



## Intertemporal price discrimination and competition

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### ABSTRACT

In this study we investigate the impact of competition on markets for non-durable goods where intertemporal price discrimination is possible. We develop a simple model of different potential scenarios for intertemporal price discrimination and implement it in a laboratory experiment. We compare the outcomes in monopolies and duopolies. Surprisingly, we find that competition does not necessarily prevent intertemporal price discrimination, as our model predicts. However, competition generally reduces sales prices, but by far less than theory predicts. As expected – but not predicted by our simple model – competition increases efficiency.

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### 1. Introduction

The modern discussion on intertemporal price discrimination started with the Coase Conjecture (Coase, 1972), which states that a monopolist, who sells durable goods in the absence of a commitment device, is not able to price discriminate and will even be forced to sell at marginal cost. The Coase Conjecture was formalised by Stokey (1981) and proven to hold in the continuous time limit with a continuum of sufficiently patient buyers and constant marginal cost. Gul et al. (1986) show that the Coase Conjecture also holds in a game-theoretic framework under the same cost and demand assumptions. Under certain circumstances, monopolists can eliminate, or at least alleviate, the intertemporal commitment problem. Butz (1990) shows that the monopolist can at least secure the static monopoly profit by using best-price provisions as a commitment device. Another way of maintaining some monopoly power is a credible pre-commitment to limit production (Bulow, 1982). The use of non-stationary strategies can also help to overcome the commitment problem (Ausubel and Deneckere, 1989). However, in all these cases monopolists can never achieve profits higher than those that could be achieved by credibly committing to the static monopoly price.

If one relaxes the assumption of a continuum of consumers then monopolists may not only be able to overcome the commitment problem, but also to achieve profits beyond that of a static monopolist by practicing intertemporal price discrimination. Bagnoli et al. (1989) show that a monopolist can perfectly price discriminate – i.e. change the price over time such that consumers self-select and buy at prices equal to their reservation price – if the number of consumers is finite, the time horizon is infinite and trading occurs in discrete time. Dudev (1996) investigates the same question for non-durable goods monopolies and finds that a monopolist can perfectly price discriminate if infinitely patient consumers have demand for more than one unit of the good.<sup>1</sup>

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<sup>1</sup> Non-commitment prices above the pre-commitment monopoly prices become also possible if the good can be stored (Dudine et al., 2006).

Standard intuition suggests that in an environment with multiple firms competing in prices the law of one price will prevail. Firms should not be able to price discriminate regardless of discontinuities on the demand side. Competing firms are expected to end up there where the Coase Conjecture puts the monopolist—at sales prices equal to marginal cost. Casual observation of the author, who regularly flies between major Australian cities, indicates that this might not be true. Despite the competition between two to three airlines on the same route, intertemporal price discrimination seems to be the rule. This paper explores reasons why intertemporal price discrimination sometimes can coexist with competition and why monopolists sometimes are not able to sustain intertemporal price discrimination, even in the most favourable environment where theory predicts profits above those earned in a static monopoly.

Some econometric evidence suggests that the extent of price dispersion in markets for non-durable goods – such as airline tickets and perishable commodities – does not negatively depend on the competitiveness of the market, as basic intuition suggests. [Stavins \(2001\)](#) and [Borenstein and Rose \(1994\)](#) even find that competition increases price dispersion. There are a variety of possible reasons for the persistence of intertemporal price dispersion in competitive markets. Candidates offered in the literature are repeated interaction, demand uncertainty, capacity constraints or costly buyer search.

Price dispersion can be discriminatory, i.e. customers with different preferences pay different prices, or the consequence of real cost differences. These two cases are hard to disentangle, as anti-trust cases have repeatedly shown. For example, airline tickets that are purchased well in advance are usually cheaper than tickets that are bought close to the departure date. This can be interpreted as intertemporal price discrimination, as holiday makers with low reservation prices purchase in advance, while business travellers with high reservation prices buy close to the time of departure. Alternatively, it can also be argued that the different ticket prices just reflect real cost differences.

[Lott and Roberts \(1991\)](#) argue that the higher price for late bookers includes the opportunity costs arising from the airline's risk of having empty seats. They also argue that price dispersion cannot be discriminatory, since competition and low search cost prevent pricing above marginal cost. Can we therefore conclude that all intertemporal price dispersion in markets for non-durables with more than one firm, can only be due to cost differences? A growing body of theoretical literature suggests that this conclusion is not valid, as it shows that under certain circumstances intertemporal price discrimination is possible, even in competitive non-durables markets.<sup>2</sup> Some kind of uncertainty, capacity constraints and/or repeated interaction are the necessary ingredients for models where intertemporal price discrimination for non-durables prevails under competition.<sup>3</sup>

[Gale \(1993\)](#) shows in a model, where consumers ex ante do not know which variety of a good they prefer, that the price dispersion between advance-purchase prices and spot prices is higher in a duopoly than in a monopoly. The results are driven by the consumers' uncertainty, which implies that goods are ex ante homogeneous, but become differentiated once the consumers have learned their preferences. So, ex post there is some scope for price discrimination. [Dana \(1998\)](#) shows that market segregation of low and high-valuation customers can be achieved by competitive firms if capacity is costly and there is some correlation between individual valuations and demand uncertainty. In a model with durable goods [Sobel \(1984\)](#) shows that price cycles (high prices with periodical discounts) are an equilibrium even when there are multiple firms selling a homogenous good. The discounts are used to get low-valuation customers to buy and firms make supernormal profits. The main reason why the Bertrand logic of undercutting not necessarily applies in durable goods markets is that repeated interaction gives rise to trigger strategies which support an equilibrium with price cycles. This logic can easily be extended to firms that compete repeatedly in subsequent non-durable goods markets. [Burdett and Judd \(1983\)](#) and [Stahl \(1989\)](#) show that price dispersion can prevail under competition if consumers' costly search creates some demand uncertainty.

In this paper we test experimentally whether intertemporal price discrimination really disappears with competition when we use a very simple framework that does not exhibit any of the characteristics that were used to theoretically explain price discrimination. Put differently, are there any behavioural reasons why we might observe intertemporal price discrimination even when the competitive environment appears to favour the law of one price? Alternatively, are there potential reasons why we should not observe price discrimination even with a monopolist seller operating in an environment where theory would predict it?

A potential behavioural factor that mitigates the pressure of competition towards a stable sales price is the limited depth of iteration exhibited by consumers. To see this, put yourself in the shoes of a consumer who wants to purchase an airline ticket. Assume for instance that you know that there are more seats than potential travellers. You check the ticket prices of the different operators continuously on the web. For the Bertrand logic to work, i.e. price undercutting down to marginal cost without any sales at prices above marginal cost, consumers have to anticipate and to be sure that firms will eventually undercut each other. Consumers also have to be sure that the other customers also know this and will act accordingly. For certain conjectures about the behaviour of the other market participants, it becomes optimal for a customer to buy in advance and at a price above marginal cost.

On the other hand, fairness considerations could explain why a monopolist loses some of his price-discrimination power. Suppose your plan to fly develops at short notice. From experience you know that the price will be quite high and would have been much lower if you had booked earlier. If you are spiteful about the unfairness of the monopolist trying to extract a very

<sup>2</sup> [Elmaghraby and Keskinocak \(2003\)](#) provide a comprehensive overview over current dynamic pricing practices. Both cost and discrimination are shown to be reasons for firms changing prices over time.

<sup>3</sup> The potential existence of static interfirm equilibrium price-discrimination was first outlined in [Prescott \(1975\)](#) and formalised by [Eden \(1990\)](#).

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