Recently, firms have introduced or plan to introduce highly sophisticated products such as OLED television or OLED lighting, and the OLED panels used will require highly complex technologies for production and wide application (high-complexity). It is thus expected that the impact of alliances on firm value is smallest for those that are working on low-complexity products. It is, however, also true that the technological uncertainties and costs are highest for high-complexity products, which would result in negative effects on firm value. Overall, impacts are not clear.

Previous studies classified high-tech and low-tech at an industry level. Researchers paid attention to the effect of the technology level of the industry in which alliances are formed on the firm value. For example, Chan et al. (1997) reported that high-tech alliances showed larger positive abnormal returns than low-tech alliances, while Brooke and Oliver (2005) reported there was little difference between them. However, not all products in a high-tech industry or alliance are really “high-tech” products. Some are “low-tech” compared to others. This is particularly likely when an industry is in its infancy and advancing rapidly. This study thus uses the complexity level (Rycroft & Kash, 1999) in its analysis to describe the trajectory of the OLED instead of the high-tech and low-tech classification. We are not aware of any studies paying attention to specific technologies or products to examine the impact of alliances on firm performance.

### Table 2 Abnormal returns by alliance type

<table>
<thead>
<tr>
<th>Study</th>
<th>Alliance firm type</th>
<th>Abnormal return at the event day (%)</th>
<th>Cumulative abnormal return (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campart &amp; Pfister (2007)</td>
<td>R&amp;D alliances n/a</td>
<td>4.20***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Production/marketing alliances n/a</td>
<td></td>
<td>2.64***</td>
</tr>
<tr>
<td>Chan, Kensinger, Keown &amp; Martin (1997)††</td>
<td>High-tech firms 1.12***</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low-tech firms 0.10</td>
<td>0.85†</td>
<td></td>
</tr>
<tr>
<td>Das, Sen &amp; Sengupta (1998)</td>
<td>Technology alliances n/a</td>
<td>1.4***††</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marketing alliances n/a</td>
<td>0.2**</td>
<td></td>
</tr>
<tr>
<td>Koh &amp; Venkataraman (1991)</td>
<td>Technology exchange 0.80***</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marketing agreements 0.01</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

† 3-day return around the event day. †† Chan et al. (1997) compared high-tech and low-tech firms in alliances.

*Our calculation from Table 3; significance level is not available. 

**Two-day return (days -1, 0).

***significant at 1% level; **significant at 5% level; *significant at 10% level.
3. Data and Methodology for Analysis

Data

We used the Nikkei TELECOM21, a major business database to collect information about the purpose and characteristics of alliances and the involved partners from the archived articles of the Nikkei Shim bun. The database covers a wide range of publicly available Japanese sources, including national and local newspapers, industry publications, general and business journals, or securities filings that occurred as far back as 30 years ago. The coverage of business- and industry-related events is thus comprehensive. We used the Nikkei Shim bun because it is the major and only newspaper with special strengths in the areas of businesses and industries in Japan. The data is not free from limitations, however. It does not include business activities consummated by Japanese firms that were not reported in a newspaper. However, the Nikkei Shim bun is still ideal for empirical analysis focusing on industries in Japan since the data are probably the richest source of information on business activities there.

We used the keyword "Yuki-EL," which is equivalent to OLED in Japanese, to identify OLED-related articles. The announcement date of the alliance was set as the event date. This search identified 126 alliances among 64 firms between 1999 and 2009. The first alliance that appeared in the data source was the collaborative research alliance between Kodak and Sankyo in 1999.

As for the financial data, event study methodology requires using the stock prices of publicly traded firms and a composite index to estimate the market normal returns. Based on the available financial data, we identified 90 events among 44 firms to be used in the analysis. Some firms enter into alliances multiple times and thus appear as different events.

Methodology

In this study, we used the standard event study methodology based on the market adjustment return model (Inoue & Kato, 2006; Mitsui, 2009) to measure the market response to alliance formation. Let \( t = 0 \) be the event date at which an alliance appears in the data source, and \( R_{it} \) is the return of firm \( i \) in the stock market at day \( t \). \( R_{it} \) is defined by

\[
R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}
\]

where \( P_{it} \) is the stock price of firm \( i \) at day \( t \). The market return, \( R_m \), at the day \( t \) is also estimated in the same manner for the market index, \( P_m \). Then the abnormal return of firm \( i \) at day \( t \), \( A_{it} \), is defined as the difference between the return of the firm \( i \) and the market return

\[
A_{it} = R_{it} - R_{mt}
\]

The abnormal returns are summed across the three-day event window \([t-1, t+1]\), which is a common practice (Inoue & Kato, 2006; Mitsui, 2009). The cumulative abnormal return, \( CA_i \), is defined by

\[
CA_i = \sum_{t=0}^{2} A_{it}
\]

The standard event study methodology assumes market efficiency and that the market quickly reflects all the available information. It also assumes that the volatility of the stock is constant on the event day, so the methodology has some limitations because these assumptions are not necessarily assured (Campbell, Lo, & McKinlay, 1997; Compart & Pfister, 2007).

We used the Nikkei225 Index as the benchmark to estimate the market returns. It is a composite index of the stock prices of the 225 most-actively-traded stocks listed in the Tokyo Stock Exchange’s First Section. The stocks included in the index are reviewed annually and replaced with new ones to capture accurate market movements and sector balance. An alternative index would be the Tokyo Stock Price Index (TOPIX), which represents the market value of all stocks listed on the Tokyo Stock Exchange’s First Section. We chose the Nikkei225 Index for the following reasons. First, a majority of firms in our sample are large and established firms in the manufacturing sectors (cf. Table 3 in Section 4), so their stocks are listed in the Tokyo Stock Exchange’s First Section. Second, TOPIX is most affected by the changes in the market value of banks and other financial firms that tend to have a high aggregate market value. We consider the Nikkei 225 to be an appropriate benchmark for this study since the abnormal return derived by this index best explains the returns attributed to the effect of an event of a relevant firm (Campbell, Lo, & Mckinley, 1997). Finally, we replaced the Nikkei225 Index with TOPIX and repeated the analysis (Section 4) to see if the analysis might be influenced by the choice of benchmark index, and we found no qualitative change in the results.3

4. Analysis

Initial Analysis

Table 3 shows the distribution of 44 firms by
industry and size that are measured by number of employees. They are all Japanese firms. Thirty-seven firms (84% of the total) are large firms with 1,000 or more employees. Four firms are small-medium firms with less than 500 employees. As for industry distribution, 39 firms (89%) belong to the manufacturing sector. Eighteen firms (41%) belong to the electronics sector, followed by machinery (8 firms, 18%) and chemical (6 firms, 14%). Most noticeably, very large electronics firms (50,000 or more employees) are prominent in the sample, suggesting that the OLED technology requires a combination of a wide range of knowledge and technologies and that firms are required to possess a wealth of resources to support R&D activities in the technology field.

Table 4 summarizes the abnormal returns regarding the alliance formation, on average, over the three-day event window around event day 0, where event day 0 corresponds to the announcement day of the alliance formation. The table reports cumulative abnormal returns as well. The abnormal return for the announcement day is not only a statistically significant 1.34%, but larger than the abnormal returns reported in previous studies (Table 1). The initial analysis implies the importance of alliances in emerging industries. Cumulative abnormal returns for the announcement and next days are also statistically significant at 1.69% and 1.94%, respectively. We reference the cumulative abnormal returns hereafter, following the customary practices in management studies.

Table 5 summarizes the cumulative abnormal returns by alliance type. The abnormal return for the manufacturing alliances is, at the highest, 4.42% and only statistically significant, which is a sign of the stock market’s expectation of large benefits in the near future. In contrast, the abnormal returns for R&D and marketing alliances are positive but small and insignificant. The reaction of the market is rather mixed.

Regression Analysis

We used the OLS regression to further examine the impacts of alliance type and technology complexity level of focal products on firm value.

We used a set of dummy variables, R&D, Manufacturing and Marketing, to assess the impact of alliance type on firm value. The dummy variable R&D was set at 1 if the purpose of the focal alliance was related to R&D activities, for example. We categorized alliances using the collected information. The dummy variables were not mutually exclusive because often alliances are intended to serve multiple purposes simultaneously. We expected that the most positive impact would be for Manufacturing, followed by R&D and Marketing.

We used another set of dummy variables, Low-complexity, Medium-complexity and High-complexity, to assess the impact of the complexity level of OLED products of interest to alliances on firm value. The dummy variable Low-complexity was set at 1 if the focal products required only a relatively low level of technological complexity, for example. Specifically, we categorized alliances as Low-complexity if their focal products did not demand color displays or a wide display area, such as display panels for car audio systems. We categorized display panels for digital cameras and cell phones as Medium-complexity, and those for television and lighting as High-complexity.
The direction of the impact of complexity level of focal products on firm value is ambiguous.

Firms’ attempts to commercialize OLED technology often involve R&D activities focused on the manufacturing of equipment. Some alliances are, in fact, interested in the equipment. To distinguish them from the rest, we also included a dummy variable, Equipment, which was set equal to 1 for such alliances.

We also included several control variables in the estimation to control for firms’ experience in alliance, firm size and growth, and their R&D efforts in the estimation. Specifically, we included the number of OLED alliances that the firms had entered prior to the focal alliance, firms’ net sales (logarithm), growth of net sales compared to the previous year, the ratio of R&D expenditures to net sales and firm industry dummy variables, respectively. The inclusion of the control variables showed no qualitative change in the results, so we do not report them in this paper.\(^5\)

Tables 6 and 7 provide descriptive statistics of the variables and the correlation matrix, respectively.

### Regression results

Table 8 presents the estimation results. In the table, Model I uses the dummy variables for alliance type. Model II uses the dummy variables for the complexity level of focal products. Model III uses the variables from Model I and Model II. We added the interaction between alliance type, R&D and the complexity level of focal products in Model IV. We also assessed the interaction between other alliance types (Manufacturing and Marketing) and the complexity level of focal products. However, we did not find any qualitative changes or significant impacts of the interaction terms in the results, so we do not report them in this paper.\(^4\)

First, the estimation results for alliance type are quite strong. All variables are statistically significant. No signs reverse across models, and the size of the coefficients remains relatively stable. Specifically, the coefficient for Manufacturing is positive, while those for R&D and Marketing are negative. These results seemingly contradict the general understanding about the impact of alliances on firm performance. One should recall, however, the case of Kodak. The company had struggled in the commercialization of the OLED technology for eight years prior to R&D project termination. The results suggest that the stock market assessed the OLED industry as being still in its infancy, and thus it shied away from uncertain R&D activities or marketing of under-matured products during the analysis period (1999-2009).

Second, the variables for the complexity level of the products in which alliances are interested are non-significant across all models with one exception, suggesting that the complexity level of focal products plays only a small role there. Instead, the expected market size seems to matter more. The coefficient for Equipment is positive across models, though not significant, suggesting that the stock market favors equipment alliances since they may result in positive spillover, regardless of the complexity level of focal products, from manufacturing of consumer products.
Table 8  Regression results

<table>
<thead>
<tr>
<th></th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alliance type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D</td>
<td>-6.539***</td>
<td>-5.567**</td>
<td>-8.254**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.077)</td>
<td>(2.328)</td>
<td>(4.118)</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>3.439*</td>
<td>4.798**</td>
<td>6.894***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.867)</td>
<td>(2.219)</td>
<td>(2.378)</td>
<td></td>
</tr>
<tr>
<td>Marketing</td>
<td>-4.210*</td>
<td>-4.543*</td>
<td>-7.669***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.226)</td>
<td>(2.300)</td>
<td>(2.476)</td>
<td></td>
</tr>
<tr>
<td>Complexity level</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-complexity</td>
<td>-1.572</td>
<td>-0.698</td>
<td>5.460</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.042)</td>
<td>(4.019)</td>
<td>(8.950)</td>
<td></td>
</tr>
<tr>
<td>Medium-complexity</td>
<td>0.745</td>
<td>-2.719</td>
<td>-7.771</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.980)</td>
<td>(3.075)</td>
<td>(5.703)</td>
<td></td>
</tr>
<tr>
<td>High-complexity</td>
<td>-0.179</td>
<td>-0.547</td>
<td>-14.061**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.285)</td>
<td>(2.332)</td>
<td>(5.893)</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>4.242</td>
<td>2.659</td>
<td>5.093</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.916)</td>
<td>(2.843)</td>
<td>(4.207)</td>
<td></td>
</tr>
</tbody>
</table>

Complexity level of R&D (Interaction term)

|                  |         |          |           |          |
| Low-complexity product R&D | -6.832   |           |           |          |
|                  | (10.374) |           |           |          |
| Medium-complexity product R&D | 4.877   |           |           |          |
|                  | (6.271)  |           |           |          |
| High-complexity product R&D | 14.554** |           |           |          |
|                  | (6.279)  |           |           |          |
| Equipment R&D    | -7.969 |           |           |          |
|                  | (5.630)  |           |           |          |

Constant               6.485*** | 1.300 | 5.647** | 8.168** |
|                       (2.078) | (1.861) | (2.498) | (3.560) |

*of observations

|                  | 90     | 90     | 90     |
| R^2              | 0.1507 | 0.0371 | 0.1792 | 0.3022 |
| F-value          | 5.09*** | 0.82  | 2.56** | 3.07*** |

***significant at 1% level; **significant at 5% level; *significant at 10% level.

An interesting result is the combination of the negative coefficient for High-complexity and the positive coefficient for the interaction between R&D and High-complexity in Model IV. We observe here the market’s second thoughts about R&D activities in highly complex products. The market expects that the outcome from alliance activities involving highly complex products could be quite large in the future, enough to counterbalance the market’s unfavorable attitude regarding R&D activities in highly complex products although the combined effects are not large enough to compensate for the market’s unfavorable attitude regarding R&D activities in general.

5. Conclusion

In this study, we aimed to evaluate how alliance type and complexity level of focal products influence the firm value in an emerging industry. We applied the standard event study method to data on alliance formation in the OLED industry in Japan for the assessment.

The cumulative abnormal returns for the alliance formation, 1.94% on average, are larger in the OLED industry than in other industries previously studied, which suggests that forming an alliance is quite a valuable strategy in an emerging industry. The values of abnormal returns are quite different across alliance types, however. The abnormal return for the manufacturing alliances is large and only statistically significant. In contrast, R&D and marketing alliances show positive but small and insignificant abnormal returns. The regression analysis also shows that the market favors manufacturing over R&D and marketing alliances. Recall that the OLED industry is an emerging and rapidly growing industry and that the industry technologies are not mature or stable yet, and the manufacturing itself is closer to R&D activities in mature industries. Manufacturing alliances therefore perform like quasi-R&D alliances in mature industries. R&D activities in the OLED industry are, in turn, closer to the basic research stage where the government, instead of firms, plays an important role. These results, therefore, confirm that the OLED is still in its infancy while they seem to contradict the findings of previous studies reporting higher abnormal returns from technology-oriented alliances at first glance. As for marketing alliances that are not technology-oriented, the regression analysis shows that their impacts on firm performance are not only smaller than those of manufacturing alliances, but they are negative. Das et al. (1998) found negative impacts of marketing alliances with event study analysis and argued that marketing alliances are, in general, formed when products enter the mature or declining phase of their life cycle. A firm’s entry into such alliances would be bad news for the market. In the case of the OLED industry, the marketing alliance could be perceived as a signal of unsuccessful R&D activities halfway to the realization of higher-complexity products that involve higher uncertainty and costs but also potentially large gains.

The regression analysis also shows that the complexity level of focal products has little impact on the market. However, when we introduced the interaction between R&D and the complexity level into the analysis, an interesting outcome emerged. The market’s expectation for R&D alliances involving highly complex products is large enough
to counterbalance the market's unfavorable attitude regarding R&D activities related to highly complex products, which suggests that the market has high expectations regarding the introduction of revolutionary products (i.e., OLED television and lighting). However, the combined effects are not large enough to compensate for the market's unfavorable attitude regarding R&D activities in general, perhaps for the reasons we have discussed in this section.

The findings provide important managerial implications. It is now widely recognized that forming an alliance is an effective business strategy. This study not only confirms that alliances are important in emerging industries but also goes a step further. An alliance is not a panacea. R&D managers need to scrutinize the use of alliance formation as a strategy. It is a preferable strategy for product manufacturing in emerging industries, which is close to R&D activities in mature industries. Firms can gain the access to complementary resources, learning and developing new competencies from the partners, and risk and/or cost sharing through alliances, among which the aspects of access, learning, and developing are particularly important for industries like the OLED since it requires a wide range of knowledge and technologies, each of which is likely to be possessed by different firms. This also implies that the firms need to experiment with several combinations of partners (i.e., technologies) to find an optimal configuration. An alliance can facilitate this process. On the other hand, managers need to carefully assess the costs and benefits associated with alliances in R&D projects or marketing in emerging industries, since there might be cases when the costs, including those associated with a negative signal perceived by investors, outweigh the benefits.

There are some limitations in this study. We used a time scale between 1999 and 2009, which is short, especially for an industry, like the OLED, which is still in its infancy. The industry should be revisited in the future for reexamination. Another limitation concerns the sample population. This study's interest is Japanese firms in the OLED industry since they are major players in early years worldwide. The industry structure has changed quickly in recent years, however. Korean firms and those from other countries have been gaining a greater presence. More studies are necessary to examine the industry in the global context in the future.

This study contributes to the extant literature by adding empirical evidence concerning the effectiveness of alliance formation as a corporate strategy. It also expands the scope of the existing studies to emerging industry and reveals a more detailed picture of the trajectory of a particular technology. More studies should be encouraged to validate the results of this study concerning alliances in other industries in various stages of technology development and/or market contexts.

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Notes

1. There exists a large body of literature on or using event study method, such as Campbell, Lo, & McKinlay (1997) or McWilliams & Siegel (1997).
2. Brooke & Oliver (2005) classified high-tech and low-tech at an alliance level. They classified an alliance as high-tech if it is an R&D alliance.
3. They are available from the corresponding author upon request.
4. Ibid.
5. Ibid.

References

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