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Optimal software upgrade strategy: Should we sell products or premium services in the presence of piracy?

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ABSTRACT

This research explores the software upgrade strategy in the presence of piracy. When a firm introduces an upgrade, it can adopt a freemium strategy, by offering free products and paid services, or by adopting traditional strategy, and continuing to sell products. We develop a two-period joint model of upgrading and piracy, and use it to compare these two strategies. We find that whether a firm should adopt copyright protection depends on the reservation price for unethical consumers. Additionally, the presence of piracy and premium services can reduce price competition between the original product and the improved version. Freemium strategy always dominates traditional strategy except when the two conditions are satisfied. First, the differentiation between the original product and the improved version in terms of consumer preference must be relatively small. Second, the differentiation between the original product and the improved version in terms of product value must be moderate.

1. Introduction

Software upgrades that exhibit product innovation are prevalent in traditional organizations, especially for firms that strive to enhance the security and stability of their products. There are two reasons for the popularity of software upgrades. First, they add some new functionality and fix confirmed defects and bugs. For example, Microsoft released an anniversary update to Windows 10 by adding new security, inking and gaming features on August 2, 2016. AutoCAD 2017 updated its previous version by integrating an enhanced editing tool and a 3D graphics subsystem; the former is used to create and edit the centreline and the centre mark, while the latter improves system stability. Second, software upgrades can increase market coverage under certain conditions. For instance, a monopoly firm that provides a minor or moderate upgrade will obtain a larger market share of products when the firm does not provide upgrade pricing (Bala and Carr, 2009).

When a firm introduces a new software update, it should consider the effects of piracy because any software product can be pirated promptly with advanced information technology. According to a global software survey report by the Business Software Alliance (BSA), 2016, the installation ratio of unlicensed software on computers worldwide reached 39% in 2015. Also, 26% of workers load unauthorized software onto company networks, and the number is nearly the double the one that many CIOs estimate. Even in certain critical industries, including banking, insurance and securities, the unlicensed use rate worldwide amounts to 25%. As is widely known, unlicensed software can harm a firm's cybersecurity and credibility. The research firm IDC estimated that the global cost of cyberattacks exceeded USD 400 billion in 2015. Therefore, software piracy is a growing concern for software providers and governments. Pirated versions usually play a competitive role against legal products. Most consumers can reasonably predict the functionality of newly developed products by obtaining and analysing various information, and they must choose between upgrading to the new version and using an original version in the presence of piracy.

In the presence of piracy, the most traditional upgrade strategy is to sell products. For instance, Microsoft sold Office Home and Student 2013 in July 2012, and sold a new version, Office Home and Student 2016, beginning on March 18, 2015. A similar practice was observed with the operating systems: Windows 7 was published in October 2009, and Windows 8 was published in October 2013. This phenomenon is not restricted to Microsoft alone; many other examples have also emerged in recent years. For INSTANCE, Adobe upgraded Adobe Acrobat XI Pro to Adobe Acrobat Pro DC in 2015. MathWorks upgraded MATLAB 9.0 to MATLAB 9.1 in 2016. However, to rapidly expand the market share of legal products, many firms began to transform their strategy to freemium

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strategy, providing free fundamental products and paid add-on services beyond software upgrades. Apple adopted a freemium model when they released the free Mac OS X 10.9 Maverick in 2013 and charged for App Store.

In the context of anti-virus software, Avira provides Free Antivirus, which includes anti-virus and file protection. If users need webpage protection, firewall and backup, they must purchase Antivirus Premium or Internet Security. Recently, Microsoft has been embracing the freemium model, offering free Windows 10 upgrades for Windows 7, Windows 8.1 and Windows phone 8.1 for one year (2)[2]. Microsoft has set the goal of having Windows 10 on one billion active devices within two to three years of launch. Their purpose is to increase the number of legal upgrade users to obtain future profit from the add-on functionalities.

Providing free products MAY increase competitive power against pirated products, but free products can cannibalize the demand of premium functionality to reduce a firm's profit. For example, providing free functionality may reduce piracy to some extent (Cheng et al., 1997). Additionally, a case in point is a survey on Spotify, according to which the downloading of pirated music via BitTorrent dropped 20% in Australia during the first year after the streaming platform adopted freemium strategy. However, research has not yet explored whether freemium strategy dominates traditional strategy in the presence of piracy when a firm upgrades its product. In particular, we consider the competition between the original product and the upgrade product. Thus, when and whether a firm should sell products or premium services under the competition between the original product and improved product in the presence of piracy has become a critical issue for information goods providers. We investigate the above issues and search for the reasons underlying them.

Our research is interested in answering the following critical questions. First, should a firm implement copyright protection policy under the competition between the original product and improved product in the presence of piracy? Second, what is the effect of premium services on the price of original products? Third, when a firm upgrades its products, under what conditions should the firm adopt freemium strategy to obtain more users and increase profit? Finally, what is the optimal pricing strategy when a firm jointly decides on the value of the premium services in the second period and the prices in each period?.

To analyse these questions, we develop a two-stage model of upgrading and piracy to determine whether a firm should adopt freemium strategy or traditional strategy. Our model analyses the competition between original products and improved versions. In general, a Hotelling model (Hotelling, 1929) or a Salop model can be used to solve competition. For example, Ma and Kauffman (2014) used a Salop model to study the competition between SaaS providers by examining optimal pricing strategy. In our model, the original products and the upgrade products are on the opposite ends of the Hotelling line because the two products' interfaces, colours, and fonts are different. Additionally, there are two types consumers in the market. The first type is ethical consumers who are not price sensitive. They ascribe much lower value to pirated products, and they find pirated products to be morally unacceptable; thus, they do not use these products. The second type is unethical consumers, who are usually price sensitive. They may consider using pirated products instead of legal products according to the copyright protection level.

Our research provides several significant insights into competitive upgrade strategy. First, whether a firm should implement copyright protection depends on the reservation price for unethical consumers. Specifically, perfect copyright protection is optimal when the reservation price for unethical consumers is relatively high. When the reservation price for unethical consumers is relatively low, no copyright protection is profitable for the firm. Second, a firm that adopts a freemium strategy can charge a higher price for original products than a firm that adopts traditional strategy. Third, a freemium strategy is profitable for a firm when the differentiation in consumer preference between original products and upgrade products is relatively high. Additionally, when the differentiation between original products and upgrade products is relatively low in terms of consumer preference and is not moderate in terms of product value, freemium strategy can lead to higher profit than traditional strategy. Finally, a freemium strategy may lead to a larger market share than traditional strategy, and it will increase second-period profit if the added value of premium services is high.

2. Literature review

We next demonstrate how our work is connected to broad domains of research and explains the novelty of our setting. A monopoly firm faces a problem in determining if it should adopt a traditional business model or a freemium model when it provides upgrades in the presence of piracy. In this regard, our research is related to the literature on *software upgrades*, *software piracy*, and *free strategies*. These three areas constitute the *versioning of software* (Dey and Lahiri, 2016; Chellappa and Mehra, 2017).

The existing literature on software upgrades mainly addresses two aspects: what is the upgrade pricing strategy (Kornish, 2001; Bala and Carr, 2009; Mehra et al., 2012; Zhu and Zhou, 2012) and what is the optimal timing of investments in upgrades (Mukherji et al., 2006; Mehra et al., 2014; Morgan and Ngwenyama, 2015; Ngwenyama et al., 2007). Studies have considered other aspects of upgrade strategies, such as the social and economic impacts on the diffusion dynamics of open-source software (Zaffar et al., 2011; Mehra and Mookerjee, 2012), the impacts of switching costs and IT investment strategy (Demirhan et al., 2007), and the relationship among the maintenance, upgrade policy and optimal warranty (Sahin and Zahedi, 2000).

Additionally, Chang et al. (2007) compare two models, the analytic network process and the analytic hierarchy process, and they find that interdependencies would affect real decisions. Zhang and Seidmann (2010) analyse the optimal software license strategy in the presence of network effects and quality uncertainty. They compare a perpetual license, a subscription contract that users can automatically update for each period and a hybrid model. They find that the firm provides a hybrid model that contains perpetual licensing, and subscription is optimal when the network intensity is sufficiently large. In our model, we also execute the strategy comparisons, but we compare the traditional model with freemium model in the presence of piracy. Our work is different in three dimensions because it incorporates piracy behaviour, free strategy and the competition between the two periods products, which affects consumer decisions and firm policy.

The second stream of research is closely related to our work and centres on free strategy (Zhang et al., 2016; Roma and Ragaglia, 2016). Some of the literature studies freemium strategy, mainly the functionality-limited freemium and time-limited freemium types (Niculescu and Wu, 2014). For example, Cheng and Tang (2010) examine a limited functionality free trial strategy with network effects. They derive that offering a free trial is optimal when the network intensity is strong. Dey et al. (2013) explore a time-locked free trial with a general learning function, and they find that adopting a time-locked trial is a dominant strategy if and only if the rate of learning is sufficiently large. Niculescu and Wu (2014) compare three business models – functionality-limited freemium, seeding and the conventional business model – by developing a two-period consumer valuation learning model that can be influenced by word-of-mouth effects. Different from this stream