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Journal of Economic Theory 148 (2013) 1179–1212

JOURNAL OF Economic Theory

www.elsevier.com/locate/jet

Quality, upgrades and equilibrium in a dynamic monopoly market ☆

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Received 13 June 2011; final version received 11 August 2012; accepted 19 October 2012

Available online 19 December 2012

Abstract

We examine an infinite horizon model of quality growth for a durable goods monopoly. The seller may offer any bundle(s) of current and previous quality improvements (upgrades). Subgame perfect equilibrium seller payoffs range from capturing the full social surplus down to only the initial flow value of each good, as long as the value of all future quality growth exceeds the value of a single unit. Each of these payoffs is realized in a Markov perfect equilibrium that follows the socially efficient path. However, inefficient delay equilibria, with bundling, exist for innovation rates above a threshold.

JEL classification: C72; C73; D42; L15

Keywords: Upgrades; Durable goods; Monopoly; Market power; Coordination; Bundling

We examine the commercialization process – pricing and adoption – of an upgrade good in a dynamic monopoly market. Prominent examples are provided by technology markets, such

☆ We are grateful to the Fuqua Business Associates Fund and Microsoft for financial support. We thank Harvard Business School, the Portuguese Competition Authority, and UCSD for their hospitality where some of this research was conducted. We also thank the associate editor and referees, as well as Jacques Cremer, Leslie Marx, Larry Samuelson, Jean Tirole, Mike Waldman, Dennis Yao, many colleagues at conferences and seminars, and, especially, Joel Sobel for many helpful conversations. The views in this work are solely are own.
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0022-0531/$ – see front matter
http://dx.doi.org/10.1016/j.jet.2012.12.006

as those for software, where cycles of upgrades to existing products have become the norm.[1] Ongoing innovation implies that buyers face a sequence of purchasing decisions. Thus, rather than timing a single purchase and then exiting the market, buyers have an incentive to return to the market and 'upgrade' to a higher quality. Buyer expectations are pivotal for these decisions and, given the recurrent aspect of upgrading, bundling by the seller emerges as a critical aspect of the upgrade offers.

The Microsoft antitrust cases highlight a fundamental question regarding prices in an upgrade market. Fudenberg and Tirole [11] observed that the expert witnesses all appeared to agree that Microsoft was pricing the Windows operating system well below the static monopoly price. There was, however, wide disagreement as to why. Prominent arguments included network formation with low prices spurring adoption, limit pricing where a low price deters rivals, and leverage to gain sales in markets for application programs. Implicit in all of these arguments is the presumption that prices would be higher in the absence of these forces. There is, however, no model of dynamic monopoly that provides a basis for this claim. We provide a game theoretic analysis of dynamic monopoly pricing for an upgrade good and establish that, in equilibrium, high prices are not a necessary outcome. Significantly, low prices, as measured by a seller who captures a small share of the social surplus, emerge in equilibrium.

Upgrade markets, by definition, regularly confront buyers with the choice of adopting a new higher-quality version or remaining with their current version. Microsoft's recent introduction of Vista was an adoption failure as buyers overwhelmingly chose to stay with their existing XP version, echoing a previous episode with Windows Millennium in 2000. Microsoft moved quickly to introduce a new version. Windows 7 was launched in late October 2009 to a much more favorable buyer response. As early as May 2009, Microsoft CEO Steve Ballmer acknowledged that "If people want to wait [for Windows 7], they certainly can." This simple observation, which implicitly takes the failure of Vista as a given, leads to a more subtle set of questions.

Consider the initial offer of Vista. An individual buyer has the option of remaining with XP. If most other buyers had purchased Vista then we can expect a concern about "falling behind" the market to be pivotal for an individual buyer's willingness to pay. Given that others did not purchase Vista, an individual buyer who stayed with XP is in the position Ballmer described. By purchasing Vista a buyer would "jump ahead" of the market and then be confronted with the choice of purchasing Windows 7 to "keep up" with market, assuming that Windows 7 is widely adopted. How does this recurrent interplay of individual and collective decisions with respect to incentives to "fall behind" or "jump ahead" of the market work to determine prices and adoption in an upgrade market? We argue that the ability of the seller to tempt an individual buyer to "jump ahead" is the critical factor and that this incentive provides the basis for a credible threat to reject an upgrade offer. Moreover, low prices can emerge even when buyers have a very strong incentive not to "fall behind" the market.

Our infinite horizon model of an upgrade market has a very simple economic structure. Innovation is exogenous but ongoing and in each period it is feasible for the seller to offer an additional quality increment. Buyers are homogeneous and have a fixed valuation per unit of quality; this corresponds to a horizontal demand curve in a static setting. Building on the recent literature, we assume 'upgrade' goods satisfy a downward complementarity property: an

[1] Quality improvement is important in durable goods markets, as emphasized by Waldman [20]. In addition to software, upgrades to cellular networks often allow vendors to offer, for an added charge, new or improved services such as web browsing, e-mail access and text messaging. Many capital goods are regularly upgraded, including airports (terminals and runways) and oil refineries, among others.