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Technology Transfer in the Intermediate Goods: One Case in Vietnam

Thi Hoang Oanh Nguyen[1], Thi Thuy Linh Duong[2]

[1,2]*The Department of Economics, Thainguyen University of Technology, Vietnam*

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Abstract *- Vietnam has to integrate into the international economy and take part in the global supply chain. Therefore the importation of intermediate goods from foreign providers is inevitable. However, the input supplies initiative helps Vietnamese firms reduce the dependency on the foreign supplies and make productive plans actively. This paper finds the conditions that a foreign firm-a a technology owner- becomes a licensor, and a state-owned enterprise (SOE) becomes a licensee in a good intermediate market. In contrast, the foreign firm competes with the SOE in the input market and a domestic downstream firm in the Cournot fashion's final market.*

Keywords *- Technology transfer; licensee; licensor; profit; social welfare.*

I. INTRODUCTION

Improving competitive ability and enhancing participation in the global supply chain by technology transfer are firm-level and country-level purposes. Vietnam has reformed, opened its economy, and integrated with the international economy for nearly three decades. During this period, Vietnam has got some successes. The opening index increased from 20% to 173% in 1985-2015, GDP per capital increased from $98 to above $2100 during 1990-2015 (World Bank). Vietnam has had a trade relationship with over 240 countries and territories (Vietnam Chamber of Commerce and Industry-VCCI). Two of the largest trade partners are China and the United States of America. The trade flows between Vietnam and two of these partners change overtime differently, however.

During twenty years (1995-2015), trade flows with the two biggest partners could separate into two periods. Firstly, from 1995 to 2000, net trade values (export minus import values) between Vietnam-China and Vietnam-U.S. were the same trend and values. In contrast, the opposite net trade values between Vietnam-China and Vietnam-U.S. exited after 2000. While net trade with the U.S. was surplus, net trade with China was the deficit. Especially, the total deficit value is greater than the total surplus one. For example, in 2014, net trade with United State was $22347.7 million, whereas one with China was negative $28719.3 million (General Statistics Office of Vietnam-GSOV)

Secondly, in the supply chain, intermediate goods and final goods between Vietnam and China have special characteristics. The trade inflow of intermediate goods from China increased eighty-three folds, trade outflow of intermediate goods to China increased sixty-three folds over ten years (1998-2008). Importantly, exporting intermediate goods to China only was $3.55 million, while from China it was $10.42 million in 2008. In the final market, exporting value to China increased nineteen folds and exporting value to Vietnam increased sixteen folds (1998 – 2008 (Ha Thi Hong Van – Intermediate goods trade between Vietnam and China).

Should domestic firms import all inputs from foreign countries or supply themselves actively in the integration process to an integrated international world? Is establishing an upstream firm by licensing from foreign firms a useful choice? And what kind of upstream firm the host country should build, private or public or mixed?

Related technology transfers and good intermediate trade, we can easy to find numerous kinds of literature. Spencer and Ronald (1991) find that the vertical firm's decision is significantly affected by domestic supply conditions of inputs supplied by a foreign firm and foreign country. In contrast, the foreign firm competes with the domestic firms in the final good market in the Cournot or Bertrand model. Wang (1998) finds that royalty licensing can be superior to fixed-fee licensing for the patent-holding firm when the cost-reducing innovation is non-drastic. Wang (2002) analyzes and compares two licensing cases: means of a fixed-fee and means of royalty in a differentiated Cournot duopoly model. The results show the different preferential between firms holding the patent and the consumers in choosing the means. Arijit and Enrico (2006) analyze the choice of exclusive owners of advanced technology licenses to a foreign firm or domestic firm in the host country. If the host country uses tariff commitments, it

gains more from the increased competition if it can induce the foreign incumbent to transfer technology to the host country firm. Lemarié (2005) uses the case a patent holder as an upstream firm who can license its innovation to some downstream companies that compete on a final market with differentiated products and means of a license. Both fixed fee and royalty show that the royalty works better with vertical integration. Chang (2005) shows the optimal level of privatization depends crucially on the strategic substitutability-complementarity assumption and Cournot competitor or a Stackelberg leader in a mixed duopoly. A public home firm competes with a more efficient foreign firm.) Chang et al. (2013) conclude that an outside innovator's optimal licensing strategy is a royalty contract with a non-exclusion licensing case. It considers vertically-related markets where the outside innovator transfers new technology. The role of supplying intermediate goods on time is the key to creating comparative advantage sources. Gamberoni et al. (2010) suggest that the institutions should invest in the infrastructure and foster trade facilitation to boost a country's participation in production networks to get this comparative advantage.

Soo (2018) builds up a model of intermediate and final goods trade based on comparative advantage. The author finds that firms are more beneficial if they produce final and intermediate goods than if they only produce final goods. Wang and Zeng (2019) find that in a mixed duopoly, the privatization is different in cases of the licensing to the public firm and private firms, where the former reduces the and the latter increases incentive for privatization compared to the situation without licensing. The relationship between privatization and licensing also is analyzed by other authors such as Chen et al. (2014), Chen et al. (2018), Wang, Arijit, and Zeng (2020), etc.

This paper analyses the conditions of technology transfer in the input market. The host country amounts the social welfare to build up an SOE that competes with a foreign firm that owns patents by offering a fixed fee in Cournot competition. The foreign firm agrees to be a licensor if the host country commits the degree of privatization at least as equal to a positive level, meaning that the host country cannot build up an SOE full nationalization. The ratio of market size and the marginal cost of foreign firms is the key factor that the host country decides to be in license regime and capacity of absorbing of the SOE is at least three over ten.

This paper's remainder is organized as follows: Section 2 outlines the model and shows technology sold by the foreign licensor in the fixed-fee games; section 3 is the conclusions.

II. MODEL

The model is linear demand function $p = a - q_1 - q_2$ where p is the market price, a is market size, q_1 and q_2 are quantities of firm 1 and firm 2, respectively. Firm 1 is a foreign upstream firm producing both final goods and intermediate goods and owns the technology. Firm 2 is a domestic firm in the host country and imports intermediate goods from firm 1. The technological capacity is simplified by assuming that one intermediate product unit can produce one unit of the final product. Therefore none of the other factors is needed in the production process. Firm 1 produces the final goods at the constant marginal cost c_1, and zero for intermediate goods. The host country offers a fixed fee to firm 1 for the technology transfer. If firm 1 rejects, we move to the sub-game so-called non-license regime, where firm 1 decides the input's price and firm 1 and firm 2 compete in the final good market by using Cournot competition. If firm 1 accepts, we move to the sub-game so-called license regime. The host country establishes an SOE that produces intermediate goods, supplies those to firm 2, and determines the optimal privatization. Firm 1 competes with SOE in the input market and competes with firm 2 in the final good market by using Cournot fashion. In the host country, social welfares are firm 2's profit and firm 2's profit plus SOE's profit, respectively rejecting and accepting technology transfer.

A. Non-license regime

The sub-game equilibrium incorporates two stages of decision. In stage 1, firm 1 decides the price v charge its rival for the input, equivalent to the quantity x_1 which it exports the input at this stage. In stage 2, the number of final products is determined by Cournot competition. R_1^N, R_2^N, W^N are firm 1, firm 2's profit, and the host country's social welfare, respectively.

The total profit of firm 1 from exporting the number of final products q_1 and inputs x_1 (x_1 equals to q_2 in this model) and the total profit of firm 2, which purchases x_1 at a price, v to produce q_2 are expressed in Equations (2.1) and (2.2) as follows:

$$R_1^N = p\,q_1 - c_1\,q_1 + v\,q_2 \tag{2.1}$$

$$R_2^N = p\,q_2 - v\,q_2 \tag{2.2}$$

At stage 2, we apply the Cournot equilibrium for the final goods, and firm 1 sets its output q_1 to maximize (2.1), given v, similarly firm 2 sets its output q_2 to maximize (2.2), given v. The first-order conditions (using subscripts to represent partial derivatives) are

$$\begin{aligned} &\frac{\partial R_1^N}{\partial q_1} = a - c_1 - 2q_1 - q_2 = 0 \ ; \\ &\frac{\partial R_2^N}{\partial q_2} = a - q_1 - 2q_2 - v = 0 \end{aligned} \tag{2.3}$$

The second-order conditions for profit maximization hold, and the Cournot equilibrium is unique if and only if $R_{11}^N < 0$; $R_{22}^N < 0$ and $H = R_{11}^N R_{22}^N - R_{12}^N R_{21}^N > 0$, where R_{11}^N and R_{22}^N is the second derivative of R_1^N and R_2^N; R_{12}^N and R_{21}^N are firm 1 and firm 2 marginal profit decline with an increase in

the other firm's number of products. (2.3) is reaction functions of firm 1 and firm 2 and interaction point between them is the firms' Cournot equilibrium quantities:

$$q_1 = \frac{1}{3}(a - 2c_1 + v) \quad ; \qquad q_2 = \frac{1}{3}(a + c_1 - 2v) \tag{2.4}$$

To make q_2 is positive, the condition of input's price v must be less than $\frac{(a+c1)}{2}$

Now we consider the input price choice that firm 1 charges its rival for input in stage 1. Considering the second-stage relation, firm 1's profit is a function of the input price v.

$$R_1^N = p\,q_1 - c_1\,q_2 + v\,q_2 \tag{2.5}$$

Easy to get the first and second condition maximizes (2.5) concerning v and the optimal input price firm 1 charge is

$$v = \frac{1}{10}(5a - c_1) \tag{2.6}$$

Firm 2 will compete with firm 1 in the final good market corresponding with the optimal input price if the marginal cost to produce the final goods of firm 1 is positive. Quantity demanded the price of final goods, firm 1 and firm 2's profits and social welfare in the host country are as following:

$$q_1 + q_2 = \frac{1}{10}(5a + 3c_1) \; ; \; p = \frac{1}{10}(5a - 3c_1) \tag{2.7}$$

$$R_1^N = \frac{1}{20}(5a^2 - 10ac_1 + 9{c_1}^2) \; ; \; R_2^N = \frac{4{c_1}^2}{25} \; ; \; W^N = \frac{4{c_1}^2}{25} \tag{2.8}$$

Proposition 1: 1. The optimal of output's price and quantity demanded, and input price is $p = \frac{1}{10}(5a - 3c_1)$; $q_1 + q_2 = \frac{1}{10}(5a + 3c_1)$;$v = \frac{1}{10}(5a - c_1)$, respectively. 2. Firm 1 and Firm 2's profits maximized are $R_1^N = \frac{1}{20}(5a^2 - 10ac_1 + 9{c_1}^2)$; $R_2^N = \frac{4{c_1}^2}{25}$, respectively.

If firm 1's marginal cost is very small, it will reduce the intermediate quantities supplied to firm 2 or charge with a higher price as a monopolist, and firm 2 exits in the final good market.

B. License regime

In this model, we assume that the SOE tries to maximize the objective function negotiated between the two types of shareholders. The function consists of profit and welfare components. The sequence to move in this model includes four stages. In stage 1 host country offers a fixed fee to firm 1; in stage 2, the host country decides the optimal degree of privatization of the SOE; in stage 3, firm 1 and SOE compete with each other in the input market; and in stage 4, firm 1 and firm 2 compete in a final good market.

In stage 4, firm 1 and firm 2 compete in the final good market. Objective functions of the two firms as follows,

$$R_1^L = p\,q_1 - c_1\,q_1 + vx_1 + f; \quad R_2^L = p\,q_2 - v\,q_2 \tag{2.9}$$

where R_1^L and R_2^L are profit functions of firm 1 and firm 2; q_2 is the number of inputs which is bought from firm 1 and SOE, and it is equal to x_1 plus x_2 (x_2 is supplied by SOE), and f is a fixed fee for licensing.

The first and second conditions to maximize two functions in (2.9) and unique solution conditions are the same in sector 2.1. The firms' Cournot equilibrium quantities q_1 and q_2 are the same (2.4). We move to stage 3, where SOE produces inputs and competes with firm 1 in the input market. Let the home country's social welfare be W^L, and it is equal to firm 2's profit plus SOE's profit. Where SOE's profit is so-called R^{SOE}

$$R^{SOE} = vx_2 - \frac{d(x_2)^2}{2} - f \tag{2.10}$$

$$W^L = R_2^L + R^{SOE} \tag{2.11}$$

where x_2 quantity input produced by SOE and $q_2 = x_1 + x_2$; the SOE's marginal cost is an increasing function, d is constant (the efficiency of absorbing technology transfer). From the optimal output of firm 2, we have the inverse derived demand for input is as Equation (2.12):

$$v = \frac{1}{2}(a + c_1 - 3(x_1 + x_2)) \tag{2.12}$$

The objective function of the SOE is a negotiated outcome between public and private shareholders, which is a share-weighted average of their objectives:

$$Y = g\,R^{SOE} + (1-g)W^L \tag{2.13}$$

Where g is the fraction of private ownership of the SOE. The degree of partial privatization increases when g is greater, and the firm becomes more profit-oriented. SOE chooses x_2 to maximize Y and firm 1 chooses x_1 to maximize R_1^L when competing in the input market by Cournot competitor. The first-order conditions are as follows:

$$\frac{\partial R_1^L}{\partial x_1} = c_1 - \frac{5x_1}{2} - x_2 = 0 \qquad \frac{\partial Y}{\partial x_2} = \frac{1}{2}(a + c_1 + x_1 - 4gx_1 - 2(1 + d + 2g)x_2) = 0 \tag{2.14}$$

We are easy to find the second-order and unique solution conditions to maximize firm 1's profit and SOE's objective function. From reaction functions of firm 1 and the SOE, we find Cournot equilibrium quantities and the price of the input which is exchanged in the input market as follows:

$$x_1 = \frac{-a+c_1+2c_1d+4c_1g}{6+5d+6g} \; ; \; x_2 = \frac{5a+7c_1-8c_1g}{12+10d+12g} \; ; \; v = \frac{a+c1}{2} - \frac{3(3a+c_1(9+4d))}{4(6+5d+6g)} \tag{2.15}$$

Note that foreign firms become the licensor if the host country commits to private SOE at least as gmax, where gmax is the degree of privatization of SOE to make sure $R^L{}_1 - R^N{}_1 \geq 0$ (difference of its profit between non-licensed and license).

We move back to stage 2, where the SOE determines the optimal privatization level to maximize social welfare in the host country. Social welfare function is expressed in Equation (2.16) as follows:

$$W^L = \frac{1}{8(6+5d+6g)^2}\left(-8f(6+5d+6g)^2 + a^2(33+25d+60g) + 2ac_1(27+19d+12(5-4g)g) + {c_1}^2(57+81d+32d^2+4(51+32d)g-32(3+2d)g^2)\right) \quad (2.16)$$

The first-order condition to maximize social welfare is

$$\frac{\partial W^L}{\partial g} = -\frac{(3a+c_1(9+4d))(a(3+30g)+c_1(-15+66g+8d(-2+5g)))}{2(6+5d+6g)^3} = 0 \quad (2.17)$$

The second-order condition is

$$\frac{\partial^2 W^L}{\partial g^2} = -\frac{(3a+c_1(9+4d))(c_1(333+d(429+100d-240g)-396g)+3a(2}{(6+5d+6g)^4} \quad (2.18)$$

Proposition 2: The optimal degree of privatization is $g = \frac{-3a+c_1(15+16d)}{30a+66c_1+40c_1d}$; it has a positive relationship with the marginal cost of firm 1 and the SOE efficiency and negative relation with the market size.

The market size increases, social welfare increases if the marginal cost and the efficiency of absorbing the SOE are constant; however, quantity equilibrium increases, which means that SOE's part in the objective function is higher. To stimulate competition when the SOE and firm 1 are low, the host country should increase the home firm's privatization ownership.

Concerning the optimal degree of privatization in stage 2, the quantity input equilibrium of firm 1 and SOE and input's price is as follows:

$$x_1 = \frac{-5a+c_1(7+10d)}{27+25d}\ ; x_2 = \frac{25a+19c_1}{54+50d}$$
$$v = \frac{-5c_1(9+2d)+a(9+50d)}{4(27+25d)} \quad (2.19)$$

Therefore, $a < \frac{c_1(7+10d)}{5}$ must hold to be sure x_1 positive. The outputs of final goods concerning the optimal degree of privatization and input quantities are expressed in Equation (2.20).

$$q_1 = \frac{39a-87c_1+50ad-70c_1d}{108+100d}$$
$$q_2 = \frac{15a+33c_1+20c_1d}{54+50d} \quad (2.20)$$

From (2.18) $a > \frac{87c_1+70c_1d}{39+50d}$ must hold to have positive q_1. To sum, we have

$$\frac{87c_1+70c_1d}{39+50d} < a < \frac{c_1(7+10d)}{5} \quad (2.21)$$

to make sure x_1 and q_1 positive. And $d > \frac{3}{10}$ must hold to make (2.19) being reasonable.

In stage 1, the host country offers a fixed fee to the foreign firm, and the foreign firm accepts to transfer technology for the host country if the difference between $R_1^L - R_1^N$ is at least as equal to zero. This difference is expressed in Equations (2.22) and (2.23).

$$R_1^L - R_1^N = -\frac{(25a+19c_1)(5a(63+100d)-c_1(279+100d))}{80(27+25d)^2} + f \quad (2.22)$$

$$f = \frac{(25a+19c_1)(5a(63+100d)-c_1(279+100d))}{80(27+25d)^2} \quad (2.23)$$

There fixed fee f at least is equal to (2.23) to the foreign firm accept to be the licensor. Social welfare in this regime is

$$W^L = \frac{1250ac_1(9+2d)-125a^2(9+50d)+{c_1}^2(18531+10d(2279+800d))}{80(27+25d)^2} \quad (2.24)$$

Proposition 3: In the licensing regime, firm 2's output and the host country's social welfare are $q_2 = \frac{15a+33c_1+20c_1d}{54+50d}$; $W^L = \frac{1250ac_1(9+2d)-125a^2(9+50d)+{c_1}^2(18531+10d(2279+800d))}{80(27+25d)^2}$.

Firm 2's output and the host country's social welfare not only depends on firm 1's marginal cost c_1 but also on the market size a, differs from the result in Proposition 1.

However, the host country only offers the fixed fee f if social welfare after licensing is greater than social welfare in the non-license regime. This condition is held if $W^L - W^N \geq 0$. The difference of social welfare between the non-license and the license is expressed in Equation (2.25).

$$W^L - W^N = -\frac{(25a+19c_1)(25a(9+50d)-c_1(2421+1450} {400(27+25d)^2} \quad (2.25)$$

$W^L - W^N \geq 0$ is held if $a < \frac{c_1(2421+1450d)}{(9+50d)}$ holds, combining with (2.19), the ratio between market size and the marginal cost of firm 1 equivalently satisfies to have technology transfer in equilibrium.

$$\frac{87+70d}{39+50d} < \frac{a}{c_1} < \frac{(7+10d)}{5} \text{ and } \frac{a}{c_1} < \frac{(2421+1450d)}{(9+50d)} \quad (2.26)$$

Proposition 4: The condition of the ratio between market size and marginal cost is the deciding factor in making sure the host country to found an SOE to produce input, and this condition is $\frac{87+70d}{39+50d} < \frac{a}{c_1} < \frac{(7+10d)}{5}$ and $\frac{a}{c_1} < \frac{(2421+1450d)}{(9+50d)}$. And (2.19) is reasonable if d>3/10.

Diagrammatically, the regime between two lines is where the government in the host country will license. Otherwise, the government should not build up the upstream industry, as shown in fig.2.

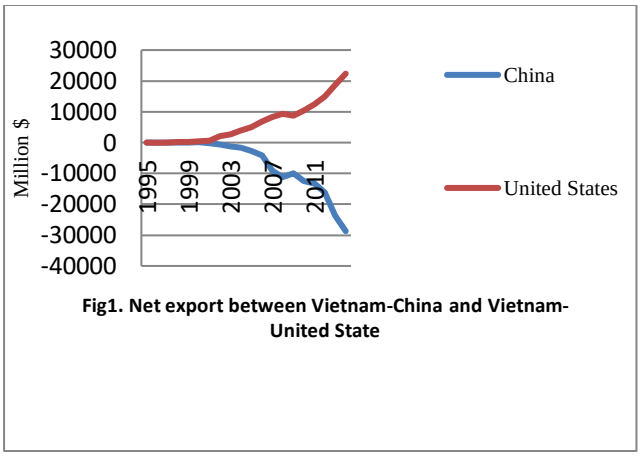

Fig1. Net export between Vietnam-China and Vietnam-United State

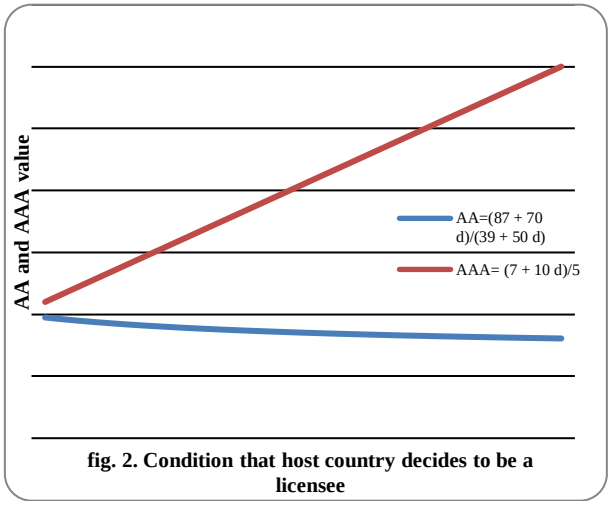

fig. 2. Condition that host country decides to be a licensee

III. CONCLUSION

In a world where countries push trade relationships by signing bilateral or multilateral agreements, tariffs are not used to protect producers in the host countries. Technology transfer becomes an efficient choice by many countries to improve firms' competitive abilities and protect producers in host countries. Vietnam also signed both bilateral and multilateral free trade agreements with some countries. This work has helped Vietnam exporting easier but importing more. For example, Vietnam has imported intermediate goods from China, significantly increasing over time, especially after 2000. The high dependency on foreign input supplies could cause difficulty in production processes, such as foreign input suppliers deciding to stop supply or crisis.

To reduce the dependence on foreign input supplies, technology transfer by establishing an SOE to compete with a foreign firm in the input market can be a useful choice. Based on calculating profits and welfare from licensing, the host country decides the degree of nationalization that the foreign firm agrees to be a technology licensor. And in linear demand, Cournot fashion, a foreigner competes with an SOE in the input market and a domestic firm in the goods market. The degree of nationalization must be less than unity.

Besides the degree of nationalization of SOE, the host country and the foreign firm's decisions to be the licensee and licensor also depend on the absorbing capacity of the SOE. Suppose the absorbing capacity of the SOE is less than 3/10. In that case, the host country decides not to build up an SOE because the efficiency of using technology make lower the social welfare in the licensing regime than the social welfare in the non-licensing regime.

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REFERENCES

[1] B. J. Spencer, and. J, Ronald, -Vertical Foreclosure and International trade policy, The Review of Economic Studies, 58 (1) (1991) 153-170.

[2] D. Chen, L. F. S. Wang, andJ. Y Li, -Foreign Ownership, Privatization and Sub-sidization with Shadow Cost of Public Funds, North American Journal of Economics and Finance, 2018, Forthcoming.

[3] E. Gamberoni, R. Lanz, and R. Piermartini, -Timeliness and Contract Enforceability in Intermediate Goods Trade, Staff Working Paper ERSD-2010-14, WTO.

[4] K. T. Soo, -The gains from trade in intermediate goods: A Ricardo-Sraffa-Samuelson model, International Review of Economics and Finance, 54, (2018), 244-261.

[5] L. F. S. Wang andC. Zeng, -Licensing, entry, and privatization, International Review of Economics & Finance, 62, 2019 230-239.

[6] L. F. S. Wang, A. Mukherjee and C. Zeng, -Does technology licensing matter for privatization?, Journal of Pulic Economic Theory, 22(5) (2020) 1462-1480.

[7] M. Arijit, andP. Enrico, -Tariffs, licensing and market structure, European Economic Review, 50, (2006) 1699–1707.

[8] M. C. Chang, J. L. Hu, and C. H. Lin, -The Optimal Licensing Strategy of an Outside Patentee in Vertically-Related Markets, International Journal of Economics and Finance 5(3), (2013), ISSN 1916-971X E-ISSN 1916-972.

[9] S. Lemarié, -Vertical integration and the licensing of innovation with fixed fees or royalties, The 32nd EARIE conference, Porto, 2005.

[10] S. Niu, -Privatization in the presence of patent licensing, Journal of Economics, 116, (2015) 151-163.

[11] T. H. V. Ha, -Intermediate goods trade between Vietnam and China", Intermediate Goods Trade in East Asia: Economic Deepening Through FTAs/EPAs, Bangkok, Thailand, (2011).

[12] W. W. Chang, Winston W., -Optimal Trade and Privatization Policies in an International Duopoly with Cost Asymmetry, The Journal of International Trade &Economic Development, 14(1), (2005) 19 - 42.

[13] X. H. Wang, -Fee versus royalty licensing in a Cournot duopoly model, Economics Letters, 60, (1998) 55–62.

[14] X. H. Wang, -Fee versus royalty licensing in a differentiated Cournot duopoly, Journal of Economics and Business, 54(2), (2002) 253-266.

[15] Y. W. Chen, Y. P. Yang, L. F. S. Wang, and S. J. Wu, -Technology Licensing in Mixed Oligopoly, International Review of Economics and Finance, 31, (2014) 193-204.

[16] Atreyee Sinha Chakraborty, Innovation, Technology Transfer and North - South Trade, SSRG International Journal of Economics and Management Studies 3(6) (2016) 11-15.