

# Delivered versus mill nonlinear pricing with endogenous market structure

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## Abstract

This paper discusses a model where consumers differ according to one unobservable (preference for quality) and one observable characteristic (location), with nonlinear prices arising in *equilibrium*. The main question addressed is whether firms should be allowed to practice different nonlinear prices at each location (delivered nonlinear pricing) or should be forced to set a unique nonlinear contract (mill nonlinear pricing). Assuming that firms can costless relocate, we show that the free entry long-run number of firms may be smaller, equal, or higher under delivered nonlinear pricing. Moreover, delivered nonlinear pricing yields higher long-run welfare when (i) fixed costs are low and when (ii) fixed costs are intermediate and consumer types are not very similar. © 2007 Elsevier B.V. All rights reserved.

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## 1. Introduction

Regulation theory has been one of the most active areas of research in the last decade. However, regulation of firms' pricing policies has been almost neglected within this wave of research. This paper revisits the issue of whether regulatory authorities should prohibit firms from practicing price discrimination among consumers who differ according to some observable characteristic.

The currently accepted view that unregulated markets are more competitive has been justified by economic

theory using spatial pricing models. Most of existing studies compare spatial discriminatory pricing with non-discriminatory mill pricing<sup>1</sup> for a given market structure (see, for example, Norman, 1983; Thisse and Vives, 1988). Under spatial discriminatory pricing firms can price discriminate across locations, hence firms compete in each of them. On the other hand if firms have to practice the same price in every location, competition occurs only at the boundary of each firm's market. As a consequence, for a given market structure discriminatory pricing is more

<sup>1</sup> Implicit in this comparison is the idea that without pricing regulation firms will practice discriminatory prices. Thisse and Vives (1988) have shown that if firms are free to choose their pricing policy, in equilibrium, they will in fact price discriminate even though this implies lower profits for all firms.

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competitive than mill pricing. However, as pointed out by Norman and Thisse (1996), the previous analysis is incomplete if one does not consider the effect of pricing policies on market structure since entry incentives are not the same under both pricing policies.

Norman and Thisse (1996) analyze the economic justification of firms' pricing policies regulation taking into account the effect of pricing policies on welfare for a given market structure and the effect of pricing policies on market structure. They consider a circular model of horizontal product differentiation where the location of each consumer is observable and firms may price discriminate (delivered pricing) or set a mill price (mill pricing). The free entry long-run equilibrium and its number of firms (number of product varieties<sup>2</sup>) is computed for each pricing policy and degree of spatial contestability (when firms' relocation is costless we have spatial contestability; when location is once-for-all we have spatial noncontestability). Their work illustrates an important trade-off: as delivered pricing implies fiercer competition and lower profits, in the long-run it acts as an entry deterrent and reduces the free entry number of firms. Therefore, mill pricing always leads to more variety than delivered pricing. However, this higher variety is not necessarily welfare improving. When relocation is costless, both mill and delivered pricing have too much product variety. Thus, the equilibrium number of firms under discriminatory pricing is closer to the socially optimal one and discriminatory pricing leads to higher social surplus. Under spatial noncontestability the welfare comparisons are less clear. In this case, there is too much product variety under mill pricing but too little product variety with delivered pricing.

The previously mentioned works consider linear prices: mill linear price is compared to discriminatory linear price, in a setup where consumers differ according to one observable characteristic (location). However, if consumers differ according to one unobservable (e.g. quality preference) we would expect nonlinear prices to arise in equilibrium. In order to explore nonlinear pricing, our work adds vertical differentiation to the Norman and Thisse (1996) setup. This is an important extension since horizontally differentiated firms competing in product

lines are notorious in various markets (e.g., car,<sup>3</sup> telecommunications, airline, etc.). Within this more realistic setup, we assume that firms have uncertainty about consumers' quality preferences but observe their location (or brand preferences parameter). Under these circumstances, firms set price/quality nonlinear contracts that screen consumers according to their preference for quality. The regulatory issue<sup>4</sup> is then whether firms should be allowed to practice different nonlinear price contracts at each location (*delivered nonlinear pricing*) or, on the contrary, should be forced to set a unique nonlinear price contract (*mill nonlinear pricing*).

The regulatory issue of whether nonlinear price discrimination should or not be allowed has been implicit in the debate around price differentials in the European Union car market. The recent policy of the European Commission acts upon the cars' distribution sector in order to reduce/stop the practices on which car manufactures rely to prevent arbitrage (therefore acting upon a crucial feature for price discrimination). The economic justification of the European Commission is the need to create more competition to the advantage of European consumers: claiming that "the consumer should be in the driver's seat", to build a single market may put pressure on price differentials.<sup>5</sup>

Our work builds on previous results on nonlinear pricing under oligopoly.<sup>6</sup> The framework we use is similar to the one first presented by Stole (1995), who named it *vertical uncertainty*. Stole studies delivered nonlinear price contracts considering a continuous of consumer types. Delivered nonlinear pricing with a discrete number of consumer types was studied by Pires and Sarkar (2000) and Valletti (2002). Both analyze the locational equilibrium, the former considering price/quantity nonlinear contracts and the latter price/quality nonlinear contracts. The discrete case analysis shows

<sup>3</sup> Most car manufactures, for example, offer a product line with a range of cars varying in terms of power size, engine capacity, etc. (so they offer cars which differ in terms of quality). The way manufacturers differentiate themselves is through factors such as styling and brandname. Thus the car market provides one example where there exists simultaneously horizontal and vertical differentiation.

<sup>4</sup> Regulation always acts upon discrimination in terms of some observable characteristic. In our model this characteristic is location.

<sup>5</sup> Brenkers and Verboven (2002) discuss the impact on competition from liberalizing the European car market distribution system and show empirically that there may be a reduction in international price discrimination and price differentials.

<sup>6</sup> Our work is also related to the more general literature of mechanism design with competing principals (e.g. Peters, 2001; Martimort and Stole, 2002). Martimort and Stole argue that one can use the revelation principle to derive the best response of each principal, given the offers of the remaining principals.

<sup>2</sup> The free entry long-run number of firms has been interpreted as the number of product variety (MacLeod et al., 1988; Anderson and Palma, 1988). When firms use delivered pricing, they customize the basic products in order to offer consumer's optimal product specification. Since firms' location can be seen as the basic products characteristic, the free entry long-run number of firms measures the degree of product variety.

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