

Digital Rights Strategies in a Virtual World Marketplace

Yuanrong Hu, Si Fan, and QiuHong Wang^(✉)

School of Management, Huazhong University of Science and Technology,
Wuhan, China
qhwang@mail.hust.edu.cn

Abstract. This paper adopts the Heckman two-step model to analyze the impact of copyright strategy on sales performance of digital product, using the panel data comes from online virtual goods transaction website Xstreet.com. The results show that (1) significant relationship exists between sales performance and copyright strategy of digital product, but the influence of each copyright strategy on sales performance are different; (2) A seller's copyright structure within same product line can also affect sales performance of a digital product, thus in order to optimize the copyright combinations, a seller should fully consider the copyright strategy within the whole product line.

Keywords: Copyright strategy · Digital products · Virtual products

1 Introduction

Rapid advances in Web2.0 and digital technologies now enable end-users to create and share digital contents through Internet. A large amount of user generated content (UGC) are created on social networks such as wikis, blogs, Twitter feeds, as well as in virtual worlds such as Second Life [1]. The proliferation of UGC greatly enhances the production and consumption of digital content, and thus offers a great business chance for content providers. Meanwhile, concerns were raised about digital rights violations. To protect their benefit, Many right-holders adopt technological methods, i.e. DRM (Digital right management system), to deterring rights piracy. However, copyright control technologies make them confronted with a digital dilemma [2]. On the one hand, the copyright protection technologies allow rights-holders well control the permissions granted to end-users (i.e. View, Copy, edit, move, etc.). On the other hand, it may in turn decrease demand due to the possible restriction on user rights. Prior researchers have done a lot of works on copyright protection strategy (either technological or administrative) to compete with piracy [3–6] and impact of the piracy on digital product sales performance [7–10]. Some find that both the legal demand and the willingness to pay for digital content will increase without DRM due to the increased consumer utility [6]. Therefore, in order to maximize profits, the rights-holders must find the optimal copyright strategies to keep balance between copyright protection and the legal use of end-users [5]. This study investigates the relationship between digital rights strategy and digital products' sales. Our main objectives is to (1) examine how copyright strategies affect sales performance of digital contents; (2) examine how the

rights-holders set copyright strategies optimize copyright strategies under multi-product sales and different market structure.

We base our research on the online virtual goods transaction website www.Xstreet.com. Xstreet is the official transaction marketplace of Second Life. More than two million items and 22 categories of user-created virtual goods are for sale on XStreet SL. These virtual goods have many similarities to digital products. Firstly, they are digital and can be sale and distributed though Internet. Secondly, creators of virtual goods in Second Life own entire copyright of the product. To maximize benefits, sellers in Xstreet adopt different copyright strategies for virtual goods [11]. The three basic right permission (i.e. copy, modify, and transfer) are very similar to the three main rights of digital content illustrated in DRM system (i.e. render, transport, and derivative right) [12]. Thirdly, Different copyright strategy can affect user's perceived utility and thus have impact on demand [11, 13]. These similarities provide the probability of applying our findings based on virtual goods to general digital products. Furthermore, Xstreet has tens of thousands of active buyers and sellers. According to Second Life statistics, the daily transactions for virtual goods are 1.2 million in 2013.¹ So it provides us a favorable research platform to study the relationship between the copyright strategy and digital content sales performance.

Our findings suggest that (1) Sales performance of digital content significantly correlates to its copyright permission. Relative to no right permission strategy, the only modify strategy and the only transfer strategy will decrease the product's probability of entering into top 1000 sales ranking list, while other four strategies can increase the probability. (2) Other things being equal, digital contents with completely open copyright (e.g. Copy & modify & transfer) will cannibalize the market share of seller's other products in same category or with same function. The right-holders shall optimize his copyright strategies by taking into consideration the permission setting of other similar goods in his own product line or even the whole market.

The rest of this paper is organized as follows. Next section reviews the related literatures. Section 3 presents research date and some theoretical assumptions. Section 4 presents the estimation results and research findings. Section 5 concludes the paper.

2 Related Literatures

Our paper is directly related to four streams of literature, including the literatures about (1) virtual goods consumption; (2) Digital Rights Management (DRM); (3) information goods pricing and versioning; (4) open source product.

2.1 Virtual Goods Consumption

Various studies focus on consumer's virtual item purchasing behavior in virtual world [14–18]. Guo et al. (2009) provides us the empirical evidence that factors such as social

¹ http://community.secondlife.com/t5/Featured-News/bg-p/blog_feature_news

influence, trust, perceived profit-making opportunities are most concerned by purchasers [16]. Therefore, except the function of virtual item, players also compare prices and seller's credit ratings before purchasing. Guo et al (2011) further find that the higher degree of customization will significantly increase the consumer's purchase intention [17]. Yee (2005) also find consumers can get satisfaction with customizing their avatar appearance and using unique accessories [18].

These literatures about consuming behavior in virtual world constitute solid theoretical basis for our study. In SecondLife, Modify permission can increase the customization degree by enabling purchasers to change the original design. Transfer permission can increase buyers' profit-making opportunity in the future. Thus, different right permissions can definitely affect user's purchasing behavior. However, prior literatures do not identify the right permission of virtual items as an important factor influencing sales performance. Basulin et al. (2009) recognize the problem and conduct an empirical study to examine the relationship between price and permission of virtual items in Second Life. the results show the positive effect of "copy" permission on virtual goods pricing strategy [11].

Our paper is closest to the research of [11] but differs from it in four aspects. First, we consider right permission in our model as a copyright strategy, not as one of the product attributes. Second, we aim to test the relationship between copyright strategies and sales performance (not price) of virtual product. Third, we also examine how sellers optimize copyright strategies under multi-product sales condition and different market structure. Fourth, we view virtual goods as one special form of digital content and thus extend our conclusions to digital product area.

2.2 Digital Rights Management (DRM)

DRM, which is defined as technologies, tools and processes to protect intellectual property during digital content business, can help right holders well control the use and distribution of the digital content and effectively prevent piracy [4]. Rosenblatt et al. describe the three main rights granted to users in DRM: render (including view, print and play), transport (including copy, move and loan) and derivative rights (including extract, edit and loan) [12]. The rights description in [4] and [12] are similar to the main three types of rights (i.e. COPY, MODIFY, and TRANSFER) in our setting. [19] and [20] find evidence about the role of DRM in enhancing producer's control ability in movie industry. However, Sinha et al. [6] empirically demonstrate that the revenue of music producers will increase as they supply DRM-free rather than DRM music in the market. DRM-free environment can increase the demand and consumers' willingness to pay for legal product [6]. Foroughi (2002) consider that, in order to maximize the profits, the rights-holders must seek to find the optimal copyright strategies to keep a delicate balance between copyright protection and the legal accessibility of end-users [5]. Our paper is different from [5] and [6] in that it presents a more specific model involved eight different copyright permissions and investigate how these permissions affect sales performance. Thus, our work contributes this literature by quantifying the influence of different copyright strategy on sale.

2.3 Information Goods Versioning

From copyright perspective, virtual goods share some similar features with information goods. Free-trial software is analogous to virtual goods with copy and transfer permissions. Customized information goods are similar to the modified virtual item. While online sharing music and open source software are in common with transferable virtual product. The versioning of information goods has attracted considerable interest in the literature. Shapiro proposes that content provider can execute price discrimination by supplying different version in the market to satisfy consumer demand of different level. By this way they can gain more consumer surplus [21]. Chen et al.(2007) and Bhargava et al.(2008) indicate versioning is optimal for the seller when there is multiple outside option for customers and high-end customers would not be attractive by lower-quality version [22, 23]. In our paper, we consider copyright permission as a method of versioning. Virtual goods seller can set different copyright permission for similar products to meet different needs and thus attract more potential consumers. Meanwhile, our results suggest some permission strategy may not necessarily increase sales. Rather, it could lead to cannibalization effect in same category. This paper adds to the existing literatures a delicate analysis of cannibalization effect occurring in similar products with different copyright permissions.

2.4 Open Source Software (OSS) and License

OSS is software that is subject to a particular type of license. The OSS licenses ranges from very permissive to more restrictive [24]. Conversely, Proprietary software normally restricts user's rights to copy, redistribute, or modify. Sen et al. (2011) suggest that more restrictive license will decrease user's perceived value from two aspects: (1) limit the commercial use in the future; (2) lack of compatibility with other software with less restrictive license. Thus, the less restrictive (more permissive) the license is, the more the user OSS can attract [25]. Subramaniam et al. (2009) find that if great efforts are needed to improve OSS, the following developer would prefer less restrictive license [26]. The situation is similar for digital product, especially in an age of UGC. UGC is usually created based on the existing digital products. For the creative work requiring more professional technology, users want more permission to copy, share or resell the product so that they can gain revenue. In virtual world Second Life, modifying a virtual good such as Script products is difficult for common users, so only-modify permission cannot positively affect user interest and sales performance. By contrast, full permission will attract more users and developers due to the possibility to sell the improved products in the future.

3 Hypothesis and Research Model

In this section, we outline the main hypothesis addressed in this paper and discuss the theoretical rationale underlying each hypothesis.

Different copyright permission would affect user's expected utilities and purchasing decision. From this perspective, Second Life provides us a rich date pool to study the

relationship between the copyright strategy and digital product sales performance. Different from other virtual world, Second Life users are an important part of the largest user-generated 3D virtual goods economy in the world. They create, merchandise, and sell virtual goods for Linden dollars, which is exchangeable for real currencies such as U.S. dollars. Furthermore, Creators of virtual goods in Second Life own entire copyright of their creations and can set different copyright permissions to protect their intellectual property and limit the usage rights of next owner. Though combination of the three basic permissions, there are eight permission strategies seller can set: Copy-only, Modify-only, Transfer-only, Copy & Modify, Copy & Transfer, Modify & Transfer, Copy & Modify & Transfer (full-permission), and No-permission. If a consumer gets a product with Copy & Modify permission, he can revise the original design of the product according his own preference (modify permission) and make a lot of copies of this product (copy permission). However, resell and redistribute the original product and the duplicates are not allowed without Transfer permission.

3.1 The Impact of Copyright Permission on Sales Performance

Basulin (2009) points out consumers in virtual world may tend to use many same products at the same time [11]. For example, consumers may need more than one of same virtual chairs to decorate his virtual kitchen. Copy permission ensure consumer legally own and use the copies of the virtual product without any additional cost, thus can increase the utility of consumer and encourage the purchasing behavior. The existing literature revealed that, customized products and service become the important competitive advantage of online commerce [27, 28]. Compared with traditional products, customized goods can meet consumer's special preference and increase purchasing willingness. Modify permission enable purchasers to change the product's original design, thus can satisfy the different demand of individual customer. Therefore, we consider copy permission and modify permission have positive impact on sales.

Berry et al (2002) consider convenience as a method to measure the level of time and effort saving in buying and using the product [29]. The more convenient the purchasing process is, the stronger the consumer's willingness to purchase due to the decreased transaction cost. Thus, convenience is positive correlated with purchase willingness. Transfer permission grants consumer the legal right to resell and redistribute the virtual product to others in the future, which can reduce the decision complexity. If the product is not satisfactory, purchaser can resell it to minimize his lost. Additionally, Transfer permission can increase buyers' profit-making opportunity in the future. Thus, we consider transfer permission have positive impact on sales.

Based on the above analysis, we hypothesize as follows:

Hypothesis 1.1(H1.1): COPY, MODIFY, TRANSFER permission all have positive impact on sales performance.

If the three permissions all have positive impact on sales performance, we can further assume that product with more-than-one permissions would be more popular than which with single permissions. We further state the hypothesis as follows:

Hypothesis 1.2(H1.2): Any combination of the three permissions has a larger impact on sales performance than single permission.

3.2 The Cannibalization Effect of the Copyright Permission on Sales Performance of Products Within the Same Product Line

In general, multiple product manufactures tend to provide a wide range of products under same product line so that consumers have more choice to meet their individual preference and budget constraint. For instance, Hyundai produces advanced limousines XG for wealthy customers, Accent for consumers of small cars, and Santa Fe for consumers favor multi-purpose vehicle. A lot of researches have shown that product variety strategy can effectively promote sales and expand market share [30–32]. Similar to conventional product producer, many digital companies like Borland sold different versions of their programs—one was low priced and could not be copied and the other was high priced and could [21]. Shapiro and Varian (1998) suggest that digital information goods can be differentiated though granting different rights for user to store, duplicate, print or otherwise manipulates the digital product [21]. Thus, copyright permissions can be used as important method of distinguishing digital products. However, product variety also leads to the cannibalization effect within same product line. If digital product producer provide different versions so as to induce consumers to self-select, the cannibalization may occur within same product line. Considering the dual role copyright permission paly, it is important for profit-maximizing right-holders to decide whether they should set same copyright permission within product line or not. We state our hypothesis as following:

Hypothesis 2 (H2): The cannibalization effect exists between products within same product line when different copyright permissions assigned to them.

4 Data and Econometric Specifications

4.1 Data and Variables

The panel data used in this paper comes from online virtual goods transaction website www.Xstreet.com. We focus on products in 5 categories: Animations, Arts, Audio and Video, Business, Scripts. During the study period starting from January 2011 to May 2011, we collect the detailed information of all products in focused categories, including item ID, item name, seller name, price, right permission, the highest history rank, current rank, number of reviews, number of discussions, and number of votes, score and item category. Thus the final panel data have 20-weeks.

4.1.1 Dependent Variable

Given Linden Lab did not officially publish transaction date such as cumulative transaction volume, we use sales rank as a proxy for the number of products sold in XStreet market. XStreet.com lists the Top 1000 best-selling products, with 1 corresponding to the highest selling product. Literatures related to economics and marketing revealed that sales and sales rank follows a Pareto distribution [33, 34]. The higher the rank is, the more the sales, and vice versa. Thus we use RANK and RANK_YN as an indicator of digit product sales performance in second life. RANK_YN is a 0-1 variable to denote that whether the products enter into the TOP 1000 ranks (equal to 1) or not (equal to 0). RANK is the actual ranking of the product on the TOP list.

4.1.2 Independent Variables

In Second Life, The combination of three basic permissions (Copy, Modify, and Transfer) forms eight copyright permission strategies. We create a set of copyright dummy variables to represent seller's copyright setting: CRC, CRM, CRT, CRCM, CRMT, CRCT, CRCMT, and CRN. CRC, CRM, CRT represent Copy, Modify, Transfer permission only respectively. CRCM represent Copy & Modify permission, CRMT represent Modify & Transfer permission, CRCT represent Copy & Transfer permission, CRCMT represent full permission, CRN represent No permission.

4.1.3 Control Variables

In our study, we control for other factors that could affect sales performance but are not explored in this research: price, score, category, market competition factors, and total number of products sold by seller.

Prior research shows that online scoring system play a very important role in establishing consumer trust and thus is a crucial factor affecting seller's success [35]. We incorporate seller's score into our model, denoted by SCORES. In order to control the impact of business scale on sales performance, we incorporate the total number of product of a seller into our model, represented by TOL. Two variables (WEEK, WEEKS) are introduced to control the change of market factors, such as the total number of products for sale in XStreet, the total weekly transaction volume, WEEK reflect the linear impact of linear factors, and equal to $0 \sim 19$. WEEKS reflect nonlinear impact of unobserved factors, and equals to $0^2 \sim 19^2$. Finally, we create four dummy variables (ANI, ARTS, AUVI, BUZ) that control the impact of category on sales performance. The ANI=1 when the product is in animation category, otherwise ANI=0. Similarly, ARTS=1, AUVI=1, BUZ=1 when the virtual product is in arts, Audio and Video, Business category respectively. Script is benchmark group.

The summary statistics of all variables discussed above is given in Table 1.

Table 1. Summary Statistics (N=1,360,483)

Variables	Mean	Std.dev.	Min	Max
PRICE	416.6456	18887.21	0	10000000
RANK	486.9281	282.9132	1	1000
RANK_Y	0.0013598	0.0368506	0	1
SCQRES	4.10082	0.667001	1	5
TOL	176.3738	461.7694	1	2936
CRC	0.107036	0.309159	0	1
CRM	0.062512	0.242084	0	1
CRT	0.147555	0.354658	0	1
CRCM	0.20795	0.405841	0	1
CRMT	0.219565	0.413952	0	1
CRCT	0.042979	0.20281	0	1
CRCMT	0.122365	0.327707	0	1
CRN	0.079822	0.271018	0	1

4.2 Results

4.2.1 Copyright Strategy Impact on Sales

In order to eliminate selection bias, we adopt the following Heckman two-step model to examine the impact of copyright strategy on sales performance of digital products. In step 1, we estimate the relationship between the copyright strategy and the probability of a product entering the TOP 1000 rank. In step 2, we incorporate the inverse Mills ratio (calculated from step 1) into the equation and further analyze the impact of copyright strategy on product's sales performance (RANK). In order to reduce the disturbance of numeric volatility, we take the log form of RANK_YN, RANK and TOL. Due to many sellers provide freebie goods (price=0), PRICE is transferred to $\ln(\text{price}+1)$. The coefficient estimates (β_1 - β_7) for CRC, CRM, CRT, CRCM, CRMT, CRCT, CRCMT are of our interest. CRN is benchmark variable. Table 2 reports the main results of the econometric estimation.

Table 2. Estimats for Heckman two-step model (N=1,360,483)

VARIABLE	RANK_YN	log(RANK)
CRC	-0.0271	0.1805
CRM	-0.4605***	0.8326 ⁺
CRT	-0.2473***	0.1511
CRCM	0.3852***	-0.4175 ⁺
CRMT	0.1590**	-0.0789
CRCT	0.1349 ⁺	0.2386
CRCMT	0.1703**	-0.1072
ANI	0.4164***	-0.3356
ARTS	-0.4953***	0.0326
AUVI	0.2325***	-0.5478***
BUZ	-0.2058***	0.3551**
log(PRICE+1)	0.2140***	0.1294*
SCORE	0.3339***	-0.2628
log (TOL)	-0.1226***	0.1433***
WEEK	-0.0071	0.0165
WEKKS	0.0003	-0.0004
Invers Mills ratio		-0.3876
R ²	0.1741	0.1045
Chi ² /F	3325.95***	10.54***

$$\text{probit}(\text{RANK}_{\text{YN}_{it}}) = \beta_0 + \beta_1 \text{CRC}_{it} + \beta_2 \text{CRM}_{it} + \beta_3 \text{CRT}_{it} + \beta_4 \text{CRCM}_{it} + \beta_5 \text{CRMT}_{it} + \beta_6 \text{CRCT}_{it} + \beta_7 \text{CRCMT}_{it} + \beta_8 \text{ANI}_i + \beta_9 \text{ARTS}_i + \beta_{10} \text{AUVI}_i + \beta_{11} \text{BUZ}_i + \beta_{12} \ln(\text{PRICE}_{it} + 1) + \beta_{13} \text{SCORES}_{it} + \beta_{14} \ln(\text{TOL}_{it}) + \beta_{15} \text{WEEK}_t + \beta_{16} \text{WEEKS}_t + \varepsilon_{1it}$$

(step 1)

$$\ln(\text{RANK}_{it}) = \beta_0 + \beta_1 \text{CRC}_{it} + \beta_2 \text{CRM}_{it} + \beta_3 \text{CRT}_{it} + \beta_4 \text{CRCM}_{it} + \beta_5 \text{CRMT}_{it} + \beta_6 \text{CRCT}_{it} + \beta_7 \text{CRCMT}_{it} + \beta_8 \text{ANI}_i + \beta_9 \text{ARTS}_i + \beta_{10} \text{AUVI}_i + \beta_{11} \text{BUZ}_i + \beta_{12} \ln(\text{PRICE}_{it} + 1) + \beta_{13} \text{SCORES}_{it} + \beta_{14} \ln(\text{TOL}_{it}) + \beta_{15} \text{WEEK}_t + \beta_{16} \text{WEEKS}_t + \beta_{17} \lambda_{it} + \varepsilon_{2it}$$

(step 2)

Note that the coefficient of CRC, CRM, and CRT in RANK_YN model is all negative, though the coefficient of CRC is not significant. That means that products with single permission have lower probability of entering TOP 1000 rankings than those with no permissions. Thus, hypothesis H1.1 is not approved. Instead, the coefficient for CRCM, CRCT, and CRCMT in RANK_YN model is significant and positive. The coefficient of CRMT is positive but not significant. The results indicate that the probability of entering TOP 1000 rankings is higher for goods with multiple permissions than those with single and no permissions. Thus, hypothesis H1.2 is approved.

In general, the estimates for RANK_YN indicate that the multiple permission strategy is superior to single permission strategy. Among all copyright strategies, the copy&modify work best. However, we should also note that all coefficient of our interest are not significant in RANK model (step 2). This indicates that the promotion effect of copyright strategy only exists before the products entering the TOP ranks. Thus at the early stage of promotion, the seller should optimize the copyright strategy to gain market share rapidly. Once the product list in Top 1000 ranking, right permission is not a primary factor for consumer's purchasing decision.

4.2.2 Cannibalization Effect

Generally, product variety strategies can be effective in expanding market share [30–32]. However, Prior research has generated substantial evidence that extensive differentiation can lead to significant cannibalization within the firm's product line [36, 37]. On SL virtual product market, a lot of products with similar function are sold with different copyright permission. In a particular category, if a seller grants his products with varies permission, the cannibalization may exist between these products. In this part we will further analyze how the seller's copyright distribution in his product line affects sales performance.

Consider a seller have many products on sale with varies permissions. We construct a set of variables CR_k/CR_j ($k, j=1, 2, \dots, 7$, and $k \neq j$) to identify sellers copyright distribution ($i=1$ for copy, 2 for modify, 3 for transfer, 4 for copy&modify, 5 for modify&transfer, 6 for copy&transfer, 7 for copy&modify&transfer). If a product is granted CRM permission, then $j=4$. CR_j represents the number of products with CRM strategy the seller provides. CR_k represents the number of products with other 6 permissions respectively. Thus we totally get 42 variables. For each $j \neq 4$, we set $CR_k/CR_j=0$. We use these variables to measure the impact of other products' permission strategy on a products' probability of entering the TOP 1000 list (Table 3).

We use the following Probit model to test our hypothesis H2.

$$\begin{aligned} \text{probit}(\text{RANK}_{YN_{it}}) = & \beta_0 + \beta_1 \text{CRC}_{it} + \beta_2 \text{CRM}_{it} + \beta_3 \text{CRT}_{it} + \beta_4 \text{CRCM}_{it} + \beta_5 \text{CRMT}_{it} \\ & + \beta_6 \text{CRCT}_{it} + \beta_7 \text{CRCMT}_{it} + \beta_8 \text{ANI}_i + \beta_9 \text{ARTS}_i + \beta_{10} \text{AUVI}_i + \beta_{11} \text{BUZ}_i \\ & + \beta_{12} \log(\text{PRICE}_{it} + 1) + \beta_{13} \text{SCORES}_{it} + \beta_{14} \log(\text{TOL}_{it}) + \beta_{15} \text{WEEK}_i \\ & + \beta_{16} \text{WEEKS}_i + \gamma \text{CR}_{kit} / \text{CR}_{jit} + \varepsilon_{1it} \end{aligned}$$

Note that, $\gamma = [\gamma_{-1}, \gamma_{-2}, \dots, \gamma_{-42}]$.

Table 3. Impact of copyright distribution on sales performance

$\begin{smallmatrix} i \\ k \end{smallmatrix}$	1	2	3	4	5	6	7
1		+	+	-	+	+	-
2	+		-	-	-		
3	-	-		-	-		-
4	-	-	+		+	-	-
5	+	-	-	-		-	-
6	+		-	+	+		-
7	-	-	-	-	-	-	

The estimation results show that only some coefficients are statistically significant. Therefore we adopt the non-parameters symbols test to focus on the signs of the estimated regression coefficients. The results are reported in Table 7. The signs in line 3 and line 7 are all negative, indicating that a products’ sales would be cannibalized by products with CRT and CRCMT permissions.

5 Strengths and Weaknesses of the Study

This paper is one of the first steps in examining the impact of copyright permission strategy on digital products transaction in a virtual market. Applying Heckman models, we are able to find that virtual goods’ copyright permission settings on Second Life are not random rules, but strategic in this user-generated virtual word. Price strategy and copyright permission of virtual goods in Second Life is a leverage of selling virtual. Some results of our initial data analysis are consistent with prior research work.

This paper has its limitations. As for the great volume data, it takes a quite long time to download the whole dataset and the Linden Lab strategically makes a fast and complete download impossible. So we cannot get the whole dataset from XStreet; meanwhile, sellers do adjust their item settings along the time, but we cannot capture how, when and what they change, which lower our dataset’s accuracy. We also can see from our data collection that a great amount of items in XStreet have never been paid attention or even been purchased, i.e. items without Votes records. There are quite a few missing values for a certain number of items. We do not have virtual goods transaction volume data; even though we use XStreet sales rank as proxy of buyers’ demand, the result still contains bias. In addition, definition of “similar-item” is not accurate. Given the varieties of subcategories, we think items within same category can be totally different, which will result in biased and inconsistent parameter estimations.

In this paper, we discuss the impact of copyright strategies on virtual goods transaction in Second Life Marketplace. These virtual goods bear certain similarities with other information goods, i.e. e-book, software and online music. Prior research on copyrights of information goods focus on a market structure with few vendors and mass consumers, while our study focus on an online market with many creators and sellers. Some of our conclusions can be extended to other digital goods. We hope this paper will shed light on users of virtual world and attract practitioners and researchers

to explore the general or universal optimal permission strategy that can be taken by all digital goods.

Acknowledgements. We thank for the financial support from the Natural Science Foundation of China (71371082) and the innovation research funding (2013TS088) from the Huazhong University of Science and Technology.

References

1. Halbert, D.: Mass culture and the culture of the masses: a manifesto for user-generated rights. In: *Vand. J. Ent. & Tech. L.*, 11, 921(2008)
2. Aichroth, P., Hasselbach, J.: Incentive management for virtual goods: about copyright and creative production in the digital domain. *Virtual Goods* **2003**, 70–81 (2003)
3. Jamkhedkar, P.A., Heileman, G.L.: Digital rights management architectures. *Comput. Electr. Eng.* **35**(2), 376–394 (2009)
4. Fetscherin, M.: Digital rights management: what the consumer wants. *J. Digit. Asset Manage.* **2**(3–4), 143–149 (2006)
5. Foroughi, A., Albin, M., Gillard, S.: Digital rights management: a delicate balance between protection and accessibility. *J. Inf. Sci.* **28**(5), 389–395 (2002)
6. Sinha, R.K., Machado, F.S., Sellman, C.: Don't think twice, it's all right: Music piracy and pricing in a DRM-free environment. *J. Mark.* **74**(2), 40–54 (2010)
7. Chen, Y.N., Png, I.: Information goods pricing and copyright enforcement: Welfare analysis. *Inf. Syst. Res.* **14**(1), 107–123 (2003)
8. Khouja, M., Park, S.: Optimal pricing of digital experience goods under piracy. *J. Manage. Inf. Syst.* **24**(3), 109–141 (2007)
9. Khouja, M., Smith, M.A.: Optimal pricing for information goods with piracy and saturation effect. *Eur. J. Oper. Res.* **176**(1), 482–497 (2007)
10. Khouja, M., Rajagopalan, H.K.: Can piracy lead to higher prices in the music and motion picture industries? *J. Oper. Res. Soc.* **60**(3), 372–383 (2009)
11. Ba, S., Ke, D., Stallaert, J., Zhang, Z.: Why give away something for nothing? Investigating virtual goods pricing and permission strategies. In: *ACM Transactions on Management Information Systems (TMIS)*, 1(1), p. 4 (2010)
12. Rosenblatt, W., Trippe, W., Mooney, S.: *Digital Rights Management: Business and Technology* (2002)
13. Ba, S., Ke, D., Stallaert, J., Zhang, Z.: An empirical analysis of virtual goods pricing strategies in virtual worlds. In: *PACIS*, p. 86 (2010)
14. Lehdonvirta, V.: Virtual item sales as a revenue model: identifying attributes that drive purchase decisions. *Electron. Commer. Res.* **9**(1–2), 97–113 (2009)
15. Martin, J.: Consuming code: use-value, exchange-value, and the role of virtual goods in second life. *J. Fost Virtual Worlds Res.* **1**(2), 1–21 (2008)
16. Guo, Y., Barnes, S.: Virtual item purchase behavior in virtual worlds: an exploratory investigation. *Electronic Commer. Res.* **9**(1–2), 77–96 (2009)
17. Guo, Y., Barnes, S.: Purchase behavior in virtual worlds: an empirical investigation in second life. *Inf. Manage.* **48**(7), 303–312 (2011)
18. Yee, N.: Motivations of play in MMORPGs. In: *DiGRA*. Vancouver, Canada (2005)
19. Waterman, D., Ji, S.W., Rochet, L.R.: Enforcement and control of piracy, copying, and sharing in the movie industry. *Rev. Ind. Organ.* **30**(4), 255–289 (2007)

20. Kuchinskas, S.: Mazingo: DRM plus content could equal handheld movies. *Econtent-Wilton*-**26**(3), 52–53 (2003)
21. Shapiro, C., Varian, H.R.: Versioning: the smart way to. *Harvard Bus. Rev.* **107**(6), 107 (1998)
22. Chen, Y.J., Seshadri, S.: Product development and pricing strategy for information goods under heterogeneous outside opportunities. *Inf. Syst. Res.* **18**(2), 150–172 (2007)
23. Lee, C.Y.: When is Versioning Optimal for Information Goods? (2010)
24. Sen, R., Subramaniam, C., Nelson, M.L.: Determinants of the choice of open source software license. *J. Manage. Inf. Syst.* **25**(3), 207–240 (2008)
25. Sen, R., Subramaniam, C., Nelson, M.L.: Open source software licenses: strong-copyleft, non-copyleft, or somewhere in between? *Decis. Support Syst.* **52**(1), 199–206 (2011)
26. Subramaniam, C., Sen, R., Nelson, M.L.: Determinants of open source software project success: a longitudinal study. *Decis. Support Syst.* **46**(2), 576–585 (2009)
27. To, P.L., Liao, C., Lin, T.H.: Shopping motivations on Internet: a study based on utilitarian and hedonic value. *Technovation* **27**(12), 774–787 (2007)
28. Franke, N., Schreier, M., Kaiser, U.: The “I designed it myself” effect in mass customization. *Manage. Sci.* **56**(1), 125–140 (2010)
29. Meuter, M.L., Ostrom, A.L., Roundtree, R.I., Bitner, M.J.: Self-service technologies: understanding customer satisfaction with technology-based service encounters. *J. Mark.* **64**(3), 50–64 (2000)
30. Bayus, B.L., Putsis Jr, W.P.: Product proliferation: an empirical analysis of product line determinants and market outcomes. *Mark. Sci.* **18**(2), 137–153 (1999)
31. Chong, J., Ho, T., Tang, C.S.: Product structure, brand width and brand share. In: *Research Advances in Product Variety*, Kluwer Academic Publishers, Boston, MA (1998)
32. Kekre, S., Srinivasan, K.: Broader product line: a necessity to achieve success? *Manage. Sci.* **36**(10), 1216–1232 (1990)
33. Sundararajan, G.O.S.A.: Are Digital Rights Valuable? Theory and Evidence from eBook Pricing (No. 06-01). CeDER Working Paper (2006)
34. Devi, J.I.: Estimating the helpfulness and economic impact of product reviews. *Int. J. Innovative Res. Dev.* **1**(5), 232–236 (2012)
35. Qu, Z., Zhang, H., Li, H.: Determinants of online merchant rating: Content analysis of consumer comments about Yahoo merchants. *Decis. Support Syst.* **46**(1), 440–449 (2008)
36. Hui, K.L.: Product variety under brand influence: an empirical investigation of personal computer demand. *Manage. Sci.* **50**(5), 686–700 (2004)
37. Moorthy, K.S.: Market segmentation, self-selection, and product line design. *Marke. Sci.* **3**(4), 288–307 (1984)