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Journal of Economic Theory 159 (2015) 728–774

JOURNAL OF  
**Economic  
Theory**

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# Revenue management by sequential screening <sup>☆</sup>

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Received 13 June 2013; final version received 13 July 2015; accepted 22 July 2015

Available online 29 July 2015

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## Abstract

Using a mechanism design approach, we consider a firm's optimal pricing policy when consumers are heterogeneous and learn their valuations at different times. We show that by offering a menu of advance-purchase contracts that differ in when, and for how much, the product can be returned, a firm can more easily price discriminate between privately-informed consumers. In particular, we show that screening on when the return option can be exercised increases firm profits, relative to screening on the size of the refund alone, only if the expected gains from trade are higher for consumers who learn later. We show that in some settings (mean-preserving spread) the firm can achieve the complete-information profits and analyze the optimal contract in other settings (first-order stochastic dominance) in which the first-best allocation is not always feasible.

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<sup>☆</sup> We would like to thank Johannes Hörner, Hao Li, Larry Samuelson and Kathryn Spier, as well as the editor, Alessandro Pavan, an anonymous associate editor, and two referees, for very helpful comments and suggestions on earlier versions of the paper. Thanks also go to seminar participants at Carnegie Mellon University, Columbia University, Duke University, INSEAD, New York University, Northwestern University, Stanford University, University of Maryland, University of Rochester, University of Southern California, University of Texas at Austin, University of Toronto, Washington University in St. Louis, Wharton, and Yale University, as well as to participants at the Econometric Society Summer Meetings and the INFORMS Revenue Management and Pricing Conference. We also thank the National Science Foundation (CMMI 1351821 and CMMI 1334194), Booth School of Business, University of Chicago, Carnegie Mellon University, the Kellogg School of Management, Harvard Business School, and Northeastern University for their financial support.

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<http://dx.doi.org/10.1016/j.jet.2015.07.016>

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*JEL classification:* D82; D4; D42; D47

*Keywords:* Price discrimination; Revenue management; Dynamic pricing; Intertemporal price discrimination; Dynamic mechanism design

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This paper analyzes an optimal advance-purchase pricing, or revenue-management, problem when consumers learn their valuations for future consumption over time. We assume that each consumer begins with private information about both the distribution of her valuation and the time when she will learn her valuation. Later, once she has learned her valuation, she also has private information about the realization of her valuation. For ease of analysis, we assume that each consumer's type, or initial private information, is the time that she will learn her valuation, and that the distribution of each consumer's valuation is a function of her type. In this way, consumers begin with private information about two characteristics, the distribution of their valuations and the time that they will learn their valuation, but their initial private information can be represented as a single dimension of information.

We formulate the firm's optimal pricing problem as a dynamic mechanism design problem. The firm maximizes its profit over the set of dynamically incentive-compatible direct-revelation mechanisms when the firm knows only the ex ante distribution of consumers' private information. We characterize the optimal direct-revelation mechanism and show that the firm can implement the optimal mechanism with a menu of contracts with different prices and different refund terms, including both the size of the refund available and the time at which the refund option can be exercised. Such pricing strategies are widely used by airlines, hotels, and railroads, as well as a variety of other firms in the retail, transportation and event industries.

The main contribution of the paper is to demonstrate that time can be a powerful screening device when consumers learn their valuations at different times and their valuations are correlated with when they learn. By explicitly assuming consumers learn at different times, we are adding additional periods (a continuum of periods since we assume a continuum of consumer types) to the sequential screening model analyzed by [Courty and Li \(2000\)](#). While the information consumers have before learning and after learning is the same as in [Courty and Li \(2000\)](#), the existence of these additional reporting periods creates an additional screening device which the firm can potentially use to earn significantly higher profits and even, in some cases, to implement the first best.

While [Courty and Li \(2000\)](#) focus on screening on the size of the refund that consumers receive in a model in which consumers learn their valuations (and make their return decisions) at the same time, we assume consumers learn their valuations at different times and then allow the firm to screen on both the size of the refund and when the refund option can be exercised. Intuitively, screening on when the refund can be exercised allows the firm to costlessly satisfy all of its "downward" local incentive compatibility constraints. No consumer wants to report that she will learn her valuation just before she actually does, because doing so will require her to report her valuation before she learns it and hence to forgo the option value of returning the good if her valuation is low – a positive discrete cost. Because screening on when the refund option can be exercised may relax incentive constraints, it has the potential to increase profits, but only if those relaxed incentive constraints were binding. We show that profits may increase, and may even increase all the way to the complete-information profits, but that profits may also be the unchanged (relative to a model in which consumers learn their valuations simultaneously).

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