Economics Letters 151 (2017) 39–43

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Compatibility, network effects, and collusion☆

Alexander Rasch*

Duesseldorf Institute for Competition Economics (DICE), University of Duesseldorf, Universitaetsstrasse 1, 40225 Duesseldorf, Germany

HIGHLIGHTS

- A market with network effects in which firms collude on prices is considered.
- Full collusion is easier to sustain under compatibility.
- Incentives to introduce compatibility under collusion may be higher or lower than under competition.
- Intertemporal preferences can have an ambiguous effect on firms' compatibility decisions.

ARTICLE INFO

Article history:
Received 7 September 2016
Received in revised form 17 November 2016
Accepted 23 November 2016
Available online 25 November 2016

JEL classification:
L13
L14
L15
L41

Keywords:
Collusion
Compatibility
Network effect
Standard

ABSTRACT

I consider a market with network effects in which firms collude on prices. Depending on the fixed costs for achieving compatibility, there may be a non-monotone relationship between firms' decisions to make their products compatible and their intertemporal preferences.

1. Introduction

Introducing a common standard to make products compatible is an important consideration in markets both with and without network effects. The compatibility issue has been extensively theoretically addressed in competitive market environments in which network effects are not present (see, e.g., Matutes and Regibeau, 1988, Economides, 1989, and Chou and Shy, 1990) and those in which they are (see, e.g., Katz and Shapiro, 1985 and Farrell and Saloner, 1986). However, the relationship between compatibility and collusion has received only limited attention. The sole exception is Lambertini et al. (1998), who consider a market without network effects. The authors analyze the implications of an increasing discount factor on the incentives to introduce (costly) compatibility, showing that there is a non-monotone relationship. I complement this previous literature by investigating the relationship between collusion and firms' incentives to introduce compatibility in a market with network effects.

In industries with network effects, customers benefit from a larger network, i.e., from the larger number of customers who use the same network. In such cases, compatibility means that customers benefit not only from other customers opting for the same network but also from those who use a compatible network.

One important industry in which network effects, compatibility, and collusion are prominently featured is the telecommunications sector. With regard to network effects, in their analysis of 1335 subscribers to one of the five South Korean mobile phone networks, Kim and Kwon (2003) find that consumers prefer larger networks; price discounts for on-net calls and quality signals are likely sources of this network effect. Similarly, based on quarterly data from Polish mobile phone providers between 1996 and

☆ I am grateful to Jesko Herre, Bernd Schauenberg, Jörg Schiller, and Achim Wambach for their helpful comments on an earlier version of the paper. I also thank an anonymous referee for his or her valuable suggestions.

* Fax: +49 0 211 81 15499.
E-mail address: rasch@dice.hhu.de.

http://dx.doi.org/10.1016/j.econlet.2016.11.031
0165-1765/

2001, Grajek (2007) reports that strong network effects exist in the Polish market for telecommunications.[1]

At first glance, compatibility in the telecommunications sector appears to be widespread, but this is not true for all countries. Various mobile operators use GSM (Global System for Mobiles) as a common standard in most European countries, but in the United States, there are two coexisting mobile phone technologies that are not compatible: GSM and CDMA (Code Division Multiple Access).

With regard to collusive practices in the telecommunications sector, Chen and Lin (2002) describe a case of collusion among mobile phone service providers in Hong Kong in 2000. In their empirical study, Nunn and Sarvary (2004) analyze the mobile telecommunications industry, using price and quantity data from ten countries around the world; they conclude that "market power in different countries may originate from [...] collusive pricing among cellular operators" (p. 377).

I use these observations as a starting point to investigate the interplay of collusion and compatibility in a market with network effects.

2. The model

I use the model developed by Hotelling (1929) with added network effects similar to the setup in Farrell and Saloner (1992) (see also Doganoglu and Wright, 2006). There are two symmetric firms. Firm 1 is located at $L_1 = 0$ on a linear city of unit length; firm 2 is located at $L_2 = 1$. Firms' marginal and fixed costs for providing the network product are normalized to zero. Firms compete in prices p_i (with $i \in \{1, 2\}$) and may invest fixed costs of f (per firm) to make their products compatible. Firms have a common discount factor δ.

Customers of mass one are uniformly distributed along the linear city. They derive an intrinsic utility of one from buying the network product. They also benefit from the participation of other customers who buy the same or a compatible product (network effect); the extent of this beneficial effect is measured by ς (with $0 \leq \varsigma$). Customers incur linear transport costs τ per unit of distance.[2] Hence, a customer located at x derives the following net utility when buying from firm i:

$$u_i = \begin{cases} 1 - p_i - \tau |L_i - x| + \varsigma n_i & \text{under incompatibility} \\ 1 - p_i - \tau |L_i - x| + \varsigma & \text{under compatibility,} \end{cases}$$

where n_i denotes firm i's customer base, which is equal to 1 under compatibility (see Assumption 1 below).

The timing of the game is as follows:

Period 1 Firms decide on the introduction of compatibility.
Periods 2–∞ In each period, there are two stages:

Stage 1 Firms simultaneously set prices.
Stage 2 Customers observe prices and decide which firm to buy from.

I look for subgame perfect equilibria, which implies that customers form rational expectations in determining the size of each network given the prices they observe.

With regard to the price-setting decision, I assume that firms use grim-trigger strategies (Friedman, 1971), meaning that they collude as long as no firm has deviated from the collusive path in previous periods. Should such deviation occur, firms revert to competition forever. The use of grim-trigger strategies leads to the critical discount factor, defined as

$$\bar{\delta}_j := \frac{\pi_j^D - \bar{\pi}_j^K}{\pi_j^D - \pi_j^N},$$

where π_j^N, π_j^D, and $\bar{\pi}_j^K$ denote competitive (punishment) profits, deviation profits, and maximum collusive profits, respectively, and $j \in \{I, C\}$ denotes the cases of incompatibility (subscript I) and compatibility (subscript C). Note that collusion at maximum prices is stable if and only if $\delta \geq \bar{\delta}_j$.[3]

To avoid the possibility of a cornered market equilibrium, the transport-cost parameter must not be smaller than the network effect.[4] In order to ensure that the market is always covered (i.e., that all customers along the line buy from one of the two firms), transport costs must not be too high. Hence, I make the following assumption:

Assumption 1. Transport costs are such that $\varsigma \leq \tau \leq 2/3 + 2\varsigma/3 =: \bar{\tau}$.[5]

3. Analysis and results

I first report competitive, collusive, and deviation profits in periods 2–∞. Subsequently, I analyze less-than-maximum collusive profits and firms' compatibility decisions.

3.1. Prices and profits

Competition

I start by reviewing the competitive case.[6]

No compatibility. The symmetric competitive equilibrium price is given by

$$p_I^N = \tau - \varsigma.$$

The firms share the market equally, and the equilibrium profit per firm amounts to

$$\pi_I^N = \frac{\tau}{2} - \frac{\varsigma}{2}.$$

Compatibility. Suppose now that firms have decided to make their products compatible. In this case, competition is equal to the case without network effects, i.e., the equilibrium price is equal to

$$p_C^N = \tau.$$

Given compatibility investments (which are sunk after period 1) and equal market shares, the per-period profit for each firm amounts to

$$\pi_C^N = \frac{\tau}{2}.$$

[1] Again, lower on-net prices and other issues such as quality signals and conformist behavior are important factors. See Birke (2009) for a survey of the empirical contributions.

[2] In light of the results in Rasch and Wambach (2009), assuming quadratic transport costs instead should not qualitatively change the results.

[3] Of course, one could also use optimal punishments (Abreu, 1986). But as Häckner (1996) observes when comparing his results to those of Chang (1991), who uses grim-trigger strategies, "the relationship between cartel stability and product differentiation is fairly robust to changes in the punishment mechanism for the class of models characterized by Bertrand competition and horizontal differentiation" (p. 613).

[4] If this (standard) assumption is violated, a customer located at one of the extreme points may still want to buy from the distant firm at equal prices if he expects everyone else to do so. This raises the possibility of multiple consistent network sizes for given prices, which I ignore.

[5] Note that this implies that $\varsigma \leq \bar{\tau} \Leftrightarrow \varsigma \leq 2$.

[6] These results are taken from Doganoglu and Wright (2006).