Value co-creation in the video game industry

Graziano Abrate
Department of Economic and Business Studies. University of Eastern Piedmont (Italy)
Email: graziano.abrate@uniupo.it

Anna Menozzi
Department of Economic and Business Studies. University of Eastern Piedmont (Italy)
Email: anna.menozzi@uniupo.it

Abstract

Purpose. The process of value creation is rapidly shifting from a product- and firm-centric view to personalized consumer experiences. Networked and active consumers are increasingly co-creating value with the firm. This paper aims at contributing to the evidence on unpaid competing complementors and on network effects by asking how a form of creation that is user-driven and not motivated by sales incentives, impacts on producers' sales. The video game industry, where the so-called "modders" provide free contents ("mods") that improve the video game experience, provides an excellent field of study.

Methodology. The video games demand function and the supply of new mods, in the retail video game market, are modelled. A system of equations is estimated by applying an instrumental-variables approach to account for possible endogeneity biases and uncover causal relationship.

Findings. The creation of new mods increases video game retail sales. The more popular is a video game title, the higher are the sales. The video game demand elasticity is attenuated by the continuous creation of new mods.

Practical implications This paper shows that direct and indirect network effects between video games and mods take place even with unpaid competing complementors and that (even) traditional distribution outlets can benefit from them.

Originality/value. The paper quantifies the effect that the creation of mods exerts on sales and on price elasticity. Weekly (instead of monthly) time periods provide a period short enough to capture the short development cycles of mods and small and rapid responses of user demand.

Keywords
Co-creation; network effects; video games; mods; retailing.

1. Introduction

Information technology has deeply changed the way producers and consumers interact, enabling new forms of collaboration in the product development process (Füller et al., 2010) and redefining the whole concept of consumer (Cova and Dalli, 2009).

The interactions between user and producer innovation give rise to a new "user and producer innovation paradigm", in which the traditional microeconomic demand side of the market becomes a source of innovative designs and product (Gambardella et al., 2016). From the point of view of producers, consumer innovators have two linked and opposite attributes, one positive and one negative. On the one hand, they can develop new product designs of potential commercial value, thus enhancing the producer's R&D outcomes. On the other hand, their ability to create by themselves goods they should otherwise buy can reduce the producer's market. As a consequence, producers can either compete with consumer innovators by internally developing solutions that substitute for any potential contributions from the user domain, or they can conduct in-house R&D activities that are complementary to user innovation. In this second case, new models of knowledge creation may emerge, where firms encourage consumer innovation as part of their business strategy (Lee and Cole, 2003) and outsource part of the entire innovation process to digital consumer communities (Arakji and Lang, 2007).

The literature on network effects, and in particular that on indirect network effects, provides support to the consumer innovation phenomenon that concerns the creation of complementary goods. Positive (negative) network effects arise when the consumer utility of using a product or service increases (decreases) with the number of users of that product or service. A good exhibits indirect network effects if the demand for that good depends on the provision of one or more complementary goods, which in turn depends on demand for the original good. Shankar and Bayus (2003) suggest that network effects are a function of both network size (i.e. customer base) and network strength (the marginal impact of a unit increase in network size on demand). Network effects could also be "interactive", when they operate through the interaction of user base with one or more marketing mix variables such as price and advertising. If the agents demanding the original and the complementary goods interact through an intermediary or platform, a multi-sided market takes place where both same-side (direct), cross-side (indirect) and interactive network effects possibly exist.

The existence of regular two or multi sided-network effects relies on two assumptions: first, users prefer platforms with many complementors and second, complementors' incentives to develop will be higher for a platform with many users, who represent a larger potential market. The peculiarity of the consumer innovation phenomenon is that in most cases contributors do not receive any payment for their work so that the second assumption is missing: complementors are motivated by their own interest on the product and on the improvement of their user experience, by their identification in a network community as well as by the desire to signal their skills to the public. Indeed, recent research has questioned the achievement of network effects under arrangements in which complementors are motivated by factors other than sales and are consequently making offers to platform users at sub-competitive, i.e. zero, charges (Boudreau and Jeppesen, 2015). More precisely, signalling and reputational motivations are a plausible driver of development activity as platforms grow larger but any positive responses to platform growth may face an opposing negative effect as many independent competing complementors will suffer for limited attention and anyone's signal may degenerate along with increasing noise and confusion. As a result, no overall network effect may occur.

This paper aims at contributing to the limited evidence on unpaid competing complementors and on possibly countervailing network effects. In our empirical model, we

explore the interplay of three key variables. The first one captures the intensity of complementor incentives to invest in development by tracking the creation of new complements. The second one refers to the decreasing attention complementors receive as far as the size of the complementor crow increases and, possibly, the complements' development rate decreases. The third and key variable is the user demand, which is expected to positively respond to growth on the complements side of the platform. Quite surprisingly, previous empirical research has taken for granted the positive reaction of demand to the increase in complementary goods within the user and producer innovation paradigm. The assessment of overall network effects in a user-complemented market must take into account all possible interactions between final users, complementors and complements and clearly identify the contribution of both network size and network strength. From the methodological point of view, a system of equations is estimated by applying an instrumental-variables approach via three-stage least squares to account for possible endogeneity biases and uncover causal relationship.

2. User innovation in the videogames industry

This paper investigates how a form of innovation that is user-driven and not motivated by sales incentives, impacts on producers' sales. To this goal, the video game industry provides an excellent field of study. Despite receiving less attention from marketing researchers than other industry such as music and movies, it has grown into one of the largest and most profitable entertainment industries (2013's worldwide sales amounted to more than 80 million dollars, almost the same as the movie industry) and presents a high degree of innovation and dynamics (Marchand and Hennig-Thurau, 2013). More importantly, it offers an example of vibrant online communities contributing to the production process with free labour, "*voluntarily given and unwaged, enjoyed and exploited*" (Postigo, 2003). In fact, games are suitable platforms for user creativity and the so called practice of modding – the act of modifying an existing hardware or software consumer good – intensely permeates the modern-day game culture (Nieborg and Van der Graaf, 2008; Jeppesen, 2004). Building on existing computer game titles, some users – so called modders, or complementors – modify the original source-code in order to perform functions not necessarily authorized or imagined by the original manufacturer, to respond to their personal preferences or to create entirely different gaming experiences (Münch, 2013). These modifications, usually abbreviated as mods, can range from minor alterations (e.g. add-ons, patch) to more extensive variations such as partial or total conversion and, once generated, are made available to the online community for free as complementary contents to the original PC version of the game. Within the user and producer innovation paradigm (Gambardella et al., 2016), mods represent a "user-complemented market", as they are user-created complements, involving modifications built onto or into producer products, and are diffused peer to peer.

From the game producers' perspective, digital modders represent an opportunity to increase profits and stimulate demand (Jeppesen, 2004). Arakji and Lang (2007) argue that firms should stimulate consumer driven innovation either by opening (at least partially) proprietary content to modders or by promoting some form of rewards to the best modders. Postigo (2003) underlines that software production is driven by rapid and continuous innovation and short market-life and, to this regard, the work of hobbyist can help extending the life of game beyond their natural limits.

Stimuli to the demand may also come from the network effects (Economides, 1996; Rysman, 2009). In the video games industry, positive network externalities may arise when the gaming experience improves, or when the probability of starting to play increases, due to

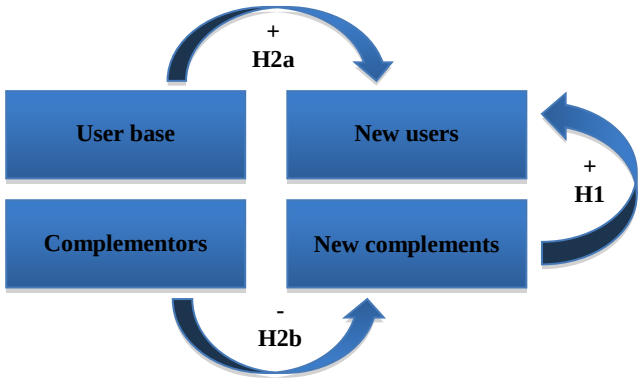
an increase in the number of users. While this is evident for multi-player game modes, it could also happen in single-player games as a result of the game popularity. In this sense, if mods increase the video games user base, they can also indirectly enhance the network effect. Shankar and Bayus (2003) find evidence of network effects in the home video game platforms (Sega and Nintendo), showing both a direct effect of installed customer base and an indirect effect through reduced price elasticity and improved advertising effectiveness. On the contrary, focusing specifically on the role of unpaid producer of complementary goods in multi-sided networks, Boudreau and Jeppesen (2015) did not find evidence of overall network effects in multi-player online game platforms. In particular, the authors show that the development rates and the number of complementors increase with the platform usage, apparently suggesting the presence of a network effect. However, such effect is countervailed by the fact that motivation in unpaid complementors – and thus development rates – might decrease due to large numbers of complementors competing for a limited audience.

Differently from previous works, this paper focuses on the demand estimation of computer video game titles rather than platforms. The following hypotheses are tested in the empirical analysis.

H1: The intensity of user innovation stimulates the demand.
H1a: User innovation has a positive impact on sales.
H1b: User innovation reduces the price elasticity of the demand.
H2: In markets with user-generated complements, network effects are asymmetric: they arise on the users' side but not on the complementors' side.
H2a: User base has a positive impact on sales.
H2b: The number of complementors has a negative impact on the generation of new complements.

Figure 1 represents the interaction between complementors, complements and final users in terms of network effects.

Figure 1. Hypotheses on network effects



3. Dataset

The initial dataset was collected by GfK Italy and includes information on 5 single player, best-selling video games sold in Italy through retailers (thus excluding on-line sales), from the 12th week of 2006 to the 48th week of 2014. The initial week of the sample period reflects the earliest release date of the games included in the sample, the latest week is the last one for which the information on sales and price was provided by GfK[1]. For each version of a video

[1] Data are confidential and the games' real titles could not be displayed due to privacy reasons.

game (standard release or limited and collector editions), identified by a European Article Number (EAN) code, the initial dataset included weekly sales, unit price and total units sold by platform (PC or PS3, X360, DS console) in the Italian retail market.

To investigate the impact of users' innovation on the video game demand, information about the number of available mods for each game in each time period was added and has made this dataset unique. The games are similar for genre (action or adventure) and popularity both in terms of sales volume and in terms of number of mods, which are mostly made available through the Nexusmods.com and the Moddb.com fan sites. The concentration of mods in few databases facilitated the collection and the validity of information: for each (PC version's) EAN, the weekly number of new mods created, chosen among the 300 most popular ones, were tracked together with the corresponding number of weekly downloads. The popularity of mods was measured at the end of 2014 by the number of users' endorsements for the Nexusmods.com's mods and, in absence of information about endorsements, by the total number of downloads for the Moddb.com's ones. Data referred to similar versions were aggregated under a unique EAN (sales and weekly new mods were summed up, while prices were averaged across versions). The final sample is an unbalanced panel identified by 16 distinct EANs ordered by week (from that of release to the latest with positive sales, whose maximum is equal to 453) and resulting in 5199 EAN-week observations.

We infer the variation in the intensity of user innovation from changes in the rates of new complementary development, represented by the number of mods made available each week for the PC versions of each title and captured by the variable *modnew*. Since the mods are targeted for the PC version of the video game, variable *modnew* has observations for the EANs referred to the PC platform only (5 EANs and 1610 EAN-week observations)[2]. Following Boudreau and Jeppesen (2015), the cumulative number of mods (variable *modcum*) is used as a proxy for the number of complementors. For the 5 PC platform EANs, along with the number of units weekly sold (variable *units*) and the average weekly price (variable *pricePC*), the database includes a variable *priceCON* capturing the average weekly price charged for the corresponding non-PC platforms' EANs.

A descriptive analysis of data (not shown) would highlights that the distribution of sales across time is skewed to the right and concentrates in the first three months after release but shows regular peaks during the Christmas season. In the context of the overall decline of the retail market, it is not immediate to detect a relationship between units sold and mods, and the causality direction itself is not clear. On the one hand, the availability of new, free of charge, mods can increase the appeal of the original product and attract new users. On the other hand, a greater number of units sold implies an expansion of the users' community network and spurs the developers' incentives to generate new mods. To capture the network effect generating from the platform's usage, two additional variables were created, the first one focusing on the PC platform only (*KPC*) and the second one on all but the PC platforms (*KCON*), respectively defined as the cumulative number of PC or console units sold at each time period.

Table 1 summarizes the list of abbreviations for the variable names used in the paper, along with their detailed description.

[2] The issue of cross-platform portability of mods is complex, in any cases it is reasonable to assume that the main impact of the creation of new mods concerns the PC version of video games.

Table 1. List of variables

Variable	Description
units	Number of PC game units sold by EAN
pricePC	Average PC game's price (euro)
priceCON	Average console game's price (euro)
KPC	Cumulative number of PC game units sold
KCON	Cumulative number of console game units sold
modnew	Number of new mods
modcum	Cumulative number of mods

4. Methodology

The starting point of the empirical strategy is modelling the demand function in the retail video game market. In this way, we can obtain an estimate of the impact of the intensity of users' innovation on the video game demand (H1), as well as an initial evaluation of the game network effect on the user side (H2a). In Equation [1], *units* depend on *modnew* (lagged by one week in order to reduce the risk of endogeneity), and on the user network base, *KPC*.

$$units_{it} = \alpha + \beta modnew_{it-1} + \gamma KPC_{it} + \delta pricePC_{it} + \theta priceCON_{it} + \vartheta(pricePC_{it} * modnew_{it}) + \pi_i + \sigma_t + \varepsilon_{it} \quad [1]$$

The own-price and cross-price elasticities can be estimated including both the average price of each title's PC versions (*pricePC*) and that of the console equivalent versions (*priceCON*). To capture the possibility that a novel offer of complementary goods positively affects the demand of video games by also reducing the video game's own-price elasticity, we include the interaction term *pricePC*modnew* (H1b). Finally, the panel structure of the data is exploited by using time-period and EAN fixed effects to unambiguously control for cross-sectional variations and general macro industry trends (in the model, terms π_i and σ_t, respectively).

Together with Equation [1], we want to explore the determinants of *modnew*, questioning the achievement of network effects on the complementors' side. Therefore, two additional equations are included in the system:

$$modnew_{it} = \mu + \rho KPC_{it} + \varphi modcum_{it-1} + \pi_i + \sigma_t + a_{it} \quad [2]$$

$$modcum_{it} = \omega + \tau KPC_{it} + \pi_i + \sigma_t + \epsilon_{it} \quad [3]$$

In Equation [2], the users' network base (*KPC*), represented by all clients that have already bought a PC version copy of the video game title, is supposed to be positively related with the potential appeal of the video games market, thus providing incentive to the creation of new mods; nevertheless, at the same time, the cumulative number of the already generated mods might discourage the creation of new ones, acting as a competitive threat (H2b) to the developers. In turn, Equation [3] models *modcum* itself as a function of the network base.

The system of equations [1]-[2]-[3] can be estimated via the three-stage least squares procedure. An important issue concerns the treatment of the possible endogeneity of the *KPC* variable. To this regard, the peculiarity of our database offers an interesting solution, since for each title and week, the information on video games sales for non-PC platforms (captured by the variable *KCON*, the cumulative number of console game units sold) is available. Such variable provides an alternative proxy of the video game title popularity, which is certainly correlated to the PC platform user base but not directly correlated either with the number of

weekly units bought for PC or with the number of mods (*modnew* and *modcum*), given that mods are not specifically designed for console platforms. Thus, *KCON* has been used as an instrumental variable for *KPC*.

5. Results

Table 2 reports the results of the three-stage least squares estimates. The model fit is satisfactory and the estimation procedure addresses the issue of potential endogeneity of the user base (*KPC*) by using as instrumental variable the user base over all but PC platforms (*KCON*). Column (1) presents the determinants of retail sales.

Table 2. Results

VARIABLES	(1) $units_t$	(2) $modnew_t$	(3) $modcum_t$
$modnew_{t-1}$	8.515***		
	(2.212)		
KPC_t	0.00163***	6.47e-05***	0.00243***
	(0.000568)	(8.30e-06)	(7.28e-05)
$pricePC_t$	-1.777***		
	(0.517)		
$priceCON_t$	2.294***		
	(0.843)		
$pricePC_t$*$modnew_t$	0.312***		
	(0.0518)		
$modcum_t$		-0.0219***	
		(0.00205)	
Constant		6.595***	
		(1.312)	
Time dummies	yes	yes	yes
EAN dummies	yes	yes	yes
Observations	1,605	1,605	1,605
R-squared	0.829	0.477	0.961

Three-stage least squares estimation.
The dependent variables are the number of PC game versions' units sold (*units*, model 1), the number of new mods created every week (*modnew*, model 2) and the cumulative number of mods (*modcum*, model 3). *KPC* is the cumulative number of PC game units sold and it has been instrumented through the variable *KCON*, the cumulative number of console game units sold. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The lagged number of *modnew* captures the impact of user innovation and its positive and significant coefficient indicates that, as expected, new complements stimulate the market demand for the original game title (H1a). This implies that the unpaid contribution of modders generate free returns for the retailers. The negative sign of the interaction terms *pricePC*modnew* strengthens this result, indicating that the video game demand elasticity is attenuated by the continuous creation of mods (H1b). In the context of the typical dynamics observed in the video game industry, where new titles tend to exhibit a short market-life, this represents a key strategic opportunity. In the presence of intense users' innovation, the life cycle of the product is enhanced and strategies based on price promotions can be postponed.

In addition, the more popular is a title, the higher are the sales on PC, as the positive and significant coefficient of *KPC* shows (H2a). Thus, new mods produce new sales, implying higher user base and setting conditions for further sales.

Column (2) and (3) extend the model by exploring, respectively, the determinants of new complements (*modnew*) and the cumulated number of complements (*modcum*). Results are consistent with Boudreau and Jeppesen (2015) and provide support to H2b: while user base is positively related with complements, the generation of new complements reduces with the increase of complementors. As the user base increases by one unit, the cumulated number of complements increases by 0.00243, which in turn generates a decrease in the generation of new complements by 0.00243*0.0219=5.3217e-05; this compensates the direct effect that a unitary increase in the user base has on the generation of new mods, 6.47e-05 (the difference is not statistically significant).

As a consequence, although user-base innovation is not self-propelling, it helps videogame producers to attract new users thus contrasting the natural decline in revenues that characterize entertainment products.

6. Conclusions and future research

The paper presents an original analysis of the video game demand and quantifies the effect that the creation of mods exerts on sales. Previous works do not include demand estimates in the assessment of network effects and make use of monthly observations of mods at best (for example, Boudreau and Jeppesen, 2015). Weekly time periods provide a period short enough to capture the short development cycles of mods and even small and rapid responses of user demand.

Game developers can benefit from the vitality of user community and should therefore favour the creation of a collaborative environment among players. In fact, the active participation of users and fans, perfectly aware of the consumers' needs, can drive the realization of successful complementary contents that significantly improve the quality of the product. Such contents, available for free, provide an impulse to the original video game demand and force retailers to renew their strategies in a sector that is usually characterized by short market-life and rapidly falling prices. Firms can encourage digital user innovation by opening, at least partially, proprietary contents to modders and by promoting competitive rewards to the best modders. Of course, the risk associated to the opening of intellectual property must be carefully evaluated. Comino and Manenti (2011) show that an appropriate definition of the licensing terms of distribution of open source software help firms balance the opposing effect of going open source.

The paper presents some limitations that future research could usefully address. At the present, the results refer to a limited number of video games. An increase in sample size to include a greater number of video games' titles is likely to reinforce the conclusions of the analysis. In addition, the present analysis refers to the Italian retail market and disregard online sales, that nonetheless constitute a great part of the industry revenues.

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