



Multiproduct trading with a common agent under complete information: Existence and characterization of Nash equilibrium [☆]

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Abstract

This paper focuses on oligopolistic markets in which indivisible goods are sold by multiproduct firms to a continuum of homogeneous buyers, with measure normalized to one, who have preferences over bundles of products. By analyzing a kind of extended contract schedule (*mixed bundling prices*), the paper shows that *pure strategy* efficient equilibria always exist in such settings. While inefficient equilibria may exist, this can be ruled out by refining the equilibrium correspondence using the concept of subgame perfect *Strong equilibrium*. In addition, the paper shows that each principal's set of equilibrium contracts of minimum cardinality may contain at least three offers. When the social surplus function is monotone and unit costs are constant, only two offers are required at the equilibrium outcome.

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1. Introduction

This paper focuses on oligopolistic markets in which indivisible goods are sold by multiproduct firms to a continuum of homogeneous buyers, with measure normalized to one, who have preferences over bundles of products. In these settings linear pricing does not guarantee the existence of efficient subgame perfect Nash-equilibrium outcomes and, even worse, sometimes equilibrium (either efficient or inefficient) fails to exist. We wish to investigate whether a kind of nonlinear pricing, *mixed bundling pricing*, restores equilibrium existence and efficiency. Mixed bundling refers to the practice of offering a consumer the option of buying goods separately or purchasing packages of them at a special price.

Our analysis contributes to the literature of delegated agency games extending their insights to multiproduct markets with indivisibilities and where the agent's preferences need not be monotone. In our model, the principals are multiproduct oligopolists offering a menu of prices for the different bundles of their own indivisible products and the agent is the consumer. More particularly, we extend [Chiesa and Denicolò \(2009\)](#)'s abstract model of trading to cover multiproduct markets with indivisibilities and an agent with preferences over bundles of products. Like theirs we also analyze unrestricted offers. In this setting we show the equilibrium existence and efficiency and characterize the set of equilibrium payoffs and strategies.

Under decentralized contracting, the *Revelation Principle* characterizes the set of feasible allocations. Unfortunately, for multi-contracting environments, the applicability of the Revelation Principle comes into question. We take the path followed by [Peters \(2001\)](#), [Martimort and Stole \(2002\)](#) and [Page and Monteiro \(2003\)](#), who give up the Revelation Principle even in its generalized form. What really matters *per se* is not the kind of communication that the principal uses with his agent but the set of options that this principal makes available to the agent. In particular, [Martimort \(2007\)](#) states that, in economic applications with quasi-linear payoff functions, the space of mechanism allowing a full description of all pure strategy equilibrium allocations is the space of nonlinear prices.

In multiproduct settings, where firms sell products of a very general nature, a firm has always the incentive to offer exclusive dealing contracts for subsets of its goods. Therefore a realistic pricing schedule is where firms set prices for individual items as well as for subsets of their goods. Implementing this idea, each principal's strategy space is enlarged to offer prices not only for separated items but also for all possible subsets. This means that at pure strategy equilibrium, prices could be nonlinear and their role in our model is twofold. On the one hand, they can be seen as an aggressive pricing policy for exclusive dealing equilibrium outcomes and, on the other, as out-of-equilibrium offers sustaining more collusive outcomes: the equilibrium consumption sets of individual components in delegated common agency allocations.

The rationale behind these contracts is similar to that of [Martimort and Stole \(2003\)](#), who analyze the equilibrium set of a simple common agency game with direct externalities. They demonstrate the great importance of out-of-equilibrium choices under delegated agency. When principals are forced to use singleton contract offers (i.e., direct revelation mechanisms) rather than menus of offers in a delegated common agency, the only pure strategy equilibrium (when it exists) is for head-to-head competition for the right of exclusive agency; principals earn zero profits. With a more realistic extension of the strategy spaces to allow for nonlinear prices, they

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