Journal of Economic Behavior & Organization 99 (2014) 85–95

Contents lists available at ScienceDirect

Journal of Economic Behavior & Organization

journal homepage: www.elsevier.com/locate/jebo

Implicit collusion in non-exclusive contracting under adverse selection

Seungjin Han*

Department of Economics, 1280 Main Street West, McMaster University, Hamilton, Ontario, Canada L8S 4M4

ARTICLE INFO

Article history:
Received 2 April 2013
Accepted 21 December 2013
Available online 9 January 2014

Keywords:
Collusion
Non-exclusive contracting
Competing mechanism

ABSTRACT

This paper studies how implicit collusion may take place through simple non-exclusive contracting under adverse selection when multiple buyers (e.g., entrepreneurs with risky projects) non-exclusively contract with multiple firms (e.g., banks). It shows that any price schedule can be supported as equilibrium terms of trade in the market if each firm's expected profit is no less than its reservation profit. Firms sustain collusive outcomes through the triggering trading mechanism in which they change their terms of trade contingent only on buyers' reports on the lowest average price that the deviating firm's trading mechanism would induce.

1. Introduction

Trading in decentralized markets often take place when one trader has private information that features common values in the sense that it affects not only his payoffs but also the payoff of the trader whom he trades with: For example, a car owner know the quality of his car but buyers do not observe it. Akerlof (1970) showed how this type of the market for lemons is operated in a decentralized economy. The analysis is based on the competitive market equilibrium. It admits multiple equilibria so that aggregate equilibrium allocations differ across equilibria but every equilibrium has the same qualitative properties: Transaction price correctly reflects the average quality of the good traded in the market and only bad-quality goods are traded in every equilibrium.

Rothchild and Stiglitz (1976) show how firms strategically compete in the competitive market for lemons. When an insurance company is able to use a menu of contracts to screen the individual's inherent risks, the adverse selection problem can be partially mitigated in the sense that both types of the individual will buy an insurance contract. In equilibrium, insurance companies have all zero profits. Equilibrium may not exist at all especially when a large fraction of individuals have low risks.

However, it is not clear whether the non-existence problem is something inherent in the market for lemons or it is due to the restriction of the exclusive trading imposed in their model; an individual can buy insurance from only one insurance company. In fact, trading in a decentralized market is frequently non-exclusive by nature. For example, an entrepreneur may borrow money from multiple banks to finance his risky project. A buyer who faces the underlying asset risks associated with interest rate, credit, or foreign exchange may buy contingent claims from multiple sellers to diversify those risks in the risk transfer markets.

Attar et al. (2011) provide a noble strategic foundation of the lemon's problem (Akerlof, 1970) in non-exclusive trading where a single buyer buys the good from multiple sellers. They showed that equilibrium in fact exists under mild conditions

* Tel.: +1 905 525 9140.
E-mail address: hansj@mcmaster.ca

0167-2681/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jebo.2013.12.013

in non-exclusive trading. Their results are consistent with Akerlof in the sense that the transaction price correctly reflects the average quality of the good traded in the market. However, aggregate equilibrium allocations are shown to be unique in their model.

Non-exclusive trading in fact happens on both sides of the market; buyers with the underlying risks buy contingent claims from multiple sellers and sellers sell contingent claims to multiple buyers as well in the risk transfer markets; entrepreneurs borrow money from multiple banks and banks lend money to multiple entrepreneurs as well in loan contracting. When we model non-exclusive trading explicitly on both sides of the market, it raises a new scope of negotiation for parties who offer contracting schemes. For example, when a bank negotiates a pair of principal and repayment with a borrower, it can make its offer based not only on communication with that borrower but also on communication with all the other borrowers.

Generally, non-exclusive contracting with multiple buyers (e.g., entrepreneurs in loan contracting) is generally a complex process for firms (e.g., banks in loan contracting, sellers) because buyers can also contract with competing firms. In this contracting environment, buyers may well communicate with firms at the contracting stage because firms can ask buyers about competing firms' terms of trade (e.g. principal and repayment pairs in loan contracting). Importantly, when multiple buyers communicate with firms, firms can compare what buyers are telling. This may make it easier for firms to acquire the true information on competing firms' terms of trade from buyers' reports on competing firms' terms of trade. Subsequently, firms may want to offer their negotiation schemes (formally, trading mechanisms) in which their terms of trade depend on buyers' reports on competing firms' terms of trade. In this way, firms can punish a deviating firm by changing their terms of trade upon buyers' reports on the deviating firm's terms of trade and hence they may sustain many collusive outcomes.

The idea of collusion through complex negotiation schemes motivates the literature on competing mechanism design in which, for example, multiple firms compete in designing their trading mechanisms (Epstein and Peters, 1999; Yamashita, 2010). However, the languages that are required for buyers to use in the negotiation schemes are quite complex.[1] Furthermore, in order to punish the deviating firm, buyers play the (worst) continuation equilibrium for the deviator upon his deviation to an arbitrary complex negotiation schemes while the other firms offers what they are supposed to offer. However, the literature on competing mechanism design does not show how to derive the continuation equilibrium that punishes the deviator upon his deviation to an arbitrary negotiation schemes because it focuses on a general methodology. For these reasons, very few economic applications have been developed despite of its huge potential on applications.

Given the prevailing examples of non-exclusive trading under adverse selection, it is quite important to develop a model that provides tractable negotiation schemes for various collusive outcomes among firms. In this context, the simplicity of a buyer's communication seems important to understand implicit collusion in the applications of non-exclusive trading problems. The purpose of this paper is two folds: First, it aims to develop a simple equilibrium mechanism that can minimize the buyer's communication burden, for a better understanding of implicit collusion in non-exclusive contracting under adverse selection such as investment financing, insurance, and various other trading problems. Second, it completely characterizes the continuation equilibrium that punishes the deviating firm upon its deviation to any arbitrary trading mechanism.

Consider a market for a good where each privately informed buyer can buy from any number of firms and each firm can also sell its product to any number of privately informed buyers. Firms can freely offer any arbitrary trading mechanism that make quantity and monetary payment pairs across buyers contingent on their messages. The market terms of trade can be characterized by a price schedule that specify monetary payment from the buyer as a function of the quantity that the buyer buys. The key result of the paper is to show how to construct an equilibrium trading mechanism for firms, given their implicit agreement on a price schedule, in a way that no firm gains by deviating to any arbitrary complex trading mechanism. Then, we show that any price schedule can be supported as equilibrium terms of trade in the market as long as it ensures that each firm receives no less profit than its reservation profit.

This paper proposes the triggering trading mechanism with which firms can maintain their implicit agreement on a price schedule, say $\tilde{\mathbf{y}}$. A triggering trading mechanism asks each buyer to report, along with the quantity that he wants to buy from the firm, whether there is a deviating firm and, if so, what would be the deviating firm's lowest average price that he believes he would face if he was the only one who bought from the deviating firm. When buyers are anonymous so that the trading mechanism is anonymous, each buyer has the same belief on the lowest average price that the deviating firm's trading mechanism would induce when he would be the only one who participated in the deviating firm's trading mechanism. As shown later, this approach is easily extended to the case in which sellers offer different price schedules to ex-ante heterogeneous buyers.

The triggering trading mechanism has the following structure. When two or more buyers participate in a firm's triggering trading mechanism, and more than half of their reports on the deviating firm's lowest average price are all p, then the firm offers a linear price schedule such that its unit price matches the minimum between p and the lowest average price of $\tilde{\mathbf{y}}$, which is a price schedule firms implicitly agree on. In all other cases, the firm continues to offer $\tilde{\mathbf{y}}$.

Let us now characterize the continuation equilibrium that punishes the deviating firm upon its deviation to any arbitrary trading mechanism. When a firm deviates to an arbitrary trading mechanism, each buyer reports his true belief p to non-deviating firms. Then, each non-deviating firm's price schedule is the linear price schedule in which the unit price matches the

[1] The buyer needs to send a message that is an infinite sequence of real numbers (Epstein and Peters, 1999) or need to recommend to the firm an entire mapping (i.e., direct mechanism) from buyers' types to the firm's actions that the firm should implement (Yamashita, 2010; Peters and Troncoso Valverde, 2010).