



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# Economic Cooperation in Natural Rubber: The Impacts on Natural Rubber's World Supply and Indonesia's Economy

Kiki Verico

Faculty of Economics, University of Indonesia

Email: kiki@lpem-feui.org or kverico@yahoo.com

## ABSTRACT

*In 1999, the International Natural Rubber Agreement (INRA) which had regulated the world's natural rubber since 1979 collapsed. This paper analyzed the impacts of this international agreement on both the global trade and supply of natural rubber as well as on Indonesia, a major producer of rubber. This study adopted two approaches in its assessment: (1) The Cournot-Nash Equilibrium, which analyzes the "external effects" or the global market conditions for natural rubber before and after the collapse of INRA; and (2) The Input-Output Table Simulation on rubber products, which assesses the "internal effects" or the economic conditions in Indonesia before and after the collapse of INRA.*

**Keywords:** oligopoly market, international investment, Cournot-Nash Equilibrium, International Tripartite Rubber Organization

**JEL classification:** L13; F21; C72

## INTRODUCTION

**Background**

Historically,<sup>1</sup> the world's major importers and exporters of natural rubber managed this product under an arrangement called the International Natural Rubber Agreement (INRA). This international agreement was launched in 1979 with the objective to control the supply side of natural rubber in terms of quantity and price level. Two agreements followed in 1987 and 1995, but INRA still retained the main objective from the 1979 agreement, which was signed by both major exporting and importing countries. This first agreement covered seven exporting countries and 25 importing countries, thereby controlling 95 percent of exports and 75 percent of imports worldwide.

The 1979 agreement included a buffer stock system of a maximum of 550,000 metric tonnes (MT), in which 400,000 MT is allocated as regular stock and 150,000 MT is for contingency purposes. This buffer stock is equally funded by the exporting and importing signatories of the INRA. This policy has been connected to the movement of the Daily Market Indicator Price (DMIP), a composite weighted average of daily official prices of the Kuala Lumpur, London, New York, and Singapore markets.<sup>2</sup> Price level intervention consists of upper ('may sell') and lower limits ('may buy') at around  $\pm 15$  percent. Periodic revisions to the DMIP are not impossible, particularly when price levels fluctuate whenever the buffer stock has been exhausted.

Nevertheless, given that exporting and importing countries have different interests, potential conflicts are unavoidable. One conflict first occurred during their conference in 1985. Exporting country members proposed stabilization of export earnings by increasing export volumes while importing members insisted on a buffer stock policy that maintained export volumes and reduced excessive price fluctuations.

A second conflict took place again during a conference in 1994. Exporting country members again proposed an increase in reference prices and an increase in the lower and upper indicative price interventions of the 1987 agreement while importing members argued that the agreement was fine as it had already accommodated their interests.

The third conflict became the turning point and led to the international agreement's collapse. Following the Asian economic crisis, several of INRA's exporting members met in Kuala Lumpur in 1998 and proposed a 5 percent price hike for natural rubber. Major exporters Thailand, Indonesia, and Malaysia wished to gain more international reserves in response to the Asian economic crisis.<sup>3</sup>

However, the proposal to raise natural rubber prices was again unanimously rejected, which resulted in the withdrawal of major producers Thailand, Malaysia, and Sri Lanka from the Third International Natural Rubber Agreement in September 1999 as well as the collapse of the Council of International Natural Rubber Organization in December 1999.

1 For an overview of INRA and ITRO, see UNCTAD (2007) and UNCTAD (1997)

2 In the 1995 agreement this composite covered other three grades: RSS 1, RSS 3, and TSR 20 with a proportion of 2:3:5.

3 The Asian economic crisis caused the local currencies of Indonesia, Malaysia, and Thailand to significantly depreciate vis-à-vis international currencies which forced them to increase their international reserves in order to: (1) maintain import demand given import price hikes following the local currency depreciation, (2) protect the value of local currency from further severe depreciation, and (3) keep it in its appropriate rate.

Two years later, in 2001, major Southeast Asian producers Indonesia, Malaysia, and Thailand (further referred to as IMT) established the International Tripartite Rubber Organization (ITRO) in order to serve their interests, and the International Rubber Company (IRCo Ltd.) was established in October 2003 to stabilize world prices for natural rubber. IRCo's initial capital amounted to USD 225 million.<sup>4</sup>

### Specific Economic Arguments

This study presents several arguments as to why it is important to analyze the economic impacts of the collapse of INRA and the establishment of ITRO by the three member states of the Association of Southeast Asian Nations (ASEAN):

1. Both the comparative trade indicator of revealed comparative advantage<sup>a</sup> (RCA) and the competitive trade indicator of constant market share analysis<sup>b</sup> (CMSA) reveal that ITRO's founding members have both the comparative (RCA) and competitive (CMSA) advantage in the agriculture sector.
2. Natural rubber is one of the agricultural products in Southeast Asia in which some countries have absolute and comparative advantages. Thailand, Indonesia, and Malaysia have been controlling more than 65 percent of the world's natural rubber production for more than 20 years (1988 to present). This proportion is more than enough to create an oligopoly in the natural rubber market.
3. ITRO is the only organization after the collapse of INRA that manages the supply side, both in the production and trade of natural rubber. Unlike the INRA in which member states came from both major exporting and importing countries, ITRO's member states are only the major exporting countries. This organization was established to protect the producer's interests. Therefore, the big question is what happened to the global market after the collapse of INRA? Was there an oligopoly?
4. ITRO brings to mind the European Union's (EU) experience with the European Coal and Steel Community (ECSC), a good forerunner organization for the EU as it successfully enhanced economic integration in Europe by controlling both production and trade of primary products.<sup>5</sup> ITRO is also expected to enhance trade and investment integration in Southeast Asia as it controls both the production and trade of a primary agricultural product. This is a proxy of solid sub-regional economic cooperation in Southeast Asia. Solid economic integration among the most influential founding members of the ASEAN (Indonesia, Malaysia, and Thailand) is a necessary condition for solid economic integration in the region (Ravenhill 1995).
5. In order to gain economic value added, natural rubber is transformed into a rubber product. Rubber is one of the most prioritized products in both trade and

4 Details in UNCTAD (2004).

5 ECSC (1952–1957) is the forerunner of regional economic organization in the early years of the EU. Reviewing the history of the EU, there are 5 steps before achieving single currency or political union. These are free trade area (FTA), custom union (CU), common market (CM), single monetary union (SMU), and single currency (SC) or political union (PU). Before EU had its FTA, it had ECSC. Among many reasons which explain why EU's original member states (Germany, France, Italy, Belgium, Netherlands, and Luxembourg) established this organization, one was to avoid the potential of war by managing 'coal and steel' as the main component of ammunition, creating equality shares and common management over these natural resources. ECSC controlled both the production and trade side. It is believed that supply-side management of primary products like coal and steel is an important factor that enhanced member-state cooperation in the region. ECSC is believed to be one of the important factors in the successful achievement of EU's regional economic integration development.

investment liberalization. Rubber was among the first products listed for the ASEAN Free Trade Agreement's (AFTA) trade liberalization and in its open list of investment liberalization among the three countries, Indonesia, Malaysia, and Thailand (See Appendix A). Rubber is among the top 11 priority products for the ASEAN Economic Community (AEC) 2015. Rubber is highly prioritized and is expected to become the engine of growth in fostering and shifting ASEAN economic integration and liberalization, from free flows of goods to free flows of capital. Trade and investment integration of rubber product is considered as one of the important factors in the ASEAN's comprehensive economic integration stages.

#### GENERAL HYPOTHESIS

As stated by the United Nations Conference on Trade and Development (UNCTAD):<sup>6</sup>

Natural rubber is a commodity which has shown a rising trend in production and consumption. As a necessary input in manufacturing, its price elasticity of demand is low. Its short-term supply also does not greatly vary in response to price fluctuations. (p. 19)

This statement indicates that natural rubber producers can have oligopoly market power. Following this, the general hypothesis is that the higher the oligopoly market power of particular primary producers, the higher the incentive for investors to invest in exporting countries given their expected profit from an increase of oligopoly market power.

This confirms that major exporting countries that had established ITRO cannot

only create oligopoly in the international market of natural rubber but also increase both trade and investment inflows for its member states: Indonesia, Malaysia, and Thailand. This is expected to benefit the economy of each of its member states, including Indonesia.

#### OBJECTIVE

This article attempts to prove the general hypothesis above: whether the major exporting countries making up the ITRO can create oligopoly in the global natural rubber market and therefore give economic benefit to its member states.

In order to observe the impacts on the global market of natural rubber on the global market, this paper compares the global market before and after INRA's collapse in 1999. This is classified as the "external effects." If the global market became an oligopoly, then the ITRO would have succeeded in managing natural rubber's supply-side, but if the global market became competitive instead, then this would indicate ineffectiveness on the part of the organization to ensure that its member states comply with the organization's set quota.

For the "internal effect," this article attempts to observe ITRO's effect on both economic linkages and multipliers of rubber. This study takes Indonesia, the second major exporting country in the world and one of the founding members of ITRO as a case study. It will utilize Indonesia's comparative input-output table simulation of rubber product before and after the collapse of INRA in 1999. An increase in economic linkages and multipliers of rubber after the collapse of INRA would indicate that ITRO has a positive impact on the economy of a major rubber producer.

---

<sup>6</sup> See UNCTAD (1997), p. 19

Finally, this study will analyze the results of the “external” and “internal” effects in order to identify the relation between the impacts of the collapse of INRA and the establishment of ITRO on the global natural rubber market and the economy of major rubber-exporting countries.

## LITERATURE REVIEW

Bhuyan and Lopez (1997) wrote about the oligopoly market power function and its relationship to the expected profit function as a basic signal to investors in their article entitled “Oligopoly Power in the Food and Tobacco Industries.” This article explains profit maximization and its relation to elasticity as a proxy for oligopoly market power as follows:

$$\begin{aligned}\pi &= P_t(Q_t) \cdot Q_t - C(W_t, Q_t) \\ \eta &= - \left( \frac{dQ_t}{dP_t} \times \frac{P_t}{Q_t} \right) \\ \pi' &= \frac{dP_t}{dQ_t} \cdot Q_t + P_t \cdot \frac{dQ_t}{dQ_t} - MC_t = 0 \\ &= - \left( \frac{P_t}{\eta} \right) + P_t = MC_t = 0 \\ &= \frac{P_t - MC_t}{P_t} = \frac{1}{\eta}\end{aligned}$$

where  $\eta$  is elasticity, showing the relationship between percentage change in quantity due to percentage change in price. The oligopoly market power of the major producing countries was assessed in relation to how it manages its production and trade quota and its effect on the world's price level. The model adopts the relationship between quantities of dominant exporting countries and non-dominant exporting countries. The oligopolist gains a high profit if it can maintain its “inelastic quantity demand” function. This means it must keep its price levels high in comparison to competitive

market prices. This requires credibility from the organization and a non-empty threat policy to make its members follow the quota.

Meanwhile, Alaouze, Watson, and Sturgess (1978) focused on the demand and supply mechanism. This mechanism was affected by the bargaining power between the oligopolist from the producers' side and the oligopsony of consumers. Before 1972, the price of wheat was stable for a long period. The export market was an oligopoly controlled initially by duopoly of exporters: USA and Canada, which then became a triopoly after Australia increased its wheat production in 1969. The emerging wheat production by Australia made the oligopoly unstable. The price fluctuated until it fell in 1972. Some scholars found that the strong collusive oligopoly market of wheat controlled by the USA and Canada had turned into a competitive market.

In order to manage export quantities by preventing excess supply and price falls, Australia established the Australian Wheat Board to control the quantity of wheat. This organization was invited by the duopoly exporters (Canada and USA) to meet in Washington anytime there seemed to be wheat oversupply. This was an important meeting for all of the major producers, as it made them realize that they must communicate with each other in order to keep the oligopoly power of wheat and avoid market destruction. Yet, it was still difficult to protect oligopoly market power because Australia did not have a good storage system to keep the quantities when it exceeds demand and the triopolist could not ask the consumers to delay its demand. This then induced the retaliation from other countries (USA and Canada) to sell more than their quota. In the end, the triopolist was cornered in a prisoner's dilemma of being competitive rather than collusive because each of them had the incentive to sell their exportable surplus.



The triopolist fell apart in 1972, resulting in each producer independently defining their own export quota from then on.

### RESEARCH QUESTIONS

Based on the background and objective, this article attempts to respond to the following questions:

1. How is natural rubber traded after the collapse of INRA? The answer will help describe natural rubber's global market conditions before and after INRA's collapse (external effect).
2. Have the country's economic linkages and multipliers of rubber increased after INRA's collapse? The answer to this question will determine the impact of INRA's collapse—which was followed by ITRO's establishment—on the economy of its major exporting members (internal effect).

### METHODOLOGY

This article adopted a microeconomic approach using Cournot-Nash Equilibrium (CNE) in which an equilibrium is set to see whether the world's trade volume of natural rubber is above (competitive market) or below (oligopoly market) the CNE. If, after the collapse of INRA, the world's trade volume is below the CNE, then the ITRO has thus succeeded in turning the global trade market into an oligopoly. This indicates that ITRO members comply with their trade quota commitment and that ITRO gives investors the signal to do long-run investment in rubber. This result in the end will benefit the country's economy. Therefore, as a case study, this study needed a country's input-output table simulation from one of the ITRO's founding countries. This study selected Indonesia, the second largest exporting country

of natural rubber in the world. This study also observed the economic impacts of the collapse of INRA and the establishment of ITRO on Indonesia's economy, particularly on its rubber economic multipliers and linkages.

Adopting Bhuyan and Lopez's (1997) approach, this study attempted to observe how major exporting countries of natural rubber control both production and trade quantities after INRA's collapse. This study adopted ITRO because it is the only organization that carries out the interests of major exporters of natural rubber. This would hypothetically affect market prices of natural rubber as expressed in elasticity ( $1/\eta$ ). Oligopolists may gain high profits if they can maintain the inelastic quantity demand function of their product. This requires the organization's credibility and a non-empty threat policy to make its members follow the quota.

For these purposes, this article applied two methods. First, CNE was employed in order to assess oligopoly power over trade of natural rubber, both before and after INRA's collapse which was followed by the establishment of ITRO. This method was adopted to assess the oligopoly market power of major exporting countries, particularly those that established ITRO.

The simple logic of this analysis is that if the oligopoly market power of ITRO is high, then it can be proven that ITRO is effective in controlling its member states to comply with the committed quantity of trade, which also confirms its credibility in ruling its member states. This in turn would attract long-run investments (foreign direct investment [FDI] inflows) into the natural rubber industry. The effectiveness in managing trade quantities and attracting FDI inflows indicates that ITRO is also effective in enhancing trade and investment integration in Southeast Asia, and thus reflects its ability to generate a solid sub-regional economic integration.

However, if the quantity of natural rubber trade increases above the CNE after ITRO was established, then it can simply be said that ITRO is ineffective in getting member states to comply with their production and trade quota. This shows ITRO's ineffectiveness in making solid economic integration, particularly in trade and investment.

There are two models of oligopoly market analysis: price and quantity. This paper chose to analyze CNE from its quantity patterns because previous studies using panel data analysis of macroeconomic approach (Verico 2010) found that FDI inflows in rubber have significant and positive relationship with the quantity (production volume) of natural rubber.

The basic assumptions of the Cournot model are that (1) two firms exist, and that (2) they simultaneously decide the quantity of production ( $q_1$  and  $q_2$ ) (Mas-Colell, Whinston, and Green 1995). Consequently the price will adjust to the level of  $p = (q_1 + q_2)$ , where the relationship between price and quantity is negative or, in other words, the price function is basically an inverse demand function  $p(\cdot) = x^{-1}(\cdot)$ .

Equilibrium in Nash quantity is an aggregate output  $Q_K^* = (q_1^* + q_2^*)$  which is always higher than the quantity of monopolists:  $Q_K^* = (q_1^* + q_2^*) > q^m$  where  $p = (q_1^* + q_2^*)$ .

Optimization in CNE is achieved at first-order condition of total revenue which is equal to competitive output (socially optimal or symbolized as  $s$ ) and is computed as follows:

$$p^t(Q_K^*) \cdot \frac{Q_K^*}{K} + p \cdot (Q_K^*) = s$$

Static analysis of classic CNE is one of the most useful tools to observe ITRO's ability to have oligopoly market power. This study classifies exporting countries of natural rubber into ITRO and non-ITRO member states; where ITRO produces natural rubber at quantity  $Q_1$

and sells it at price  $P_1$  while non-ITRO states produce at quantity  $Q_2$  and sell at price  $P_2$ . In the competitive market, the production function is assumed to have the price function of  $P_1 = A - Q_1$  with the total revenue function and marginal revenue function described as follows:

$$\begin{aligned} TR_1 &= A - Q_1 \\ &= (A - Q_1) \cdot Q_1 \\ &= A \cdot Q_1 - Q_1^2 \end{aligned}$$

$$MR_1 = A - 2 \cdot Q_1 = 0$$

$$Q_{1 \text{ competitive}} = \frac{A}{2 \cdot Q_1}; Q_{2 \text{ competitive}} = \frac{A}{2 \cdot Q_2}$$

The collusive market will have the following quantity function:

$$Q_{1 \text{ collusive}} = \frac{\frac{A}{2 \cdot Q_1}}{2} = \left( \frac{A}{4 \cdot Q_1} \right);$$

$$Q_{2 \text{ collusive}} = \frac{\frac{A}{2 \cdot Q_2}}{2} = \frac{A}{4 \cdot Q_2}$$

This formula shows that the quantity of a collusive product will always be less than that of a competitive market. CNE has the following function:

$$Q_1 = \frac{A}{Q_1} - 2 \cdot Q_2; Q_1 = \frac{A}{2 \cdot Q_1} - \frac{1}{2} \cdot Q_2$$

$$\frac{A}{2 \cdot Q_1} = \frac{3}{2} \cdot Q_2$$

$$Q_{1 \text{ CNE}} = \frac{A}{3 \cdot Q_2}; Q_{2 \text{ CNE}} = \frac{A}{3 \cdot Q_1}$$

The formula above shows that the equilibrium quantity of a collusive market is less than the CNE while the CNE quantity is less than its competitive market, described as follows:

$$Q_1 = \frac{A}{4 \cdot Q_2} < \frac{A}{3 \cdot Q_2} < \frac{A}{2 \cdot Q_2};$$



$$Q_2 = \frac{A}{4 \cdot Q_1} < \frac{A}{3 \cdot Q_1} < \frac{A}{2 \cdot Q_1}$$

These formulas show that CNE is important and useful in assessing whether the product's quantity at year  $t_i$  is competitive (more than Cournot-Nash quantity) or collusive (less than Cournot-Nash quantity). There are three possibilities that connect quantity of products in markets: (1) competitive, (2) Cournot-Nash, or (3) collusive (Figure 1).

This classic CNE theorem is applied to assess control power of these three major rubber exporters (Indonesia, Malaysia and Thailand) over the quantity of trade. Simple CNE is described in the following equations:

$$Q_{1t} = \alpha + \beta \cdot Q_{2t} + \varepsilon \quad (1)$$

$$Q_{2t} = \alpha + \beta \cdot Q_{1t} + \varepsilon \quad (2)$$

$Q_{1t}$  is trade quantity of three major exporters (ITRO members: Indonesia, Malaysia, and Thailand), while  $Q_{2t}$  is trade quantity of the rest of the world (non-ITRO members). This article uses the total of  $Q_{1t}$  and  $Q_{2t}$  as the CNE line (total trade quota). This line is applied to identify whether world natural rubber trade is above or below the quota which would indirectly prove if it is a competitive or oligopoly market.

Second, input output analysis (I-O analysis) is applied to describe the economic effects at country level. If ITRO can turn the global natural rubber market into an oligopoly market where it plays as the leader, then the expected price will increase as an effect of its oligopoly market power. The power of ITRO as price maker will increase expected profits and, in the end, increase economic linkages and multipliers of rubber in ITRO's members, which are basically the major producers and exporters of natural rubber.

This study used Indonesia's I-O table from the years 2000 and 2005 as a case study to assess the internal effect before and after the establishment of ITRO. As the ITRO was established in 2001, this study adopts the I-O table of year 2000 (before the establishment of ITRO) and year 2005 (after the establishment of ITRO). This I-O table contains 175×175 products. In fact, this calculation accounts for the impact on all sectors, but this study will focus only on rubber (product code: 12), a derived product of natural rubber in Indonesia's I-O table.

This study used backward linkage (*BL*), forward linkage (*FL*), multiplier impact of profit ( $\pi$ ), wage or salary ( $W$ ), and indirect tax ( $T$ )<sup>c</sup> as an approach to assess the impact of natural rubber on Indonesia's economy before and after the establishment of ITRO.

## DATA ANALYSIS

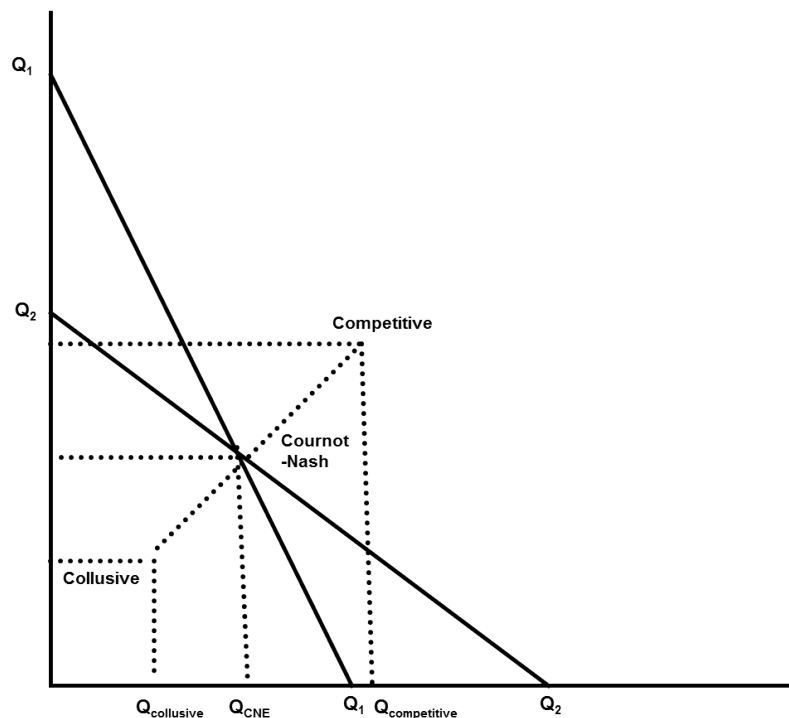
This study applied time-series analysis to the time period 1988–2008. Observation period was limited to the year 2008 in order to avoid the impact of the 2008 global economic crisis.

Since 2001, the natural rubber producers in the world have been divided into major (ITRO) and non-major (outside ITRO) producers. Figure 2 shows Thailand, Indonesia and Malaysia as the major producers of natural rubber in the world:

Figure 3 shows that the share of Thailand, Indonesia, and Malaysia in the total production volume has decreased in the last 20 years but remains at over 60 percent of the total natural rubber production in the world. Therefore, hypothetically, they still have the potential to have oligopoly market power.

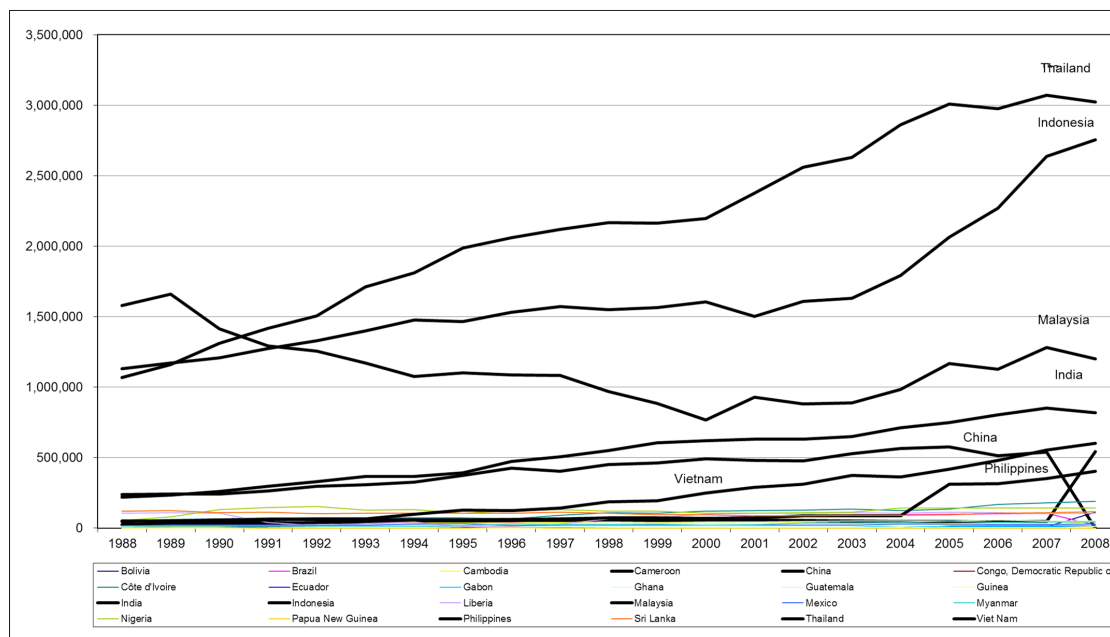
Understanding that they have potential oligopoly market power, the ITRO implements quota regulations on both production and trade of natural rubber. For the production side, the

**Figure 1. Quantity of Collusive, Cournot-Nash equilibrium (CNE), and competitive market**



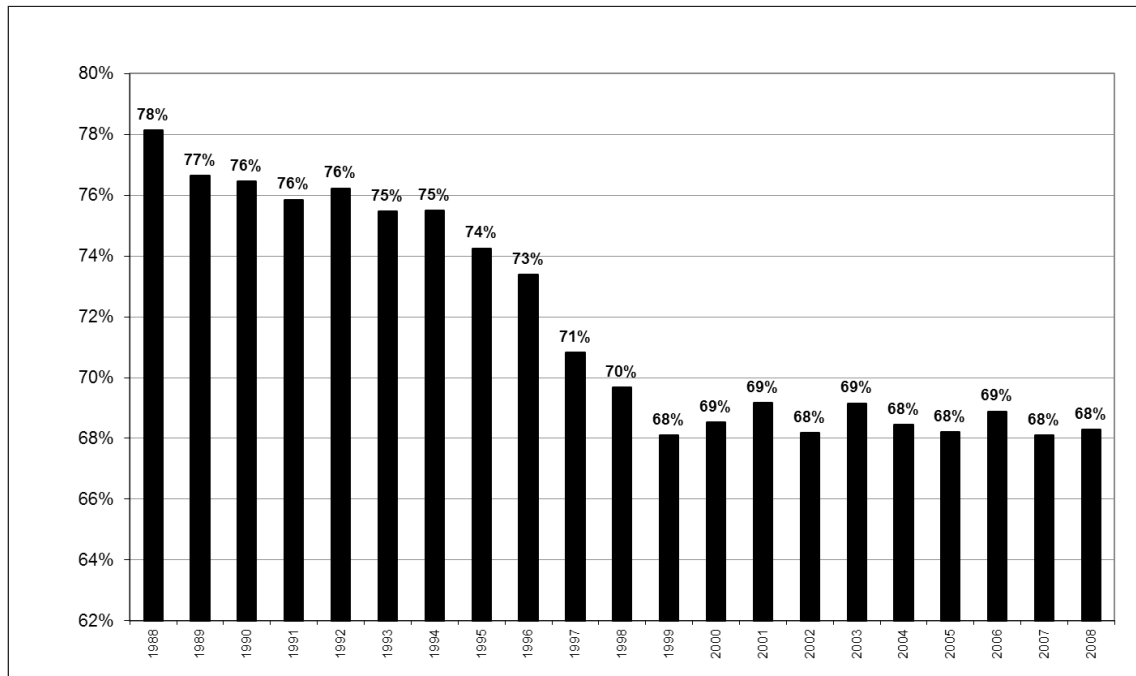
Source: Author's Illustration based on Pindyck and Rubinfeld (2005)

**Figure 2. Volume of natural rubber production by country (t/year), 1988–2008**



Source: Author's calculation based on FAO statistical data

**Figure 3. Natural rubber production volume (% of world total) of Indonesia, Malaysia, and Thailand, 1988–2008**



Source: Author's calculation based on FAO statistical data

quota policy is called Supply Management Scheme (SMS), in which member states agree to reduce their production by 4 percent. As for the trade side, the quota policy is called Agreed Export Tonnage Scheme (AETS) in which member states agree to reduce their export volume by 10 percent.<sup>7</sup>

SMS was launched in 2001 and AETS in 2002 to limit production and trade of natural rubber. In 2004, both of these were complemented by the strategic market operation (SMO) policy which helps the organization decide whether to buy or to sell natural rubber in the global market at any time that the price decreases or increases, respectively.

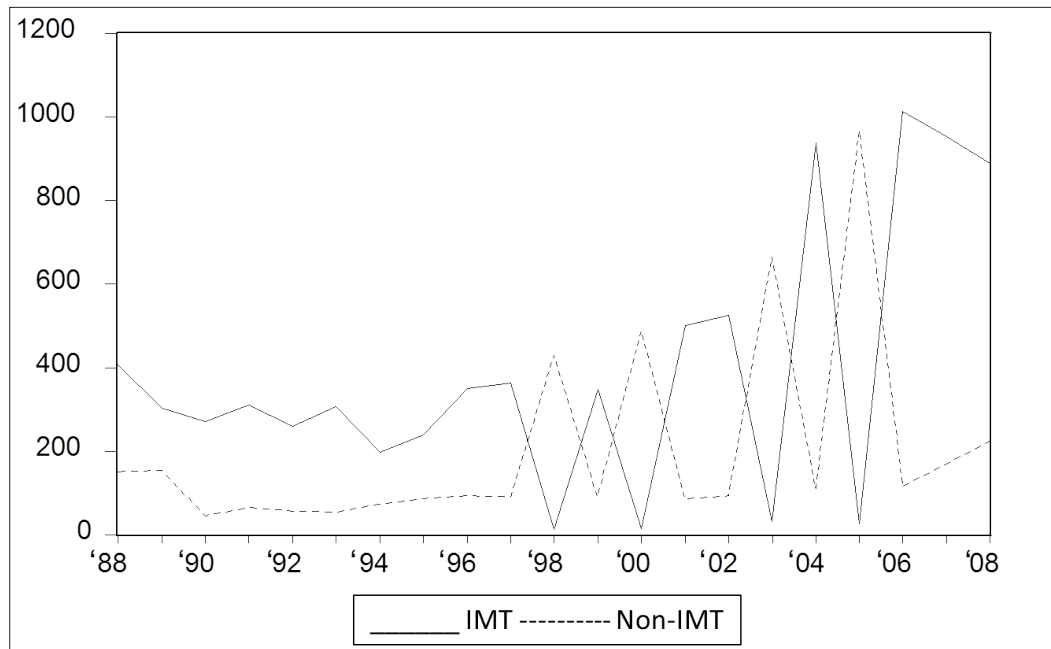
If proven effective, all of these policies will increase the oligopoly power of Indonesia, Malaysia, and Thailand and stimulate investors

to channel FDI to these three countries. Oligopoly power sends a positive expectation of profit to potential investors, and so investors therefore prefer to invest in an oligopoly market than in a competitive market. Furthermore, if the governments of these member countries open their domestic markets to foreign investors, then long-run investment would enter the host countries.

CNE analysis of quantity needs data on trade quantity of natural rubber by country. This article adopted a basic CNE approach with two players: major producers and exporters (Thailand, Indonesia, and Malaysia) and non-major producers and exporters (the rest of the world). Trade quantity of natural rubber was split based on these two groups for the 21-year observation period (Figure 4).

<sup>7</sup> See UNCTAD 2007

**Figure 4. Trade quantity (in thousand metric tonnes) of ITRO's founding members (Indonesia, Malaysia, and Thailand) and the rest of the exporters (non-ITRO members), 1988–2008**



Source: Author's calculation based on FAO statistical data

This graph compares the traded quantity of major producers Thailand, Indonesia, and Malaysia to the quantity traded by non-major producers or the rest of the world. This indicates that if major exporting countries increase their production, then non-major countries decrease theirs. Even if they are no longer part of one organization (INRA), they seem to remain organized in terms of avoiding excess supply. This indicates that both parties have complete information about each other's strategies.

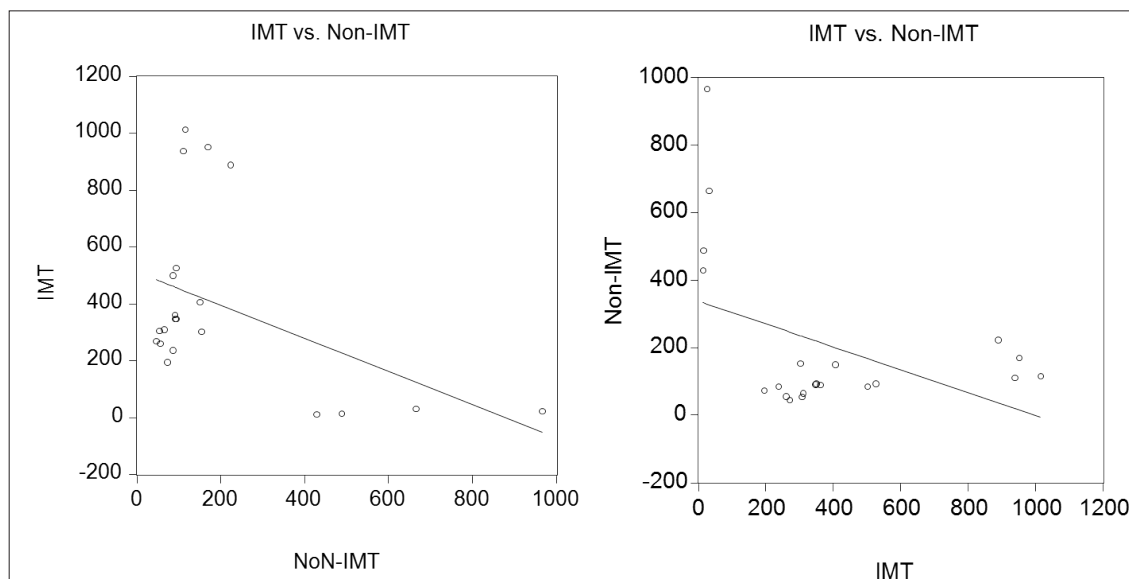
The graph also shows that in practice, the patterns of trade between major exporting countries (ITRO) and non-major exporting countries (non-ITRO) "mirror" each other, particularly after the major exporting countries' proposal to raise prices was rejected before the third international conference of INRA in 1998. The graph clearly demonstrates that before 1998, the trade patterns were relatively stable with no intersection between the two groups. Yet

after 1998, it is clear that the trade patterns have become "unstable," with complete intersections between them. When major traders decrease trade quantity, the non-major traders seem to increase theirs and vice versa. These trade quantity patterns show that the basic model of the CNE of trade quantity's response functions can be applied.

Figure 5 shows scattered graphs with regression lines which show that trade quantities between major exporting countries and non-major exporting countries have a linear inverse-function relation:

Both graphs illustrate that the application of complete information and the static game theory of CNE are reasonable and feasible. This analysis needs simple ordinary least squares (OLS) of time-series data on trade quantity to describe CNE between major exporting countries and non major exporting countries. This study applied a simple OLS of linear

**Figure 5. Trade quantity (in metric tonnes) of ITRO founding members (IMT) vs. non-ITRO members (Non-IMT), 1988–2008**



Source: Author's calculation based on FAO statistical data

model on the quantity's response functions. The results are described as follows:

$$Q_{1t} = 481,462 - 0.58 * Q_{2t}$$

$$p=0.0000 \quad p=0.0004$$

$$t=6.64 \quad t=-4.24$$

$$Q_{2t} = 343,184 - 0.39 * Q_{1t}$$

$$p: 0.0035 \quad p: 0.05$$

$$t\text{-stat}: 3.33 \quad t\text{-stat}: -2.03$$

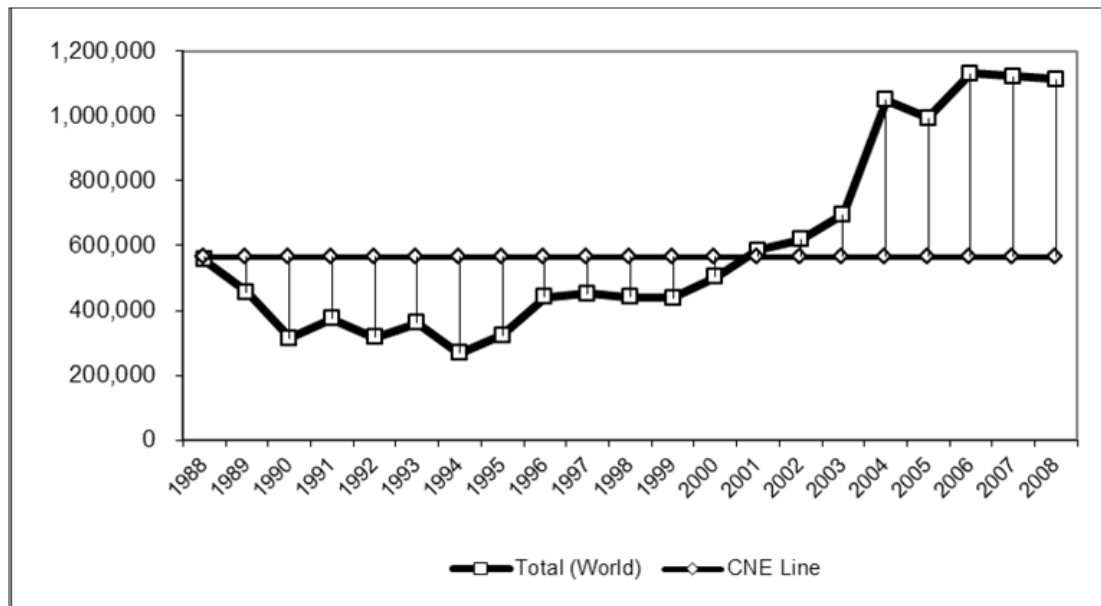
Both functions are merged to find CNE on trade quantities ( $Q_{1t}^*, Q_{2t}^*$ ).  $Q_{1t}^* : 364,973$  (t/year) is CNE trade quantity for major exporting countries (ITRO), while  $Q_{2t}^* : 200,845$  (t/year) is CNE trade quantity for non-major exporting countries (Non-ITRO). Total quantity of CNE is gained from the summation of both quantities at 565,818 t/year.<sup>8</sup> This number is applied to draw the world's CNE boundary line of natural

rubber. This line is useful to evaluate natural rubber's trade strategy before and after INRA collapsed. Figure 6 is a time-series graphic on trade quantity market and uses CNE to define whether there is a collusive or competitive market.

The graph shows that after 2001, the year the ITRO was established, the world's natural rubber trade quantity has been continuously higher than its CNE line. This organization was established to generate oligopoly market power but ironically after its establishment, the world natural rubber market turned out to be competitive instead of collusive. This finding indicates the low oligopoly market power of the major exporting countries.

Empirical data show that total trade quantity from the major exporting countries of Thailand, Indonesia, and Malaysia has already exceeded

<sup>8</sup> INRA limits buffer stock quota for natural rubber at 550,000 metric tons per year (UNCTAD 2007), while ITRO limits it to 700,000 metric tons per year (Adnan 2009).

**Figure 6. World's natural rubber trade volume and CNE lines (in metric tons), 1988–2008**

Source: Author's calculation based on FAO statistical data

their CNE trade quantity. According to FAO statistical data in 2001 and 2002, ITRO member states sold 501,257 and 525,500 metric tonnes per year whereas according to the findings of this study, the CNE of natural rubber's major exporting countries is 364,973 MT per year. In 2004, the trade quantities from major exporting members of ITRO (Thailand, Indonesia, and Malaysia) went up to 938,489 t per year, higher than their committed trade quota under the AETS. Furthermore, this number consistently increased in 2006, 2007, and 2008 at 1,014,300 t, 951,858 t, and 889,416 t, respectively. These numbers are even higher than ITRO's quota limitation of about 700,000 t per year. Excess supply in major exporting countries shows that the global market of natural rubber is competitive, thus causing it to become less attractive to investors.

Some previous studies confirmed similar results regarding the difficulties organizations encounter in attempting to control production

and trade of primary products. These previous studies include the work of Steffen, Normann, and Oechssler (1999), which found that:

1. It is unlikely that inexperienced players would immediately coordinate on an equilibrium, there is a general intuition that over time players would learn to play according to the Cournot-Nash Equilibrium... (p. 80)
2. Inverse demand is non-stochastic and decreasing in quantity...there have been few individual attempts to establish cooperation by supplying limited quantities. But this was always exploited by other firms so that the cooperators eventually gave up...In all treatments average behavior was more competitive than the Cournot prediction... There were no successful attempts of collusion....More information about behavior and profits of others yield more competitive outcomes... (p. 87)
3. Competition, however, is always strong enough to frustrate any attempts to collude (p. 93).



Others, such as Karp and Perloff (1988) argued that the probability that quantity lies between competitive and Cournot-Nash is greater than that between Cournot-Nash and collusive. Usually, collusion in primary products results in competitive instead of collusive markets. Unfortunately, a competitive market of primary products is less attractive for investors due to its negative expected profits. Nevertheless, to some extent, the major producers and traders (IMT) can still have significant, dominant, and important roles in affecting the trade of natural rubber as long as they comply with their own regulations on both production and trade quantity.

This study confirms that ITRO faces challenges in controlling its self-committed quota particularly its traded quantity (AETS), thus resulting in low oligopoly market power. Empirical data that indicate this low oligopoly market power can be seen in the Industry Outlook of Thailand (Thai Portal Company 2011):

The natural rubber industry in Thailand is currently facing difficulties because the market price for rubber has been declining. Export volumes have been increasing, but revenue earned has decreased because of the devalued baht and low rubber price.

Additionally, Malaysia, the world's third largest producer, generated an excess supply of natural rubber that hurts market sentiment in the near term and prompted some investors to unwind their positions (Suwannakij 2010).

Excess supply of major exporting countries turned the global market of natural rubber into one that is competitive and less attractive to investors. The FDI Intelligence statistical data show that the proportion of FDI inflows of rubber to the total FDI inflows in Southeast Asia before and after INRA collapsed and after ITRO was established has decreased from 2.18 to 0.67 percent. In addition, from being ranked

12th among all economic sectors in 2000, it was ranked 22nd in 2008.

Microeconomic analysis with CNE shows that total global trading of natural rubber has been significantly increased above the CNE line following the establishment of ITRO in 2001. Even comparing it with ITRO's export trade quota (AETS), world trade volume still exceeds its limit. This indicates that ITRO generates excess supply which decreases ITRO's oligopoly market power. This low oligopoly market power makes investment in rubber less attractive to the investor as it sends an expectation of lower profit. The excess supply which is described in the downward shifting of supply drives the price to decrease. Excessive supply of rubber and its decreasing price levels can be found in the related news about rubber after ITRO's establishment.<sup>d</sup>

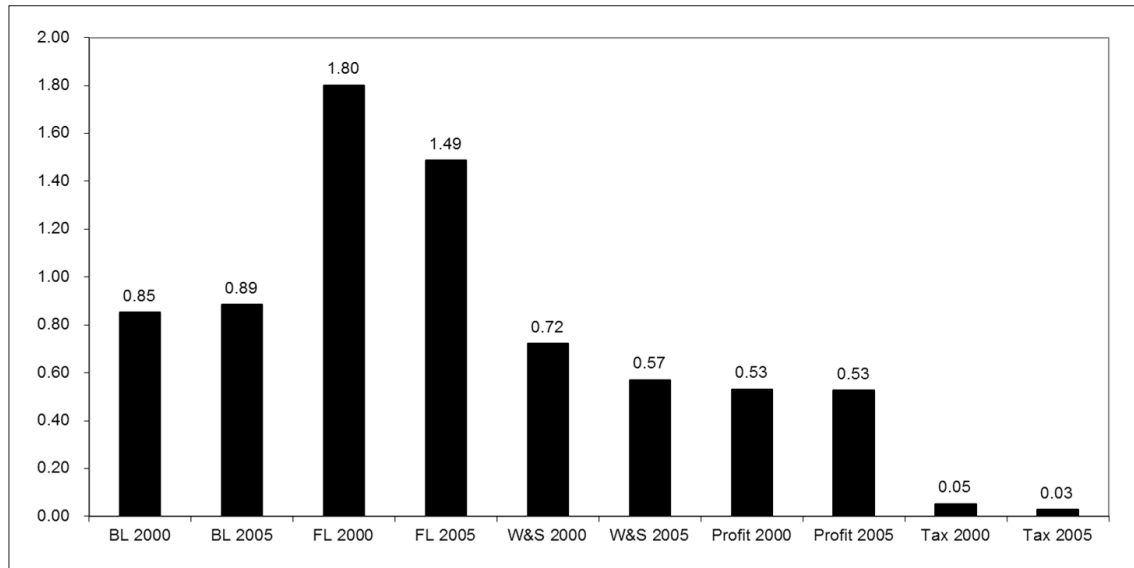
I-O analysis is useful to confirm this microeconomic finding. Indonesia was selected as a case study to compare the I-O table at before and after the establishment of ITRO.

This study found that among BL (Backward Linkage), FL (Forward Linkage),  $\pi$  (multiplier of profit), W/S (multiplier of wage/salary), and T (multiplier of indirect tax), only BL increased from year 2000 to 2005 while the rest of the indicators decreased (Figure 7).

Combining the microeconomic approach with the results from the analysis of Indonesia's I-O table, this study proves that the quantity of supply increases ( $\Delta Q > 0$ ), as shown in both the microeconomic approach of CNE analysis and the input-output analysis of BL (an increase in BL), which causes the price level to decrease ( $\Delta P_1 < 0$ ). However, from the demand side, the quantity of demand decreases ( $\Delta Q_d < 0$ ) as shown in the FL analysis (a decrease in FL). This doubly decreases the price level ( $\Delta P_2 < 0$ ).

As the demand market power is higher than its supply ( $\Delta Q_d \geq \Delta Q_s$ ), both the quantity ( $\Delta Q^* \leq 0$ ) and the price ( $\Delta P^* < 0$ ) have dropped in the new equilibrium. Both the decreasing

**Figure 7. Impact of rubber on Indonesia economy I-O table analysis (value), 2000 and 2005**



Source: Author's calculation based on Indonesia's I-O Table, 2000 & 2005

price and quantity results in a decrease in total revenue ( $TR < 0$ ) which then leads to a decline in profit ( $\Delta\pi < 0$ ) and in the multiplier of wage/salary ( $\Delta W < 0$ ) and indirect taxes ( $\Delta Tax < 0$ ).

This study provided comprehensive results that connect microeconomic findings and input-output table simulations (Figure 8).

## CONCLUSION

Since INRA collapsed, the ITRO has been the only organization to manage both the production and trade of natural rubber. This study observed both (1) the global market of natural rubber, and (2) the specific case of Indonesia's rubber economic linkages and multipliers before and after the collapse of INRA and the establishment of the ITRO. Based on these observations, this study makes the following conclusions.

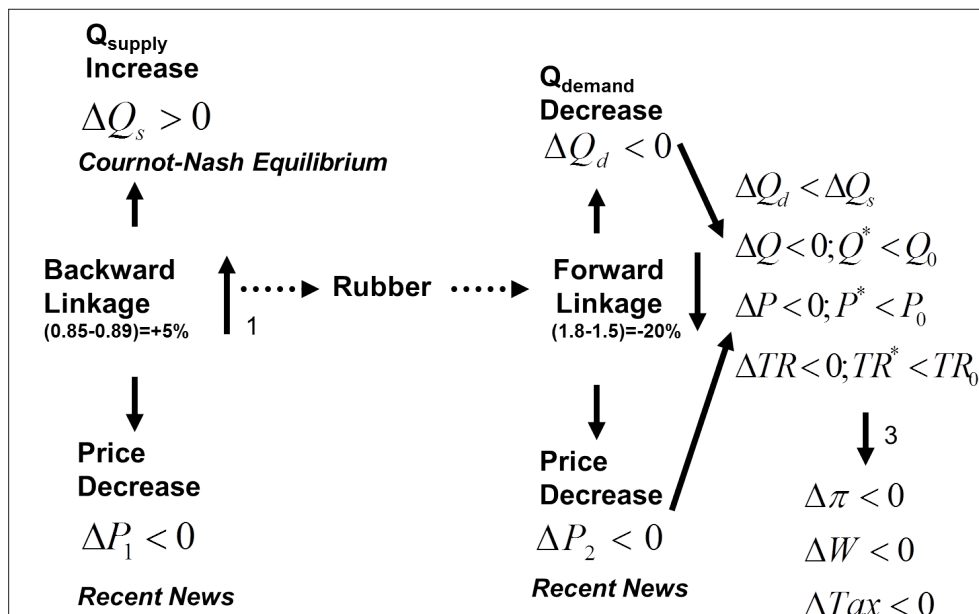
First, the microeconomic approach using the CNE model proves that after INRA's collapse, the world trade quantity of natural

rubber has surpassed its CNE. This proves that after INRA's collapse, instead of becoming an oligopoly market, the global market for natural rubber has, in fact, become competitive. This study determined the CNE quantity limit for both the major exporting countries of ITRO (Thailand, Indonesia, and Malaysia) and non-major exporting countries.

Second, empirical data shows that total trade quantity from major exporting countries has exceeded their calculated CNE quantity. This indicates that major exporting countries of ITRO are not complying with their own committed production and trade quota, further emphasizing ITRO's low oligopoly market power. The member states basically compete with each other and this indicates both the weak economic integration within ITRO's members and the weak sub-regional economic integration in Southeast Asia. In other words, it can be implied that ITRO does not support solid regional economic integration of the ASEAN.

Third, the case study of Indonesia's input-output table simulations shows that most of

**Figure 8. Illustration of the connection between CNE and Indonesia's I-O analysis (2000 and 2005)**



rubber product's economic impacts such as forward linkage and multiplier effects (profit, wage and tax) decrease and only backward linkage of rubber increases. An increase in BL confirms an increase in rubber supply while the decline in FL confirms a simultaneous decrease in rubber demand. Thus, a decrease in BL and an increase in FL result in the decrease of both the price and quantity level as well as a decrease in all of the economic multiplier impacts of profit, wage, and tax. As a case study, the input-output table simulation of Indonesia shows that following an excess in the world supply of natural rubber after the establishment of ITRO, the economic multiplier of rubber decreased.

Fourth, empirical facts show that major exporting countries in ITRO face challenges in maintaining their natural rubber's committed quota. However, because ITRO controls more than 65 percent of the world's natural rubber production, it still has large potential to generate a strong oligopoly power, increase common profit, and attract long-run international investment inflows in natural rubber. This

potential can be realized if its member states (Thailand, Indonesia, and Malaysia), which are also the top three natural rubber exporters and producers, comply with their own regulations on production quantity and trade quantity. If this can be achieved, then ITRO will play an important role in connecting trade and investment integration of natural rubber, and thus enhance both the sub-regional and regional economic integration in Southeast Asia.

#### ACKNOWLEDGEMENT

The author would like to express his gratitude to his PhD supervisor, Professor S. Urata, his colleagues at Seminar Class of International Economic Issues in Asia-Pacific in Waseda University, and his colleagues at the Faculty of Economics in the University of Indonesia (FE-UI). He would also like to thank all of the participants to the following gatherings for their invaluable comments: (1) the 44th Annual ASPAC International Conference at

Portland State University in Oregon, USA on June 18-20, 2010; (2) The 3rd Summer Institute at Waseda University on August 2-6, 2010; and (3) the Economic and Political Discussion at the Faculty of Economics in University of Indonesia (FE-UI) on July 5, 2010.

## REFERENCES

- ADB (Asian Development Bank). 2009. *Key Indicators for Asia and the Pacific 2009*. Manila: ADB
- Adnan, H. 2009. "Rubber Officials to Discuss Agreed Export Tonnage Scheme." *The Star Online*, November 2. Accessed February 6, 2012. <http://www.thestar.com.my/story.aspx/?file=%2f2009%2f11%2f2%2fbusiness%2f4957508&sec=business>
- Alaouze, Chris M., A.S. Watson, and N.H. Sturgess. 1978. "Oligopoly Pricing in the World Wheat Market." *American Journal of Agricultural Economics* 60 (2): 173–185.
- Bakhori, Syaipul. 2012. "Harga Karet Anjlok, Warga Jambi Menjerit." *Tempo*, June 24.
- Bhuyan, Sanjib, and Rigoberto A. Lopez. 1997. "Oligopoly Power in the Food and Tobacco Industries." *American Journal of Agricultural Economics* 79 (3): 1035–1043.
- FAO (Food and Agriculture Organization of the United Nations). 2002. "Recent Developments in Natural Rubber Prices." Paper presented in the Consultation on Agricultural Commodity Price Problems, Rome, FAO, March 25–26.
- . 2013. FAOSTAT. Accessed March 5, 2013. <http://faostat3.fao.org/faostat-gateway/go/to/home/E>
- Information Center for Natural Rubber. n.d. "World Natural Rubber Production is Forecast to Rise 4.3 Percent." Accessed June 8, 2013. <http://www.rubber-foundation.org/docu/2575natural.pdf>
- Karp, Larry S., and Jeffrey M. Perloff. 1988. *Dynamic Oligopoly in The Rice Export Market*. California: UCLA.
- Ravenhill, John. 1995. "Economic Cooperation in Southeast Asia: Changing Incentives." *Asian Survey* 35 (9): 850–866.
- Rubber Market News. 2012. "India: Physical Rubber Prices Decline on Buyers' Resistance." *Rubber Market News*, May 10.
- Sheppard, Laurel M. 2014. "Latex." Accessed June 8, 2013. <http://www.madehow.com/Volume-3/Latex.html>
- Steffen, Huck, Hans-Theo Normann, and Jorg Oechssler. 1999. "Learning in Cournot Oligopoly—An Experiment." *The Economic Journal* 109 (454): 80–95.
- Suwannakij, Supunnabul. 2010. "Malaysia Rubber Output May Rise 17% to 1 Million Tons." *Rubber Market News*, March 9. <http://rubbermarketnews.blogspot.com/2010/03/malaysia-rubber-output-may-rise-17-to-1.html#UwRvR859i3o>
- . 2011. "Natural Rubber Output From Key Growers May Rise 4.8%." *Jakarta Post*, January 25. <http://www.bloomberg.com/news/2011-01-25/natural-rubber-output-from-key-growers-may-rise-4-8-update2-.html>
- Thai Portal Company, Ltd. 2011. "Industry Outlook: Rubber." Accessed February 9, 2012. [http://www.thailand.com/exports/html/industry\\_rubber.htm](http://www.thailand.com/exports/html/industry_rubber.htm)
- UNCTAD (United Nations Conference on Trade and Development). 2007. "Economic Policies." Accessed February 7, 2012. <http://www.unctad.org/infocomm/anglais/rubber/ecopolicies.htm>
- . 1997. Evaluation of the International Natural Rubber Agreements of 1979, 1987, and 1995. Accessed February 7, 2012. <http://unctad.org/en/Docs/poitcdtedd1.en.pdf>
- . 2004. "Commodity Atlas: Natural Rubber." Accessed February 8, 2012. [http://unctad.org/en/Docs/ditcom20041ch17\\_en.pdf](http://unctad.org/en/Docs/ditcom20041ch17_en.pdf)
- Verico, Kiki. 2010. "The AFTA, BFTA and ITRO Effects on Trade-Investment Relations in Southeast Asia: Case Study of Indonesia, Malaysia and Thailand." Paper presented at the Summer Institute of International Conference, August 2–6, GIARI, Waseda University, Tokyo.
- . 2011. "The Impact of Direct Bilateral" [http://www.adb.org/Documents/Books/Key\\_Indicators/2009/xls/INO.xls](http://www.adb.org/Documents/Books/Key_Indicators/2009/xls/INO.xls)
- The World Bank. 2012. *World Databank: Global Development Finance*. Accessed March 26, 2012. <http://data.worldbank.org/data-catalog/global-development-finance/gdf-2012>
- . 2012. *World Databank: World Development Indicators*. Accessed March 26, 2012. <http://databank.worldbank.org/data/home.aspx>
- World Trade Organization. 2013. *International Trade and Market Access Data*. Accessed March 5, 2012. [http://www.wto.org/english/res\\_e/statis\\_e/statis\\_e.htm](http://www.wto.org/english/res_e/statis_e/statis_e.htm)

## ENDNOTES

a 
$$RCA_{t0} = \frac{\frac{X_{ij_{t0}}}{X_{j_{t0}}}}{\frac{X_{iw_{t0}}}{X_{w_{t0}}}}$$
 where:  $X_{ij_{t0}}$  = value of export commodity  $i$  in country  $j$  at  $t_0$  time;  $X_{j_{t0}}$  = total value of export in country  $j$  at  $t_0$  time;  $X_{iw_{t0}}$  = value of export commodity  $i$  in the world ( $w$ ) at  $t_0$  time;  $X_{w_{t0}}$  = total value of export in the world ( $w$ ) at  $t_0$  time

b CMSA: 
$$X_{inwt1} - X_{inwt0} = \sum m_{iw\Delta t} \cdot X_{inwt0} + \left( m_{iw\Delta t} - \sum m_{iw\Delta t} \right) \cdot X_{inwt0} + (X_{inwt1} - m_{iw\Delta t} \cdot X_{inwt0})$$

General factor: 
$$\sum m_{iw\Delta t} \cdot X_{inwt0}$$
 Composition factor: 
$$m_{iw\Delta t} - \sum m_{iw\Delta t} \cdot X_{inwt0}$$
 Comparative factor: 
$$X_{inwt1} - X_{inwt0} - m_{iw\Delta t} \cdot X_{inwt0}$$

where:  $X_{inw_{t_0}}$  = value of export commodity  $i$  in country  $n$  to world at  $t_0$  time;  $X_{inw_{t_1}}$  = value of export commodity  $i$  in country  $n$  to world at  $t_1$  time;  $\sum m_{iw\Delta t}$  = change in total world import;  $m_{iw\Delta t}$  = change in world import on commodity  $i$

c Input-output tables describe the elements in the GDP formation of the three approaches which are the expenditure side of GDP: final demand ( $C, I, G, XM$ ), the return on input (input value), and value-added sectors of GDP. The GDP based on value added sectors is widely developed since it shows the relationship between sectors. Rows in the IO table (left to right) indicate values of sector output while columns (top to bottom) indicate values of sector input. A benefit of the IO tables is that they help measure the size of the economic multiplier effects. The multiplier coefficient calculations need technological approach. This coefficient matrix is obtained by cultivating relationships between sectors by dividing the total input. The total input is equal to the total output. Technology coefficient is expressed as follows:

$$a_{ij} = \frac{x_{ij}}{X_j} \quad \text{where: } X_{ij} = \text{value of value of inputs in sector } i \text{ to } j; X_j = \text{total input; } a_{ij} = \text{coefficient of technology}$$

To see the connection among sectors, inverse calculation of the technological matrix coefficient is required, which is expressed as follows:

$$\begin{aligned} X - A \cdot X &= Y \\ X \cdot (1 - A) &= Y \\ X &= (1 - A) \cdot Y \end{aligned} \quad \text{where } X \text{ is output vector; } A \text{ is coefficient of technology and } Y \text{ is final demand. The multiplier matrix is expressed as } B = (I - A)^{-1}$$

$I$  is an identity matrix, a square matrix that has an equal number of rows and columns and which is diagonally filled with number one:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

while matrix  $A$  is a coefficient of the technology matrix, which is described as follows:

$$\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ \dots & a_{22} & \dots & \dots \\ \dots & \dots & a_{33} & \dots \\ a_{n1} & \dots & \dots & a_{nn} \end{bmatrix}$$

$a_{ij}$  is the value of particular input divided by total input (total output). Value of  $a_{nn}$  is equal to the number of columns or rows. Matrix of this value is a coefficient technology matrix. The identity matrix is deducted from the coefficient technology matrix with the result inversed to get the multiplier matrix. It can be described as follows:

$$B = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} - \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ \dots & a_{22} & \dots & \dots \\ \dots & \dots & a_{33} & \dots \\ a_{n1} & \dots & \dots & a_{nn} \end{bmatrix}^{-1} = \begin{bmatrix} b_{11} & a_{12} & \dots & b_{1n} \\ \dots & b_{22} & \dots & \dots \\ \dots & \dots & b_{33} & \dots \\ b_{n1} & \dots & \dots & b_{nn} \end{bmatrix}$$

Adding up the numbers at the side of the matrix from the left to right rows will obtain forward linkage (FL), which shows forward linkages from one sector to another. Meanwhile, adding up the numbers from top to the bottom will obtain backward linkage (BL), which shows backward linkages from one sector to others. Rows indicate the use of output in certain sectors and the columns indicate the use of inputs for a particular sector. FL calculation is useful to detect the encouraging capacity of a particular sector to others (by rows), while BL calculation is useful to determine how much output of particular sector uses input from other sectors. The calculation of FL and BL are as follows:

$$r_1 = b_{11} + b_{12} + \dots b_{1n}; \left( FL = \sum r_{1-n} \right) \quad s_1 = b_{11} + b_{21} + \dots b_{n1}; \left( BL = \sum s_{1-n} \right)$$

Calculation of square matrix is equal between the total of rows in unit 1n and columns in unit n1, expressed as:

$$\sum r_{1-n} = \sum s_{1-n}$$

This total is then divided by the number of sectors to have the average, shown as follows:

$$\frac{\sum s_{1-n}}{175} = \frac{\sum r_{1-n}}{175}$$

And this average is used to see the details in each unit of sector. It can be obtained by dividing the number in each row (FL) and column (BL) with it:

$$FL_i = \frac{r_i}{\left( \frac{\sum r_{1-n}}{175} \right)} \quad BL_i = \frac{s_i}{\left( \frac{\sum s_{1-n}}{175} \right)}$$

Taken with BL (the capacity to boost input from other sectors) and FL (the capacity to generate output to other sectors) analyses, this multiplier effect can be seen in the impact of input-output on wages and salary, profit, and indirect government tax. The *B* matrix (175×175) is also used to analyze the impact of wages and salary, as well as profit and indirect tax by dividing each number by the total input and output. If a 175×1 matrix is multiplied by the *B* matrix, it then turns into the 175×1 matrix of each indicator (wages and salary, profit, and indirect tax). It can be described as follows:

$$W_i = B \cdot \sum \sum \frac{W_i}{\sum_i^n X_{i-n}} \quad \text{where } W_i \text{ is wage and salary in sector;}$$

$$\pi_i = B \cdot \sum \sum \frac{\pi_i}{\sum_i^n X_{i-n}} \quad \pi \text{ is profit in sector } i;$$

$$T_i = B \cdot \sum \sum \frac{T_i}{\sum_i^n X_{i-n}} \quad T_i \text{ is tax in sector } i; \text{ and}$$

$$\sum_i^n X_{i-n} \text{ is total input or output.}$$

d The aim of ITRO is to reduce rubber output by 4 percent beginning in 2001 (FAO 2002). However... "World natural rubber production is forecast to rise 4.3 percent annually to 2013." (Information Center for Natural Rubber n.d.). "Natural-rubber supply may expand 4.8% in 2011 as farmers continue to boost supply..." (Suwannakij 2011). "Higher supply of natural rubber hurts market sentiment in the near term (2010)," said Chaiwat Muenmee, an analyst at DS Futures Co, which "prompted some investors to reconsider their positions." (Suwannakij 2010). "The natural rubber industry is currently facing difficulties because the market price for rubber has been in decline". (Rubber Market News 2012). Although "export volumes have been increasing (2010), revenue earned has decreased because of the low rubber price." (Thai Portal Company 2011). The latest news revealed that rubber farmers are placed at a greater disadvantage especially after the world's commodity price for rubber decreased due to the global economic crises (Bakhori 2012).