2010

An Empirical Analysis of Virtual Goods Pricing Strategies in Virtual Worlds

Sulin Ba
University of Connecticut, sulin.ba@business.uconn.edu

Dan Ke
University of Connecticut, dan.ke@business.uconn.edu

Jan Stallaert
University of Connecticut, jan.stallaert@business.uconn.edu

Zhongju Zhang
University of Connecticut, John.zhang@business.uconn.edu

AN EMPIRICAL ANALYSIS OF VIRTUAL GOODS PRICING STRATEGIES IN VIRTUAL WORLDS

Sulin Ba, School of Business, University of Connecticut, Storrs, CT, USA,
sulin.ba@business.uconn.edu

Dan Ke, School of Business, University of Connecticut, Storrs, CT, USA,
dan.ke@business.uconn.edu

Jan Stallaert, School of Business, University of Connecticut, Storrs, CT, USA,
jan.stallaert@business.uconn.edu

Zhongju Zhang, School of Business, University of Connecticut, Storrs, CT, USA,
John.zhang@business.uconn.edu

Abstract:

3D Virtual worlds are computer mediated environments intended for the users to inhabit and interact via their representational avatars. Trading virtual goods in 3D virtual worlds plays an important role in realizing the virtual economy. This essay examines the impact of the unique virtual goods permission settings (Copy, Modify, and transfer) on creators' pricing strategies. We collect data of virtual items from the Second Life marketplace XStreet to explore the factors that affect virtual goods prices. We use ANOVA to test the relationship between each permission and price, and conduct random effects model to investigate how permissions affect price in different categories. Our empirical results show that "Copy" permission, which might be regarded to reduce the profit of the creators, has a positive effect in virtual goods pricing strategies. Virtual items are more likely to be assigned "Copy" which seems to give additional duplicates for free. Furthermore, prices of virtual goods with "Copy" permission are higher than those without, and the more copies a consumer wants, the higher the price difference between the items with "Copy" and those without "Copy" permission. The effects of other issues on virtual goods prices are analyzed and managerial implications are discussed.

Keywords: Virtual Worlds, Virtual Goods, Second Life, Pricing Strategies, Permission Rights

1. INTRODUCTION

Virtual worlds are computer-simulated 3D platforms intended for its users to inhabit and interact via avatars represented by their 3D graphical humanoids[1]. Virtual worlds enable the users to act as if they were "physically" living in a real-world community, and are characterized as real-time actions, distance communication, and real-world rules on user interaction. Originated from early stage massive multiplayer online games, virtual worlds have evolved into comprehensive platforms for diverse applications, such as collaborative educating and training centers, online social communities, and open-trading business environment. Plenty of studies and technology statements (Bridges et al. 2007; Fetscherin and Lattemann 2007) have addressed that the development of virtual world industry is on a path of dynamic growth and innovation.

With the rapid development of virtual world industry in the past a few years, trading of virtual goods and service has played a significant role in contributing to the virtual economy (Castronova 2002). Users not only consume the virtual products or services in world, they themselves build up the economy of the virtual world. The virtual items collected are effective in preventing users from switching into another world (Shapiro and Varian 1999). Virtual goods, either for sale, or as a new form of in-world advertisement as well as other purposes, have been stated as a new business model in our life[2]. Some virtual goods in a virtual world bear similar utilities of real products in real world, which enables virtual world users to feel like living within the world and consuming the virtual goods. For example, virtual avatars make up themselves to attend social activities; they furnish virtual home to accommodate their friends; they play with virtual balls for entertainment. A latest activity of free Michael Jackson glove virtual gift[3] shows the potential of virtual goods for generating social media. Revenue of virtual world industry has achieved $2.2 billion in 2006 and is forecasted to be $5.9 billion in 2012[4]. One of the most prosperous virtual worlds, Habbo Hotel, has brought $70 million revenue, of which virtual goods sales make up 85%[5]. It is estimated that the total trading of virtual goods in virtual worlds (including Second Life, Tencent, Gaia Online, Habbo Hotel, and hi5) is at about 1.5 billion euro in the recent years (Kappe 2009).

Among the most popular virtual worlds, Second Life[6] has gained a lot of attention from both academia and industry since its first millionaire Anshe Chung was reported on Business Week[7]. It is an Internet-based 3D virtual world where users can network, participate in various activities, and create and trade virtual goods with each other. It is a successful example of user-generated virtual world, which has shown its potentials for cross-selling of real world business, animated advertisement, etc (Ondrejka 2007). Creators of virtual goods in Second Life can sell their creations for Linden dollars, which is exchangeable for real currencies such as U.S. dollars. Second Life's free-trading mode provides the users a motivating channel to make profit in virtual world. According to Second Life statistics[8], Second Life economy (user-to-user transaction) totals $567 million US dollars in 2009, i.e. 65% growth over 2008; Sales of user generated virtual items on XStreet SL[9], reaches L$1.6 billion or US$6.1 million, growth of 74% over 2008. Second Life's prosperity of virtual economy verifies that virtual goods trade is no longer a phenomenon of entertainment on the Internet. However, it becomes an interesting business model worth investigating for both researchers and practitioners.

It is interesting that the creator of a virtual good in Second Life can assign permission rights such as "Copy", "Modify" or "Resell/give away (Transfer)" to the next owner. They are not ordinal or nested

[1] http://en.wikipedia.org/wiki/Virtual_world
[2] http://www.techcrunch.com/2007/06/20/virtual-goods-the-next-big-business-model/
[3] http://www.insidefacebook.com/2009/07/07/michael-jackson-breaks-several-facebook-records-during-memorial-service/
[4] http://gigaom.com/2007/05/03/virtual-world-revenues-6-billion-by-2012/
[5] http://www.virtualgoodsnews.com/2009/03/virtual-goods-make-up-85-of-habbo-revenue-ads-and-new-products-to-grow.html
[6] http://secondlife.com
[7] http://www.businessweek.com/the_thread/techbeat/archives/2006/11/second_lifes_fi.html
[8] https://blogs.secondlife.com/community/features/blog/2010/01/19/2009-end-of-year-second-life-economy-wrap-up-including-q4-economy-in-detail
[9] https://www.xstreetsl.com/modules.php?name=Marketplace, a website that lists all the virtual items or services for sale on Second Life.

to each other. Creators can assign one of several permissions at the same time or assign no permission at all. Thus there are eight possible permission settings that could be assigned to a virtual creation when it is on the virtual goods market: "Copy", "Modify", "Transfer", "Copy, Modify", "Copy, Transfer", "Modify, Transfer", "Copy, Modify, Transfer", or "No permission". For example, the next owner of a virtual dress with "Modify" permission can change the color or size according to his preference, but he cannot make additional copies or resell this virtual dress in the virtual goods market. If the dress is assigned "Copy, Transfer", he has the permission to make many copies as he wants and to resell these items to others or send them for free.

Some permission settings in other virtual worlds are subject to price discrimination by limiting the period of usage, i.e. buyers would have different time period of usage of the virtual item at the cost of the corresponding price. This type of permission could be set by the seller (Neopia sellers assign a permission right on a virtual item and charge a fixed price), or be chosen by the buyers (sellers of Tencent QQ, 9 you, and There provide several permission-price options for buyers to decide how much they would like to pay for using the virtual item within a particular time period). These examples of virtual goods trading lack interaction among end users, and prices of virtual goods are not negotiable (Castronova 2001).

However, when purchasing a physical good in real life, consumers do not limit themselves to thinking about its duration (like the period of usage of a virtual good); they instead take into account how much quantity they want, whether the size or color is favorable, whether its quality keeps as original when sent away as a gift, etc. Thus, the unique form of virtual good permissions rights COPY, MODIFY, and TRANSFER in Second Life distinctly implies the real world consuming pattern. Moreover, as virtual goods' utility in Second Life matches their archetypes in real world, users' demand for virtual goods follows the demand theory of physical goods in real world economy. That is, the possibility of using multiple copies of the identical goods simultaneously increase a consumer's utility in the virtual world, as in the real world. To be specific, a consumer in real life might be in need of duplicate chairs to furnish his/her house; he/she might like the pant to be shorter than original design; or he/she might simply want to send a gift to his/her friends. It is normal that in the real world consumers would not get duplicate goods for free due to the manufacturing cost of real products. However, in Second Life, the COPY permission enables the buyers to possess duplicate copies by purchasing only a single item of virtual good. Therefore, the economic property of demand aggregation of virtual goods intrigues us to study the virtual goods pricing strategies in consideration of their permission rights and from the perspective of users' demand in Second Life.

In this paper we aim to examine the pricing strategies and permission settings of virtual goods on the marketplace of Second Life. Copy, Modify and Transfer are unique terms of permission rights in Second Life, and we are eager to know whether and how each of them plays a role in virtual goods pricing strategies. Thus the research questions of this paper are: To deploy the optimal pricing and permission strategies to maximize the profit, whether there is any relationship between price and permissions? Furthermore, we are examining what other factors would affect virtual goods prices.

The following sections are organized as below: Section 2 is an overview of related research in terms of pricing strategies. We present the theoretical framework based on which the empirical estimations are carried out. Section 3 is the data description we collected from XStreet. Section 4 provides the empirical analysis of the impact of permission rights on the virtual goods pricing strategies. Section 5 is the managerial implications of our empirical results, the limitations of this paper, and directions of future research.

2. PRIOR RESEARCH

As a special form of digital goods, virtual goods share the same cost structure with digital information goods, i.e. substantial production cost vs. negligible marginal cost. For example, free trial of software has some similarity of virtual goods with COPY permission; the degraded pirate is modified product of original version; online sharing of music and open source software have the characteristics of sending away virtual goods for free, which is permitted by TRASFER permission. Thus pricing

strategies of information goods leave some insights on virtual goods pricing. In this section we will refer to some previous literature of information goods versioning, piracy and online sharing.

Versioning is the strategy that assigns the information goods with several quality levels to satisfy the demand of different consumers. It has been studied from the perspectives of pricing structures, consumer surplus, and social welfare (Varian 1997, Shapiro and Varian 1998, Bhargava and Choudhary 2008). Bhargava and Choudhary (2008) identify the conditions under which versioning is optimal. Other studies on versioning have also considered the impact of network externality on information goods pricing. A common business strategy to promote product adoption in software industry is to provide a free trial version with limited functionalities of the commercial product to increase the installed user base. The positive presence of network externality makes free trials very appealing as it increases user base, which can lead to increased profit for the seller (Conner 1995, Cheng and Tang 2007, Cheng and Liu 2008).

Research on versioning information goods and free trials of software mainly focuses on quality differentiation of the digital good. However, our research focuses on the digital goods of the same quality considering permission rights in Second Life. The same item of virtual good with different permissions could be regarded as virtual goods in different versions with the same quality. So the free trials of software could be a reference to the copy permission to virtual goods. Versioning information goods especially free trials of software have been accepted as useful marketing strategies, which could be a reference to virtual goods permission strategies.

Literature that looks at the impact of piracy (illegal copying and sharing of information goods) discusses the situations of duplicating information goods of the same quality as the original, as well as copied goods of inferior quality. The possible additional quantities of information goods made through illegal copying (pirating) can alter seller profitability and social welfare considerably. Belleflamme (2002) points out copying information goods may increase social surplus, but at the expense of the producer's profits. Some empirical research, however, have shown that sharing tends to have a demand aggregation effect which decreases buyer diversity (Bakos et al. 1999). Pirating of information goods can, therefore, actually increase seller profitability (Bakos et al. 1999, Varian 2000, Chellappa and Shivendu 2005). Online sharing of music (Bhattacharjee et al. 2006; Gopal et al. 2006) and open source software (Raghu et al. 2009), which might have been regarded as a reason for losing profit, do not necessarily hurt the sellers.

Several researchers have examined the impact of allowing (or restricting) the copying of information goods in the general framework of digital rights management. Through an analytical model characterizing the choice of digital rights by a firm that also offers a physical version of the information good (such as a regular printed version of a book and an eBook) with empirical testing using data from the eBook industry, Oestreicher-Singer and Sundararajan (2006) find that the copying rights enable a seller to raise prices only when they can enhance the digital experience associated with purchasing an eBook. For example, the ability to copy relevant parts from an eBook to one's document adds utility to a consumer.

The theoretical and empirical results of digital goods pricing provide insight for virtual goods pricing strategies. Piracy and online sharing are illegal but might be stimulating sales for the sellers. However, the permissions of virtual goods are additional power for the creators to allocate and exchange virtual goods in the virtual worlds. Thus it is worth investigating how virtual goods creators apply their permission and corresponding pricing strategies in virtual worlds.

Besides digital goods pricing strategies, Ba et al. (2009) develop a multi-period economic model to examine under what conditions the COPY permission leads to the highest profit for the creator of a virtual good. In our paper, we test some results of Ba et al. (2009)'s paper and explore the underneath factor that affects virtual goods pricing strategies. Permissions of virtual goods, especially Copy, allow the consumers to have free duplicates which seems to shrink sellers' market share and meanwhile induce more transactions in the virtual world. In this paper we want to explore virtual goods sellers' pricing and permissions strategies based on the empirical analysis of data from Second Life Xstreet.

3. RESEARCH METHODS

We collect data of virtual good items from XStreet SL marketplace. There are over two million items of virtual goods ever been created for sale on XStreet SL, and we collect creations that have been purchased by June 2009. Since only those who have purchased can vote for their virtual item, we get purchased items by deleting the data with no record of votes from online collections. There are altogether 16 categories, which are animals, animations, apparel, art, avatar accessories, avatar appearance, building components, business, celebrations, gadgets, home and garden, miscellaneous, recreation and entertainment, scripts, vehicles, and weapons. For each category, we generate a sample of 200 IDs among the items that have been voted with Excel Analysis ToolPak add-in, and then extract detailed information for each item on the item webpage from XStreet SL using HappyHarvester. We clean the data by deleting the items with missing values such as the creator's total production and the number of votes. We finally get a data set of 2606 items for data analysis.

The information for each item includes item ID, item name, whether it is a featured item (a featured item is an advertisement offered by XStreet SL), number of images, creator's name, quantity of the creator's total creations, category ID, category name, permissions (COPY, MODIFY, TRANSFER), price, number of comments, number of discussions, number of votes, and average ratings. Table 1 is the summary statistics for the numerical variables. In the multivariate analysis, we find that the number of reviews and the number of votes are positively correlated (0.7967), and the number of reviews and number of discussions are slightly correlated (0.3165).

Variables	Descriptions	Mean	Std Dev	Min	Median	Max
Images	Number of images	1.58	1.37	1	1	5
Creator's Tol	Creator's total production	207.28	344.72	1	93	3438
Price	Virtual good price	151.33	114.51	3	100	600
Reviews	Number of reviews	0.43	1.48	0	0	33
Discussions	Number of discussions	0.14	0.02	0	0	24
Rating	Average rating by buyers	4.24	0.64	1	4.4	5
Votes	Number of votes	11.57	22.36	3	6	547

Table 1: Summary statistics for the numerical variables

To investigate the impact of each permission on price, we transform permissions to be three dummy variables to indicate whether or not COPY, MODIFY or TRANSFER is assigned to a virtual item respectively, i.e. *Copy*=1 when COPY is assigned, and 0 vice versa. Among the collected items, 56% have COPY permission, 55% with MODIFY permission and 49% with TRANSFER. This means the virtual goods creators are more likely to assign COPY permission on the creations. Among all categories, building components have the highest probability of being assigned COPY, accounting for 88%. The most common permission and their combinations assigned to the virtual items are "Copy", "Copy & Modify", "Transfer", and "Modify & Transfer". Table 2 is the incidences of whether each permission is assigned by category, including assigned with other permissions.

Category	Total items	# and % of copy assigned		# and % of modify assigned		# and % of transfer assigned	
Animals	158	51	32%	69	44%	91	58%
Animations	168	51	30%	112	67%	105	63%
Apparel	198	109	55%	130	66%	84	42%
Art	138	39	28%	95	69%	78	57%
Avatar Accessories	181	90	50%	130	72%	73	40%
Avatar Appearance	153	89	58%	71	46%	47	31%
Building Components	173	153	88%	159	92%	129	75%
Business	162	115	71%	105	65%	83	51%
Celebrations	168	50	30%	84	50%	112	67%

Gadgets	152	81	53%	68	45%	54	36%
Home and Garden	192	114	59%	69	36%	78	41%
Miscellaneous	135	44	33%	57	42%	90	67%
Recreation & Entertainment	171	66	39%	69	40%	84	49%
Scripts	178	156	88%	92	52%	117	66%
Vehicles	148	122	82%	70	47%	37	25%
Weapons	131	102	78%	58	44%	20	15%
Grand Total	2606	1432	55%	1438	55%	1282	49%

Table 2: Incidences and percentage of permission rights by category

4. ANALYSIS

The demand of different virtual goods differs as consumers need various quantities of virtual goods for different categories, as far as COPY permission is concerned (Ba et al. 2009). This coincides with real life experience that people need duplicate in-door chairs and decoration units to serve friends, but they want unique appearance to distinguish themselves from others. Consumers also consider whether they want to keep the virtual item for everyday use or transfer it after one time virtual experience. So before we analyze the relationship between price and permissions, we first test whether virtual goods permissions and prices differ in category.

We apply a *Log* transformation on price as the distribution of the dependent variable *Price* is very skewed. *LogPrice* satisfies the normality and constant variance assumptions of statistical analysis, thus we use *LogPrice* in the following the Welch ANOVA, the random effects regression model, etc.

We use contingency analysis (Simpson 1951) to count the incidence of each permission assigned or not, and apply Pearson's chi-square test to test whether each permission is contingent on category. To test whether prices are significantly different in each category, we apply the Welch ANOVA to test if the variance of price in each category equals and then to compare the equality of means of prices for each category.

The results in table 3 show that permissions are contingent on virtual good category. In other words, creators' decisions on whether to assign COPY on virtual goods differ in category. So do modify and transfer. The result of Welch ANOVA test (at the alpha level 0.05) shows that variances of price in each category are unequal and prices differ in category.

(P-value)	*Copy*	*Modify*	*Transfer*	*LogPrice*
	Pearson's chi-square test			Welch ANOVA Test
Category	451.66 (<0.0001)	234.636 (<0.0001)	262.849 (<0.0001)	F = 11.5518 (<0.0001)

Table 3: Contingency Test of permissions and price over category

Our data supports that both permissions and prices differ in categories. That is, as for different categories, virtual goods creators apply different pricing and permission strategies to their creations. To solve the research question, we will test how each permission affects virtual goods prices next.

4.1 Whether permissions affect price

We propose that COPY, MODIFY and TRANSFER plays a significant role in virtual goods prices respectively. Thus, we hypothesize that prices differ in whether each of the permission is assigned:

Hypothesis 1a: Virtual goods prices significantly differ in whether COPY is assigned or not.

Hypothesis 1b: Virtual goods prices significantly differ in whether MODIFY is assigned or not.

Hypothesis 1c: Virtual goods prices significantly differ in whether TRANSFER is assigned or not.

We conduct Student's t–Test to compare the means of virtual goods' price with COPY permission and those prices without COPY, given that these two groups have different variances of price. We apply the same test to compare the means of price with the impact of MODIFY/TRANSFER or not. Table 4 illustrates the results of the comparison of prices regarding each permission is assigned or not respectively. Our findings support that items with COPY permission are charged higher than those without. But we found that there is no significant difference between prices of with MODIFY and No MODIFY situation. There is no significant difference between TRANSFER and no transfer strategies either. Thus, virtual goods prices in Second Life differ in whether COPY is assigned, but are independent of MODIFY and TRANSFER permission. It is consistent with the virtual goods property that with COPY permission, the consumers get more utility by consuming multiple copies simultaneously; however, MODIFY or TRANSFER permissions may increase consumer's incentive to purchase but do not affect virtual goods' utility as COPY permission does.

Welch's t-Test to compare the mean of LogPrice with each permission assigned or not									
	No Copy	Copy		No Modify	Modify		No Transfer	Transfer
Mean	4.563743	4.719116	Mean	4.61848	4.674008	Mean	4.663872	4.633886
Var.	0.904934	0.926321	Var.	1.157047	0.730943	Var.	1.052859	0.78775
Items	1174	1432	Items	1168	1438	Items	1324	1282
H0: Pc=Pnc			H0: Pm=Pnm			H0: Pt=Pnt		
df		2516	df		2201	df		2572
t Stat		-4.12652	t Stat		-1.43426	t Stat		0.798658
P(T<=t) one-tail		<0.0001	P(T<=t) one-tail		0.07582	P(T<=t) one-tail		0.212281
t Critical one-tail		1.645459	t Critical one-tail		1.645546	t Critical one-tail		1.645446
P(T<=t) two-tail		<0.0001	P(T<=t) two-tail		0.151641	P(T<=t) two-tail		0.424562
t Critical two-tail		1.960907	t Critical two-tail		1.961042	t Critical two-tail		1.960887

Table 4: Student's t-Test for price difference based on permissions

The empirical analysis has supported that prices of virtual goods differ in category, and that prices are dependent on COPY permission. We further examine whether this impact of permission COPY on prices differs in categories. According to Ba et al. (2009)'s model, "Prices and profits associated with a COPY strategy approach the ones from a NO COPY strategy when typical consumers want very few copies of an item." Thus we propose that:

Hypothesis 2: The impact of COPY permission on prices differs in categories. To be specific, the more copies a consumer wants for the virtual goods, the higher the price difference between the COPY and NO COPY strategies.

Category	Two-tail F ratio	P-value
Animals	0.6344	0.4270
Animations	0.0176	0.8945
Apparel	0.0223	0.8813
Art	0.1412	0.7077
Avatar accessories	0.2729	0.6020
Avatar appearance	0.6185	04328
Building components	12.2467	***0.0006****
Business	1.5832	0.2101
Celebrations	0.0984	0.7542
Gadgets	2.3826	0.1248
Home and garden	361.4063	***0.0001****

Miscellaneous	2.0684	0.1527
Recreations & entertainment	1.8169	0.1795
Scripts	0.0905	0.7639
Vehicles	0.0446	0.8331
Weapons	0.3168	0.5745

Table 5: Welch ANOVA test of LogPrices with COPY or not by category

We apply student's t-Test to compare the means of prices with COPY or not in each category, and to test hypothesis 2 that whether COPY in each category has different effects in price. Table 5 is the summary of the student's t-Test.

Our results in table 5 show that prices in categories *building components* and *home and garden* are significant different between COPY and No COPY strategy. In these two categories, virtual goods prices with COPY permission are higher than those without. Other categories of virtual items have not shown such significant difference in their prices with COPY permission or not. This result intuitively matches our understanding of the demand for virtual goods. In Second Life, when an avatar builds up his/her home, he/she may want a few copies of chairs in the room; he/she may also need some textures to furnish his virtual house. This kind of demand for multiple virtual goods applies in categories *building components* and *home and garden*. But for other categories of virtual goods, consumers normally would not demand duplicate copies of a single item, so the prices with COPY or not do not differ significantly. Since *building components* and *home and garden* are the two categories in which users most possibly demand copies of virtual goods, the significant difference in price with COPY or not in these two categories verifies hypothesis 2. These results are consistent with Ba et al. (2009)'s model as well.

4.2 Which factors impact price

To further investigate which factors would impact virtual goods pricing strategies, we conduct a linear regression model with all possible independent variables. Since there are eight possible permission settings for a virtual item, and applying two of them may have different effect on price, e.g., the seller will be afraid to lose the whole market if Copy and Transfer are assigned together. Thus we add the interaction effect of COPY, MODIFY, and TRANSFER into the model to test whether any combination of permissions would be significantly impacting prices. For example, *Copy*Modify* indicates whether COPY and MODIFY are assigned together. Table 6 is the description of non-continuous variables and some of their interaction effects. The continuous variables in the model have been described in table 1.

Binary variables	Indication of the variable
Copy	=1 When COPY is assigned, =0 vice versa.
Modify	=1 When MODIFY is assigned, =0 vice versa.
Transfer	=1 When TRANSFER is assigned, =0 vice versa.
*Copy*Modify*	=1 When COPY and MODIFY are both assigned, =0 otherwise.
*Copy*Transfer*	=1 When COPY and TRANSFER are both assigned, =0 otherwise.
*Modify*Transfer*	=1 When MODIFY and TRANSFER are both assigned, =0 otherwise.
*Copy*Modify*Transfer*	=1 When full permissions are assigned, =0 otherwise.
IfFeatured	=1 when an item is a feature item, =0 vice versa.

Table 6: Descriptions of binary variables in the model

We add the cross effect of *Rating* and *Votes* in the model (1), in that their intersection implies the evaluation by purchasers and the popularity of the virtual item meanwhile. Thus *Rating*Votes* as multiplied regressors are more convincing than buyer's average rating or the number of buyer's votes alone. In table 3 we have verified that prices differ in category, and then we examine virtual goods category's further impact on prices to in the regression model, eg., whether virtual goods in one

category has higher or lower average prices than other items on the marketplace. We take virtual goods category as a random effect (Long 1997) in the regression model (1). We have tested in the multivariate analysis on the continuous variables that the number of reviews is positively correlated the number of votes, and slightly correlated with number of discussions as well. To avoid multicollinearity, we do not use the number of reviews as an independent variable in the random effects regression model (1).

$$LogPrice_{i,j} = \mu + \alpha_i + X_{i,j}{}^{\mathrm{T}} \cdot \beta + \varepsilon_{i,j} \quad (1)$$

In model (1), i is the index of category, and in our analysis $i=1, 2,\ldots, 16$. j is the index of virtual items, thus $j=1, 2, \ldots, Ni$, when an items belongs to category i. Ni is the count of items in category i in the dataset. μ is the average intercept in the regression model of *LogPrice*. α_i is the random effect of price in category i. $\varepsilon_{i,j}$ is the residuals of regression model.

$$X_{i,j} = (Copy, Modify, Transfer, Copy \cdot Modify, Copy \cdot Transfer,$$
$$Modify \cdot Transfer, Copy \cdot Modify \cdot Transfer, IfFeatured, Images,$$
$$CreatorTol, Discussions, Rating, Votes, Rating \cdot Votes)_{i,j}{}^{\mathrm{T}}$$
$$\beta = (\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}, \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14})^{\mathrm{T}}$$

Table 7 shows the estimates and significance for the fixed effects. The R square of the linear regression model with random effects is 0.0986. The t Ratio and p-value for each parameter estimates of the model indicate that COPY plays a significant role in pricing strategy. The significant permissions impacting prices are COPY, TRANSFER, and the interaction effect of COPY/MODIFY, and COPY/TRANSFER. Other significant factors in the random effects model are *IfFeatured, Creator's total production, Votes* and its intersection with *Rating*.

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	4.2816264	0.195685	21.88	<.0001
Copy	0.080644	0.029282	2.75	**0.0059***
Modify	0.039073	0.027463	1.42	0.1549
Transfer	0.05854	0.02834	2.07	**0.0390***
Copy*modify	-0.054444	0.027426	-1.99	**0.0472***
Copy*transfer	-0.106127	0.0287	-3.70	**0.0002***
Modify*transfer	-0.026763	0.027329	-0.98	0.3275
Copy*modify*transfer	-0.047183	0.027121	-1.74	0.0820
IfFeatured	0.325679	0.124854	2.61	**0.0091***
Image	-0.006475	0.013308	-0.49	0.6266
Creator's total production	-0.000122	5.556e-5	-2.20	**0.0278***
Discussions	0.0417732	0.021554	1.94	0.0527
Rating	0.1512483	0.032261	4.69	**<.0001***
Votes	0.0004615	0.000902	0.51	0.6090
Rating*Votes	0.0090579	0.002591	3.50	**0.0005***

Table 7: Estimates of fixed effects and their significance in the regression model

Permission settings COPY, TRANSFER, and permission combinations Copy/Modify, Copy/Transfer are significantly impacting virtual goods pricing strategies. Thus COPY is a pivotal issue in virtual goods pricing strategies, in that not only COPY permission itself has an incremental effect in virtual good prices as we tested in hypothesis 1a , but also its permission combinations with MODIFY or TRANSFER are significant factors. COPY permission brings an item aggregation utility. This affects the demand of virtual items and become a hint how to obtain pricing strategies. Prices with COPY permission are higher than those of No COPY, which coincides with the intuition that when consumers do not want the item for many quantities, prices associated with a COPY strategy are close to the ones from a No COPY strategy. If consumers want many quantities of an item like chairs, the prices with COPY are significantly higher than those with No COPY. TRANSFER, instead, increase the users' willingness to purchase a virtual item, as TRANSFER enables the next owner to resell or

give the item away flexibly without any quality depreciation if he/she does not feel like it. Thus it is reasonable that items with TRANSFER permission are charged significantly higher than those with no transfer permission. The combination of COPY and TRANSFER has a significant negative interaction effect. Creators may be afraid that the next owner will be able to resell the creation with many duplicates. The percentage of incidence shows that assigning copy and transfer together is not a common permission setting (no more than 2%). COPY/MODIFY has a negative interaction effect. But since both COPY and MODIFY have positive effects, their combination effect is still positive.

Whether the item is *featured* and the creator's total production are both significant factors in virtual goods pricing strategies. The importance of featured items shows that in-world advertising and information dissemination is helpful to impress consumers and market the creations (Berthon et al. 1996). Featured items are charged higher than non-featured items. The virtual good creators pay for their creations to be featured on the marketplace, and in turn they will benefit from this Internet-based advertisement. However, the creators with more production charge lower prices for their creations. The more production they have, the more possibility they could copy, modify and transfer virtual items and thus lower the cost of creating new items. It could also be explained by the theorem of economies of scale in real world manufacturing industry (Krugman 1980). *Rating* and its intersection with *number of votes* are both positive factors of pricing virtual goods. This verifies that an influencing factor in 2D Internet marketing (Chevalier and Mayzlin 2006), word of mouth, is yet working in 3D virtual goods marketplace.

The random effects model predicts the categories that have different mean of prices than average as well. Table 8 is the predictions of random effects for each category.

Category	BLUP	Std Error	t Ratio	Prob>|t|
Animals	0.0866935	0.087096	1.00	0.3237
Animations	-0.082852	0.086294	-0.96	0.3411
Apparel	0.3059566	0.082895	3.69	0.0005*
Art	-0.327114	0.090561	-3.61	0.0006*
Avatar Accessories	0.149193	0.084511	1.77	0.0832
Avatar Appearance	0.0266631	0.087683	0.30	0.7621
Building Components	0.1950697	0.092315	2.11	0.0385*
Business	-0.150214	0.087143	-1.72	0.0901
Celebrations	-0.183434	0.085986	-2.13	0.0373*
Gadgets	0.0908009	0.08772	1.04	0.3049
Home and Garden	0.2150929	0.084809	2.54	0.0141*
Miscellaneous	-0.425449	0.090627	-4.69	<.0001*
Recreation and Entertainment	0.1431397	0.085288	1.68	0.0990
Scripts	-0.13289	0.089417	-1.49	0.1425
Vehicles	-0.079144	0.089422	-0.89	0.3796
Weapons	0.1684884	0.091852	1.83	0.0713

Table 8: Predictions of random effects generated by each category

The categories with significant different prices are *apparel, art, building components, celebrations, home and garden,* and *miscellaneous.* According to the sign of BLUP (best linear unbiased predictor) of the random effects, *apparel, building components,* and *home and garden* charge higher prices than average, whereas *art, celebrations,* and *miscellaneous* are cheaper in general. In categories like home and garden and building components, the items are complicated to create, i.e. more prims (the 3D single parts in-world) are needed to assemble such virtual items. Thus they are relatively more expensive than other items such as decorating gifts in celebrations category. However, virtual items like *art*, are created not only for sale, but also as an exhibition to potential users. Thus the creators would not charge high for these items.

5. CONCLUSION

This paper explores the relationship between virtual good pricing and permission strategies. The virtual good permissions on Second Life are not random rules, but instead strategic settings in a user-

generated virtual world. Virtual good permissions in Second Life become a leverage of selling virtual items. Based on real data analysi, most items are assigned COPY permission. The permission COPY, used to be regarded as a risk of losing market share, proves to be a significant factor that impact pricing strategies. The results of our data analysis are consistent with Ba et al. (2009)'s economic model of virtual goods pricing strategies in Second Life that investigates when to assign COPY permission to virtual items. Both permission settings and price strategies vary in different categories, as consumers' demand shape for virtual goods are similar within one particular category but are distinguished over different categories.

From a seller's perspective, a new seller would have no idea of consumer behavior and demand of virtual goods. Under this scenario of imperfect information on market, it is suggested he assign a higher price with copy permission at the beginning. As he becomes familiar to the virtual good market, he should lower the price of his creation and change permission rights according to his knowledge about consumer's demand for the item. This is compatible to the empirical result of information goods pricing in the presence of piracy (Chen and Png 2003).

As for a new player who wants to purchase some virtual items, it is better to look into those with transfer permission so that he can resell it if he feels not like it. In a long term, if a virtual item is necessary in virtual life, transfer permission becomes not so important because the used item would not be a good sale when it is out of fashion. Nevertheless, copy permission turns to be more critical as avatars have clear idea how much quantity he wants for a kind of virtual item after exploring virtual world for a while. And this issue in turn is the key issue to assign copy permission with perfect information on market.

This paper has its limitation. As for the data, since Second Life virtual goods trading are still new phenomenon within the past years, a lot of sellers are still exploring the virtual world without guidance. We can see from the XStreet data, a large proportion of virtual items have never been paid attention, i.e. with no incidence of buyers' votes. There are quite a few missing values for some items. We look forward to more complete data when virtual goods market in the future.

There are quite a few directions for future research within the area of virtual goods trading. We are staying in the stage of studying permissions of virtual goods on SL, which is a unique permission setting mode from other virtual worlds. Having optimal permissions and pricing strategies, we could think of predicting virtual good sales revenue as well. Current virtual world consulting corporations have summarized the virtual worlds' revenue and forecasted their trend from the vendors' perspective. As open-trading virtual worlds gain more popularity, it is interesting to predict revenue from single user's perspective. Virtual goods as advertisements have been widely applied either for real world product or as in-world promotion. Featured items on Second Life XStreet are the fixed-fee in-world advertisements for virtual items. Whether this benefits virtual goods sales or how to set an optimal advertising scheme is worth investigating. Virtual goods have artistic value. Some virtual items may have higher value than its real-world archetypes as they are easy to exhibit and not depreciating. The optimal quantity of virtual goods design is a question to realize its artistic value in virtual worlds. We hope this paper will shed light on users of virtual world and attract potential users to take part in virtual goods trading.

Reference

Ba, S., Ke, D., Stallaert, J. and Zhang, Z. (2009). Why give away something for nothing when you can charge? Investigating virtual goods pricing and permission strategies. Working paper.

Belleflamme, P. (2000). Pricing Information Goods in the Presence of Copying. Available at SSRN: http://ssrn.com/abstract=333323.

Bakos, Y. and Brynjolfsson, E. (1999). Bundling Information Goods: Pricing, Profit and Efficiency. *Management Science*. 45(12), 1613-1630.

Belleflamme, P. (2002). "Pricing Information Goods in the Presence of Copying," Available at SSRN: http://ssrn.com/abstract=333323.

Berthon, P., Pitt, L.F., and Watson, R.T. (1996). The World Wide Web as an advertising medium. *Journal of Advertising Research*, 36(1), 43-54.

Bhargava, H.K. and Choudhary, V. (2008). "When Is Versioning Optimal for Information Goods?" *Management Science*, 54(5), 1029-1035.
Bhattacharjee, S. Gopal, R.D. Lertwachara, K., and Marsden, J.R. (2006). Consumer Search and Retailer Strategies in the Presence of Online Music Sharing. *Journal of Management Information Systems*. 23(1), 129-159.
Bridges, C., Hummel, J., Hursthouse, J., Moss, R. (2007). Metaverse roadmap – pathways to the 3D web. http://www.metaverseroadmap.org/MetaverseRoadOverview.pdf .
Castronova, E. (2001). Virtual Worlds: A First-Hand Account of Market and Society on the Cyberian Frontier. The Gruter Institute Working Papers on Law, Economics, and Evolutionary Biology, 2.
Castronova, E. (2002). On Virtual Economies. CESifo Working Paper Series No. 752. Available at SSRN: http://ssrn.com/abstract=338500
Chellappa, R. and Shivendu, S. (2005). "Managing Piracy: Pricing and Sampling Strategies for Digital Experience Goods in Vertical Segmented Markets." *Information Systems Research*. 16 (4), 400-417.
Chen, Y. and Png, I. (2003). Information Goods Pricing and Copyright Enforcement: Welfare Analysis. *Information Systems Research.* 14(1), 107-123.
Cheng, H.K. and Liu, Y. (2008). "Software Free Trial: How Long is Optimal?" Available at SSRN: http://ssrn.com/abstract=1013459.
Cheng, H.K. and Tang, Q.C. (2007). "Free Trial or No Free Trial: Optimal Software Product Design with Network Effects." Available at SSRN: http://ssrn.com/abstract=1082120.
Chevalier, J.A. and Mayzlin, D. (2006). The effect of word of mouth on sales: online book reviews. *Journal of Marketing Research.* 43(3), 345-354.
Conner, K. (1995). Obtaining Strategic Advantage from Being Imitated: When Can Encouraging 'Clones' Pay. *Management Science*. 41(2), 209-225.
Fetscherin, M., Lattemann, C. (2007). User acceptance of virtual worlds – an explorative study about second life. Rollins College/University Potsdam. Http://www.fetscherin.com/UserAcceptanceVirtualWorlds.htm .
Gopal, R.D., Bhattacharjee, S. and Sanders, G.L. (2006). "Do Artists Benefit from Online Music Sharing?" *Journal of Business*. 79(3), 1503-1534.
Kappe, F. (2009). An Interoperability Framework for the Free Trade of Virtual Goods and Services Across Virtual Worlds. ICT Proposers Day, Budapest, Hungary. (http://ec.europa.eu/information_society/events/cf/document.cfm?doc_id=9411)
Krugman, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade. *The American Economic Review*, 70(5), 950-959.
Long, J.S. (1997). Regression models for categorical and limited dependent variables. Thousand Oaks : Sage Publications.
Oestreicher-Singer, G. and Sundararajan, A. (2006). "Are Digital Rights Valuable? Theory and Evidence from eBook Pricing." CeDER Working Paper No. 06-01. Available at SSRN: http://ssrn.com/abstract=871243.
Ondrejka, C. (2007). Collapsing geography. Second life, innovation, and the future of national power. Innovations 2(3):27-54.
Raghu, T. S., Sinha, R., Vinze, A. and Burton, O. (2006). Willingness to Pay in an Open Source Software Environment. *Information Systems Research*. 20(2), 218-236.
Shapiro, C. and Varian, H. (1998). Versioning: the Smart Way to Sell Information. *Harvard Business Review*, Nov-Dec, 106-144.
Shapiro, C. Varian, H.R. (1999). Information rules: a strategic guide to the network economy. Harvard Business School Press, Boston.
Simpson, E. H. (1951). The interpretation of interaction in contingency tables. *Journal of the Royal Statistical Society*. Series B (Methodological), 13 (2), 238-241.
Varian, H. (1997). "Versioning Information Goods." *The Economics of Digital Information*. Discussion paper, MIT Press, MA.
Varian, H. (2000). Buying, Sharing and Renting Information Goods. *The Journal of Industrial Economics*. 48(4), 473-488.