Switching Cost, Market Effects and the Pricing Model of e-Commerce

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Abstract

Our paper develops a Walrasian general equilibrium model based on impersonal networking decisions to investigate the role of switching cost, trading efficiency and fixed learning cost in a competitive market of e-Commerce. Since the general equilibrium in our model is always Pareto optimal as long as nobody can block free entry into any sector and nobody can manipulate relative prices and numbers of specialists, the implications of our model is straightforward that if the e-Commerce market is efficient and with lower switching cost, it ensures that network effects of division of labor can be fully exploited and the real income will improve, yet the relative price in term of e-Commerce service will be cheaper. To business practitioners, our model suggests that successful transformation from conventional commerce to e-Commerce service is a key for business viability in the future business environment.

I. Introduction

Electronic commerce changes the relationships between sellers and buyers dramatically. The new properties of electronic markets offer customers added values. New customer value propositions have to be established in most markets and new marketing strategies must be formulated. Due to a precipitous decline in transaction costs from Internet based commerce it may be efficient for firms to restructure themselves around e-Commerce. The radical transformations in the conduct of business entail fundamental restructuring of existing operations. The e-Commerce induced fall in transaction costs is unleashing a revolution in the mode and conduct of market exchange. The ease of information dissemination and the unique properties of online trade have enabled more efficient and more informed market behavior. Understandably then, this smooth intermediary for the execution of transactions has been realized exponential growth. The decline in transaction costs may well explain why, in the past few years, we have been observing a spate of business restructuring. Online trade has also facilitated greater fluidity of labor exchange by eroding the transaction costs that reside in the labor market. Moreover, it is expected that e-Commerce may fundamentally transform the business pattern of commerce.

Switching cost are costs induced when economic agents change their suppliers. As such, ex-homogeneous products become ex-post heterogeneous. These costs originate from a host of reasons, economic as well as psychological. Various preferences, cognitive dissonance problems and similar phenomena are just a few examples for the psychological origins of switching costs. Inter-temporal product and service compatibility, network externalities, informational investment in business relationships are few examples of the economic origins of switching costs. From the theoretical perspective, customer's switching costs confer market power on firms. As classified by Klemperer (1987a, 1987b), there are at least three types switching costs: transaction costs, learning costs, and artificial or contractual costs. Economics has studied that switching costs can affect a variety of critical competitive

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phenomena. For instance, switching costs have linked to prices, entry decisions, new product diffusion patterns, and price wars. Much of the economics literature has focused on market-wide switching costs. For example, switching costs due to product compatibility or network externalities has been extensively discussed, both in general and more specifically in software markets (Bresnahan 2002). Although the economics literature have stressed the importance of switching costs that can be deliberately varied by firms through retention investment or by customer heterogeneity in switching cost or brand loyalty, the emphasis of the parallel literature in marketing. Chen and Hitt (2002) devised a technique for measuring switching costs based on the random utility framework. Random utility models have been extensively applied in studying consumer choice behavior among multiple products (Smith and Brynjolfsson 2001). Their analysis relies on comparing the choice behavior of new customers with those of existing customers. The marketing literature has not focused on switching costs directly but has extensively examined customer product choice behavior including the choice to change providers or products. The focus of this literature has been on the concept of "brand loyalty" which is the tendency of at least some consumers to engage in repeat purchases of the same brand over time. However, this research has not directly measured the magnitudes of switching costs faced by customers at different firms.

While electronic markets appear to have reduced switching costs since a competing firm is "just a click away" (Friedman 1999), recent research suggests that there is significant evidence of brand loyalty in electronic markets. For example, using data from a price comparison service, Smith and Brynjolfsson (2001) found that customers were willing to pay premium prices for books form the retailer they had dealt with previously. Examples include frequent-purchaser programs, use of user profiles for personalization, "click-through" rewards, and affiliate programs (Bakos 2001). Others have suggested that online retention is influenced indirectly through engaging website design (Cremer and Hariton 1999). However, the drivers of retention have proven difficult to determine empirically because of a lack of suitable measurable methods and data.

This paper investigates the impact of e-Commerce on market exchange and transaction costs. Section 2 provides a theoretical model to investigate the impacts of e-Commerce on the network division of labor with switching cost. Section 3 extends the prospects of e-Commerce, particularly its prospects for exchange facilitation and its impact on transaction costs that exist in goods and services markets. It also unveils the relationship between e-Commerce, transaction costs and business restructuring. Section 4 will conclude the paper.

2. The General Framework of Pricing Model of e-Commerce with Switching Cost

Following the infra-marginal analysis (Yang and Ng, 1993), we consider an economy with a continuum of consumer-producers of mass *M*. This assumption implies that population size is very large. It avoids an integer problem of the numbers of different specialists, which may lead to non-existence of equilibrium with the division of labor (Yang 2001, Chapter 13). Each consumer-producer has identical, non-satiated, continuous, and rational preference represented by the following utility function:

$$u = f(x^c, y^c), \tag{1}$$

where $x^c \equiv x + k\cdot(t+t^d)\cdot x^d$ and $y^c \equiv y + k\cdot(t+t^d)\cdot y^d$ are the amounts of the two final goods that are consumed, x and y are the amounts of the two goods that are self-provided, x^d and y^d are the amounts of the two goods that are purchased from the market. In order to facilitate the transaction, we need search information and other trading services which can be the conventional commerce pattern, denoted as t, or through e-Commerce, denoted as t^d. Besides, k is a trading efficiency coefficient, which represents the conditions governing transactions. k relates to transportation conditions and the general institutional environment that affects trading efficiency. Fraction 1-k of a good sold disappears in transit due to an iceberg transaction cost. Moreover, $f(.)$ is assumed continuously increasing and quasi-concave. For simplicity, it is assumed that $f(.) = (x^c)^{\alpha}\cdot(y^c)^{1-\alpha}$ and $\alpha = \frac{1}{2}$.

Each consumer-producer's production functions are:

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$x^p = x + x^s = Max\{0, l_x - a\}$ and $a \in (0,1)$;

$$y^p = y + y^s = Max\{0, l_y - a\} \text{ and } a \in (0,1). \quad (2)$$

Here, x^p and y^p are the amounts of the two final goods produced, x^s and y^s are the amounts of the two final goods sold; a is the fixed learning and training costs in producing goods.

The amount of trading services produced is shown as,

$$t^p = t + t^s = Max\{0, l_t - b\} \text{ and } b \in (0,1), \quad (3)$$

where t^p is the total amount of the transaction services produced, which can be through conventional commerce or e-Commerce; t^s is the amount of the trading services sold to the market; and b is the switching cost for changing the service pattern or provider of trading service, for instance from conventional pattern to subscribing e-Commerce service.

The endowment constraint for each individual is assumed to be endowed with one unit of working time, and is given as follows:

$$l_x + l_y + l_t = 1, \quad (4)$$

where l_x, l_y, and l_t are the amount of labor allocated to the production of these goods and services. This system of production implies that each individual's labor productivity increases as she narrows down her range of production activities. As shown by Yang (2001, chapter 2), the aggregate production schedule for three individuals discontinuously jumps from a low profile to a high profile as each person jumps from producing three goods to a production pattern in which at least one person produces only one good (specialization). The difference between the two aggregate production profiles is considered as positive network effects of division of labor on aggregate productivity. This network effect implies that each person's decision of her level of specialization, or gains from specialization, depends on the number of participants in a large network of division of labor, while this number is determined by all individuals' decisions in choosing their levels of specialization (so-called the Young theorem, see Young, 1928). Since economies of specialization is individual specific (learning by doing must be achieved through individual specific practice and cannot be transferred between individuals), labor endowment constraint is specified for each individual, so that increasing returns are localized.

The budget constraint for an individual is,

$$p_t(t^s - t^d) + p_x(x^s - x^d) + p_y(y^s - y^d) = 0 . \quad (5)$$

Here, p_x and p_y are the prices of good x and y; and p_t is the price for subscribing e-Commerce service.

Due to the continuum number of individuals and the assumption of localized increasing returns in this large economy, a Walrasian regime prevails in this model. The specification of the model generates a trade-off between economies of division of labor and transaction costs. The decision problem for an individual involves deciding on what and how much to produce for self-consumption, to sell and to buy from the market. In other words, the individual chooses nine variables $x_i, x_i^s, x_i^d, y_i, y_i^s, y_i^d, t_i, t_i^s, t_i^d \geq 0$. Hence, there are $2^9 = 512$ possible corner and interior solutions.

The set of candidates for each individual's optimum decision includes many corner and interior solutions. In order to narrow down the list of the candidates, Yang and Ng (1993), and Yang (2001) used the Kuhn-Tucker conditions to establish the following lemma:

LEMMA 1: *Each individual sells at most one good, but does not buy and sell the same good, nor buys and self-provides the same good at the same time.*

We define a *configuration* as a combination of zero and positive variables which are compatible with Lemma 1. When labor trade and bundling are allowed, there are six configurations from which the individuals can choose. A combination of all individual's configurations constitutes a *market structure*, or *structure* for short. After examining all structures that might occur in equilibrium, there will be three types of structures: 1. Structure A: Autarky; 2. Structure B: Structures with Partial Division of Labor; 3. Structure C: Complete Division of Labor.

According to Yang (2001, chapter 13), a general equilibrium exists for a general class of the models of which the model in this paper is a special case under the assumptions that the set of individuals is a continuum, preferences are strictly increasing and rational; and both local increasing returns and constant returns are allowed in production and transactions. A general equilibrium in this model is defined as a set of relative prices of goods and all individuals' labor allocations and trade

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plans, such that, (1) Each individual maximizes her utility, that is, the consumption bundle generated by her labor allocation and trade plan maximizes her utility function for given prices; (2) All markets clear. Following this procedure, we can solve for corner equilibria in all three structures. Information about such solutions of corner equilibria in 3 structures are summarized in the following Tables 1.

Table 1: The Corner Equilibria of Three Market Structures

Market Structures	A	B
Relative Price	N/A	$\frac{p_x}{p_y} = 1$
Number of Specialists	N/A	$\frac{M_x}{M_y} = 1$
Per Capita Real Income	$u^A = \frac{1-2a}{2}$	$u^B = \frac{(1-a-b)^{\frac{3}{2}}}{3\sqrt{3}} \cdot k^{\frac{1}{2}}$
Market Structures	C	
Relative Price	$\frac{p_x}{p_t} = \frac{p_y}{p_t} = \frac{3(1-b)^{\frac{4}{3}}}{4 \cdot \sqrt[3]{4}(1-a)} \cdot k^{\frac{1}{3}}$	
Number of Specialists	$\frac{M_t}{M_x} = \frac{M_t}{M_y} = \frac{(1-b)^{\frac{1}{3}}}{\sqrt[3]{4}} \cdot k^{\frac{1}{3}}$	
Per Capita Real Income	$u^C = \frac{\sqrt[3]{4}(1-a) \cdot (1-b)^{\frac{2}{3}}}{12} \cdot k^{\frac{2}{3}}$	

3. General Equilibrium and Its Infra-marginal Comparative Statics

For any given structure, each individual can plug the corner equilibrium prices into her indirect utility functions for all configurations including those that are not in this structure. She has no incentive to deviate from a constituent configuration in this structure if this configuration generates a utility value that is not lower than in any alternative configurations under the corner equilibrium values of prices in this structure. Each individual can conduct such total cost-benefit analysis across configurations. Let indirect utility in each constituent configuration not be smaller than in any alternative configurations under the corner equilibrium prices in this structure. We can obtain a system of semi-inequalities that involves only parameters. This system of semi-inequalities defines a parameter subspace within which the corner equilibrium in this structure is the general equilibrium. This total cost-benefit analysis is very tedious and cumbersome. Fortunately, the Yao Theorem (see Yang 2001, chapter 6) can be used to simplify this total cost-benefit analysis. It states that in an economy with a continuum of ex ante identical consumer-producers having rational and convex preferences and production functions displaying individual specific economies of specialization, a Walrasian general equilibrium exists and it is the Pareto optimum corner equilibrium. Here the Pareto optimum corner equilibrium is a corner equilibrium that generates the highest per capita real income. Since our model in this paper is a special case of the above mentioned general class of models, the individuals have no incentive to deviate from their chosen constituent configurations in a structure if and only if individuals' corner equilibrium utility value in this structure is not lower than that in any other corner equilibria. With the Yao theorem, we can then compare corner equilibrium per capita real incomes across all structures, and the comparison partitions the three-dimension (a, b, k) parameter space into several subspaces, within each of which one corner equilibrium is the general equilibrium. As parameter values shift between different subspaces, the general equilibrium discontinuously jumps between corner equilibria. This is referred to as infra-marginal comparative statics of general equilibrium. The results are shown at Table 2.

Table 2: General Equilibrium and Its Infra-marginal Comparative Statics

a	$a_1 \le a < 0.5$		
k	$0<k<k_1$	$k_1<k<k_3$	$k_3<k<1$
Equilibrium Structure	A	B	C

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a	$0 \le a < a_1 \equiv f(b)$	
k	$0 < k < k_2$	$k_2 < k < 1$
Equilibrium Structure	A	C

Here, $k_1 \equiv \frac{27(1-2a)^2}{4(1-a-b)^3}$, $k_2 \equiv \frac{3\sqrt{6}(1-2a)^{\frac{3}{2}}}{(1-a)^{\frac{3}{2}}(1-b)}$, $k_3 \equiv \frac{256(1-a-b)^9}{27(1-a)^6(1-b)^4}$, and $a_1 \equiv f(b)$ can be implicitly resulted from the equation $k_3 - k_1 = 0$.

Then, let's first examine the change of per capita real income in response to changes in trading efficiency, in fixed learning cost, and switching cost, which results in the following inequalities, $\frac{du^A}{da} < 0$; $\frac{\partial u^B}{\partial a} < 0$, $\frac{\partial u^B}{\partial b} < 0$ and $\frac{\partial u^B}{\partial k} > 0$; $\frac{\partial u^C}{\partial a} < 0$, $\frac{\partial u^C}{\partial b} < 0$ and $\frac{\partial u^C}{\partial k} > 0$, which imply that to improve the per capita real income level, we can either by increasing the trading efficiency, or by reducing the fixed learning cost or the switching cost. Applying to e-Commerce service, if switching cost from conventional commercial pattern to e-Commerce is reduced, then the real income level will be improved when the transformation is completed. Similarly, we can calculate the

If we examine the change of relative prices with the changes in trading efficiency, in fixed learning cost, and switching cost, there will be the following results, $\frac{\partial(p_x/p_t)}{\partial a} = \frac{\partial(p_y/p_t)}{\partial a} > 0$, $\frac{\partial(p_x/p_t)}{\partial b} = \frac{\partial(p_y/p_t)}{\partial b} < 0$ and $\frac{\partial(p_x/p_t)}{\partial k} = \frac{\partial(p_y/p_t)}{\partial k} > 0$.

These inequalities imply that there are positive correlation between relative price $\frac{p_x}{p_t}$ or $\frac{p_y}{p_t}$ with the trading efficiency and switching cost, while a negative correlation with the fixed learning cost. Hence, if the trading efficiency is improved and switching cost is declining, then the e-Commerce companies can charge cheaper price for their services.

Following Yang (2001, chapter 6), it can be shown that a general equilibrium in our model is Pareto optimal. This first welfare theorem in our model with impersonal networking decisions and endogenous network size of division of labor implies that the very function of market is to coordinate impersonal networking decisions and to fully utilize network effects of division of labor on aggregate productivity, net of transaction costs. e-Commerce in a competitive market is an effective way to promote division of labor and productivity progress. The above analysis leads to the following proposition.

PROPOSITION 1:

1. As trading efficiency is improved, the equilibrium level of division of labor increases, thereby the real income level is also increased. Trading efficiency has negative correlation on the relative price in term of e-Commerce service; 2 .If switching cost is getting lower, it will simultaneously improve the real income level, promoting the level of division of labor and productivity progress, and offer the e-Commerce companies the flexibility to charge cheaper price; 3. The fixed learning cost has negative impact on real income, and also on the relative price in term of e-Commerce service.

Proposition 1 implies, as switching cost declined, the e-Commerce companies are able to have more flexibility and space to change their charge for service, yet the real income level is still increasing. It also helps to explain why sometimes these companies subsidize customers switching to them since they can extract form the captured customers for more revenue. Besides, Proposition 1 also indicates that with the improvement of trading efficiency, the e-Commerce service is more preferred and profitable, which is probably the reason why many companies are presently enthusing about providing e-Commerce service despite the relatively exorbitant fixed initial investment.

4. Concluding Remarks

This paper develops a Walrasian general equilibrium model based on impersonal networking decisions to investigate the role of switching cost, trading efficiency and fixed learning cost in a competitive market of e-Commerce. Since the general equilibrium in our model is always Pareto optimal as long as nobody can block free entry into any sector and nobody can manipulate relative prices and numbers of specialists, the implications of our model is straightforward that if the e-Commerce market is efficient and with lower switching cost, it ensures that network effects of division of labor can be fully exploited and the real income will improve, yet the relative price in term of e-Commerce service will be cheaper. To business practitioners, our model suggests that successful transformation from conventional commerce to e-Commerce service a key for business viability in future business environment.

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