Evolutionary Learning of the Optimal Pricing Strategy in an Artificial Payment Card Market*

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Summary. This chapter introduces an artificial payment card market in which we model the interactions between consumers, merchants and competing card issuers with the aim of determining the optimal pricing structure for card issuers. We allow card issuers to charge consumers and merchants fixed fees, provide net benefits from card usage and engage in marketing activities. The demand by consumers and merchants is only affected by the size of the fixed fees and the optimal pricing structure consists of a sizeable fixed fee to consumers, no fixed fee to merchants, negative net benefits to consumers and merchants as well as a high marketing effort.

13.1 Introduction

Payment cards - more commonly referred to as credit and debit cards - are of ever increasing importance for making payments. In 2002 (7) report that 1.8 billion cards were used to buy products and services worth more than US$ 2.7 trillion with high growth rates since then. Despite the importance of payment cards the competition between the different card issuers, most prominently Mastercard, Visa, American Express, Discovery, JCB and Diners Club, is not well understood. In this paper we provide a model of this competition by using an agent-based approach allowing us to introduce complex interactions between the various market participants which is not easily possible using other modeling approaches. In our model we are able to derive the main driving factors of the demand for payment cards and the profits made by card issuers, as well as the optimal pricing strategy.

What distinguishes the market for payment cards from most other markets is that it is a two-sided market, i.e. both partners in the transaction, consumers and merchants, using a payment card need a subscription to a specific payment card. Modeling such markets is challenging as the behavior of market participants is determined

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by a set of complex interactions between consumers and merchants as well as within the group of consumers and the group of merchants. Consumers and merchants face network externalities as a larger number of merchants and consumers using a certain card makes a subscription to it more valuable and card issuers will also affect behavior by changing subscription fees and benefits associated with the cards. In order to capture these numerous interactions we have developed a novel approach to the payment card market using an agent-based model.

Agent-based models study dynamic systems of interacting agents, where agents can be any participants in a system. In economic systems such agents might be consumers, merchants or investors. A good introduction to agent-based modeling in general is given in (15). A main characteristic of agent-based models is that each agent can be given his own behavioral rule, they are generally interacting with a small fraction of available agents and for that reason exhibit significant heterogeneity. Agent-based models in economics and finance have become more popular in recent years, in particular as they have been able to provide insights into the complex dynamics of economic systems, financial markets in particular. These advances, as summarized in (11), have given rise to the insight that the interactions between agents are of central importance for the emergence of realistic properties. As traditional economic and financial models do not consider such interactions between (mostly homogenous) agents, they fail to derive such properties. Similarly such models have brought important insights into macroeconomics, the spatial development of economies as well as the structure of organizations, among many others, see (16) for an overview of the current literature. The interactions between agents and heterogeneity of their behavioral rules makes it in most cases impossible to obtain an analytical solution and therefore requires the use of computer experiments to analyze their properties.

Most models of the payment card market only give cursory considerations to these complex interactions and how they affect competition; the literature focuses on a peculiarity of the payment card market, the so called interchange fee (7, 9, 12–14, 17, 18). This fee arises as follows: card issuers do not directly issue payment cards to customers but rather allow banks to distribute them in their own name; card issuers only provide a service in form of administering the payments made using these cards. Similarly, merchants have a contract with a bank that allows them to accept payments made using a specific payment card. In the majority of cases the consumer will have been given his card from one bank with the merchant having a contract with another bank. In this case the bank of the merchant will have to pay the bank of the consumer a fee for making the payment, which is called the interchange fee. Not only does much of the academic literature focus on the interchange fee, it is also the focus of regulators (4–6, 8).

With the focus on the interchange fee the literature makes a number of very simplifying assumptions on the behavior of consumers and merchants. In contrast, we explicitly model the behavior of consumers and merchants and concentrate on the competition between payment cards to attract subscribers and transactions. We abstract from the interchange fee by implicitly assuming that payment cards are directly issued by card issuers, i.e. neglecting the role of banks in the market. This approach allows us to analyze all the fees paid by consumers and merchants using payments