AN ANALYSIS OF FACTORS AFFECTING TOTAL DOMESTIC CONSUMPTION FOR INDONESIAN NATURAL RUBBER (1980-2003)

A THESIS

Presented as Partial Fulfillment of the Requirements
to Obtain the *Bachelor Degree* in Economics Department

By

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INTERNATIONAL PROGRAM
FACULTY OF ECONOMICS
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Examiner:

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Yogyakarta, August 27, 2004
International Program
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Dean,

Drs. H. Suwarsono, MA

In the name of Allah, Most Gracious, Most Merciful

By (the Token of) Time (Through The ages),

Verily Man Is in Loss,

Except such as have Faith, And do righteous deeds, And (joint together) In mutual teaching Of Truth, and of Patience and Constancy.

Al-Ashr (Time Through the Age)

I dedicate this thesis to Mother, Father, the "Pandawa" Five and the Future ...

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An Analysis of Factors Affecting Total Domestic Consumption for Indonesian Natural Rubber (1980-2003). Permana, Didin (2004). Yogyakarta, Thesis Advisors: Prapti, Endang Sih, MA, Dra. and Hidayati, Sari. Economics Department, Faculty of Economics, Islamic University of Indonesia.

ABSTRACT

Natural rubber has been an important agricultural commodity of Indonesia with significant contribution to national income for a long time. The dominant amount of natural rubber production in Indonesia was exported while only a small amount was domestically consumed. Hence, the tendency of natural rubber (NR) market depends a lot on foreign markets.

This study discusses about the demand model of economy, that is, factors affecting domestic consumption (or industrial absorption) for Indonesian natural rubber to know how promising the domestic market of natural rubber is. As such, the domestic demand model will be formulated based on the derived demand theory by using Partial Adjustment Model as the regression tool. The research uses annually time series data for the period between 1980 and 2003.

The empirical results of the demand model are satisfied with high r-square and theoretically follow the initial hypothesis. The size of estimated R^2 shows that about 81 percent of the variation in the domestic consumption is explained by price of NR (*PNR*), total real GDP (*GDP*), price of synthetic rubber (*PSR*), and dummy (*D*) which explain the fluctuation of domestic consumption for NR. These variables of the model are statistically significant and have a joint impact on industrial business absorption of NR in Indonesian market (the regressand) since the F-test is also significant. With stability test, the model has a degree of reliability in their estimated coefficients with very small structural change and parameter fluctuation.

In both short-run and long-run, the research finds that natural rubber does not show any good prospect in domestic market since the commodity is both inferior and elastic price elasticity. This elastic price shows that NR has been considered an unimportant commodity. The consumer simply can substitute to the related goods, such as synthetic rubber (obviously, the cross elasticity is positive) and or even the imported natural rubber. Besides, externality factors are identified significant in this model and are responsible for the fluctuation of domestic consumption for NR. Then, the contribution of factors not included in this model is extremely small (indicated by the estimated constant) compared with the annually average consumption coming from the three factors plus dummy variable.

The adjustment of the way toward its long run or desired level is very quick of about 70 percent adjusted in a year period. And all classical assumptions are satisfied in this regression model.

Key Word: *Rubber, Consumption, Absorption, Demand, and Indonesia.*

Analisa Faktor-Faktor yang Mempengaruhi Total Konsumsi Domestik terhadap Karet Alam Indonesia (1980-2003). Didin Permana (2004). Yogyakarta, Pembimbing Skripsi: Dra. Endang Sih Prapti, MA.dan Sari Hidayati. Jurusan Ekonomi Pembangunan, Fakultas Ekonomi, Universitas Islam Indonesia.

INTISARI

Karet alam merupakan komoditi pertanian yang penting bagi perekonomian Indonesia dan keberadaanya berperan besar terhadap pendapatan nasional. Sebagian besar produksi karet alam nasional diekspor dan hanya sebagian kecil saja yang dikonsumsi pasar domestik. Sehingga pangsa pasar karet alam nasional saat ini sangat bergantung pada perkembangan pasar luar negeri.

Studi ini membahas tentang model ekonomi pada sisi permintaan yaitu faktor-faktor yang mempengaruhi konsumsi (penyerapan industri) domestik terhadap karet alam Indonesia untuk mengetahui sejauh mana prospek karet alam Indonesia di negerinya sendiri. Dan ini akan diderivasi berdasarkan teori permintaan dengan menggunakan instrumen regresi Partial Adjustment Model (PAM). Data yang digunakan adalah bentuk time series untuk kurun waktu 1980-2003.

Hasil-hasil empiris dari model ini adalah sesuai dengan hipotesa awal dan didukung dengan R^2 yang tinggi yaitu sekitar 81 persen variasi dalam konsumsi domestik dijabarkan oleh harga lokal karet alam (*PNR*), total PDB riil (*GDP*), harga dunia karet sintetik (*PSR*) dan vaiabel dummy (*D*) yang menerangkan fluktuasi jumlah karet alam yang dikonsumsi. Variabel-variabel ini terbukti signifikan dan mempunyai pengaruh secara bersamaan terhadap konsumsi (penyerapan industri) karet alam nasional di dalam negeri (F-test signfikan). Dan test stabilitas menunjukan bahwa koeffisien yang didapat sangat kecil kemungkinannya untuk berubah dan berfluktuasi.

Hasil penelitian menunjukan, baik secara jangka pendek maupun jangka panjang, bahwa karet alam nasional bersifat inferior terhadap pendapatan dan elastis pada harga sendiri sehingga dapat dikatakan bahwa karet alam nasional berprospek buruk di dalam negeri. Elastisitas harga juga menunjukan bahwa karet alam sudah tidak dianggap penting, para konsumen dengan mudah beralih pada barang sejenis seperti karet sintetis (terbukti dengan elastisitas silang yang positif) dan malah karet alam impor. Selain itu, model ini mengidentifikasi adanya faktor eksternal yang bertanggung jawab terhadap fluktuasi konsumsi domestik. Kemudian, kontribusi faktor-faktor yang tidak dimasukan dalam model ini sangat kecil dibanding dengan jumlah rata-rata konsumsi per tahun yang datang dari ketiga faktor tersebut di atas plus variabel dummy.

Penyesuaian terhadap jumlah stok yang diinginkan (jangka panjang) berlangsung dengan cepat sekitar 70 persen disesuaikan setiap tahunnya. Dan semua asumsi klasik dapat diterima pada model regresi ini.

Key Words: *Karet, Konsumsi, Penyerapan, Permintaan, dan Indonesia.*

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CHAPTER I
INTRODUCTION

1.1. Background

During the past three decades, a remarkable globalization of the world economy has taken place. Economic liberalization, which is marked by global market context, has preceded by AFTA in the year 2002, GATT and/or WTO in the year 1995 for the developed nations while developing country have just gone into effect in the year 2004, then APEC which is began in the year 2020 for developing country. Obviously, it would generate consequences which are responsible for all its member nations. The increasing integration of national economies into global market promises to alter the volume and character of international resource flows. As consequences, the trading systems, including agricultures commodity, are progressively transparent and, then, it requires the quality improvement to be able to compete in the global market.

Table 1.1: Summary of the World Output*
(Annual percent change)

	1998	1999	2000	2001	2002
World	**2.8**	**3.7**	**4.7**	**2.4**	**3**
Advanced economies	2.7	3.5	3.8	1.1	1.7
United States	4.2	4.4	3.7	0.5	2.2
Euro area	2.9	2.8	3.5	1.6	0.9
Japan	-1.2	0.2	2.8	0.4	-0.3
Other advanced economies	2	4.6	5.2	1.7	3
Other emerging market and developing countries	3	4	5.9	4.1	4.6

*Real GDP
Source: IMF World Outlook 2003

Recently, global economy contraction slowed from 4.7% growth in 2000 to estimated 2.4% in 2001 since the recession of Japan's economy in 1998 and the

tight money policy in the United States (US) and European countries. It has slowed down world economic activities. The US economy declined from 3.7% growth in 2000 to 0.5% in 2001, while Euro area, in the same year, declined from 3.5% growth to estimated 1.6%, and so did Japan, from 2.6% growth in year 2000 to 0.4% in 2001, respectively. In such condition, it therefore brings significant impact to the world commerce.

IMF (2003:187) in its report informs that the volume of goods commerce, including agriculture commodity, drastically turned down from 12.5% growth in 2000 to only 0.1% in 2001. It was due to decreasing in demand in the US and Euro area markets. As a result, the prices of agriculture commodity in international market decreased and worsen off. These situations eventually threaten Indonesia and other developing countries of which the economy are dependent on export.

In contrast, Indonesian export, particularly agriculture products, which is believed to be able to accelerate the Indonesian economy, in the reality, does not give real contribution to the economic recovery. Very often, agriculture products incurred rejection by major importing countries with the reasons of SPS (Sanitary and Phytosanitary) and TBT (Technical Barrier to Trade).[1] Moreover, internal problems, such as the degradation in extensive harvest; less-supported infrastructure; low productivity; unprofessional post-crop management, etc., had made agricultural sector unable to compete globally.

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[1] Pejabat Eselon III dan II lingkup Deptan dan Depperindag (September 2003), Telaah Bersama "*Aksi Pemenuhan Kebutuhan Dalam Negeri dan Pemningkatan Ekspor Komoditas Pertanian Prioritas*".

Considering Indonesian agriculture product represents one of backbones to boost up the economy and foreign exchange, it needs further effort to overcome various existing problems. Therefore, the government should support it by using their instruments to deal with competitive agriculture export.

International agreement of GATT encourages agriculture product being traded without any restraints in international market. As a consequence, since ill-assorted low domestic production growth relative to the demand, various foreign agriculture commodities would be simply entering Indonesian market. However, it needs an effective policy to keep domestic producers survive (Meuthia Rachmaniah, October 2004).

In this situation, the policy makers, government, have to maintain agriculture sector to be able to contribute more against the process of the economic recovery. Promoting over domestic market, beside exports, is not impossible to be applied because it relates to people prosperity, which is about 60 percent of Indonesian labor force, smallholder, are in agriculture sector.

Besides, Indonesia beckons as a potential market, a country with more than 212 million people estimated in 2002, and the fourth most populous nation in the world. The most densely populated island is Java with an average of 870 inhabitants per square kilometer. However, Irian Jaya has only five inhabitants per sqm. Indonesia is the largest country in South East Asia consisting of more than 17,500 islands and spread over 5,000 kilometers of ocean.[2] These favorable circumstances, potential domestic market, give opportunity to agriculture sector to

[2] IMF, "Indonesia Agri-Food Market Assessment Report", *Agri-Food Trade Service*, (May 2000).

make use of the benefits. Indeed, it depends on how the related parties could exploit the advantage owned.

There are some alternatives to determine the commodity requiring support in making-up of both domestic and international market, and/or support to allow import protection (Siswono Yudo Husodo, April 2004). The selections are based upon some following reasons: pay attention on consumption within the country; improve foreign exchange acquirement; absorb a lot of labor; improve the farmer prosperity; protect the consumer interest from security aspect, health, safety and environment; Insusceptible to the crisis and having value-added.

There are some agriculture products which are reasonably given attention by the government in the form of policies. They are food crop covering rice, soy, maize; cash crop covering sugar, palm oil, palm kernel, coconut, rubber, coffee, cacao, tea, pepper, tobacco, cloves; animal husbandry covering the husk, chicken flesh, and milk; horticultures covering the shallots, and oranges.

The research object in this study will be focused on one of the potential cash crop commodities, namely natural rubber, which traditionally has been an export crop and the consumption is mainly in the industrialized countries. Mostly, Indonesian natural rubber is exported, while only a small amount is domestically consumed by businesses which are natural rubber as the raw material.

A significant new trend has emerged in the recent years whereby most of the natural rubber-producing countries are moving "downstream", converting a significant proportion of their production into manufactured products for domestic

use and export with the result that the three largest exporting countries, Thailand, Indonesia and Malaysia, have now joined the ranks of the 12 largest consuming countries.

ANTARA (April 14, 2004), with its highlight "North Sumatra's Rubber Export up", stated an official of the North Sumatra industry and trade office, in the meantime, he said Indonesia's rubber consumption is still quite low reaching only 250,000 tons per year, including 136,000 tons of natural rubber. The low rubber consumption in the country is particularly due to the fact that industries producing rubber goods, except tyres, have not developed properly, as it is very costly to develop such industries these days.

1.2. Problem Identification

This study will just discuss about factors affecting domestic consumption for natural rubber. The term of *consumption* here has a meaning of the absorption of industrial businesses producing natural rubber goods in Indonesian market since the commodity is not ready to consume. Instead of consumption function, the study thoroughly discusses about *the demand model of economy*. However, the terms of consumption, industrial business absorption, and demand will be used in the same connotation.

There are two reasons why the researcher interested in conducting the research. *First*, it is because of little attention of the academic researchers on the demand side of natural rubber commodity. They are much concern on export demand rather than domestic demand. *Second*, market of elastomer, particularly

the natural rubber, tends to be *oligopsoni* when there are only few buyers in a given number of sellers. This situation is not beneficial to Indonesia as the natural rubber producing country because it can make the potential commodity of NR very dependent on the development of other countries. Indonesian will be better to encourage or stretching out the market in domestic along with the international market.

Concerning to the overview, hence, the researcher would like to present thesis which is entitled "**An Analysis of Factors Affecting Total Domestic Consumption for Indonesian Natural Rubber (1980-2003)**".

1.3. Problem Formulation

Based on some facts above, the problems that will be analyzed in this study are:

A. Does domestic price of natural rubber (NR), in Rp/Kg, affect total domestic consumption for NR?

B. Does Indonesian total real GDP, in billion USD, affect total domestic consumption for NR?

C. Does the world price of synthetic rubber, at London, in USD/tonne, affect total domestic consumption for NR?

D. Does dummy affect the fluctuation of domestic consumption for NR?

1.4. Research Objectives

This thesis intends to analyze the behavior of variables affecting domestic consumption. The research objectives are:

A. To know how far changes in domestic price of natural rubber, total real GDP, and the world price of synthetic rubber influence the total consumption for natural,
B. To know how far the externalities influence the total consumption for natural rubber,
C. To predict the development of consumption in the future to optimize the domestic market.

1.5. Research Benefits

The research are purposed to give an erudite contribution as well as base for encouraging strategy of market stretching of natural rubber in Indonesia. As this approach, Indonesia is able to maintain the agriculture sector in both local and international market.

In addition, to the researcher himself, this thesis is set to fulfill the partial requirements to obtain the bachelor degree in Faculty of Economics, International Program, Islamic University of Indonesia.

1.6. Writing Systematic

This thesis is presented in 6 chapters, which are divided into:

- **Chapter I,** which discusses the background of the study, the topic, the reasons why the researcher interested in, the problem formulation, the objectives, the benefits and the writing systematic
- **Chapter II**, which presents literatures review, theoretical foundation, hypotheses and assumptions.
- **Chapter III**, which presents research methodology selected as guidance in conducting the research.
- **Chapter IV**, which discusses more detail description of the research subject. That is the uses and the brief history of both natural and synthetic rubber, and its development in the world and domestic market.
- **Chapter V**, which presents the core of the study containing the analysis, testing, and the interpretation.
- **Chapter VI,** which contains the conclusion, implications outlining the whole chapters of the thesis.

CHAPTER II
CONCEPTUAL FRAMEWORK

2.1. Literature Review

2.1.1. 'The Indonesian Natural Rubber Export: An Analysis Regarding the Demands and Supply' (Amirudin, 1996)

The study describes factors influencing export volume of Indonesian natural rubber (NR) derived from the demand and supply side. It identifies three problems of factors affecting the supply, export, and demand for Indonesian NR. It uses annually time series secondary data for the period between 1979 and 1994 and applies TSLS (Two Stage Least Square) as the regression tool. In analyzing the data, it begins with estimating NR price equation, demand equation, supply equation, and finally developing the export equation. The equations are then analyzed and interpreted to find out the result.

The research results ***domestic demand*** is positively influenced by national income and population; with estimated coefficients are 8.68 and 1308.9, respectively. But the price negatively affects the demand with coefficient of -19.86. Cumulatively and partially variables of domestic price and extensive planted area positively influence the number of NR offered. In ***supply side***, number of NR offered are price-inelastic (with coefficient of 0.06), but elastic against the planted area (with coefficient of 1.4%). In ***export side***, the three independent variables—NR price, SR price, and world NR price—negatively influence the export. However, those three variables are inelastic against export with estimated coefficient of 0.12, 0.96, and 0.13, correspondingly.

2.1.2. 'Demand for Natural Rubber in the USA, Japan and China: With Special Reference to Thai Natural Rubber' (Nida Sang-ngam, 1994)

The USA, China and Japan are the main importers of Thai natural rubber (NR). This study formulates NR export demand models of these three countries based on the derived demand theory by using the Ordinary Least Square (OLS) estimation.

The empirical results of the three countries demand models are satisfied with high r-square and followed the hypothesis. The statistically significant variables of all three models are GDP per capita variables which represent the consumer's economic position, and the total tyre production variables. Stability test indicates the models have a degree of reliability in their estimated coefficients with very small structural change and parameter fluctuation.

The demand models of three countries are used to forecast their future demands. Total NR demand from Japan in the year 2000 would be the largest followed by China and the USA. Under the same year, Japan would be the largest consumer of Thai NR while the second in China and the USA. In the same way, the Chinese market is also attractive for Thai exporters because the share of Thai NR in this market is quite high and has been increasing.

The production and export targets of Thailand in the year 2000 will not be sufficient when the quantity of all Thai NR demands of three countries and demand from the rest of the world are included together. As a result, Thailand should promote more NR production and increase more exports to capture all

additional demand from the world. Several ways are area-planting expansion, promotion of more high-yielding trees and the production process improvement.

2.1.3. 'Economic Growth and the Future of Natural Rubber' (Yomoussoukro, 2001)

This study indicates to what extent such economic developments affect the outlook for NR. Is the fear of a future shortage a thing of the past and will the prices remain low or can producers still look forward to higher price and is a shortage still around the corner? And the questions analyzed who can and will produce NR terms of availability of land and labor and of revenues.

The paper reports on developments in the natural rubber (NR) market and describes projections as derived from econometrical model. Regarding to structural model of the NR economy only the main features are reviewed. The complete model consists of: the analysis of NR production capacity, the first pillar for the analysis of rubber market; the analysis of total rubber demand, the second one; and the model describing reactions of demand, supply and prices to each other. Most of the model is the form of linear and nonlinear econometric equation.

The year 1997 to 2000 was turbulent year for the economies in South-east and East Asia. The results of the analysis find the economies of key players in the NR market both on the demand and supply side were severely affected: substantially lower or even negative growth and dramatic declines in exchange rate. This has resulted in turbulent development in the NR market in that period as

well as in the year 2000. During 2001 the downturn appeared to be imminent because of some externalities like terrorism issues.

2.1.4. 'Demand for Indonesian Natural Rubber in the USA and Japan: An Analysis of Constant Market Share' (Dwi Novitawati, 2001)

The study analyzes the future chance of Indonesian natural rubber (NR) in Japan and the US market which currently the commodity has a strong position in the markets. The problems to be analyzed are: how the progress of Indonesian NR export to Japan, and can Indonesia depend its market share with respect to the competitors.

This research uses annually time series secondary data for the period between 1987 and 1999 (divided into six parts) and applies CMS (Constant Market Share) as the analysis tool. In analyzing the data, it considers four effects influencing the export. They are world export growth effect, the effect of commodity composition, market distribution effect, and competition power effect.

The research concludes that Indonesian has a comparative advantage in NR indicated by constantly positive change in the export. Then, Indonesia is not the main supplier and is not able to defend the competition power, with exception in the period 1989-1991 and 1991-1993. The effect of world import contributes to the increase of NR export. After that, the compositions of Indonesian export are distributed on commodity which the demand grows fast in the world market. Finally, Indonesian export is distributed on the market where the import grows slowly.

2.1.5. 'Indonesian Natural Rubber: An Econometric Analysis of Its Export Supply and Foreign Import Demand' (Ida Yunia Soependi, 1993)

This study concerns with a quantitative examination of Indonesian natural rubber (NR). It analyzes the nature of supply and demand for Indonesian NR and applies a simultaneous equation model consisting of fifteen behavioral equations and six definitional identities which are hypothesized to describe the annual structure of Indonesian NR and its place in the world market for the period 1970 up to 1990. The Micro-TSP computer software package was used to carry out the analysis in this study. The data used were primarily taken from several sources.

The study finds that production and export supply of Indonesian NR, demand for NR both in the U.S. and outside the U.S. markets, and foreign import demand for Indonesian NR were perfectly price inelastic. Moreover, level of production which depends mainly on the extent of the planted area and yield primarily determines the export supply, and the yield is influenced by the price of NR in both the world and domestic market. And demand for NR is influenced mainly by the automobile industry. The implication is that diversification of export crop must be continued.

2.2. Theoretical Foundation

2.2.1. Market

A market is mechanism by which buyers and sellers interact to determine the price and quantity of a good or service. Market types can be distinguished based on (a) kinds of goods traded in, that is output and input market; (b) number

of seller at a given number of buyer, that is perfect-competition, monopoly, oligopoly, and monopolistic-competition market—included in output market; (c) number of buyer at a given number of seller, that is monopsoni and oligopsoni.

Output market, which its type is determined by numbers of seller at a given number of buyers, could be explained as follows:

Monopoly is a system when a single seller with complete controls over an industry. It is the only firm producing in its industry, and there is no industry producing a close substitute.

Oligopoly means "few sellers", in this context, could be 2 sellers or at most 10 or 15 sellers in a given number of buyers.

Monopolistic Competition occurs when a large number of sellers produce differentiated products. This market structure resembles perfect competition in that the products sold by different firms are not identical.

2.2.2. Demand

Both common sense and scientific observation that the amount of a commodity people buy depends on its price. The higher the price of goods the fewer units consumers are willing to buy. The lower its market price, the more units of it are bought. The market demand curve is found by adding together the quantities demanded by all individuals at each price. Domestic market demand therefore is defined as the amount of a commodity—goods and services, that will be bought by consumers within the country. These consumers comprise individual household, businesses, and/or government. (Samuelson and Nordhaus, 1998:44).

There are some factors influencing how much a commodity will be demanded. Those are commodity price, average levels of income, the size of the population, the price and availability of related goods, individual and social tastes, and special influences. A consumer's problem is to get as much utilities by spending the limited income that the consumer has available. How much the consumer demands of the product depends on a number of influences like tastes, the price of the product, the prices of the related products and income.

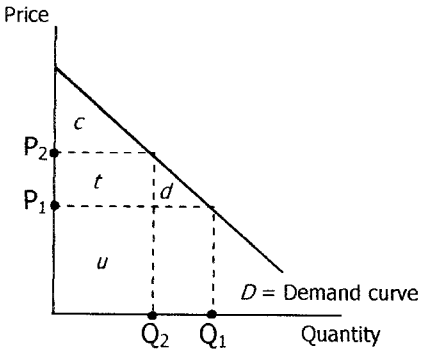


Figure 2.1: Demand for Product A

Figure 2.1 pictures demand for product A by focusing on one major determinant, the products price. The market demand curve D slopes downward. It means that an increase in the product's price (say, from P_1 per unit product A to P_2) results in a decrease quantity demanded (from Q_1 to Q_2 product A purchased per time period). This is a movement along the demand curve because of a change in the product's price. The increase in price results in a lower quantity demanded as people switch to substitute products.

The quantity demanded tends to fall as price increase. The reason is ***substitution and income effect***. Substitution effect occurs when the price of a good rises, consumers will substitute other similar goods for it. While income effect occurs when a price goes up, consumers find somewhat poorer than they

were before. These two effects collaborated when consumers determine to decrease the quantity purchased of a goods as the price increases.

A measure of responsiveness is ***elasticity***. The price elasticity demand is the percent change in quantity demanded resulting from a 1 percent increase in price. Quantity falls when price increases, so the price elasticity of demand is negative number. If the price elasticity is more than 1, in absolute, then quantity demanded is substantially responsive to a price change—demand is *elastic*. If the price elasticity is less than 1, in absolute, then quantity demanded is not that responsive—demand is *inelastic*.

A willingness to pay for product A lies in the demand curve D. At a price of P_2 per unit product A, consumers buy Q_2 and pay P_2Q_2 (equal to area $t + u$). Because paying P_2 per unit of product A, when many consumers value the product more highly than P_2, still lives consumers with a net gain or ***consumer surplus***. The consumer surplus (area c) is the difference between the total value to consumers (area $c + t + u$) and the total payment to buy the product (area $t + u$). Consumer surplus is used to measure the impact on consumers of a change in market price.

The average income of consumers is a key determinant of demand. As consumers' income increase—individual households, businesses, and/or the government, they tend to buy more of almost everything, thus, it evokes change in demand. These changes in demand depend on features of the commodity.

The concept of ***income-elasticity of demand*** measures how much the change in demand of a commodity occurs as income increases by 1 percent. It is summarized that when (a) income-elasticity is more than 1, the goods are *normal* and *luxurious*; (b) income-elasticity is positive and less than 1, the goods are *normal* and *necessities*; (c) income-elasticity is negative, the goods are *inferior*.

The price and availability of related goods influence the demand for a commodity. Demand for good A tends to be low if the price of substitute product B is low. Based on the concept of elasticity, it measures how much the change in demand of a commodity (say A) as price of related commodity (B) increases by 1 percent. Hence, there would be a ***cross-elasticity of demand***. It is important to take note that: (a) the relationship of commodity A and B are substitution goods, when the cross-elasticity of both commodity are more than zero; (b) it is complementary goods relationship when the cross-elasticity are less than zero; (c) and it would be independent goods relationship when the cross-elasticity of both commodity are equal to zero.

As consumer's tastes change against one commodity, at price remaining constant, it therefore will indicate a change in demand. For instance, if a commodity is preferred in one area, the demand will increase. Cultures or traditional behavior of *Padangnees* might consume more chilies for their cooking.

The more populous of a country the more commodities are demanded. Indonesian inhabitants are fifty times more than Singapore. Indonesia population currently is more than 210 million citizens while the population Singapore is only

4.13 million citizens estimated in 2001. For that reason, in the case of textiles, Indonesia exactly demands more clothing rather than Singapore.

As mentioned before, a market is mechanism by which buyers and sellers interact to determine the price and quantity of a good or service. In this context, price of commodity is determined by both its demand and its supply.

2.2.3. Supply

Consumption is not the only thing that changes when price rises. Businesses also respond to price in their decision about how much to produce. Supply, is defined as the amount of a commodity—goods and services, that will be produced and sold by producers at a given price within the country. As domestic demand market, domestic supply is also influenced by several factors. These factors are the commodity price, the price of related goods, input price, climate, government policy, the factor endowment, and levels of technology.

The major Influences on how much of a product supplied by producers are the price and the cost of producing and selling the product. The producer supplies the product if the price exceeds the extra (or marginal) cost of producing it, the producer should supply that unit because it makes a profit on it. The producer then will supply units up to the point at which the price received just about equals the extra cost of another unit. The cost of producing another unit depends on the input (such as labor, capital, land and material) needed to produce the extra unit, and the price that have to be paid for these input.

Figure 2.2 pictures supply of product A which focuses on how the price of the product affects quantity supplied. The market supply curve S slopes upward. It means that an increase in the product's price (say, from P_1 per unit product A to P_2) results in an increase in quantity supplied (from Q_1 to Q_2 product A produced and sold per time period). This is a movement along supply curve.

Quantity supplied is more responsive if the slope is flatter. The price elasticity of supply is the percent increase in quantity resulting from a 1 increase in market price. Quantity supplied is not that responsive to price, supply is *inelastic*, if the price elasticity is less than 1. Quantity supplied is substantially responsive; supply is *elastic*, if the price elasticity is greater than 1.

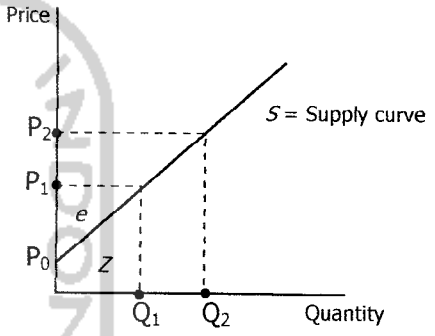


Figure 2.2: Supply for Product A

At the price of P_1 per unit product A, the total revenue received by producers, area $e + z$, is the product of the market price and the quantity sold. Producers would have been willing to supply some products A at a price higher than P_0. At a price of P_1, receiving the going market price for all units, results in a net gain in economic well-being or producer surplus. The producer surplus, area e, is the difference between total revenues (area $e + z$) and total cost (area z). Producer surplus is used to measure the impact on producers of a change in market price.

2.2.4. The Consumer Behavior

To describe the way consumers choose among different consumption possibilities, consumers tend to choose those goods and services they value most highly to meet their satisfaction. There are two approaches to observe the consumer behavior in attaining satisfaction or utility. Those are cardinal and ordinal approaches.

From the cardinal approaches, it is known law of diminishing marginal utility (MU) which evokes the downward sloping MU curve. This law states that the amount of extra or marginal utility declines as a person consumes more and more of a good. Demand theory (which is derived from cardinal approach) considers that marginal utility can be valued in term of money. It means that the more MU people gain, the more people willing to pay, in contrast, the less MU people gain, the less amount of money people willing to pay. Therefore, downward sloping MU curve and downward sloping demand curve are identical. The Price is the MU value. Consuming of a good by OQ_1, the consumer is willing to pay for OP_1. Meanwhile, consuming OQ_2, the consumer only willing to pay for P_2 because $MU_1 > MU_2$.

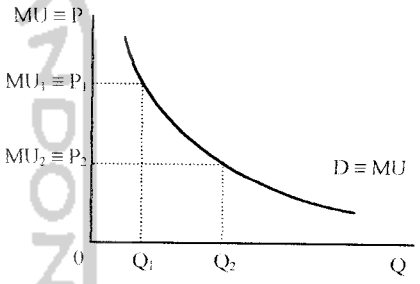


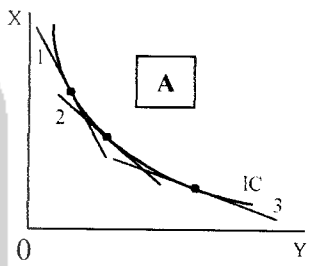
Figure 2.3: Downward Sloping MU Curve

In explaining the consumer behavior, ordinal approach says that utility resulting from consuming goods can be made into order. In order to be able to make order, consumer is assumed to be rational, means if A is prefer to B, and B is prefer to C than A is prefer to C. the more units of a good consumed the more

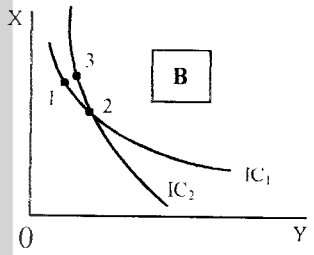
utility will be enjoyed. In making preferences, it is understood that the consumer acts individually.

Indifference curve (IC) is curve in which each point on graph shows different combination of unit X and Y but it results the same utilities. IC has several characteristics. They are as follows:

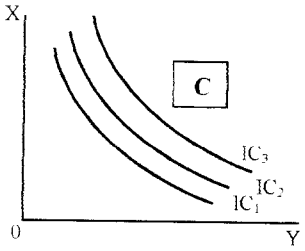
1. IC has a negative slope. The curve is drawn upper left to the lower right. This indicates that the relationship between X and Y is substitution.



2. IC is convex to the origin (in figure A). It means that the more people consume X, the sacrificing of Y getting smaller (decreasing MRS_{xy}).



3. For each consumer, that is a set of IC. The set of IC is called indifferent map. The characteristics of indifferent map are as follows:
   - ICs in an indifference map cannot intersect each other (in figure B).
   - If ICs cannot intersect each other means that they file up one and another (coverage characteristic)



   - If it is coverage characteristic means that the higher IC the bigger utilities (in figure C).

2.3. Hypotheses and Assumptions

From the problem formulation, that is the demand model of economy, it can be developed the hypothesis. Hypothesis is something expectedly being true for maintaining or stating an argumentation and the rightness of that statement is temporary. The hypotheses will be tested by statistical and econometrical tests using one-tail and two-tail test. The hypotheses are as follows:[3]

H1 is whether the price of natural rubber has negative and significant effect on total consumption for natural rubber (NR).

H2 is whether the total Indonesian real GDP has positive and significant effect on total consumption for NR. Therefore, NR is superior if the effect is positive but NR is inferior if the effect is negative.

H3 is whether the world price of synthetic rubber (SR) has negative and significant effect on total consumption for NR. Therefore, SR is substitute to NR if the effect is positive but SR is complementary to NR if the effect is negative.

H4 is whether the dummy variable has significant effect on total consumption for NR.

Other independent variables, excluding the four variables above, having effects on total absorption of Indonesian NR in domestic market are being held constant, ceteris paribus.

[3] The term of price of NR has a meaning of "domestic" price of NR as well as "domestic" consumption.

CHAPTER III
RESEARCH METHODOLOGY

Research methodology represents the guidance for a researcher in conducting a research (Moh. Nasir: 1998). Sequences being performed within this research cover type and sources of data, operational data and data analysis methods.

3.1. Type and Sources of Data

This research makes use of secondary data that is collected from literatures, governmental and international agency as well as from a private organization. The data are taken from newspapers, websites, International Financial Statistics, Central Bureau Statistics of Indonesia (CBSI), Indonesia's Directorate General of Estates Crop (DGEC), Indonesian Rubber Trade Association GAPKINDO, and other reports and publication related to this research. Meanwhile, the research uses time series data pertain to Indonesia for the period 1980 to 2003.

3.2. Operational Data

To avoid from misinterpretation against both independent and dependent variables, it is necessary to make them obvious. These annual data pertain to Indonesia for the period 1980 to 2003. The variables are defined as follows:

A. *C*, consumption for natural rubber (NR), the dependent variable (in 000 metric tonne), is obtained from total production in a year minus export.

B. ***PNR***, price of NR (in Rp/Kg), the independent variable, is initially weighted (and/or divided) by consumer price index. (1995=100).

C. ***GDP***, total real GDP (in billion USD), the independent variable, is initially weighted (and/or divided) by the average of ASEAN[4] (without Indonesia) total real GDP. (1995=100).

D. ***PSR***, world price of synthetic rubber (SR) at London (in USD/tonne), the independent variable, is obtained by firstly transforming Pound-sterling to USD and then divided by UK's CPI to get the real price. (1995=100).

E. ***D***, dummy variable, the independent variable, "1" for NR consumption greater than (or close to) a hundred and "0" otherwise ("1" if $C_t > 100$ and "0" if not).

3.3. Data Analysis Methods

Indonesia has long been experienced in the "rubber world" since the colonial system government up to now. However, this research uses annually time series data for the year between 1980 and 2003 as an object of observation.

Both descriptive and quantitative analysis will be applied to give details about the effects raised by explanatory variables, the perennial question whether NR could be "traded on" in our own domestic market, and other findings obtained from the analysis.

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[4] ASEAN includes Brunei Darussalam, Cambodia, Laos, Malaysia, Myanmar, Philippines, Singapore, and Thailand.

This section will provide steps in conducting the analysis of demand model of economy as a guide to obtain the empirical findings of the study. The steps are as follows:

3.3.1. Externalities Identification

Because the data of dependent variable are so fluctuate, there may be externalities affecting the data observed. It is useful to know how significant the influence is. Such qualitative factors are not observable and it is necessary to create a new variable called dummy variable to quantify the factors. The different possible outcomes of the dummy variable are then coded by numerical values of 1 and 0.

This study enables the dummy variable to receive value 1 if data value of independent variable is greater than its average value and 0 if data value of independent variable is lower that the average value.

3.3.2. Choosing the Proper Model

Considering the data is time series, naturally, it faces the problem of stationary. It is necessary to know the degree of the stationary of each variable—stationary, weakly nonstationary and/or strongly nonstationary. The detection is as follows:

A. The equation resulted in OLS multiple regression model, particularly R^2 and DW-stat, indicates whether the data is spurious or not. Data is spurious if $R^2 > DW$-stat and not spurious if $R^2 < DW$-stat. Hence, it has not to apply the error correction model (ECM) if the data is not spurious.

B. Then, the detection of stationary is necessary to know whether this present regression models are stationary or not by committing the application of *unit root tests*. Regression of a nonstationary time series on another nonstationary time series may produce a spurious regression. Unit root tests determine in what level the stationary of the factors are, whether it is in original level, 1st or 2nd level. It thus indicates the degree of stationary, weakly nonstationary and/or strongly nonstationary. The summary is as follows:

1. OLS multiple regression model is a proper model if all factors, the independent variable, are stationary in original level of unit root tests.
2. Partial Adjustment Model (PAM) is a proper model to recognize the weak nonstationary.
3. Error Correction Model (ECM) is a proper model to recognize the strongly nonstationary.

3.3.3. Choosing Between Linear and Log-Linear Regression Model

Choosing between a linear regression model (the regressand is a linear function of the regressors) and a log-linear regression model (the log of the regressand is a function of the logs of the regressors) is essential in empirical analysis. In this study, *MWD test*, a test proposed by MacKinnon, White, and Davidson, will be used to choose between two models.

3.3.4. Statistical Hypotheses Testing

The problem of statistical hypothesis testing may be stated simply as: *Is a given observation or finding compatible with some stated hypothesis (H_0)?* The word "compatible," as used here, means "sufficiently" close to the hypothesized value so that we do not reject the stated hypothesis (H_0).

Test of significance approach, one-tail and two-tail tests, is a procedure by which samples results are used to verify the truth or falsity of a null hypothesis. The objective of this test is to know the relationship between independent and dependent variable individually.

3.3.5. F-Statistic Testing

F-test is a test of overall significance of the observed or estimated regression line, that is, whether Y as dependent variable is linearly related to independent variable X_1 X_2 and X_3. In other words, that is whether all independent variable has a joint impact on dependent variable.

3.3.6. Testing Violation of Classical Assumption

This section discuss about the testing of whether or not the estimated equation contains *multicollinearity, autocorrelation, heteroscedasticity* and *specification errors*. The appropriate tools will be conducted to detect them.

Multicollinearity arises when the explanatory variables in an equation are highly or perfectly correlated. Although this only violates a model assumption in an extreme case of perfect multicollinearity, the existence of even moderate multicollinearity can cause problems with a sample regression function.

Autocorrelation is most likely to occur in time-series data. When the data are temporally ordered, the error from one time can affect the error in other time periods. For example, unexpected surge in consumer confidence can cause a consumer durable goods equation to underestimate durables consumption for two or more periods.

One of the important assumptions of the classical linear regression model is that the variance of each disturbance term u_i is some constant number equal to σ^2. This is the assumption of homoscedasticity. However, there is ***Heteroscedasticity***, symbolically $E(u_i^2) = \sigma_i^2$, notice the subscript of σ_i^2, which indicates that the conditional variances of u_i are no longer constant.

The ***specification error*** detection is whether the model commits (1) omission of important variable(s), (2) inclusion of superfluous variable(s), (3) adoption of the wrong function form, (4) incorrect specification of the error term ut, and (5) errors of measurement in the regressand and regressors.

The appropriate tools will be used to detect these violations.

3.3.7. Causality in Economics

Regression analysis that deals with the dependence of one variable on other variables does necessarily imply causation. In other words, the existence of a relationship between variables does not prove causality or the direction of influence. However, in regression involving time series data, the situation may be somewhat different. To test such phenomenon, this study will present the Granger Causality Test.

CHAPTER IV
NATURAL RUBBER, A POTENTIAL CASH CROPS COMMODITY

We use Rubber in so many ways; it becomes a servant that follows us literally, from the cradle to the grave...
– The late Ralph Wolf, chemist and author, in an article in the October 1964 edition of "Rubber World."

4.1. Introduction

Civilization as people knows it today is wholly dependent on rubber. It is a material of many uses, unlike anything that the world had previously known. It enters into daily lives in a thousand ways. It is indispensable in transportation, in communication, in cushioning the bodies and protecting the senses from the jars, virus. Even in spending the leisure time, rubber is essential, for there are only few sport games which do not use rubber-made ball. It is a servant that follows everyone.

As Ralph Wolfe's poetic prose confirms, (*IISRP Articles*, 2002) rubber is as indispensable to modern society as steel and wood and mortar. Everyone use products made of rubber at work, at home, at play, even when they travel. Automobiles, trains and aircraft rely on it for safety and comfort. Industry uses it to produce hoses, belts, gaskets, tyre, molding, and thousands of other products.

It comes from two sources: nature and man. Natural rubber (NR) is drawn off from cultivated trees on plantations in Asia and Africa. Synthetic rubber (SR) is man-made and is produced around the world in manufacturing plants that synthesize it from petroleum and other minerals.

Whether it is *natural* or *synthetic*, rubber in its native form is virtually useless. However, after chemicals are added, it takes on properties that, as Ralph

Wolf noted, make it totally "unlike" any material the world has ever known. Depending on the chemicals used, products made of rubber can be as soft as a sponge, as elastic as a rubber band, or as hard as a bowling ball. As a result, much rubber products are used with varying degrees of hardness in people's daily lives.

NR has been available for centuries, SR for less than a hundred years. Although man began experimenting with synthetic in 1906, not until after World War II did he improve the quality to the point that it rivaled that of NR. Wartime necessity became the impetus for the emergence of synthetic on a large-scale basis when developed countries began building plants to offset NR shortages. SR plants were built around the world after 1945, primarily in Europe, North America, and Japan. In 1960 use of synthetic surpassed that of natural for the first time.

4.2. World Data

Currently, about 65 percent of rubber production is synthetic product which is made of crude oil. North America, European Union and Japan dominate about 60 percent of SR utilization in both the production and the consumption since automotive industry is essential to them. Nevertheless, the utilization trends are decreasing as the recent prices of crude oil turn out to be quiet expensive.

Production of natural rubber from the tree ***Hevea brasiliensis*** plays a major role in socio-economic fabric of many developing countries. Over 80 percent of the production comes from small farms, each typically 2 ha or less (INRO articles, August 2002). Asia is the centre of the production, accounting for 95 percent of the world production. The three largest producers are Thailand,

Indonesia and Malaysia and the rests are in Africa, and tropical America, the original home of ***Hevea brasiliensis.***

Table 4.1: Supply/Demand Balance for Rubber ('000 tonnes)

	1998	1999	2000	2001	2002	2003
Natural Rubber						
World Production	6,821	6,831	6,836	6,930	7,130	7,264
World Consumption	6,494	6,709	6,920	6,893	7,450	7,690
Synthetic Rubber						
World Production	9,884	10,476	10,998	10,819	11,830	12,383
World Consumption	9,890	10,377	10,971	10,953	12,101	12,736

Source: LMC International Ltd

There is only one kind of Natural Rubber (NR). Because the rubber plant only thrives in hot and damp regions near the equator, about 90 percent of true rubber production today occurs in the Eastern Asian countries of Thailand, Indonesia, India, Malaysia, etc. Table 4.2 shows that in 2002, the first three countries mentioned are now leading the world NR production by shares of 34%, 22% and 9%, respectively. However, its huge amount of NR mostly is exported while only in small number is consumed domestically.

Table 4.2: Total Production of NR ('000 tonnes)

	1999	2000	2001	2002	2002
Thailand	2,199	2,378	2,424	2,456	34%
Indonesia	1,604	1,610	1,607	1,630	22%
Malaysia	769	615	546	589	8%
India	605	622	630	650	9%
Other	1,659	1,705	1,923	1,939	27%
	6,831	6,836	6,930	7,130	100%

Sources: FAO-STAT

Some interesting cases occur and it is necessary to notify that China is now the most-consuming country of NR exceeding the US and Japan with the shares about 16.5%, 13.3%, and 10.4% of total world consumption, respectively (see table 4.3). The demand for NR is increase because of the fast growing

industry of automotive within the country when US' and Japan's suffer from their contracted economies. India also succeeds optimizing its local market with the self-sufficient of NR utilization when the international market is not help much due to the decreasing price.

Table 4.3: World Consumption for NR ('000 tonnes)

	1999	2000	2001	2002	2002
USA	1,116	1,087	978	937	13%
China	920	1,000	1,075	1,155	16%
Japan	733	753	727	734	10%
India	617	638	655	682	10%
Other	3,323	3,442	3,458	3,524	50%
total	6,709	6,920	6,893	7,032	100%

Sources: FAO-STAT

However, expanding in NR utilization is not followed by its price. The price tends to drop at the world market. It estimates the price goes down up to 0.45 USD or decline more than 75 percent for the last fifty years. That is caused by the demand and supply imbalance. The world's largest rubber producers, Indonesia and Thailand, practices to over-flooding the world market when they were experiencing a highly currency depreciation in 1998-1999. They tend to compete rather than gathering efforts to increase the price at the world market.

The impact of SR substitution products attack also influences the NR price to decrease. Of the world total consumption on NR, 65% of it came from SR utilization and only 35% of it came from NR. Unfortunately, world producers of SR are mainly developed countries (and they act as the world consumers on NR as well). Therefore, it is too hard for NR to compete in the same market, Mostly the US and Japan.

4.3. Indonesian Natural Rubber Structure (Market Opportunity)

NR is one of the most important agriculture commodities in Indonesian economy. Despite its declining contribution to total non-oil exports, NR is the second largest agriculture commodity in revenue terms after animal husbandry. Smallholdings who have 85 percent of the plantation dominate 76 percent of national production (CBSI 2003).

The rubber-growing areas of Indonesia stretch across a five-thousand kilometer band, from Aceh to Irian. The most extensive plantings are in West Java, Riau, North and South Sumatra, and West Kalimantan. These regions are tropical areas, with a well-distributed annual rainfall of 2000-2500 mm, having average temperatures of 24-28°C, and most of the soil is provided with adequate drainage. These are necessary conditions for successful rubber cultivation.

Since the early 1970s several government initiatives have been launched to improve the rubber sector. An important initiative, which gave significant benefits to the estates, was the provision of low-cost capital for rubber development and encouraging rejuvenation with high-yielding clone material (Barlow and Muharminto, 1982; Ririn Purnamasari, Oscar Cacho, and Phil Shimmons, 1999). Smallholding rubber development was initiated through various Nucleus Estate Smallholder System (NESS) schemes in 1977. The NESS program and other integrated schemes have caused a massive increase in total area planted. In 1967, total area of rubber was 2.1 million ha, and by the end of 2003, the total planted area was 3.7 million ha. (See table 4.4)

4.4. Industry Status

4.4.1. Natural Rubber Production

Improvement in the production of Indonesian natural rubber is dominated by the area intensification and high productivity through "PIR", project implementation unit (UPD), and small scale rubber development project (PPKR). In the decade of 1970s the growth of NR production was 2.22% in average.

Table 4.4 Planted Area and Production of NR

Obs	Planted Area (in '000 ha) (productivity growth)[5]			Production (in '000 tonnes) (production growth)		
	Smallholder	Estates	Total	Smallholder	Estates	Total
1990-94*	13,766.9	2,643.3	16,410.2	1,031.1	328.4	1,359.4
	3.5%	*2.4%*	*2.9%*	*5.66%*	*0.90%*	*4.50%*
1995-99*	15,057.5	2,662.1	17,719.6	1,229.3	326.5	1,555.8
	0.0%	*-2.8%*	*-0.7%*	*1.64%*	*-1.94%*	*0.85%*
2000	3,046.0	549.0	3,595.0	1,125.2	375.8	1,501.0
	-5.5%	*27.0%*	*1.1%*	*-6.73%*	*27.95%*	*0.06%*
2001	3,120.6	548.0	3,668.6	1,210.5	396.6	1,607.1
	5.0%	*5.7%*	*4.9%*	*7.58%*	*5.53%*	*7.07%*
2002	3,120.6	548.0	3,668.6	1,143.1	486.9	1,630.0
	-5.6%	*22.8%*	*1.4%*	*-5.57%*	*22.77%*	*1.42%*
2003	3,132.4	549.0	3,681.4	1,168.0	597.8	1,765.8
	1.8%	*22.5%*	*8.0%*	*2.18%*	*22.77%*	*8.33%*
Average	***0.8%***	***5.7%***	***1.81%***	***2.2%***	***5.6%***	***3.0%***

Sources: CBS 2003, IMF, FAO-STAT

*in average

As seen in table 4.4, since the beginning of 1990s, total NR production continually grows as the previous rejuvenation takes the results begun in this period. The rapid growth of total production is due not only to increases in the area but also the improvement of productivity in both smallholdings and large

[5] Productivity Growth is obtained by firstly find out its productivity (say Pt), in percentage. Then, obtain $((P_t - P_{t-1})/P_{t-1}) \times 100\%$

estates. Between 1967 and 2003 smallholdings improve the yield from 262 kg per ha to 373 kg per ha. This yield is still low reaching as large estates are able to improve the yield from 506 kg per ha to 1,088 kg per ha in the same period.

The productivity-growth of both smallholdings and large estates tend to increase. A significant trend, from period 1990-2003, identified 0.8 percent of smallholding productivity-growth in average and 5.7% productivity-growth of large estates in average, respectively.

Indonesian productivity is now below the Thailand's (as the highest production in less planted area). Indonesia has much potency to boost NR production because of having large planted area. This represents key indicator of the projection which predicts Indonesian NR production will surpass Thailand in 2006, and it is not exaggerates.

4.4.2. Import-Export of Natural Rubber

Cash crops commodity is potential to generate foreign exchange, provide the raw materials for agro-industries, and absorb a large quantity of manpower. Before and during the monetary crisis in 1998, cash crops commodity gives consistent contribution to the country through their export.

Table 4.5 shows that approximately 90 percent of Indonesian NR production is exported. The three main destinations are the United States, Japan, and Singapore which in 2002 accounted for 39.5%, 13.9%, and 4.8% of total NR exports respectively. Though, the exports have suffered from fluctuations in prices.

Table 4.5: Export Volume of NR by Major Country of Destination

(in '000 tonnes)

	1998	1999	2000	2001	2002
USA	726.5	694.9	562.5	517.2	593.1
Japan	87.8	126.2	144.6	151.6	208.1
Singapore	152.1	115.6	89.6	78.1	72.5
Germany	50.6	41.8	56.4	62.5	62.3
Belgium & Luxemburg	39.5	30.5	39.5	53.5	47.0
Others	584.7	485.6	487.0	590.5	513.0
Total	**1,641.2**	**1,494.6**	**1,379.6**	**1,453.4**	**1,496.0**

Source: CBSI 2003

The annual volume of natural rubber export increases. On the other hand, the export values are declined as the prices drop significantly. In 2001, although the NR export volume to Japan increases by 7000 tonnes (table 4.5), its value declines for 7.8 million USD. It is caused by the severe currency depreciation and the decreasing price.

Table 4.6: Export Value of NR by Major Country of Destination

(in million USD, fob)

	1998	1999	2000	2001	2002
USA	487.8	400.3	363.7	281.7	395.8
Japan	55.8	71.0	91.1	83.3	159.3
Singapore	81.7	66.1	56.4	43.8	54.2
Germany	70.1	24.4	37.0	33.3	43.2
Belgium & Luxemburg	26.3	17.3	24.9	29	34.7
Others	379.8	270.0	315.5	315.1	347.5
Total	**1,101.5**	**849.1**	**888.6**	**786.2**	**1,034.7**

Source: CBSI 2003

Some issues come into view when the NR producers face problems of declining prices and currency depreciations. For this reason, in 2002, the three major producing countries (Thailand, Indonesia, and Malaysia) decide to establish an association, namely the *International Tripartite Rubber Corporation* (or ITRCo). The objective is to overcome the declining price and is expectedly able to raise the currency. They agreed to cut their rubber productions by 4 percent and to reduce their rubber exports by 10 percent to align with slower growth in the global rubber industry after the terrorist attacks of 11th September. To following up the

agreement, Indonesia lowered its rubber exports to 1.23 million tons as well as Thailand and Malaysia that lowered exports to 1.93 million tons and 227,000 tons, respectively.

4.4.3. Natural Rubber Consumption

Natural rubber is the raw material used in the manufacture of industrial products (conveyor belts, rubber rollers, etc.), automotive products (fan belts, radiator hoses, etc.), latex products (rubber gloves, toys hygienic products, etc.) and adhesives. The major users of natural rubber are the tyre and footwear industries.

Traditionally, natural rubber is an export crop and until recently consumption was mainly in the industrialized countries. A significant new trend has emerged in recent years whereby most of the producing countries are moving "downstream", converting a significant proportion of their production into manufactured products for domestic use and export with the result that the three largest exporting countries have now joined the ranks of the 12 largest consuming countries (LMC Commodity Bulletin, January 2002).

In the period 1990-94 Indonesia consumed moderately as much as 154,600 ton, in average, because of a rapid growth in elastomer goods, motorcycles, bikes, and tyre industry. Since the seventies, new investment in both foreign-firms expansion (Goodyear, Dunlop, and Bridgestone) and national firms (Intirub, Mega Rubber, United kingstone, and United Kingland) has absorbed lots of natural rubber as their raw material. Tire industry absorbed at least 65% of it (each unit of tire needs 9-10 natural rubber as their material). The need for rubber is not only

fulfilled by local rubber but also by importing synthetic rubber, elastomer goods, and even importing natural rubber.

Table 4.7: Indonesian Production, Export and Consumption for NR

(in '000 tonnes)

Obs	Total Production	Total Export	Consumption*	Consumption Growth (%)
1990-94	1,359.4	1,204.8	154.6	25.10
1995-99	1,555.8	1,462.0	93.8	-35.15
2000	1,501.0	1,379.6	121.4	2107.27
2001	1,607.1	1,453.4	153.7	26.61
2002	1,630.0	1,496.0	134.0	-12.82
2003	1,765.8	1,541.4	224.3	67.43

Sources: CBS 2003, IMF, FAO-STAT

*Consumption = Production – Export

After the period 1995, industrial business demand for NR, gradually decreased since many of investors pulled back their investment because Indonesian economic condition are not preferable for them to invest their capital. Many of business firms suffered from the monetary economy crisis attacked in 1998. Furthermore, the government only encourages the export while discourages the absorption of NR by domestic industries. Industries producing rubber goods, except tyres, have not developed properly, as it is very costly to develop such industries. It is often found that, ironically, Industry which uses NR as the raw material has to buy the material in term of dollar

Consequently, businesses switch to synthetic rubber substitution product[6] and more SR enters Indonesian market. This is in contradiction with the world rubber consumption, which is switching to natural rubber. Therefore, it is not surprised when Indonesia's rubber consumption, currently, is still quite low

[6] "Investment Opportunities Labuhan Ratu: Crumb Rubber Industry", *North Sumatra Regional Investment Coordinating Board*, BPKMD Sumut (2000)

reaching only 224,000 tons per year. Thus, Indonesia's NR consumption per capita is about 1.5Kg/year. It is significant gap as developed countries reach 15-20Kg/year per capita NR consumption.

What action should be taken by Indonesian government to optimize the strategic position of natural rubber as potential cash crops commodity? If it is promoted in Indonesian domestic market, what is the prospect? And can Indonesian natural rubber be "traded on" in domestic market—beside international market? In next chapter, this thesis will try to discuss farther about the problems.

CHAPTER V
DATA ANALYSIS AND INTERPRETATION

5.1. Description of data

This research applies secondary data that is collected from literatures, governmental and international agencies as well as from private organizations. Those are International Financial Statistics, Central Bureau Statistics of Indonesia (CBSI), some related reports and other publications. Meanwhile, the research uses annually time series data for the period between 1980 and 2003. In discussing econometric techniques, a sophisticated and user-friendly statistical package, Eviews, is used to minimize errors in processing data.

To avoid from misinterpretation, again, it is necessary to make variables obvious. These annual data pertain to Indonesia for the period 1980 to 2003:[7]

- ***C***, consumption for NR or industrial businesses absorption of NR
- ***PNR***, price of NR
- ***GDP***, total real GDP
- ***PSR***, (world) price of synthetic rubber (SR)
- ***D***, dummy variable, "1" if $C_t > 100$, or closed to 100, and "0" if otherwise

5.2. Externalities Identification

By referring to the raw data in appendix A.2, the actual data of C (the absorption of NR) has no pattern in trend since it fluctuates from year to year. The values grow up and down. There can be externalities affecting the fluctuation of

[7] See variable definition in section 3.2.

the demand. For this reason, dummy variable are included into the model as dependent variable (D_t).

Rubber market is influenced by many externalities. The supply of natural rubber is conducted by the nature meaning that the harvest time allows the quantity supplied to peak. The other factors are like government policy which encourages the export will influence the local market of natural rubber, devaluation (which Indonesia have experience in 1983 and 1986), buffer stock strategy imposed by seller countries, etc. When the buffer stock is released into the market, the supply is overwhelmed with the commodity and Indonesia will hard to sell abroad. Finally, the domestic consumption is increase.

5.3. Choosing the Proper Model

The results of OLS multiple regression model shows that *DW*-stat is clearly greater than R^2 (1.8016 > 0.6397) meaning that the data is not spurious. Therefore, it does not need to use the error correct model (ECM).[8]

5.3.1. Unit Root Test

In the case of $\boldsymbol{PNR_t}$ (price of NR), the result is that the three different forms of DF test (excluded the *random walk*) obtain estimated $|\tau|$ exceeding the MacKinnon critical tau value at any level of significant (1, 5 and 10%). It means the null hypothesis that $\delta = 0$ is rejected, in which case the time series of $\boldsymbol{PNR_t}$ is ***stationary*** in original level. For instance,

[8] See appendix A-4

$\Delta PNR_t = -0.0378\ PNR_{t-1}$
t = (−0.7646) $R^2 = 0.024$ $d = 2.40$
MacKinnon critical t values are −2.67; −1.957; −1.623 for 1, 5, and 10% respectively.

$\Delta PNR_t = -0.7616\ PNR_{t-1} + 17.16$
t = (−3.6325) (3.5174) $R^2 = 0.3858$ $d = 1.762$
MacKinnon critical t values are −3.75; −2.997; −2.638 for 1, 5, and 10% respectively.

$\Delta PNR_t = -0.8519\ PNR_{t-1} + 0.1956\ t + 16.87$
t = (−3.9384) (1.3491) (3.5224) $R^2 = 0.4371$ $d = 1.771$
MacKinnon critical t values are −4.417; −3.622; −3.25 for 1, 5, and 10% respectively.

(5.1)

In similar way, it is estimated that time series of C_t , GDP_t and PSR_t, respectively, are nonstationary where their estimated $|\tau|$ are statistically insignificant at all 1, 5, and 10% levels of significant.

However, C_t , GDP_t ***and*** PSR_t are ***Stationary*** in the ***1st Difference***.[9]

5.3.2. Cointegrating Regression Durbin-Watson (CRDW) Test

$$GDP_t = -0.5091 + 0.0029\ PSR_t$$
$R^2 = 0.1388$ $d = 0.1785$ **(5.2)**

The 1, 5, and 10 percent critical values to test the hypothesis that the true $d = 0$ are 0.511, 0.386, and 0.322, respectively. Thus, the computed d value is smaller than critical value. Therefore, the null hypothesis of cointegration is rejected at any 1, 5, and 10 percent level of significant.[10]

To sum up, based on CRDW tests, it is found that between GDP_t and PSR_t are not cointegrated. Since the two variables may not have meaningful relationship in economic, the result of CRDW test might be true. These situations exemplify non spurious regression and hence it supports the preceding finding in

[9] See Appendix A-11 to A-13
[10] See Appendix A-14

the OLS multiple regression model that the data is not spurious, which is indicated by $d = 1.8016$ exceeding $R^2 = 0.6398$. (See appendix A-4)

Unit root test finds that the data available is not spurious but faces weak stationary. To recognize the weak nonstationary, this study applies PAM model. Hence, it is necessary to make a lag of dependent variable as the independent variable—that is C_{t-1} (the absorption of NR in the previous year).

PAM and adaptive expectation, the rationalization of the *Koyck* model, in appearance, are indistinguishable but actually they are very different. The following are reasons why the study is related to PAM model:

A. The study discusses about domestic firm's consumption for NR as input used in their production process. The firms are concerned about managing its level of inventories. A firm that does not have the optional amount of the raw material on hand. the natural rubber. will face two costs: the forgone profit from having too much or too little inventory and the cost of adjusting the current level of inventory to the optimal one (the *opportunity cost*). The adjustment may require finding a buyer for the current excess and or obtaining new storage facilities (considering NR is imperishable commodity, the latter is possible). Producers need a given number of NR stock. To minimize costs, the adjustment to the optimal level of stock should be gradual and, hence, there are changes in stock to increase or decrease the existing one. Therefore, in the consumption example Y^* represents a desired expenditure level in consuming NR. The mechanism of how the producers adjust the level of inventory follows the derivation of PAM model.

B. For reason in point A, the study postulates the PAM model of $Y^*_t = \beta_0 + \beta_1 X_t + u_t$, (rather than the adaptive expectation model of $Y_t = \beta_0 + \beta_1 X_t^* + u_t$), where the permanent or long-run dependent variables, Y^*, is a function of the current or observed X. In other words, this study considers $C^*_t = \beta_0 + \beta_1 PNR + \beta_2 GDP + \beta_3 PSR + u_t$ and in this context of demand, Y^* represents the desired quantity to be supplied or the desired acreage to be farmed. It thus determines: how promising the Indonesian natural rubber in domestic market is, and the future growth of Indonesian NR and firms producing NR goods.

C. The adaptive expectation is restricted in one explanatory variable to make it consistent with the *Koyck* model. The rationalization result of adaptive expectation with more than one X's (for example, $Y_t = \beta_0 + \beta_1 X_1^*_t + \beta_2 X_{2t} + u_t$) will not as consistent as it is in PAM model. In other words, it does not produce the common form of $Y_t = \alpha_0 + \alpha_1 X_{1t} + \alpha\beta_2 X_{2t} + \alpha_3 Y_{t-1} + v_t$.

5.4. Choosing Between Linear and Log-Linear Regression Model

Choosing between linear and log-linear regression model is essential in empirical analysis. From the results of *MWD test*, there is not an exact proper choice because Z_1 and Z_2 are both insignificant meaning that it may choose the linear or log-linear model. However, the latter is more appropriate to test the hypotheses since the variables are estimated significant.[11] Therefore, this study will apply the partial adjustment model (PAM) in log form. The estimated equation formulated as follows:[12]

[11] See appendix A-6
[12] See appendix A-5

$$\widehat{\ln C_t} = -1.0972 \ln PNR_t - 0.3799 \ln GDP_t + 1.2177 \ln PSR_t + 0.8544\, D_t + 0.3028 \ln C_{t-1} - 2.3184$$

se	=	(0.4394)	(0.1625)	(0.5751)	(0.1362)	(0.1119)	(3.6539)
t-stat	=	(-2.4970)	(-2.3379)	(2.1175)	(6.2745)	(2.7048)	(-0.6345)
Prob.	=	(0.0231)	(0.0319)	(0.0493)	(0.0000)	(0.0150)	(0.5342)

$R^2 = 0.8126$ DW stat = 2.3965 F-statistic = 14.7464

Adj $R^2 = 0.7575$ df = 18 **(5.3)**

5.5. Statistical Hypotheses Testing

Test of significance approach, one-tail and two-tail tests, is a procedure by which samples results are used to verify the truth or falsity of a null hypothesis. The objective of this test is to know the relationship between independent and dependent variables individually.

A. Test of Variable lnPNR_t, Price of Natural Rubber (NR).

The regression estimates $\beta_1\delta = -1.0972$, se $(\beta_1\delta) = 0.4394$, t-statistic = -2.4970, and df = (23-5) = 18. If it assumes $\alpha = 5$ percent at one-tail test, t_α = - 1.734 and then H_0: $\beta_1\delta = 0$ and H_1: $\beta_1\delta < 0$, hence

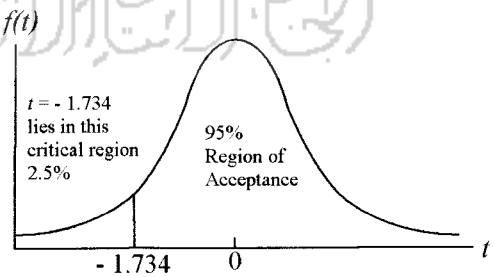

Figure 5.1.The 95% Confidence interval for t(18df)

As shown diagrammatically in figure 5.1, the observed t-statistic clearly lies in the critical region, $|t| > t_{\alpha/2.df}$. Hence, the conclusion is that t-value is statistically significant and the null hypothesis may be rejected. It

means, individually, price of NR does statistically influence consumption for Indonesian NR.

B. Test of Variable ln GDP_t, total real GDP

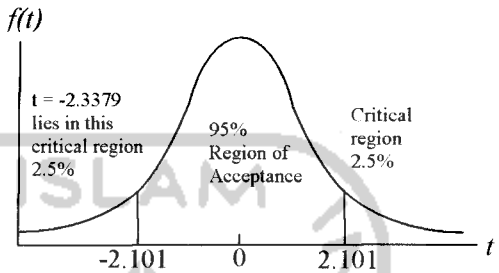

Figure 5.2 The 95% Confidence interval for t(18df)

If it assumes $\alpha = 5$ percent at two-tail test, t-statistic of $\beta_2\delta = -2.3379$; $t_{\alpha/2} = 2.101$ and H_0: $\beta_2\delta = 0$ and H_1: $\beta_2\delta \neq 0$, the observed t-value lies in the critical region 2.5% or $|t| > t_{\alpha/2,df}$. Thus, it is statistically significant and the null hypothesis is rejected. It means, individually, Indonesian total real GDP does influence consumption for Indonesian NR.

C. Test of Variable ln PSR_t, Price of Synthetic Rubber (SR)

The test procedure is the same as before, t-statistic $\beta_3\delta = 2.1175$. If H_0: $\beta_3\delta = 0$ and H_1: $\beta_3\delta \neq 0$, then the two-tail test are shown as follows:

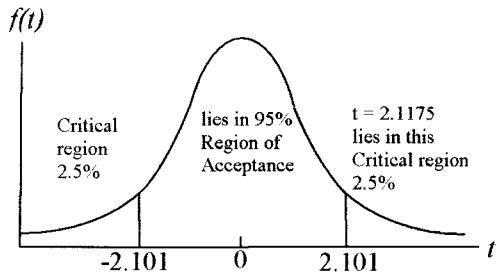

Figure 5.3 The 95% Confidence interval for t(18df)

As seen in figure 5.3, the observed t-value lies in the critical region or $|t| > t_{\alpha/2,df}$. Thus, it is statistically significant and the null hypothesis is rejected. It means, individually, the variable price of synthetic rubber does influence consumption for Indonesian NR.

D. Test of Variable D_t, Dummy Variable

As a rule of thumb that two-tail significant of ρ value is extremely small, closed to zero, it may be concluded that this dummy variable is statistically significant. In other words, there is statistically significantly differential intercept coefficient that tells how much the value of intercept of those who received the dummy value 1 differs from the intercept coefficient of the benchmark category.

E. Test of Variable $\ln C_{t-1}$, consumption for NR at previous year

The regression obtains the t-statistic of $(1-\delta)$ = 2.7048, and df = 18. Assuming α = 5 percent at two-tail test, $t_{\alpha/2}$ = 2.101. H_0: $(1-\delta) = 0$ and H_1: $(1-\delta) \neq 0$, then

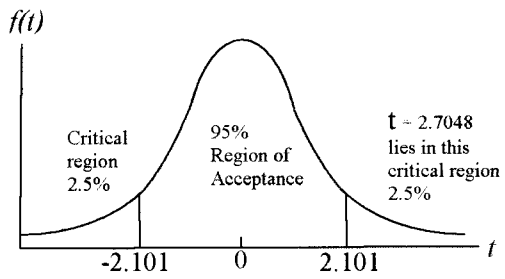

Figure 5.4 The 95% Confidence interval for t(18df)

As shown diagrammatically in figure 5.4., the observed t-statistic clearly lies in the 2.5% critical region and $|t| > t_{\alpha/2,df}$. The conclusion is that t-

value is statistically significant and the null hypothesis is rejected. It means, individually, the variable consumption for NR at previous year (lagged one), does influence consumption for Indonesian NR.

5.6. F-Statistic Testing

Testing the overall significance of a regression in terms of R^2 can use F-test as an alternative to test the eq. 5.3. To test the hypothesis of

$$H_0: \beta_1\delta = \beta_2\delta = \beta_3\delta = \beta_4\delta = (1-\delta) = 0$$

versus

H_1: Not all slope coefficients are simultaneously zero

then, as the regression result, that F-statistic is equal to 14.414 while the critical $F_{\alpha\,(k-1,n-k)}$ value is equal to 2.93, at $\alpha = 5\%$; (k-1) = 4; and (n-k) = 18, it is obtained

$$F > F_{\alpha\,(k-1,n-k)} = 14.4140 > 2.93$$

therefore, that H_0 may be rejected and that the five regressors (PNR_t; GDP_t; PSR_t; D_t; and C_{t-1}) statistically significantly have the joint impact on the absorption of industries producing NR goods.

5.7. Partial Adjustment Model (PAM)

The regression result in the equation 5.3,

$$\widehat{\ln C_t} = -1.0972\ \ln PNR_t - 0.3799\ \ln GDP_t + 1.2177\ \ln PSR_t + 0.8544\ D_t + 0.3028\ \ln C_{t-1} - 2.3184 \qquad \textbf{(5.3)}$$

represents the *short-run equation* of the absorption of industrial business producing in Indonesian market because the total number of NR demanded may

not necessarily be equal to total number demanded in the long-run. It will be estimated *the long-run equation* by simply dividing the short-run through by δ and drop the $\ln C_{t-1}$ term, and the result are:

$$\ln C_t = -1.5738\ \ln PNR_t - 0.5449\ \ln GDP_t + 1.7466\ \ln PSR_t + 1.2255\ D_t - 3.3253 \quad \textbf{(5.4)}$$

As it is presented, the finding long-run estimators is substantially greater (in absolute terms) than the corresponding short-run one.

5.7.1. The Short-Run Domestic Absorption of NR, 1980-2003

The size of R^2 is estimated 0.8126. It means that about 81 percent of the variation in absorption of NR in Indonesian market is explained by PNR_t GDP_t; PSR_t D_t and C_{t-1} (See variables definition in the data description above). It is a fairly high value considering that the maximum value of R^2 can at most be 1.

Referring to the equation 5.3., the estimated equation shows that the ***short run price elasticity*** ***(lnPNR)*** coefficient has the correct sign—negative relationship—and it is statistically significant. The elasticity of C (demand for NR) relative to PNR (price of NR) is estimated 1.0972, in absolute. It suggests that if the price goes up by 1 percent, on average, the demand or absorption of NR is decreased by about 1.10 percent, ceteris paribus. Thus, the absorption is very responsive to changes in price since NR has an "elastic" price when the elasticity is greater than 1. These

support our subjective description in previous chapter, that obviously NR is commodity that has ready substitutes.[13]

The ***short-run income elasticity*** (**ln*GDP***) coefficient is surprisingly negative, and statistically it is not different from zero. The elasticity of *C* in relation to *GDP* is about 0.3799, in absolute. It suggests that if total real GDP goes up by 1 percent, on average, the consumption for NR will reduced by about 0.38 percent, ceteris paribus. Since the consumption goes down as total real GDP increases, it can be said that natural rubber is *inferior* commodity in local market.

The relationship between natural and synthetic rubber is indeed ***substitutes*** when the ***short-run cross-elasticity*** coefficient is more than zero. It is indicated by the finding coefficient 1.2177 on the variable of synthetic rubber price (**ln*PSR***) meaning that a 1 percent increase in price of synthetic rubber affects a decrease in the demand for NR for about 1.2 percent, other things being held constant.

In the case of variable ***D***, dummy variable, it is statistically significant that there is a differential intercept coefficient for those who received the dummy value 1 as much as 0.8544 and those are equal to – 1.4640. These indicate the externalities affecting total amount of the demand for NR in Indonesian market.

[13] Businesses switch to synthetic rubber substitution product and more SR enters Indonesian market. This is in contradiction with the world rubber consumption, which is switching to natural rubber.

Rubber market is influenced by many externalities. The supply of natural rubber is conducted by the nature, government policy, buffer stock strategy, etc. Referring to the data for total consumption, those are so fluctuated. For the period 1980-1984 (excluded 1981), domestic demand for NR were below the average because mostly NR was export. As the price of oil increase, international market substitutes synthetic rubber (SR) with NR. Moreover, the 28% of rupiah devaluation on September 1983 made factor of production so costly to the industrialist. Then, in 1985-1986 a rapid growth in domestic tyre industry has made the demand for NR to increase. For period 1987-1991, a sharp decrease in oil price in 1986 and, again, the 45% of rupiah devaluation have made domestic price of NR exceeds the international price and, consequently, domestic market was sluggish. In 1992-1996 the absorption of NR grows significantly as Indonesian economy wealthier. After that, the economic crisis in the 1997 destroys the economy and shocking every business. However, not until 2000, NR market backs on the track and the demand rises exceeding the average level. In fact, there are so many externalities (it might be in thousand) affecting the fluctuation of the absorption of NR.

The adjustment coefficient is $\delta = (1 - 0.3026) = 0.6974$ (from the coefficient of ln C_{t-1}), suggesting that in any given period consumers, businesses, only adjust their consumption about 70% of the way toward its desired or long run level, ceteris paribus. In other words, the adjustment is very quick.

When the size of constant is converted to the original form (the antilog of – 2.3184), it obtains 0.0984 meaning that the contribution of factors not included in this model is only 0.0984 tonne (or equal to 98.4 Kg) of the total average 112.75 tonne. Therefore, mostly the size of domestic consumption for NR comes from the three factors plus dummy variable (*PNR, GDP, PSR,* and *D).*

5.7.2. The Long-Run Domestic Absorption of NR, 1980-2003

The long-run price elasticity of demand for NR is substantially greater (in absolute terms) than the corresponding short-run elasticity, which is also true of the income elasticity of demand for NR and the cross-elasticity demand of both commodity natural and synthetics rubber.

Returning to eq. (5.4) the estimated ***long-run price elasticity*** (**ln*PNR***) coefficient shows that the elasticity of *C* (absorption of NR) relative to *PNR* (price of NR) is 1.5738, in absolute. In other words, in the long run, a 1 percent increase in price makes the absorption to decrease by totally about 1.57 percent, ceteris paribus. It is, thus, greater than the corresponding short-run elasticity and the price elasticity is elastic.

In addition, the ***long-run income elasticity*** (**ln*GDP***) coefficient shows that the elasticity of *C* relative to *GDP*, is about 0.5449, in absolute. It suggests that in the equilibrium a 1 percent increase in the real GDP reduces the businesses' consumption ultimately by about 0.54 percent, ceteris paribus and in fact, natural rubber is still inferior.

Due to the substitutes-relationship between natural and synthetic rubber, in the long-run, consumers tend to reduce their absorption of NR as much as 1.75 percent for every 1 percent increase in price of the related good price, SR. ceteris paribus. The coefficient indicates a substitution relationship between the two commodities.

In the case of variable ***D***, in the long-run those who received the dummy value "1" have differential intercept value of 1.2255 and it is equal to –2.0998.

In the long-run, the contribution of factors not included in this model is only 0.0360 tonne (or equal to 36 Kg) of the total average 112.75 tonne. Therefore, mostly the size of domestic demand for NR comes from the five factors (*PNR, GDP, PSR, D, and* C_{t-1}).

5.8. Testing Violation of Classical Assumption

5.8.1. Detecting Autocorrelation

Note that the estimated Durbin-Watson *d* is 2.4078, which is close to 2 , suggesting that the ***Breusch-Godfrey*** test is considered better to detect autocorrelation in autoregressive models. Furthermore, the result of autocorrelation test shows that the t-stat value, $(n-j)\ R^2$, does not exceed the critical chi-square value for the 5% level of significance (1.3212 < 5.99) and the null-hypothesis of no serial correlation may be accepted. In other words, ***there is no autocorrelation*** in the error term in this model.[14]

[14] See appendix A-8

5.8.2. Detection of Heteroscedasticity

An important assumption of the classical linear regression model is that the disturbance u_t(s) appearing in the population regression function are homoscedasticity. However, the method of Glejser test will be applied to detect whether this present regression containing heteroscedasticity or not. Glejser suggests regressing the ln $|u_t|$ on the X variables that is thought to be closely associated with σ_t^2. The results of the Glejser test are as follows:

$$\widehat{\ln |u_t|} = -1.8590 \ln PNR_t - 0.4611 \ln GDP_t + 0.7212 \ln PSR_t - 0.0355 \ln C_{t-1} + 3.1872$$

se =	(1.6435)	(0.6182)	(2.2207)	(0.4231)	(13.94)
t =	(-1.1311)	(-0.7458)	(0.3248)	(-0.0840)	(0.2286)

$R^2 = 0.0756$ $\quad t_{\alpha/2,df} = 2.093$ with $\alpha = 5\%$ and df = 19 **(5.3)**

The regression results of all computed t value are statistically significant, each $|t| < t_{\alpha/2,df}$ in two-tail test. Obviously, there is no relationship between the absolute value of the residuals and the regressors. It might be concluded that ***there is no heteroscedasticity*** in the regression. Meanwhile, the Goldfeld-Quant tests also reach the same conclusion concerning this heteroscedasticity.[15]

5.8.3. The Detection of Specification Error

As shown in the appendix A-4, the Ramsey's RESET test results the F-test is insignificant at 5 % level of significance. The value of about 1.1806 is lower than $F_{\alpha\ (k-1,n-k)}$ (of about 2.71) where (k-1) = 7; and (n-k) = 15. It means the hypothesis

[15] See appendix A-7 and A-9

that the model is mis-specified is rejected. In other words, ***the model does not commit the specification errors***.[16]

5.9. The Granger Causality Test

Null Hypothesis:	F-Statistic	Decision
ln PNR_t does not Granger Cause *ln Ct*	2.9535	Sig.
ln C_t does not Granger Cause ln PNR_t	0.5963	NS
ln GDP_t does not Granger Cause ln C_t	1.6710	NS
ln C_t does not Granger Cause ln GDP_t	0.6965	NS
ln PSR_t does not Granger Cause ln C_t	6.2562	Sig.
ln C_t does not Granger Cause ln PSR_t	0.6201	NS

The result of Granger causality test, which is shown in the table 1.1, suggests that apart from $PNR_t \rightarrow C_t$ and $PSR_t \rightarrow C_t$, for the period between 1980 and 2003, at the lag (6) and 18df, there is no bilateral causality of consumption for NR against its explanatory variables, PNR_t GDP_t and PSR_t, since there are statistically insignificant at 5 percent level of significance ($F < F_{\alpha/2\ df}$). However, PNR_t may cause C_t and PSR_t may cause C_t even not for the opposite.[17]

[16] See Appendix A-4
[17] See Appendix A-10

CHAPTER VI
CONCLUSION AND IMPLICATION

6.1. Conclusion

This study discusses empirically about domestic demand for the potential cash crop commodity, natural rubber. It is the amount of natural rubber that is absorb domestically by industrial business to be used as raw material.

There are some findings from which the researcher conducts empirical investigation on domestic demand for natural rubber related to the influence of the price, total real GDP, and related-good price. They are stated as follow:

1. Partial adjustment model (PAM) is the proper model to analyze demand model of economy, that is, the effect of domestic price of NR (***PNR***), Indonesian total real GDP (***GDP***), world price of synthetic rubber (***PSR***), on domestic consumption for NR (***C***). It is shown by:
   a. the size of R^2 = 0.8126 meaning that about 81 percent of the variation in the domestic consumption is explained by *PNR*, *GDP*, *PSR* and plus dummy variable (*D*);
   b. the size of F-statistic = 14.7464 is greater than the F-table (2.93). It means that all explanatory variable has a joint impact on industrial business absorption of NR in Indonesian market;
   c. the lag of dependent variable as the independent variable (C_{t-1}) significantly influences the total consumption;

d. the size of short-run constant of -2.3184 means that in the short-run, the contribution of factors not included in the model is only 0.098 tonne (antilog of -2.3184) while in the long-run the contribution is 0.0360 tonne. Mostly, in both short- and long-run, the size of domestic consumption comes from the three factors plus dummy variable (*PNR*, *GDP*, *PSR*, and *D*) by the average of 112.75 tonne per annum.

2. It is proven that there are externality factors significantly influence total consumption for NR.
3. The long-run price elasticity of demand for NR is substantially greater (in absolute terms) than the corresponding short-run elasticity, which is also true of the income elasticity of consumption for NR and the cross-elasticity of both commodity natural and synthetics rubber.
4. In both short-run and long-run natural rubber does not show any good prospect in domestic market since the commodity is both inferior and elastic price elasticity. In the short- and long-run, the price elasticity is –1.0972 and –1.5738 and the income elasticity is –0.3799 and –0.5449, respectively.
5. The elastic price elasticity indicates that natural rubber has been considered as an unimportant commodity in domestic market. The consumer simply substitutes to the related goods, such as synthetic rubber (obviously, the cross elasticity is positive) and or even the imported natural rubber.
6. In both short-run and long-run, synthetic rubber is, in fact, substitute to natural rubber since the cross-elasticity are positive, 1.2177 and 1.7466, respectively.
7. All classical assumptions are satisfied in this regression model.

6.2. Implication

In line with the conclusion, there are several implications to be pointed out in relation to make commodity natural rubber could be promising in domestic market along with the international market. They are outlined as follow:

1. The finding tells that natural rubber is inferior in domestic market. This indicates that features of NR need to be improved. The quality controls may useful to make NR more preferred. The alternative is way to innovate new features of NR itself so natural rubber will be more ready-to-process. It, thus, needs some further labs research requiring technological advance. This highly qualified new feature of NR will, therefore, be able to compete in the market.
2. In the side of industries producing rubber products, technological advance also has an essential role in maintaining the business performance as modern life can not apart from rubber goods. It means the consumers, the businesses, change the machinery, improve the productivity, and introduce new product. As the result, the industries can increase the profits and reduce the cost in line with consuming more high-quality raw material of natural rubber.

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Comprehensive Data

Obs	(1)	(2)	(3)=(1)+(2)	(4)	(5)=(3)-(4)	(6)	(7)	(8)=(6):(7)	(9)	(10)	(11)=(9):(10)	(12)	(13)	(12)
1980	714.5	305.7	1020.2	976.3	**43.9**	760.8	29.0	**26.26**	294.0	54.3	**5.42**	**1621.57**	-	**0.00**
1981	642.3	300.8	943.1	808.7	**134.4**	575.6	32.5	**17.69**	313.3	50.9	**6.15**	**1610.15**	**43.91**	**1.00**
1982	585.6	301.8	887.4	797.6	**89.8**	507.4	35.6	**14.27**	298.3	48.4	**6.16**	**1461.67**	**134.40**	**0.00**
1983	673.6	308.5	982.1	938.0	**44.1**	912.6	39.8	**22.94**	224.3	44.8	**5.01**	**1280.35**	**89.80**	**0.00**
1984	725.0	313.7	1038.7	1009.5	**29.2**	877.1	44.0	**19.96**	212.1	39.0	**5.44**	**1209.35**	**44.10**	**0.00**
1985	733.8	357.1	1090.9	983.6	**107.3**	740.7	46.1	**16.08**	200.8	36.1	**5.56**	**1263.89**	**29.20**	**1.00**
1986	763.2	320.8	1084.0	958.7	**125.3**	970.5	48.7	**19.93**	184.2	36.2	**5.09**	**1459.67**	**107.30**	**1.00**
1987	795.2	346.1	1141.3	1093.0	**48.3**	1479.0	53.3	**27.78**	150.8	38.4	**3.93**	**1630.71**	**125.30**	**0.00**
1988	838.9	334.4	1173.3	1132.1	**41.2**	1780.3	57.5	**30.94**	155.5	39.8	**3.90**	**1772.49**	**48.30**	**0.00**
1989	853.2	327.0	1180.2	1151.8	**28.4**	1516.3	61.2	**24.76**	161.6	42.1	**3.84**	**1631.50**	**41.20**	**0.00**
1990	913.4	315.3	1228.7	1077.3	**151.4**	1414.7	66.0	**21.44**	169.2	36.9	**4.59**	**1775.78**	**28.40**	**1.00**
1991	971.4	330.1	1301.5	1220.0	**81.5**	1458.0	72.2	**20.20**	174.1	37.6	**4.63**	**1760.55**	**151.40**	**0.00**
1992	1030.4	335.0	1365.4	1267.6	**97.8**	1569.9	77.7	**20.21**	179.4	41.3	**4.35**	**1756.67**	**81.50**	**1.00**
1993	1102.0	335.0	1437.0	1214.3	**222.7**	1638.6	84.8	**19.32**	187.1	43.2	**4.33**	**1502.00**	**97.80**	**1.00**
1994	1138.1	326.4	1464.5	1245.0	**219.5**	2370.0	92.1	**25.74**	194.4	48.3	**4.02**	**1531.60**	**222.70**	**1.00**
1995	1191.1	341.0	1532.1	1323.8	**208.3**	2482.0	100.0	**24.82**	202.1	53.9	**3.75**	**1621.62**	**219.50**	**1.00**
1996	1193.1	334.6	1527.7	1434.3	**93.4**	2764.9	108.0	**25.60**	209.1	56.9	**3.68**	**1647.98**	**208.30**	**1.00**
1997	1174.5	330.5	1505.0	1416.2	**88.8**	2689.8	115.2	**23.35**	176.4	51.4	**3.43**	**1775.15**	**93.40**	**0.00**
1998	1381.4	332.6	1714.0	1641.2	**72.8**	6256.0	181.7	**34.43**	44.5	37.8	**1.18**	**1459.16**	**88.80**	**0.00**
1999	1206.4	293.7	1500.1	1494.6	**75.5**	4579.2	218.6	**20.95**	57.2	41.3	**1.39**	**1394.42**	**72.80**	**0.00**
2000	1125.2	375.8	1501.0	1379.6	**121.4**	5251.7	228.5	**22.98**	56.0	42.2	**1.33**	**1275.05**	**75.50**	**1.00**
2001	1210.5	396.6	1607.1	1453.4	**153.7**	5752.1	255.9	**22.48**	47.6	39.6	**1.20**	**1179.00**	**121.40**	**1.00**
2002	1143.1	486.9	1630.0	1496.0	**134.0**	6600.2	285.2	**23.14**	54.4	41.3	**1.32**	**1092.00**	**153.70**	**1.00**
2003	1148.1	515.2	1663.3	1439.0	**224.3**	6623.3	317.6	**20.85**	60.9	42.1	**1.45**	**1259.00**	**134.00**	**1.00**

Sources: CBSI, BI, IRSG, and IFS

(1) NR Production of Smallholder Estate — 000 tonne
(2) NR Production of Large Estate — 000 tonne
(3) Total Production of NR — 000 tonne
(4) Export Volume of NR — 000 tonne
(5) Total Consumption of NR — 000 tonne
(6) Price of NR, in domestic market — Rp/Kg
(7) CPI, Indonesia — 1995=100
(8) Price of NR, implicit CPI

(9) Indonesian Total Real GDP, Indonesia — Billion USD
(10) ASEAN Total Real GDP, in Average (w/o Indonesia) — Billion USD
(11) Weighted Indonesian Total Real GDP
(12) Price of Synthetic Rubber, at London — USD/tonne
(13) Total Consumption of NR at time (*t-1*) — 000 tonne
(14) Dummy Variable
D = 1 for Yt > 100 (and or close to 100)
D = 0 Otherwise

Raw Data Table

Obs	C_t	PNR_t	GDP_t	PSR_t	D_t	C_{t-1}
1980	43.91	26.26	5.42	1621.57	0.00	-
1981	134.40	17.69	6.15	1610.15	1.00	43.91
1982	89.80	14.27	6.16	1461.67	0.00	134.40
1983	44.10	22.94	5.01	1280.35	0.00	89.80
1984	29.20	19.96	5.44	1209.35	0.00	44.10
1985	107.30	16.08	5.56	1263.89	1.00	29.20
1986	125.30	19.93	5.09	1459.67	1.00	107.30
1987	48.30	27.78	3.93	1630.71	0.00	125.30
1988	41.20	30.94	3.90	1772.49	0.00	48.30
1989	28.40	24.76	3.84	1631.50	0.00	41.20
1990	151.40	21.44	4.59	1775.78	1.00	28.40
1991	81.50	20.20	4.63	1760.55	0.00	151.40
1992	97.80	20.21	4.35	1756.67	1.00	81.50
1993	222.70	19.32	4.33	1502.00	1.00	97.80
1994	219.50	25.74	4.02	1531.60	1.00	222.70
1995	208.30	24.82	3.75	1621.62	1.00	219.50
1996	93.40	25.60	3.68	1647.98	1.00	208.30
1997	88.80	23.35	3.43	1775.15	0.00	93.40
1998	72.80	34.43	1.18	1459.16	0.00	88.80
1999	75.50	20.95	1.39	1394.42	0.00	72.80
2000	121.40	22.98	1.33	1275.05	1.00	75.50
2001	153.70	22.48	1.20	1179.00	1.00	121.40
2002	134.00	23.14	1.32	1092.00	1.00	153.70
2003	224.30	20.85	1.45	1259.00	1.00	134.00

Raw Data Table, in Log Form

$\ln C_t$	$\ln PNR_t$	$\ln GDP_t$	$\ln PSR_t$	$\ln C_{t-1}$	D_t
3.78	3.27	1.69	7.39	-	0.00
4.90	2.87	1.82	7.38	3.78	1.00
4.50	2.66	1.82	7.29	4.90	0.00
3.79	3.13	1.61	7.15	4.50	0.00
3.37	2.99	1.69	7.10	3.79	0.00
4.68	2.78	1.72	7.14	3.37	1.00
4.83	2.99	1.63	7.29	4.68	1.00
3.88	3.32	1.37	7.40	4.83	0.00
3.72	3.43	1.36	7.48	3.88	0.00
3.35	3.21	1.34	7.40	3.72	0.00
5.02	3.07	1.52	7.48	3.35	1.00
4.40	3.01	1.53	7.47	5.02	0.00
4.58	3.01	1.47	7.47	4.40	1.00
5.41	2.96	1.47	7.31	4.58	1.00
5.39	3.25	1.39	7.33	5.41	1.00
5.34	3.21	1.32	7.39	5.39	1.00
4.54	3.24	1.30	7.41	5.34	1.00
4.49	3.15	1.23	7.48	4.54	0.00
4.29	3.54	0.16	7.29	4.49	0.00
4.32	3.04	0.33	7.24	4.29	0.00
4.80	3.13	0.28	7.15	4.32	1.00
5.04	3.11	0.18	7.07	4.80	1.00
4.90	3.14	0.28	7.00	5.04	1.00
5.41	3.04	0.37	7.14	4.90	1.00

OLS Method

Dependent Variable: C_t
Method: Least Squares
Sample: 1980 2003
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PNR_t	-2.0294	2.5827	-0.7858	0.4417
GDP_t	-8.7084	7.1151	-1.2239	0.2359
PSR_t	0.0356	0.0489	0.7272	0.4760
D_t	88.8698	18.3784	4.8356	0.0001
Constant	87.6842	79.1411	1.1079	0.2817
R-squared	0.6398	Mean dependent var		109.8767
Adjusted R-squared	0.5639	S.D. dependent var		61.7492
S.E. of regression	40.78	Akaike info criterion		10.4371
Sum squared resid	31590.24	Schwarz criterion		10.6825
Log likelihood	-120.2451	F-statistic		8.4366
Durbin-Watson stat	1.8016	Prob(F-statistic)		0.0004

Specification Error Test

Ramsey's RESET Test:

F-statistic	1.1806	Probability	0.3341
Log likelihood ratio	3.3624	Probability	0.1861

Dependent Variable: ln C_t
Method: Least Squares
Sample: 1981 2003
Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ln PNR_t	-16.6452	63.3409	-0.2628	0.7963
ln GDP_t	-5.7948	21.8474	-0.2652	0.7944
ln PSR_t	18.4022	70.0650	0.2626	0.7964
D_t	13.3901	49.4310	0.2709	0.7902
ln C_{t-1}	4.7214	17.4492	0.2706	0.7904
Constant	-58.2068	215.6210	-0.2699	0.7909
FITTED^2	-2.7668	13.1859	-0.2098	0.8366
FITTED^3	0.1672	0.9955	0.1679	0.8689
R-squared	0.8381	Mean dependent var		4.5621
Adjusted R-squared	0.7626	S.D. dependent var		0.6168
S.E. of regression	0.3005	Akaike info criterion		0.7017
Sum squared resid	1.3548	Schwarz criterion		1.0967
Log likelihood	-0.0696	F-statistic		11.0944
Durbin-Watson stat	2.3928	Prob(F-statistic)		0.0001

Partial Adjustment Model (PAM)

A. Non linear model

Dependent Variable: ln C_t
Method: Least Squares
Sample(adjusted): 1981 2003
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ln PNR_t	-1.0972	0.4394	-2.4970	0.0231
ln GDP_t	-0.3799	0.1625	-2.3379	0.0319
ln PSR_t	1.2177	0.5751	2.1175	0.0493
D_t	0.8544	0.1362	6.2745	0.0000
ln C_{t-1}	0.3028	0.1119	2.7048	0.0150
constant	-2.3184	3.6539	-0.6345	0.5342
R-squared	0.8126	Mean dependent var		4.5621
Adjusted R-squared	0.7575	S.D. dependent var		0.6168
S.E. of regression	0.3037	Akaike info criterion		0.6740
Sum squared resid	1.5681	Schwarz criterion		0.9702
Log likelihood	-1.7508	F-statistic		14.7464
Durbin-Watson stat	2.3965	Prob(F-statistic)		0.0000

B Linear model

Dependent Variable: C_t
Method: Least Squares
Sample(adjusted): 1981 2003
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PNR_t	-2.8635	2.5509	-1.1225	0.2772
GDP_t	-7.7950	7.0207	-1.1103	0.2823
PSR_t	0.0313	0.0464	0.6745	0.5091
D_t	77.7590	18.1813	4.2769	0.0005
C_{t-1}	0.3170	0.1511	2.0983	0.0511
constant	82.5992	75.6411	1.0920	0.2901
R-squared	0.6983	Mean dependent var		112.7448
Adjusted R-squared	0.6095	S.D. dependent var		61.4807
S.E. of regression	38.4179	Akaike info criterion		10.3544
Sum squared resid	25090.84	Schwarz criterion		10.6506
Log likelihood	-113.0754	F-statistic		7.8685
Durbin-Watson stat	2.1464	Prob(F-statistic)		0.0005

MWD Test

A Linear model

Dependent Variable: C_t
Method: Least Squares
Sample(adjusted): 1981 2003
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PNR_t	-2.8683	2.6221	-1.0939	0.2902
GDP_t	-7.1573	7.5222	-0.9515	0.3555
PSR_t	0.0293	0.0481	0.6076	0.5520
C_{t-1}	0.3258	0.1580	2.0616	0.0559
Z_1	-29.2864	97.4918	-0.3004	0.7677
D_t	77.8447	18.6904	4.1650	0.0007
constant	83.3253	77.7877	1.0712	0.3000
R-squared	0.7000	Mean dependent var		112.7448
Adjusted R-squared	0.5875	S.D. dependent var		61.4807
S.E. of regression	39.4890	Akaike info criterion		10.4357
Sum squared resid	24950.1209	Schwarz criterion		10.7813
Log likelihood	-113.0107	F-statistic		6.2212
Durbin-Watson stat	2.1645	Prob(F-statistic)		0.0016

B Non Linear model

Dependent Variable: ln C_t
Method: Least Squares
Sample(adjusted): 1981 2003
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ln PNR_t	-1.2246	0.4572	-2.6784	0.0165
ln GDP_t	-0.4592	0.1779	-2.5807	0.0201
ln PSR_t	1.3643	0.5945	2.2948	0.0356
ln C_{t-1}	0.2983	0.1117	2.6714	0.0167
Z_2	-0.0082	0.0069	-1.1815	0.2547
D_t	0.8272	0.1382	5.9851	0.0000
constant	-2.8916	3.7014	-0.7812	0.4461
R-squared	0.8245	Mean dependent var		4.5630
Adjusted R-squared	0.7586	S.D. dependent var		0.6167
S.E. of regression	0.3030	Akaike info criterion		0.6955
Sum squared resid	1.4687	Schwarz criterion		1.0411
Log likelihood	-0.9980	F-statistic		12.5241
Durbin-Watson stat	2.3981	Prob(F-statistic)		0.0000

Heteroschedasticity

A. Glejser Test

Dependent Variable: ln $|u_t|$
Method: Least Squares
Sample(adjusted): 1981 2003
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PNR_t	-1.8590	1.6435	-1.1311	0.2729
GDP_t	-0.4611	0.6182	-0.7458	0.4654
PSR_t	0.7212	2.2207	0.3248	0.7491
C_{t-1}	-0.0355	0.4231	-0.0840	0.9340
constant	3.1872	13.9400	0.2286	0.8217
R-squared	0.0756	Mean dependent var		1.9852
Adjusted R-squared	-0.1298	S.D. dependent var		1.0959
S.E. of regression	1.1648	Akaike info criterion		3.3327
Sum squared resid	24.4222	Schwarz criterion		3.5795
Log likelihood	-33.3256	F-statistic		0.3681
Durbin-Watson stat	2.3162	Prob(F-statistic)		0.8282

B. Goldfelt-Quant Test

Dependent Variable: C_t
Method: Least Squares
Sample: 1980 1989
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PNR_t	-5.1627	9.4440	-0.5467	0.6137
GDP_t	-11.7245	13.1722	-0.8901	0.4237
PSR_t	-0.0485	0.0886	-0.5478	0.6130
C_{t-1}	0.6809	0.4040	1.6856	0.1672
D_t	98.2436	28.7415	3.4182	0.0268
constant	220.0517	211.1759	1.0420	0.3562
R-squared	0.7895	Mean dependent var		118.7800
Adjusted R-squared	0.5265	S.D. dependent var		62.2893
S.E. of regression	42.8629	Akaike info criterion		10.6376
Sum squared resid	7348.92	Schwarz criterion		10.8192
Log likelihood	-47.1880	F-statistic		3.0013
Durbin-Watson stat	2.2761	Prob(F-statistic)		0.1546

Autocorrelation

Breusch-Godfrey Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.9751	Prob.	0.3381
Obs*R-squared	1.3212	Prob.	0.2504

Dependent Variable: u_t
Method: Least Squares
Sample(adjusted): 1982 2003
Included observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ln PNR_t	0.0616	0.4442	0.1387	0.8914
ln GDP_t	0.0240	0.1646	0.1459	0.8858
ln PSR_t	-0.0854	0.5818	-0.1469	0.8851
D_t	-0.0253	0.1387	-0.1830	0.8571
ln C_{t-1}	0.0509	0.1233	0.4128	0.6852
u_{t-1}	-0.2744	0.2779	-0.9875	0.3381
constant	0.1880	3.6604	0.0513	0.9597
R-squared	0.0574	Mean dependent var		0.0000
Adjusted R-squared	-0.2960	S.D. dependent var		0.2669
S.E. of regression	0.3039	Akaike info criterion		0.7013
Sum squared resid	1.4774	Schwarz criterion		1.0469
Log likelihood	-1.0655	F-statistic		0.1625
Durbin-Watson stat	2.1916	Prob(F-statistic)		0.9832

Data of Goldfeld-Quant Test

PNR_t	GDP_t	PSR_t	D_t	C_{t-1}	C_t	Obs	
14.27	6.16	1461.67	0.00	134.40	89.80	1982	
16.08	5.56	1263.89	1.00	29.20	107.30	1985	
17.69	6.15	1610.15	1.00	43.91	134.40	1981	
19.32	4.33	1502.00	1.00	97.80	222.70	1993	
19.93	5.09	1459.67	1.00	107.30	125.30	1986	
19.96	5.44	1209.35	0.00	44.10	29.20	1984	
20.20	4.63	1760.55	0.00	151.40	81.50	1991	
20.21	4.35	1756.67	1.00	81.50	97.80	1992	
20.85	1.45	1259.00	1.00	134.00	224.30	2003	
20.95	1.39	1394.42	0.00	72.80	75.50	1999	
21.44	4.59	1775.78	1.00	28.40	151.40	1990	
22.48	1.20	1179.00	1.00	121.40	153.70	2001	The Middle Three
22.94	5.01	1280.35	0.00	89.80	44.10	1983	
22.98	1.33	1275.05	1.00	75.50	121.40	2000	
23.14	1.32	1092.00	1.00	153.70	134.00	2002	
23.35	3.43	1775.15	0.00	93.40	88.80	1997	
24.76	3.84	1631.50	0.00	41.20	28.40	1989	
24.82	3.75	1621.62	1.00	219.50	208.30	1995	
25.60	3.68	1647.98	1.00	208.30	93.40	1996	
25.74	4.02	1531.60	1.00	222.70	219.50	1994	
27.78	3.93	1630.71	0.00	125.30	48.30	1987	
30.94	3.90	1772.49	0.00	48.30	41.20	1988	
34.43	1.18	1459.16	0.00	88.80	72.80	1998	
26.26	5.42	1621.57	0.00	-	43.91	1980	

Causality Test

Null Hypothesis:	Lag	Obs	F-Stat	Prob.	Decision
ln PNR_t does not Granger Cause ln C_t	6	18	2.9535	0.1275	Sig
ln C_t does not Granger Cause ln PNR_t			0.5963	0.7273	NS
ln GDP_t does not Granger Cause ln C_t	6	18	1.6710	0.2948	NS
ln C_t does not Granger Cause ln GDP_t			0.6965	0.6669	NS
ln PSR_t does not Granger Cause ln C_t	6	18	6.2562	0.0313	Sig
ln C_t does not Granger Cause ln PSR_t			0.6201	0.7127	NS
ln PNR_t does not Granger Cause ln C_t	5	19	1.6954	0.2413	NS
ln C_t does not Granger Cause ln PNR_t			0.8067	0.5757	NS
ln GDP_t does not Granger Cause ln C_t	5	19	0.6188	0.6904	NS
ln C_t does not Granger Cause ln GDP_t			0.7332	0.6187	NS
ln PSR_t does not Granger Cause ln C_t	5	19	2.7081	0.1014	Sig
ln C_t does not Granger Cause ln PSR_t			0.3936	0.8403	NS
ln PNR_t does not Granger Cause ln C_t	4	20	0.9977	0.4490	NS
ln C_t does not Granger Cause ln PNR_t			0.5524	0.7016	NS
ln GDP_t does not Granger Cause ln C_t	4	20	0.5965	0.6727	NS
ln C_t does not Granger Cause ln GDP_t			0.5538	0.7006	NS
ln PSR_t does not Granger Cause ln C_t	4	20	0.8976	0.4977	NS
ln C_t does not Granger Cause ln PSR_t			0.6367	0.6470	NS
ln PNR_t does not Granger Cause ln C_t	3	21	0.8260	0.5012	NS
ln C_t does not Granger Cause ln PNR_t			0.9408	0.4472	NS
ln GDP_t does not Granger Cause ln C_t	3	21	1.0508	0.4009	NS
ln C_t does not Granger Cause ln GDP_t			0.4195	0.7419	NS
ln PSR_t does not Granger Cause ln C_t	3	21	1.0794	0.3897	NS
ln C_t does not Granger Cause ln PSR_t			0.3303	0.8036	NS
ln PNR_t does not Granger Cause ln C_t	2	22	1.1916	0.3279	NS
ln C_t does not Granger Cause ln PNR_t			1.5325	0.2444	NS
ln GDP_t does not Granger Cause ln C_t	2	22	1.8662	0.1850	NS
ln C_t does not Granger Cause ln GDP_t			0.3048	0.7412	NS
ln PSR_t does not Granger Cause ln C_t	2	22	1.5514	0.2405	NS
ln C_t does not Granger Cause ln PSR_t			0.1076	0.8986	NS
ln PNR_t does not Granger Cause ln C_t	1	23	0.0209	0.8865	NS
ln C_t does not Granger Cause ln PNR_t			1.9039	0.1829	NS
ln GDP_t does not Granger Cause ln C_t	1	23	1.2989	0.2679	NS
ln C_t does not Granger Cause ln GDP_t			0.8496	0.3676	NS
ln PSR_t does not Granger Cause ln C_t	1	23	0.9255	0.3475	NS
ln C_t does not Granger Cause ln PSR_t			0.0000	0.9990	NS

Unit Root Test

DF Test in Original Level with no Lag

1. Random Walk

C_t		Critical Value	
ADF t-stat	**-0.5320**	1%	-2.6700
		5%	-1.9566
		10%	-1.6235
PNR_t			
ADF t-stat	**-0.7646**	1%	-2.6700
		5%	-1.9566
		10%	-1.6235
GDP_t			
ADF t-stat	**-1.4472**	1%	-2.6700
		5%	-1.9566
		10%	-1.6235
PSR_t			
ADF t-stat	**-0.7251**	1%	-2.6700
		5%	-1.9566
		10%	-1.6235

2. Random Walk with Intercept

C_t		Critical Value	
ADF t-stat	**-2.4916**	1%	-3.7497
		5%	-2.9969
		10%	-2.6381
PNR_t			
ADF t-stat	**-3.6325**	1%	-3.7497
		5%	-2.9969
		10%	-2.6381
GDP_t			
ADF t-stat	**-0.6145**	1%	-3.7497
		5%	-2.9969
		10%	-2.6381
PSR_t			
ADF t-stat	**-1.4463**	1%	-3.7497
		5%	-2.9969
		10%	-2.6381

3. Random Walk with Incercept and Trend

C_t		Critical Value	
ADF t-stat	**-2.8873**	1%	-4.4167
		5%	-3.6219
		10%	-3.2474
PNR_t			
ADF t-stat	**-3.9385**	1%	-4.4167
		5%	-3.6219
		10%	-3.2474
GDP_t			
ADF t-stat	**-2.6811**	1%	-4.4167
		5%	-3.6219
		10%	-3.2474
PSR_t			
ADF t-stat	**-1.5156**	1%	-4.4167
		5%	-3.6219
		10%	-3.2474

ADF Test in Original Level (with Lag-1)

C_t		Critical Value	
ADF t-stat	**-2.8951**	1%	-4.4415
		5%	-3.6330
		10%	-3.2535
PNR_t			
ADF t-stat	**-3.1390**	1%	-4.4415
		5%	-3.6330
		10%	-3.2535
GDP_t			
ADF t-stat	**-2.3878**	1%	-4.4415
		5%	-3.6330
		10%	-3.2535
PSR_t			
ADF t-stat	**-1.9232**	1%	-4.4415
		5%	-3.6330
		10%	-3.2535

Test in the 1st Different

ADF Test Statistic	**-3.9328**	1% Critical Value*	-3.7856
		5% Critical Value	-3.0114
		10% Critical Value	-2.6457

Dependent Variable: D(ABSO,2)
Method: Least Squares
Sample(adjusted): 1983 2003
Included observations: 21 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ABSO(-1))	-1.3647	0.3470	-3.9328	0.0010
D(ABSO(-1),2)	0.2432	0.2263	1.0747	0.2967
C	7.6755	13.6724	0.5614	0.5815
R-squared	0.5558	Mean dependent var		6.4252
Adjusted R-squared	0.5065	S.D. dependent var		88.8534
S.E. of regression	62.4199	Akaike info criterion		11.2372
Sum squared resid	70132.47	Schwarz criterion		11.3864
Log likelihood	-114.9907	F-statistic		11.2629
Durbin-Watson stat	2.0183	Prob(F-statistic)		0.0007

ADF Test Statistic	**-4.1514**	1% Critical Value*	-3.7856
		5% Critical Value	-3.0114
		10% Critical Value	-2.6457

Dependent Variable: D(GDP_t,2)
Method: Least Squares
Sample(adjusted): 1983 2003
Included observations: 21 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP_t(-1))	-1.3671	0.3293	-4.1514	0.0006
D(GDP_t(-1),2)	0.2427	0.2182	1.1122	0.2807
Constant	-0.3017	0.1577	-1.9132	0.0718
R-squared	0.5781	Mean dependent var		0.0057
Adjusted R-squared	0.5312	S.D. dependent var		0.9413
S.E. of regression	0.6445	Akaike info criterion		2.0908
Sum squared resid	7.4761	Schwarz criterion		2.2400
Log likelihood	-18.9531	F-statistic		12.3318
Durbin-Watson stat	1.8923	Prob(F-statistic)		0.0004

ADF Test Statistic	-3.7852	1% Critical Value*	-3.7667
		5% Critical Value	-3.0038
		10% Critical Value	-2.6417

Dependent Variable: D(PSR,2)
Method: Least Squares
Sample(adjusted): 1982 2003
Included observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PSR(-1))	-0.8759	0.2314	-3.7852	0.0012
C	-12.9731	31.8752	-0.4070	0.6883

R-squared	0.4174	Mean dependent var	8.1100
Adjusted R-squared	0.3883	S.D. dependent var	188.21
S.E. of regression	147.21	Akaike info criterion	12.9081
Sum squared resid	433402.06	Schwarz criterion	13.0073
Log likelihood	-139.9888	F-statistic	14.3279
Durbin-Watson stat	1.8872	Prob(F-statistic)	0.0012

Cointegration Test

Dependent Variable: GDP_t
Method: Least Squares
Sample: 1980 2003
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PSR_t	0.0029	0.0015	1.8827	0.0730
Constant	-0.5091	2.3096	-0.2204	0.8276
R-squared	0.1388	Mean dependent var		3.7979
Adjusted R-squared	0.0996	S.D. dependent var		1.6414
S.E. of regression	1.5575	Akaike info criterion		3.8037
Sum squared resid	53.3665	Schwarz criterion		3.9018
Log likelihood	-43.6441	F-statistic		3.5447
Durbin-Watson stat	0.1785	Prob(F-statistic)		0.0730

Dependent Variable PSR_t
Method: Least Squares
Sample: 1980 2003
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_t	48.29	25.6485	1.8827	0.0730
Constant	1315.41	105.7705	12.4364	0.0000
R-squared	0.1388	Mean dependent var		1498.81
Adjusted R-squared	0.0996	S.D. dependent var		212.78
S.E. of regression	201.90	Akaike info criterion		13.5331
Sum squared resid	896801	Schwarz criterion		13.6312
Log likelihood	-160.40	F-statistic		3.5447
Durbin-Watson stat	0.4503	Prob(F-statistic)		0.0730