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December 2001

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COMPETITION BETWEEN B2B ELECTRONIC MARKETPLACES: DIFFERENTIATION, PRICING STRATEGY, AND INDUSTRIAL STRUCTURE

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Abstract

Fueled by vast investment and immense management interest, B2B electronic marketplaces are rapidly evolving into a new volatile intermediation/informediation industry. While much work has been done on the efficiency and welfare of a single marketplace, the competition and interactions between marketplaces remain largely unexplored. This research attempts to analyze the dynamics of competition between B2B e-marketplaces with a focus on industrial structure and the pricing strategies under the structure.

Building upon Gehrig 1996 model of financial intermediation, we use a two-stage game theoretic model to explore the competition between B2B e-marketplaces. Business traders who use different IT infrastructures are modeled as being on different islands and are not able to trade with each other directly. B2B marketplaces invest to build networks that connect the islands and bring buyers and sellers together. The larger the network is, the higher the liquidity of the marketplace. B2B marketplaces play a two-stage game. In the first stage, they simultaneously choose the IT infrastructures they want to support, thereby determine the liquidity of the marketplaces. In the second stage, they compete on the prices of their services, whose qualities are differentiated in terms of liquidity. We study the characteristics of market equilibrium, the resulting industrial structure as well as its sensitivity to the market size.

So far, our analytical results show that the price competition between B2B exchanges is imperfect as in markets of vertically differentiated products. Moreover, the industrial structure of B2B exchanges exhibits a natural oligopoly in the sense of Shaked and Sutton (Econometrica, 1983, 51, 1469-1483). The number of active B2B exchanges in a market is bounded regardless of the market size.

Keywords: Electronic commerce, electronic marketplace, vertical differentiation, industrial structure, natural oligopoly

Introduction

MIS researchers by now have learned some benefits of electronic marketplaces as well as some efficiency and welfare issues of a single marketplace (Bailey and Bakos 1997, Bakos 1997); yet little is known about the competition and interaction between electronic marketplaces (Viswanathan 2000). This research attempts to analyze the dynamics of competition between B2B electronic marketplaces with a focus on industrial structure and the pricing strategies under the structure.

Motivation

The rapid growth of B2B electronic commerce is transforming the whole business landscape. Forrest Research predicted that the value of B2B transactions conducted online will reach $2.3 trillion in the United States by 2003 and 52.6% of these will take place in B2B electronic marketplaces. By reducing transaction costs, increasing access to more buyers and sellers and enabling

innovative business models, B2B electronic marketplaces are believed to be able to bring great benefits to business traders, therefore attract vast investment, immense management interest and intensive press coverage.

The recent years have witnessed the rise of B2B electronic marketplaces. In just a few years, B2B electronic marketplaces have been set up to facilitate trading of various products and services such as automobile parts and supplies (Covisint), metal (MetalSite, e-Steel), chemicals(Chemdex), paper(PaperExchange), plastics (PlasticsNet), Insurance(Catex), Credit(CreditTrade) and intellectual properties (TechEx). According to Forbes July 2000, over 1500 B2B e-marketplaces have been announced in 37 industries.[1]

The rapid growth incurs intensive competition. As Clint Willis noted below:

> Most of today's B2B marketplaces will disappear. Sites with the best technology, partnerships, and content/community features in a particular industry will generate the most liquidity and take control of their respective markets. The rest will disappear or get bought by the winners. (Clint Willis, *Forbes ASAP,* 08.21.00)

In August 2000, the formation of B2B electronic marketplaces came to a sudden stop. In July-August 2000 , only 15 new B2B electronic marketplaces were announced as opposed to 115 two months earlier. B2B electronic marketplaces realize that they are facing fierce competition with each other and they are quickly evolving into a new volatile intermediary/informediary industry.

To the center of competition is liquidity, the probability of making a transaction in the marketplace. Higher liquidity attracts larger trading volume. Larger trading volume again creates higher liquidity. To achieve high liquidity and trading volume in the marketplace was recognized as the one of the most important factors to survive and succeed (Sculley and Woods 2000). It is important because a large portion of the revenue of e-marketplaces comes from commission fee that is based on the number of transaction. High liquidity of existing e-marketplaces creates high barriers of entry as well.

Existing theories has mostly focused on a single marketplace; research on the interaction and competition between marketplaces is sparse. However, the existence of competition changes the behavior of all participants and generates complex dynamics that cannot be fully captured by an isolated model of single marketplace. This research tries to highlight the interaction and competition between them.

Research Questions

One of the most valuable roles the B2B electronic marketplace plays is the matchmaker (Bailey and Bakos 1997). By bringing more buyers and sellers together in the virtual marketplace, B2B marketplaces increase the probability that buyers and sellers find each other. The probability of trading, often called the liquidity of the marketplace, is critical to the success of the electronic marketplace The marketplaces will invest to achieve liquidity, so that later on they generate revenue by charging a commission fee on each transaction that takes place in the marketplace. With the practitioners' concern in mind, we recognize these important factors in our model: liquidity, cost of liquidity, and price of service (commission fee). We are interested in the following questions:

1) In the equilibrium, what will be the industrial structure? Will it be a monopoly due to the network externalities, or be close to perfect competition as the entry cost decreases with the development of Information Technology? Will the marketplaces conduct head-on competition therefore wipe out profits or will they try to differentiate and coexist?
2) How does liquidity affect competition? How much will the marketplaces invest to achieve the liquidity?
3) How will B2B marketplaces price their services?

Building upon Gehrig (1996) model of financial intermediation, we use a two-stage game theoretic model to explore competition between B2B e-marketplaces. Business traders who use different IT infrastructures (e.g. different ERP systems) are modeled as located on separated islands. B2B e-marketplaces invest to build networks that connect the islands and bring buyers and sellers together. The larger the network size is, the higher the liquidity of the marketplace. B2B e-marketplaces play a two-stage game. In the first stage, they simultaneously choose the islands to connect, thereby determining the liquidity of the e-marketplaces. In the second stage, they compete on the prices of their services, whose qualities are differentiated in terms of liquidity. We study the characteristics of market equilibrium, the resulting industrial structure as well as its sensitivity to the market size.

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[1]For a list of B2B electronic marketplaces, see http://www.b2business.net.

Related Literature

The idea of this research is drawn from three streams of literature: the literature on electronic marketplaces, traditional intermediaries and industrial structure of vertically differentiated markets.

Literature on Electronic Marketplaces

Bakos (1997) explores the implications of reducing buyers' search cost in electronic marketplaces, the benefits for buyer and seller, the social welfare and the incentives to create such a marketplace. Bhargava et al (1999) analyzes an intermediary's strategies with respect to the quality of service provided and pricing in electronic markets for decision technologies, and how marginal cost and presence of network externalities affects the strategies. These two studies, among many others, focus on a single marketplace. Garicano and Kaplan (2000) provides empirical evidence that the benefits of electronic marketplaces may come from price advantage as well as process improvement. Dai and Kauffman (2000) look into the trader's choice between direct trade using extranets or Inter-organizational Systems versus intermediated trade through electronic marketplaces. From the intermediary's perspective, Viswanathan (2000) investigates the competition between traditional channels and online channels and shows that the competing channels will horizontally differentiate themselves based on the characteristics over which consumers have the maximum variety in relative valuation.

Literature on the Traditional Intermediary

The research on traditional intermediary has analyzed an intermediary's role as expert, source of trust, marketmaker and matchmaker. This paper concentrates on the intermediary's role as a matchmaker. A matchmaker's job is to establish matches between market parties without being involved into the interaction between matched agents. The models of Gehrig (1996) and Raalte and Webers (1998) consider intermediaries as matchmakers. Gehrig (1996) studied the competition between matchmakers in the light of vertical differentiated markets. Raalte and Webers (1998) analyze the competition of two matchmakers using a variant of Salop's spatial competition model.

Literature on Industrial Structure of Vertically Differentiated Markets

A number of researches on "vertical product differentiation" have developed the idea that if the nature of technology and tastes in some industry take a certain form, then the industry must necessarily be concentrated; and must remain so, no matter how large the economy becomes (Gabszewicz and Thisse 1979, Shaked and Sutton 1982, 1983). This property is called "natural oligopoly" in Shaked and Sutton (1983). The basic idea is when firms vertically differentiate in quality, the competition between 'high quality' products drives the prices down to a level at which not even the poorest consumer would prefer to buy certain low quality products even at the price zero. Therefore, the number of products that can survive at the equilibrium is finite.

Model

The benefits of B2B electronic marketplaces come from two major resources: aggregation and facilitation (McAfee 2000). By aggregation, the marketplace brings a group of dispersed buyers and sellers together. The more traders are there in the marketplace, the higher the probability that they can find a match. By facilitation, the marketplaces provide the capability of streamlining procurement processes via software systems that integrate with traders' IT infrastructures such as their corporate enterprise systems and organizational intranet, therefore greatly reduce the transaction cost.

Consider a market where potential traders who use different IT infrastructures are modeled as located in separated islands i=1,.., I. They rely on the marketplaces to find them a match and generate certain benefits. In order to help buyers and sellers find each other and facilitate their trading, the marketplaces must invest to build networks that connect the islands. Let *Im* be the set of islands that marketplace m connects to, and *S(Im)* be the degree of the set. Suppose there is a constant fixed cost *k* to connect each island and therefore total cost of building the network is proportional to the number of islands included in the marketplace *S(Im)*.

There are *A(i)* potential buyers and sellers on island *i*. For each transaction, a total benefit of *2r* will be generated and be equally divided by the buyer and seller after negotiation and bargaining. The valuation r varies by traders and is uniformly distributed over [a, b].

Define the liquidity of e-marketplace *Lm* as the probability of making a traction at marketplace *m*. Therefore

$$L_m = \sum_{i \in I_m} A(i) / \sum_i A(i)$$

(1)

The expected utility of a trader on island *i* to trade on marketplace *m* is defined as:

$$U_m^i(r) = r * L_m - P_m^i$$

(2)

where P_m^i is the commission charge for each transaction by marketplace *m* on the island *i*.

r can be explained as preference for liquidity. The higher r a trader has, the more he likes liquidity of a marketplace. He would like to pay a little more for a higher liquidity.

We now define a two-stage game. In the first stage, the B2B marketplaces decide simultaneously about the size of their trading networks, i.e. which islands to connect, thereby determine their liquidity *Lm*. They will incur a fixed cost of *k*S(Im)* to build the network. In the second stage, the marketplaces compete in commission charges. Now the traders choose the marketplace based on their own preference *r*, the liquidity and price of the marketplace.

The trader's problem is to choose an e-marketplace that maximizes his utility. The e-marketplace's problem is to decide on the set of islands to connect *Im* and the price on each island P_m^i to maximize profits.

Profit of marketplace $m = \sum_{i \in I_m} P_M^i * Q_M^i - k * S(Im)$

(3)

Where Q_m^i is the actual trading volume of marketplace *m* at island *i*.

The traders' problem and the marketplaces' problem are interrelated as traders choose marketplace based on their liquidity and price, therefore determine the trading volume on each marketplace and thereby affect the profit of the marketplaces.

Resolution of the Model and Results

We shall analyze the model backwards. First we will solve for the subgame perfect Nash Equilibrium for the second stage—price competition. Then based on the result, we try to find out the marketplaces' investment decisions in the first stage.

We first consider a basic model where all islands are symmetric in size. That is *A(1)=A(2)=…=A(I)*. We shall follow the technique used in Shaked and Sutton (1982) and Gehrig (1996). In the model, we first sort all the B2B electronic marketplaces by liquidity so that *L1>=L2>= …>=Lm*. We then identify a critical trader *Ti* (*Ti* has a critical value of r) who would be indifferent between choosing marketplace *m* at price *Pm* and marketplace *m+1* at the price *Pm+1*. i.e.

$$U_m^i(P_m^i) = U_{m+1}^i(P_{m+1}^i)$$

(4)

For simplification of notation, we define

Cm=Lm/(Lm-Lm-1)

(5)

Combining (2) (4) and (5), we can get

Tm=Pm-1(1-Cm)+Pm Cm

(6)

This way we can partition the markets into several segments. The marketplace m will expect a trading volume of

$$Q_m^i = T_{m-1}^i - T_m^i \tag{7}$$

on island m. The revenue it can generate from island *i* will be:

Ri(m)=Qi(m)* Pi(m) (8)

We can then prove that when traders are not widely dispersed, only finitely many marketplaces will have a positive market share regardless how large the market is and how low the fixed cost is to establish a marketplace. Thus we show that the B2B electronic marketplaces demonstrate the natural oligopoly in the sense of Shaked and Sutton (1983). The following lists some of preliminary results:

Result 1: if Lm=Ln then $P_m^i = P_n^i = 0_i$ *∀i ∈* Im ∩ *In*

If Lm>Ln then $P_m^i > P_n^i$ *∀i ∈* Im ∩ *In*

Proof: The first part is a standard result from Betrand Competition. The second part is self-evident as the low liquidity will get *zero trading volume if his price is higher.*

Result 2: When 4a>b, there will be at most 2 level of liquidity that can have positive market share.

Proof: Since the price games on each island are independent of each other and do not affect the liquidity of marketplaces. We can use the argument of Lemma 1 in Shaked and Sutton (1982) to get the result.

Result 3: When A(i) is large enough,
       (1)   When I=1, the market equilibrium features a natural monopoly.
       (2)   When I>=2, Exactly three large marketplaces exist, one connects to all island and the other 2 connects to I-1
               islands each.

The results show that there will be a natural oligopoly in electronic marketplaces regardless of how large the market is. If the user preferences are not highly diversified (4a>b), only three electronic marketplaces can survive. In many cases, the electronic marketplaces will provide their service for free just to gain liquidity in their marketplace. Therefore, it would be risky for the electronic marketplaces to base their revenue models solely on transaction fees. They have to find other means such as advertisements to generate revenue.

Limitation and Future Directions

Our investigation of competition between B2B electronic marketplaces has several limitations. Firstly, notice that the traders in our model are one-shot traders who can freely choose a marketplace based on their preference and commission charge, no switch cost and no lock-in effect. But in reality, traders often have to invest a considerable amount to get in a B2B electronic marketplace, therefore will face a substantial switch cost and lock-in effect. Secondly, our analysis focuses on vertical differentiation in terms of liquidity. In real life, the marketplaces seek not only to vertically differentiate in liquidity, but also to horizontal differentiate in marketplace characteristics and features such as product comparison and evaluation, ease of purchase, after-sale support, etc. Therefore the real world may have a different picture than painted in this research. Finally, this model does not consider the effects of direct trade. The software that supports peer to peer direct transaction is under rapid development. The reduction of cost of direct trader will attract more traders to disintermediate, therefore might change the dynamics of competition between intermediaries. In future research, we would like to incorporate lock-in effects into our model. We will reinterpret the island in our model as big traders who have large volume of transaction. There would be a fixed cost for traders to join the marketplace. We will study how the size of island (the market power of traders) will affect the competition strategies of B2B electronic marketplaces.

In the last decade, the development of IT has enabled the business trader to interact in a way one could hardly foresee. The B2B electronic marketplace prevails as one of the dominant B2B electronic commerce models. We hope our research, though limited, can shed light on the current development of the volatile industry and serve as a starting point for further and deeper research.

Electronic Commerce

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