Introduction
1. INTRODUCTION

Oligopoly markets have always been in the spotlight of industrial organization research, for good reasons: Regulators want to devise socially optimal competition policy, while entrepreneurs study strategic interactions to pursue the upper hand in competition. This dissertation presents several models of Markov-perfect industry dynamics, as well as their applications to the analysis of entry, exit, and competitive conduct in oligopoly markets.

The models of Markov-perfect industry dynamics studied in this dissertation belong to a larger class of structural models. In the recent decades, thanks to advancements in game theory, econometrics, and computational economics, structural models have taken their place on the empirical industrial organization research agenda. In this new research paradigm, researchers explicitly model firms’ behavior in an equilibrium context to give empirical work a solid microeconomic foundation. These models are estimable in the sense that their underlying primitives can be estimated from observed market outcomes.

The marriage of economic theory and econometrics brings at least two benefits. First, it helps researchers to circumvent the lack-of-data issue in empirical research. For instance, data on entry costs and payoffs are often unavailable to researchers. Bresnahan and Reiss (1991) propose a model of oligopoly competition to infer these values using numbers of firms and market sizes, which are commonly available from administrative data. Second, it provides a vehicle for counterfactual policy experiments. Because the causal relation between primitives and market outcomes is modelled explicitly, the structural models are not subject to the “Lucas critique” (Lucas, Jr. 1976). Therefore, researchers are able to quantify markets’ responses to policy changes that shift primitives. For instance, Bresnahan and Reiss’s model allows us to examine what would happen to market concentration if the government reduces licensing levies.

Spearheaded by Maskin and Tirole (1988a, 1988b) and Ericson and Pakes (1995), models of Markov-perfect industry dynamics receive attention for their theoretically and empirically appealing features. First, these models entail plausible assumptions on firms’ behavior. They have multiple periods in which firms make optimal decisions based on time-varying information. Compared to static models, they provide an environment that better fits the dynamic nature of oligopoly competition. Second, models of Markov-perfect industry dynamics can explain not only the “snapshot” of market structures, but also the structures’ transition over time. Therefore, they
facilitate the econometric analysis of longitudinal datasets, which are increasingly available.

Despite these attractive features, their complexity limits their application. As demonstrated by Besanko, Doraszelski, Kryukov, and Satterthwaite (2010), these models often suffer from equilibrium multiplicity. In general, even after reasonable refinement, the number of equilibria remains unclear, rendering the computation of all equilibria nearly impossible and the results of policy experiments dubious. What is worse, researchers have no reliable algorithm to quickly compute any equilibrium.

In the models developed in this dissertation, I attempt to make a breakthrough on equilibrium unicity and computation. In Chapter 2 (based on Abbring, Campbell, and Yang 2012a) of the dissertation, my co-authors and I develop a tractable model for the computational and empirical analysis of infinite-horizon Markov-perfect oligopoly dynamics. It features aggregate demand uncertainty, sunk entry costs, stochastic idiosyncratic technological progress, and irreversible exit. We develop an algorithm for computing a symmetric equilibrium quickly by finding the fixed points of a finite sequence of low-dimensional contraction mappings. If at most two heterogeneous firms serve the industry, the result is the unique “natural” equilibrium in which a high profitability firm never exits leaving behind a low profitability competitor. With more than two firms, the algorithm always finds a natural equilibrium.\(^1\) We present a simple rule for checking ex post whether the calculated equilibrium is unique, and we illustrate the model’s application by assessing the robustness of Fershtman and Pakes’ (2000) finding that collusive pricing can increase consumer surplus by stimulating product development. The hundreds of equilibrium calculations this requires take only a few minutes on an off-the-shelf laptop computer. We also present a feasible algorithm for the model’s estimation using the generalized method of moments.

In Chapter 3 (based on Abbring, Campbell, and Yang 2012b), we develop a dynamic econometric framework for the analysis of entry, exit, and competitive

\(^1\)In a companion paper, Abbring, Campbell, Tilly, and Yang (2012), we analyze the simpler version of this model in which all firms have the same technology. We show that the simpler model has an essentially unique symmetric Markov-perfect equilibrium. The simpler model is rich enough for a range of applications, such as the welfare analysis of licensing requirements, start-up subsidies, and environmental laws. Although firm-level heterogeneity is ignored, the model’s light computational burden makes it easy to accommodate market-level heterogeneity. Moreover, its analysis provides a starting point for the analysis of more general models. Due to the preliminary status of this work, it is not included in this dissertation.
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conduct in oligopolistic markets. This framework only requires panel data on the demand and producer counts of geographically dispersed markets over time. It is a dynamic extension of Bresnahan and Reiss’s (1990; 1991) framework for the analysis of static competition in a cross-section of markets. Our extension facilitates the empirical analysis: sunk entry costs and uncertainty. Moreover, it is needed for the consistent measurement of static market primitives, such as the toughness of competition. Our model’s timing and expectation assumptions help to select an essentially unique Markov-perfect equilibrium that can be computed quickly by solving a finite sequence of dynamic programming problems with low-dimensional state spaces. We apply our model to the empirical re-analysis of sunk costs and the toughness of competition in the US market for dental services, using Bresnahan and Reiss’s (1993) panel data on the number of dentists across geographical markets in the US.

In Chapter 4 (based on Yang 2012), I extend and apply the model developed in Chapter 2 to analyse creative destruction in the Dutch retail grocery market. In this market, technological innovations in inventory, logistics, and sales give grocery chain stores a profitability advantage over old-fashioned local stores. With chain stores advancing, local store incumbents gradually exit. Two questions concerning this creative destruction process are central to competition policy. How do chain stores make entry decisions? How does a chain store’s entry impact incumbent stores’ profitability and survival? In this paper, I develop a tractable dynamic oligopoly model to examine these two questions. All of the model’s Markov-perfect equilibria that survive natural refinements can be quickly computed by finding the fixed points of a sequence of low-dimensional contraction mappings. I estimate this model using observations of grocery stores’ entry and exit in small Dutch municipalities. The average sunk cost of entry in some cases is multiple times a store’s expected discounted profit, possibly because Dutch zoning regulation greatly limits potential entrants’ locations. The high average sunk cost considerably delays chain stores’ expansion. An entering chain store reduces local incumbents’ net present values by 26% to 62%. A policy experiment with the estimated model shows that cutting average sunk costs by 40% almost doubles chain store entry.

Proofs, computational details and some supplementary materials are collected in the appendices. The replication packages including the Matlab code implementing the computation and estimation routines are published on the authors’ websites.