Growth and Competition Dynamics of Online Game Market in Taiwan

Weiyang Wang

National Kaohsiung University of Applied Sciences

Department of Information Management

wyang@cc.kuas.edu.tw

Yatsai Tseng

Tunghai University

Department of Business Administration

yttseng@thu.edu.tw

Abstract

In recent years, Taiwan government has offered incentives and supportive policies such as tax reduction with a hope to foster the development of domestic online game industry. However, domestically developed online games are failed to dominate the online game market. Over seventy percents of the market share is occupied by foreign games, especially those from Korea. In this paper, a system dynamics model is built to explore the growth and competition dynamics of the online game market. The model shows that multiple reinforcing feedback loops and limited market size together led to the rapid but temporal market growth. The market reached its limit so quickly that Taiwan's domestic game developers lost the opportunity to grow because of unavoidable time delays in R&D capacity expansion and game development and commercialization process. The online game case shows that market growth and R&D expansion that contrast sharply in lead times could cause tough barriers that are far beyond late entrants' abilities to conquer, even governmental support might hardly be useful.

Keywords: online game, market growth, system dynamics, competition

1. Introduction

As broadband penetration becomes more widespread, various kinds of digital services are attracting more public attentions and continue their expansion into both established and emerging entertainment markets. Online game exactly is a representative of the newly emerging Internet-based industry that started within this decade (Meagher and Teo 2005; Lee, et al. 2004; Zhu and Wang 2005; Cheng, Kao, and Lin 2004). Though originated from personal computer games (PC games), online games have developed more complex and interesting arenas for players from different locations to interact, compete, and collaborate. Online games are also named massive multi-player online role playing games (MMORPG) or massive multi-player online games (MMOG). The cyber society and environment created by a popular online game may carry even up to hundreds thousands game players.

Taiwan's online game market began in year 1998 and generated high market revenue of NT $ 480 millions in year 2000. The rapidly developed online game market outgrew traditional PC games within 3~4 years and has been dominated Taiwan's digital game market in recent years. Figures 1-1 through Figure 1-5 summarize the development of Taiwan's online game market. From these figures, we noticed some interesting characteristics of the market. Firstly, the market experienced a rapid but short growth in less than ten year. As shown in Figure 1-1, Figure 1-2, and Figure 1-3, market revenue, the number of agents who sell and issue game into the market, and the amount of games be issued and played in the market grew rapidly from year 1999 to year 2003. Afterwards, the market growth slowed down and began to stagnate. Secondly, in spite of the fast growing market, Taiwan's domestic online industry did not benefit from the market growth as much as foreign game developers. From Figure 1-5, it shows that domestic online games only counted for twenty to thirty percents of total amount of games in the market. Even today, Taiwan's online game market is still dominated by games from abroad, especially games from Korean. Although Taiwan government has attempted to inspire domestic online game industry, both the number of game developers in Taiwan (as shown in Figure 1-4) and the market share of Taiwan's domestic games could not follow the same rapid pace as the market itself.

Based on the aforementioned observation, this paper adopts a systemic perspective (Maruyama 1963; Masuch 1985; Forrester 1994a; Senge 1990; Weick 1979) to explore how interlocked decisions and actions by different industrial sectors contribute to the growth dynamics of online game market in Taiwan. A system dynamics model, comprising of R&D activities, agents, and game players, etc., is built to explore essential mechanisms underlying the market growth dynamics. With a series of simulation experiments, it is found that multiple positive feedbacks loops, delayed R&D capacity investment and expansion, product development lead time, competitions between Taiwan domestic games and games from abroad, and a limited online game market together led to a rapid but stagnated growth of the online game market. The online game case shows that market growth and R&D expansion that contrast sharply in lead times could cause tough barriers that are far beyond late entrants' abilities to conquer, even governmental support might hardly be useful. Accordingly, some discussions and suggestions about government policies to online game industry are detailed later in this paper.
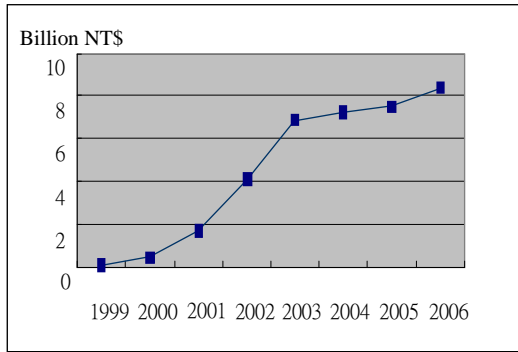
Fig. 1-1 Yearly revenue in online game market
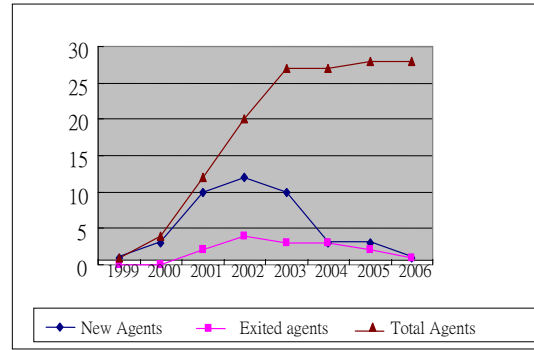

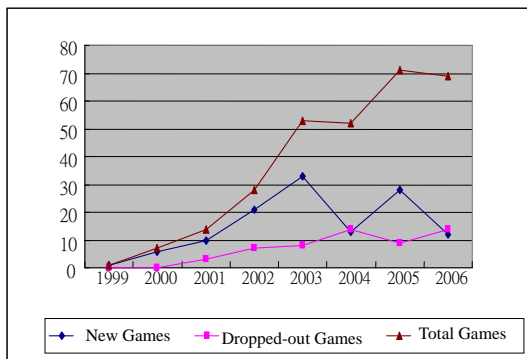Fig.1-2 Changes of online game agents
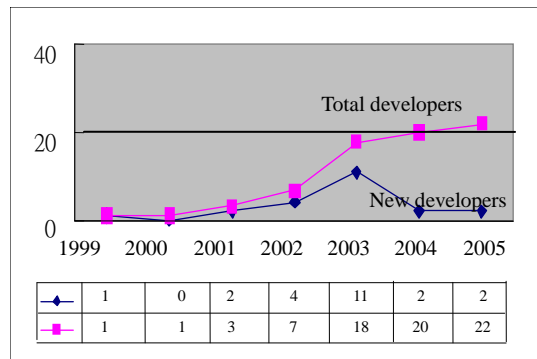

Fig. 1-3 Game Issued in the market
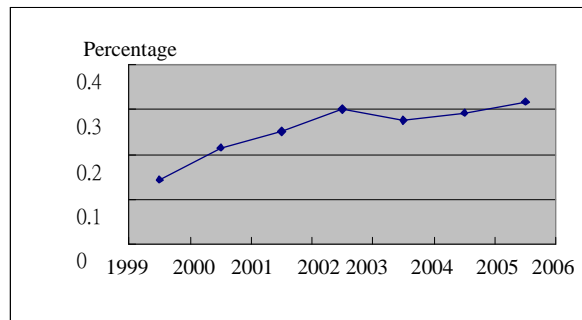

Fig. 1-4 Changes of game developers

Fig. 1-5 Percentage of Domestic games in the market

2. Literature review

Most online game related research focuses on topics as online player's behavior analysis (Charlton and Danforth, 2007; Choi and Kim, 2004; Hsu and Lu, 2004; Lee, et al., 2004; Whang, 2003; Kim, et al., 2002), pricing and marketing (MacInnes and Hu, 2007; Meagher and Teo, 2005); diffusion model (Zhu and Wang, 2005; Cheng, et al., 2004), supply chain management and partnership, etc. Existing research helps the buildup of basic knowledge of online game market, however, how an online game market and industry develops and changes over time still lacks for a more systemic and clear exploration.

Another thread of research about virtual network and characteristics (Shapiro and Varian 1999; Katz and Shapiro, 1985; Arthur, 1989, 1994; Sterman, 2000; Sterman, et al., 2007) also helps to understand the development of online game market. For example, network externality that describes how a product or service's increasing value is resulted from the increase of customers or the usage of the

product or services is also observed in online game market. According to Katz and Shapiro (1994), Sterman (2000), and Sterman, et al. (2007), network externality phenomenon may lead to lock-in effect and path dependence and further result in a landslide victory of a specific product or services. To exploit the advantage brought by network externality, firms are suggested to adopt strategies as low pricing, alliance, or capacity expansion to get big fast so that they can be the winners who take all (Spence, 1981; Shapiro and Varian, 1999; Fudenberg and Tirole, 1983; 2000; Park and Van Alstyne, 2005).

In online game market, network externality resides in both the overall market's rapid growth and the competition between games. To people at a specific range of ages, they talk and discuss about online games. Playing online game has become a subculture among its players. The more people play online games, the stronger the subculture is and the more tightened their relationships are. As a result, online game market as a whole has a higher attractiveness to potential players and existing players. Similarly, in the level of game competitions, the more players gather in a specific game, the more interactions, collaborations, and competition among people occur, in turn attracting more players to join. Network externality often enlarges the gap between popular games and unpopular games. Popular games may freeze out unpopular games and lock players in their own networks.

In addition to the property of network externality, online game market is also characterized by low switching cost, temporary lock-in effect, and localized market. As to switching cost, problems as compatibility and industrial standards are not critical in online game market. Hence, agents who issue games and paid players all have a high degree of freedom to switch between different games (Katz and Shapiro, 1985; Farrell and Saloner, 1986; Economides, 1996; Shapiro and Varian, 1999). Low switching cost for game players also implies that the aforementioned lock-in effect may be temporary if newly introduced games grasp game players' attention. Averagely short product life that lasts about 1~2 years is observed in the online game market. Besides, different from the image of the "flat world" and boundless market about Internet-based services and products, online game market is actually restricted to local game players. Cultural and language differences are critical barriers for game players in Taiwan to join foreign arenas. Similarly, there are few game players in other countries, regardless of the country is Asian or Western one, will join games in Taiwan.

The aforementioned characteristics seem to be related to some interesting market development patterns that are shown in Figure 1-1 to 1-5. For example, as shown in Figure 1-2 and Figure 1-4, instead of being dominated by a few products that is suggested by network externality, the rapid growing market is accompanied by consistently increasing number of games. Besides, rather than being overwhelmed by the stronger foreign games, the market consistently keeps a space for domestic games. Altogether, how the market changes over time can not be explained simply by the concept of network externality. Hence, in the following sections, a system dynamics model is built and discussed to explore how the online game market and industry develops and changes over time.

3. Model building and validation

In modeling the growth and competition dynamics of online game market, we

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collected data from both interviews and industry reports by government and private research institutes, annual financial reports, news, academic publications. We held on nineteen interviews with interviewees from four major firms in the online game market. Interviewees were selected to cover a great variety of working background, including marketing, game R&D, channel management, and top management as CEOs. Each interview lasted about half an hour to one hour. Supplementary questions and discussions were carried by phone or via Internet phone-Skype or questionnaires by emails. Data collection focused mainly on concrete industry numbers, i.e., market revenues or the amount of games in the market, decisions and actions by major market participants, i.e., human resource management, game development process, etc., and general industry structure and consumer behaviors.

Based on Graham (1980) and Hamilton (1980), parameters and equations were estimated and modeled in four major ways: (1) concrete data acquired was directly used for modeling, such as the amounts of games, agents, and game developers; (2) concrete data was used to calculate and derive required information, for instance, data about broadband household and game player characteristics is used to derive the number of game players; (3) interview data and concrete report data were examined and combined to estimate the value of parameters, i.e., average agency fee; (4) representative interviewee's response were used to estimate common industry practice, such as agents' willing to issue new games. The simulation software Vensim was used for model building and simulation. Time patterns of six variables that embraced critical aspects of online game market were chosen to be historical and reference patterns for modeling and validation, including market revenue, the amount of domestic games, the number of agents, and the number of domestic game developers, and the amount of high-ranked or popular games that account for about 75% of market revenues. While our reference patterns were spanned from January, 1998 to December, 2006, we set the simulation time to be 178 months that started from January, 1998 and extended to December, 2014 for a more complete discussion about policy redesign.

As to model validation, we first examined and ensured the consistency between simulation results with historical reference patterns. From Figure 3-1 through Figure 3-6, it shows the model indeed has the capability to reproduce the reference patterns. In addition to behavior reproduction test, a series of validation tests including steady state test, extreme value test, and parameter sensitivity test were also conducted to ensure the model's robustness in representing online game market's growth and competition (Forrester and Senge 1980; Sterman 2000; Homer 1983). The model structure and findings were presented to top management of each interviewee firm to check if any major model calibrations and revisions were required. After necessary model revisions and corrections, the model was ensured to pass both the internal and external validation. The final version of the model is detailed and discussed in following sections.
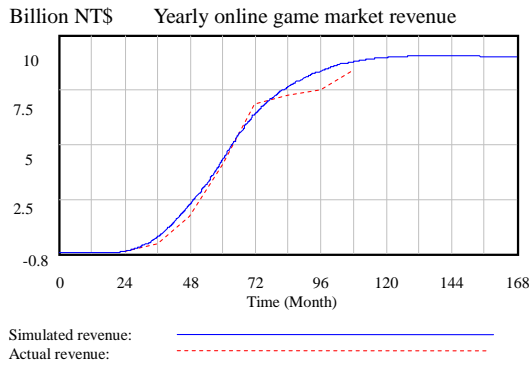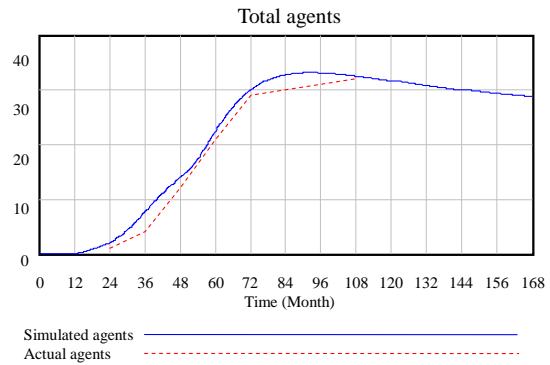
Billion NT$ Yearly online game market revenue

Fig. 3-1 Simulated market revenue

Total agents

Fig. 3-2 Simulated online game agents
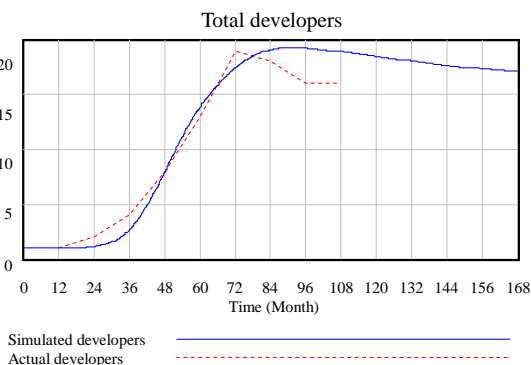
Total developers

Fig. 3-3 Simulated game developers

Total games
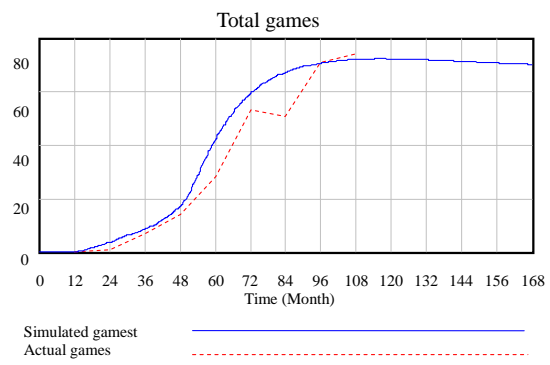
Fig. 3-4 Simulated total issued games
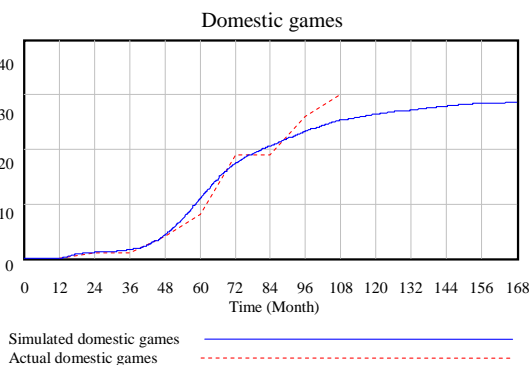
Domestic games

Fig. 3-5 Simulated total domestic games
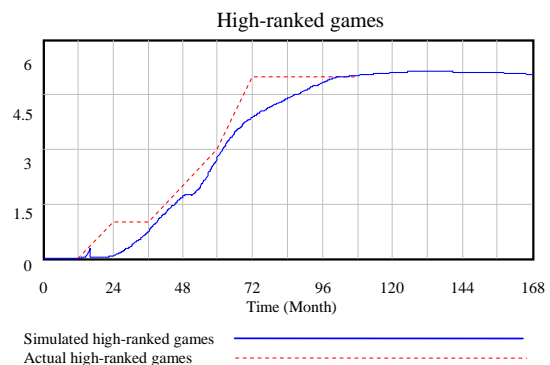
High-ranked games

Fig. 3-6 Simulated high-ranked games

4. A system dynamics model of market dynamics of online games

4.1. Model overview

A model overview of the growth and competition in online game market is shown in Figure 4. The model comprises of four sectors: the Agents Sector, Market Sector, Games Sector and Game Developers Sector. Complex interactions interlock the four sectors. For example, the amount of total games in the Games Sector increases when more agents in the Agents Sector attempt to introduce new games to the market; the amount of games to be introduced to the market is influenced by R&D capacity in the Game Developers sector. Since each sector is characterized by a main stakeholder or object, such as agents in the Agents Sector and game players in the Market Sector, major stakeholder or object in the online game market is briefed as follows to offer a basic knowledge of the online game market. Afterwards, the growth and competition mechanisms in the online game market are discussed separately first

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to build up understanding of how the market works. A deeper discussion in Section 5 then demonstrates why the market growth is of a short period of time and why domestic game growth is limited. To stress on the feedback structure and the dynamics essence of the market growth, causal loop diagrams instead of the quantitative simulation model are used for following discussions.
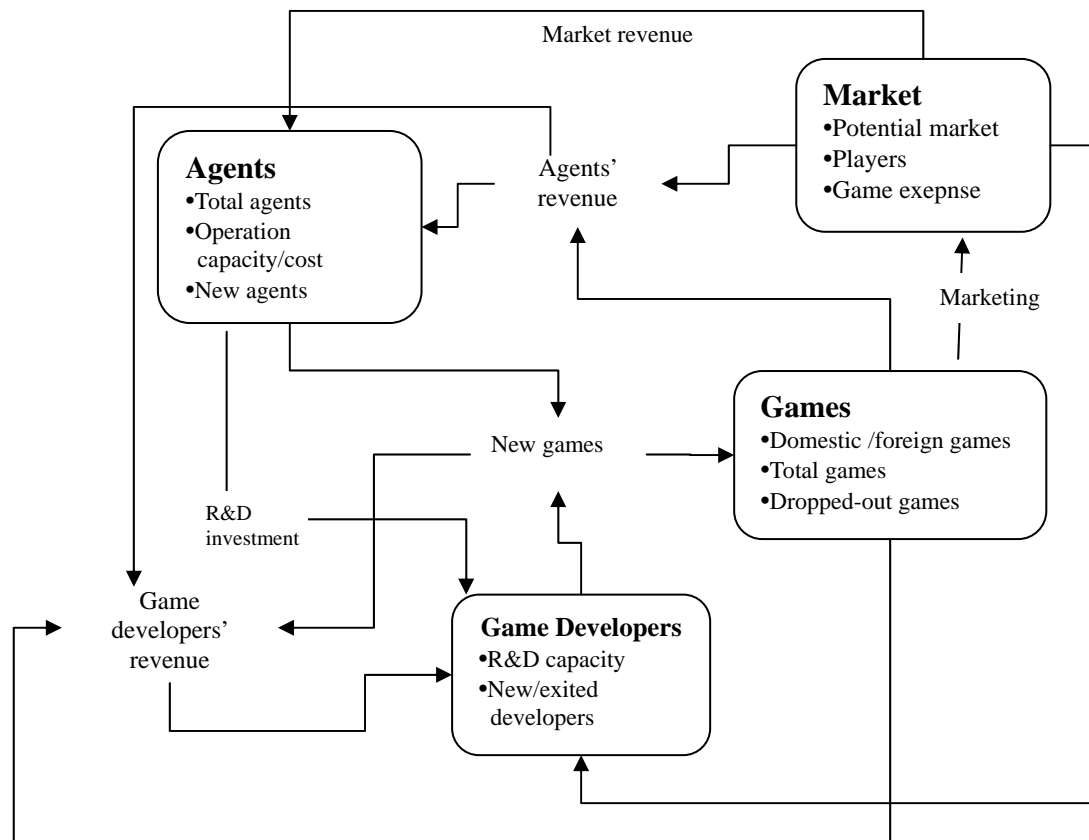

Fig. 4 Model overview

Game developers

Game developers are domestic software firms that devote to game development, investigation of new game platforms, and new software tools learning. Game developers receive two kinds of fees from agents who issue and publicize games: agency fees and authorization fees. While the former is paid for acquiring the right to sell/operate a game, the latter is paid for sharing agent's profit to game developers whenever a new paid player join the game. In normal conditions, it takes two years for an R&D team of twenty-five to thirty staffs to complete a game development project. But the actual R&D lead time is greatly influenced by the R&D team's experience. When Taiwan's online game market began in year 1998, some traditional PC game developers turned to online games but only few could produce high-quality games attract market attention. The totally different core techniques between online game and PC game development and the much greater scope of online game R&D projects than PC game were major barriers. Not good enough domestic games in early times often caused agents to look for more mature foreign games. The up-rising revenues of foreign games in the market attracted more game developers and original PC game developers to join the industry, in spite of prior failures. In addition, profitable agents also aggressively invested in R&D investment, seeking to vertically integrate the

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industry supply chain.

Agents

Agents' major jobs are marketing and managing the platforms and servers of online games. Agent plays a mediate role between game developers and game players. They pay to game developers to acquire games and charge fees for game playing from players. In the market development process, the number of agents obviously grew much faster than game developers, as shown in Figure 1-2 and Figure 1-4. High expectation of market revenue and low entry barriers to market were two major causes of the rapid growth. In confrontation of not enough qualified and interesting domestic online games, agents sought for games from abroad, especially Korean games with styles that were highly accepted by players. As more and more agents proposed their request on foreign games, foreign game developers raised their agent fees to a higher and higher amount, leading to agents' investment in developing their own games for vertical supply chain integration. Presently, most large game agents in Taiwan are involved in game development.

Game players

According to a Taiwan government-funded research report, every one from three Internet users plays online games. Besides, according to research reports, over 85% of online game players are students and white collar workers. Among the total online game players, younger players at ages under twenty years old constitute about two-fifths of the market. Players at ages under thirty-years old make up almost about eighty percents of the total market. According to interviews and some reports and research (Zhu and Wang, 2005; Cheng, et al., 2004), online game players influence their peer group to a great extent, especially to those younger players. The words-of-mouths of popular games often spread out quite quickly.

Games

In spite of a great number of games are available in the market, only twenty-five percents of online games are highly popular and profitable. These popular games can attract over seventy-five percents of online game players. Hence, if an agent owns a popular game, he tends to lengthen the life time of the game by upgrading or offering new-versions. The average life time of a popular game lasts about one to two year. Unpopular games are short-lived and may be quitted within two or three months.

4.2. Growth and competition in the online game market

4.2.1. Engines that drove online game market to grow

Several positive feedback loops are found to constitute the growth engine underlying the growth of online game market. The growth engine lies mainly in the fast growing number of players, agents, and games which are interlocked together to contribute the growth of market as a whole. How the market is driven to grow is discussed with the demonstration of simplified causal loop diagrams as follows.

The fast growth of game players and agents

There were two forces that drove the rapidly increasing number of online game players. One was the totally different experience of online game in compared to traditional PC games and the other was the network externality effect. The intensive interactions and virtual society in cyber space connected people together.

Word-of-mouth quickly spread out and attracted people to join online games. The more people joined the cyber space of online games, the more interesting and attractive the game networks were, in turn more people were attracted to play. The positive feedback loop on the right side of the top of Figure 4 illustrates the reinforcing mechanism that drove the growth of game players.
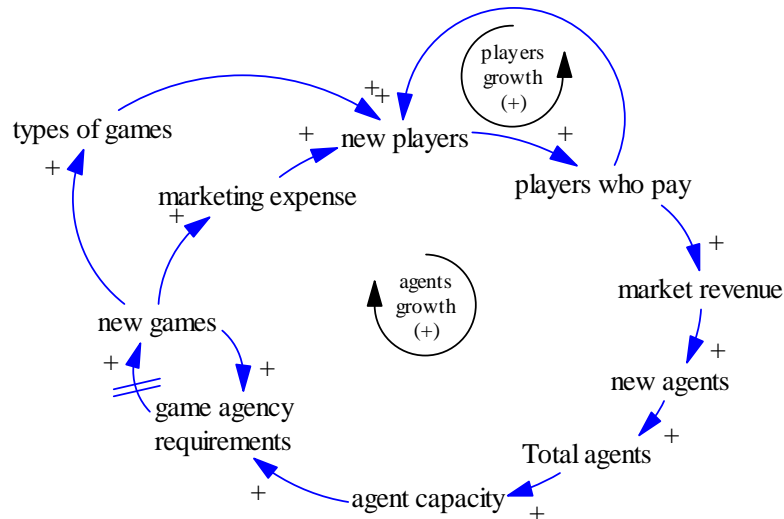

Fig. 4 Growth momentums of agents and players

Accompanied with the growing number of players was fast rising market revenue. Agents were attracted to the market and attempted to introduce more games with their expanded agent capacity. Notify that the expanded agent capacity stood not only more games agents could handle but also the greater agency requirements to achieve financial balance. Consequently, more and more new games were introduced to the market. A closer look of the growth pattern of total agents and the growing number of games in Figure 3-2 and Figure 3-4, respectively, one can observe a steeper slop of the growth of games than the growing number of agents. The delayed growth was resulted from the necessary time for agents to look for appropriate game products and negotiate with original game providers. To compete with the sharply increasing new games, agents not only searched for various kinds of games but invested a large amount of money in marketing to attract game players. More players were attracted to the market by fancy marketing information and by the great variety of different types of sharply increasing new games. As a result, the demand side of the market, the number of game players and the supply side, the amount of agents and the number of agents, all grew and expanded quickly in short time.

Popular games: winner-takes-all

While the online game market as a whole grew fast, network externality effect among games was getting stronger and impacted on the distribution of profit to popular and unpopular games. As described in the Literature review Section, the more players join a specific game, the more interactions, collaborations, and competition occur, in turn more players are attracted to join the game network. When rapidly expanded agent capacity brought lots of games and players into the market, the player base that popular games could attract was enlarged. Network externality of popular games made popular games more attractive and gathered game players in popular

games' networks. From our collected data, we found that the portion of games that could account for seventy-five percents of market revenue got smaller and smaller as the market grew, implying the greater the attractiveness of popular games had and the more incompetent of low-ranked games in attracting players to their networks. In Figure 5, it shows that when players were attracted to high-ranked games, low-rank games with few revenues were forced to exit the market. Dropped-out games further triggered agents' game agency requirements to look for new games, bringing more and more new games into the market and further strengthening the two network externality feedback loops shown in Figure 5. Though popular games would be replaced by some unknown new games someday, the revenue gap and competition existing among popular games and unpopular games remained underway.
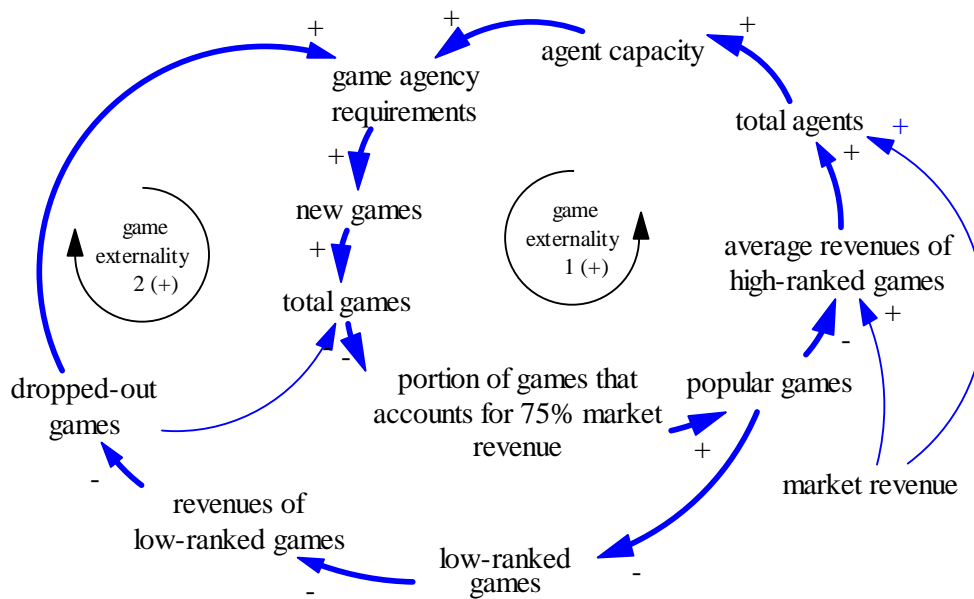

Fig. 5 Growth of popular games

Competition between domestic games and games from abroad

Domestic games and games from abroad competed with each other to be selected by agents. In order to seize on market opportunity, each agent attempted to fully utilize their agency capacity, resulting in high game agency requirement. In addition, agents with dropped-out games also looked for new games to re-enter the market. All these rising game agency requirements should be satisfied by game supplies from domestic and foreign games, as illustrated by the two balancing loops shown in Figure 6. Principally, agents would choose a game based on the amount of agency fee they had to pay, the quality of design, the topic or story, and the maintenance cost. However, when encountering a shortage of game supply, games of "good enough" quality would be chosen as long as they were available. Agent's attitude toward games led to their turning to foreign games because the late development of online game in Taiwan could not offer games that were as good and attractive to satisfy market demand. Domestic games were failed in attracting agents and competing in the market. Only when average agency fee that was charged by foreign game developers got too high, would some agents turn to domestic games as their choice.
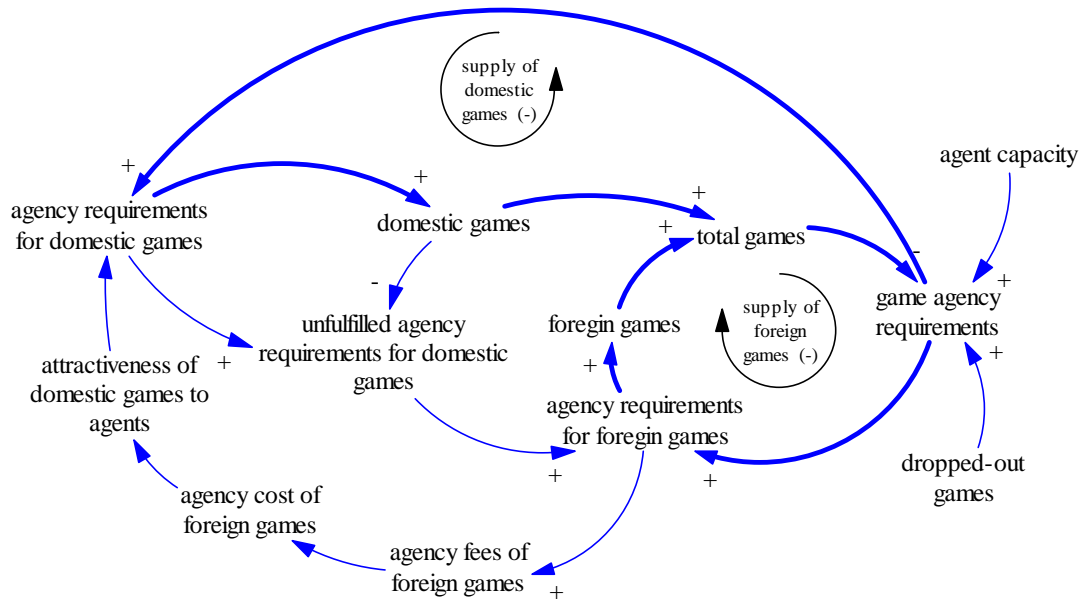
Fig. 6 Competition between domestic and foreign games

4.2.2. R&D capacity development

In the beginning of online game market development, there were only few software houses devoted to game development in Taiwan. Lacking of enough online game development skills and knowledge, domestic game developers could not produced games of high quality to attract market attention. However, when one foreign game was introduced to Taiwan in 1999, an overwhelming popularity started the rapidly development of online game market in Taiwan. The growing market demand aforementioned attracted agents and traditional PC game developers to establish their own game development capacity and capability. Existing domestic game developers were also motivated to expand their R&D capacity. The capacity investment and expansion momentums are detailed described as follows.

Vertical integration and transformation of PC game developers

Suffered from higher and higher agency fees to acquire foreign games, agents were forced to seriously consider the necessity of R&D investment to have their own game development capabilities. As illustrated in Figure 7, high agency cost led agents to invest in R&D activities to lower their demand for foreign games. High market revenues also motivated agents to extend their profit from game agency to game development. Traditional PC game developers were also eager to pursuit the growing market revenues. However, agents did not invest in R&D activities until the agency cost was too high. Besides, it required one to two years to complete a game development project. Hence, the growths of R&D capacity and domestic games development were still unavoidably to be lagged behind the market growth and failed to satisfy the market demand in time.
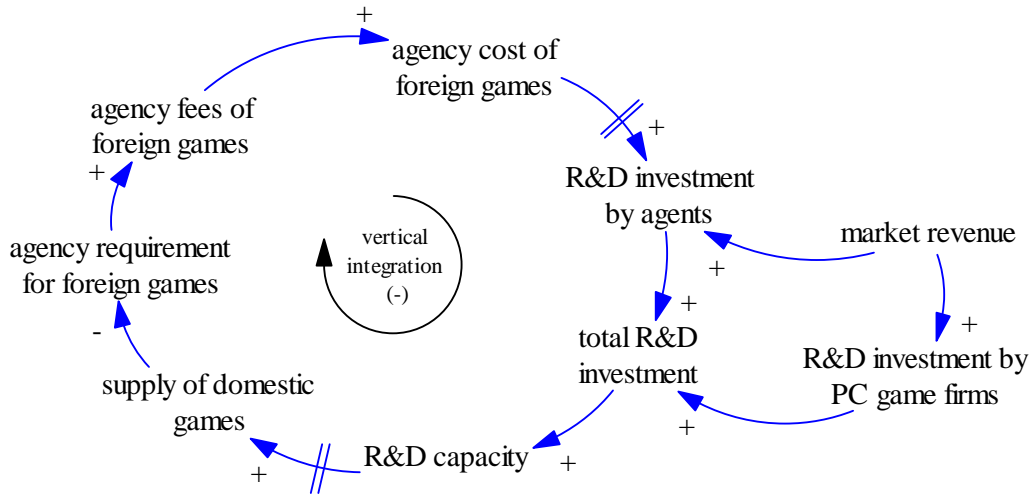
Fig.7 Vertical integration by agents

Development of domestic online game industry

As illustrated by the goal-seeking loop about *R&D expansion* shown in Figure 8, online game developer's R&D capacity expansion action was not only stimulated by growing market revenue but also strengthened when agents proposed more and more urgent requests for domestic games. Though developing high-quality online games indeed took time, domestic game developers hoped to enhance their R&D capability and improve the quality of domestic games to increase product attractiveness to agents. The *R&D expansion* and *improving quality* loops shown in Figure 8 illustrate domestic game developers' attitude toward capacity and games, respectively.
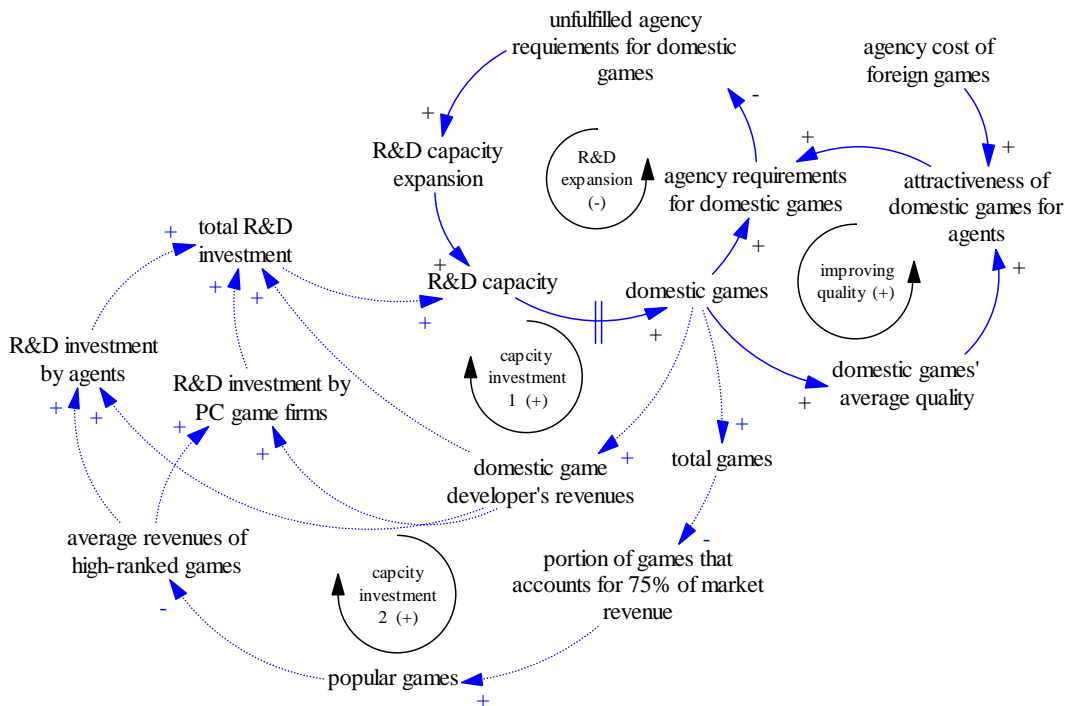

Fig. 8 Development of domestic online games industry

To agents and game developers, the ideal development of online game industry in Taiwan could be far better than it was. Agents expected to learn from foreign games and game developers planned to gradually accumulate game development experience and improve game quality. Domestic games were expected to have a distinguishing competitive advantage: game subjects and stories should culturally fit in with the experience and background of players. Hence, they could attract market attentions more easily and generate more revenues. In Figure 8, the two positive loops plotted in dash-line illustrate the ideal capacity investment momentums to bring online industry in Taiwan to grow.

The ideal development of online game industry was not realized until today. The actual development is limited R&D capacity and relatively minor position of domestic games in the market. In the following section, why the rapid growth of online game market only lasted for a short time, namely, about two to three years, is firstly discussed. Then, why domestic online game developers can only play a secondary role in the market is analyzed. Afterwards, whether government policies may contribute to the limited development of domestic online game industry is further discussed through a series of policy designs and experiments.

5. Simulations and policy design

Based on the operation structure and competition characteristics of the online market aforementioned, the growth and competition dynamics of the online market in Taiwan is analyzed and discussed by simulation and policy experiments. Since how the market operates and how popular and unpopular games compete with each has been detailed in prior sections, some causal loop diagrams aforementioned are simplified and combined in following discussions.

5.1. Stagnation of market growth

In Figure 10, aforementioned growth momentums embedded in and between online game players, agents, and games is simplified as a big reinforcing feedback loop driving market's rapid growth. As mentioned in Section 4.1, online games attract people of ages under thirty years old and every one from three of Internet users tends to play online games. While online games rapidly attracted people to join the market, the base of potential game players did not expand at the same pace. In fact, most Internet users in Taiwan started using Internet before year 2000. Customer that the online game market interacts with actually is a limited number of potential game players. Hence, as shown in figures from 1-1 to 1-4, the growth of online game market soon slowed down and stagnated during 2003 to 2004. Notice that though online game runs on Internet, the market itself can not be expanded to wherever Internet connects. Cultural difference and languages barriers not only restrict potential players in Taiwan to domestic game networks but also discourage foreigners in joining Taiwan's local game networks. The market unavoidably faces its limit to growth due to its limited market size.
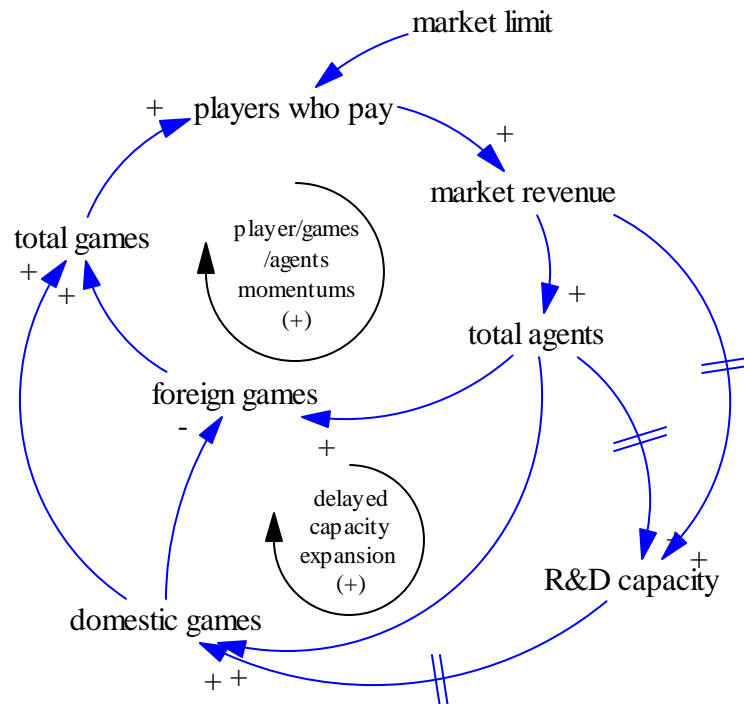
Fig. 10 Simplified market growth momentums

5.2 Window of opportunity to growth

The rapid market growth aforementioned gave a great momentum for foreign games to enlarge their market share and revenues. Due to capacity investment/expansion and game development delays, rapidly increasing agents' game agency requirements could not be satisfied by domestic games in time. Most agents acquired games from abroad and the market was mostly occupied by foreign games. As illustrated in Figure 10, foreign games brought the market a stronger force to grow for feedback. The market itself had a complete growth engine to keep growing and soon reached its limit. Although the growing market revenue and rushing agency fees paid for foreign game developers not only attracted but also forced agents to establish their own R&D capacity, the market as a whole got reached to its limit so fast that the motivation for R&D capacity investment did not sustain too long. Capacity expansion and game development delays also diluted the capacity expansion and quality improvement momentums of existing game developers. Most domestic game developers did not produce high quality games and experience high profit generated from popular products. The two capacity investment loops that are shown in Figure 8 were not strongly activated. As a result, the development of online game industry in Taiwan was limited.

The discussion above shows that domestic game developers and investors who entered market late or had capacity development lagged behind the market growth unavoidably confronted the problem of constrained growth. There was a window of opportunity for online game industry to grow but online game industry in Taiwan missed the opportunity. The window of opportunity to growth changed in opposite direction of both the speed of market growth and the delays in building up capacity. The faster the market grew, the narrower the window of opportunity to grow was; the longer was the time for capacity investment and development for a late entry into market, the higher the possibility that the late entry's growth might be constrained. In

addition to the problem of the short time frame of window of opportunity to growth, online game industry in Taiwan was also suffered from the essential network externality characteristic that made more severe the competition between games. Not enough time for domestic game developers to improve the quality of their products was another cause that led to the poor performance of domestic games. From a systemic perspective, online games in Taiwan and games from abroad competed with each other in a market that grew in a high speed (as illustrated in Figure 10). Delays in R&D capacity buildup and game development in contrast to the speed of market growth is exactly the most critical factor in determining whether domestic games or games from abroad would dominate the competition and become the major player of the market.

The development of the online game industry in Taiwan is a typical example of industry development model that follows the path of product-buying and agency first and research and production later. In this model, domestic online game agents and developers tend to stimulate market growth and learn from market behavior by selling foreign competitor's products first and make their R&D investment only when the market potential is ensured and product and market knowledge is believed to be accumulated enough. However, seemingly rational investment decision in such a whole new market ignores the complex interlocked relationships between the speed of market growth, the limit to market growth, and time delays of R&D capacity and product development. The conservative attitude towards market competition and industry development results in the shrinking of window of opportunity for late entrants to grow and the creation of an insuperable barrier to success.

5.3. Simulation and experiment

The aforementioned discussion about window of opportunity to growth may exist in industries with rapidly growing market and long delays in R&D capacity buildup and product development activities. The existence of such a window of opportunity suggests that an early start of R&D capacity investment and product development activities is of the essence to win the market. An early start of product development can supply the market what it requires and the market will reward the early entrants by involving them into the multiple growth momentums that are shown in Figure 10. The growth momentums will soon enlarge the revenue gap between early and late entrants, narrow the time frame of window of opportunity for late entrant to grow, and discourage late entrants from R&D investment. What could government do if domestic industry is in confrontation of such a tough situation?

In Taiwan, online game industry now asks government for more actions to support its development by reducing operational costs of firms through actions as tax reduction, subsidizing, and legislation, etc. The industry takes Korea as an example and hopes Taiwan government to take similar actions. Korean government purchases some critical techniques, software, and game development facilities as studio first and then rents out these purchased items to game development companies with a few amount of money. By legislation, Korean government also gives game development companies tax reduction as incentives to hire more R&D staffs. To examine whether government support can successfully generate momentums for domestic online game industry to accelerate capacity investment and create higher chances for domestic industry to win the market back, we assume a government support by reducing operation cost for online game developers. As shown in equation (P1), the

government policy is assumed to run at early stage of market growth, at the 24th period or about year 1999. Policy impact on industry practice is supposed to reveal gradually, as represented in a smooth function in the equation. The same policy is also experimented at the stagnation stage of the market growth, namely, the 84th period or about year 2004 to examine the impact of timing of government support on industry development.

$$M_b^{'} = M_b * (1 - SMOOTH(STEP(0.5,24),1)) \qquad (P1)$$

$$M_b^{'} = M_b * (1 - SMOOTH(STEP(0.5,84),1)) \qquad (P2)$$

M_b：Average cost of domestic game developers

$M_b^{'}$：Average cost of domestic game developers with government support

Based on the simulation results that are shown in Figure 11-2 to Figure 11-5, we found that government support policy may have greater impact on the improvement on industry development if it is implemented earlier. The different improvement results of policy 1 (policy with early implementation timing) and policy 2 (policy with late implementation timing) is resulted from their different impact on the speed of market growth and delays of R&D capacity expansion. If government implements the policy at the beginning of market growth, there will be more sufficient time for agents to invest in vertical integration and game developers to expand their capacity and share the rapidly growing market revenues. Government support in cost reduction and the motivation from market reward altogether foster domestic online game industry to develop. Different from the early implementation of government policy, however, a late supporting policy will hardly be useful because it is run when market almost reaches its limits. The lack of market potential offers not enough incentives to motivate a large scale of R&D capacity investment. Government policy can only avoid the exit of existing game developers by reducing their operation cost. Under the policy of late government support, the simulated R&D capacity, the amount of domestic game, and total games in the market are all almost the same as their actual changes.
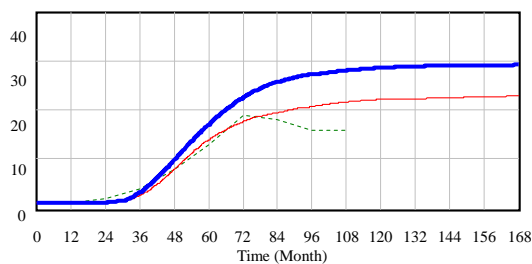
P2 policy-early support _____
P1 policy-late supportt _____
Actual R&D capacity - - - - - - -

Fig. 11-1Comparison of R&D capacity
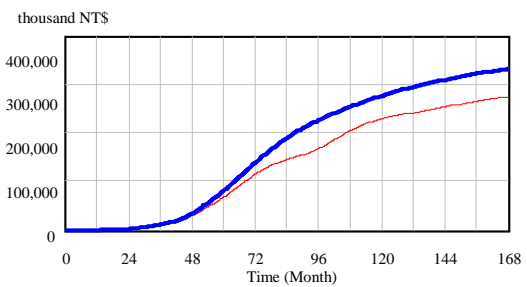
P2 policy-early support _____
P1 policy-late support _____

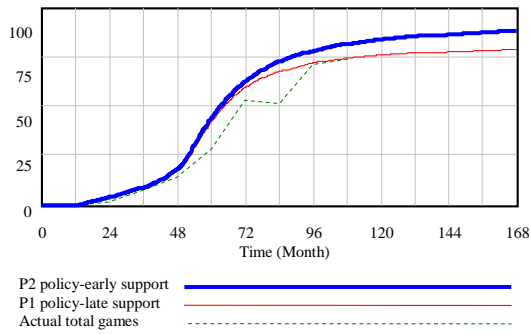Fig. 11-2 Comparison of domestic developers' revenue
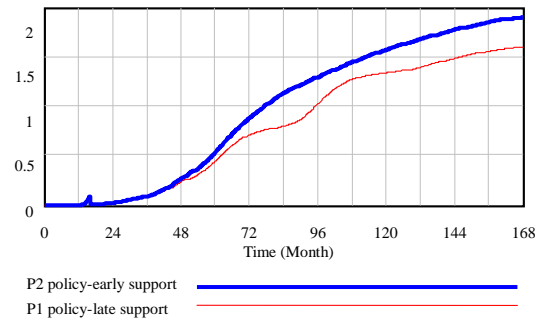
Fig. 11-3 Comparison of total games

Fig. 11-4 Comparison of the number of high-ranked domestic games
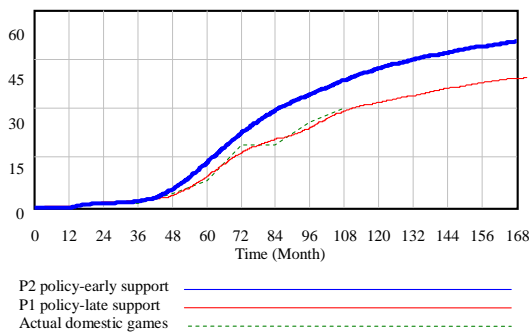

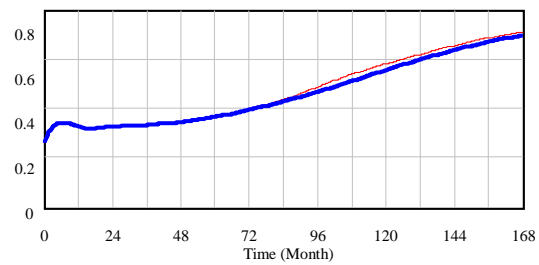Fig. 11-5 Comparison of total domestic games

Fig. 11-6 Comparison of the average quality of domestic games

In addition to the aforementioned impact of government support, we found that cost reduction policies unexpectedly made the competition between agents and games more severe. Since cost reduction lowered the exit rate of game developers, more domestic games were introduced to market, resulted in a larger number of total games. As illustrated in Figure 5, the more the total games in the market, the smaller the portion of games that accounted for the 75% of market revenue. With the supporting government policy, market competition might be more severe than ever before. To domestic online game developers, government's support did not raise their possibility to win the market in such a severe competition because average quality of domestic games would not be enhanced simply by cost reduction policy. While the R&D capacity in the domestic online game industry as a whole might increase or be kept by government support, the quality of games developed by each game developer could be improved only through the learning-by-doing process. Not enough game development experiences caused domestic game developers to have games of poor quality. As a result, most domestic games were low-ranked games in confrontation of the severe competition. Growth momentum for domestic online game industry that is shown in Figure 10 was weak in relative to the market growth momentum.

The above experiment shows that simply cost-reduction support cannot improve late market entrant's weak market position. Aimed at enhancing average quality of games to attract market attention, another experiment that assumed government support in facilitating game developer's R&D skills and capability was conducted. Simulation result indicate that with government support on cost reduction and acquisition of R&D professionals and skills, average quality of domestic games could

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be improved and some domestic games could even successfully become the so-called high-ranked games regardless of the timing of cost-reduction policy. Based on the experiments conducted, government policy is suggested to cover cost reduction and support in R&D knowledge acquisition simultaneously.

6. Conclusion

In this paper, we build up a system dynamics model to explore why online game market in Taiwan has grown so fast and why domestic online game industry can not catch up the growing market and stay as a minor player in the whole market. Based on the simulation model, it is found that the most critical factor to succeed in a fast growing market is R&D capacity investment in time. In online game market, there are several growth engines driving the market's rapid growth. While time delays in buildup of R&D capacity and online games development are unavoidable, those who start game development earlier may catch up with the growing market and acquire greater competitive advantage over late market entrants. To late entrants, their only chance to win the market is determined by how much time they have to buildup R&D capacity and develop games that are good enough to attract the market before market begins to stagnate. The longer the time delays in R&D capacity investment and product development, the firmer the early entrant's competitive advantage is and the less the chance for late entrants to win the market is.

Based on the acquired understanding of market dynamics in online game, this paper further discusses whether government support is helpful in strengthening late market entrant's power over the market. After a series of experiments and simulations, two things are found to be critical for late entrants to succeed. First, government support by reducing late entrants' operation cost is helpful only if the supporting policy is implemented as early as the market begins to grow. Second, support on quality enhancement of late entrants' product may be a more important government policy if late entrants have missed the time to grow. Although quality enhancement may not make late entrants to become the major player in the market, late entrants with games of higher quality can have a greater chance to attract players and sustain their competitive position rather than being forced to exit.

In this paper, though our focus is on the online game market in Taiwan, we believe that the interlocked relationship of rapid market growth and long R&D delays may be common in other industry, especially for Internet related industry. Future research is suggested to investigate more industry examples with properties that are similar to online game and discover simple but common structure underlying complex market growth dynamics.

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