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Product line design ☆

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Abstract

We characterize the product line choice and pricing of a monopolist from the upper envelope of net marginal revenue curves to the individual product demand functions. The equilibrium product line constitutes those varieties yielding the highest upper envelope. In a generalized vertical differentiation framework, the equilibrium line is exactly the same as the first-best socially optimal line. These upper envelope and first-best optimal line findings extend to symmetric Cournot oligopoly.
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1. Introduction

Economic analysis typically describes single-product firms even though almost all actual firms offer many varieties in the same product class. Our contribution is two-fold. First, we provide a surprisingly simple characterization of the pricing of a monopolist's product line using marginal revenue curves. The monopolist prices its product line (and segments consumers) following the upper envelope of marginal revenue curves to the individual product demand functions. This pricing characterization determines the varieties to include in a product line as those in the upper envelope of marginal revenue.

Second, we show that, in the general Mussa and Rosen [10] vertical differentiation framework, the equilibrium product range is the same as the first-best socially optimal range. This is because the upper envelope of demands corresponds exactly with the upper envelope of marginal revenues, even though the sets of consumers assigned to each variety can be quite different at the two solutions. Our main monopoly results extend cleanly to a symmetric Cournot oligopoly.

Our analysis builds on Itoh [6] and Johnson and Myatt [7,8], and it complements Johnson and Myatt [9].[1] Itoh [6] analyzes the effects on product prices of introducing a new variety in a standard Mussa–Rosen framework. We provide a simpler derivation of his results while extending them to more general preferences. To do so, we deploy an "upgrades" approach (which was implicit in the work of Itoh), whereby a product variety can be seen as a base product plus a series of upgrades corresponding to each additional higher quality variety in the range. Then, each upgrade can be associated to a price premium. Such an upgrades approach was pioneered by Johnson and Myatt [7], who emphasized its usefulness in analyzing product line and pricing choices of multi-product firms in monopoly and Cournot duopoly (incumbent-entrant) contexts. Johnson and Myatt [8] used the same approach to characterize product line choices for an n-firm multi-product Cournot oligopoly.

Mussa and Rosen [10] recognized that the monopolist sets the net marginal revenue of each upgrade to zero: "the optimal assignment equates the marginal cost and marginal revenue of increments of quality" [10, p. 311].[2] We implement this insight in our graphical treatment of the monopolist's solution by noting that setting the net marginal revenue of a quality increment to zero is equivalent to setting the net marginal revenue of adjacent qualities equal. This means that equilibrium prices can be identified from the intersections of the net marginal revenue curves, which implies that the equilibrium product line is determined from the upper envelope of the net marginal revenue curves: a variety with a dominated net marginal revenue will not be used.

Johnson and Myatt [9] clarify some of Itoh's results and extend them to Cournot oligopoly, engaging the set-up in Johnson and Myatt [7,8]. In particular, they highlight Itoh's finding that the price of each variety is set equal to its stand-alone profit-maximizing price when the individual demand curves are ρ-linear. They then show that this property extends to Cournot oligopoly. They also show that equilibrium prices are often close to prices in stand-alone single product markets under other reasonable specifications. We draw heavily on their insights on the "upgrades" approach and on how to carry over the monopoly results to symmetric oligopoly. We also deliver, for both monopoly and Cournot oligopoly, a welfare equivalence between market and socially optimal provision of varieties for a general class of Mussa–Rosen preferences.

[1] We also contribute to the resurgent research interest in price discrimination (e.g., Aguirre et al. [1], Anderson and Dana [2], and Armstrong [5]). See Armstrong [4] for a recent survey.

[2] We thank a referee for this quote and for a very perceptive take on the literature, on which we have drawn heavily.

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