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DIFFUSION IN PLATFORM-BASED MARKETS: BIG DATA DRIVEN AGENT-BASED MODEL

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ABSTRACT

Adoption of competing platforms, such as video game consoles, is usually explained retrospectively with cumulative, direct (overall quantity of other players) and indirect network effects (overall quantity of games). An agent-based model, fed with big data representing the competition between PlayStation 3 and Xbox 360, shows that the quality of the network effects explain adoption more accurately than the mere strength of these effects. Instead of choosing a console with the strongest network effects (highest amount of other players and games), players choose the console with the highest quality of direct network effects (amount of friends among the players) and indirect network effects (amount of games that are aligned with the preferences of the player).

1 INTRODUCTION

Modeling diffusion of innovations, the process through which innovations are adopted by the social system over time (Rogers 2003), has been practiced since the late 1960s. Most diffusion models have dealt with product category level, yet understanding diffusion of competing products is particularly interesting to managers. Also, too few diffusion models explain how interdependencies between complementary products affect their diffusion (Peres et al. 2010). In the so called platform-based markets – in which we can identify two or more sides in the market, where the innovation or technology is used to connect these sides – the complementarity of the platform and products on the platform strongly affect their diffusion (Evans and Schmalensee 2007; Zhu and Iansiti 2012). Even though platform-based markets are common and thriving these days, only few, if any models, explain their diffusion dynamics.

Thus, we examine the diffusion of innovations in the competitive setting between two diffusing platforms. The purpose of this study is to extend our knowledge of diffusion of competing platforms by contributing to diffusion modeling literature. We ask, how do competing innovations diffuse in platform-based markets? In order to answer this question, we simulate a big data driven agent-based model on the competition between PlayStation 3 (hereafter PS) and Xbox 360 (hereafter Xbox).

2 THE MODEL

The structure of the platform-based market is two- or multi-sided, when an intermediary (i.e., platform) must succeed in bringing both sides of the market (i.e., customers and suppliers) together. An example of such platform-based market is the video game console market, where platform providers (i.e., Sony and Microsoft) each produce game consoles, associated with their own developer and player communities. Traditionally, the direct (i.e., the overall quantity of other players) and indirect network effects (i.e., the overall quantity of games) have been used to explain adoption of platforms (Evans and Schmalensee 2007; Zhu and Iansiti 2012). Here, instead of focusing on the quantity of the direct and indirect network effects, we focus on the quality of these effects.

There are three types of agents in the model: players, consoles, and games. Players choose to adopt between the two consoles. The adoption decisions are based on two quality-related factors: amount of friends among the players of a console and amount of games on a console that are aligned with the preferences of the player. The player chooses to adopt the console that is better in terms of both quality factors, or the console that is better in either quality factor and equally good in the other. If one console is better in either quality factor, and the other console is better in the other, the player's preferred factor dictates the adoption decision (if the player has more friends than on average, he or she prefers games, and friends are preferred when the player has less friends than on average). When consoles are equally good in both quality factors, the player chooses randomly. Thus, 10 of 11 possible adoption decisions are deterministic, and one is random. Timing of adoption decisions is controlled by real console adoption data over time (PS and Xbox combined). Also, the timing of game launches and qualities of games published on each console over time are controlled by data that were collected from www.metacritic.com using a tailor-made Web scraper.

To represent friendships between players, a random network with varying degree of connectedness between players is generated. When a game is launched, players decide individually whether they consider the game to be aligned with their preferences or not. The probability that the game is aligned with the preferences of a player is the game's Metacritic review value (0-100) divided by a common and constant game quality divider parameter. Also, three additional parameters (common and constant) are imposed: the time a game is considered to be aligned with the preferences of a player; and upper limits for both the amount of friends and amount of games that matter in console adoption decisions.

Simulation time ranges from October 2005 to June 2013 with a time step of one month. Due to the stochastic nature of the model, 10 000 iterations were run and the average predictions were compared to real adoption data.

3 RESULTS AND CONCLUSION

The maximum (absolute) difference in the modeled and real cumulative adoption for PS is -2,620,534 adopters (at June 2013), and -2,065,440 adopters for Xbox (at December 2011). Relatively, these errors are low (-3,2 % for PS and -3,5 % for Xbox). In the beginning of the simulation, the relative errors are high: at highest (December 2006), for PS the difference is approximately 58,3 % and -23,2 % for Xbox. However, from August 2008 to the end of the simulation time the relative differences are between -5 % and 5 % for both PS and Xbox. In total, 85,2 % of the PS and 87,7 % of the Xbox predictions differ less than 5 % of the actual cumulative adoption. Finally, in the end of simulation time the differences between predicted and real cumulative console adoption are -2,620,534 users (-3,2 %) for PS and 1,350,056 users (1,9 %) for Xbox. On average, throughout the whole simulation time, the prediction difference is -151,710 users (2,3 %) for PS and -95 017 (-1,2 %) for Xbox.

Our results show that the quality of the network effects explains adoption more accurately than the mere strength of these effects. We conclude that the diffusion of competing platforms is strongly affected by the quality of direct and indirect network effects. Moving forward from this study, more attention is called for developing diffusion models incorporating these effects in the context of competing platforms.

REFERENCES

Evans, D. S., and R. Schmalensee. 2007. "The Industrial Organization of Markets with Two-Sided Platforms." *Competition Policy International* 3: 150-179.

Peres, R., E. Muller, and V. Mahajan. 2010. "Innovation diffusion and new product growth models: A critical review and research directions." *International Journal of Research in Marketing* 27: 91-106.

Rogers, E. M. 2003. *Diffusion of Innovations*. 5th ed. Unites States of America: The Free Press.

Zhu, F., and M. Iansiti. 2012. "Entry into platform-based markets." *Strategic Management Journal* 33: 88-106.