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THE EFFECTS OF SWITCHING COSTS ON THE ADOPTION OF ELECTRONIC MARKETS

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ABSTRACT

Innovations in information technologies have greatly reduced the time and cost of processing and communicating information. Some researchers predict that this will cause a reduction of coordination costs and will lead to an overall shift toward proportionally greater use of markets rather than hierarchies. This paper broadens the understanding of the selection of markets and hierarchies by investigating the impact of uncertainty and switching costs on this decision. One significant result of this research is that when switching costs are high or unobservable, hierarchies prove to be the better alternative.

INTRODUCTION

Economies have two basic mechanisms for coordinating transactions: markets and hierarchies [14]. Markets coordinate the transaction activities through supply and demand forces which determine the design, price, quantity, quality, and delivery schedule for a given product. The buyer of the product compares its many possible sources and makes a choice based on the best combination of these attributes. Hierarchies coordinate the transaction of goods through managerial decisions rather than interaction of market forces. Thus, buyers do not select a vendor from a group of potential suppliers; they simply work with a specific predetermined one.

In the past, the decision to adopt markets or hierarchies was based on the relative importance of production costs or coordination costs. When comparing markets and hierarchies, production costs in a market environment are lower than in a hierarchy because of competition among suppliers. However, coordination costs in a market are relatively higher than in a hierarchy since the buyer must gather and analyze information from various suppliers.

Advances of information technology (IT) have greatly changed today's business environment. In particular, IT innovations have facilitated the transmission of information in larger quantities, at higher speed, and substantially lower cost. It has been observed that in some industries the improvement of IT price/performance has resulted in the shift from hierarchies toward markets. In the airline industry, for example, the selling process was governed by the hierarchical relationship between the seller and the buyer as reservations were made by customers calling the airline directly. Since the introduction of the American Airlines reservation system, seventy percent of the sales have been coordinated by the market relationship between the travel agent and the airline. These changes have led Malone and his colleagues [8, 9, 10, 11] to predict that IT advances will cause an increase in transactions coordinated by markets because decreases in coordination cost gained by a firm switching to an electronic market outweigh the value of features unique to a hierarchy. It is further asserted that vertical firm size will decrease as the use of IT grows though some have argued otherwise [4].

Although the impact of information technology on the selection of market mechanisms is significant, current research has ignored such factors as switching costs, quality, security, and uncertainty. Among these, switching costs have a significant impact on determining the transaction coordination mechanisms. Von Weizsäcker [13] has shown that as switching costs increase, buyers' choices are influenced more by future considerations and relatively less by their current preferences. With sufficiently high switching costs, a buyer will always make future purchases from the same supplier. Farrell and Shapiro [3] show that if transactions must take place over time and if switching costs are unobservable, long-term price contracts can outperform short-term contracts, which implies that hierarchies are better than markets.

This paper examines the viability of electronic markets from the perspective of switching costs. The paper is organized as follows. Section 2 discusses various switching costs and the factors influencing them. Section 3 analyzes the relationship between switching costs and transaction coordination mechanisms through a quantitative model. The impact of IT on this relationship is also addressed there. Concluding remarks follow in Section 4.

SWITCHING COSTS AND RELEVANT FACTORS

Switching costs are defined as the costs incurred by a buyer when a switch is made from the current supplier of a product to another supplier. In economic terms switching costs represent a loss of utility. Switching costs impact buyers in two ways. The first is that if switching costs are high, the buying firm will continue to purchase from their current source even if there are other suppliers who offer superior products. The second is that switching costs influence the buyers' initial purchasing decision. Economic theory has shown [14] that without switching costs, buyers will buy the product from the supplier who offers the best combination of price, quality, service, and delivery schedule in the current period without looking into the future. However, in the presence of switching costs, a rational buyer considers expected future costs when making current purchasing decisions.

Measurable Switching Costs

There are a variety of factors which constitute switching costs. For the purposes of this paper, we have partitioned them into two sets: *measurable* and *unmeasurable*. Measurable switching costs are defined as those costs which are observable and quantifiable. Previous research [2, 5] has identified some of these costs. In this paper we have expanded and structured these measurable costs into four categories: *search and testing costs*, *shut down/set up costs*, *integration costs*, and *accrued benefit loss*.

(a) **Search and testing costs** If switching suppliers is being contemplated, buyers incur costs associated with the gathering of information about prices and product characteristics from potential suppliers [2]. In addition, communication costs are also incurred. If the product is purchased as a raw material used in a manufacturing process, it will require testing to insure that it performs properly. This is the always the case for differentiated products. It also holds for some homogeneous products. The chemical industry provides an example of this behavior. There are standard industrial chemicals that have small variations in properties from supplier to supplier. For some processes where these chemicals are used these variations have no effect on the finished product. However, in others the effects can be significant. In this case, companies will have to perform laboratory tests on a chemical if it comes from a previously untested supplier.

For manufacturing companies, a method must be established to insure that raw materials conform to specifications. One commonly used method is for the buyer to examine the supplier's manufacturing process to establish that procedures are in place which guarantee conformance. Often, the buyer will advise the supplier on ways to upgrade their processes to meet the required standard.

(b) **Shut down/set up costs** In many cases, buyers incur expenses from both terminating the relationship with their existing supplier and initializing the relationship with the new supplier. We classify these costs as shut down/set up (SD/SU) costs and identify two cases:

Shut down costs Upon terminating the relationship with a supplier, the buyer has to settle all accounts and agreements previously made. This settlement may involve additional costs. For example buyers that lease equipment would pay for the handling and transportation costs

of returning the machinery. In some contractual relationships, the buyer is assessed a penalty for terminating the agreement prior to a stated time. Note that in the past, banks would charge borrowers a prepayment penalty if a loan is repaid prior to the agreed upon date.

Set up costs When a relationship with a new supplier is started, buyers can incur additional one-time costs. These take the form of application fees and other initialization costs. Refinancing mortgages exemplifies this as the borrower must pay an application fee and/or one-time finance charge (points) to the new mortgage writer. In addition, the borrower will often need to have a new survey and title search performed.

(c) Integration costs Buyers that switch suppliers for products are sometimes required to make adjustments within their business processes to accommodate differences between the current and former supplier's product.

Consider the problem of purchasing a new piece of equipment. In order for workers to use it properly, the buyer will incur training costs. The costs can be in two forms: direct training costs and a loss of worker productivity. The direct training costs emanate from courses taken by users or training material (books, video's, etc) that must be purchased. For example, firms switching from using MacIntosh PCs to IBM PCs will have to pay to retrain users to work in a DOS environment.

In the course of training users, buyers will also suffer the loss of worker productivity. Workers who are being trained will spend time on this at the expense of their normal responsibilities. In addition, their productivity will suffer as they become proficient using the new product. A good example of the latter is the cost firms experience when they change software development environments. For companies that have large and experienced COBOL programming staffs, the cost to switch to another programming language would be immense as the staffs' expertise in COBOL would be completely lost.

(d) Accrued benefit loss Some industries structure their pricing and service such that the buyer accrues future benefit from today's purchase. If the buyer stops buying, these accrued benefits are lost without any compensation. A good example of this practice is the airline's frequent flyer program. For industrial purchasers the effect is more direct. A common practice in industry is to provide for quantity discounts. That is, a buyer will either receive a price discount or a rebate according to a schedule that is based on the quantity of products purchased over time. If a buyer stops buying from this supplier, these discounts will be forfeited.

Unmeasurable Switching Costs

While not quantifiable, there are elements in the buyer-supplier relationship which potentially impose a cost on the buyer. We have identified three costs of this type.

(a) Risk of opportunistic behavior For differentiated products, buyers who contemplate switching suppliers incur a potential cost that the new supplier will behave in an opportunistic manner [14]. Differentiated products typically have high intergration costs. As this is known by suppliers, they can charge a premium for services after the purchase is made. Buyers can estimate the potential of this behavior from their current supplier based on past history. The reliability of estimating this for new suppliers is low since there is no historical information. Thus the buyer incurs the risk that the new supplier could act in a more opportunistic manner than the existing supplier.

(b) Relationship building costs Over the course of time, a buyer and a seller establish a personal relationship that can sometimes translate into increased value for both parties. For the buyer, the relationship can yield preferential treatment. Examples of this are receiving unscheduled delivery service, testing or analysis services at no charge (or at a reduced rate), and proportionally larger amounts of raw material in times of shortages. Note that there is no contractual obligation on the supplier to provide these services. The creation of this relationship is typically lost when changing to a new supplier. The

supplier provides them only when they are assured that the buyer is worthwhile customer, which is established over time.

(c) Risk of non-performance The largest unmeasurable cost incurred by a buyer is the risk of non-performance of a supplier. The non-performance could be in terms of service (unreliable delivery) or product conformance (material below buyer specification). For a manufacturing company, the consequences of the former will be production delays and the latter poor or unacceptable finished good. Either of these failures will have impact on the organization and the person responsible for coordinating purchases. For this reason buyers are careful to choose suppliers who reduce this risk. As with opportunism, buyers evaluate potential risk based on prior history, with a supplier.

Factors Influencing Switching Costs

In addition to understanding the cost factors that affect switching costs, it is important to analyze product characteristics and the market in which the product is purchased. The following sections discusses general factors about products and markets and predicts the effect of the factors on the components of switching costs.

(a) Frequency of purchase As could be expected, the frequency of purchase of a product has a significant effect on switching costs. Two costs are particularly affected by this factor: transaction and integration. If a product is purchased frequently and has large transaction costs, then changing suppliers would be prohibitive. In addition, if the product requires considerable effort to integrate into the organization, then changing suppliers would again be prohibitive.

(b) Complexity of product description Complexity of product description refers to the amount of information needed to describe a product in sufficient detail so that buyers can determine if the product is what they want. Common stock is an example of a product with low complexity of description. The specification of a computer program is a product with a high complexity of description. The largest effect of this factor is on search costs. The complexity of product description is proportional to the amount of data associated with the description. This means that buyers would be transmitting larger amounts of information to prospective suppliers and incurring larger communications costs. In addition, if the complexity is high, it will be harder to find and/or narrow the set of potential suppliers of the product. Upon receiving the suppliers responses, the buyer will need to spend considerable time analyzing the data. Finally, if the complexity is high, it is likely that more highly trained employees will be required to assist in the evaluation process.

(c) Quality required by buyers Sparked by superior reliability of Japanese products and growing global competition, firms have incorporated product quality as a principle that the entire organization must strive to meet. This has a direct impact on two elements of switching costs. The first is testing. If quality of the finished good is to be maintained, the quality of the raw materials used to manufacture it must meet the standard. If a change in supplier was contemplated, then the sample materials from prospective suppliers would need to be rigorously tested.

The second cost is risk. Consider the case in which a supplier has a history of providing raw materials that meet quality standards. Suppose, the current supplier's price is non-competitive. If a switch is made to a lower price supplier, the buyer incurs the risk that the new supplier will not be able to consistently provide material at the required standard.

(d) Heterogeneity of the product A product is considered to be homogeneous if there exist many suppliers whose products have almost the same price, quality, and other characteristics. In general, the switching costs for these products are low. For example, buyers of airline tickets are not subjected to large switching costs when they change travel agents. A product is considered to be differentiated if there does not exist many suppliers who offer a product that have similar price, quality, and other characteristics. For these products, search costs, integration costs, risk of non-performance, and risk of

opportunism are likely to be high, leading to overall high switching costs.

(e) Product dependency Employees are dependent on certain products in order to function. For example, in some organizations office workers are dependent on electronic mail in order to communicate. If an organization switches suppliers for one of these types of products, it will incur switching cost that will be proportional to the number of employees dependent on it. Specifically, there will be a cost to train each employee that uses this product. If the dependent personnel are highly skilled, the loss will be even larger as the cost will be multiplied by higher labor rates.

In addition to employees, business processes are dependent on products to function. An example of this would be the dependency of application software on the operating system. If a buyer switches operating systems, the cost of integration would be large.

In general, the greater the employee or process dependency on the product, the larger the switching cost.

(f) Number of Alternate Suppliers The number of alternate suppliers has direct effect on search costs. The search costs are proportional to the number of alternate suppliers. Obviously the cost of communicating and possible testing of product increases as the number of suppliers increases.

THE EFFECT OF SWITCHING COSTS ON THE ADOPTION OF MARKETS AND HIERARCHIES

In this section, we examine the effect of switching costs on the selection of transaction coordination mechanisms. We assume that buyers make repeated purchases of products from a large set of suppliers who sell differentiated products that are substitutable. We first look at the problem under the assumption that there is no contractual relationship between buyers and sellers. In other words, buyers have no obligation to make repeated purchases from the same supplier. Then we move to the situation in which contracts exist between buyers and sellers. The effect of IT will also be investigated under each situation.

The Buyer-Seller Relationship Without Contracts

We consider spot-market relationships. In a spot-market buyers can switch from their current supplier to another in one of two ways. The first method is for the supplier to set price, quality and other product attributes and the buyer will decide if this is sufficient to change sources. The second method has the buyer setting price, quality and other attributes and the supplier determines whether they wish to sell to those specifications. In a spot-market no contract exists between buyer and supplier allowing each party to terminate the relationship without any reason nor any subsequent responsibilities.

Given these definitions, we will show that the presence of switching costs will lead to a less competitive market, and thus, there is an incentive for the buyer to invest in *relationship-specific assets* [3].

Let a vector $\mathbf{x} = (x_1, \dots, x_n)$ represent attributes of the product such as price, quality, quantity, delivery, etc. and $u : \mathbb{R}^n \rightarrow \mathbb{R}$ be the utility function of the buyer. Suppose both parties have complete information of the market. Denote:

- u_0 : the current utility level of the buyer
- u_m : expected utility of the buyer if he decides to switch to the market
- p_0 : current price the buyer pays for the product
- p_m : expected market price of the product
- s : expected switching costs

Since there is no contract between the buyer and the seller, whether the buyer switches or not, the buyer's expected losses due to future changes in attributes will be the same. Hence, the buyer's switching costs are only setup costs which include search, testing, learning, and transaction costs. Obviously, the buyer will not switch unless his utility is increased. Thus, we have the following proposition.

Proposition 1 Assume that there is no contractual relationship between the buyer and the supplier and both have complete information about the market. The buyer will not make a switch unless $u_m(p_m + s, \cdot) > u_0(p_0, \cdot)$. If the current seller provides the same attributes as the market provides except price, then the buyer will not switch unless $p_m + s < p_0$.

It is clear from Proposition 1 that if the current supplier provides the product with average attributes except price, the buyer will change suppliers if and only if the switching costs, s , is less than the difference between p_0 and p_m . An alternative supplier, providing product with average attributes, will attract the buyer if his price, p_a , satisfies $p_0 - p_a > s$. Hence, if other suppliers cannot offer sufficiently lower prices, it will be to the current supplier's advantage to retain the buyer's business.

Note that the size of switching costs vary by product. For example, the costs of changing long-distance telephone services are very limited. By offering coupons which are equivalent to reduction of prices, telephone companies can easily sway buyers to switch from their competitors. The learning costs for new computer software, the testing costs for a new chemical material, or the transaction costs for moving a banking system from one place to the other, however, can be very high and thus, prevent buyers from switching.

When switching costs are significant and the buyer has no incentive to leave the current supplier, it would be better for both parties to establish a contractual relationship through bargaining. The benefits of this relationship for the buyer are: quantity discounts, stable quality level, and guaranteed delivery schedule. The supplier's benefits include guaranteed business (the seller does not have to lower price to get buyers) and reduction in transaction costs (advertising, processing and communicating information). Note that since the contract obligates the buyer to purchase from a specific supplier in the future, the supplier seems to have incentive to deliver a product with attributes which are below expectations of attributes not specified in the contract. However, the locked-in buyer has bargaining power in the form of breaking the contract and purchasing material from another supplier. In order to compensate for this, the original supplier is forced to make a cheap introductory order to potential new customers. Thus, we arrive the following proposition.

Proposition 2 Assume that there is no contractual relationship between the buyer and the seller and both have complete information of the market. If the buyer's switching costs are significantly high, then both the buyer and supplier have incentives to establish a contractual relationship. In addition, the buyer's utility can be improved through bargaining.

The Buyer-Seller Relationship With Contracts

Once a hierarchical relationship is established, switching costs, especially unobservable switching costs, prevent buyers from returning to the non-contractual relationship or switching to another contractual relationship.

Farrell and Shapiro [3] show that some switching costs are observable and some are not. For example, learning costs are observable, whereas switching costs due to unsatisfied quality and/or opportunism are usually not observable. Without loss of generality, denote $\mathbf{x}_o = (x_1, \dots, x_m)$ and $\mathbf{x}_u = (x_{m+1}, \dots, x_n)$ such that the switching costs are observable with respect to attributes \mathbf{x}_o and unobservable with respect to attributes \mathbf{x}_u . Consequently, s_o and s_u will denote observable and unobservable switching costs, respectively.

If the buyer decides to switch to the spot-market, then both s_o and s_u should be offset by the low market price. Otherwise, there is no incentive for the buyer to switch. In this situation, we have the following proposition.

Proposition 3 A rational buyer will switch from the current contractual relationship to the market if and only if $u_m(p_m + s_o + s_u, \cdot) \geq u_0(p_0, \cdot)$.

In the current business environment, with increasing emphasis on unobservable costs such as quality, the s_u can be perceived to be larger than it actually is. Thus, buyers will not switch to the spot-market purchases if their perceived s_u is significant.

It is possible that an alternative supplier will try to compete with the current supplier by offering a superior contract from the buyer's perspective. In order to attract the buyer, the alternative supplier normally absorbs all observable switching costs of the buyer. However, the perception of unobservable switching costs for the buyer and the new seller can never be the same. Thus, it is impossible for the new seller to compensate the buyer's unobservable switching costs. This proves the following proposition.

Proposition 4 *A rational buyer will switch from the current contractual relationship to another contractual relationship if and only if $u_a(p_a + s_u, \cdot) \geq u_0(p_0, \cdot)$ provided that all observable switching costs are absorbed by the alternative supplier.*

The Impact of IT on Switching Costs

The use of IT substantially reduces the time and cost of processing and communicating information. It is possible that components of the switching costs, transaction costs for example, can be reduced by the application of IT. However, IT does not necessarily reduce learning, testing, and most unmeasurable costs. In general, the impact of IT on switching costs is very marginal.

It is clear that to assess the influence of IT on switching costs, one needs to examine the influence of IT on the factors to which switching costs are related. In the remainder of this section, we focus on the relationships between IT and quality and IT and product homogeneity.

(a) IT and quality There have been studies [7] showing that poor communication between buyer and supplier is a fundamental weakness that adversely affects the goal of quality improvement. The problem stems from the adversarial relationship, not from the lack of efficient communication technology.

The implementation of a quality driven purchasing policy will incorporate the following ideas:

- Identify one or a small set of suppliers for each purchased good. These suppliers will be qualified by a rigorous evaluation process. This process examines the supplier's manufacturing and financial status. Attention must be paid to the quality controls the supplier has in place.
- Establish a close rapport with the supplier. The supplier should be informed of goals and methodologies. Whenever possible, include the supplier in the design process.
- Foster a quality improvement relationship. This might include providing the supplier with quality training or the installation of a statistical process control (SPC) program.
- Monitor supplier performance.

To lower implementation costs, current research suggests that the total number of suppliers be reduced. By doing so, the cost to implement each part will be reduced. Our empirical study shows that most companies deal with less than three suppliers per purchased good in a relationship that is hierarchical.

It does not seem that improvements in IT price/performance will affect the implementation process to allow selection from a larger set of suppliers. The tasks associated with the first three steps are unstructured or interpersonal and therefore unlikely to be affected by IT. The last task would gain from IT advances. However, it is not clear that the cost savings gained would be sufficient to change purchasing policy to work in an electronic market.

(b) IT and heterogeneity of the product Firms that seek competitive advantage through product differentiation influence the

purchasing decision in a variety of ways. Landeros and Monczka [6] maintain that conventional price-driven purchasing will hinder manufacturing firms who emphasize product differentiation. They posit that suppliers should be selected on the basis of the relevancy of the supplier's research and development with respect to the buying firm's product line.

Two other considerations that impact the purchasing decision need to be discussed. The first is the need for material specifications that exceed the industry standard. The second is the need to maintain security of material purchased. These two concerns and the point made by Landeros and Monczka, are best addressed by buyers purchasing within a hierarchy.

(i) Material Specialization Industrial goods can be segmented into two classes: commodities and specialties. A commodity is a good that can be purchased from many suppliers, where there is very little difference in the characteristics of the good from supplier to supplier. A specialty is a good that has few suppliers and/or the difference in its characteristics from supplier to supplier is large.

In some industries, buyers are blurring this distinction. In the chemical industry, for example, buyers are turning commodities into specialties by specifying product acceptance criteria that exceed the industry accepted standard for that product. These requirements are better served in a hierarchy than in a market. In order to satisfy the buyer's requirement of tighter quality controls or manufacturer specific material, detailed knowledge and coordination are needed between buyer and supplier.

For the purchase of specialty goods, the use of markets seems limited. First, if there are few suppliers, the information gathering cost is low even without an electronic market. Second, it is unlikely that once a specialty is incorporated into a process, a substitute for the specialty could be used without extensive testing. Third, since a specialty has no industry standard name, it would have to be described through some language. We suspect that it is not possible to create a universal language for all industries. In fact, it is likely that a unique language would be required for each industry. (Within the EDI domain, specialization of the same business document was required for different industries.)

(ii) Security The user of an electronic market transmits to all participating suppliers the requirements of the materials being purchased. These requirements include material specification, quantity, delivery schedule, etc. In general, any company that wishes to join the electronic market could receive this information. That is, if the electronic market was administered by a third party, then the only restriction to accessing this information would be that a company pay the fee for joining and using the market.

In some industries, the knowledge of the names and the quantities of the raw material purchased is proprietary. (For example, in the pharmaceutical industry, it is possible to deduce a formula for a proprietary drug given a few of its ingredients.) Within an electronic market this information would be available to a competitor if the competitor subscribed to the electronic market as a supplier.

We can think of three ways that electronic markets could be structured to address the security problem. All three methods impose restrictions that would severely limit the electronic market's utility. The following describes the methods and their restrictions.

- Allow buyers to submit requests anonymously. This solution has the drawback that suppliers typically will not quote unknown buyers. While it seems counter-intuitive that a supplier would be reluctant to inform a potential customer of its products, this does happen. For fear of providing competitors with useful information, some industrial organizations will standardly request background information from prospects. The information is checked for its veracity. If the review of the prospect's information is suspicious, either general information or no information will be sent. (Our empirical research supports this.) Additionally, if

the sales department is given only general information about the prospect, it is likely that standard or list pricing would be given. The prospect would have no chance to negotiate a better price based on promises for continued business.

- Restrict the electronic market to only those suppliers who have demonstrated that they are capable of supplying the materials for which they are receiving requests for quotations. This solution means the electronic market provider needs to validate the production/distribution capabilities of all supplier members of the market. In addition, the provider would have to periodically update this validation. For a market that lists many products, this task would be difficult and expensive.
- Allow the buyer to select the set of suppliers that would receive information. This solution reduces the effectiveness of the electronic market as the buyer is essentially selecting approved suppliers. This method would address the security issue but would sacrifice the ability of the electronic market to provide the best price, as the lowest price supplier may not be included in the set of approved suppliers or is unknown to the buyer. In the current environment, firms with this security concern tend to limit the number of suppliers with which they deal. They do so in order to reduce the possibility of unauthorized disclosure of their purchasing information.

It is our conclusion that most switching costs cannot be eliminated or reduced through the use of IT. Thus, even if the cost of gathering and communicating information can be substantially reduced with the use of IT, the presence of switching costs still makes hierarchies the preferred transaction coordination mechanism for some industries or products.

SUMMARY

Discussions on switching costs have mostly been focused on multi-period duopoly models as well as bargaining strategies of buyers and sellers. The significance of this paper is to identify the impact of switching costs on the market structure and how they will be affected by information technology. Our analysis shows that:

- (1) Switching costs are one of the key factors to be considered when companies decide to choose appropriate transaction coordination channels. Although the adoption of either markets or hierarchies depends upon many other factors, switching costs, especially unmeasurable switching costs, favor a hierarchical structure.
- (2) The size of switching costs is largely affected by frequency of purchase, complexity of product description, quality, homogeneity of the product, and dependency of the organization to the product.
- (3) The use of IT may result in a decrease of some measurable switching costs, but usually cannot cut down unmeasurable switching costs. Consequently, the general prediction that electronic markets will become a dominant force in marketplace is unlikely to prevail.

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