An Analysis of Virtual Economies in MMORPG (Massively Multi-players in Online Role Playing Game)

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Abstract

MMORPG, massively multi-players in online role-playing game, is the most popular genre in online games. Because large number of players interacts with each other, virtual worlds in MMORPG are alike communities of real worlds. Moreover, players in virtual worlds trade game items with real money. This paper is to find impacts of real-money trading into real worlds, and game operators, by using two-period model between players of the game and the game operator. It was found that real-money trading benefits game operators, and there exists optimal supply of game items to maximize the profit of game operator. Moreover we found that the income disparity in real worlds could be decreased when real-money trading is allowed. To support the analytical model, we used an empirical analysis using real-money trading data, and find the relationship among play time of MMORPG, transaction volume of real-money trading, and price of game items. In empirical analysis, it was found that real-money trading benefits game operators. Moreover, it was found that play time and price have positive relationship.

Keywords:

MMORPG, real-money trading, virtual economy

Introduction

Online games became a popular platform in the game industry nowadays. Not like other platforms, online games are played on the internet. Therefore, people can enjoy games with anonymous opponents. It attracts people who want new types of social relationship. Moreover, it is more profitable for game operator, because it can make fixed monthly incomes – other game platforms only receive the price of game program. The market size of online games is smaller than that of video games, but it grows three times as large as 5 years ago.

The MMORPG, massively multiplayer online role-playing game is the most popular genre in the online game industry. Normally, most online games focus on interaction between two people. In MMORPG, on the other hand, a large number of people interact with each other in a world called "virtual world" which is made by game operators. For example, 'World of Warcraft,' one of the most popular MMORPG, has over 6 millions of active subscribers[1]. It is similar to populations in big cities. In virtual worlds, People have a job in virtual world, hunt monsters, talk to each other, and try to increase their own virtual assets, just the same as real lives.

Players in MMORPG started to sell their items which is produced in virtual worlds. In 2001, Edward Castronova found that people in the virtual world called 'Norrath' exchange their virtual money into real money. He also calculated the value of virtual currency to be greater than that of Japanese Yen. Moreover, Sony, provider of 'Everquest,' made "Station Exchange" that provides players method of buying and selling items in Everquest. On the other hand, Blizzard Entertainment, which creates the most popular MMORPG 'World of Warcraft,' banned real-money trading between players[2].

Because of real-money trading, people can earn real money from playing MMORPG. It implies that people can acquire both happiness and wealth in virtual worlds. It may give a significant "brain drain" in real world [4]. For the side of game operators, it is important to maintain the balance between the efforts to gain virtual money and exchange rates between virtual currencies and real currencies. For example, in 2003, Blizzard Entertainment which creates "Diablo II" decided to close more than 112,000 accounts to prevent cheating on Diablo II[3]. Due to this cheating, the efforts to collect items in this game had been decreased and the price of items also had been decreased. Therefore controlling the value of virtual asset in online games is the key strategy for game operators.

A lot of previous researches in online games are about the social behavior and legal issues in virtual world, and there is lack of analysis of economic impacts of virtual worlds. The main purpose of this paper is to analyze the economic impacts of virtual worlds on real worlds and the implication

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1 http://www.mmogchart.com
2 http://en.wikipedia.org/wiki/Real-money_traiding
3 http://www.fragland.net/news.php?id=5425

of business strategies for game operators. As an initial approach to these issues, this research considered the following problem, market equilibrium of real-money trading, optimal supply of game items, benefits of real-money trading, and change in wealth distribution of real worlds. The rest of the paper has four sections. In the first section, we will review the related literature and justify the assumptions of our model. The second section explains the model and derives supply and demand of the market of game items. The third section is to analyze real-money trading and find the optimal strategy for game operators, and an effect on real worlds. The final section is to give some empirical evidence of the model. Also conclusion and limitation will be discussed.

Literature Review

Key Concepts

MMORPG: Most MMORPGs follow the typical fantasy setting, and massive players participate in virtual worlds. Players have job such as fighters or sorcerers and they usually hunt or loot monsters in this worlds. Generally, a character development system in MMORPG consists of levels and experience points. Levels are based on the concept of goals and rewards. If players hunt monsters[4], they receive certain amount of experience points as a payment. When player's experience points reach a certain limit, players' level increase discretely.

Real-money Trading: In the field of online game industry, Real-money trading (RMT) usually means trading virtual assets for real money. Generally, the basic mechanism of real-money trading is as following. First, a player sells on online auction site, such as eBay, virtual money or game items which are obtained from playing MMORPG. Other players will bid on virtual assets. After the transaction, the seller will hand over the virtual assets in virtual worlds to the buyer.

Overview of Virtual Economy

One of the main characteristic of virtual economies is that the marginal utility is partially negative. Castronova mentioned "The Puzzle of Puzzles" in online games [4], which mean that a puzzle that is too easy or too difficult is less fun. Castronova asserted that players allocate time between the game and work to maximize their own utility. This implies that wages are significant variable to decide game time. People with high wage rate will demand more game time, because they can afford to pay higher price of game time. But on the other hand, a higher wage rate also means a higher opportunity cost of gaming. Namely, wage rates have both income and substitution effects.

The market mechanism in virtual economies is almost like bartering in the "stone age" [21]. In this perspective, Yamaguchi suggest that real-money trading is occurred because of the trade-off between real wage rate and level of skills in virtual worlds [21]. On the other hand, Kelly had a slightly different standpoint [15]. He compared marginal value of play with wage rates and decided playing time. Huhh asserted that the quantity of items and game money are directly proportional to player's play time [12]. Like others, he used a time allocation of each player and derived supply and demand of game items. A lot of previous researches did not consider the control variable of firm side. Therefore, previous researches were hard to find the detailed managerial implication for game company.

In perspective of effects of virtual economy, Castronova expected that virtual economies might be merged into real economies [4]. He said that migration to virtual worlds and taxation issue in virtual worlds could be a problem. A lot of researches agreed that extension of virtual worlds could be a problem in real worlds, but they just suggested it without detailed analysis [21]. In managerial view, Kelly and Huhh asserted that real-money trading increases population of MMORPG and gives more profits to game companies [12][15]. But Huhh, in his another paper, suggested that real-money trading might decrease the durability of online games in a long-term perspective [13]. In legal issues, the ownership of virtual assets is not legally recognized [23]. Technically speaking, real-money trading couldn't be illegal, but most game companies banned real-money trading [23].

Model Setup

This model assumed that each player's marginal value depends accordingly on how much time player has played the game in the past. And the past play time is expressed by the concept of 'Levels' and 'Experience points'. People with higher past play time have higher levels and experience points, and more ability [2].

For an analysis about real-money trading, we construct the two-period model between group of people and the game operator. People decide their time allocation to maximize their utility, and the game operator decides the quantity of game items in MMORPG they built to maximize total sum of each player's play time. For simplicity, in this model, profits of game operator are replaced by total sum of each player's play time. Also we assume that there exists only one level in the game. Let $\bar{\theta}$ be the maximum experience points. Therefore, if a player exceeds the maximum experience points ($\bar{\theta}$), players do not continue the game. Assume that all players have zero experience points at first. In addition, assume that there is only one kind of item in the online game, and players are not able to have two or more items in one period. For simplicity, we exclude game money and avatars, and assume that game items are the only goods traded in the market of real-money trading. Items are given to players who exceed the certain amount

[4] Typically, monsters in MMORPG imply NPC (Non-player character) which is created by game operators. Hunting monsters is the main activity in virtual worlds

of experience points. The individual utility and total sum of each player's play time is as follows. People are distributed by their wage rates ($w \sim U[0,W]$)

$$u(w,h_t,\varphi,\theta_{t-1}) = I(w,h_t) + \alpha v(h_t,\varphi,\theta_{t-1}) \quad (1)$$

$$\theta_t = \theta(h_t,\varphi,\theta_{t-1}) \quad (2)$$

$$T = \int_0^W (h_1 + h_2)dw \quad (3)$$

h_t is the time that a player spend at t-th period, and θ_{t-1} is experience points at (t-1)-th period. The individual utility is divided by two parts – utility of real worlds and that of virtual worlds. $I(w,h_t)$ is the income function for working in real life, and is linear decreasing function for h_t. $v(h_t,\varphi,\theta_{t-1})$ is the value function for playing the online game. We assume that the value function is quadratic and concave function for h_t. We also assume that $v(h_t,\varphi,\theta_{t-1})$ is increasing function of θ_{t-1}. When a player uses an item, $\varphi = 1$ and $\varphi = 0$ when they are not. Players get higher value when $\varphi = 1$ than when $\varphi = 0$ – i.e. $v(h_t,1,\theta_{t-1}) > v(h_t,0,\theta_{t-1})$. Experience points is accumulated according to past play time. Assume that experience points are linear to play time. For controlling the quantity of items, we have to decide who will receive items or not. It is assumed that if a player's play time exceeds h_q, then a player will receive an item. The game operator decides h_q to maximize total play time.

The process of this model is as follows. 1) In first period, each player decides the optimal playing time (h_1). Next, 2) According to h_1, some players will attain an item(if $h_1 > h_q$), others will not get an item. 2-1) If players have an item, they decide to sell an item or to use it. On the other hand, 2-2) if players do not have an item, they decide to buy an item or to play without an item. 3) After making decision about an item, players decide the optimal playing time (h_2). 4) The Game operator decide the quantity of an item to maximize T.

Deriving Supply and Demand of Game Items

After the first period, It would be decided whether player receive an item or not. And players whose experience point in the first period exceeds the maximum experience points cannot play the online game at the second period. Moreover, if optimal play time is lower than 0, players will not participate in the game. For these reasons, players are divided by four groups, after the first period. Figure 1 shows these four groups.

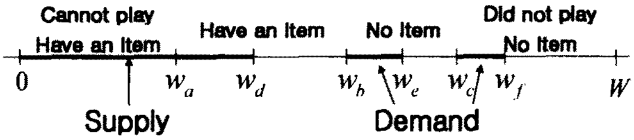

Figure 1 – Players' status after the first period

According the result, each player's optimal play time is inversely linear proportional to their wage rates. Players in $[0,w_b]$ have game items, so they will be the suppliers. Players in $[w_b,W]$ did not receive items after first period. In the same way we decided the supply side, the demand side will be decided by comparing the utility of buying an item with utility of just playing the game. However, players in $[w_c,W]$ did not play the game in first period. Therefore, if they don't buy an item, they will not play the game.

Analysis of Real-money Trading

The Equilibrium Price

According to above results, supply and demand functions of game items can be derived. Supply becomes different by total quantity of items in the game (w_b). Therefore, if the number of players who received an item (w_b) is lower than the number of players who exceeded the limit experience points (w_a), all suppliers sell their items for free. In that case, supply would be a vertical line, because it was independent from its price. If w_b is larger than w_a, then supply would be like the graph in Figure 2.

Table 1 – Supply and Demand Function

Supply	w_d/W	If $w_b \geq w_a$
	w_b/W	If $w_b < w_a$
Demand	$(w_c - w_b + w_f - w_c)/W$	

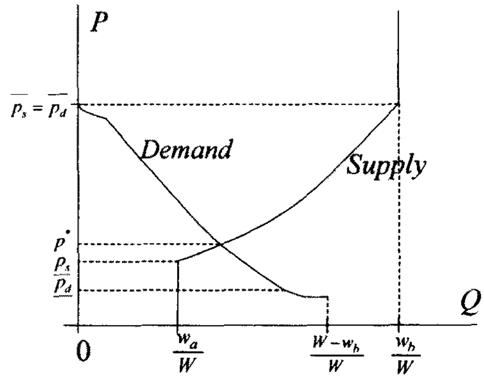

Figure 2 – Supply and Demand Function when $w_b \geq w_a$

If the minimum supply is bigger than the maximum demand, the transaction could not be occurred. Therefore, the equilibrium price exists only when $w_a \leq W - w_b$. In addition, if the number of player who received an item increases, supply will be more elastic, and demand will be less elastic. Therefore, it can be conclude that the equilibrium price of game items decreases as the number of players who received an game item increases. Also, the price decreases as number of players who exceed the limit experience points increases.

Proposition 1. The equilibrium price of game items p^* exists by following conditions.

$$\exists p^* \text{ s.t. } w_e(p^*) = w_e(p^*) - w_b + w_f(p^*) - w_c \quad \text{when } w_a + w_b \leq W \ \& \ w_b \geq w_a$$

$$\exists p^* \text{ s.t. } 2w_b = w_e(p^*) + w_f(p^*) - w_c \quad \text{when } w_a + w_b \leq W \ \& \ w_b < w_a$$

Proposition 2-1. The equilibrium price decreases as total supply of game items (w_b) increases.

Proposition 2-2. The equilibrium price decreases as number of retired players (w_a) increases.

Decision for Game operators

Real-money trading increases total population of the game. However, technically speaking, total sum of play time is more important for game operators than total population, because profit of typical MMORPG is directly related to play time itself. Equation (4) is the total playtime when real-money trading is allowed.

$$T = T_1 + \int_{w_a}^{w_d} h_2^*(w,0)dw + \int_{w_d}^{w_e} h_2^*(w,1)dw + \int_{w_e}^{w_c} h_2^*(w,0)dw + \int_{w_e}^{w_f} h_2^*(w,1)dw \quad (4)$$

T_1 is the sum of total play time in first period, and it is constant. w_d, w_e, w_f are dependent on the price of items (p). And the price is a function of total quantity of items (w_b). Then we can find the optimal supply of game items in MMORPG.

Proposition 3. There exists the optimal supply of game items to maximize total sum of each player's play time.

Clearly, real-money trading increases total participant in online games. It gives a chance people whose marginal value of playing game is low to increase their marginal value and participate in online games. But it did not mean that total sum of play time increase. The equation (5) is total sum of play time when real-money trading is not allowed. We can compare the equation (4) and (5) according to change of the supply of game items of the game operator. According to the result, if the quantity of game items is optimal, then total sum of play time when real-money trading is allowed is larger than when it is not. Figure 3 shows the result of comparing total play time of each case.

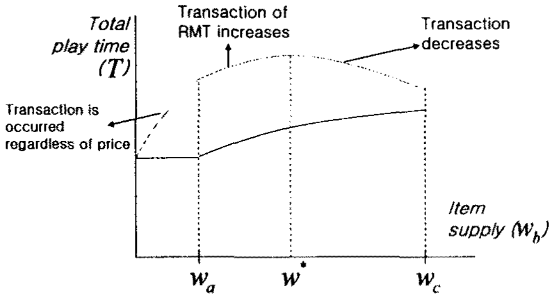

Figure 3 – Comparing Total Sum of Play Time

Proposition 4. When real-money trading is allowed, the game operator earns more profit when it is not.

Maturity of MMORPG

Maturity of MMORPG can be defined by the number of possible entrant and retired players. If the number of possible entrant increases, population of MMORPG will increase, and MMORPG can maintain its system. However, if the number of retired players increases, population will decrease, and MMORPG will shrink down. Therefore, game operators should control these two numbers. The number of retired players can be defined by w_a, the number of possible entrant can be defined by $W - w_c$. Assume that total population is fixed, then maturity will be

$$Maturity(M) = \frac{W - K - w_a}{w_a} \quad K = w_c - w_a \quad (6)$$

Equation (6) tells that if retired players increase, then maturity decreases. In proposition 2-2, the equilibrium price decreases when the number of retired players increases (w_a). Therefore, it can be derived the relationship between maturity and the price of game items.

Proposition 5. If the number of retired players increases, maturity of MMORPG decreases and also the equilibrium price decreases.

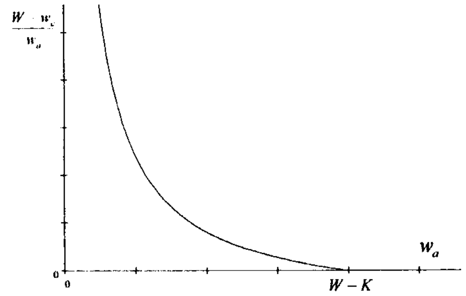

Figure 4 – Maturity by The Number of Retired Players

An effect of Real-money Trading on Real World

Players with higher play time may sell game items and earn money of real worlds. We are going to analyze the income distribution in real worlds in three cases - No game, No RMT, and RMT is allowed. Without MMORPG, each player's income is linear proportional to wage rates. When real-money trading is banned, the ordered income is quadratic function to wage rates. And when real-money trading is allowed, players with lower wage rates can make money by selling game items, and players with higher wage rates spend more time for the game by buying game goods. In that sense, the gap between these two groups will be narrowed. Comparing Lorenz curve of three cases, we can assert that real-money trading may result a income redistribution effect to real economy.

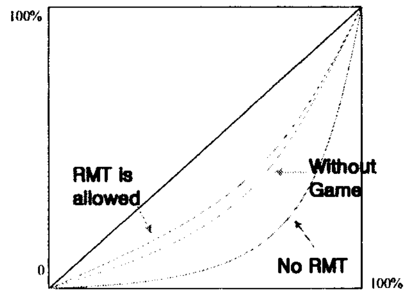

Figure 5 – Lorenz Curve at Each Case

Proposition 6-1. The Lorenz curve of when RMT is allowed is less convex than that of when it is not.
Proposition 6-2. The Lorenz curve of when RMT is allowed is less convex than that of when there is no game.

Empirical Analysis of Real-money Trading

Data Set

To support the results of analytical model, an empirical analysis was conducted with real-money trading data. This empirical analysis is to find an effect of real-money trading on profit of game operators. In that sense, data consist of total play time, transaction volumes of real-money trading, and price of game items. Data were obtained by 'Itembay[5]', real-money trading intermediary companies in Korea, and 'Gametrics[6]', game research company. This model used daya of 'Lineage'. The dates of data range from January 1st, 2005 to December 31, 2006 for play time, and from January 1st, 2004 to December 31st, 2006 for transaction data. Also, daily data were obtained in each MMORPG.

Empirical Methodology

First, we analyzed correlation and causality between play time and transaction volumes, and verified the autocorrelation. For causality test, we used 'Pairwise Granger Causality Test'. Next AR model was used for time series analysis between play time and transaction volumes, and tried to find the effect of real-money trading on profit of game operators. Play time is the proxy for profit, as used in the analytical model. After that, we analyzed the process for the relationship between play time and price. Finally we defined correlation and causality of these three variables, and found the effect of real-money trading. Eviews program was used for regression tool.

Empirical Result

In case of 'Lineage', if transaction volumes decrease 100%, which means that real-money trading is not allowed, it was found that play time decreases 21.84% (coefficient: 0.2184). According to this result, it can be said that real-money trading increases play time, which is similar argument to proposition 4. Correlation test shows significantly positive correlation between play time and transaction volumes (coefficient: 0.6461). In causality test between transaction volume and play time, both null hypotheses, transaction volume does not Granger Cause play time (p=0.02171) and vice versa (p=0.01316), were rejected. This result said that both play time and transaction volumes have interaction effect to each other in case of 'Lineage'.

Dependent Variable: LOG(Play Time)
Method: Least Squares
Sample: January 8th, 2006 - December 24th, 2006
Included observations: 51

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.362507	0.911135	9.178123	0.000000
LOG(Transaction Volume(-1))	0.218384	0.045654	4.783504	0.000000

R-squared	0.318326	Mean dependent var	12.720810
Adjusted R-squared	0.304415	S.D. dependent var	0.055448
S.E. of regression	0.046245	Akaike info criterion	-3.271320
Sum squared resid	0.104789	Schwarz criterion	-3.195562
Log likelihood	85.418670	F-statistic	22.881910
Durbin-Watson stat	1.774403	Prob(F-statistic)	0.000016

*Adjusted R-square: Reliable if more than 0.2

[5] http://www.itembay.com
[6] http://www.gametrics.com

Figure 6 – Relationship between Play Time and Transaction Volumes

In relationship between play time and transaction volumes, it was found that there is a positive correlation. In causality test, "price does not Granger Cause transaction volume" was not rejected (p=0.8989), but vice versa was rejected (p=0.12521). This result said that transaction volumes are cause of price. Figure 6 shows that if transaction volume decreases 10%, price decrease about 4.69% (coefficient 0.4688). To summarize, it can be said that play time and price have positive relationship. This result supports partially proposition 2-1, increase of item supply decrease the price and proposition 3, increase of item supply decreases play time. Like 'Diablo II case', this empirical result can be evidence that Lineage also has an inflation problem.

Dependent Variable: LOG(Price)
Method: Least Squares
Sample(adjusted): January 8th, 2006 - December 24th, 2006
Included observations: 49 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.499240	2.984332	4.523370	0.000000
LOG(Transaction Volume(-1))	0.468807	0.257109	1.823377	0.074700
AR(1)	0.607341	0.136165	4.460347	0.000100

R-squared	0.436084	Mean dependent var	18.947170
Adjusted R-squared	0.411568	S.D. dependent var	0.077413
S.E. of regression	0.059383	Akaike info criterion	-2.750356
Sum squared resid	0.162210	Schwarz criterion	-2.634530
Log likelihood	70.383730	F-statistic	17.786200
Durbin-Watson stat	1.887271	Prob(F-statistic)	0.000002
Inverted AR Roots	0.610000		

Figure 7 – Relationship between Transaction Volumes and Price

Conclusion

This research showed the existence of equilibrium price of game items. Moreover it also showed that there is an optimal supply of an item that maximizes the company's profit. Most previous researches did not consider managerial implications for game operators. For this point of view, this research is different from previous researches. This research also proved that real-money trading benefits game operators. In perspective of real economy, this research proved that virtual economies may reduce income disparity of real economies. A lot of previous researches expected that virtual economies give negative effect to real economy without economic analysis. However our result shows that virtual economies may give a positive effect in some occasion. Using empirical analysis to support above results has significant meaning. However, we cannot find effects of real-money trading to the consumption of real economy. It is very important issue, because real-money trading increases the transaction volumes in real economies and may affect the monetary policy in real economies. Also inflation problem in virtual worlds should be analyzed. Inflation in virtual worlds affects the effort to increase avatar's power. Therefore, it is an important issue for game companies these days. Moreover, social welfare and total sum of income in real worlds should be analyzed for further research.

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