Available online at www.sciencedirect.com
ScienceDirect
Information Economics and Policy 20 (2008) 54–66
INFORMATION ECONOMICS AND POLICY
www.elsevier.com/locate/iep

Contracting with asymmetric information in the presence of positive network effects: Screening and divide-and-conquer techniques ☆

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Received 28 June 2006; received in revised form 26 October 2007; accepted 26 October 2007
Available online 7 November 2007

Abstract

This paper shows how pessimistic expectations reduce the effectivity of monopolist screening techniques with positive network effects, and demonstrates how divide-and-conquer strategies can solve the consumers' coordination problem. In the sequential mechanism, different expectations about future network size become relevant in the incentive constraints of different consumer types. Screening consumers is less costly in later periods, so pooling may be beneficial in early stages of contracting. The joint presence of asymmetric information and positive network effects yields a strict downward distortion from the welfare-maximizing quantity scheme, while unique implementation has further downward distorting effects.

JEL classification: D42; D62; D82; L12

Keywords: Network effects; Expectations; Second-degree discrimination; Sequential contracts; Divide-and-conquer strategies; Monotone comparative statics

1. Introduction

This paper shows how pessimistic expectations can decrease a monopoly's power in practicing second-degree discrimination techniques in the presence of positive network effects, and demonstrates the use of sequential contracting techniques in solving the consumers' coordination problem by unique implementation.

☆ This paper is based on Chapter 4 of my doctoral thesis at Central European University (2006). I thank Patrick Rey for motivating discussions, and Mark Armstrong, Peter Benczur, and seminar participants at UCL, Keele University and the 2006 European Meeting of the Econometric Society for their comments on earlier versions. Finally, I am grateful to Editor Tommaso Valletti, an anonymous Associate Editor, and two anonymous referees for their insightful suggestions. All remaining errors are mine.
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0167-6245/$ - see front matter
doi:10.1016/j.infoecopol.2007.10.003

Positive network effects are also called complementarities in consumption, and are present if economic agents' utility is positively affected by the consumption level (or number) of other agents using the same or compatible products. These effects commonly arise in various modern industries, like telecommunications, hardware and software, and these usually highly concentrated industries give hundreds of examples for nonlinear tariffs.[1] With network effects, consumers' expectations play a decisive role in which equilibrium the economy will end up with,[2] so it may be in the firms' best interest to influence the formation of these expectations, in order to avoid unfavorable outcomes.

We take a simple example to demonstrate the contracting problem. Suppose there are only two types of consumers for a network good, we call them sophisticated and normal, where the sophisticated ones benefit more both from individual consumption and network size. It is well known that due to asymmetric information, it is optimal to distort downwards the first-best optimal quantity devoted to normal consumers in order to make switching less attractive to sophisticated consumers. However, it leads to a decrease in network size, so sophisticated consumers' utility is negatively affected, therefore their consumption should be distorted downwards as well. An additional problem is that there exists another pessimistic rational expectations equilibrium in which each consumer expects the others not to buy anything. Although the former equilibrium trivially Pareto-dominates the 'no purchases' outcome, its riskiness might prevent consumers from coordinating on this equilibrium.[3] The excess intertia resulting from the possibility of these pessimistic expectations clearly hurts the monopoly, so the main question is how to have all consumers surely 'on board' and simultaneously minimize the resulting loss in profit.

Sequential contracting might be a way to circumvent coordination problems. If the contract devoted to the consumer group contracted first is designed such that its members can expect a non-negative utility if all of them join but none of the second group, it is optimal for them to accept this contract. But since the second group also observes the same menu of contracts, no matter how pessimistic prior expectations they had, they will realize that first group members will accept their contract in any case. Therefore the monopoly is able to design the menu devoted to sophisticated consumers to reap their larger network benefits at the cost of leaving some smaller benefits for normal consumers (the network benefits created by the other group).[4]

The use of these so called divide-and-conquer strategies is also technically possible by making the network good devoted to normal consumers partially incompatible with the network good devoted to sophisticated ones, while maintain full compatibility for the latter one. We see therefore that compatibility decisions and coordination issues may be highly related. Software markets indeed give examples where normal consumers are supplied with a partially incompatible good, in order to ensure a higher network for sophisticated consumers but deter them from switching.[5]

The main contribution of this paper is to show how to combine divide-and-conquer strategies with screening techniques, so it can be applied for settings with asymmetric information that typically exists for sellers. For unique implementation, it should be ensured at every step that all consumers choose the menu devoted to them, no matter which type of expectations they might have about the final network size.[6] This approach leads however to an important theoretical problem: if we want to achieve self-selection, then high-type consumers should be given incentives not to switch when they have the most pessimistic expectations about the final network size, while low-type consumers' relevant incentive-compatibility constraints should be formulated for the most optimistic scenario.

We show that the screening motive is much stronger in designing the contracts for consumers at later stages. In the early contracting stages, the gap between the most optimistic and pessimistic expectations may be so big

[1] For a recent summary on network effects, see Margolis and Liebowitz (2002) and references therein.

[2] See the seminal contributions of Farrel and Saloner (1985) and Katz and Shapiro (1985) to this problem.

[3] On experimental evidence demonstrating this result, see for example Cooper et al. (1990).

[4] Unless the relative density of normal consumers is too high, it is always optimal to contract normal consumers first. Note however, that consumers of the same type may still have coordination problems among themselves, so the 'no purchases' equilibrium still remains.

[5] A typical example on the profitable use of incompatibility strategies in a static setting is the functional degradation policy of software companies (for example Adobe Acrobat), examined in Csorba and Hahn (2006). On incompatibility strategies in dynamic setting, see Ellison and Fudenberg (2000) and Nahm (2005), among others.

[6] This 'better safe than sorry' approach can be also applied if the seller is infinitely risk-averse, since it prepares to the worst-case scenario for the mechanism designer.