EMPIRICAL ANALYSIS OF NETWO APPLICABILITY IN VIETNAMESE

Nguyen Thi Tuong Anh[*]

Abstract

By using data from GSO, the paper investigates the possibility of applying network effect in some industries in Vietnam at firm level. The paper confirms that (1) income of consumer, educational qualification of employee and manager, firm's efficiency are necessary conditions to apply network effect in business effectively; (2) in such industries as telecommunication service, banking, insurance, e-commerce…, network effect applicability is higher than others.

Keyword: *Network effect, Vietnam*

1. Introduction

Network effect (or network externality) was firstly mentioned in late of 20th century in some economics papers. In comparison to other economic theories, network effect is quite new but its influence on economy as well as firm's activities is significant. By creating network effect for their product, firms can earn profit dramatically and exponentially. Hence, all firms are eager to apply it. The questions are what the conditions are to create network effect; which areas are most suitable for network effect; how to evaluate the applicability network effect of a firm (or industry)… To answer above questions, this paper aims to introduce network effect and then, shows how network effect presents in Vietnamese economy. Finally, the paper tests the probability of applying network effect in some industries in Vietnamese economy and points out in which industries network effect would be most applicable.

2 Literature review

At very beginning, Liebowitz, S. J. and Margolis, S. E. in their paper "*Are network effect a new source of market failure*?" in *Research In Law and Economics* 17 (1995) pointed out definition as well as characteristics of network effect. Katz M. L. and Shapiro C. (2000) wrote "*Network externalities, competition, and compatibility*" in *American Economic Review* 75: 1-22 to emphasized the role of network effect in

[*] PhD, Foreign Trade University, (Corresponding Email: tuonganh@ftu.edu.vn)

competition. In another research, S.J. Liebowitz and Stephen E. Margolis continued the topic about network effect through the paper "*Path Dependence, lock-in, and history*" in *Journal of Law, Economics and Organization No 11* to introduce about network market, critical mass and lock-in market. Especially, W. Brian Arthur showed a quite new term, i.e *increasing returns* in "*Increasing Returns and the New World of Business*" in *Harvard Business Review,* July - August 1996. These researches played a very important part in providing a deeper understanding about network effect. However, they just dealt with network effect in theoretical aspect but not practical one with applicability in reality.

On the side of practical application, some researchers built empirical model to see the presence of network effect in a certain market. Pipat Lueprasitsakul in "*Empirical evidence of network externality of Thailand Telephone system"* (1999) about network effect in telecom industry or William P. Osterberg and James B. Thomson in "*Network Externalities: The catch –22 of retail payments innovations*" in *Federal Reserve Bank of Cleveland, Economic Commentary, Cleverland (1998)* about network effect in e-banking or Atip Asvanund, Karen Clay, Ramayya Krishman, Michael D. Smith wrote "*An Empirical Analysis of Network Externalities in Peer-to-peer Music-Sharing Networks*" in *Information Systems Research*, 2004 are typical authors of this topic. Meanwhile Pipat said that price of access, price of use and number of subscribers are determinants in creating network effect in telephone market, Asvanund added one more determinant, i.e user's incentives in network design

However, the above researches just mentioned about one certain market but not various goods (markets). The presence and the effectiveness of network effect in economy are rarely dealt with. Moreover, to design network effect for many industries in general, what are the needed conditions? How to evaluate the applicability of network effect in these industries? How to identify the most efficient industry in designing and applying network effect? This paper aims to give out some fundamentals about network effect, shows how network effect plays in Vietnamese enterprises as well as points out the most potential areas for network effect applicability.

3 Fundamental about network effect

3.1. Definition

"*Network effect*", an economic phenomenon, is defined as the added benefit that a consumer can get from a product when there are more people consume that product (Michael Katz and Carl Shapiro, 1985). In other word, network effect appears when the value of a product depends on or has positive relationship with the number of its users - more users means more benefits for each user in the market. When benefit of each consumer increases gradually, there would be more people want to join into the market. This, in turn, helps to increase the benefit of both insiders and new comers. Finally, more customer means supplier's profit will increase exponentially.

Besides, network effect can be seen in a wider definition as an added value a consumer gets from an action when other people have the same action with him (S.J. Liebowitz and Stephen Margolis, 1995).

A classic and typical example for "network effect" is network created by fax machine users. In the market, if there is only one user, a fax machine has no value because it can not help contact other people. When the second person joins into the market, these two people

can contact with each other and at that time, fax machine is a tool for communication. More people in the network means more benefit for users because they can easily contact with many other people. Two people can create one connection, five people have 10 connections and 12 people with fax machine have 66 connections. Generally, n people in the network will create $\frac{n(n-1)}{2}$ connections. So, if a person is considering a tool to communicate with other people, he will choose the one which helps him to contact as many people as possible. Determinants in his demand function at that time are not only the quality of the product or service from the supplier but also the number of current and potential customers in the network (Asvanund, 2004).

3.2. Classification

Network effect has two types: direct and indirect network effect (Michael Katz and Carl Shapiro, 1985; Nicholas Economides, 1996).

Direct network effect happens when the increase in the number of consumers directly leads to the increase in the value of that good or service. Internet, telephone or fax machine are examples for this type. It is the case where the product meets the common standard (common language) and is accepted by the users. Direct network effect will become bigger when the scale of the network expands and users can contact more people. In example of fax machine, if we have *n* users, the number of connections that user *i* can create equals to the number of connection that user *j* creates, i.e *(n-1)* connections. Hence, more users means more connections.

Indirect network effect appears when the value of a product increases if the number of complementary goods or services increases. ATM card and ATM station is a typical example. The benefit of ATM card owner increases when there are more ATM stations, so that he can draw cash anywhere easily. This makes potential users feel that using ATM card is comfortable and it will attract more users to the network. More users urge supplier to set up more stations and when there are more stations, drawing money is easier and benefit of users increases acordingly.

3.3. The origin

Neither the product nor consumers nor producer creates network effect. It exists thanks to the interaction between customers, between products in the same network. To build this interaction, there are four main elements: (1) the expectation (desire) from consumers; (2) the cooperation among consumers and cooperation among producers; (3) technical compatibility and (4) transition cost to change to another product/supplier.

Consumer's expectation: For certain products, benefit of a consumer depends on the number of buyers, therefore, when a customer is making a choice, his expectation directly affects total revenue of that product or complementary goods for it. If customer expects that more customers makes benefit of each user in the network increases, he will buy that product. Otherwise, he will not.

Firms compete with each other; therefore, they try to take advantage of consumer's expectation to maximize profit, especially when information in the market is asymmetric. They usually over-estimated their revenue to make customer misunderstand that they are the leader in the market.

Cooperation, by its own way, can create network effect. The cooperation between consumers will bring two things. First, if consumers can coordinate with each other, the risk of choosing wrong network will be lower.

Second, if they cooperate with each other to choose the same type of product, the network will be very big. Besides, the cooperation among producers is also very effective. This technical cooperation happens when producers come to agreement to create the compatibility for their products. More attracted customers means more opportunity to expand the network.

Technical compatibility between two products appears when the cost for them to operate together is zero. This needs the agreement in advance from firms to have compatible products. Moreover, market itself pushes producers to produce compatible products to access consumers easier.

Transition cost means the cost consumer has to pay to move from one network to another. This helps to create network effect because it acts as a barrier to keep consumers from running to another network. Without this cost, changing supplier will be very easy and whenever a new and better supplier appears in the market, consumers will easily run after this new comer to search higher benefit. Hence, network effect will no longer stay with the old supplier. With transition cost, customer must consider carefully before changing the supplier and network. Big network effect means high transition cost and vice versa.

3.4. Conditions to apply network effect

When a product has network effect, it attracts more and more customers and hence, brings huge and exponent profit to the firm. Therefore, all firms want to create network effect for their product. The question is how to create network effect or what are conditions to maintain network effect for a product?

There are 2 groups of conditions: external and internal conditions. About *external conditions*, they are: (1) the development of infrastructure, especially the development of telecommunication industry; (2) income of consume or the willingness to buy of consumer; (3) government's investment in technology, especially high technology and (4) the development of venture investment in economy.

About *internal elements*, or elements belong to the firm itself, the conditions are: (1) the quality of human resource, both employer and employee; (2) firm's investment in research and development (R&D) and (3) the effectiveness of firm's activities, measured by firm's annual profit.

From these conditions, it may be forecasted that network effect can be applied most efficiently in some industries, which apply high technology, i.e, telecom industry, e-banking, e-commerce… Hereinafter, the paper will investigate the above hypothesis by answering the research question "what is the applicability of network effect in telecom industry, e-banking, e-commerce… in Vietnam's economy"

4. Empirical model

4.1. The model

There are 3 methods to estimate an empirical model where dependent variable is dummy:

+ The linear probability model

+ Logit model

+ Probit model

In this case, with the research question "what is the possibility of network effect application in telecom industry, e-banking, e-commerce… in Vietnam's economy", the most suitable model is either Logit or Probit model. These two model are similar to each other (Gujarati, 2004, page 614-615), therefore, the author decided to choose the Logit model to answer the above question.

In Logit model, probability p_i is determined

as:

$$p_i = \frac{e^{\beta_1+\beta_2 X_{2i}}}{1+e^{\beta_1+\beta_2 X_{2i}}} = \frac{e^{X_i\beta}}{1+e^{X_i\beta}} = \frac{\exp(X_i\beta)}{1+\exp(X_i\beta)} \quad (*)$$

$X=(1,X_2)$; $X_i=(1,X_{2i})$; $\beta'=(\beta_1, \beta_2)$

In this model, *X* and *β*'s value range from -∞ to +∞ and *p* receives value from 0 to 1.

The general model is:

S = F(LnProfit, Education, R&D, Manager, Location)

In which

S: Sector

=1 if industry with code 4791 (e-commerce), 61 (telecomunication), 649 (banking), 651 (insurance)

*=0 if other industries (*based on Vietnam industries classification system in 2009*)*

LnProfit: Firm's profit, higher profit means firm operates more efficiently and vice versa.

Education: educational qualification of employees,

= 1 if college level or higher

= 0 if other

R&D: Firm's spending on research and development (R&D)

Manager: educational qualification of manager

= 1 if graduate level or higher

= 0 if other

Location: cities/provinces

=1 if Hanoi, Hochiminh city, Danang, Haiphong and Cantho (national cities)

= 0 if others

Location was chosen with implication that it stands for income per capita. According to the statistics from GSO, income per capita in national cities is always higher than in other cities (provincial cities), and hence, becomes an advantage in applying network effect.

4.2. Hypothesis

- Higher profit brings higher possibility of successful network effect application for firms in telecom industries, e-banking, e-commerce… than other industries in Vietnam economy

- Higher educational qualification of managers brings higher possibility of successful network effect application for firms in telecom industries, e-banking, e-commerce… than other industries in Vietnam economy

- Higher educational qualification of employees brings higher possibility of successful network effect application for firms in telecom industries, e-banking, e-commerce… than other industries in Vietnam economy

- Applying network effect in higher income location, i.e. national cities brings higher possibility of successful network effect application for firms in telecom industries, e-banking, e-commerce… than other industries in Vietnam economy

4.3. Data

Data in the model were taken from the survey of 65.536 firms in all sectors of the economy in the year 2009. This is an annual survey conducted by GSO about the performance of firms during a year. The quality of the feedback depends on the willingness of firms to answer the questionnaires and hence may be different from years. In the year 2009, 65.536 firms were invited to join in the survey but just more than 600 firms answered the question about firm's investment in R&D. Therefore, data about this index is biased in comparison with other indexes and the author decided to drop this variable in the model.

4.4. Result

With chosen model, Stata 10 revealed the following result:

The result in the table shows that all variables in the model are significant. From the value of β, we can calculate the probability of each variable as follows (Nguyen Quang Dong, 2009, page 45-46):

- For profit (LnProfit), β=0,164, hence .

$$p = \frac{e^{0,164}}{1+e^{0,164}} = \frac{1,178}{1+1,178} = 0.54$$

This means when profit in telecom industries, e-banking, e-commerce… increases by 1%, the probability of successful application for network effect in these industries is 54% in comparison with other industries.

Dependent variable: Sector	**(1)** OLS	**(2)** Logit	**(3)** Probit
LnProfit (a)	0.000458***	0.164***	0.0460***
	(6.07)	(5.73)	(4.66)
Education (b)	0.0000777***	0.0230***	0.00778***
	(11.40)	(9.93)	(9.69)
Manager	0.00779***	0.754***	0.300***
	(7.60)	(3.28)	(3.45)
Location	0.000154	0.0531	0.000408
	(0.35)	(0.30)	(0.01)
Constant	-0.00161***	-7.750***	-3.335***
	(-4.30)	(-40.86)	(-55.73)
Observations	81291	81291	81291
R^2	0.004	0.0794	0.0760
Adjusted R^2	0.004		

Note: **, **, *** indicate significance at a 10%, 5% and 1% level respectively. T-stat displays in the parenthesis*

For the educational qualification of employees (Education), β = 0,023, p=50,56%, means if the number of employees with college level in telecom industries, e-banking, e-commerce… increases by 1%, the probability of successful application for network effect in these industries is 50,56% in comparison with other industries.

For the educational qualification of managers (Manager), β = 0,754, p=68%, means if the number of manager with graduate level in telecom industries, e-banking, e-commerce… increases by 1%, the probability of successful application for network effect in these industries is 68% in comparison with other industries.

For income of consumers (Location), β=0,0531, p=51,34% means if apply network effect in national cities, where income per capita is higher than other provinces, the probability of

successful application for network effect telecom industries, e-banking, e-commerce…is 51,34% in comparison with other industries.

This result shows that the hypothesis of the model is correct, i.e, higher profit, higher educational qualification, hgher income bring higher possibility of network effect application for firms in telecom industries, e-banking, e-commerce… than other industries in Vietnam economy.

Logit and Probit model are not so different from each other, hence, the coefficient in Probit model can be calculated by multiplying the coefficient in Logit model with 1,81 (Gujarati, 2004, page 615). The author will not calculate the coefficient of Probit model and consider that the result of these two model are the same in terms of statistic.

To Vietnamese enterprises, network effect is relatively new. However, some of them already gradually applied and gained some fruits, especially firms in telecom industries, e-banking, e-commerce… such as Viettel, Mobiphone, Vinaphone, ATM system of Vietnamese banks, groupon websites like www.muachung.com or www.nhommua.com. We do hope that in the near future, network effect will be applied more in businesses and contribute more to the development of the economy.❑

References

1. W. Brian Arthur, Positive Feedbacks in the Economy, *Scientific American*, 262, 92-99, Feb.1990
2. W. Brian Arthur, *Increasing Returns and the New World of Business*, Harvard Business Review, July-Aug.,1996
3. Atip Asvanund, Karen Clay, Ramayya Krishman, Michael D. Smith, An Empirical Analysis of Network Externalities in Peer-to-peer Music-Sharing Networks, *Information Systems Research*, Linthicum:Jun 2004, Vol.15, Iss,2; pg.155, 20 pgs

4. Caroline Boivin, Desire Vencatachellum, RD in Markets with Network Externalities, *Economics Bulletin*, Vol 12, No 9 pp.1-8, 2002, http://www.economicsbulletin.com/2002/volume12/EB-02L0002A.pdf

5. A. Chevalier, The pros and cons of entering a market, *Judith Financial Times* November 1, 1999, Monday survey MST1, pg.5

6. Nguyen Quang Dong, *Advanced Econometrics,* Science and Technology Publishing House, 2009

7. Nicholas Economides, The economics of Networks, September 1995, *International Journal of Industrial Organization* vol.14, no 2 (March 1996)

8. Nicholas Economides, Durable Goods Monopoly with Network Externalities with Application to the PC Operating Systems Market, *Quarterly Journal of Electronic Commerce*, vol.1, no.3, 2000

9. W. Brock Gerald, Spatial economic analysis of telecommunications Network Externalities, *Journal of economic Literature*, Nashville: Mar1996. Vol.34. Iss.1; pg.170, 2pgs

10. D. N Gujarati., *Basic Econometrics*, The Mc Graw Hill Companies, 2004

11. M.L. Katz and C. Shapiro, 1985, Network Externalities, competition, and compatibility, *American Economic Review*, Vol75, pp.424-440

12. Tokuri Kikuchi, Network Externalities as a source of comparative advantages, Kobe University, *Economics bulletin*, Vol.6, No.7 pp.1-9, 2005, http://www.economicsbulletin.com/2005/volume6/EB-05F10003A.pdf

13. S.J. Liebowitz and Stephen E. Margolis, Network Externality: An Uncommon Tragedy, *Journal of Economic Perspectives*, Volume 8, No.2, Spring 1994

14. S.J. Liebowitz và Stephen E. Margolis, Are Network Externalities a new source of market failure?, S.E. 1995b, *Research In Law and Economics* 17:1-22

15. Pipat Lueprasitsakul, Empirical evidence of network externality of Thailand Telephone system, *NIDA paper*, The National Institute of Development administration, 1999

16. Joana Stavins, Network Externalities in the market for Electronic Check payments, *New England Economic Review*, Boston: 2003, pg.19