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# An Transaction Cost Analysis on Products' Adaptability to E-Commerce

Long Yong<sup>1</sup>, Liu Guizhong<sup>1</sup>, Pan Hongchun<sup>1</sup>, Xu Liang<sup>2</sup>

1. College of Economics and Business Administration, Chongqing University, Chongqing 400044, China

2. College of International Business, Sichuan International Studies University, Chongqing 400030, China

**Abstract:** Based on theories of transaction cost economics, this paper study up on the relationship between product cognitive, transaction complexity and transaction cost, and examined the impact of product cognitive, transaction complexity on the product suitable for E-commerce. Being difference from the previous point of view that the product cognitive would reduce transaction cost, and transaction complexity would increase transaction cost, that combination with previous researches, we conclude that transaction cost tends to influence product suitable for E-commerce; and with the product cognitive increasing and transaction complexity reducing, transaction cost reduced so that the product are more suitable for E-commerce.

**Keywords:** suitable for E-commerce, transaction cost, product cognitive, transaction complexity.

## 1. Introduction

According to the 29<sup>th</sup> Statistical Report on Internet Development issued by CNNIC(China Internet Network Information Center), by the end of December 2011, more than 194 million people made purchases with e-tailers. while B2C made it to the mainstream with the proliferation of B2C services like TMall, 360buy, Joyo, Dangdang and so on(CNNIC,2011). According to 2011 annual core data of E-commerce released by "iResearch", the total amount of e-commerce trade in China in year 2011has reached 7 trillion RMB, with an increase of more than 46.4% over the last year. And transaction scale of B2C

transaction was 179.11 billion RMB, 20% of the overall China online shopping market; Share of apparels, digital and home appliance is over 50% in all sub-categories. Clothing, Shoes. , Hats, and. Bags. 26.5%, 3C and Home Appliances. 24.2%, Cosmetics. 4.9%, Books, Audio and Video Products. 3.0%, Others 41.4%. ( iResearch, 2012). As a new marketing channel, e-commerce has changed the way of people shopping and will bring new opportunities and chances for existing businesses. Hence we can conclude that different products adapt to e-commerce differently, and whether the product is suitable for e-commerce largely depends on the features of product or service (Peterson, et al., 1997). It is important for the company to understand the effect of products' typology on consumers' online shopping behavior.

In the context of consumers' online behavior, there are many consumer choice models of E-commerce , such as Technology Acceptance Model (TAM ) (Davis, 1989; Davis, Bagozzi,and Warshaw,1989;Sejin and Leslie,2009), Theory of Reasoned Action (TRA) (Verhoef and Fred,2001; Jinsook,2004) and Theory of Planed Behavior (TPB) (Ajzen,1991;Paul and Mendel,2006)explain the consumer choice of E-commerce. The approach in this paper uses the theory of Transaction Cost Economics to explain the consumer choice of E-commerce and what products is more adaptable to E-commerce. In other words, this paper investigates the effect of product characteristics on consumers' perceptions of E-commerce and consumers' intention to adopt E-commerce. Most importantly, this can answer the questions of what products and services are adaptable

to E-commerce and why they are adaptable.

## 2. Conceptual Framework and Hypotheses

### 2.1 Transaction cost theory

A transaction is a process by which a good or service is transferred across a technologically separable interface (Williamson, 1975; Williamson, 1985). In classic economic theory, it is assumed that information is symmetric in the market and the transaction can be executed without cost. In reality, however, markets are often inefficient. In order to proceed with a transaction, consumers must search for information and monitor the on-going process to ensure a favorable deal. The costs involved in such transaction-related activities are called transaction costs (Coase, 1937). TCE theoretically explains why a transaction subject favors a particular form of transaction over others. The basic principle of TCE is that people like to conduct transactions in the most economical way. TCE has been successfully applied in many domains. Among the well-known examples are TCE applications to facilitate the make-or-buy and business integration decisions. The market mechanism is popular when the transaction cost of buying outside is lower than manufacturing inside, while organizational hierarchy is used other-wise. Since purchasing from electronic stores can be considered as a choice between the electronic commerce and traditional commerce, it is reasonable to assume that the consumer will go with the channel that has a lower transaction cost (assuming other costs being equal) .

The transaction cost may be affected by three dimensions or variables that are employed to characterize any transaction (i.e., uncertainty, asset specificity, and transaction frequency) and two main assumptions of human behavior (i.e., bounded rationality and opportunism).

Asset specificity refers to the degree to which an asset can be redeployed to alternative uses without

sacrifice of productive value by alternative users. This is related to the notion of sunk cost. But the full ramifications of asset specificity become evident only in the context of incomplete contracting and went unrecognized in the pre-transaction cost era (Williamson, 1975) (Williamson, 1979; Klein, et al., 1978). And Williamson introduced six kinds of asset specificity: site specificity, physical asset specificity, human asset specificity, dedicated assets, brand name capital, temporal specificity (Williamson, 1991). A central premise of transaction cost theory is that transaction cost increases as trans-actors make greater asset-specific investments. When using electronic commerce, consumers need to invest some time or energy to collect product information, even study some special skills of identifying the product with the goal of knowing more about the product or perceive the goods better. And these investments seem to be specific, which means they cannot be fully utilized in other situations. Hence, in order to describe the cost paid by consumers when purchasing goods online, we replace the asset specificity with the asset-specific investment belonged to consumers.

Uncertainty causes problems because of bounded rationality, information asymmetries and the danger of opportunism. The issue here is the difficulty to predict possible events that may occur during the course of a transaction. As such, the length of time over which the transaction will happen becomes crucial (Williamson, 1981). Transactions that occur in "spot markets" will have relatively little uncertainty because one does not have to predict the future. In contrast, transactions that involve a commitment over time have more uncertainty built in. While environmental uncertainty refers to unanticipated changes in circumstances associated with an exchange (Noordewier, et al., 1990), behavioral uncertainty arises from difficulties associated with assessing performance and contractual compliance of exchange part-

ners (Rindfleisch and Heide, 1997). In the real context of E-commerce, as the consumers do not hold perfect information and cannot process too much information, they are confronted with risks such as quality, quantity, or delivery delay and so on. In this paper, we explore uncertainty to depict the cost paid by customers when using electronic commerce.

Transaction frequency refers to the frequency with which transactions recur. According to Williamson, higher levels of transaction frequency provide an incentive for firms to employ hierarchical governance structures, as it will be easier for these structures to recover large transactions of a recurring kind [Williamson, 1985]. However, TCE researchers have been largely unsuccessful in confirming the hypothesized positive relationship between transaction frequency and hierarchical governance [Rindfleisch and Heide, 1997]. Further, John and Weitz considered transaction frequency as a dichotomous phenomenon (distribution between one-shot exchange and recurrent exchange) and controlled transaction frequency by examining only recurring exchanges (John and Weitz, 1988). Consequently, we omit this variable from our model as (Teo, 2004). So in the context of E-commerce, we include two types of asset specificity: specific physical asset and specific human asset. Specific physical asset refers to the asset which is invested for the online shopping, such as personal computers and modems. These equipments are necessary to E-commerce, and cannot be replaced by some other stuff. Specific human asset refers to the investment in time and effort to accumulate online shopping experience [White, 2000]. All investments mentioned above increase transactions costs. In addition, with the increase of the degree of asset specificity, transaction cost led by asset specificity can be increased. It follows that:

**H1a: There is a positive relationship between asset specificity and transaction cost, and the in-**

**fluence is increasing.**

There is a high uncertainty when the consumers are shopping online; the uncertainty mainly includes product uncertainty and the uncertainty of the behavior of the sellers. The communication between the consumers and sellers is limited (mainly a simple communication online), hence it is easy to bring about an information asymmetry. This may cause an opportunism behavior of sellers, and the consumers may do not trust in the E-commerce. In addition, after purchasing the goods, the consumers may find it is not the goods they really want. And in this case, they may pay a lot of time to send the goods back. This may increase the money cost. In order to decrease this uncertainty, the consumers have to spend more time to search on the internet, and this will bring about a higher searching cost. For some goods whose price is not transparent, the consumers may pay more money for the goods. Thus, the uncertainty of transaction makes the transaction cost increase. In addition, with the increase of the degree of uncertainty, the change of transaction cost will also increase. It follows that:

**H1b: There is a positive relationship between uncertainty and transaction cost, and the influence is increasing.**

In the context of E-commerce, researchers have conducted studies using TCE to explain firm-level and consumer-level issues. Liang and Huang developed a model (with two antecedents of transaction costs-uncertainty and asset specificity) based on TCE theory to explain the acquisition decision of consumers (Liang and Huang, 1998). Teo et al extended Liang and Huang's work by examining more antecedents (six instead of two, i.e. product uncertainty, behavioral uncertainty, convenience, economic utility, dependability, and asset specificity) of transaction costs and tested the model across two countries (i.e., the USA and China)(Teo et al, 2004). They also conducted in Singapore to test the model that consumers' willing-

ness to buy online is negatively associated with their perceived transaction cost, and perceived transaction cost is associated with uncertainty, dependability of online stores and buying frequency (Teo and Yu, 2005). The test conducted in China, USA, and Singapore all proved that transaction cost is negatively related to willing to buy online. And whether the product can be suitable for E-commerce need the product will be bought by consumers. So we can think that whether the product or the product portfolio is suitable for E-commerce based on the transaction cost that consumer perceived when they purchase online. The lower the transaction that consumer perceived, the more the product or the product portfolio is adaptable to E-commerce.

**H2: The lower the transaction cost that consumer perceived, the more suitable a product is for E-commerce.**

## 2.2 Product cognitive

In the E-commerce environment, goods—as much service—are perceived to be intangible. This is because consumers cannot touch, taste, feel, hear and smell the goods before they make purchase decisions. In other words, consumers in the E-commerce environment do not differentiate services from goods [Liu and Wei, 2003]. Xu and Chen pointed out consumers' purchasing experience would influence purchase decisions, which means consumers always recognize products by making use of one or several senses of sight, touch, taste and smell. Therefore, a product that depends on the touch, taste and smell senses can't be suitable for E-commerce, and a product depends on sight and listen senses can be suitable for E-commerce (Xu and Chen, 2000). However, Brown found that when the product tactile senses can be described on the Internet, consumers will be more likely to purchase (Brown, 2001). Comparing search goods, experience goods and credence goods--based

on whether the consumer can get enough product information before the purchase, Girard found that the search category products are more likely to succeed than the experience and credence category products (Girard et.al, 2002). For search-goods such as CD, books, the consumers can get enough information before the purchase. Bei found that consumers of experience products tended to use more online information than those of search products (Bei, 2004). Because consumers cannot get enough information for experience before the shopping on the net, especially when the important attribute of experience goods is hard to be obtained via the network (Levin et.al, 2005). For those goods whose description information cannot meet consumers' satisfaction, only when consumers have used or experienced the goods, can they know if they get the right things. And this will result in a higher product uncertainty (Hu, Liu and Zhang, 2007). So we can conclude that whether the product can be experienced with and the product information can be available (useful and effective) will influence consumer decisions behavior. On the other hand, the buyer hopes to increase price transparency in the market transactions, so that the seller doesn't provide detailed price information, or doesn't provide price information, which intentionally reduces price transparency, such as "Winner Curse" (Zhang, 2004). Then the complexity of consumer's price perceived is increased, let it difficult to know the real price and fell uncertainty. Therefore, whether the consumer have clearly product cognitive, such as information transparency, price transparency and product experience, will influence consumers' perceived uncertainty and consumers specific asset investment. The more clearly the product cognitive consumers have, the less uncertainty the consumer perceive and less asset investment they spend. We hereby assume that:

**H3a: Under a certain degree of transaction**

**complexity, the product cognition that consumers have will reduce the asset specificity, and has an increasing influence to the latter.**

**H3b: Under a certain degree of transaction complexity, the product cognition that consumers have will reduce the uncertainty, and has an increasing influence to the latter.**

### 2.3 Transaction complexity

Product cognitive describes the idea that clearly recognized product is better for consumer to make buy decisions. But whether the product can be transformed online partly depends on whether the transaction can be practiced, as transaction complexity. A typical characteristics of E-commerce is that consumer buying behavior is conduct by "human-machine" model, which maks E-commerce different with traditional channel in several ways. First, for some commodities (such as real estate sales, luxury goods) or personal recommendations affect the valuation goods (antiques) and personal skills great impact to the completion of the transaction of goods (such as medical services, image consultant, etc.), the involvement of sellers will raise the uncertainty of the product and the uncertainty of the sellers. Second, after paying for the product, consumers can generally receive it immediately if they purchase it at a physical store, except for some special items such as furniture, which need home delivery service, By e-shopping, however, consumers will have to wait for the product delivery, unless the product is downloadable like software and music (MP3), or certain kinds of service such as online banking and online consultation. A delay of delivery not only causes late satisfactio, but also creates uncertainty because consumers will find it difficult predicating the quality of the product (Liu and Wei, 2003) (Hsiao, 2009). So the product deilvery increases the transaction complexity that leads to high uncertainty, consumers may invest specific

asset to reduce perceived risk(Hsiao,2009; Koyuncua and Bhattacharya,2004). Different products need different assessment knowledge. The complexity of products requires professional assessment skills that consumers need to invest specific asset, such as health care products, since consumers cannot do exactly the assessment by themselves, and higher technology or profession skills to identify are needed. Meanwhile, products such as books, electronic products, clothes are easy to be assessed. According the iResearch 2009 Research Report on the Behavior of 3C Online Shoppers in China, 62.5% of Internet users think that no purchase of large home appliances online is because they are not sure about post-sales service(iResearch,2009). Sun pointed that after the product purchase, the product return process, product assurance, and after-sales service are the main sources of consumers' perceived risk (Sun et.al 2005). So we can assure that

**H4a: Under a certain degree of products cognition, transaction complexity will increase the asset specificity, and has an increasing influence to the latter.**

**H4b: Under a certain degree of products cognition, transaction complexity will increase the uncertainty, and has an increasing influence to the latter.**

## 3. Mathematical Model

### 3.1 The relationship of transaction complexity and transaction cost

Based on the assumptions H1 and H4, we derive the relationship between transaction complexity and transaction cost by establishing functional relationships between the transaction complexity, asset specificity, and uncertainty. In this paper, transaction complexity is replaced by  $ti$ , asset specificity is replaced by  $s$ , the level of uncertainty is replaced by  $u$ , transaction cost is replaced by  $tc$ ; Set all functions in the

domain are continuous and second order differentiable (Xu et.al, 2008) .

Based on the assumption (H4a), the functional relationship between transaction complexity and asset specificity can be described as follows:

$$s = s(ti), ti \in [0, +\infty) \tag{1}$$

And,

$$s'(ti) > 0; s''(ti) > 0 \tag{2}$$

Based on the assumption (H4b), the functional relationship betweenof transaction complexity and uncertainty can be described as follows:

$$u = u(ti), ti \in [0, +\infty) \tag{3}$$

And

$$u'(ti) > 0; u''(ti) > 0 \tag{4}$$

The functions (1) and (3) that meet attributes (2) and (4) are described as follows

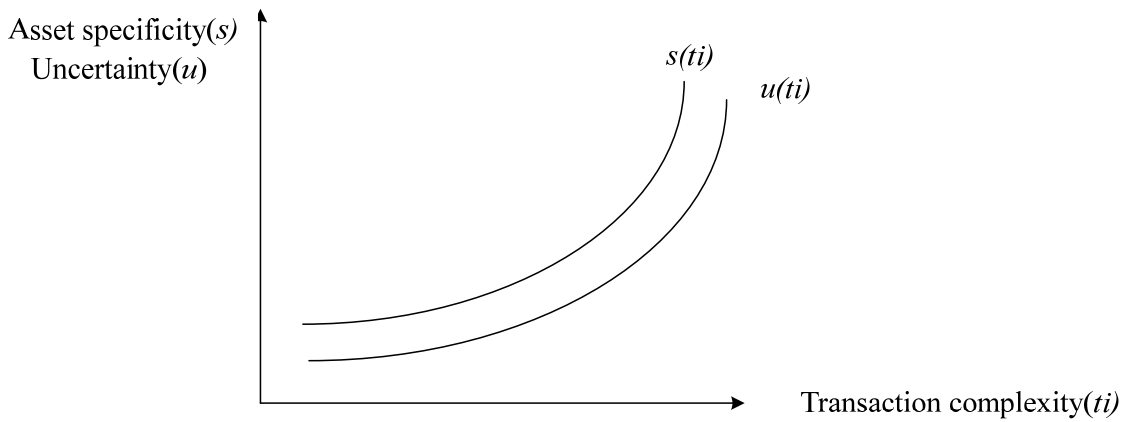


Figure 1: the relationship between transaction complexity, asset specificity and uncertainty

Based on the assumption H1a and H1b, the functional relationships between transaction complexity and various influencing factors can be described as follows:

$$tc = tc(s, u), s, u \in [0, +\infty) \tag{5}$$

In order to facilitate the derivation, we assume that the two factors that affect transaction cost are independent of each other, then (5) becomes:

$$tc = tc(s, u) = tc_1(s) + tc_2(u), \tag{6}$$

where,  $s, u \in [0, +\infty)$ . And

$$tc'_1(s) > 0, tc''_2(s) > 0 \tag{7}$$

$$tc''(ti) = tc''_1 [s'(ti)]^2 + tc'_1 s''(ti) + tc''_2 [u'(ti)]^2 + tc'_2 u''(ti), among, rc \in [0, +\infty) \tag{13}$$

According to formula (7), (2), (8) and (3), in the domain of technical complexity,  $tc'(ti) > 0, tc''(ti) > 0$ , therefore, this function in the  $[0, +\infty)$  is monotone increasing and the concave function, and this function at the 0 point made only

$$tc'_1(u) > 0, tc''_2 > 0 \tag{8}$$

Thus, according to function (1) and (3), the functional relationship between transaction complexity and transaction cost can be described as follows:

$$tc = tc_1(s) + tc_2(u) = tc_1(s(ti)) + tc_2(u(ti)), \tag{9}$$

where  $ti \in [0, +\infty)$ .

Judge the nature and shape of function (9) as follow:

$$tc'(ti) = tc'_1 s'(ti) + tc'_2 u'(ti),$$

therefore,

the minimum.

Therefore, proposition1: higher level of transaction complexity will cause transaction cost to increase gradually. The relationship between of transaction complexity and transaction cost is shown in figure 2.

**3.2 The relationship between product cognitive and transaction cost**

By the same reasoning above we can reach to

proposition 2: the higher product cognitive will reduce the transaction cost. And the relation is shown in figure3:

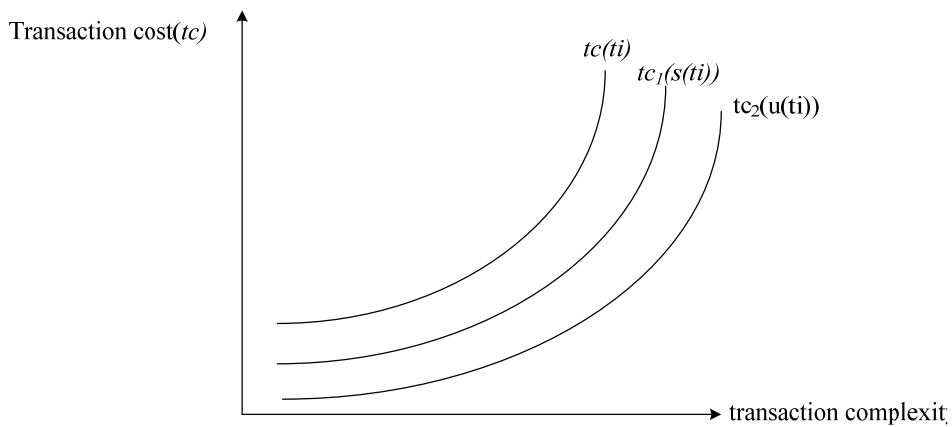


Figure 2: the relationship between transaction complexity and transaction cost

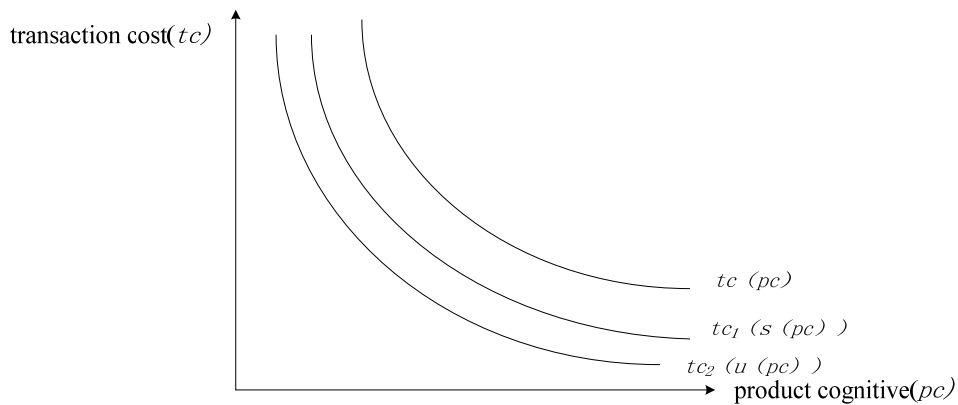


Figure 3: the relationship between product cognitive and transaction cost

**3.3 Transaction complexity and product cognitive on the impact of E-commerce adaptability**

The relationships between transaction complexity and transaction cost (proposition 1), product cognitive and transaction cost(proposition 2) are shown in figure 3. Under certain conditions, the transaction cost below the curve  $tc(ti)$  (the area full of vertical

lines) is lower than the upper part of the curve  $tc(ti)$ . In other words, the higher transaction complexity, the higher transaction cost. With the relationship between transaction cost and E-commerce adaptability (H2), we conclude in proposition 3 that: the higher degree the transaction complexity is, the less suitable it is for E-commerce. Under certain conditions, the product



cognitive below the curve  $tc(pc)$  (the area full of dash lines) is lower than the upper part of the curve  $tc(pc)$ . In other words, the higher product cognitive, the lower transaction cost, and combined with the relationship between transaction cost and E-commerce adap-

tability (H2), it is concluded in proposition 4 that: the higher level the product cognitive is, the more suitable it is for E-commerce.

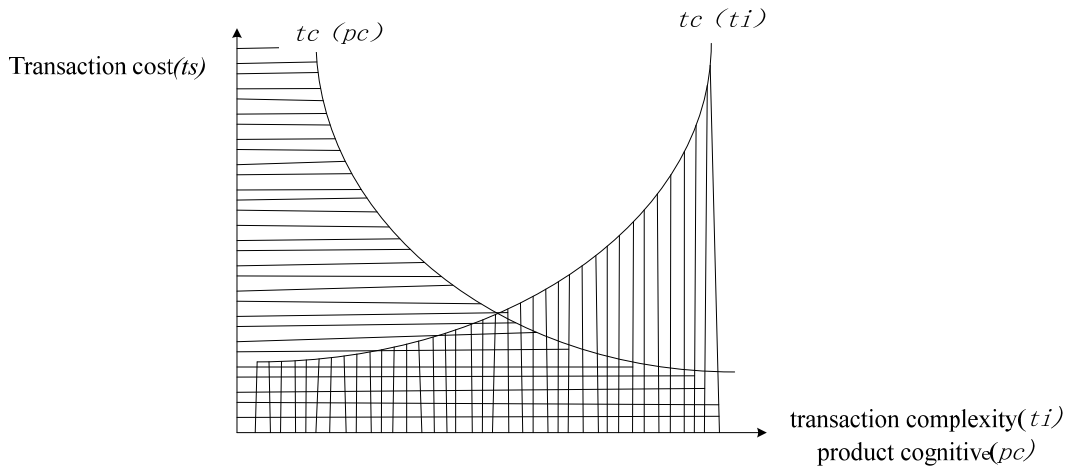


Figure 4: the relationship between transaction complexity, product cognitive and transaction cost

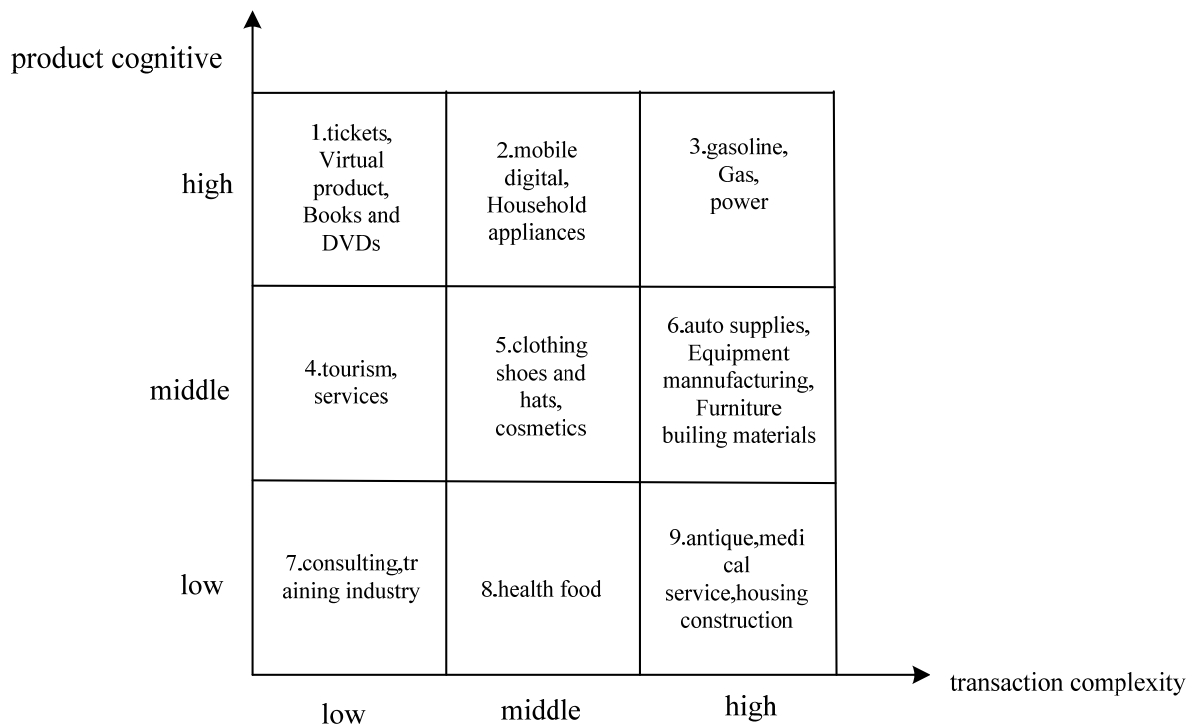


Figure 5: Two dimensional analysis of adaptability to E-commerce

Based on transaction complexity and product cognitive, we can find that it is most suitable for E-commerce in the cross area. In other words, the

lower transaction complexity and the higher product cognitive makes a product more suitable for E-commerce.

Based on the functional relationships between transaction cost, transaction complexity, and product cognitive, we draw a two-dimensional chart of products' adaptability to E-commerce based on dimensions of transaction complexity and product cognitive as Figure 5.

**Phase 1. Virtual product, Books, Records and Tickets: high product cognitive, low transaction complexity.**

For the search goods such as virtual product, books, records and tickets, most of the key attributes can be determined online. Consumers have clear cognitive of the product by the product information and price parameter, the degree of price transparency for those goods is very high, consumers have no bargaining space, and they have no worry about distributors to raise the price deliberately and information asymmetry. Meanwhile, the transaction complexity of such goods is very low, the product doesn't depend on the sellers, can be delivered online by existing logistics, and doesn't need consumers' professional knowledge to assessment it, so consumers perceived low transaction cost. Therefore, those goods are suitable for E-commerce.

**Phase 2. Mobile phones, home appliances, PC: Moderate transaction complexity, high product cognitive**

Those products are also searching goods. Consumer can have clearly cognitive of those product with effective and useful information, such as product pictures, product parameter and third-part information. And the degree of price transparency for those goods is high, and consumers have little bargaining space. However, customers are not able to access complete knowledge about how to assessment the product quality, for some large home appliances, the existing logistics and after-sale support and services cannot meet the product requirement. Consumers perceive moderate transaction cost, so those products need

traditional channel to provide distributions, after-sale support and services and national quality assurance. So for these products, distribution channels of E-commerce and chain stores are coexisting. But the E-commerce is the development trend in future.

**Phase 3. Petrol, Natural gas: High product cognitive, high transaction complexity.**

Those products have high product cognitive, because those products are credence goods which are national standard quality and standard price. However, those product cannot deliver by existing logistics and need consumers' professional knowledge to assessment it, so consumers perceived high transaction cost. Therefore, those goods are not suitable for E-commerce. Consumers have to depend on the traditional channel

**Phase 7. Cosmetics, Clothing: Moderate transaction complexity, Moderate product cognitive**

Those products are experience goods. Consumer are not certain about those products performance by information or picture, and they need to use their senses to evaluate. The level of uncertainty is high in this category. The degree of price transparency for those goods is moderate, and consumers have some bargaining space. Therefore, the product cognitive is moderate. On the other hand, since customers are not able to access complete knowledge to assess the product quality except for experience, consumers' perceived moderate transaction cost, and those products need the traditional channel to provide experience service. Hence for these products, distribution channels of e-commerce and chain store are coexisting. And E-commerce is also the development trend in future.

**Phase 9. Medical services: Low product cognitive, high transaction complexity**

The medical services require professional medical skills and knowledge, and depend on doctors'

treatment. Difference usually exists when a consumer is diagnosed by different doctors. These factors make a low product cognitive and high transaction complexity. However, nowadays many hospitals make some online advertisements and reservation services which are standard.

We therefore conclude that in this two dimensional chart, the more near the product is to the Top Left Corner, the more suitable the product is for E-commerce, and that the more close the product is to the Lower Right Corner, the less suitable the product is for E-commerce. Firms can enhance the adaptability of product to E-commerce by enhancing the product cognitive or by reducing the transaction complexity, or change via both ways. For example, online retailers in Taiwan started introducing a so-called "online purchase, convenience stores picking-up" service several years ago. This kind of picking-up service enables consumers to take a purchase order over the Internet, and then pick up the product ordered at a nearby convenience store appointed by consumers. The density of convenience stores per person in Taiwan is the highest in Asia Pacific's (perhaps highest in the world's), with 0.000357 stores per person or one store per 2800 people (ACNielsen, 2005), which makes such a service practicable. Consumers can even choose not to pay for the product until they pick it up at the convenience store, which lowers the transaction complexity. Such a service has been well received in Taiwan, but it is still limited to certain types of products such as those not perishable or small in size. On the other hand, firms can enhance product cognitive by using difference display ways such as detailed pictures, video and 3-D displays of the product, or by using intangible information such as product brand, credit and assurance, or third-party information such as consumers' reviews, WOM, and so on. Those ways can enhance the product cognitive by changing the experience goods to search goods (Li,

Tan and Xie, 2002; Bae and Lee, 2011; Pana and Zhang, 2011); which is more useful for search goods than experience goods. Amazon.com and Dangdang sell search goods of books, CDs and DVDs, and achieve great success. 360buy.com lowers the transaction complexity by well-designed price assurance and return service, which ensures that consumers can return the product and give back money if they aren't satisfied with the product ordered (Liu and Wei, 2003). VANCL.com and Tmall.com sell experience goods of clothes and cosmetic products by using enhance product cognitive and transaction transparency to improve the payment and delivery process. eBay acquired PayPal in 2002 to enhance its payment function (Wingfield, 2002). eBay also extended its relationships with UPS and the USA postal service to arrange home pickup, online postage calculation, shipping label printing, and package tracking services (Boulton, 2003; Murphy, 2005). These are all successful practices of the two dimensional chart depicting the typology of products suitable for E-commerce.

#### 4. Conclusion

Based on the theory of transaction cost economics, this paper proposes a conceptual model with the two dimensions of the degree of product cognitive and transaction complexity. We try to provide an insight into the question that what product is more adaptable to E-commerce, and also theoretical explanations for successful practices. Examples of using online to sell search goods are Amazon.com and Dangdang.com which sell high cognitive and high transaction complexity goods, such as books, CDs, and DVDs online. 360buy.com sells 3C products which are highly product cognitive and moderate transaction complexity by enhancing transaction transparency and providing national assurance, price assurance, return assurance and so on. VANCL.com and Tmall.com sell

moderate product cognitive and moderate transaction complexity product—clothes and cosmetic product through difference display ways and price assurance, return assurance and so on. According to this paper, the major obstacles for firms are to provide the products that consumer can cognitive though website and the products which can be easily transformed.

The model concludes with the two-dimensional chart depicting that the more near the product is by the Top Left Corner, the more adaptable the product is to E-commerce, and that the more near the product is by the Lower Right Corner, the less suitable the product is for E-commerce. Firms can easily measure what product is more suitable for E-commerce and how to transform a less adaptable product to a more adaptable product. This model provides an easy and useful way for firms' practices to better use E-commerce in the future.

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