THE EFFECTS OF DISCOUNT PRICING AND BUNDLING ON THE SALES OF GAME AS A SERVICE: AN EMPIRICAL INVESTIGATION

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ABSTRACT

Although many prior studies have discussed the effect of discount pricing and product bundling on sales, few investigated the effect on Game as a Service (GaaS) applications, which has been rapidly growing in the IT industry. We investigate the effect by adopting large empirical market data, including 112,858 observations of 5,570 GaaS applications in the theoretical perspective of perceived value, price fairness, expected utility, and competitive intensity. We found that both discount pricing and bundling have positive effects on the daily sales of the applications. Specifically, discount rate and the amount of discounted price (i.e., reduced price) have positive relationships with the sales increase, while the effect of discount pricing decreases as more discount deals are available in the market. However, we did not find a significant interaction effect of bundling on the relationship between discount rate and the sales increase.

Keywords: Discount pricing; Bundling; Cloud computing; GaaS (Game as a Service); Competitive intensity

1. Introduction

One of the most noticeable trends in the contemporary IT industry is the rapid growth of cloud computing, providing information technology (IT) services through the Internet, such as the services for networks, servers, storage, and applications [Armbrust et al. 2010; Mell & Grance 2011]. According to Gartner Inc. and Forbes [2016], the global market revenue of cloud computing has increased from $58.6 billion in 2009 to $175 billion in 2015, approximately 300% growth for six years. In business, 95% of the organizations are currently relying on cloud computing services for their business [RightScale 2016]. The industry expects that the explosive growth will continue due to its managerial benefits such as reduced operational costs, flexibility, scalability, rapid deployment, remote access and mobility, and green computing.

Cloud computing can be categorized into three platform models by the capability provided to users: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) [Mell & Grance 2011]. Among the services, SaaS is the most popularly used, driving the overall growth of the industry. In 2015, SaaS applications generated approximately 61% of the cloud computing industry revenue [Technology Business Research 2015]. The video gaming industry is one of the IT domains that has actively adopted the cloud-computing platform, particularly SaaS due to its capability to offer interactions between the users and to update gaming contents. In the mobile app market, for instance, a large portion of the game apps rely on the SaaS platform [Lowthorpe et al. 2013]. The format of conventional video games are also moving from tangible software packages (i.e., ROM pack and CD) to the SaaS platform, which is called cloud gaming or games as a service (GaaS) [Gopal & Kaushik 2016]. It allows the players to use gaming applications on the cloud via either file or video streaming. It also enables them to enjoy games with other users who access to the cloud platform (e.g., servers).

According to research conducted by Software Advice, a subsidiary of Gartner Group, the two most popular marketing strategies in the U.S. are discount pricing and bundling [Wolf 2015]. Discount pricing can increase product sales by affecting the evaluation of consumers on product value [Chen et al. 2012; Dawson & Kim 2009; Sheng et al. 2007; Yin & Jin-Song 2014]. Prior literature discussed its effect in various domains such as apparel [Alford & Biswas

2002], food [Mishra & Mishra 2011], electronics [Della Bitta et al. 1981], and automobile [Goldberg 1996]. The literature commonly indicated a positive impact of discount pricing on the consumer value perception on product [Alford & Biswas 2002; Della Bitta et al. 1981], intention to purchase and purchase incidence [Mishra & Mishra 2011], and net profit of the product vendors when it is used at an optimized level [Lee & Rosenblatt 1986; Monahan 1984]. Bundling, the other popular marketing strategy, can encourage the consumers' purchase by offering additional values [Stremersch & Tellis 2002]. Extant literature for product bundling reported its positive effect on sales increase in various product domains, such as digital music [Zhu & MacQuarrie 2003], mobile TV services [Rautio et al. 2006], and video gaming console and software [Derdenger & Kumar 2013].

However, some academic literature and business reports have warned that the strategies may negatively affect sales. Concerning discount pricing, they argued that it induces a low-quality perception on products [DelVecchio & Puligadda 2012; Raghubir & Corfman 1999] and thus, may discourage their sales. Marketing practitioners also suggested the same ideas on discount pricing. According to double-blind tests on drug, health products, and cosmetics, the discount deals actually appeal less to consumers than products at full price [Dennedy & Marrs 2011]. Product bundling also can impose the negative effect on sales because it may decrease the perceived quality and increase the perceived risk related to the purchase. Particularly, when the bundled product is new to market [Harris 1997] or combined with invaluable free gifts, it can harm the perceived quality [Krishna et al. 2002] and accordingly, may decrease the sales.

Although numerous studies discussed discount pricing and bundling in various market domains, there are several research gaps, allowing further investigation on the topics. As discussed, first, the studies reported contradictory findings on the effect of discount pricing and bundling and little discussed their effect in the GaaS market. Therefore, their effect remains ambiguous in the domain. Second, the literature on discount pricing and bundling mainly focused on their impact for conventional, tangible products, which are different from SaaS products. Different from tangible products, which discount pricing or bundling cannot be easily applied or modified, SaaS products are highly amendable to such changes based on market reaction [Wan et al. 2017]. In addition, consumers in the SaaS domain are able to monitor price changes and compare them over almost all available products at convenient online distribution channels with substantially lower search cost. Such well-informed consumers may react differently to the offers than those in conventional markets. For example, the informed consumers would not purchase a SaaS product at discount if they had found the quality of the product is poor (e.g., online consumer review valence) or it is unpopular (e.g., online ranking list) in the market. Third, little research examined the effect of both discount pricing and bundling adopting empirical data of the GaaS market. Lastly, although a few recent studies tested the effect of discount pricing for digital products [Ghose & Han 2014], they neglected to consider competitive intensity, which refers to the degree of competition in a market (e.g., the number of competitors offering discount deals). The effect can be substantial or insignificant according to the number of competitors providing similar offers [Raju 1992]. However, such a critical factor has not be considered in the extant digital product research on discount pricing. These research gaps suggest several interesting questions:

RQ1: Do discount pricing and bundling increase or decrease sales of GaaS applications?
RQ2: Is discount pricing more effective than bundling for sales increase when applied to bundled applications?
RQ3: Does competitive intensity affect the effectiveness of discount pricing for GaaS applications?

To address these questions, we examine the effect of discount pricing and bundling on the sales of GaaS applications, adopting a large panel dataset including 112,858 observations of 5,570 GaaS applications. Particularly, we seek to clarify (1) the effectiveness of discount pricing given discount rate and the amount of discounted price, (2) the effectiveness of bundling strategies as well as its interaction effect on discount rate, and (3) the impact of the number of discount deals offered in the market. We expect that our findings contribute to the knowledge concerning perceived value, price fairness, expected utility, and competitive intensity with empirical evidences as well as providing useful implications to the practitioners in the GaaS market.

2. Literature Review

2.1. Research on Discount Pricing

Discount pricing refers to reduction of the initial price of a product or service [Chen et al. 1998], which is effective in increasing sales volume in a short time [Guerreiro et al. 2004]. It has been extensively investigated in the context of diverse markets such as apparel [Alford & Biswas 2002], food [Han et al. 2001; Mishra & Mishra 2011], electronics [Della Bitta et al. 1981], automobile [Ayres 1991; Ayres & Siegelman 1995; Goldberg 1996], and e-commerce [Ghose & Han 2014; Zuo & Iida 2017]. These studies adopted perceived product value to explain its effect on product sales. Since price discount induces higher value perception on proposed products with discount, buying intention of consumers increases [Alford & Biswas 2002; Della Bitta et al. 1981; Nusair et al. 2010]. In general, the value perception increases when the level of discount (i.e., discount rate or discounted price) is higher [Coulter & Coulter 2007; Lee & Rosenblatt 1986; Monahan 1984] because consumers can attain desired benefits at lower price than their reference price.

The effect of discount pricing can differ by various conditions. For instance, females and minorities (e.g., African Americans in the U.S.) tend to be more sensitive to price changes when purchasing vehicles [Ayres 1991; Ayres & Siegelman 1995]. Original product price also can influence the value perception and purchase intention of consumers. Coulter and Coulter [2007] found that consumers tend to have greater value perception and intention to purchase for the higher-priced products offered at lower discount rate than for the lower-priced products at higher discount rate. This finding corresponds to the results of DelVecchio and Puligadda [2012] and Raghubir and Corfman [1999], suggesting that discount may induce a low quality perception on products and thus, discourage consumers to purchase. Therefore, optimal discount pricing is crucial to maximize sales of the product. Recent e-commerce research examined the optimal discount level. Ghose and Han [2014] investigated the effect of discount pricing on the sales of mobile apps, using empirical data collected from Googleplay.com. They reported that an optimized price discount, approximately 50%, maximizes the sales of mobile apps. Zuo and Iida [2017] also illustrated that an effective discount rate ranges between 49% and 64% for the products in Amazon.JP (Amazon Japan).

2.2. Research on Bundling

Bundling is a widespread marketing practice to increase sales, offering two or more individual products in one package [Sheng et al. 2007; Wan et al. 2017]. Due to its effectiveness, it has been employed in various market domains. For instance, telecommunications companies offer their services, such as cable TV, Internet broadband, and telephone, in bundles to attract or retain their customers [Sheng et al. 2007]. Although it is generally beneficial for business, extant studies presented that its success relies on various factors. Complementarity between bundled items is one of the determinants for success of the strategy. When the items complement each other (e.g., TV and DVD player), consumers are more likely to purchase the bundle [Koukova et al. 2008; Lee & Kwon 2011; Popkowski Leszczyc & Häubl 2010]. Likewise, similarity between bundled items (e.g., electricity/gas bundle for heating and air conditioning) increases the effect of bundling [Agarwal & Chatterjee 2003]. Price is another critical determinant. Shen et al. [2007] illustrated that when a bundle is offered at a discounted price, consumers tend to consider it poor quality although complementarity between the items can lessen such a perception. For mixed CD bundles, however, Lee et al. [2011] found that as price discount for both the focal item and the added item increases, the purchase intention does, suggesting that higher discount on bundled products can enhance their sales. Product brand also affects the effectiveness of bundling. The effect tends to decrease when bundled items have different brands [Chung et al. 2013] or when they do not have an established brand reputation in the market [Lee et al. 2011].

2.3. Summary of Literature Review

As summarized in Table 1, little extant literature for discount pricing and product bundling has examined the effect of the strategies on sales of GaaS applications, as well as reporting inconsistent findings on their effect. In addition, most relied on survey, experiment, or analytical modeling to investigate their effect. Therefore, our study is one of the first attempts to explore the effects in the context of the fast-growing GaaS market with large empirical market data. The remaining sections are as follows: Hypothesis Development introduces major hypotheses based on theoretical foundations. Empirical Models describes analytic models to test the hypotheses, while Dataset discusses details of the dataset adopted. Analysis and Result illustrates analytic approach employed and hypothesis test results. Discussion presents interpretations and implications of the hypothesis test results, and Theoretical and Practical Contributions discusses how the findings contribute to academia and industry. Limitations and Future Research illustrates recommendations for researchers investigating this topic, followed by Conclusion.

Table 1: Selected Research on Discount Pricing and Product Bundling

Category	Article	Major Findings	Market	Data Source
Discount Pricing	Zuo & Iida [2017]	Optimized discount rate (49%-64%) maximizes product sales at e-commerce website	e-commerce	Market Data (Amazon.JP)
	Ghose & Han [2014]	Optimized discount rate (around 50%) maximizes mobile app sales	Mobile App	Market Data (gooleplay.com)
	DelVecchio and Puligadda [2012]	Excessive discount pricing induces low quality perception on the product	Food	Experiment
	Coulter and Coulter [2007]	Low discount rate for high-priced products is more effective than high rate for the low-priced	In-line Skate	Experiment
	Alford & Biswas [2002]	Discount pricing increases perceived value and buying intention	Apparel	Experiment
	Ayres & Siegelman [1995]	Effect of discount pricing differs by gender and ethnicity	Automotive	Survey
Product Bundling	Chung et al. [2013]	The effect of bundling is reduced when bundled items have different brands	None	Analytical Modeling
	Lee & Kwon [2011]	When bundled items are complementary bundling is more effective	Ubiquitous services	Analytical Modeling
	Lee et al. [2011]	Higher discount on bundled products increases product sales	Music CD	Experiment
	Shen et al. [2007]	Bundling decreases perceived quality of the bundled	Washer and dryer	Experiment
	Agarwal & Chatterjee [2003]	Similarity between bundled items increases the effectiveness of bundling	Telecomm. (phone, TV, cellular)	Experiment

3. Hypothesis Development

3.1. The Impact of Discount Pricing on the Sales of GaaS Applications

Discount pricing is one of the most effective ways to increase sales [Chen et al. 2012; Dawson & Kim 2009]. Two theoretical viewpoints can explain the reason: price fairness evaluation and expected utility. In the evaluation of fairness of a product price, consumers use two types of price: perceived price and internal reference price [Sheng et al. 2007]. Perceived price refers to the price recognized by a consumer, generally a listed price of a product while internal reference price means a price that plays as a scale to evaluate the appropriateness of the perceived price. If the perceived price is lower than the internal reference price, consumers may believe it is valuable [Kalyanaram & Winer 1995; Maxwell 2002]. Hence, the internal reference price has a significant influence to the purchase decision of consumers [Sheng et al. 2007]. Discount pricing encourages consumers to buy products by decreasing the perceived price, reducing the gap from their internal reference price. It also decreases the internal reference price of consumers when multiple similar products at discounted prices are available. Due to the lowered internal reference price, consumers perceive products at regular prices less valuable than those at discount. The expected utility provides another explanation for the effectiveness of discount pricing. Consumers, as rational and self-interested individuals, make economic decisions to maximize their benefits, taking account of the costs and benefits [Mongin 1997; Schoemaker 1982], suggesting that the individuals would not buy products when their prices are higher than their potential benefits [Reavis Conner & Rumelt 1991].

For software products, discount pricing is known to increase chance of buying software by decreasing the cost to attain the benefits [Chen & Png 1999]. A recent study of Ghose and Han [2014] also illustrated that the profit from mobile apps can be maximized when they are at discounted prices, suggesting that discount pricing can increase not only short-term sales but also overall net profit of the apps. Although it may have a negative impact on sales by inducing low-quality perception [DelVecchio & Puligadda 2012; Dennedy & Marrs 2011; Raghubir & Corfman 1999], consumers in the digital product markets have affluent reference sources, such as consumer review (e.g., 5-start rating system) and online communities/forum, to verify the quality of the products at discounted prices. Therefore, they would not necessarily drop off the discounted products in their purchase decision simply because of the discount. Given the discussion above, we propose the following hypothesis:

H1: *GaaS applications offered at discount price are likely to have higher sales than those at regular price.*

3.2. The Impact of Discount Rate on the Sales of GaaS Applications

Consumers may pay attention to not only whether a desired product is at discounted price but also its discount rate. Prior studies on discount pricing commonly indicated that consumers consider the rate important in their purchase decision [Chen et al. 1998; Coulter & Coulter 2007; Heath et al. 1995] because the rate would closely address the gap between their perceived price and their internal reference price on a product. For instance, consumers would perceive $10 discount more attractive for a t-shirt at $20 (i.e., 50% reduction in the perceived price) than for a TV at $200 (i.e., 5% reduction). Likewise, consumers in the GaaS market would perceive applications at a higher discount rate more valuable. Given that the GaaS market is a substantially competitive market where multiple vendors provide similar products [Murphy 2015], a high discount rate should promote the sales of GaaS applications by attracting more consumers. Thus, we suggest the following hypothesis:

H2: *For the GaaS applications offered at discount, the sales of the applications is likely to increases as the discount rate increases.*

3.3. The Impact of the Amount of Discounted Price on the Sales of GaaS Applications

Although discount rate is high, it may not be appealing if its original price is substantially low. For example, a discount rate of 10% for a $50,000 automobile would allow consumers to save $5,000, while the same rate could only save $1 for a $10 frozen pizza. Therefore, the amount of discounted price (i.e., difference between a regular price and a discount price) will be as important as the rate in the purchase decision of consumers. A recent study shows that price discount can directly lead to the increased volume of the promoted product on Google search [Zhao 2018], thereby contributing to its sales volume. Prior research on the impact of discount pricing on market demand illustrated that the amount of discounted price has a proportional relationship with the quantity of product order [Hui-Ming & Yu 1997; Lee & Rosenblatt 1986] and overall sales volume [Raju 1992]. From the perspective of consumer behaviors, the amount can encourage more potential consumers by increasing the perceived value of the products [Della Bitta et al. 1981]. The price range of GaaS applications varies from $0.5 to $199. Therefore, the consumers should consider the amount of discounted price, which represents their actual savings. They would be more likely to purchase the applications when the savings are larger. This discussion induces the following hypothesis:

H3: *For the GaaS applications offered at discount, the sales of the applications is likely to increases as the amount of discounted price increases.*

3.4. The Number of Discount Deals and Sales of GaaS Applications

Competitive intensity, which refers to the degree of competition in a market, is another important factor in estimating the impact of discount pricing. The intensity tends to have a negative impact on the sales; If there are more competitors, each product in the market has more difficulties achieving sales increase [Raju 1992]. Likewise, the impact of discount pricing on sales would be subject to competitive intensity. As more vendors offer their products at discounted prices, consumers would perceive the discount less attractive and consequently, each product should have fewer chances to increase its sales [Kopalle et al. 1999]. However, the large number of vendors offering discount deals may raise overall market demand, generating interests from more potential consumers. In the e-commerce context, the traffic to shopping websites increase when they have more discount deals, such as Black Friday and Cyber Monday, and accordingly each may have higher sales on these days.

Although both viewpoints are legitimate, we expect that the total number of discount deals will have a negative relationship with the sales of each application in the GaaS market. Conventional e-commerce websites such as Amazon.com have numerous types of products. The increased traffic to the websites by discount deals, hence, may generate cross-selling opportunities, encouraging the visitors to extend their purchase to other discounted products. According to research conducted by Amazon.com, cross-selling generates up to 35% of its revenue [Cohn 2015]. However, GaaS application distributors such as steam.com, origin.com, and GOG.com provide only gaming applications, which directly compete against each other. The increase of discount deals in a single product category would hardly generate cross-selling opportunities because consumers barely buy more products in the same category due to the discount. In addition, consumers do not repurchase the same GaaS applications (i.e., repeat purchase) even though they are offered at discount because their value does not decrease or disappear as used. As competitive intensity indicates, rather, the increase should cannibalize the sales of each application, inducing a severe price discount competition. Therefore, we propose the following hypothesis:

H4: *For the GaaS applications offered at discount, the sales of the applications is likely to decrease as the number of discount deals available at that time increases.*

3.5. The Impact of Bundling on the Sales for GaaS Applications

Bundling strategy refers to offering more than one products or services as a combined package [Adams & Yellen 1976; Stremersch & Tellis 2002]. Due to added value by bundling of multiple products or services, consumers prefer bundled packages and consequently, the products tend to have higher sales than the unbundled [Stremersch & Tellis 2002]. For digital information goods, prior studies reported that bundling has a positive impact on the sales of digital music [Zhu & MacQuarrie 2003], and mobile TV services [Rautio et al. 2006].

In the video gaming market, product bundling has been widely adopted to boost sales, attracting potential consumers [Derdenger & Kumar 2013]. For example, Nintendo may introduce “Super Mario Bundle” including a series of Super Mario game titles such as Mario Cart and Super Mario Advance. In the GaaS domain, vendors often bundle their applications with other applications, premium game contents, or music soundtrack of the game titles, attracting more potential consumers. As some extant literature argued, however, bundling can lower the perceived quality of the product particularly when it is new to market [Harris 1997]. This implies that when consumers have not experienced the bundle, they may doubt its quality, believing that it is bundled with other products (or features) because of lack of quality. Because video gaming applications are experience goods, which consumers do not fully understand their quality before experiencing them [Lian & Yen 2013], consumers in the GaaS market would have a negative perception on the bundled. However, such a quality concern about the bundled may lessen as the amount of available information to confirm the quality increases, providing indirect experience to the consumers [Ye et al. 2011]. As aforementioned, consumers in the GaaS domain can have affluent indirect experience about the quality of applications through online communities/forum and consumer review. Hence, the consumers would rely more on the indirect experience to examine the quality than simply perceive the bundle as low quality. Therefore, we suggest the following hypothesis:

H5: *Bundled GaaS applications are likely to have higher sales than single applications.*

3.6. The Moderation Effect of Bundling on the Relationship between Discount Rate and Sales of GaaS Applications

Discount pricing often combines with other additional offers such as bundling. Consumers tend to perceive such products as more attractive [Sheng et al. 2007] and are more likely to purchase [Janiszewski & Cunha 2004]. This suggests that they perceive price discount more valuable when applied to a bundled package than a single product, if all other conditions are equal. For example, if a single product and a bundled package have the same discount rate and discounted price, consumers would more likely purchase the bundle due to its additional value. In the GaaS market, the vendors often apply price discount on bundled applications as well as on single ones. When a bundled package and a single application have the same discount rate, the bundle would attract more consumers due to its additional values such as gaming applications, game music soundtracks, and game contents (e.g., new game characters). Therefore, we can expect that a higher discount rate should have a more significant impact on the sales of bundled application packages. Based on this discussion, we suggest the following hypothesis:

H6: *For the bundled GaaS applications offered at discount, the sales of the applications is likely to increaseas the discount rate increases.*

Figure 1 summarizes the hypotheses discussed above, illustrating the relationships between the factors and sales of GaaS applications.

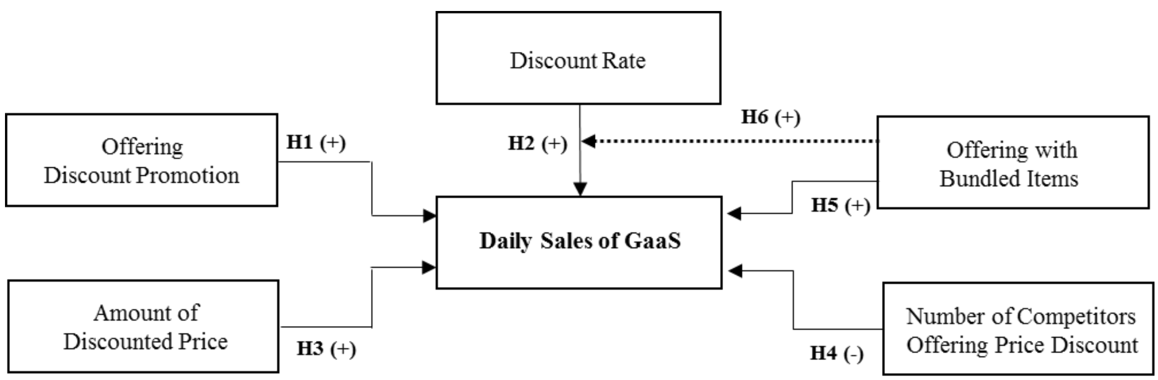

Figure 1: Research Model

4. Empirical Models

We developed two empirical models to test our hypotheses. The dependent variable of the two models is $DailySales_{i,t}$, which represents the sales of each GaaS application. Model 1 includes $DiscountDummy_i$ (c.f., discounted = 1, not discounted = 0) and $BundleDummy_i$ (c.f., bundled = 1, not bundled = 0), the variables for testing Hypotheses 1 and 5, as well as five control variables. We constructed Model 2 to test how specific discount pricing factors affect the sales, such as discount rate, discounted price, and the number of available discount deals. These factors should be examined in a separate model from Model 1 because Model 1 is estimated for all of the GaaS applications in the dataset to examine the impact of discount pricing and bundling on sales. The discount pricing factors should be estimated only for the applications offered at discount, which have the factors in the dataset. Model 2 tests Hypotheses 2, 3, 4, and 6, examining the main and interaction effects of discount pricing and bundling on the sales. The independents of Model 2 are $DiscountRate_{i,t}$ representing the percentage of price discount (H2), $DiscountedPrice_{i,t}$ standing for the amount of price discounted (H3), $DiscountDeals_{i,t}$ meaning the total number of discount deals on the date (H4), and $BundleDiscountRate_{i,t}$ standing for the moderation effect of bundling on the relationship between discount rate and the sales (H6). It also contains five control variables. Table 2 illustrates the definitions of the variables of Model 1 and Model 2.

Model 1 testing H1 and H5:

$$\boldsymbol{DailySales_{i,t}} = \alpha_0 + \boldsymbol{\alpha_1 DiscountDummy_{i,t}} + \boldsymbol{\alpha_2 BundleDummy_i} + \alpha_3 Owners_{i,t} + \alpha_4 UserScore_{i,t} + \alpha_5 ProductAge_{i,t} + \alpha_6 CurrentPlayers_{i,t} + \alpha_6 Increase_{i,t} + \varepsilon_{i,t}$$

Model 2 testing H2, H3, H4 and H6:

$$\boldsymbol{DailySales_{i,t}} = \beta_0 + \boldsymbol{\beta_1 DiscountRate_{i,t}} + \boldsymbol{\beta_2 DiscountedPrice_{i,t}} + \boldsymbol{\beta_3 DiscountDeals_t} + \beta_4 BundleDummy_i + \boldsymbol{\beta_5 BundleDiscountRate_{i,t}} + \beta_6 Owners_{i,t} + \beta_7 UserScore_{i,t} + \beta_8 ProductAge_{i,t} + \beta_9 CurrentPlayers_{i,t} + \beta_{10} Increase_{i,t} + \varepsilon_{i,t}$$

Table 2: Definitions of Variables

Variable	Role	Definition
$DailySales_{i,t}$	Dep.	The daily sales of GaaS *i* on date *t*
$DiscountDummy_{i,t}$	Ind.	If GaaS *i* offers price discount = 1, if not = 0
$DiscountRate_{i,t}$	Ind.	The discount rate of GaaS *i* on date *t*
$BundleDummy_i$	Ind.	If GaaS *i* is bundled = 1, if not = 0
$BundleDiscountRate_{i,t}$	Ind.	The interaction term of *BundleDummy* and *DiscountRate* of GaaS *i* on date *t*
$DiscountedPrice_{i,t}$	Ind.	The amount of discounted price of GaaS *i* on date *t*
$DiscountDeals_t$	Ind.	The number of discount deals on date *t*
$Owners_{i,t}$	Cont.	The number of owners of GaaS *i* on date *t*
$UserScore_{i,t}$	Cont.	The accumulated evaluation score on GaaS *i* on date *t*
$ProductAge_{i,t}$	Cont.	The age of GaaS *i* on data *t* (i.e., how long has been in the market)
$CurrentPlayers_{i,t}$	Cont.	The number of GaaS *i* players in last two weeks on date *t*
$Increase_{i,t}$	Cont.	The increase in percentage GaaS *i* on date *t* compared to the number of owners on date *t-1*

※ Dep.: Dependent Variable, Ind.: Independent Variable, Cont.: Control Variable

5. Dataset

We collected data from two data sources, steamspy.com and steamdb.info. Steamspy.com provides a sales tracking service for GaaS applications served by Steam, which is the largest GaaS provider in the world. Steam has the largest number of active user accounts in the GaaS market, approximately 40 million taking more than 50% of the entire downloadable PC games [Chiang 2011; Mudgal 2012; Reinhardt 2012]. The data available in Steamspy.com include daily sales, total number of owners, price, active players, and average playtime. Although the data are estimated based on a sampling approach using approximately 100,000 to 150,000 user accounts per day, they are known to be highly accurate [Gilbert 2015], close to the real data within 0.33% error margin [Orland 2015]. We collected the data for pricing discount, such as discount rate and discounted price at steamdb.info. The website offers various information about special deals on the applications. We collected daily data from the two websites for four months, from November 11, 2015 to March 11, 2016.

Table 3 is the descriptive statistics of the variables in Model 1. Our dataset includes 112,858 observations of 5,570 GaaS applications. In the dataset, 11,501 observations of 3,210 products were concerned with discount pricing and/or bundling. We used the entire dataset for Model 1 to examine the impact of discount pricing and bundling on sales (i.e., comparison between the applications with vs. without price discount or bundling). Testing Model 2, we adopted the 11,501 observations of 3,210 GaaS applications that are offered at discount because it tests how the impact of discount pricing on sales differs by the degree of specific discount factors such as discount rate, discounted price, and the number of discount deals (i.e., competitors) available in the market. Table 4 provides the descriptive statistics of the variables in Model 2.

Table 3: Descriptive Statistics of Model 1

Variables	Mean	Standard Deviation	Minimum	Maximum
DailySales	4524.269	4487.985	1001	121495
Owners	367221.400	875365.400	1167	20700000
UserScore	0.758	0.179	0.030	1
ProductAge	1094.955	835.869	0	4625
CurrentPlayers	605.637	9981.024	0	669198
Increase	0.056	0.091	0.0001	7.881
Frequency (n=112,858)				
DiscountDummy	6546			
BundleDummy	452			

Table 4: Descriptive Statistics of Model 2

Variables	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
DailySales	4253.996	5815.123	1001	121495
DiscountRate	0.643	0.204	0.100	0.950
DiscountedPrice	9.564	15.349	0.988	539.910
DiscountDeals	3759.883	2621.161	80	5877
Owners	354484.200	1152566	1167	20400000
UserScore	0.757	0.184	0.080	1
ProductAge	865.807	860.860	0	6290
CurrentPlayers	887.291	13515.470	0	653957
Increase	0.0767	0.169	0.0001	7.162
Frequency (n=11,501)				
BundleDummy	36			

6. Analysis and Results

Since our dataset is panel data, we conducted specification tests for OLS estimation assumptions. For both models, VIF (Variance Inflation Factors) did not indicate a significant multicollinearity (VIF: Model 1 = 1.12, Model 2 = 1.27). Not surprisingly, however, Breusch-Pagan/Cook-Wisberg test and Wooldridge test respectively reported heteroscedasticity and first-order autocorrelation in both Model 1 and Model 2. Therefore, we used a random effects model with Hueber/White standard error correction to address the issues [Baltagi 2008; Freedman 2012]. Although Hausman specification test indicated the necessity of a fixed effects estimator, it is inappropriate for our models because the estimator eliminates important time-invariant variables in the models. In addition, because the dataset has substantially larger number of the applications (5,570 applications) than the number of time-period (162 days), the fixed effects estimator is highly inefficient in terms of degree of freedom.

Table 5 demonstrates the analysis results for Model 1 and Model 2, including coefficients and p-values of the variables. Model 1 tests Hypothesis 1 and Hypothesis 5. The coefficient for DiscountDummyi (H1) for testing the impact of price discount on GaaS sales is positive and significant at the 1% level. This result supports Hypothesis 1. The coefficient of BundleDummyi (H5) is positive and statistically significant at the 1% level. This suggests that bundled GaaS applications tend to have higher sales than unbundled, supporting Hypothesis 5.

We examined Hypothesis 2, Hypothesis 3, Hypothesis 4, and Hypothesis 6 with Model 2. The coefficient for DiscountRatei,t (H2) is positive and significant at the 1% level. This implies that the higher the discount rate of a GaaS application, the higher the daily sales, supporting Hypothesis 2. The coefficient for DiscountedPrice i,t (H3) is positive and significant at the 1% level. This indicates that the daily sales of the applications increases as the amount of discounted price does, supporting Hypothesis 3. The coefficient for DiscountDealsi,t (H4) is negative and significant at the 1% level, suggesting a negative relationship between the number of the discount deals and the sales of each application. This negative relationship suggests that the sales of each application at a discount decreases as the number of the deals increases at the time, supporting Hypothesis 4. The coefficient for interaction term, BundleDiscountRatei,t, (H6) is positive but not statistically significant, which does not support Hypothesis 6.

In order to examine potential lag effects of the independent variables, we regressed the dependent, DailySalesi,t, on lagged independent variables because their actual impact on the sales may be shown a few days later. We ran DailySalesi,t on the independent variables at t-1 day, t-2 day, and t-3 day. Although their coefficients slightly differ by the time points, overall hypothesis results remain constant with the initial results reported in Table 2. In both models, however, the major independents were not significant when we extended the time lag to more than t-3 day. This is understandable because the applications in our dataset conducted discount pricing for 3.26 days on average. Figure 2 summarizes the overall hypothesis test results.

Table 5: Analysis Results of Model 1 and Model 2

Dependent: $DailySales_{i,t}$	**Model 1(All GaaS's)**	**Model 2 (GaaS's at Discount)**
$DiscountDummy_i$ (H1)	***173.135*****	*NA*
$DiscountRate_{i,t}$ (H2)	*NA*	***720.494****
$DiscountedPrice_{i,t}$ (H3)	*NA*	***17.965*****
$DiscountDeals_t$ (H4)	*NA*	***-0.066*****
$BundleDummy_i$ (H5)	***942.556*****	-1441.776
$BundleDiscountRate_{i,t}$ (H6)	*NA*	***3488.334***
$Owners_{i,t}$ (control)	0.003**	0.003**
$UserScore_{i,t}$ (control)	2156.499**	25.542**
$ProductAge_{i,t}$ (control)	0.169**	0.454**
$CurrentPlayers_{i,t}$ (control)	-0.031**	0.216*
$Increase_{i,t}$ (control)	-229.387	1674.905**
Constant	1752.430**	334.364
Fit Statistics (Wald χ^2)	***793.47*****	***972.57*****

※ *p < 5%, ** p < 1%

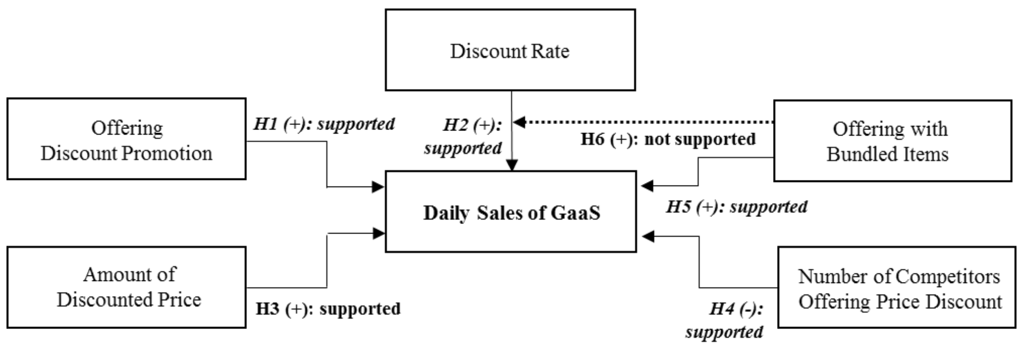

Figure 2: Summary of Hypothesis Test Results

7. Discussion

Support for Hypothesis 1 indicates that discount pricing has a positive impact on the sales of GaaS applications. This result corresponds to the previous studies that employed price fairness evaluation and expected utility theories. This implies that consumers in the GaaS market have similar purchase behaviors to those in other domains. In addition, it suggests that discount pricing is effective to increase the sales of the applications. Therefore, practitioners in the market may consider this strategy to increase the sales. Support for Hypothesis 2 and Hypothesis 3 suggests that both discount rate and the amount of discounted price have positive relationships with the sales of the applications. These findings are consistent with the extant literature concerning discount pricing, illustrating the positive effect of discount rate [Chen et al. 1998; Coulter & Coulter 2007; Heath et al. 1995] and the amount of discounted price [Della Bitta et al. 1981; Hui-Ming & Yu 1997; Lee & Rosenblatt 1986; Raju 1992] on sales. We conducted an additional analysis to examine how discount pricing affected the sales of the applications, comparing each application's average sales when it is at a discount and at an original price. As illustrated in Fig. 3, our findings suggest that on average, the sales does not necessarily increase as the rate increases; the rate between 40% and 50% generated the highest sales increase, selling approximately 421 more copies. This is fairly consistent with the result of Ghose and Han [2014], reporting that the optimal discount rate to boost sales of mobile apps is approximately 50%. This implies that higher discount rate may not necessarily guarantee higher sales increase although the discount leads to a positive sales change. This finding is consistent with the literature on discount pricing that excessive discount pricing on products with uncertainty can decrease the perceived value of the products [Bergemann & Välimäki 2006; Bojanic 1996]. Because GaaS applications are digital experience goods, excessive discount may impose a doubt about the quality of the applications, thus discouraging consumers' purchase. Figure 3 illustrates the comparison of the effects by discount rates on the sales of the applications.

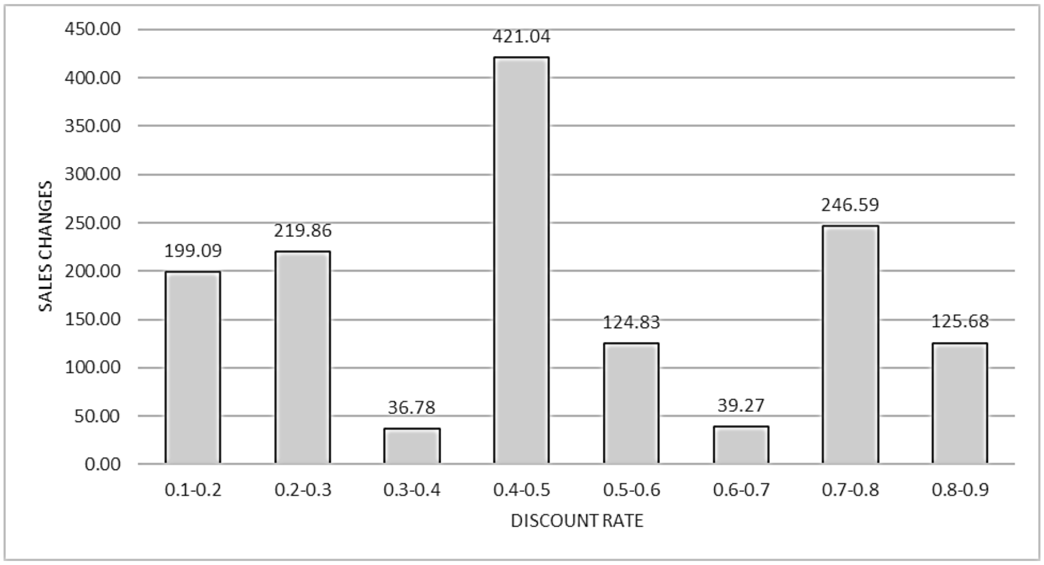

Figure 3: Effects of Discount Pricing on Daily Sales by Rate

As Hypothesis 4 predicted, we found that the number of the applications offered at discounted price has a negative relationship with the sales of each application. It implies that if there are more discounted GaaS applications, each tends to have lower sales. This is consistent with the previous literature on competitive intensity; as the number of discount deals increases, each product has fewer chances to generate sales [Kopalle et al. 1999; Raju 1992]. Therefore, the practitioners in the market may consider executing discount pricing when fewer competitors offer it. It also extends the knowledge about discount pricing by illustrating that as the number of total discount deals in the market increases, its effect decreases.

Support for Hypothesis 5 indicates a positive impact of bundling strategy for GaaS applications on their sales. This shows that the bundles have advantage in their sales, corresponding to the extant literature [Bakos & Brynjolfsson 1999; Rautio et al. 2006; Stremersch & Tellis 2002; Zhu & MacQuarrie 2003]. However, the bundling does not have a significant moderation effect on the relationship between discount rate and the sales of the applications, not supporting Hypothesis 6. This result implies that although a higher discount rate helps increasing the sales of the applications, the effect is neither more nor less significant for the bundles. One of the possible explanations for this unexpected result is the attractiveness of added contents (i.e., bundled products) to the applications offered at discounted prices. In the datasets used for this study, most discounted applications are generally bundled with trivial contents, such as game instructions, characters, or stages, which may be insufficient to appeal to the consumers.

8. Theoretical and Practical Contributions

This research provides theoretical contributions to the literature of price fairness evaluation and expected utility. It extends the scope of the theories to the GaaS market by suggesting empirical evidence of the effect of discount pricing on sales increase. The findings of this study indicate that discount pricing reduces the gap between internal reference price and perceived price, encouraging consumers to purchase products [Kalyanaram & Winer 1995; Maxwell 2002]. In terms of expected utility, consumers in the market, who are rational individuals, are more likely to purchase products when the same benefits are attainable at lower costs [Mongin 1997; Schoemaker 1982]. Similarly, the consumers tend to prefer bundled applications to the singles because they can obtain more benefits (i.e., bundled items) at the same cost. In addition, this research is one of the first attempts to consider competitive intensity in discount pricing literature. It illustrates that the effect of the discount decreases as the number of competitors offering discount deals increases, supporting the theory. This is particularly important for discount pricing literature concerning digital product markets (e.g., digital music and mobile apps), where a tremendous number of products compete by changing their price frequently. In the dataset adopted in this study, for instance, discount pricing lasted for 3.26 days on average, indicating prevalence of dynamic pricing in the market.

The findings discussed above suggest useful implications for practitioners in the GaaS market. First, discount pricing is effective for sales increase of GaaS applications. However, practitioners who want to boost sales of GaaS applications will have to consider both discount rate and discounted price in planning discount pricing. For instance, high discount rate might not generate expected sales increase if the actual discounted price (i.e., saved cost by consumers) is minimal because the consumers consider both factors in the discount deals. Concerning optimal discount rate for maximizing sales increase, our study suggests that it ranges between 40% and 50%. However, the effect tends to lessen as more competitors offer discount deals at the time. This finding implies that overall demand for GaaS applications does not necessarily increase as the number of the deals increase, which is different from the general belief in the e-commerce domain [eMarketer 2017]. For conducting discount pricing, thus, the practitioners need to avoid busy seasons when the deals are pervasive in the market because their deals can be less noticeable or perceived unattractive by consumers. This study also shows that bundling can increase sales of GaaS applications. The practitioners may expect sales increase by bundling their applications with additional contents such as game music, characters, or other GaaS applications. However, it would not generate additional sales increase although combined with discount pricing, suggesting that the practitioners need to utilize each strategy respectively. GaaS providers may also want to consider offer GaaS applications to potential users with basic features free of charge and premium features for additional payment in addition to the pricing and bundling strategies. The freemium marketing strategy could be effective at increasing the number of potential users, and promoting their interactions, thereby increasing sales and sustainable profitability [Kim 2018].

9. Limitations and Future Research

As with other studies, our research has several limitations. With regard to bundling strategy, GaaS applications use various types of bundling strategies by added contents such as free video titles, instructions, game OST, and extended game contents. Although they must have different effects on the sales, however, we did not distinguish in testing the relevant hypotheses. In addition, while estimating the impact of the number of total discount deals on the sales of the applications, we did not distinguish direct and indirect competitors. For instance, a FPS (First Person Shooter) GaaS application directly competes with the applications in the same genre but would not with RPG (Role Playing Games) applications. Future research may consider adopting more thoroughly categorized data for different types of bundling strategies and direct/indirect competitors in their analysis. Another limitation is concerned with the datasets adopted in the analysis. Although the datasets are large, including approximately 113,000 observations, they cover four months from November 2015 to March 2016. Therefore, they may not represent the overall market dynamics of the GaaS market. In addition, the period includes important peak seasons such as Thanksgiving, Christmas, and New Year. Therefore, our findings may be partially subject to the sales of the peak seasons and consequently, may not demonstrate general effects of discount pricing and bundling strategies in the domain. Researchers investigating this topic may consider using a more extensive dataset to rule out these potential biases in their research. Many factors, such as sense of gaming community, social influence, social influence, could also affect the sales of GaaS applications [Hsieh 2018]. Future study may want to investigate whether pricing and bundling strategies have varying influence on the sales of GaaS applications in different gaming communities. Moreover, there is one possibility for the insignificance of the interaction between bundle and discount rate found in the study. It is possible that gamers may already have some of the games in the bundle, thus the discount rate of the bundle is still less economic than buying the additional games separately. This could be another future research direction.

10. Conclusions

As the number of video games are available on the cloud, vendors need to compete with each other on the delivery of not only exciting gaming experiences but also attractive deals. We investigated the effects of discount pricing and bundling on the sales of GaaS applications, adopting large empirical market data collected at steamspy.com and steamdb.info. In the context of the fast-growing GaaS market, our analysis results confirmed the positive effect of discount pricing, discount rate, and the amount of discounted price on the sales, while the effect decreases as the number of available discount deals increases. However, we did not find an empirical evidence supporting that combining discount pricing with bundling is necessarily more appealing to consumers in the market. Our findings also verified the positive effect of product bundling on the sales increase of the applications. The overall findings contribute to the theoretical foundations of perceived value, price fairness, expected utility, and competitive intensity by providing empirical evidences on the concepts. In the practical aspect, practitioners in the GaaS domain may utilize the findings to design effective pricing and bundling strategies for sales increase.

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