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Consumer Responses to Behaviour-Based Price Discrimination

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Abstract

The abstract

1 Introduction

Choe et al. (2018) is chosen due to its significant contribution to the literature. The model they develop is dynamic and was innovative in the sense that endogenously created asymmetric information leads to multiple and asymmetric equilibria with and without endogenous product choice even when firms are symmetric ex ante. The asymmetry in equlibrium depends on the foward-looking tendency of firms (positive discount factor for the future). Siehe Content-Reiter Citavi

1.1 Price Differentiation

Types of price discrimination

1.2 Spatial Competition

Mostly Hotelling (incl. impossibility result → relevance for Choe) and maybe also the circle (see Belleflamme)

2 Choe et al. (2018): BBPD and Spatial Competition in a Dynamic Model

This section provides an introduction to the model presented in Choe et al. (2018). The present a model that combines behaviour-based price discrimination with spatial competition. A brief overview of the model is followed by a thorough exposition below. The model is dynamic and comprises two periods and two firms. In the first period, firms choose their location as they do in the standard Hotelling model with quadratic transportation costs but also track all consumers that decide to purchase from them in this period. This creates informational asymmetries as firms can only track customers that purchased from *them*. Once chosen, locations are fixed for the entirety of the game. Note that the competiton for location is also a competition for information. In the baseline model, this thus concludes the spatial competition between firms. Customer's location in the Hotelling linear city over $[0, 1]$ is the only source of heterogeneity in the set of consumers.[1] In the second period, firms can exploit their private information by discriminating against consumers based on their decisions from the first period: firms offer 'personalised pricing' (p. 5672) to *each* consumer who purchased from that firm in the first period. Firms also set a uniform 'poaching' price (p. 5672) in order to attract consumers who previously purchased from their competitor. Firms simultaneously choose the poaching price first, after which they set the individualised prices for their existing customers. This price structure hinges on the ability of firms to track their customers in the first period and endogenously create private information.

[1] This is sufficient as a source of heterogeneity as variation in willingness to pay based on different transportation costs is the only property required by the model.

Consumers then observe three prices prior to their purchase decision in the second period: their personalised price and the two poaching prices; they only care about the lowest price absent any loyalty or fairness concerns. The authors assume that the inclusion of "bevioral elements to consumer choice is likely to change [the] results substantially." (p. 5672) The model is dynamic since firms have multiple periods to act, multiple decisions to make and interact with one another. Accordingly, firms intertemporally maximise their total profits over both periods. The authors thus endow firms (and consumers) with positive discount factors. The discounting of future profits by firms ensures the existance of asymmetric equilibria; if firms have no intertemporal prefence for second-period profits, equilibria are symmetric irrespecive of consumers' discount factors.

2.1 Baseline Model

The firm comprises two firms that compete in a Hotelling linear city with quadratic costs for location and consumers in a two-stage game with perods $\tau = 1, 2$. Consumers are uniformly distributed on $[0, 1]$ where consumer x is simply located at x. Consumers incur quadratic transportation costs. Firms have full knowledge of this setup. Furthermore, firms are assumed to have constant marginal cost of production; this is – as is common in this strain of the literature – normalised to 0. Over the course of the game, firms gather information and engage in price discrimination against consumers. Consumers are price takers and simply act as a source of demand without having any notable actions to chose from.

2.1.1 Firms

Grafiken erstellen, um Spiel aus Sicht der Firma anschaulicher darzustellen? Firms are indexed by $i = A, B$ and act as duopolists. Firms compete for location for $\tau = 1$. Since firms can only gather relevant information in the first period, the location game is at the same time a contest for (private) information. The outcome of this game determines the distribution of endogenously created private information among the dupolists and their respective ability to engage in price discrimination. Firms set a unform price P_i^1 in the first period and track their customers. For each consumer, a firm knows whether it was a customer in the first period. Choe et al. (2018, p. 5672) describe the information gain from tracking as follows: let $\mathscr{A}$ denote the set of consumers that are a customer of firm A in $\tau = 1$. After $\tau = 1$, firm A knows $\forall x \in [0, 1]$ whether $x \in \mathscr{A}$ and also the location x of consumer x if that consumer was indeed a customer of firm A in the first period. This similarly holds with customer set $\mathscr{B}$ and customers y for firm B. The model structure assumed by Choe et al. (2018) in conjunction with the tracking mechanism implies that both firms know the location of the indifferent consumer $\hat{x}$ benennen ja/nein? (marginally above (below) the rightmost (leftmost) consumer in their set of first-period customers, depending on whether the firm served the customers to left (right) of the indifferent consumer) and can, with certainty, assign non-customers their first-period supplier since there are only two firms and the world is linear. If the model were to include $n > 3$ competing firms, setting an efficient poaching price would likely be a much more involved process for any given firm.
The pricing strategies available to firm i in period $\tau = 2$ are determined by the informational asymmetries that result from the outcome of the location game. Choe et al. (2018, p. 5672) let

firms set two different types of prices in period $\tau = 2$. Based on the private information obatained in $\tau = 1$, firms engage in price discrimination in two disctinct ways. They[2] discriminate *between* first-period customers (all $x \in \mathscr{A}$) and consumers that chose the competitor (all $x \notin \mathscr{A}$, i.e. all $x \in \mathscr{B}$ since the authors assume a duopoly) but also *within* $\mathscr{A}$. Firms set a uniform poaching price, e.g. $P_A(\mathscr{B})$, aimed at all consumers who chose their competitor in the first period and an individualised price, e.g. $P_A(x)$. The poaching price is designed to incentivise consumers to switch to another firm in $\tau = 2$ while the individualised pricing schedule is designed to appropriate the highest possible surplus based on the information obtained in the first period. However, each consumer chooses among their personsalised price and the two poaching prices. Note that the uniform poaching price can be viewed as primarily a function of set membership, while the individualised price offered to a given customer $x \in \mathscr{A}$ is a function of their specific location along the $[0, 1]$-line Mit oder ohne Bindestrich?. Firms set their poaching price first, followed by the individualised prices (p. 5672). ibid? Autor ja/nein? Nur Seitenzahl? Discriminating between the two major groups of consumers is first/second/third; nachschauen was Choe et al. schreiben, aber auch mal neben Definitionen legen price discrimination. Price discrimination against the consumers in $\mathscr{A}$ (or $\mathscr{B}$, respectively) is first-degree price discrimination.
Choe et al. (2018, p. 5672) endow firms with a positive discount factor $\delta_f \in [0, 1]$. The discount factor is identical for both firms but may differ from the discount factor of the consumer population, δ_c. The model produces asymmetric equilibria as long as $\delta_f > 0$ (p. 5673). Firms thus face an intertemporal decision problem to maximise their total discounted profit $\Pi_i = \pi_i^1 + \delta_f \pi_i^2$ and compete for location (information) based on their pricing regimes.

2.1.2 Consumers

The model assumes a single set of homogenous consumers. Consumers are indexed by their location x in Hotellings linear city. All consumers are within the interval [0, 1]. Consumers incur transportation costs as a quadratic function of distance travelled to their preferred retailer. All consumers have the same valuation v for the good sold by the firms and only differ in their location within Hotellings linear city. Furthermore, all consumers have an identical discount factor, δ_c, which may differ from δ_f, the discount factor of the duopolists; while Fudenberg and Tirole (2000) assume $\delta_c = \delta_f = \delta$, Choe et al. (2018) assume the general case of $\delta_c \neq \delta_f$ (p. 5673). For δ_c consumers are completely myopic and disregard the utility derived from the second-period purchase while $\delta_c = 1$ implies that consumers value both instances of purchasing the good equally. Consumers are price takers and are de facto only a source of demand for firms; they have no meaningful action set. The only variation among consumers results from their location on the [0, 1] interval and by extension the different transport costs that are incurred by different consumers. Household in a given period is defined as $v - P_i(x) - t(x - l)^2$ when buying from firm i (p. 5672). v is a consumers utility from consumption, $P_i(x)$ is the price set by firm $i = A, B$ for consumer x. That firm is located at l, implying distance travelled is $|x - l|$. Recall that firms set a uniform price in the first period, a uniform poaching price in the second period but also engage in personalised pricing in period where possible. Thus, consumers effectively encounter five different prices over the course of the game. While never explicitly

[2]For brevity I assume the perspective of firm A in the following description of price setting.

stated, consumers seem to maximise expected utility

$$v - P_i^1(x) - t^1(x - l_i)^2 + \delta_c[v - P_j^2(x) - t^2(x - l_j)^2] \tag{1}$$

which is simply the discounted sum of the individual utilities. Here, the superscripts refer to the period in which the price is paid and the transport costs are incurred, respectively. Making this disctinction for prices is obvious. However, since consumers may switch from one firm to another when making their purchase decision in $\tau = 2$, consumers may travel some other distance relative to $\tau = 1$ and thus incur the corresponding transportation costs. Since customers can remain loyal to their first-period choice, $i = j$ is possible. In Section 5 I consider extensions that introduce heterogeneity to the set of consumers, such as departing from the assupmtion of a single discount factor δ_c.

2.2 Related Literature (tbd)

- p. 5672: "we abstract away from these issues mainly because our aim is to clearly understand how changes in informational assumptions lead to different equilibria in otherwise the same model as Fudenberg and Tirole (2000)"
- die Autoren nennen 3 Referenzmodelle, mit denen sie sich vergleichen (ua FT2000), ggf gibt es noch andere; die im Artikel genannten sind relativ alt
- Ähnlichkeiten zu Armstrong/Vickers
- Ähnlichkeiten zu add-on market: es scheint, als ließen sich die Konsumenten aus Choe mit variierenden Diskontfaktoren in die Agenten aus dem anderen Paper umbauen. Myopes wären dann sogar (fast?) identisch, da sie die zweite Periode (äqivalent zum Add-on price) ignorieren (nicht kennen); einziger Unterschied sind Transportkosten?

3 Armstrong and Vickers (2019): Discriminating Against Captive Consumers

3.1 Captive Consumers – Consumer Myopia

4 Zwischenfazit: What we have learned so far, where we stand now and where we are going next

Preliminary conclusion: Model Components oder so ähnlich

5 Extensions

5.1 Intersecting Choe et al. (2018) and Armstrong and Vickers (2019)

5.2 Consumer Responses: Signalling and Search

5.2.1 Signalling

5.2.2 Search

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