Economics Letters 120 (2013) 379–383

Contents lists available at SciVerse ScienceDirect

Economics Letters

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

Price discrimination or uniform pricing: Which colludes more?

Niklas Horstmann *, Jan Krämer

Karlsruhe Institute of Technology (KIT), Institute of Information Systems and Marketing (IISM), Englerstr. 14, 76131 Karlsruhe, Germany

HIGHLIGHTS

- We study the impact of uniform pricing and price discrimination on tacit collusion.
- We conduct a laboratory experiment with two symmetric firms and markets.
- We find that price discrimination leads to higher prices than uniform pricing.
- These differences cannot be explained by existing theory.

ARTICLE INFO

Article history:
Received 9 November 2012
Received in revised form
24 April 2013
Accepted 10 May 2013
Available online 18 May 2013

JEL classification:
C92
L13

Keywords:
Price discrimination
Uniform pricing
Multimarket contact
Experimental economics
Collusion

ABSTRACT

Conventional wisdom attributes different economic outcomes of uniform pricing and price discrimination to the heterogeneity in market conditions or market participants, such as differences in demand elasticity or production costs. We offer a new explanation for the observed differences that relates to behavioral aspects rather than demand- or supply-side effects. In particular, in a symmetric Bertrand duopoly laboratory experiment, for which theory predicts no differences between the two pricing regimes, we find that tacit price collusion is systematically higher under price discrimination than under uniform pricing.

1. Introduction

When firms sell their products in more than one (geographic) market, they may either charge the same price across markets (uniform pricing) or they may charge differentiated prices according to the specific market conditions (price discrimination). According to conventional wisdom, firms should price discriminate whenever possible, due to asymmetric costs or differences in demand elasticity across markets. Although some exceptions to this conventional wisdom were identified (Dobson and Waterson, 2008), the existing literature agrees that price discrimination and uniform pricing generally yield different market outcomes when there are differences in the market conditions. On the contrary, there is currently no theory that predicts differences in market outcomes due to the two pricing regimes when there are *no* differences across markets.

In this note, we demonstrate in a laboratory experiment that price discrimination leads to higher average prices than uniform pricing even when firms and markets are symmetric. Thus, we identify a new explanation for differences in economic outcomes between the two pricing regimes that relates to their impacts on tacit collusion, rather than cost or demand asymmetries. Previous experimental studies on tacit collusion have not considered the possibility to price discriminate as a treatment variable (Engel, 2007).

In this context, our findings also relate to the literature on mutual forbearance (Edwards, 1955), which discussed the collusive effects of multimarket contact. Whereas under price discrimination the underlying markets remain, in principle, independent, uniform pricing creates a bond between the markets that effectively makes them one market. Porter (1980) argued that firms meeting in several markets (price discrimination) may find it easier to tacitly collude than firms meeting only in one market (uniform pricing). This is because every colluding firm anticipates that a price deviation in any *one* market will be punished by price cuts in *all* markets by the other firms. However, Bernheim and Whinston (1990) criticized this view and argued that a rational price deviation should

* Corresponding author. Tel.: +49 721 608 48387; fax: +49 721 608 48399.
E-mail addresses: horstmann@kit.edu (N. Horstmann), kraemer@kit.edu (J. Krämer).

0165-1765/$ – see front matter
http://dx.doi.org/10.1016/j.econlet.2013.05.011

never occur only in one, but in all markets simultaneously, thus rendering the multimarket retaliation as no more effective than the retaliation in a single market environment. Moreover, the authors formally established an irrelevance result, which states that multimarket contact cannot facilitate tacit collusion between symmetric firms meeting in symmetric markets.[1] Hence, our findings can also not be explained by the mutual forbearance theory.

2. Experimental design

We consider an industry with two distinct markets, A and B, in which two symmetric, price competing firms, $i \in \{1, 2\}$, offer a homogeneous product for T periods, respectively. The supply of one unit of the product to either market implies marginal cost of c to each firm. The number of consumers per market is N. Denote i's price for market $X \in \{A, B\}$ by p_i^X. Then, according to Bertrand competition, the demand of firm i in market X in each period is given by

$$D_i^X(p_i^X, p_{-i}^X) = \begin{cases} N & \text{if } p_i^X < p_{-i}^X \text{ and } p_i^X \le v \\ N/2 & \text{if } p_i^X = p_{-i}^X \text{ and } p_i^X \le v \\ 0 & \text{if } p_i^X > \min\{p_{-i}^X, v\}, \end{cases}$$

where $-i$ is the index of the other firm and v is the consumers' homogeneous willingness to pay. Consequently, i's total profit in each period is

$$\pi_i(p_i^A, p_i^B, p_{-i}^A, p_{-i}^B) = D_i^A \cdot (p_i^A - c) + D_i^B \cdot (p_i^B - c)$$

in case firms are allowed to price discriminate across markets. Similarly, if firms commit to uniform pricing, $p_i = p_i^A = p_i^B$.

It is well known that the unique strict Nash equilibrium of the above Bertrand stage game is

$$p_i^{A^*} = p_{-i}^{A^*} = \lceil c \rceil \quad \text{and} \quad p_i^{B^*} = p_{-i}^{B^*} = \lceil c \rceil$$

under price discrimination, where $\lceil \cdot \rceil$ returns the smallest feasible price level that is larger than its argument. Likewise, under uniform pricing

$$p_i^* = p_{-i}^* = \lceil c \rceil.$$

Further, under reasonable assumptions about the equilibrium concept of the finitely repeated Bertrand game, the above unique equilibrium of the Bertrand stage game is also the unique price equilibrium of the repeated Bertrand game. For example, Farrell and Maskin (1989) showed that the price equilibrium of the Bertrand stage game is the unique weakly renegotiation proof price equilibrium of the repeated Bertrand game. It is also the unique subgame perfect equilibrium. In conclusion, the theoretical prediction of both pricing scenarios is equivalent in terms of equilibrium prices and hence in terms of profits and consumer surplus.

In the experiment, participants played $T = 10$ repeated interactions (periods) of the Bertrand stage game. Profits were accumulated over the periods. For a more direct relation between reward signals and participants' decisions, the model was parameterized using EUR instead of an experimental currency unit. Marginal costs were set to $c = 30$ cent. Each market had $N = 10$ consumers with a willingness to pay of $v = 50$ cent each. The minimum price increment was chosen to be 1 cent. Treatments differed only with respect to whether participants could price discriminate (PD) or were restricted to uniform pricing (UP) between the two markets. As noted above, the unique strict Nash equilibrium entails that both firms choose prices $p^{A^*} = p^{B^*} = 31$ cent for both markets (treatment PD) or $p^* = 31$ cent as the uniform price (treatment UP) during all periods.

[1] In their model, Bernheim and Whinston consider an infinite time horizon, whereas we consider a finite time horizon. However, note that collusion is harder to sustain with a finite time horizon (Harrington, 1987) and thus, the irrelevance result remains to hold in the present context.

3. Experimental procedure

For each treatment condition, there were twelve sessions with four subjects each, i.e., 96 participants in total. The experiment was designed between subject, i.e., participants were exclusively assigned to one treatment condition. In total, each subject participated in three *rounds*. Each round consisted of ten consecutive repetitions of the Bertrand stage game, which we refer to as *periods*. Within each round, there was a fixed partner matching. However, after each round, participants were matched with a new partner that they did not previously encounter. Thus, each subject played with all other participants of the same session for exactly one round (i.e., for ten periods). Since firms were designed to be symmetric, we avoided labelling subjects in any order. Instead, a firm's current partner was referred to as 'the other firm'.

Every effort was made to ensure salience in the experiment. Participants were equipped with a calculator and the experimental software provided a forecast tool for demand and profit in the next round, given a subject's expectation of both firms' prices. Moreover, a history of previous prices within the same round and the same group was provided. However, there was no exchange of information or interaction between subjects in different groups, i.e., no population feedback (Bruttel, 2009). To avoid budget effects, the earnings of only one round were paid out. Participants threw a dice to determine which of the last two rounds was paid out to them. The first round, which was declared a practice round, was not relevant for the final payoff and thus it is not considered in the subsequent statistical analysis. The experimental instructions provided to the subjects covered all stated design features of the experiment, including the number of periods and rounds as well as how the profits and their final payment would be determined.[2]

The experiment was computerized using *z-Tree* (Fischbacher, 2007). All sessions were run at the Karlsruhe Institute of Technology in Karlsruhe, Germany, in May and June 2012, and April 2013. Participants were recruited via the *ORSEE* platform (Greiner, 2004). Subjects were exclusively students of economic fields. None of the 24 sessions lasted more than one hour. No initial budget was given to the participants. A subject's average monetary earning was 10.86 EUR.

4. Results

We aggregate our data by computing the average market price over all ten periods of a round. Note that under price discrimination the average is taken also across markets. Thus, at the group level an observation is uniquely identified by treatment (UP or PD), session (1–12), group (1–2), and round (1 or 2). Thus, there are 48 observations for each of the treatments. However, note that due to our matching scheme, observations from a single session are not statistically independent. We control for this by means of a hierarchical mixed-effects regression model and by considering only the session-averaged market prices, respectively. First, however, in Table 1 we report the descriptive statistics with respect to a subject's average price and profit, and a group's average market price as a measure for tacit collusion. Moreover, Fig. 1 shows the average market price for both treatments over the ten periods and contrasts it to the equilibrium price. Table 1 and Fig. 1 already indicate two notable deviations from the theoretical prediction. First, prices have a positive offset from marginal costs, i.e., from the theoretical equilibrium. This is in line with previous experimental results on Bertrand competition (cf. Engel, 2007). Second, there seem to be differences in market prices and hence in tacit price collusion between the treatments. On average, the market price is 4.15 cent (10.71%) higher for the PD treatment.

[2] The instructions as well as screenshots are provided in the Appendix.