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An Analysis of Events in Online Game Industry and Stock Price Reactions

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Abstract
The online game industry is an emerging entertainment software industry. It is successful and fast growing. Prior studies have identified characteristics of this industry that are distinctive from traditional entertainment industries. Currently one of the most important business challenges this industry faces is securing investments for development or evaluation of development projects. An online game development project requires large-scale investments during production and initial marketing stage. The reason for this challenge lies in difficulties in forecasting future market success of online games. Hence, capital market is desperately seeking good signals of quality of projects. We maintain that stock price reaction is one of signals generated by market evaluation. We analyze the relationship between events that occurred in the development process, such as the game content rating information or public announcements, and stock market prices of the online game companies. We examine the information of 10 online game companies that are listed on Korean stock markets between the periods of 2002 to 2009. In this study we adopt event study methodology, which is widely used in finance and MIS literature. Our results show positive and significant correlation between the game rating events and stock price reaction. We show the existence of direct network externalities, positive stock price reaction of casual games, and companies that have development organizations or adopt vertical integration model are preferred in the market. Finally we suggest implications that may improve the value of the online game industry.

Keywords: Online Game, Event Study, Entertainment Industry, Information Goods
1 INTRODUCTION

1.1 Online games

Over 2/3 American households play computer and video games, and 23% of them play online games. Six of the top 10 best-selling computer games in 2008 were online games. The computer game market revenue surpassed the movie box office revenue in 2001 (Beinisch et al. 2005) and the recorded music market revenue in 2007 (Long 2007). Online games are often simply divided into the following two groups by the industry: Massively Multiplayer Online Games (MMOGs) or casual games (Elverdam and Aarseth 2007). MMOGs are defined as games of which a large number of players simultaneously interact with each other in a given virtual world while casual games are the relative complement set of MMOGs. Another report predicts that by 2013 consumers of Europe and North America will spend US $2 billion on subscription based MMOGs. Both markets were worth US $1.4 billion in 2008. Despite the recession in 2008, MMOGs subscription numbers still showed a significant growth in 2008. The online game market of China will reach $8.9 billion by 2013 from $2.75 billion in 2008 and players of online games were expected to reach 64.9 million in 2009 (Graft 2009). The boom of online games is happening everywhere in the world. Figure 1 shows that online games were expected to have the fastest growth in the world game industry. Only the online game segment was expected to grow more than 20 percent during 2007-2008. The other game industry segments showed a negative growth in 2010 (Ministry of Culture 2009).

Figure 1 Computer based game market segments (1999 – 2008) (OECD 2005)

Online games exploit the connectivity of the Internet, which appears to trigger rapid growth of the online game industry (Beinisch et al. 2005). There are also other factors that boost its growth. The online game industry is technology-intensive as well as the traditional video game industry (Aoyama

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2 ScreenDigest "There's life beyond World of Warcraft. Online gamers will spend $2bn on MMOG subscriptions by 2013," in: Screen Digest, Screen Digest, 2009.
and Izushi 2003) and it depends on complementary technologies such as micro payments, broadband diffusions, and popularization of PCs (Wi 2002; Adomavicius et al. 2006). In the early stages of online games in the 2000s, studies were conducted to determine which factors were dominant in the growth of online games (Wi 2002; Aruede et al. 2006). These studies concluded that the growth of complementary industries and inactive substitute markets are dominant factors in the abovementioned growth. Many prior studies focused on design factors (Nam 2008; Zagal and Nussbaum 2000; Whang and Chang 2004; Choi and Kim 2004; Lee 2000), on the online game players (Griffiths, Davies, and Chappell 2003; Choi and Kim 2004), and on the possibility of the use of online games as teaching tools (Wong et al. 2007). Other studies focused on the virtual society and economics in them (Lo, Wang, and Fang 2005; MacInnes 2005).

Online games have several different features from traditional video games. First, the lifecycle of online games is longer compared to traditional video games and Hollywood blockbuster movies. Traditional video games normally sell about 80 percent of their total sales volume in the initial release period, which may last from one week to two months. However, online games need a certain time to financially take-off and have usually a long lifecycle (Choi et al. 2007). For instance, Lineage and Lineage 2, the successful online games developed and serviced by NCSoft, are still in service, and have been running for more than 13 years and 8 years by now. Traditional video game users are limited in sharing their experience by indirect network method such as words of mouths. Online games however have their own virtual society and economic platforms. So they can provide a direct participation experience in social life and economic transactions through active actions of the players (Jung and Lee 2007; Hemp 2006). Traditional video games and online games have a similar cost structure: they require high fixed costs during the development process; but low or almost zero variable costs to serve additional clients after the development is done.

Despite such differences online games and traditional video games also share some similar aspects. Traditional video games and online games are both experience goods, which means it is not easy to judge their value before use (Reinstein and Snyder 2005). The characteristics of experience goods make it difficult for managers and investors of game industries to allocate resources such as money, staffs. However, to the best of our knowledge, the aspects of marketing and financing problems for online games did not studied enough and few research was done with market or real online game data. We try to fill such void in this study.

The approach of marketing and financing a brand new online game industry will be different than that of the traditional video game industry or other entertainment or media industries given uniqueness of the product. The primary objective of this study is to investigate information spillovers to the stock market during the product development cycle, a subject which has not been studied yet. These information spillovers will be a good starting point to reveal marketing and financing issues of online games. The information spillover of an uncharted developing product could be a signal to investors and people who are interested in this product. By analyzing the information spillovers, the market may accordingly change the present value of undergoing products. So the related matters of information spillovers of online games (i.e. when they happen, what is included, which steps are important, or which steps are voluntary or forced by law) may be critical to managers, marketers, and investors of online game industry.

An online game development is a process that requires large amounts of financial resources. Compared to other software development projects it is also very time consuming. According to statistics the average development period for a typical online game is 21.9 months and an average of 21.3 persons are required to finish it (Ministry of Culture 2009). During this long course of development, various information spillover events take place and the market reacts to them.

The impact of market reaction could have two positive implications to game producers. It may not only help the producer in securing financial resources but may also be used as a device to measure the success of the marketing campaign if such reactions turn out to be positively correlated with future success of the game. Hence, our primary concern is to determine which kind of activities (or information) during the development cycle actually do have any impact on the stock market.

We adopt event study methods to discover reactions of stock markets during the online game development process. This methodology is widely adopted in finance (Fama 1965; MacKinlay 1997; McWilliams and Siegel 1997) and MIS studies (Koh and Venkatraman 1991; Filson 2004; Im, Dow, and Grover 2001; Subramani and Walden 2001).

This paper is organized as follows: the ensuing section proposes hypotheses derived from analysis of features of online games and its industry structure. Section 3 explains data and research methodology. In the next section, we provide results of empirical testing. In the last section, conclusions are provided with limitations of the current study, and further research directions.

2 LITERATURE REVIEW AND HYPOTHESES

From prior literature, we identify unique features and industry structure that are believed to impact on stock price reactions when signals are made by online game business.

2.1 Online Game Characteristics

Network Effects of Games

Usually an MMOG consists of two key components: a seamless vast virtual world and a large number of multiple users. The virtual world evolves on a real time basis through interactions of the users. Massive user connectivity, interactivity, and a continuing virtual world make it difficult to technically implement a MMOG game and require vast amounts of investment for development. On the contrary a conventional casual game creates disposable virtual spaces and a number of 2~32 clients participate in the game that is hosted in such spaces. At the end of a game session these virtual space are removed, and results of the game are saved in the central databases.

Many studies revealed that video games have indirect network externalities (Shankar and Bayus 2003; Clements and Ohashi 2005; Corts and Lederman 2009). Meagher and Teo (2005) modeled the existence of network externality in multi playable online games (MPOGs) using a two-part tariffs model. The model in this study is consistent with observed examples of online games pricing strategies. Traditional video games are based on their dedicated platform, and their strategies contribute to the survival of indirect network externalities by increasing third parties to produce games for their platforms. But most online games do not have dedicated platforms. Online games generally make use of a personal computer and the Internet broadband. Choi and Kim (2004) show that not only personal interactions, but also social interactions help players to empirically reach flow. Steinkueler and Williams (2006) said that “by providing spaces for social interaction and relationships … MMOs have the capacity to function as one form of a new ‘third place’ for informal sociability”. Many people anticipate relationships when they choose to play an online game. A user will have more utility when she/he selects an online game in which more players are participating. This feature may generate direct network effects: as more people participate in a game, a player will be bestowed with more utility.

The Game Rating Board of Korea examines game contents, and rates it with one of the following 4 rates: “Everyone”, “Everyone 12+”, “Everyone 15+”, and “Adults only”. “Everyone” can be played by every user, including “Everyone 12+”, “Everyone 15+”, and “Adults only” potential clients. But “Adults only” grade games are only playable by users who have the age of 18 or are older. The difference of potential players between “Everyone” and “Adults only” grade reduces the pool of

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6 In the Meagher and Teo (2005), the authors used the term MPOGs as online games including MMOGs and casual games.
Potential clients from 100% to 67.8% (Ministry of Culture 2009). “Adults only” online games contain generally prohibited activities in this world such as violent action, sexuality, blood, drug use; these contents may prevent potential clients to purchase the product, if they do not personally prefer some of these contents. Hence, positive network externality in online game suggests that direct network externality induces online games to gain more potential customers. This acquirement eventually leads to a higher stock price reaction.

H1: More potential players promote a higher stock price reaction

**Longer Life Expectancy of Online Games**

Lineage and Lineage 2, popular online games developed by NCSoft, have been run over 13 and 8 years respectively. “Crazy Arcade” developed by Nexon is also enjoying a long life of 10 years. Many online games enjoy a longer lifespan than video games. It is well known that traditional video games follow the box office revenue models of Hollywood “blockbusters”: 80% of the total revenues are made in the initial month, after which revenues quickly decline on a weekly basis (Corts and Lederman 2009). But online game revenues on the other hand increase over the time: routine and urgent updates make its life time longer. The major reason why online games usually have longer lifecycles is that they receive routine updates. A routine update generally adds new contents to the existing game. Major updates are usually applied one or two times a year, which adds whole new story portions, tweak existing game systems, and eventually enhance the gaming experience. Minor updates are mostly done every week or every month, which may add holiday events, minor story additions, and bug fixes. Figure 2 shows the expected life time for general MMOGs, casual games, and video games (Choi et al. 2007). Choi et al. (2007) pointed out the updates are the most significant feature of online games to sustain based on their own interview and survey data.

![Figure 2: Life time for games (Choi et al. 2007)](image)

So reacting to players’ demands and to solve unintended situations such as bugs or system abuse is not only crucial to succeed of an online game but also to sustaining a long life time of the game (Meagher and Teo 2005). According to aforementioned logic, we can expect that a company with game maintenance capability produces higher market reactions in the online game industry than a company without it.

H2: A company which has game maintenance and development capability can expect higher market reactions than a company without it.
Experience Goods

Many MMOGs offer trial opportunities for players. Casual games use more aggressive strategies: they offer basic game functions for free and charge for optional game items such as beautiful hats, pets, or functional items: for example, strengthening their avatar for 5 minutes. If many games operate for free, subscription based payments acts as an entry barrier for players. A game which does not charge for access is attractive (Oh and Ryu 2007). Traditional video games, including online games, are typical experience goods (Hui, Yoo, and Tam 2008). Gaining information about quality of experience goods differs from getting information about price of experience goods, and the latter is easy and low cost to obtain. It is also expected that the variance in the quality of the experience a user gets to be greater than the variance in the utility of price (Nelson 1970).

Usually casual games have much simpler structures and logics than MMOGs. The simplicity of casual games makes it much easier for users to discover their values in fewer sampling trials. So we can assume the following hypothesis:

H3: Introduction of casual games will have larger impacts on stock prices than MMOGs.

2.2. Business models in the online game industry

In the beginning of the online game industry, the late 1990s in South Korea, many companies were “dis-intermediated” by digital delivery services. With the rapid growth of the online game industry some “dis-intermediated” companies acted as contents aggregators, and they offered game portals as a function of retail and distribution. Game portals acted as “re-intermediation” (Beinisch et al. 2005).

After “re-intermediation” happened in the online game industry, a new type of portal site or game portal appeared. In the first stage of “re-intermediation”, game portals developed and served their own games. Some portals served by independent publishers did not develop their own games. They searched games that were developed by small independent developers, who did not have enough capital to fully develop and publish a game by themselves. This new type of game portal behaved like a traditional video game publisher. Video game publishers have to pay advertise and distribution fees, but an independent publisher in online game industry doesn’t need to pay high advertise and distribution fees. This type of publishers utilizes independent online game developers, and contracts with them to serve online games. The difference between a traditional video game publisher and an independent online game publisher lies in the operation. Traditional video games do not require knowledge of the technical side of the game in case of selling it. But an online game publisher has to know the whole structure and features of the game both in the technical and content aspect.

A traditional video game developer does not demand that the publisher knows the game’s internal implementation features and adopted technology. They just expect good marketing campaigns and timely selling strategies from its publisher. However unlike the video game developer-publisher relationship, the relationships of online game publisher and online game developer is a much deeper one, and requires more frequent cooperative activities and knowledge of each other from both parties in order to have success with their game. An independent developers’ behavior also resembles that of a traditional video game developer. But online game developers need to teach their game’s technical parts and contents to publishers. They also have to provide updates when bugs are reported and old contents need some overhaul in order to grab existing users.

We call the “dis-intermediated” type as a vertical integration model in this study. These companies appeared in the beginning era of online game industry. These companies have development organizations and service operation departments. They develop their own games and distribute and serve their games by themselves. It is platform providers that are similar to vertically integrated companies in the video game industry such as Sony, Microsoft, and Nintendo. But they are based on a different concept. In the traditional video game market, platform providers differentiate themselves by
incompatible hardware systems and some exclusive killer titles—such as “Super Mario”—which was only playable on Nintendo platforms. Platform providers focus on gathering competent independent developers which do not own a platform. Because “software licensing fees are the primary source of revenue for platform providers” of the video game industry (Clements and Ohashi 2005), platform providers prefer to gather more third-parties. Online game companies adopt vertical integration in order to operate their own games by themselves and to earn money directly through the service of these online games.

Figure 3 provides a classification of the companies in the online game industry divided accordingly by propensity of development and publish. Channeler acquires only a small portion of their revenue from the online game business; hence we exclude Channeler from our analysis.

<table>
<thead>
<tr>
<th>Strong - Publishing - Weak</th>
<th>Weak - Development - Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>CJInternet</td>
<td>NHN, Neowiz, nexon</td>
</tr>
<tr>
<td>YedangOnline</td>
<td>Vertical Integration model</td>
</tr>
<tr>
<td>Independent publisher</td>
<td>(Publishing &amp; development)</td>
</tr>
<tr>
<td>(Publishing only)</td>
<td>Hanbit</td>
</tr>
<tr>
<td>Yahoo! Korea</td>
<td>YNK Korea, Actoz, Webzen</td>
</tr>
<tr>
<td>(Channeler)</td>
<td>Independent developer</td>
</tr>
<tr>
<td>BUGS</td>
<td>(Development only)</td>
</tr>
</tbody>
</table>

Figure 3 Business Models in Online Game Industry

Many online game projects are high risk projects with high returns. From this point of view, online games can be viewed the same way as high risk R&D projects (Brennan and Trigeorgis 1999). Online game companies may stop their projects if they predict that it will not yield the initially targeted profits. The publisher, developer, and vertical integrated model have differences in real options when projected outcome is uncertain.

A company of vertical integrated model can enjoy various real options: they may either stop the project, simply delay it, or may acquire a company which develops an online game or is able to develop new projects for their line-up. But for an independent publisher it is not easy to delay a project or develop a new one. Similarly, an independent developer has the options to stop, delay its projects or develop a new one, but the actions are limited by contracts with a publisher. And they do not have the options of acquiring new projects that are under development or developed by others. Independent publishers cannot take actions without help from the developer’s side regarding problems such as bugs or unexpected events. Many online game publishers started without online game development teams, so they did not have sufficient experiences handling unexpected technical problems occurred when the early online games were served to general users.

So it is understandable that companies which adopt a vertically integrated model receive higher trust from the market.

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7 A third-party developer is a developer not directly tied to the primary product that a consumer is using. The primary product may be hardware or software. [http://en.wikipedia.org/wiki/Video_game_development_party#Third-party_developer](http://en.wikipedia.org/wiki/Video_game_development_party#Third-party_developer)
H4: The adopters of the vertical integration model show higher returns than independent publishers and independent developers.

3 DATA AND METHODS

3.1 Production process of online games

Figure 4 depicts the online game production processes.

![Diagram of online game production processes]

Figure 4 Production processes of a typical online game

In the first stage a company plans a new game. With the prototype of developed game, it is required for a developer to apply for a game rating before it can be released to the market (mandatory in Korea). The game rating progress in Korea is the first official promise of a market release. The Game Rating Board examines the game contents, and decides a rate out of the 4 levels. After receiving a rating, a company schedules beta tests before commercialization. Usually a closed beta test is conducted first within a short span and selected test personnel. The purpose of a closed beta test is to weed out critical bugs that may cause serious problems to the game play experience. Following open beta tests are usually available to wider range of users. The purpose of open beta tests is more on marketing than on finding technical issues nowadays. Originally beta tests were performed so that developers may test stability issues and find and fix errors, but today they are widely used as a marketing tool. After a sufficient number of beta tests have been run, the company commercializes the online game with appropriate pricing policies and peripheral services such as contracts with content delivery network (CDN) service provider, online support systems with game masters, and offline and phone consulting systems. We focused on three steps of the game development process, game rating, beta tests, and commercialization to show up our hypotheses.

3.2 Data

Our data set is limited to online games in Korea. While this may restrict generalizability of the results, the history of the Korean online game industry is the longest in the world, and the Korean online game industry itself is still a leading global market. We found that there are 12 companies listed on the Korean stock market; one company, NCSoft is listed on KSE, the others on KOSDAQ which is corresponding to NASDAQ in the United States including NHN, CJInternet, HanbitSoft, YNK Korea, Webzen, Yedang online, Softmax, ActozSoft, Neowiz (Neowiz Games), GameHI, and JC Entertainment. We selected companies which had a portion of more than 50% of online game business in their portfolios.

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8 It is mandatory to get a rating to release in Korea, optional to get a rating to release in the US market. But many well-known games get ratings voluntarily because it serves more information to customers, especially parents who purchase the games.
9 Korean Stock Exchange, this market maintains KOSPI and its derivatives.
10 Recently CJ merge internet business related subsidiaries including CJInternet as CJ E&M. We use CJInternet instead of CJ E&M in this study because the merging is done recently, 2011/3/1, but our data did not include 2011 data. We use data from 2000 to 2008 in this study.
We gathered disclosures from the website of the Korean Financial Supervisory Service for all 12 companies and collected public announcements by each company from the Yonhap news’ website, the largest news agency in Korea. We retrieve game rating information from the site of Korean Game Rating Board. In order to calculate normal returns we dropped GameHI and JCEntertainment due to their short spans. So we used 10 companies’ data for the test. We exclude financial events such as paid-in capital increase, dividend announcement, or change of big stock holders using company’s disclosures.

Public announcements contain broad information such as: announcement of a new online game development, announcements of close beta tests and open beta tests, commercialization schedules, promotions of upkeep and new online games, and update notices of upkeep games. A company distributes public announcements to the press and broadcasting companies. We chose Yonhap News Company as a source of public announcements because they have the most comprehensive database of most news and other printed information. This database provides all public announcements from January 2004 to May 2009. We supplemented them from the company’s own site and other press databases.

The Game Rating Board11 is a regulatory agency granting rates for computer game publications. The Game Industry Promotional Act enacted in 2006 prevents from publishing a game without a rating. The Game Rating Board demands expressions and substances of sustaining coherence to retain a rating. If the expressions or the substances of a game are changed without prior notice, the board has the authority to suspend any further commercial service. We acquired game rating information from board website. All of game rating information of our target companies is available from that of year 200012. Some companies published games for various platforms. For this study we only included data regarding online games. As of 2008, there were a total of 4426 cases requesting a game rating. 3375 cases (76.25%) received an “Everyone” grade and 749 cases (16.92%) were granted an “Adults only” grade. The “Everyone 12+” and “Everyone 15+” grades only took up very small portions of the total cases, just 184 (4.15%) and 118 (2.67%) respectively. Due to their small portions we did our tests only with the “Everyone” and “Adults only” cases.

<table>
<thead>
<tr>
<th>Company</th>
<th>Disclosure13</th>
<th>Public Announcements14</th>
<th>Game Rating15</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHN</td>
<td>581</td>
<td>61 (114)</td>
<td>58 (126)</td>
</tr>
<tr>
<td>NCSoft</td>
<td>689</td>
<td>54 (82)</td>
<td>46 (52)</td>
</tr>
<tr>
<td>CJInternet</td>
<td>788</td>
<td>36 (125)</td>
<td>45 (69)</td>
</tr>
<tr>
<td>HanbitSoft</td>
<td>415</td>
<td>70 (158)</td>
<td>9 (74)</td>
</tr>
<tr>
<td>YedangOnline</td>
<td>802</td>
<td>27 (28)</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Webzen</td>
<td>514</td>
<td>18 (20)</td>
<td>13 (23)</td>
</tr>
<tr>
<td>Neowiz</td>
<td>648</td>
<td>73 (194)</td>
<td>52 (68)</td>
</tr>
<tr>
<td>YNKKorea</td>
<td>614</td>
<td>34 (42)</td>
<td>19 (40)</td>
</tr>
<tr>
<td>ActozSoft</td>
<td>456</td>
<td>25 (31)</td>
<td>15 (17)</td>
</tr>
<tr>
<td>Softmax</td>
<td>400</td>
<td>2 (7)</td>
<td>0 (19)</td>
</tr>
<tr>
<td>Total</td>
<td>5907</td>
<td>400 (801)</td>
<td>260 (491)</td>
</tr>
</tbody>
</table>

Table 1 The Numbers of Events from Three Information Sources

11 Game Rating Board of Korea is similar organization to the ESRB, Entertainment Software Rating Board. But the GRB of Korea is a government organization based on Act.
12 NCSoft was listed in KOSDAQ first, but NCSoft relisted in KSE, May 2003. We analyzed NCSoft data after is was relisted in KSE. Some companies get ratings through their subsidiaries. We treat it as equal to the mother company doing it themselves.
13 Disclosures are gathered from 1/1/2000 to 5/20/2009 in http://dart.fss.or.kr
14 Public announcements are gathered from 1/1/2004 to 5/20/2009, from the Yonhap News internet service
15 Game rating information is gathered from 1/1/2000 to 5/20/2009, from the Game Rating Board internet service.
The numbers of announcements used in empirical tests from three sources are summarized in Table 1. The numbers within parenthesis stand for initially collected events. After the data gathering, we deleted invalid events that lacked sufficient event spans of at least 3 days (event day +/- 1 day).

### 3.3 Method

Many studies used event study methodology for extracting the reactions between events and stock price changes. Event study was first adopted in the finance sectors (MacKinlay 1997; McWilliams and Siegel 1997). MIS studies also used event study methodologies to research the impacts of IT companies’ strategies on market value of the companies. Koh and Venkatraman (1991) used event study for assessing joint venture formations in the internet technology sector. This paper concluded that joint ventures made positive abnormal returns at 0.87% for two consecutive days (t = -1, and t=0) and that they are significantly different from 0 at p < .01. Subramani and Walden (2001) showed e-commerce initiatives indeed leading to significant positive CARs (cumulative abnormal returns) for companies’ shareholders. In this study, the authors reported positive and significant CARs, 7.5% for the 5-day event windows and 16.2% for the 10-day event windows. Im, Dow, and Grover (2001) evaluated the effectiveness of Information Technology (IT) investments by the event study methodology. They found the size effect existed. Due to more predisclosure information from the larger firm, the impact of IT investments might be diluted, but impact of small company announcements have positive and significant average standardized cumulative abnormal returns.

Filson (2004) adopted event study to test various events that occurred every day on Amazon.com and its competitors. This research told us that service improvement with/without alliances and acquisitions had the largest impact figures, 1.25% and 1.09% respectively, but Amazon.com’s competitors showed minus or no significant results.

In this study, we adopted the traditional event study that was used in McWilliams and Siegel (1997) and Im et al. (2001). It is a standard residual analysis technique based on market model. We set event day as t = 0 which is shown in public announcements or game ratings information. Trading day prior to event day is numbered as minus, t = -1, t = -2, and trading day after event day set as plus, t = +1, t = +2. We estimated daily market model parameters for each event using 150 day returns from t = -200 to t = -51. Many MIS and financial papers generally use 200 day returns. To lessen the lack of sample problems in this study, we used 150 days returns instead of 200 days of returns. In Subramani and Walden (2001) also used an estimation period of 120 days. They reported that “the results using an estimation period of 45 days and 270 days to compute CARs are very similar” in their research.

Regression (1) is used to estimate the coefficients of the daily market model. \( R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{i,t} \)

Rit is the common stock return of company i on day t calculated by (2), and Rmt is the market return on day t calculated by (3). Because the common stock return, Rit, and the market return, Rmt, are evaluated as the difference of each price respectively, we do not put the control variables in the regression (1). Two parameters, \( \alpha_i \) and \( \beta_i \), are ordinary least squares estimators, and \( \epsilon_{i,t} \) is the market model error.

\[
R_{it} = \frac{price_{i,t} - price_{i,t-1}}{price_{i,t-1}} \quad \quad \quad \quad \quad \quad R_{mt} = \frac{price_{m,t} - price_{m,t-1}}{price_{m,t-1}}
\]

In this study, we calculated abnormal returns from the difference between the expected return of market returns at time t and individual company i’s returns at time t that is calculated in (4). The standard errors are calculated by the formula defined by Im et al. (2001) in the Appendix B.
We used the cumulative abnormal return (CAR) values for specified window sizes that contain event
days. We used (6) to calculate the cumulative abnormal return (CAR) for various window sizes. \( \tau \) and
\( \tau' \) can be different if the window size is not symmetric. Under the assumption that the returns on each
day are independent, the standard error of the cumulative return is the sum of the standard errors
(Subramani and Walden 2001).

\[
CAR_{i,t} = \sum_{i=-\tau}^{\tau} AR_{i,t} \quad \text{(6)}
\]

\[
\text{var}(CAR_{i,t}) = \sum_{j=-\tau}^{\tau} \text{var}(AR_{i,t}) \quad \text{(7)}
\]

As this study is the first trial event study about the online game industry, a field where this method has
never been applied, we tried several window sizes: \( t=\pm 1 \), \( t=\pm 3 \), \( t=\pm 5 \), \( t=\pm 10 \), and \( t=\pm 10 \) to determine which one would be appropriate. We tested asymmetric windows because of the
issue of information leakage. If any information is leaked, asymmetric windows should show higher
returns than other windows. We tested 6 window sizes and finally adopted 3 windows sizes in order to
achieve bigger cumulative abnormal returns than other returns. The adopted sizes are: \( t=\pm 3 \), \( t=\pm 5 \)
and \( t=\pm 5 \). An asymmetric window was accepted, but we did not find anything regarding
information leakage. CAR values of the asymmetric window were not superior compared to normal
windows. Finally, we employed a conventional t-test for the significance test with average
standardized cumulative abnormal return (ASCAR) and its variance.

\[
\overline{CAR}_i = \frac{1}{N} \sum_{i=1}^{N} CAR_{i,t} \quad \text{(8)}
\]

\[
\text{var}(\overline{CAR}_i) = \frac{1}{N^2} \sum_{i=1}^{N} \text{var}(CAR_{i,t}) \quad \text{(9)}
\]

\[
l = \frac{\overline{CAR}_i}{\sqrt{\text{var}(\overline{CAR}_i)}} \sim t_{(a, df \approx N-1)} \quad \text{(10)}
\]

We took stock market index and daily stock price information of our subject companies from
Fnguide.com16. We utilized a rectified stock price of each company provided by this web site. As we
assumed 150 days as the daily market model estimation time, two subject companies did not achieve
these criteria and we could not analyze them17. Neowiz announced in 2007 they would divide their
online game business division into Neowiz Games. But Neowiz kept governing Neowiz Games even
after Neowiz Games was listed as a separate company. So we only analyzed Neowiz data and
excluded Neowiz Games from our analysis with the purpose of avoiding duplication and maintaining
stock price consistency.

4 RESULTS

Table 2 presents average cumulative abnormal return (ACAR) values of our estimated three different
window sizes associated with online game development and publishing events. The numbers inside the
parenthesis represent p-values respectively. We display the level of p-values as asterisks next to the
parenthesis: a value that is p < 0.10 represents cross(††), values that are p < 0.05 are represented with
one asterisk, and values that fall under p < 0.01 are depicted as two.

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17 JCEntertainment and GameHi do not have any available events to analyze.
Regarding our overall observations, we conclude that game rating events have significant meanings. In the case of game rating event, ACARs shows positive and significant values for all window sizes. Public announcements on the other hand are negative and significant. An important premise of this research is that generally stock price reactions to game rating events will show significantly different values than zero. The information from a game rating event is regarded as a signal of the possibility that the product will be introduced into the market and also includes an outline of the game.

Many investors and managers inferred that each beta test and the final commercialization of a product would raise the company’s value: this assumption does not fit with our results. Usually plenty of media reports already deliver related information to the market before beta tests are conducted or the product is commercialized. We guess that this sufficient media coverage leaks related information about new games and as an effect reduces the abnormal return on the actual event days. These events can be interpreted as earning shocks if the real earning of a firm in the annual report is less or same to the expectation of the earning. All information is already leaked and the information is realized as a price of the stock.

(*: p < 0.10, **: p < 0.05, ***: p < 0.01)

<table>
<thead>
<tr>
<th>Event Classification</th>
<th>Window Size (in days)</th>
<th>-3 ~ +3</th>
<th>-5 ~ +1</th>
<th>-5 ~ +5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock Price Reactions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Game Rating</td>
<td></td>
<td>.0013(1.59)</td>
<td>.0019(1.65)</td>
<td>.0020(2.39)***</td>
</tr>
<tr>
<td>Public Announcement</td>
<td></td>
<td>.0001(0.11)</td>
<td>-.0004(0.37)</td>
<td>-.0010(1.27) .</td>
</tr>
<tr>
<td>Reactions to Game Rating by Age Grades</td>
<td>Everyone</td>
<td>.0031(2.79)***</td>
<td>.0047(3.05)***</td>
<td>.0040(3.67)***</td>
</tr>
<tr>
<td></td>
<td>Adults Only</td>
<td>-.0011(0.84)</td>
<td>-.0021(1.10)</td>
<td>-.0005(0.34) .</td>
</tr>
<tr>
<td>Reactions to Game Rating by Category</td>
<td>MMOGs</td>
<td>.0012(0.86) .</td>
<td>.0015(0.80) .</td>
<td>.0016(1.19)</td>
</tr>
<tr>
<td></td>
<td>Casual game</td>
<td>.0011(1.06) .</td>
<td>.0020(1.43)***</td>
<td>.0025(2.31)***</td>
</tr>
<tr>
<td>Reactions to Game Rating by Business Structure</td>
<td>Vertical Integration</td>
<td>.0013(1.34)</td>
<td>.0010(0.68)</td>
<td>.0025(2.45)***</td>
</tr>
<tr>
<td></td>
<td>Independent Developer</td>
<td>.0026(1.01)</td>
<td>.0047(1.70)***</td>
<td>.0033(1.56)</td>
</tr>
<tr>
<td></td>
<td>Independent Publisher</td>
<td>.0000(0.00)</td>
<td>.0006(0.31)</td>
<td>-.0011(0.80)</td>
</tr>
<tr>
<td>Reactions to Public Announcements by Business Structure</td>
<td>Vertical Integration</td>
<td>.0017(1.57)</td>
<td>.0002(0.20)</td>
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<td></td>
<td>Independent Developer</td>
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<td>-.0043(0.22)</td>
<td>-.0015(1.05)</td>
</tr>
<tr>
<td></td>
<td>Independent Publisher</td>
<td>-.0021(1.27)</td>
<td>-.0037(1.20)</td>
<td>-.0038(1.54)</td>
</tr>
</tbody>
</table>

Table 2  Stock price reaction to online game events

Game rating events were tested according to the rating grade the game has received. The results are summarized in Table 2. It was found that all ACARs of “Everyone” rates are positive and show significant values for all event window sizes. We guess this result mainly stems from the existence of direct network externality. The smaller potential customer size of the “Adults only” grade is one of the main reasons. Another reason is the diversity of preferences of adult users. Many people develop their own tastes while growing up. So many “Everyone” grade online games have similar appearance as they have the same large pool of potential users; whereas “Adults only” rated online games mostly contain different contents. This leads to the result that “Adults only” rated games only have a small number of potential users that would play the game and we considered hypothesis 1 as accepted. This result can be interpreted as a sign that as direct network externality exists in online games.

To test hypothesis 3 by stock price reactions to game ratings that are classified according to categories, we received the following expected result: stock price reactions to game ratings of casual games are positive and show significant values. So we can accept hypothesis 3. As opposed to the results of casual games, stock price reactions to game ratings of MMOGs do not show significantly different values from zero or less than the stock price reaction of casual games. Due to its simple game structure and contents, relatively small file sizes that make them easy to download and install, casual games can usually gather more attention in a given short time compared to MMOGs. It is reasonable to assume that many investors are also able to make proper decisions within a shorter time about casual games compared to cases of MMOGs.
The result of stock price reactions to game rating by business structure and stock price reactions to public announcements by business structure in Table 2 shows business structural influence on the market. We can see that companies with development capability show positive and significant impacts on stock price reactions to game rating by business structure in Table 2. We can accept hypothesis 2 by this analysis. All companies that have developmental organizations show positive returns. Because of the important technological aspects of the industry, development power is considered as an important factor in the online game industry. The reason that independent developers are seeing higher stock price reaction than vertical integration models lies in the timing of capitalization: independent developers can capitalize some part of the expected total earnings by licensing the product to the publisher, but companies which adopted the vertical integration model have to pay additional costs for beta tests, marketing campaigns, and commercial distribution. Generally vertically integrated companies are able to capitalize larger amounts of financial resources for a game than other company models, but the realization of such a capitalization takes more time than companies which adopted the independent developer model.

The aggregated stock price reactions to public announcements are all negative in Table 2. But analyzing public announcements by splitting them according to business models, it can be seen that vertically integrated companies show significant and positive results at t = -3 ~ +3. On the contrary, companies which adopted independent developer and independent publisher models show significant and negative results at t = -3 ~ +3, t = -5 ~ +5 and at t = -5 ~ +1, t = -5 ~ +5 respectively. These results fit with our prediction of hypothesis 4. It means that vertically integrated companies which have their development, maintenance, and publishing organizations are trusted by the market. They accumulate knowledge from their internal development projects, service operations, and publishing activities. With this knowledge and real options, they can shorten the project development period or suspend their projects according to market situations.

Independent publishers have little room to change their online game publishing schedule compared to vertically integrated companies. They are bounded to accumulate knowledge from the development process and cannot enjoy synergies when operating and development is all done within the company. There are not enough opportunities to learn state-of-the-art technologies that are used in new online games. The lack of opportunities to learn and the limited access to the source of knowledge prevents independent publishers from learning new knowhow to operate online games efficiently and effectively. They may be restricted by contracts, or by situations of partners they contracted with. Online games are a mixture of state-of-the-art technology and trends; the ability to figure out what technology is used in the market and the ability to predict new trends is important. The change of trends does not come easy; ability to shorten the development period or to intentionally delay a project is a very important factor. However the controlling schedule is not an easy one for companies within a contract-based relationship. For similar reasons as the independent publisher model as well as public announcements made by publishers, independent developers show negative values in the public announcement analysis.

5 CONCLUSIONS

With the growth of the game industries, all participants including the online game industry, managers, investors and policy makers, have a vested interest in finding ways to evaluate successful games. So far many studies have investigated only in traditional video games because they have a larger market share in the developed countries.

By analyzing publicly searchable data such as game rating information, public announcements, and disclosures of online game companies, we have identified not only online game characteristics but also...
the online game industry structure that is favorable to market reactions. We argue that these may have strategic implications to online game makers and policy makers.

We derived the following results. First, it is likely for online games to have direct network externalities generated by interactions within a virtual world network. Its managerial implication is that game companies pay more attention to boost network externalities through social interactions in the game to ensure their success in the online game industry. Prior studies (Choi et al. 2007) also confirmed that successful online games usually had sophisticated player communities and participation systems. In the circumstance of existing indirect network externality, game companies have two options: to be on the supply side or to be on the demand side. Direct network externality emphasizes the importance of being on the demand side.

Sustaining development ability (or technological competence) is an important factor. Online games are complex goods: they are technology-intensive, but the contents are also important (Choi et al. 2007). Continuous technological innovation and maintenance with technological competence make differences. Hence, the independent publisher and independent developer model may be seriously disadvantageous in this industry rather than in the traditional video game industry.

Casual games, which are simpler than MMOGs, generate stronger market reaction in the short term due to ease of quality evaluation, possibly the shorter payback cycle of investment and a smaller capital requirement for development, all of which lead to lower risk.

Companies which adopt a vertical integration model are preferred in the market. The downtime of World of Warcraft in China was due to a change-over in the Chinese game operation license regulation. This was an inevitable incident to Activision-Blizzard (Alexander 2009). It is obvious to the market that a company that has more options to avoid risk is preferred over companies that do not have such options.

There are several limitations in this study. Lee, Cho, and Lee (2002) showed that KOSDAQ (usually market for new technical start-ups) has a higher cumulative abnormal return than KSE (the market for mature businesses) This result is consistent with the size effect of Im et al. (2001). Since only one company is listed on KSE, we were not able to test difference between two markets.

We studied only stock price reaction. Linking market responses to actual game success may be an interesting topic to be explored further. That may test the efficiency of financial markets in assessing online games’ success in the market. We pooled casual games and MMOGs in this study. However, as mentioned before, MMOGs have longer lifespan. Therefore, MMOGs may require studies over longer time.

While our study is limited to online games, expansion to other entertainment genres may shed more lights on similarities and dissimilarities of online game industry against traditional entertainment markets.
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