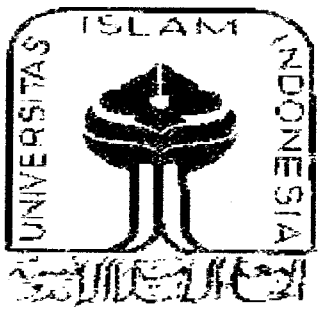
AN ANALYSIS OF FACTORS AFFECTING INDONESIA'S CRUDE OIL EXPORTS TO THE UNITED STATES:
A PARTIAL ADJUSTMENT MODEL (PAM)
1970 - 2001

A THESIS

Presented as Partial Fulfillment of the Requirements
To Obtain the S1 Degree in Economics Department



By

FARIDA KUMALA RATIH
Student Number : 99313189

DEPARTMENT OF ECONOMICS
INTERNATIONAL PROGRAM
FACULTY OF ECONOMICS
ISLAMIC UNIVERSITY OF INDONESIA
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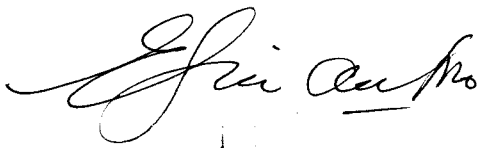
Approved by

Content Advisor,



Endang Sih Prapti, Dra., MA **February,2004**

Language Advisor,

Kusworo **February,2004**

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Examiner 1

Endang Sih Prapti, MA .....

Examiner 2

Agus Widarjono, MA .....

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International Program
Faculty of Economics
Islamic University of Indonesia
Dean

Drs. Suwarsono, MA

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DEVOTION PAGE

I Devoted My Thesis To :

- *My Parents For Their Prayers*
- *My Sister and My Brother*
- *My Families and Friends*

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ABSTRACT

Since long time, the main destination countries of Indonesian oil export has been were Japan, The United State of America, and Singapore. Even thought Japan is the main destination of Indonesian oil export and USA placed in the second order, but volume of export oil from Indonesia to USA is more stable than to Japan. Oil is the lifeblood of America's economy. Currently, it supplies more than 40% of world total energy demand. Since 1970s USA has been one of the main destination country of exporting oil from Indonesia. Besides that USA is one of developed countries, USA is also one of the industrializing countries. All the fact above interests the researcher, in holding the research to recognize the flows of export crude oil Indonesia to United States in order to support the government policy in International Trade. Hence, the title of this thesis is **AN ANALYSIS OF FACTORS AFFECTING INDONESIA'S CRUDE OIL EXPORTS TO THE UNITED STATES: A PARTIAL ADJUSTMENT MODEL (PAM) 1970-2001.**

This research attempts to investigate:

1. The effect of Indonesia's oil price on the export volume of Indonesia's oil to USA.
2. The effect of FOREX Rate on the export volume of Indonesia's oil to USA.
3. The effect of Real Total GDP of the USA on the volume of Indonesia's oil to USA.
4. The effect of coal's price on the export volume of Indonesia's oil to USA.
5. The effect of previous oil export on the export volume of Indonesia's oil to USA.

The data used in this study are secondary data consisting of the export volume of Indonesia's oil to USA, the prices of oil, FOREX Rate, USA Real Total GDP, the prices of coal, and the export volume at previous time from IFS reported by IMF, BPS and some related website. To eliminate the mistakes and to make the estimation process is easier, the researcher used computer program Eviews version 3.0. The relevance economic theory that is used in this research is demand theory. i.e. the demand of the USA on Indonesia's oil. The analytical method used in this research are PAM (Partial Adjustment Model). Since this research using PAM so volume export at previous year will be used as independent variable. The demand model can be as followed:

$$Y = F(X_1, X_2, X_3, X_4, Y_{t-1}, \mu)$$

Where:

Y = Volume of oil export of Indonesia, Million tones
X_1 = Price of oil, USD/barrel weighted by CPI of USA.
X_2 = Foreign Exchange Rate, Rp/USD
X_3 = US Real Total GDP, Bill of USD

Real Total GDP USA is weighted by average Real GDP of G4 (Japan, UK, Germany, France).

X_4 = Price of coal USD/Metric

Y_{t-1} = volume export at previous years (lagged 1 year).

μ = Error term

To reach the objective of this research, specifically, hypothesis testing, this research uses Time Series model using annually data from 1970-2001. The regression that used in this research is log linier.

The log Linier (double log) regression can be written as follow;

$$\ln Y = \ln\alpha_0 + \alpha 1 \ln X1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln Y_{t-1} + \mu_i$$

Where;

$\ln\alpha_0$ = Autonomous lnY

α_i = Elasticity of each independent variable.

The result of this research are:

1. Price of oil (X_1) has a negative and significant effect on the volume of oil export.
2. FOREX Rate (X_2) has a significant and negative effect on the volume of oil export.
3. Real Total GDP USA (X_3) has a significant and positive effect on the volume of oil export.
4. Price of coal (X_4) has a significant and positive effect on the volume of oil export.
5. Oil export at previous year (Y_{t-1}) has a significant and positive effect on the volume of oil export.

From the Short Run and Long Run PAM Regression model the researcher can conclude that Indonesia's oil is less important to the USA in the future because in the short run Indonesia's oil is inelastic and becoming more elastic in the future. Beside that, the decision of buying Indonesia's oil is more induced by income decision. In the short run the commodity is necessity, however, in the long run it becomes non-necessity. From both result the researcher can conclude that Indonesia can not rely on their income from oil. From the result elasticity, it is can be seen that coal is substitute of oil meaning that in the future Indonesia still can focus from oil to coal. FOREX Rate have no effect on the volume of oil export to USA because in the short run FOREX is very volatile.

ABSTRAK

Negara utama tujuan ekspor minyak Indonesia adalah Jepang, Amerika dan Singapura. Meskipun Jepang adalah negara tujuan utama ekspor minyak Indonesia sedangkan peringkat kedua ditempati oleh Amerika, akan tetapi volume ekspor minyak Indonesia ke Amerika relatif lebih stabil daripada ekspor minyak Indonesia ke Jepang. Minyak merupakan sumber kehidupan paling utama dari perekonomian Amerika. Hal itu menyumbang tidak kurang dari 40% dari total permintaan dunia. Sejak tahun 1970-an Amerika adalah salah satu negara tujuan utama dari ekspor minyak Indonesia. Alasan diambilnya Amerika sebagai negara tujuan ekspor adalah disamping Amerika adalah negara maju, Amerika juga merupakan salah satu negara industri terbesar di dunia. Semua faktor-faktor diatas menarik minat penulis untuk menganalisa aliran ekspor minyak Indonesia ke Amerika untuk mendukung kebijakan pemerintah di bidang perdagangan Internasional. Oleh karena itu maka pada penelitian ini mengambil judul **AN ANALYSIS OF FACTORS AFFECTING INDONESIA'S CRUDE OIL EXPORTS TO THE UNITED STATES: PARTIAL ADJUSTMENT MODEL (PAM) 1970-2001.**

Penelitian ini mencoba untuk menganalisa:

1. Pengaruh harga minyak terhadap volume ekspor minyak Indonesia ke Amerika.
2. Pengaruh kurs terhadap volume ekspor minyak Indonesia ke Amerika.
3. Pengaruh GDP Total Riil Amerika terhadap volume ekspor minyak Indonesia ke Amerika.
4. Pengaruh harga batu-bara terhadap volume ekspor minyak Indonesia ke Amerika.
5. Pengaruh volume ekspor pada tahun sebelumnya terhadap volume ekspor minyak Indonesia ke amerika.

Data yang digunakan pada penelitian ini adalah *secondary data* yang terdiri dari: volume ekspor minyak Indonesia ke Amerika, harga minyak, kurs, GDP Total Riil Amerika, harga batu-bara dan ekspor pada tahun sebelumnya yang kesemuanya diperoleh dari IFS terbitan IMF, kemudian dari BPS dan beberapa website. Untuk mengurangi kesalahan-kesalahan yang mungkin terjadi maka penelitian ini menggunakan program komputer Eviews 3.0. Teori ekonomi yang digunakan pada penelitian ini adalah teori permintaan sebagai contoh: teori permintaan ekspor minyak Indonesia ke Amerika. Metode analisis yang dipakai adalah PAM (Partial Adjustment Model). Karena penelitian ini memakai PAM sebagai metodenya maka volume ekspor pada tahun sebelumnya akan digunakan sebagai salah satu independen variabel. Fungsi permintaannya adalah:

$$Y = F(X_1, X_2, X_3, X_4, Y_{t-1}, \mu)$$

Dimana:

Y = Volume ekspor minyak Indonesia ke amerika. Juta Ton
X1 = Harga minyak USD/barel
X2 = Kurs, Rp/USD
X3 = GDP Total Riil Amerika, Trilyun USD
GDP Total Riil Amerika diboboti dengan Rata-rata GDP Total Riil G4 (Jepang, Inggris, Jerman, Prancis)
X4 = Harga batu bara USD/ metric
Yt-1 = volume ekspor pada tahun sebelumnya.
μ = error term

Penelitian ini menggunakan Time series data dari tahun 1970-2001. sedangkan regressi yang digunakan adalah regresi log-linier.

Regressi log-linier dapat dituliskan sebagai berikut:

$$\ln Y = \ln\alpha_0 + \alpha 1 \ln X_1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln Y_{t-1} + \mu_i$$

Dimana:

$\ln\alpha_0$ = Autonomous ln Y

αi = Elastisitas masing-masing independent variabel

Hasil dari penelitian ini adalah:

1. Harga minyak (X_1) mempunyai efek negatif terhadap volume ekspor.
2. Kurs (X_2) mempunyai efek negatif terhadap volume ekspor.
3. GDP Total Riil Amerika (X_3)mempunyai efek positif terhadap volume ekspor.
4. Harga batu bara (X_4)mempunyai efek positif terhadap volume ekspor.
5. Volume expor pada tahun sebelumnya (Y_{t-1})mempunyai efek positif terhadap volume ekspor.

Dari Short run dan Long run PAM Regression model penulis dapat menyimpulkan bahwa minyak Indonesia tidak begitu penting di Amerika di masa mendatang karena pada short run minyak Indonesia inelastic dan menjadi elastik di masa mendatang. Disamping itu, keputusan Amerika dalam membeli minyak dari Indonesia lebih didasarkan pada pendapatan. Pada short run minyak Indonesia adalah barang kebutuhan pokok, tetati kemudian menjadi barang bukan kebutuhan pokok. Dari hasil tersebut diatas Indonesia tidak dapat mengandalkan penerimaan pendapatannya dari minyak. Dari hasil elastisitas dapat dilihat bahwa dimasa mendatang Indonesia dapat menfokuskan diri pada ekspor batu bara sebagai pengganti minyak. Sedangkan kurs, disini tidak mempunyai pengaruh apa-apa terhadap volume eksport minyak Indonesia.

CHAPTER I

INTRODUCTION

1.1. Background of the Study

Indonesia as a country that follow open economic system will be very influenced by the changes of international economic and political situation, relevance with its inclination through world free trade system. The presence of stabilization in the monetary sector after 1997 crisis that affected on some East Asian countries, Indonesia faces the most serious problem in crisis (i.e., along with South Korea, Malaysia, and Thailand). A country that achieved decades of rapid growth, stability, and poverty reduction, is now near economic collapse. There is socio-economic hardship in the worst affected economies in the monetary and physically sector, in particular rising underemployment, poverty, the destroyed of some economic sector.

Since 1991 the structure of Indonesia Economic has been shifted from the domination of agriculture sector to manufacturing sector. This transformation shown by the share of agriculture in the GDP at current prices being declined except in 1998 and 1999.

Share of agriculture was 18.08 percent in 1998, 19.61 percent in 1999, decreased to 17.03 percent in 2000 and then decreased again to 16.39 percent in 2001. The biggest contribution to the agriculture sector came from the food crops sub-sector, mainly by rice which is the main food of Indonesians.

The mining and quarrying sector, which is constructed by crude oil and natural gas, non-oil and gas mining, quarrying, shows a fluctuative share to the GDP. In 1991, the share of mining and quarrying sector placed at the second largest after the agriculture sector. In 1998, the share of mining and quarrying sector was 12.59 percent, and then decreased to 10.00 percent in 1999, increased to 13.78 percent in 2000, and slightly decreased in 2001 to 13.59 percent.

The share of crude oil and natural gas sub-sector decreased from 7.84 percent in 1998 to 6.59 percent in 1999, then increased to 10.22 percent in 2000, and it decreased again in 2001 became 9.60 percent[1]. The high demand for finished and intermediate goods from domestic and overseas has placed the share of manufacturing in the GDP since 1991.

In 1998 the share of manufacturing was 25.00 percent and then increased to 25,99 percent in 1999, and 26.16 percent in 2000. in 2001 the share tend to decrease to 26.11 percent. The increasing share of manufacturing sector mostly came from the manufacturing of non-oil and gas, especially from foods, beverages and tobacco. In 2001 the largest contributors are from foods, beverages and tobacco with 11.59 percent, and others were less than 4.00 percent[2].

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[1] See National Income of Indonesia 2001 (BPS) P.9.
[2] Ibid P.10

Sub sector oil and gas manufacturing had a relatively fluctuated share that was from 3.47 percent in 1998 and then decreased to be 3.19 percent in 1999. But there was an increase in 2000 and 2001 by 4.15 percent[3].

Economic contribution without oil and gas in 1998 was 88.69 percent, and then increased to 90.22 percent in 1999. But, there was a decrease to 85.63 percent in 2000 and 86.25 percent in 2001.

The economic structure of Indonesia in 1998- 2001 is shown in table 1.1 below.

Table 1.1
Shares of Economic Sector in GDP at Current Prices (percent)

SECTOR	1998	1999	2000*	2001**
1 Agriculture, Livestock, Forestry, and Fishery	18.08	19.61	17.03	16.39
2 Mining and Quarrying	12.59	10.00	13.78	13.59
3 Manufacturing Industry	25.00	25.99	26.16	26.11
4 Electricity, Gas and Water Supply	1.18	1.22	1.18	1.16
5 Construction	6.46	6.15	5.94	5.64
6 Trade, Hotel and Restaurant	15.35	15.99	15.20	16.09
7 Transport and Communication	5.43	5.02	5.04	5.35
8 Financial, Ownership and Business	7.31	6.48	6.20	6.20
9 Services	8.59	9.54	9.49	9.46
GROSS DOMESTIC PRODUCT	100.00	100.00	100.00	100.00
GDP without OIL AND GAS	88.69	90.22	85.63	86.25

Sources : National Income of Indonesia (BPS)
* = Preliminary figures
** = Very Preliminary figures

[3] Ibid P.11

Value exports of Indonesia showed a slight increase since 1970 until 1985, but there was a decrease in 1986 and 1986. The development of Indonesia's export value until 1986 had already dominated by oil export. Since 1987 over 50 percent of Indonesia total export has been from non-oil export sector. Commodity from non-oil export has become more and more potential to take place of oil export in government revenue. In the 1997 non-oil sector contributed 78.3 percent to the total Indonesia export. The last was in 2001, the contribution of non-oil export tend to increase to 77,6 percent.

Table 1.2
Trend Value of Indonesia's Exports
1970-2001
Million US $

year	Total Export	Non-oil and gas	oil and gas	% oil and gas	% non-oil and gas
1970	1,108.1	106.6	1,001.5	90.38%	9.6%
1971	1,233.6	130.8	1,102.8	89.40%	10.6%
1972	1,777.7	864.6	913.1	51.36%	48.6%
1973	3,210.8	1,602.1	1,608.7	50.10%	49.9%
1974	7,426.3	2,214.9	5,211.4	70.17%	29.8%
1975	7,102.5	1,791.7	5,310.8	74.77%	25.2%
1976	8,546.5	2,542.4	6,004.1	70.25%	29.7%
1977	10,852.6	3,554.8	7,297.8	67.24%	32.8%
1978	11,643.2	4,204.7	7,438.5	63.89%	36.1%
1979	15,590.1	6,719.2	8,870.9	56.90%	43.1%
1980	23,950.4	6,168.8	17,781.6	74.24%	25.8%
1981	25,164.5	4,501.3	20,663.2	82.11%	17.9%
1982	22,328.3	3,929.0	18,399.3	82.40%	17.6%
1983	21,145.9	5,005.2	16,140.7	76.33%	23.7%
1984	21,887.8	5,869.7	16,018.1	73.18%	26.8%
1985	18,586.7	5,868.9	12,717.8	68.42%	31.6%
1986	14,805.0	6,528.4	8,276.6	55.90%	44.1%
1987	17,135.6	8,579.6	8,556.0	49.93%	50.1%
1988	19,218.5	11,536.9	7,681.6	39.97%	60.0%
1989	22,158.9	13,480.1	8,678.8	39.17%	60.8%
1990	25,675.3	14,604.2	11,071.1	43.12%	56.9%
1991	29,142.4	18,247.5	10,894.9	37.39%	62.6%
1992	33,967.0	23,296.1	10,670.9	31.42%	68.6%
1993	36,823.0	27,077.2	9,745.8	26.47%	73.5%
1994	40,053.4	30,359.8	9,693.6	24.20%	75.8%
1995	45,418.0	34,953.6	10,464.4	23.04%	77.0%
1996	49,814.8	38,093.0	11,721.8	23.53%	76.5%
1997	53,443.6	41,821.1	11,622.5	21.75%	78.3%
1998	48,847.6	40,975.5	7,872.1	16.12%	83.9%
1999	48,665.4	38,873.2	9,792.2	20.12%	79.9%
2000	62,124.0	47,757.4	14,366.6	23.13%	76.9%
2001	56,320.9	43,684.6	12,636.3	22.44%	77.6%

Source : ***BPS*** (Country's Stasistical Agency)

The decision of OPEC to increase the price of oil in 1973 and 1978 indirectly give contribution to the increase of Indonesia's oil price with the result was the oil boom in 1973/1974 and 1980/1981. Before the oil boom the price of Indonesian oil was US $ 2 per barrel increasing sharply to US $ 6 per barrel ; US $ 12.60 and finally in January 1981 the price of oil reached level of price at US $35 per barrel[4]. See table 1.3.

The table below shows that on the range of 9 month the price of Indonesia oil export slightly decreased to US $ 12.20 in September 1986 than in February 1985 at point of US $ 28.53. The lowest price of oil happened in August 1986 at the price level of US $ 9.83. In that direction, changes in the price of oil have caused economic achievement to fluctuate. The increase in the price of oil export will have impact on the increase of domestic income and government saving. But its also shown that Indonesia national development financing depend on the result of oil export.

[4] The price of synthetic fuel was US $ 45. the original plant of OPEC increasing the price of oil was close to the price of synthetic fuel. See Anggito Abimanyu in Minyak bumi dan bantuan LN dalam perekonomian Indonesia. 1988. P.9.

Table 1.3
Price of Indonesia's Oil Export
US $ per barrel
(1969 - 1987)

Month	Year	Price	Month	Year	Price
January	1969	1.67	January	1980	27.50
April	1971	2.21	February	1980	29.50
October	1971	2.60	May	1980	31.50
April	1972	2.96	January	1981	35.00
April	1973	3.73	November	1982	34.53
October	1973	4.75	February	1983	29.53
November	1973	6.00	February	1985	28.53
January	1974	10.80	January	1986	25.13
April	1974	11.70	February	1986	21.00
July	1974	12.60	March	1986	14.45
October	1975	12.80	April	1986	10.66
January	1977	13.55	May	1986	10.38
January	1979	13.90	June	1986	12.11
April	1979	15.65	July	1986	10.25
May	1979	16.15	August	1986	9.83
July	1979	18.25	September	1986	12.20
November	1979	23.50	December	1986	13.07
December	1979	25.00	April	1987	17.57
			December	1987	16.93

Sources: Mining Department of Indonesia,1987

Export volume of crude oil in 2000 decreased to 29,226 thousand million to from 35,902.5 thousand million ton in 1999. The export of crude oil in 2001 was 32,857 thousand million ton or increased around 12.42 percent compared to 2000[5]. In 2001, the total value of export of crude oil was US $ 5,714.7 million, it was lower than the value of export 2000 around 6.16 percent. Compared with export volume of crude oil in 1970s. In 1970 export volume of crude oil was 31,038 million tons with total value was 408.5 million US $ (Data shown in table 1.4.)

[5] See Indonesian Statistic 2001 (BPS).

Since long time, the main destination countries of Indonesian oil export has been were Japan, The United State of America, and Singapore. In 2001, it was oil export to Japan which increased compare to the last year (from 10 152 thousand tons to 10511 thousand tons), and also export to Singapore increased from 2 090.4 thousand tons to 2845.5 thousand tones. The oil export to USA increased from 1927.1 thousand tons to 2 169.8 thousand tons.

In terms of value, export to main countries decreased. Oil export to Japan in 2001 fell from 2 136.7 mill US$ in 2000 to 1857.5 Mill US $ in 2001, and also export to USA decreased from397.7 Mill US $ in 2000 to 378.6 Mill US $ in 2001. Export oil increased from 442.9 mill US $ to 479.0 mill US $ in 2001. The amount exported to South Korea 59.5 percent of the total export oil Indonesia. in 1999, followed by Japan around 29.4 percent, and USA around 10 percent[6]. The total Indonesian oil export reach the peak since 62014.5 Mill tones in 1980, then oil export experienced decreased in 1985 at 39126.1 Mill tones, 1997 at 38977 Mill Tones, 1998 at 36914 mill tones, 1999 at 35902.5 mill tones, 2000 at 29226 mill tones and then increased being 32857 mill tones in 2001.

From table 1.4. in 1975 and 1980 the total volume of export increased accompanied by the increase in total value. The decrease in total volume in 1985, 1997, and 1998 accompanied by the decrease in total value. But since 1998 the decrease in total volume has not been followed by the decrease in total value. The

[6] See Indonesian Statistic 2001 Edition

increasing total value of oil export since 1998 has been caused by increase in price of oil. Price of oil increase 17.98 USD/barrel in 1999, 28.24 USD/barrel in 2000 and 24.28 USD/barrel in 2001[7].

Table 1.4
Exports of Crude Oil by Country of Destination
1970 - 2001

Country of Destination	1970*	1975	1980	1985	1997	1998	1999	2000	2001
	Net weight : 000 Mill Ton								
Japan	22372	25080.4	31670.2	16249.2	13202	11757.8	12197.8	10152	10511
Singapore	-	3336.5	7976.8	3269.4	2997.8	2893.4	2190	2090.4	2845.5
People's Rep of China	-	-	-	-	5983.4	3931.8	4182.8	4483.1	2617.8
Australia	2207.1	-	1252	398.7	4968.3	6890.1	5307.6	2691.3	4950.8
USA	3978.2	17078.5	15507.4	12790.2	2791.5	3221.4	3521.2	1927.1	2169.8
South Korea	-	-	-	-	5610	4936.5	6032.5	5065	6922.4
Phillipines	1888.3	362	766.2	604.9	-	-	-	-	-
Hawaii	259.2	-	-	-	-	-	-	-	-
Thailand	-	13	-	-	-	-	-	-	-
Trinidad and Tobago	-	4991.4	3244.2	1441.1	-	-	-	-	-
Others	333.9	1550.2	1597.7	4372.6	3429.9	3283	2470.6	2817.5	2839.8
TOTAL	31038	52412	62014.5	39126.1	38977	36914	35902.5	29226	32857
	FOB value : 000 000 US $								
Japan	289.4	2360.5	7376.6	3378.9	1840.8	1042.5	1558.5	2136.7	1857.5
Singapore	-	325	1841.2	711.2	413.8	264.7	267.2	442.9	479
USA	57.2	1610	3627.8	2857.2	380.1	282.2	450.9	397.7	378.6
Others	61.9	637.6	-1174.3	1304	2845.3	1759.2	2240.7	3112.8	2999.6
TOTAL	408.5	4933.1	11671.3	8251.3	5480	3348.6	4517.3	6090.1	5714.7

Sources : Indonesia Statistic (BPS) Various Edition

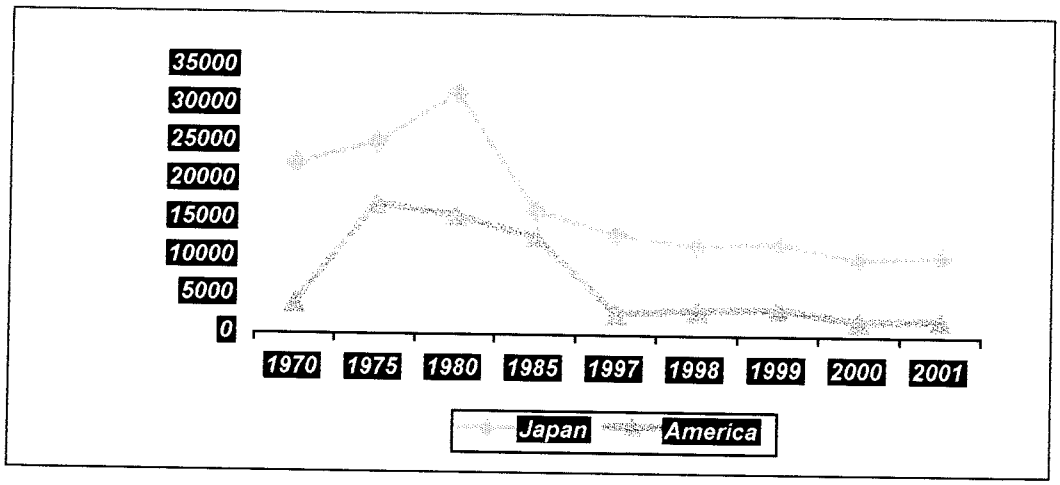
- = Gross Weight

[7] See data of variable X1 or see in International Financial Statistic 2001.

Table 1.4. shown that even thought Japan is the main destination of Indonesian oil export and USA placed in the second order, but volume of export oil from Indonesia to USA is more stable than to Japan, see chart 1.1. In 1970 to 1975 oil export to Japan has increased 2708 Mill Tons, then increased 6590 Mill Tons in 1980, in 1985 decreased by 15421 Mill Tons, in 1997 decreased by 1445 Mill Tons, in 1998 increased by 440 Mill Tons, in 2000 decreased again by 2045 Mill Tons, in 2001 increased by 359 Mill Tons. Compared with volume of oil export to USA, in 1970 to 1975 oil export to USA increased by 13100 Mill tons, in 1980 it decreased by 1571 Mill Tons, in 1985 it decreased by 2717 Mill Tons, in 1997 it decreased by 9999 Mill Tons, in 1998 it increased by 430 Mill tons, in 1999 it increased by 300 Mill Tons, in 2000 it decreased by 1594 Mill Tons, in 2001 it increased by 242 Mill tons.

Years	Japan	USA
1970	22372	3978.2
1975	25080.4	17079
1980	31670.2	15507
1985	16249.2	12790
1997	13202	2791.5
1998	11757.8	3221.4
1999	12197.8	3521.2
2000	10152	1927.1
2001	10511	2169.8

Chart 1.1. Graphic of Indonesia's oil export to Japan and USA



Oil is the lifeblood of America's economy. Currently, it supplies more than 40% of world total energy demands and more than 99% of the fuel are used in cars and trucks[8]. Since 1970s USA has been one of the main destination country of exporting oil from Indonesia. Besides that USA is one of developed countries, USA is also one of the industrializing countries. From table 1.5. we can see that total consumption oil of USA 25% of total consumption of the world. In 1999, USA consumed 882.8 million tones (25.5% share of world total usage). Total usage of the world is 3462.4 million tones. For average, USA consume 18490 thousand barrels daily[9].

[8] EIA (Energy Information Administration)USA
[9] Energy Action Statistics (National Energy Foundation of USA)

Table 1.5.
Oil Consumption
(1987 - 1995)
Million tones

	1987	1988	1989	1990	1991	1992	1993	1994	1995
1 USA	764.8	796.7	795.3	781.8	765.6	782.2	789.3	809.9	807.7
2 North America	133.5	137.4	145.2	145.4	145.2	146.1	148	156.6	147.7
3 South and Central America	161.8	166.5	167.8	166.7	168.8	176.2	179.2	187.1	194.8
4 Europe	690.8	700.1	700.4	710.2	710.6	713.3	711.2	711.4	722.2
5 Former Soviet Union	420.2	414.6	413.4	418.3	398.2	347.6	277	236.1	216.9
6 Middle East	151.2	150.5	156.4	164.5	169.2	172.2	176.3	183.6	189.9
7 Africa	84.2	88.1	91.7	94.2	95.6	97.7	99.2	101.5	105.3
8 Asia Pacific	540.7	584	617.6	654.1	681.6	727.8	756	807.5	850
TOTAL	2947.2	3037.9	3087.8	3135	3134.8	3163.1	3136.2	3193.6	3234.5
Total consumption of USA (in percent)	25,9%	26.20%	25.80%	25%	24.40%	24.70%	25.20%	25.30%	24.97%

Source : BP Statistical Review of World Energy 1998 : Oil Consumption, million tonnes (table)

The United States, with 5% of world's population, daily consumes 20 Million barrels (840 Million gallons) or 26% of world consumption[10]. US consumption is at a high record. While US oil production is low and declining, covering 45% of US consumption needs. The difference between production and consumption in USA must be provided by rising imports. USA imports about 55% of its (USA) oil needs[11]. The huge amount of oil importing by USA isn't from The Middle East. According to the most recent data regarding crude oil imports, only 31% of the USA's imports came from Arab OPEC countries (Algeria, Iraq, Kuwait,

[10] Economic energy report USA section
[11] EIA (Energy Information Administration) USA

Qatar, Saudi Arabia)in January 2002. The top six countries (by percentage of total USA imports) supplying crude oil to the USA in January 2002 were[12] : Saudi Arabia 16.9 percent, Mexico 15.1 percent, Canada 15.0 percent, Venezuela 14.4 percent, Iraq 11.4 percent, Nigeria 5.9 percent.

There are some prediction that consumption of petroleum in USA that in 2003, total oil demand is projected to increase by the amount of 170,000 barrels per day above last year's average, or by 0.9 percent, to 19.94 million barrels per day. Demand for motor gasoline, which accounts for the largest amount of oil based products, is projected to increase 1 percent for the year as a whole. Published highway travel data have shown little growth during the first half of the year, and motor gasoline demand patterns are consistent with that data. The second half of the year, however, calls for a 2 percent increase in motor gasoline demand due largely to the economic recovery, which is expected to induce growth in highway travel. Recently published data from the FAA (Federal Aviation Administration) show continuous year to year declines in jet fuel purchases. Airlines, however, seeking to increase load factors, have announced plans to trim capacity further during the rest of this year. As a result, commercial jet fuel demand is projected to contract by 1.0 percent in 2003. Moreover, domestic military demand will likely decline as a result

[12] DoE (Dept of Energy)USA

of an increase in overseas activity, contributing to the projected year-over-year decline of 3.1 percent in total jet fuel demand. Total 2004 oil demand is projected to grow by 420,000 barrels per day, or 2.1 percent, to an average 20.35 million barrels per day. All the major products (except residual fuel oil) are expected to contribute to this growth. Motor gasoline demand is projected to increase 2.6 percent, reflecting a continuous acceleration of economic growth and a 6 percent decline in retail pump prices. Such forecast was included in the report distributed by EIA of the USA Ministry of Energy. This last year this parameter, according to estimation of EIA, has grown only on 0.3 percent. Growth of demand for oil in the nearest years, in opinion of experts from EIA, will be satisfied due to import. Production of petroleum in USA in 2003 will decrease on 3 percent, in 2004 on 2 percent. Growth of consumption will be achieved, first of all, due to the increased demand for oil in American industries.

As explained above, USA as one of industrialized and developed country needs lots of oil. To fulfill its needs of oil, USA imports oil from oil exporting countries every year among them from Indonesia. Today's USA import is effected by previous years import in 2 ways. Today USA import might be negative or positive. It is called negative if USA import today isn't effected by previous years import. It is called positive if USA import today is effected by previous years import because there are some assumption, firstly that USA with its technology can heap their oil reserve

example is in California. Secondly is, USA like importing their oil reserve from Indonesia because the procedure of importing oil from Indonesia is not complicated. Thirdly, kinds of oil that USA needs are Minas that is from Indonesia. Since USA import today is effected by previous years import, this research uses PAM.

All the fact above interests the researcher, who is now studying in Economic Faculty and taking International Trade majority, in holding the research to recognize the flows of export crude oil Indonesia to United States in order to support the government policy in International Trade. Hence, the title of this thesis is **AN ANALYSIS OF FACTORS AFFECTING INDONESIA'S CRUDE OIL EXPORTS TO THE UNITED STATES: A PARTIAL ADJUSTMENT MODEL (PAM) 1970-2001.**

1.2. Problem Limitation

Economic and financial crisis in 1997 was also influenced by the value of Indonesia's crude oil export to USA. As one of the biggest industrial countries and the highest oil consumption in the world, USA is the 2nd largest Indonesian oil export destination. There are several factors effecting volume of Indonesia's crude oil export to USA, but the one that will be analysis in this thesis only 5 factors, there are;

- Price of oil, USD/barrel
- Foreign Exchange rate, Rp/USD

- US Real Total GDP, billion of USD.
- Price of coal , USD/Metric (Identification variable)
- Volume of oil export Indonesia to USA at previous year.

There are some kinds of world oil price based on the market, there are: Dubai Fateh Market, U.K. Brent, Alaska North Slope, Saudi Arabia (Ras Tanura), Libya (Es Sidra), Venezuela (Tia Juana). In this case this thesis will use world average crude price to maintain the price differences. USA as the biggest consumer of world oil consume most of total oil production from all the world. About 40 percent of oil in the USA is used by individuals (all people that life in the USA region), i.e. gasoline, kerosene, etc. And the rest is used in industry. Most of USA industries need huge amount of oil for operation[13]. For that reason, in this thesis will use Real Total GDP of USA as one of the independent variables.

1.3. Research Objectives

The objectives of the research are:

1) To know how far the changes in oil price influences the export volume of Indonesia's oil to the USA. USA as one of the biggest industrial country in the world consume almost a half of world oil consumption, every year it needs a huge amount of oil from around the world, including Saudi Arabia, Mexico,

[13] DoE (Dept of Energy)USA.

Canada, Venezuela, Iraq, Nigeria, and Indonesia. So the purpose of this research is to know whether or not oil from Indonesia is important in the USA.

2) To know how far is the changes in Exchange rate of Rupiah against USD influence the export volume of Indonesia's oil to the USA.
3) To know how far is the changes in Real Total GDP of the USA will influence the export volume of Indonesia's oil to the USA.
4) To know how far the changes in the price of coal (as a substitute of oil) influences the export volume of Indonesia's oil to the USA.
5) To know how far the previous oil export affects current oil export.

1.4. Research Benefits

The research contributions that the writer intends to achieve are:

1) For the researcher, this research is one of the way to apply all of theory that she has already got in the classroom.
2) The result of this research can be some additional information about export oil Indonesia toward Government revenue.
3) To obtain a deep understanding about oil trade between Indonesia and the USA.
4) As source of information for other researcher.

5) As the partial fulfillment of the requirements to obtain the S1 Degree in Economic of International Program of Economic Department of Islamic University of Indonesia.

1.5. Research Hypotheses and Assumptions.

Hypothesis is something that expected being true for maintaining an argumentation or state some argumentations even though the rightness of that statement is temporary. The behavior of all variables in the model will be tested by statistical test and econometrical test.

The hypotheses used as the guidance, and there for to be tested are as following:

1) That the price of oil (X_1) has a negative and significant influence on the export volume of Indonesia to the USA. The underlying assumption is that Indonesia's oil is regarded as a normal good by the USA buyer.

2) That rate of Rp/USD (X_2) has a positive and significant effect on the oil export volume of Indonesia to the USA. So if there Rupiah depreciation the export demand of Indonesia's oil by the USA will increase.

3) That the Real Total GDP of an importing country (X_3) has a significant influence on the oil export volume of Indonesia to the USA. The influence could be; positive if Indonesia's oil is regarded as superior goods by the USA;

and negative if Indonesia's oil is regarded as inferior good by the USA as the buyer.

4) That price of coal as identification variable to oil (X_4) has a positive and significant impact on the oil export volume of Indonesia to the USA with assumption that coal is substitute good for the USA.

5) That the previous year oil export (Y_{t-1}) has a significant influence on the oil export volume of Indonesia to the USA. The influence can be; positive if the needs of oil in the USA is not limited; negative if the needs oil in the USA is limited.

6) All independent variables has significant effect on oil export volume to the USA.

1.6. Research Methodology

1.6.1. Kinds and Sources of Data

Through literature research in Indonesia by studying some materials and resources which have connection with the relevance data.

1) Oil export volume to the USA.

2) Price of oil/barrel

3) Foreign exchange Indonesia against USA Dollar.

4) GDP of importer country (USA).

5) Price of coal

6) Previous year export oil volume.

1.6.2. Method of obtaining Data

The method of obtaining data is done by collecting data from secondary data. Sources of data are :

1) International Financial Statistic (IMF)

2) Statistical Year Book of Indonesia

3) Country's Statistical Agency (BPS)

4) National Income and Product Accounts/ NIPA (Bureau of Economic Analysis) USA.

All data above are taken from BPS of Yogyakarta, Bank Indonesia, UII, UPN, and some sources from website in internet.

1.6.3. Method of Analyzing Data

The relevance economic theory that is used in this research is demand theory.i.e. the demand of the USA on Indonesia's oil. It means that the demand of export are influenced by the price of that good, GDP of importer country, and foreign exchange Rp against $, Price of coal, and Previous year export oil volume from

Indonesia to the USA. Since this research using PAM so volume export at previous year will be used as independent variable. The demand model can be as followed :

$$Y = F (X_1, X_2, X_3, X_4, Y_{t-1}, \mu)$$

Where:

Y = Volume of oil export of Indonesia, Million tones

X_1 = Price of oil, USD/barrel weighted by CPI of USA.

X_2 = Foreign Exchange Rate, Rp/USD

X_3 = US Real Total GDP, Bill of USD

Real Total GDP USA is weighted by average Real GDP of G4 (Japan, UK, Germany, France).

X_4 = Price of coal USD/Metric

Y_{t-1} = volume export at previous years (lagged 1 year).

μ = Error term

To reach the objective of this research, specifically, hypothesis testing, this research uses Time Series model using annually data from 1970-2001. The regression that might be used in this research is either linier or log linier.

The linier regression model can be written as follow;

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 Y_{t-1} + \mu_i$$

Where;

α_0 = Constant (Autonomous Y)

$\alpha 1$ = Marginal of each independent

The log Linier (double log) regression can be written as follow;

$$\ln Y = \ln\alpha_0 + \alpha 1 \ln X1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln Y_{t-1} + \mu_i$$

Where;

$\ln\alpha_0$ = Autonomous lnY

α_i = Elasticity of each independent variable.

The types of data used in empirical analysis is time series data. Empirical work based on time series data assumes that the underlying time series is stationary. Beside that this research is also uses least square regression, with one tail test to maintain all factors affecting export oil of Indonesia. Ordinary Least Square (OLS) will resulting of each variable independent which shows the relationship between independent variables and dependent variable. This coefficient

is an estimation of all factors affecting export oil of Indonesia to foreign country. Then, from the regression result above we can make statistic test by T-statistic, and F-statistic.

1.6.4. Testing of Hypothesis

Hypothesis of this research are tested following research for time series.

1.6.4.1. T-Statistic Testing

Test of significant approach (T-test) is a test of significance of the procedure by which sample results are used to verify the truth or falsity of a null hypothesis[14]. The meaning of this test is to know the relationship between independent variable and dependent variable individually. This research uses one-tail test. One-tail test is used when the hypothesis is positive.

1.6.4.2. F-Statistic Testing

Testing the overall significance of the sample regression (F-test) is a test of the overall significance of the observed or estimated regression line, that

[14] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.124

is, whether Y as dependent variable is linearly related to independent variable X_1 X2 X_3[15] X_4, Y_{t-1}

1.6.4.3. PAM (Partial Adjustment Model)

One way to maintain the stationarity is using PAM. In PAM the model is in the condition of short-run model (because there is a lag in the model), since in the short run the dependent variable may not necessary be equal to its long-run level.

1.6.4.3. The Multiple Regression Coefficient of Determination (R^2)

Multiple coefficient of determination (R^2) is the quantity that gives information to know the proportion of the variation in Y explained by the variables X_1, X_2 and X_3[16], X_4, Y_{t-1}. Multiple coefficient determination is an abstraction that describes the condition of sample regression line showing all data. That R^2 lies between 0 – 1.

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[15] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.245.

[16] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.201.

1.6.5. Testing Violation on Classic Assumption

1.6.5.1. Multicollinearity

Multicollinearity refers to the existence of more than one exact linear relationship or a linear relationship among some or all explanatory variable X_1, X_2, X_3, X_4, Y_{t-1}.

1.6.5.2. Heteroscedasticity

An important assumption of heteroscedasticity is that heteroscedasticity shows the conditional of Yi increases as X increases. Here, the variances of Y_i are not the same. The researcher uses Spearman test to detect heteroscedasticity.

1.6.5.3. Autocorrelation

The term autocorrelation may be defined as " correlation between members of series of observations ordered in time or space[17]. In the regression contex, the classical linear regression model assumes that such autocorrelation does not exist in the disturbances μi. The classical model assumes that the disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation. Thus, correlation between two series

[17] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.400.

where the former is the latter series lagged by one time period, is autocorrelation. The most celebrated test for detecting serial correlation that is developed by statisticians Durbin – Watson *d* statistic. DW Statistic is being used a test spuriousness of the time series data. As Granger and Newbold have suggested[18], an $R^2 > d$ is a good rule of thumb to suspect that the estimated regression suffers from spurious regression. In another word, there is one important use of DW testing if DW is compared to R^2 the result can be used for detecting spuriousness of data.

1.7. Writing Systematization

Chapter I = Explaining the reason of choosing Indonesian crude oil export to USA as the topic of writer's thesis. This chapter explains about the way to analysis the model.

Chapter II = This Chapter explains about the importance of oil export for Indonesia income more wider than in previous chapter, oil industry, oil policy in Indonesia , and then there will be explained about USA oil industry especially in production, consumption.

Chapter III = In this chapter explains about the theory that being foundation of this thesis .i.e. theory of demand,

[18] see Gujarati. Basic econometrics. 3rd Edition.P.724.

demand curve, trade theory, cartel theory, method of analysis data.

Chapter IV = This Chapter is the core of this thesis. In this chapter there will be contain of data analysis and testing the data.

Chapter V = Conclusions and implication.

CHAPTER II

INDONESIA'S CRUDE OIL EXPORT TO THE UNITED STATES

2.1. The Economic Developments of Indonesia

In the past one and a half decade the economy of Indonesia has grown considerably. In 1969 the First Five-Year Development Plan, *Repelita I*, was introduced to recover from a long period of economic stagnation and eventually also of decline, which started with the effects of the Great Depression in the 1930s, continued through the Second World War and the struggle for Independence, and lasted through the Soekarno era. Towards the end of this period during the mid 1960s, high budget deficits had led to spiraling rates of hyperinflation, exports covered only a fraction of imports and the country's infrastructure had deteriorated severely as a result of continuous neglect. Furthermore, a complex and shifting system of regulations and controls hampered economic development.

The turnaround started in 1966 when the new government under General Suharto took power. A wide range of economic measures was introduced primarily aimed at stabilization and rehabilitation. The measures included substantial liberalization of controls and regulations, in particular of those governing foreign exchange and prices. Moreover, effective steps were taken to reduce inflation to manageable proportions. In order to encourage new economic development, substantial incentives were introduced in 1968 and 1969 to stimulate foreign and domestic private investments.

The growth which ensued extended to all sectors including the agricultural sector, where, in response to a range of measures, production increased substantially, especially of food crops. Obviously, economic growth in the 1970s was greatly facilitated worldwide oil price increases in 1974 and 1979. As a consequence foreign exchange availability became much less of a constraint to growth than in many other developing countries. Oil revenues also provided the government with substantial budgetary leeway.

2.1.1. The Structure of The Economy

During the period of the 1970s Indonesia experienced a sustained rapid rate of growth. Between 1970 and 1980 GDP increased at an average of 8.1 percent per year, well above the rates recorded in most other developing countries during the same period. As a result per capita GDP had increased to US$ 590 by 1982. With this figure Indonesia was for the first time classified into the group of lower middle-income countries (World Bank, 1984).

The high rate of growth was accompanied by substantial changes in the structure of production as illustrated by Table 2.1. The most noticeable development is the share of mining, including oil production, was not much higher in 1980 as compared to 1971. In current price, however, as shown in Table 2.1, the share of mining had increased more than threefold, from 8 percent in 1971 to 25.7

percent in 1980, though by 1983 it had declined to 19 percent[1]. The increase up to 1980 was largely due to price increases rather than to changes in volume.

Table 2.1
Gross Domestic Product by industrial origin, 1971, 1975 and 1980, at constant prices of 1973 (values in Rp billion)

Industrial origin	1971 value	%		1975 value	%		1980 value	%		Annual rate of growth 1970 to 1980
Agriculture	2,441	44.0	(44.8)	2,811	36.8	(31.7)	3,425	30.7	(24.9)	3.8
Mining and Quarrying	551	9.9	(8.0)	828	10.9	(19.7)	1,035	9.3	(25.7)	7.3
Manufacturing	490	8.8	(8.4)	848	11.1	(8.9)	1,705	15.3	(11.6)	15.2
Electricity, gas, water	25	0.4	(0.5)	41	0.5	(0.6)	78	0.7	(0.5)	13.5
Construction	171	3.0	(3.5)	365	4.8	(4.7)	639	5.7	(5.6)	15.8
Commerce, hotels, etc.	924	16.7	(16.1)	1,294	17.0	(16.6)	1,852	16.6	(14.1)	8
Transport and comm.	210	3.8	(4.4)	303	4.0	(4.1)	609	5.4	(4.3)	12.6
Other services	733	13.2	(14.3)	1,141	14.9	(13.8)	1,827	16.4	(13.4)	10.7
Gross Domestic Product	5,545	100.0	(100.0)	7,631	100.0	(100.0)	11,169	100.0	(100.0)	8.1

The figures between brackets represent the percentage distribution in current prices.
Sources : BPS, National Accounts Statistics, Various issues.

During the first few years of the 1980s the Indonesian economy was severely hit by a number of adverse developments. First of all, the international oil market suffered a serious depression. Besides of OPEC agreements, the action of oil exporting countries that is included in non-OPEC countries, in response to this depression Indonesia had to cut back its production of oil from a production of 1.6

[1] See Industry in Indonesia and Trade in Indonesia. Gajah Mada University Press.1990. P.44

million barrels per day in 1981 to 1.3 million in 1982. This was followed in 1983 by a reduction in the oil price from US$ 31 to US$ 28 per barrel. Further substantial oil price decreased occurred in 1986 with price averaging at about US$ 13[2]. Furthermore, Indonesia was affected by the general deterioration of the world economy which resulted in both declining prices and volumes of Indonesia's traditional primary export commodities. As a result of these developments, a complete stagnation of economic growth occurred in 1982. During the whole period 1980 to 1984 the average annual growth rate of GDP declined to 4.2 percent per year[3].

The development of GDP by major sector during the early 1980s is presented in Table 2.2. The table shows that by 1984 the share of agriculture in GDP had declined to only 23.9 percent. As a consequence of lower oil production and oil price levels, the share of manufacturing amounted to only 11.7 percent in 1984, having experienced an average rate of growth of 5.9 percent per year between 1980 and 1984. Higher rates of growth during this period were only experienced in the sectors electricity, transportation and services.

[2] ibid. P. 50
[3] ibid, P. 51

Table 2.2 Gross Domestic Product by sector of origin 1980,1983 (Rp. Billion)

Sector	1980 value	%	1983 value	%	1984 value	%	Rate of Growth 1980-84
Agriculture	16,399	24.6	17,696	24	18,747	23.9	3.4
Mining	16,078	24.1	13,968	19	14,948	19.0	-1.7
Manufacturing, of which	7,304	11.0	8,211	11.1	9,199	11.7	5.9
General manufacturing	5,447	8.2	6,211	8.4	6,556	8.3	4.7
Oil refining	186	0.3	129	0.2	138	0.2	-5.9
LNG	1,672	2.5	1,871	2.5	2,505	3.2	10.6
Electricity	312	0.5	524	0.7	588	0.7	17.2
Construction	3,850	5.8	4,597	6.2	4,528	5.8	4.1
Commerce	10,112	15.2	12,009	16.3	12,104	15.4	4.6
Transportation	2,911	4.4	3,978	5.4	4,317	5.5	10.4
Services	9,708	14.7	12,714	17.3	14,107	18.0	9.8
Total GDP	66,675	100.0	73,698	100.0	78638	100.0	4.2

Source: BPS, as presented in World Bank (1986)

The share of oil revenues in government revenue, however, continued to record a steady decline. The expenditure side substantial savings were achieved on various subsidies. With regard to the budgetary deficit, it can be calculated that in 1983/1984 the foreign surplus fell strongly to only 0.4 percent of GDP, while the domestic deficit fell only slightly to some 6.3 percent of GDP. As a consequence the overall budget deficit rose to around 6 percent of GDP as compared to only 3.5 percent in 1980/81. Due to further oil price decreases in 1986 from US$ 27 to an

average of US$ 14 per barrel, oil revenues are budgeted to be reduced to 45 percent of total government revenue in 1986/87[4].

2.1.2. Indonesian Balance of payments

Indonesia's external resource position is heavily influenced by the oil sector. On the current account of the balance of payments the share of oil and gas in total exports increased from 39 percent in 1971 to 75 percent in 1980[5]. In spite of the dominance of oil and gas in the increased export earnings, export of some other products, especially timber, coffee and palm oil, increased substantially as well during the 1970s as shown in Table 2.3.

Table 2.3. Summary Current Account Balance, 1975/76, 1980/81 and 1984/1985(US$ Million)

	1975/76	1980/81	1984/85
Exports (fob)	7,146	22,885	19,901
Oil and LNG	5,273	17,298	14,943
Non-oil	1,873	5,587	5,207
Agricultural products	1,469	4,145	3,379
Metals and Minerals	257	770	775
Others, including manufactures	147	672	1,753
Imports (fob)	-5,409	-14,242	-14,427
Net services	-2,591	-6,512	-7,442
Current account balance	-854	2,131	-1,968

Source: Ministry of Finance, *Nota Keuangan*,1985/1986

During the second half of the 1970s the balance of payments was characterized by an increasing resources surplus on the trade balance. By 1979 even the current account turned into a surplus for the first time in more than two decades,

[4] Ibid. P.53
[5] Ibid.P.45.

and foreign currency reserves reached an all time high of over US$ 7 billion in 1980/81, equivalent to 6.5 months of non-oil imports. Price effects played a major role in improving the Indonesia's balance of payments position in the 1970s[6].

2.2. Indonesian Oil Export

Fundamental factors, consumer countries policy, seasons, and psychologist determine the marketing and the price of Indonesian oil. The most market of Indonesian oil is Japan. The regulation about sulphur content, oil taxes, diversification, the using of nuclear and water power are most influencing on the Indonesian oil market. For the season, the demand of oil reached the lowest level on the second quarterly and the highest level in the first quarterly. Even though Japan's market is the most market for Indonesian oil, it still has some obstacles for Indonesian oil to increase their volume export. Japan's oil market depends on the season in Japan, like the rainfall and snow that push the operation of *PLTA*. With the increasing of that operation by 1 percent a year Japan can save their use of oil around 2 thousand barrel a day. The demand of oil will be lower if the cold season is not worst, whereas the demand of oil will increase if the cold season is cold or in the hot season when the weather is so hot. The increasing on temperature by 1 degree above 30 degree of Celsius will increase demand of oil by 15 thousand barrel a day [7]. The

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[6] Ibid.P.46

[7] see Ekonomi dan Energi Teori dan Praktik. Purnomo Yusgiantoro.LP3ES. p.228.

main psychologist factors are the strained on the political situation in and out of the importing countries itself and social conflict in that country.

The main destination countries of Indonesian exports countries are Japan, South Korean, China, USA, and Taiwan. In 1995 Indonesian export Japan is around 44.7 percent, USA is around 8.5 percent. From the table 2.4 we can see that in the recent years Indonesia's crude oil export has decreased although by quite small. This was because the quantity of crude oil required for processing in the domestic refineries for supplying the demand for BBM kept increasing every year.[8]

Table 2.4. Export of Crude Oil by Country of Destination 1995-1997

Country of destination	1995	%	1996	%	1997	%
	Net Weight : 000 M.Ton					
Japan	17,774.7	43.7%	14384.0	37.60%	13201.6	33.87%
Singapore	3,241.3	8.0%	3124.3	8.17%	2991.8	7.68%
RRC	5,777.9	14.2%	6757.0	17.66%	5983.4	15.35%
Australia	2,677.9	6.6%	3932.8	10.28%	4968.3	12.75%
USA	3,440.4	8.5%	2843.5	7.43%	2791.5	7.16%
South Korea	4,137.5	10.2%	4748.4	12.41%	5610.0	14.39%
Others	3,624.3	8.9%	2464.9	6.44%	3429.9	8.80%
TOTAL	40,674.0	100.0%	38254.9	100.00%	38976.5	100.00%

Source:*BPS* various edition

The main export of Indonesia is crude oil but in the recent years, Indonesia also export the residue oil with Low Sulphur Waxy Residue; LSWR) and some non-*BBM* oil production. Beside exporting oil, Indonesia also imports crude oil and *BBM* around 150-200 thousand barrel a day. To supply the special requirement of

[8] www.migas.info

some domestic refineries which have certain facilities to produce such refinery products such as lube base and asphalt; also to increase the yield of BBM, Indonesia imported crude oil from other countries. Initially the crude oil imported was Arabian Light Crude (ALC) from Saudi Arabia, but later in the framework of counter trade, Indonesia also imported crude oil from Iran (ILC). In effort to increase the yield of BBM, Indonesia imported also crude oil from Australia (Jabiru and Harriet) and from Malaysia (Tapis). During the last ten years crude oil import has increased by an average of 7.2 percent per year but in 1997 through 2000 import of crude oil suffered a decreased due to the monetary crisis which struck Indonesia. To supply the domestic demand for oil fuel "*BBM*", certain types of *BBM* must be imported. These include crude oil, diesel oil, and fuel oil. Because of the increase of *BBM* demand lately, import of *BBM* tends to increase also.

Indonesia produces oil , including the condensate, around 1.5 million barrel a day. A half of that production is used for domestic consumption, and the rest is for export. Indonesian Export oil is depends on the oil production and domestic consumption. Most of Indonesian oil export are used for oil refinery, electricity, and petrochemical. Indonesian oil mainly Minas Oil from Center Sumatra contains high level of paraffin . On the normal temperature this kind of oil can freeze, so the distribution and the place for storing oil needs heater. The primary process on the oil refinery will result 40 percent of *BBM* and the rest is residue (LSWR). For advanced process, *BBM* needs secondary process of capacity (cracking) which is very expensive. Most of Asian refinery oil must be compatibility with oil from Arab

countries. But, most of refinery oil doesn't have secondary capacity, except China and America. China has limited fund to import oil from Indonesia but China has its own oil the quality of which is the same as Minas oil from Indonesia. The long distance of shipping oil from Indonesia to America makes it difficult for Minas to compete with WTI (kind of oil with lower sulphur level) or others kind of oil that has same quality with Minas.

2.3. The Regulation on Oil Resources[9].

Indonesia is endowed with various kinds of energy resources, among others is oil , which is vital and strategic mine. Oil has an important role in the national development, particularly as a source of domestic energy, a source of foreign exchange and income for the state, and as a raw material for the national industry.

In accordance with the stipulation of article 33 of the 1945 Constitution, oil and gas must be utilized for the utmost benefit of people; and according to Article 3 of Law No.44 Prp of 1960, the national riches such as oil is controlled by the State while its mining and exploitation is executed solely by state companies. The supervision of state oil companies is handled by the Department of Mines and Energy, cq. Directorate General Oil and Gas, while the exploitation activities are conducted by Pertamina as the Holder of Oil and Gas Mining Authorization on basis of Law No.8 of 1971, which allows Pertamina to enter into cooperation with the other parties. Oil activities include exploration, exploitation,

[9] www.migas.info

refining and processing, as well as transportation and marketing activities Article 4 of Law No. 44 Prp of 1960).

Oil reserves is limited, therefore efforts must be made to utilize other sources of energy such as geothermal resources which potential in Indonesia is quite large. In view of the fact that geothermal exploitation is technically similar to that of oil, Pertamina was appointed by Presidential Decision No.22 of 1981 to execute geothermal exploitation, while the direct General of Oil and Gas is responsible with its supervision and technical development.

2.4. Indonesian Crude Price (ICP)

The price of Indonesia's crude oils is determined by a formula which is valid for 6 months, and can be extended to the next 6 months or changed with another.

- For Indonesia's crude oil types which are published in APPI (Asian Petroleum Price Index) Publication. Currently there are 8 Indonesian crude oil types which are included in APPI publication; these are Minas (SLC), Arjuna, Arun Condensate, Attaka, Cinta, Duri, Widuri and Belida. The calculation for these 8 crude oils is based on formula which is valid for the period of 1 October 1999 through 31 March 2000 as follows:

  ICP Formula = (20% APPI Formula + 40% RIM + 40% Platt's)

  Where;

RIM and Platt's are the average prices of the concerned Indonesian crude's which are published by RIM and Platt's in the current month.

The periods of ICP formula application and adjustment of the publication weight areas follows:

- The use of three (3) publications; APPI, RIM, and Platt's as the "Base Price Formula" applied as of 30 June 2000.
- The weighted percentage of each publication (APPI, RIM, Platt's) for eight (8) crude oil types will be reviewed every three (3) months.
- Average market price of each publication; APPI, RIM, and Platt's are the average market price of Indonesian crude oil published in each publication, namely APPI, RIM and Platt's with a publication period of one (1) day after the issuance of the latest APPI publication in the previous month up to the issuance of APPI publication in the running month.

- For Indonesian crude oil types which are not published in APPI publication. There are 33 Indonesian crude oil types which are not published in APPI publication, among others are Anoa, Badak, sembilang, Tanjung, Hadil, Walio, etc. for these crude oils, the price is related to the quality of the crude oil which is determined by ICP formula. For example:

The price of Walio crude = The price of Minas – USA 0.20

The price of Indonesian crude oil fluctuates in accordance with the development in the crude oil price in the world market. In 1991 the average price of Indonesian crude oils was US$ 19.47 per barrel. In 1994. the average price of Indonesian crude oil decreased to US$ 15.87 per barrel and in 1998 it was US$ 12.47 per barrel(the lowest in the last 10 years) and in 2000 it decreased to US$ 28.39 per barrel. The increased crude oil price in 2000 was caused by the agreement of OPEC members countries to reduce production beside the decreasing oil export of oil importing countries outside OPEC and the other hand there was also a decrease in crude oil stock in the advanced countries.

2.5. Indonesia Oil Reserves

Oil reserves in the last ten years, from 1991 to 2000 was very fluctuative. In 1991, oil reserve was 11.0 billion barrels consisting of 6.0 billion proven reserve, and 5.0 billion barrels. However, in 1993 it decreased to 10.4 billion barrels and continued to 2000 although it fluctuated slightly so that crude oil reserve in 2.0 billion barrels.

2.6. National Policy

Branches of production which are important for the state and control the live people are controlled by the State. Land, water, and the natural resources are controlled by the State and utilized for utmost benefit of the people (Constitution, Article 33 paragraph 3).

Oil is non-renewable natural resource, but it has strategic value for Indonesia. Since oil and gas have three main functions: collected of foreign exchange, a source of energy, and a source of raw material. Besides, oil and gas industry is a capital intensive, technology intensive and industry. Therefore, its management and regulation must be carried out wisely (In Law no.11 of 1967 jo Law No.44 Prp of 1960 is Law No.8 of 197 that oil is strategic mineral/ natural resources). In the last five years oil sub-sector has contributed an average of 33.55% domestic income per year. The important and strategic nature of oil in supporting Indonesia's budget, particularly at the time of economic crisis as presently. In supporting regional autonomy, the Department of Energy and Mineral resources has take some actions by establishing a Task Force Team which is charged with assisting the Ministry facilitating regional autonomy in energy and mineral resources.

In its implementation, the Task Force Team has carried out socialization/information activities, discussion and inventory of issues which are developing in the regional energy and mineral resources.

The legal basis that regulate oil activities are, among others as follows:

- 1945 Constitution, Article 33 paragraph 3
- Law No. 44 PrP 0f 1960, concerning oil mining.
- Law No.15 of 1962, concerning Obligation.
- Law No.8 of 1972, concerning Oil Mining Enterprise (PERTAMINA).

- Law No.22 of 1999, concerning Regional Government.
- Law No.25 of 1999, concerning Financial Balance between the Central Government.
- Government Regulation No.25 of 2000, concerning Government Authorities and Region's Authorities.
- Government Regulation No.104 of 2000, concerning Balancing Fund.
- Minister of Energy and Mineral Resources Decision No. 1454/K/MINING November 2000, concerning Technical Guidelines on Execution of Government Tasks in Oil.

Authority in oil Resource management:

- Based on Law No.44 Prp of 1960. Administration, development of oil enterprise are focused on the technical department.
- Based on Law No.22, Article 7
  - Region's authority covers all authorities in government, except in foreign policy, defence and security, judicial, monetary, fiscal.
  - Authority in other fields as mentioned in Article (1), covers political planning and macro-scale supervision of national planning, financial fund, state

administration system and state economic institutional resource development and empowerment, natural resources utilization strategic advanced technology, conservation and national standarization Note: Law No.11 of 1967 jo Law No.44 Prp of 1960.

- Based on Law No. 25 of 1999, Article 6 paragraph 6. State income from natural resources of oil mining sector production in the region is divided into the following proportions:
  - State income from mining of oil from a region's territory is divided into proportion of eighty five percent (85%) for the central government and 15% for the region. Regional income from regional share further divided as follows:
    a. Share of respective province : 3%.
    b. Share of the producing district/city : 6%
    c. Share of other districts/ city in the province : 6 %

Based on the laws and regulation as stated above it can be concluded that oil resources management lies in the hand of the Central Government

2.7. Organization Structure

The organization of the Department of Energy and Mineral Resources, as stipulated in Presidential Decision No.165 of 2000 dated 23 November 2000 jo Presidential Decision No.172 of 2000 dated 15 December 2000 which in detail was outlined in Minister of Energy and Mineral Resources Decision No. 150 of 2001 concerning the organization and Work Procedure of The Department of Energy and Mineral Resources, consists of the following:

a. Top management element : the Minister.

b. Management Assistant element : Secretariat General.

c. Control element : Inspectorate General

d. Executive elements:

   1. Directorate General of Oil and Gas.

   2. Directorate General of Electricity and Energy Exploitation.

   3. Directorate General of Geology and Mineral Resources

e. Expert staffs:

   1. On Human Resource and technology.

   2. On Economy and Finance

   3. On information and Communication

   4. On Region and Environment

   5. On Community and Institutional.

f. State Owned Companies:

   1. Pertamina

2. PT. PLN (Persero)
3. PT. Aneka Tambang (Persero)
4. PT. Tambang Batubara Bukit Asam (Persero)
5. PT. Perusahaan Gas Negara (Persero)

2.8. World Oil Reserve, Production and Consumption.

Oil is composed hydrocarbons, and was formed millions of years ago in a process that began when aquatic plant and animal remains were covered by layers of sediment-particles of rock and mineral. Over millions of years of extreme pressure and high temperatures, these particles became the mix of liquid hydrocarbons that we know as oil. The world consists of many regions with different geological features formed as the earth's crust shifted. Some of these regions have more and larger oil traps. In some reservoir rock, the oil is more concentrated in pools, making it easier to extract, while in other reservoirs it is diffused throughout the rock. The Middle East is a region that exhibits both favorable characteristic-the oil traps are larger and numerous, and the reservoir rock holds the oil in substantial pools. This region dominates the world oil supply. (see table 2.5). Other regions, however, also have large oil deposits, even if the oil is more difficult to identify and more expensive to produce. The United States, with its rich oil history, is such a region.

A secure supply of oil is unquestionably a matter of life and death, not only for an individual country, but also for all of humanity. It is, therefore

understandable that for years, the question of future oil supply has been a central issue of public debate in all parts of the world. In spite of many efforts, it is very difficult, as experience shows, for a country to develop an appropriate plan for future oriented oil supply system.

Thorough studies indicate that the total world oil demand will continue to rise, even if great efforts are made to save oil and to use it in more rational activities. The fossil fuels oil will continue to the basis of the world's oil supply in the foreseeable future.

The development of oil consumption in the world has been due partly to the increasing world population. Growth of world population and the intent on the part of governments to raise the living standard have brought about a much larger increase in oil consumption than population growth. According to UN statistics, world population grew between 1950 and 1975 from 2490 million to 3920 million people or 66%. The oil consumption during the same time grew from 252 million to 7877 million barrel or around 250%

Crude oil is not directly usable, but must first be converted in refineries to various usable products, including light distillates (Gasoline), medium distillates (diesel and heating oil), heavy distillates (Heavy heating oil), and other products (e.g. asphalt). Refined oil products have a special place in all economies, due to their versatility and the low cost transporting (pipeline or tankers). In table 2.5 below, listed countries that have most on the reserve, production and consumption. The Middle East remains the largest oil reserve region. Saudi Arabia is the most

country that has highest in oil reserve. Followed by Iraq, United Arab Emirates, Kuwait, and Iran. But in the production and consumption the most five countries that including in the highest are dominated by developed and industrial countries. The United States holds only 4 % of global proved reserves. By contrast, Indonesia just holds 0,4% of world oil reserve, and consume 76% of their production.

Table 2.5. Oil Reserves, Production and Consumption in 2001

Reserves (millions of barrels as of January 1, 2002)	Production (millions of barrels per day)	Consumption (millions of barrels per day)
Saudi Arabia: 261,750	Saudi Arabia : 8/528	**United States : 19.993**
Iraq : 112,500	**United States : 8.091**	Japan : 5.423
United Arab Emirates : 97,800	Russia : 7.014	China :4.854
Kuwait : 96,500	Iran :3.775	Germany : 2.814
Iran : 89,700	Mexico : 3.560	Russia : 2.531
Venezuela : 77,685	Norway : 3.408	South Korea : 2.126
Russia : 48,573	China : 3.297	Brazil : 2.123
Libya : 29,500	Venezuela : 3.137	Canada : 2.048
Mexico : 26,941	Canada : 2.749	France : 2.040
Nigeria: 24,000	United Arab Emirates : 2.550	India : 2.011
China : 24,000	United Kingdom : 2.540	Mexico:1.932
United States : 22,045	Iraq : 2.355	Italy : 1.881
Qatar : 15,202	Nigeria : 2.223	United Kingdom :1,699
Norway : 10.567	Kuwait : 1.838	Spain : 1.465
Algeria : 9,200	Brazil : 1.589	Saudi Arabia : 1.415
Brazil : 8,465	Algeria : 1.486	Iran : 1.109
Oman : 5,506	Libya : 1.427	**Indonesia : 1.063**
Kazakhstan : 5,417	**Indonesia : 1.384**	Netherlands : .881
Angola : 5,412	Oman :. 964	Australia: .879
Indonesia :5,000	Argentina :. 825	Taiwan : .846
World : 1,032,132	World: 75.226	World : 75.988
	World Annual :28,180	World Annual : 28,460

Source : Energy Information Administration USA

There is some activities in oil industry. There is an overview of oil exploration and production and the data that measures these "upstream" activities of the industry. Upstream activities are closer to the source, and "downstream" activities, such as refining and marketing, are closer to the consumer

Finding oil isn't a single activity . it is a series of steps: identifying a prospect , testing the rock, drilling a well, determining whether the find is commercially viable and estimating the dimensions of the reservoir with further drilling. Production wells are then installed and gathering pipelines are assembled to transport the oil to central points for further shipment.

The upstream sector involves the most investment risk because of the high capital expenditures and great uncertainty that oil will be found. On the other hand, it historically has provided greater rewards in terms of profit and return on investment than other segments of the industry. Recent technological advances have reduced the uncertainties and contributed to the more efficient use of capital. Table 2.6 shown the largest oil companies in 2003, that maintain their business in oil around the world. From the table below we can see that all of highest oil company that supplying the world oil consumption are from advance and industrial country that have limited oil resources.

Table 2.6.The Largest Oil Companies in the World (2003)

By Production (barrels per day):	By Reserves (million of barrels):
1. Exxon Mobil (USA) 2,542	1. Lukoil (Russia) 17,360
2. Royal Dutch Shell (UK/Neth) 2,220	2. Yukos (Russia) 17,281
3. Chevron Texaco (USA) 1,959	3. Gazprom (Russia) 14,902
4. British petroleum Amoco(UK) 1,931	4. Exxon Mobil (USA) 12,312
5. Yukos (Russia) 1,507	5. Royal Dutch Shell (UK/Neth) 9,469
6. Total Fina Elf (France) 1,454	6. Chevron Texaco (USA) 8,710
7. Lukoil (Russia) 1,200	7. Brithish Petroleum Amoco (UK) 8,376
8. Conoco Phillips (US) 1,019	8. Tyumen (Russia) 7,300
9. Surgutneftegas (Russia) 884	9. Total Fina Elf (France) 6,961
10. ENI (Italy) 857	10. Surgutneftegas (Russia) 6,642

Source[10]: Forbes,2003

2.9.OPEC, NON-OPEC And WORLD OIL PRICE

OPEC was formed in 1960 with five founding members Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. By the end of 1971 six other nations had joined the group: Qatar, Indonesia, Libya, United Arab Emirates, Algeria and Nigeria. These nations had experienced a decline in the real value of their product since foundation of Organization of Petroleum Exporting Countries.

As already mentioned above (2.1.1) that besides OPEC agreements, the action of oil exporting countries including non-OPEC countries influences in world oil price and Indonesian oil production. According to the data from DOE/EIA (Dept of Energy/Energy Information Administration), the OPEC production in 1950-2000 is around 30 million barrels /day or about 43% of the world's production. And the rest of oil production is produced by non-OPEC countries (US, Canada, Mexico,

[10] www.worldoil.com

and some others). Their production is about 40 million barrels/day or about 57% of world total production. It is one of why OPEC failed to control Crude oil prices. OPEC has seldom been effective as a cartel. There are some others factors that make failure of OPEC to control crude oil prices.

- Arab oil embargo (1974)
- High prices would lead to a reduction in demand. The rapid price increases caused several reactions among consumers. These factors along with a global recession caused a reduction in demand which led to falling crude prices.
- From 1982 to 1985 OPEC attempted to set production quotas low enough to stabilize prices. These attempts met with repeated failure as various members of OPEC would produce beyond their quotas.
- A December 1986 OPEC price accord set to target $18 per barrel was already broken down by January of 1987.
- Prices remained weak. The price of crude oil spiked in 1990 with the uncertainty associated Iraq invasion of Kuwait and the ensuing Gulf War, but following the war crude oil prices entered a steady decline until in 1994 inflation adjusted prices attained their lowest level since 1973.
- The price cycle then turned up. With a strong economy in the United States and booming economy in Asia increased demand led

a steady price recovery well into 1997. This came to a rapid end when the impact of the financial crisis in Asia was underestimated by OPEC. In December, OPEC increased its quotas 10 percent to 27.5 MMBPD (Million Barrels Per Day), but rapid growth in Asian economies had come to a halt.

2.10.USA

2.10.1.USA Oil Consumption

Regionally, the largest oil consuming area remains North America (dominated by the United States), followed by Asia (with Japan the largest consumer), Europe (where consumption is more evenly spread among the nations), and others regions. The United States is still heavily dependent on crude oil, in spite of the growth in use of other fuels like natural gas and coal. In 1998, oil supplied 39% of our energy needs. Natural gas and coal were the next largest fuel sources, each supplying 23% of U.S. consumption. Since, 1985, domestic crude oil production has been declining while oil product consumption has been increasing, resulting in a growing reliance on imports. In 1998, net imports of crude oil and products supplied about 52% of U.S. oil consumption, the highest percentage ever. In order to ascertain the energy demand of a country, oil consumption is broken down into categories such as consumption by industry, traffic, households, individual small consumers, etc. table2.6. shows the final oil consumption in the USA from 1950 to 1990. Table2.6. Gives

the distribution of final energy consumption according to end users in the United States for the individual sectors grew considerably from 1950 to 1990 and is expected to continue. The percentage contribution of the household and commercial sectors increased from 28% in 1950 to 32% in 1975; in the transportation sectors it grew from 30% in 1950 to 33% in 1975. The percentage share of industry decreased from 425 to 35% in the same time span. From the table below we can conclude that the most oil consumption in the USA is in industry, and then followed in the transportation sectors. Roughly half the oil consumed in transportation goes for cars and trucks.

Table 2.7[11].Final Oil Consumption for the United States from 1950 to 1990*(Million barrel)

Final Oil Consumption	Years									
	1950	%	1960	%	1970	%	1975	%	1990	%
Industry	430	42	520	39	710	37	690	35	1040	42
Household and Commercial	290	28	420	31	620	32	630	32	650	26
Transportation	310	30	390	30	590	31	670	33	800	32
Total	1030	100	1330	100	1920	100	1990	100	2490	100
Non-oil uses	40		60		110		110		230	
Consumption	1230		1620		2430		2590		3760	

Source: World Energy Outlook

The total consumption of oil of all forms in the United States was almost three times greater in 1996 than it was in 1950. In 1996 oil used in industry is more higher than in others sectors. Data from US Department of Energy, annual energy Review, Washington DC, 1996 shown that industries

[11] see World Energy Supply p.36

consumed 36% of total oil consumption, then followed Residential and commercial use 33% and transportation only 24%.

2.10.2. USA Oil Production

The oil industry gas has made significant investments in finding ways to utilize technology to continue to provide affordable and reliable resources while at the same time contributing to a cleaner environment.

Most of oil producers are privately owned companies, which tend to be much smaller than publicly traded oil producers. For example, in 1992, when the majors produced a per company average of 345,000 barrels per day , the other publicly-traded oil companies included in this report produced an average of 10,000 barrels per day and remaining oil companies produced an average of only 300 barrels per day. These small private producers are quite numerous, accounting for about 7,400 of the neatly 8,000 companies reporting oil production in the United States in 1992.

Production in the United States has several unusual aspects. One is the private ownership of resource rights. In most major producing countries, the government owns the rights to develop resources. For privately owned property in the United States, the decision to explore for and produce oil is between the landowner and the producing company. The producing company compensates the landowner by the payment of a royalty on each barrel of oil produced. Early in the industry's development, there were few government

restrictions. Now, there are overriding rules about well spacing and environmental standards. The only government agency to restrict production volume was the Texas Railroad Commission, which limited production in Texas depending on projected demand and production volumes in other areas of the United States. However, since the early 1970s, there have been no restrictions to production by government agency.

Just as oil resources are not evenly distributed around the globe, neither are they evenly distributed throughout the United States. Given the way production data are reported, the biggest production region by far is the U.S Gulf Coast, and the largest producing state is Texas. The Gulf Coast region is home to two of the most important producing provinces, the Permian Basin, located inland in West Central Texas and Eastern New Mexico, and the Federal Offshore portion of the Gulf of Mexico.

Texas has been the largest producing state since the late 1920s, when it surpassed California. For a time in the late 1980s, Alaska rivaled Texas, as the more mature Texas fields declined and production from the giant Alaskan North Slope fields, begun in 1977, was still approaching its peak level of about 2 million barrels per day. Since that time, however, production from the Alaskan North Slope has fallen rapidly.

Production from the Federal offshore, now about equal to output from the Alaskan North Slope, is limited by policy to California and the western and central Gulf of Mexico. New production areas led to a resurgence

in activity in the gulf of Mexico, the only area with active new leasing. Leasing, drilling, production and the numbers of fields under development all set records in 1997, as the deepwater Gulf of Mexico became the place to be for almost any larger oil company, domestic or foreign. These new prospective oil producing areas are further offshore, in the much more challenging deepwater.

CHAPTER III

THEORITICAL FOUNDATION

3.1. Review of Related Literature

There are some of related literature which have relation with Indonesian export :

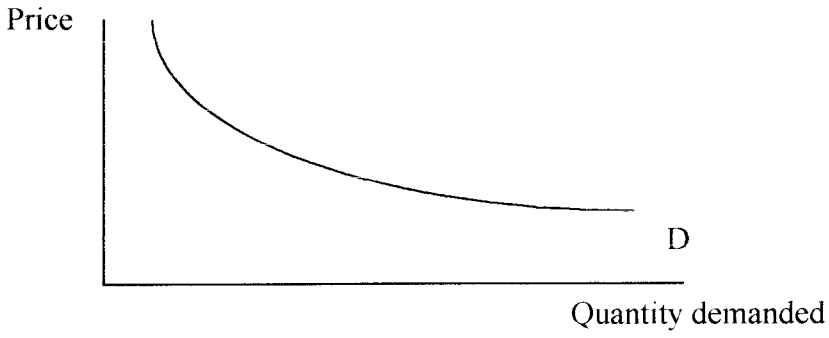
1. Volatility of FOREX rate and its relationship with volume of export (case: Indonesian non-migas export to USA) by Hamsar Lubis (2002). There are some factors that affecting non-oil export. Factors affecting non-oil that had been used are: nominal exchange rate, relative price (term of trade), US GDP, nominal exchange rate volatile and relative price volatile. The hypothesis tested with I-ECM (Insukindro Error Correction Model) model. The result shows that nominal exchange rate and relative price volatile have negative impact on non-oil export. We conclude that Indonesia's exporters are risk averter, especially on exchange rate and relative price risk. In the long run, nominal exchange rate has positive impact, relative price and US GDP have negative impacts on Indonesia's non-oil export to United States. The sign of nominal exchange rate and relative price teoritically are corrected. Negative impact of US GDP reflex that Indonesia's export are inferior good for US's consumers.
2. Thesis by Risep Triawaty with title: Marshall Lerner Analysis on trade Commodity of Copper, Aluminum, Lead to Japan (2001). Transaction used in this research is export import transaction in 1980-1994. The model of regression

that used in this thesis is OLS. Independent variables that are used: volume export and Import, price of each commodity, Real GDP of Japan. The objective of this research is to know the effect of devaluation in FOREX to the volume export-import Indonesia to Japan. The result shows that devaluation on FOREX rate has positive impact on Indonesian-Japan balance of trade.

3. Analysis of factors effecting export supply of Indonesian manufacture industry (PAM) by Ghulam G. There are some factors affecting Indonesian export supply of manufacture product. Factors affecting manufacture export that had been used are: export of price, foreign exchange rate Rp/USD, dummy (1986-devaluation), Previous export. The hypotheses was tested with PAM (Partial Adjustment Model) model. The result shows that all explanatory variables significantly has influence on the volume of export supply manufacture product.

3.2. Demand Theory on open economy

Market demand is the total quantities of a good or service people are willing and able to buy at alternative prices in a given time period; the sum of individual demands. The market demand curve expresses the combined demands of all market participants.



Aggregate demand[1] (or AD) is the total or aggregate quantity of output that is willingly bought at a given level of prices, other things held constant. AD is desired spending in all product sectors : consumption, private domestic investment, government purchases of good and services, and net exports (on open economy).

Demand curve[2] is a graph that shows how quantity demanded varies with the price of good. The downward slope of the demand curve reflects the law of demand. It is also useful to interpret points on demand curve as indicating how the willingness of buyer to pay varies with the quantity of an item actually available in a market over a period of time. The demand curve indicates that the smaller the amount of goods and services offered, the more buyers are willing to pay.

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[1] See Economics (1995) Paul A. Samuelson and William D. Nordhaus. Fifteenth Edition.P.442

2 See The microeconomy Today Bradley R. Schiller. Third Edition. Random House.P.88.

Total spending in the economy tends to decline as the price level rises, other things constant. But other things tend to change, and these influences produce changes in aggregate demand. We can separate the determinants of AD into two categories; one set includes the major policy variables under government control. In open economy system (where there is a government intervention in market) government intervention are applied in monetary policy-steps by which the central bank cab affect the supply of money and other financial conditions-and fiscal policy-taxes and government expenditure. The second category is exogenous variables, or variables that are determined outside the AS-AD framework.

A demand curve is constructed on the assumption that all determinants of demand other than price are given (i.e. constant). The demand curve is a reliable predictor of consumers behavior so long as underlying tastes, incomes, costs of other goods, or expectations do not change. As long as ceteris paribus (other thing being equal), the quantity demanded will move up or down the demand curve is response to changes in price.

But other things do not remain equal forever: tastes, incomes, opportunity costs do not change. When they do, the demand curve will shift to a new position. A shift of the demand curve result when the ceteris paribus assumption is violated-when something other than the price of the good has changed.

Accordingly, we recognize two distinct cause of changed consumer behavior:

- A change in the price of that good, which causes a movement along the existing demand curve to a new quantity demanded.
- A change in underlying tastes, income, other goods, or expectations, which causes a shift in the demand curve.

A rightward shift of the demand curve indicates that consumers are willing to buy a larger quantity at every price. A shift of demand curve occurs only when the assumption of ceteris paribus is violated.

3.3. International Trade as One Part of Economic System

In open economy, participating in the world economy and linked with other countries through trade and finance is needed. We export commodities and services that are produced most inexpensively at home and import those things in which others have a cost advantage.

Countries cannot live alone any more effectively than individuals can. Each country tends to specialize in the production of those commodities it can produce more cheaply than other countries, and then exchanges its surplus for the surpluses of other countries.

3.4. Price Elasticity of Demand

When the price of a commodity falls, the quantity demanded increases. The elasticity of demand is merely the ratio of the percentage change in the quantity demanded to the percentage change in the price. When these percentage changes are

equal (in absolute terms), the elasticity of demand is unity. When the quantity demanded changes faster than the price, the elasticity of demand is higher than unity, the demand is elastic. Finally, when the quantity demanded changes more slowly than the price, the elasticity of demand is lower than unity, and we say that demand is inelastic.

Table 3.1. Price Elasticity of Demand

Demand Response	% change in quantity demanded relative to % change in price (ignoring direction of change)	value elasticity of demand (ignoring minus sign)
Inelastic	% change in quantity demanded is less than % change in Price	Equal to or greater than 0 but less than 1
Unit Elastic	% change in quantity demanded equals % change in price	1
Elastic	% change in quantity demanded is greater than % change in price	Greather than 1

Price elasticity of demand is the percentage change in quantity demanded divided by the percentage change in price.

$$\text{Price elasticity (E)} = \frac{\text{Percentage chg in quantity demanded}}{\text{Percentage chg in price}}$$

According to the law of demand, when price increases (decreases), the quantity demanded decreases (increases). Since price and quantity demanded always move in opposite directions, the price elasticity of demanded (E) is always negative. However, E is typically expressed in absolute terms (without the minus sign).

3.5. Theory of Consumer Behavior

The model of consumer choice has four elements that describe the consumer and his market environment

- The consumer takes as given the prices at which he can buy any amount of the existing goods and services.
- The consumer has a given income available for spending.
- The consumer has taste that allow him to evaluate, or rank, alternative combinations, or baskets, of goods by the satisfaction they yield. The consumer prefer more of any one good to less.
- The consumer chooses his consumption basket so as to maximize satisfaction, or, as it is called utility.

3.6. Foreign Exchange Rate

The essential role of money is to provide a general accepted unit of exchange and standard of value. Exchange rate is the price of one country's currency expressed in terms of another's; the domestic price of a foreign currency. Most exchange rates are determined in foreign exchange markets beside government intervention. Hence, the demand for foreign currency is primarily an expression of the demand for foreign goods and services.

There are 4 methods to determine foreign exchange rates: depreciation is a fall in the price of one currency in terms of one or all others; appreciation is a rise

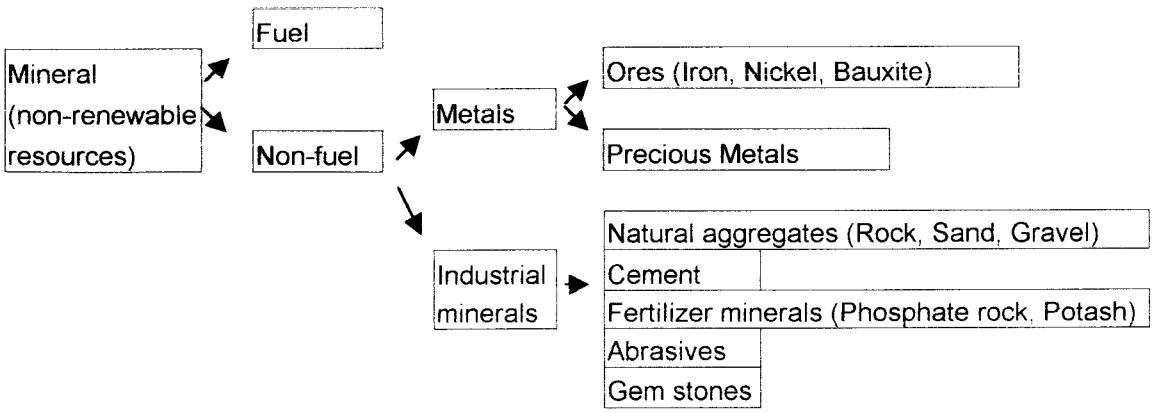
in the price of a currency in terms of another currency; devaluation is continued to situations in which a country has officially set or "pegged" its exchange rate to another currency or to gold and in which the pegged rate or parity is change by raising the price of the other currency. Appreciation and depreciation always happen in the foreign exchange market.

3.7. Substitution Effect and Income Effect

Changes in the prices of other goods can shift a demand curve in either direction. Substitute goods is goods that substitute for each other; when the price of good X rises, the quantity of good Y demanded increases(ceteris paribus). **Substitution effect** says that, when the price of a good rises, consumers will tend to substitute other goods for the more expensive good in order to satisfy their needs more inexpensive. **Income effect** happened when a lower real income generally leads to lower consumption, the income effect will normally reinforce the substitute effect in making the demand curve downward sloping.

3.8. Mineral Resource Problems

Mineral refers to the wide range of inorganic solid substances, which are normally found in or on the ground and which are used by humans for a great variety of purposes.



A mineral appears to fit the classic definition of the nonrenewable resources, one for which $\Delta S=0$. A major factor in the cost of natural resources is in exploration, discovery, and development, that is, the costs of adding to reserves. In most cases, exploration and development can increase the inventory of known deposits. With continuous exploration effort, the stock of new deposits, or new reserves, may be pushed out more or less continuously. Another important phenomenon is developments in extraction technology. Better extraction methods can make it possible to extract resources of lower grades.

In theory, if the non-renewable resources becomes more scarce their prices will rise, but in reality there has been quite a lot of up-and-down in the price. There are two major factors behind this drop in prices. First, the market simply does not see a quantitative restriction in these resources despite its non-renewable resources. The second factors causing prices to drop is technical change along natural resource exploration, discovery, development, extraction, transportation, and

processing. This happens much faster than increases in demand, with result that prices are driven down over time.

3.9. Theory of Export Quota

A nation may also exploit its monopoly power in foreign trade by directly controlling the volume (or value) of its exports. The government may decree that only a given quantity (export quota) may be exported per unit of time. For this purpose, the government may issue export licenses, which it either sells to the country's exporters or simply gives away on a first-come, first-served basis.

An export quota causes the price of the restricted commodity to rise in the foreign markets and fall in the domestic market. The margin between the domestic and foreign prices may accrue to the government of the restricting country in the form of export license fees; or it may accrue to domestic producers, to intermediaries, to foreign consumers, or even to the government officials who issue the licenses.

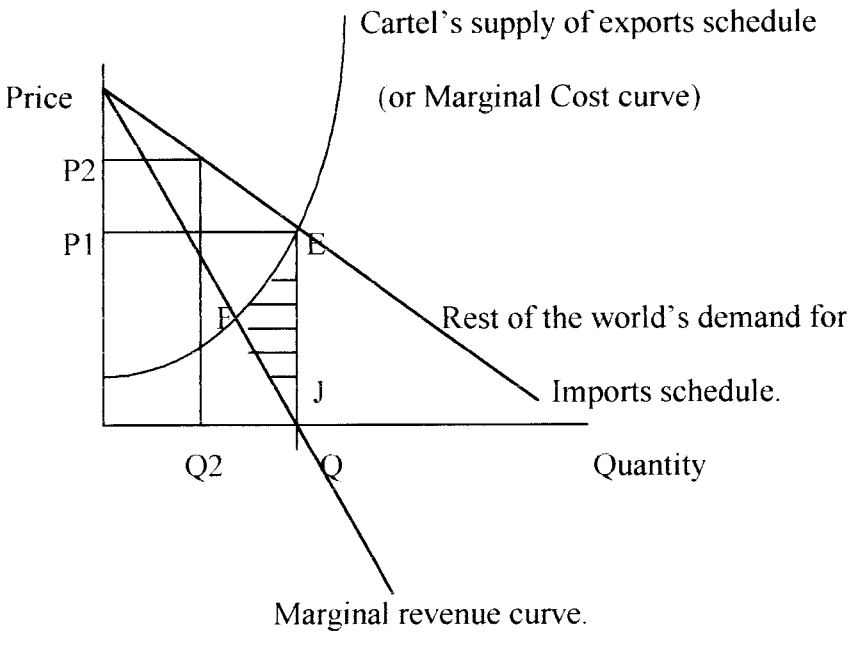
For every export quota there is an equivalent export tax. Because of their equivalence and the symmetry between export taxes and import taxes, there exists also a symmetry between export and import quotas.

3.10. International Cartel

International cartel is agreement between governments or private corporation located in various countries to effectively restrict competition among

themselves in an effort to exploit their joint monopoly power. The world economy has a long history of international cartels in many goods and services, such as bauxite, coffee, diamonds, tobacco, and airline and railway services. The majority of cartels tend to disintegrate rapidly. The most notable exception is the Organization of Petroleum Exporting Countries (OPEC).

Maximization of the cartel's profits



Perfect competition leads to equilibrium at E, where the cartel's supply-of-export schedule intersect the rest of the world's demand-for-imports schedule. To maximize profits, the cartel reduces exports from Q1 to Q2 and raises its price from P1 to P2. in particular, the cartel determines its monopoly exports at the intersection (F) of its marginal cost curve (which coincides with the supply-of-

exports schedule) and marginal revenue curve. The total profits if the cartel increase by shaded triangular area FEJ.

Economics theory identifies two conditions that are necessary for the success of an international cartel. They are following:

1. The elasticity of demand for imports by rest of the world must be low in the relevant price range.
2. The cartel members must adhere to the official set of policies (with respect to price and output) voted by cartel members.

3.11. Analysis Tools:

3.11.1. Time Series Regression

There are three types of data available for empirical analysis : time series, cross sectional, and pooled (combination of time series and cross sectional) data. Data used in this research is Time series. A time series is a set of observations on the values that are taken variable at different times. Such data may be collected at regular time intervals, such as daily, weekly, monthly, quarterly, and annually.

3.11.2. F-Statistic Testing

Testing the overall significance of the sample regression (F-test) is a test of the overall significance of the observed or estimated regression line, that

is, whether Y as dependent variable is linearly related to independent variable

X_1 X2 X_3[3] X_4, Y_{t-1}

3.11.3. T-Statistic Testing

Test of significant approach (T-test) is a test of significance is a procedure by which sample results are used to verify the truth or falsity of a null hypothesis[4]. The meaning of this test is to know the relationship between independent variable and dependent variable individually.

Independent variable will negatively influence on dependent variable individually if;

$$Ho : \alpha_i = 0$$

$$Ha : \alpha_i < 0$$

Independent variable will positively influence on dependent variable individually if;

$$Ho : \alpha_i = 0$$

$$Ha : \alpha_i > 0$$

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[3] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.245.

[4] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.124

Independent variable whether positively or negatively influence on dependent variable individually if;

Ho : $\alpha_1 = 0$

Ha : $\alpha_1 \# 0$

With statistical tables, so:

1) if computed t-value > critical t-value (df = h – k) ..... Ha is accepted

2) if computed t-value < critical t-value (df = h - k) ..... Ha is rejected

3.11.4. PAM (Partial Adjustment Model)

One way to maintain the stationarity is using PAM. In PAM the model is in the condition of short-run model (because there is a lag in the model), since in the short run the dependent variable may not necessary be equal to its long-run level.

In regression analysis involving time series data, if the regression model includes not only the current but also the lagged (past) values of the explainatory variables (the X's), it is called a distributed lag model. If the model includes one or more lagged values of the dependent variable among its explanatory variables, it is called an autoregressive model.

Thus ; $Y_t = \alpha_0 + \alpha_1 X_t + \alpha_2 Y_{t-1} + \mu$

Is an example of an autoregressive model. The latter are also known as dynamic models since they portray the time path of the dependent variable in relation to its past value(s).

3.11.5. The Multiple Regression Coefficient of Determination (R^2)

Multiple coefficient of determination (R^2) is the quantity that gives information to know the proportion of the variation in Y explained by the variables X_1, X_2 and X_3[5]. Multiple coefficient determination is a abstraction that describe the condition of sample regression line showing all data. That R^2 lies between 0 – 1. if it is 1, the fitted regression line explains 100 percent of the variation in Y. the other hand, if it is 0, the model does not explain any of the variation in Y. typically, however, R^2 lies between these extreme values. The fit of the model is said to be "better" the closer is R^2 to 1. multiple correlation, denoted by R, and it is a measure of the degree of association between Y and all the explanatory variables jointly. R^2 is always taken to be positive.

3.11.6. Testing Violation on Classic Assumption

This testing is usually used to know the validation of model. So the result of analysis can be interpreted. The validation of a model if it is free from multicollinearity, heteroscedasticity and autocorrelation.

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[5] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.201.

3.11.6.1. Multicollinearity

Multicollinearity refers to the existence of more than one exact linear relationship or a linear relationship among some or all explanatory variable X_1, X_2, X_3, X_4. There are several sources of multicollinearity. Multicollinearity may be due to the following factors[6] :

1) The data collection method employed, for example, sampling over a limited range of the values taken by the regressors in the population.
2) Constraints on the model or in the population being sampled.
3) Model specification
4) An over determined model.

The model of regression is called multicollinearity if there is a perfect multicollinearity among explanatory variable. The way to detect multicollinearity is by comparing the value of partial coefficient determination (r^2) with multiple coefficient of determination (R^2).

If (r^2) < (R^2) .....there isn't multicollinearity.

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[6] Gujarati, Damodar.(1995). Basic Econometrics: Third Edition.Singapore,McGraw-Hill Book Co.p.323.

3.11.6.2. Heteroscedasticity[7]

An important assumption of heteroscedasticity is heteroscedasticity shows the conditional of Yi increases as X increases. Here, the variances of Yi are not the same. Heteroscedasticity assumption is need variance from disturbance term μt is constant for each explanatory variable (X) which means $\Sigma (\mu t^2) = \mu t^2$. If there is differences at disturbance term it means heteroscedasticity. In another word, homoscedasticity want for each explanatory variables pair with dependent variable which has same distribution and varian.

Hereoscedasticitas happen if value between one independent variable with others independent variables pair with the value of dependent variable which is distributed from different varian. In this thesis heteroscedasticity will be tested by using Spearman ladder correlation test. Xt and μt will be tested here.

3.11.6.3. Autocorrelation

The term autocorrelation may be defined as " correlation between members of series of observations ordered in time or space[8]. In

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[7] See thesis by Risep Triaswaty " Analisa Marshall Lerner dalam perdagangan komoditas tembaga, alumunium dan timah hitam di Indonesia dengan jepang"2001.

[8] Gujarati, Damodar (1995). Basic Econometrics: Third Edition Singapore,McGraw-Hill Book Co.p.400.

the regression contex, the classical linear regression model assumes that such autocorrelation does not exist in the disturbances μi. The classical model assumes that the disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation. Thus, correlation between two series where the former is the latter series lagged by one time period, is autocorrelation.

The term autocorrelation may be defined as correlation between residual of one observation ordered in time (as in time series data) or space (in cross sectional data). If there is autocorrelation in the model, it will raise the value of residual and the impact is the number of t-test and R^2 will decline.

The tool of analysis is used to detect autocorrelation is using LM Test (Lagrange Multiplier Test). This test use the level of degree (χ^2), Ho expressing that there is no autocorrelation, with the guidance if χ^2 statistic bigger than value of χ^2 tables, hence Ho denied, and also the contrary[9].

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[9] See Insukindro, Maryatmo, Aliman. Ekonometrika Dasar dan Penyusunan Indikator Unggulan Ekonomi.2001. P.199

CHAPTER IV

DATA ANALYSIS

4.1. Data Description

Model used in this thesis is:

$$Y = f(X_1, X_2, X_3, X_4, Y_{t-1}, \mu_t)$$

Where;

Y = Volume of oil export of Indonesia, Million tones

X_1 = Price of oil, USD/barrel

Price oil/barrel (X_2) is weighted by CPI of USA based year 1990.

X_2 = Foreign Exchange Rate, Rp/USD

X_3 = US Real Total GDP , Bill of USD

Real GDP Nominal USA is weighted by average Real Total GDP of G4 (Japan, UK, Germany, France).

X_4 = Price of coal USD/Metric

Y_{t-1} = Volume of oil export of Indonesia in the previous year.

μ = Error term

Regression model that is used is PAM of log linear (double log regression)

The log Linier (double log) regression can be written as follow;

$$\ln Y = \ln\alpha_0 + \alpha_1 \ln X_1 + \alpha_2 \ln X_2 + \alpha_3 \ln X_3 + \alpha_4 \ln X_4 + \alpha_5 \ln Y_{t-1} + \mu_i$$

Where;

$\ln\alpha_0$ = Autonomous lnY

α_i = Elasticity of each independent variable.

4.2. Sources of data

Data are collected from BPS Yogyakarta, Bank Indonesia Yogyakarta, and USA official web site (NIPA National Income and Product Accounts Tables from USA Bureau of Economic Analysis) from 1970 –2001.

4.3. Data Description

X_1 (Price of oil, USD/barrel)

Price oil/barrel (X_1) is weighted by CPI of USA based on the year 1990 (1970-2001). The reason is because price is a variable that is sensitive with multicolinearity disease. So price of oil should be weighted by CPI of USA.

There are some kinds of world oil price based on the market. There are: Dubai Fateh Market, U.K. Brent, Alaska North Slope, Saudi Arabia (Ras

Tanura), Libya (Es Sidra), and Venezuela (Tia Juana). This thesis uses world average crude price to maintain the differences on the price. As mentioned in chapter 3 (OPEC, NON OPEC, and World Oil Price) world oil prices are determined by the power of market mechanism beside by the OPEC members agreement. The world oil prices are not only determined by OPEC agreement but also by the action of oil exporting countries that are included in non-OPEC countries that influence the world oil price. According to the data of DOE/EIA (Dept of Energy/Energy Information Administration) OPEC production in 1950-2000 was around 30 million barrels/day or about 43% of the world's production; and the rest of oil production was produced by non-OPEC countries (US, Canada, Mexico, and some others). Their production was about 40 million barrels/day or about 57% of the world total production.

X_2 (Foreign Exchange Rate, Rp/USD)

There are 4 methods to determine foreign exchange rates: *depreciation* is a fall in the price of one currency in terms of one or all others; *appreciation* is a rise in the price of a currency in terms of another currency; *devaluation* is a policy used in a country which has officially set or "pegged" its exchange rate to another currency. Appreciation and depreciation always happen in the foreign exchange market.

X_3 (US Real Total GDP , Bill of USD)

Real Total GDP USA is weighted by average Real GDP of G4 (Japan/Yen, UK/Pound sterling, Germany/Deutsche Mark, France/Franc) all of currency had already been calculated into US$.

This thesis uses Real Total GDP because in USA most of oil is used in industry besides by the citizen of USA who live in USA. Real Total GDP of USA is weighted by Average of Real Total GDP G4 (Japan, UK, France, German) because GDP is sensitive with the disease of multicollinearity.

4.4. Analysis Result

Hypotheses testing can be summarized as shown in table 4.1.

Table 4.1. Regression Result

R^2 = 0.933960 F = 70.71126				
Variable	Coefficient	T-Computed	Std.Error	Prob.
C	2.866506	2.231032	1.284834	0.0349
LnX_1	-1.557677	-1.242829	1.253332	0.2255
LnX_2	-0.269267	-3.003223	0.089659	0.0060
LnX_3	0.577405	2.065356	0.279567	0.0494
LnX_4	0.165565	0.988585	0.167477	0.3323
LnY_{t-1}	0.822679	8.271598	0.099458	0.0000

From table 4.1. we can conclude that:

4.4.1. The Multiple Regression Coefficient of Determination (R^2)

The model used in this research is proper, shown by the size of R^2=0.93 it means that 93% of the variability of the dependent variable is explained by the

independent variables chosen in this research. Only 7% is explained by independent variables from outside of the model.

4.4.2. F-Test

From the size of F = 70.71126 which is greater than F-Table 2.59 at α = 5%, all independent variables (Price of oil, FOREX Rate, US Real Total GDP, Price of coal, volume oil export in the previous year) on the model have the joined impact on the dependent variable.

4.4.3. Testing on Independent Variables (T-Statistic Testing).

t-table = t_{α} df (n-k)

Where;

α = level of significant

h = the amount of data = 32

k = the number of variables = 6

df = 26

Testing on price of oil (LnX_1)

t-Test of this explanatory variable uses one tailed negative t-test[1].

Ho : $\alpha_1 = 0$

[1] See Gujarati, Damodar. Essentials of Econometrics. @nd Edition.P.167

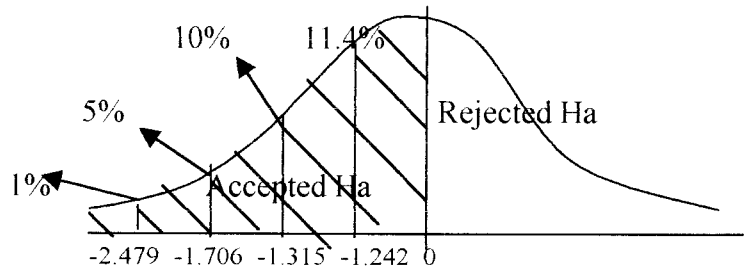
Ha : $\alpha_1 < 0$

Computed t value = -1.242829

Table value of one tail t-test

Level of significance	0.01	0.05	0.10	0.114
Critical t	2.479	1.706	1.315	1.24

Since the sign is negative , it means the hypothesis is proven.



Conclusion : Ha is accepted, price of oil has a negative and significant influence on the export volume of Indonesia to the USA at α=22.5%.

Testing on FOREX ($\ln X_2$)

T-Test of Explanatory variable uses one tailed positive t-test.

Ho : $\alpha_2 = 0$

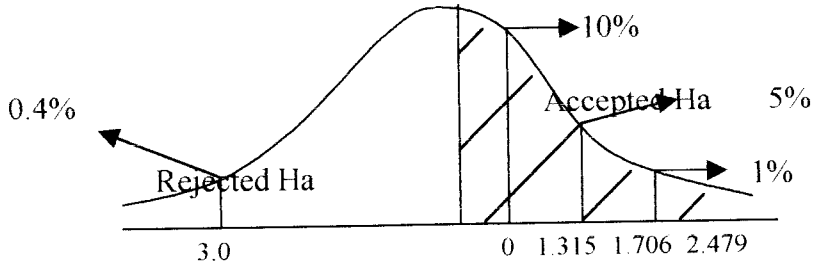
Ha : $\alpha_2 > 0$

Computed t value = -3.003223

Table value of one tail t-test

Level of significance	0.004	0.01	0.05	0.10
Critical t	3.0	2.479	1.706	1.315

Since the sign is negative, it means the hypothesis is not proven.



Conclusion : Ha is rejected, FOREX have no effect on the volume of oil export at α=0.6%.

Testing on Real Total GDP (LnX_3)

T-Test of Explanatory variable uses two tailed test[2].

Ho : $\alpha_3 = 0$

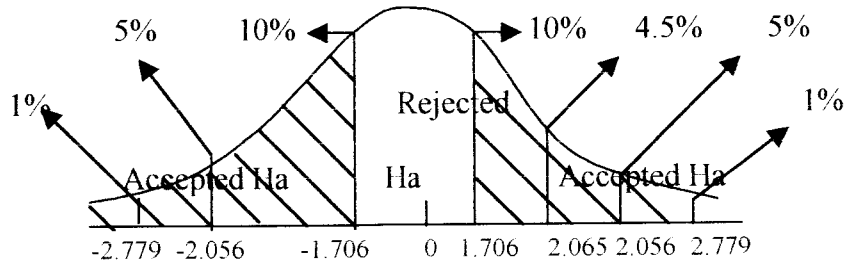
Ha : $\alpha_3 \neq 0$

Computed t value = 2.065356

Table value of two tails t-test

Level of significance	0.01	0.045	0.05	0.10
Critical t	2.779	2.065	2.056	1.706

[2] See Gujarati,Damodar..Essentials of Econometrics. 2nd Edition.P.168



Conclusion : Ha is Accepted, Real Total GDP USA has positive effect on the volume of oil export.

Testing on price of Coal (LnX_4)

T-Test of Explanatory variable uses one tail positive t-test.

Ho : $\alpha_4 = 0$

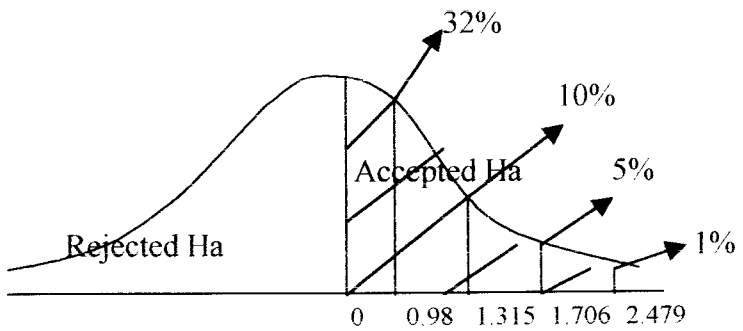
Ha : $\alpha_4 > 0$

Computed t value = 0.988585

Table value of one tail t-test

Level of significance	0.01	0.05	0.10	0.32
Critical t	2.479	1.706	1.315	0.98

Since the sign is positive, it means the hypothesis is proven.



Conclusion : Ha is accepted, price of coal has a positive and significant impact on the oil export volume of Indonesia at α=33.2%.

Testing on volume export oil at previous year (LnY_{t-1})

T-Test of Explanatory variable uses two tailed test.

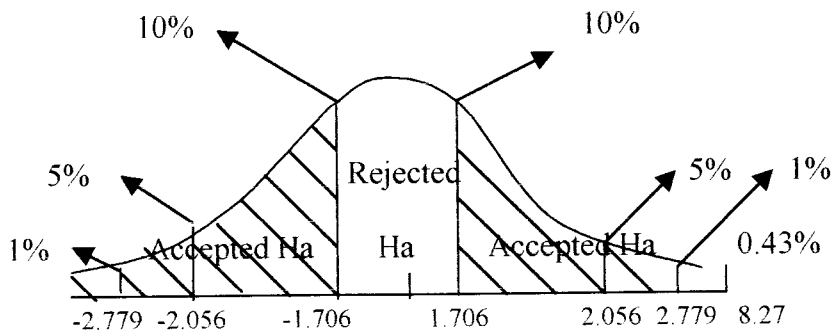
Ho : $\alpha_5 = 0$

Ha : $\alpha_5 \neq 0$

Computed t value = 8.271598

Table value of two tails t-test

Level of significance	0.0043	0.01	0.05	0.10
Critical t	8.271	2.779	2.056	1.706



Conclusion : Ha is accepted, Previous years oil export has a positive effect on the volume of oil export.

4.4.4. Coefficient PAM

The result of the PAM regression model can be seen in the following:

$$LnY = 2866506 - 1.557677\ LnX_1 - 0.269267\ LnX_2 + 0.577405\ LnX_3 + 0.165565\ LnX_4 + 0.822679\ LnY_{t-1} + \mu$$

Se =	(1.284834)	(1.253332)	(0.089659)	(0.279567)	(0.167477) (0.099458)
t- Stat =	(2.231032)	(-1.242829)	(-3.003223)	(2.065356)	(0.988585) (8.271598)

R^2 = 0.933960
Adj R^2 = 0.920752
DW = 2.449713
F-Stat = 0.000000

However, the results of PAM regression above just for short run estimation. For the long run we need to calculate the coefficient of long run PAM model;

Long run coefficient = Short run coefficient / (1 – δ)

Where; δ = coefficient of adjustment = α_5 = 0.822679

$1 - \delta = 1 - 0.822679$

$= 0.177321$

So, the long run PAM is:

$$LnY = 16.16563182 - 8.78450\ LnX_1 - 1.65154\ LnX_2 + 4.36524\ LnX_3 + 0.933617\ LnX_4 + 4.63948\ LnY_{t-1} + \mu$$

From the result above (in absolute value), the long run coefficient is bigger than the short run one, it means that the development of oil demand from USA is running slowly.

4.4.4.1. Result on Data Estimation

This research uses PAM so the estimation of the regression uses short run and long run demand functions.

Short run Estimation:

- $\alpha_1 = -1.557677$

  It means if price of oil increases 1%, volume of oil export will decrease 1.55767%.

- $\alpha_2 = -0.269267$

  It means if FOREX Rate increases (Appreciate) 1%, volume of oil export will decrease 0.269267%.

- $\alpha_3 = 0.577405$

It means if Real Total GDP USA increases 1%, volume of oil export will increase 0.577405%.

- $\alpha_4 = 0.165565$

  It means if price of coal increases 1%, volume of oil export will increase 0.165565%.

- $\alpha_5 = 0.822679$

  It means if Volume oil export Indonesia in the previous year increases 1%, volume of oil export in the current year will increase 0.822679%.

Long Run Estimation

- $\alpha_1 = -8.78450$

  The sign is negative, it means that if price of oil increases 1US$, the volume of oil export will decrease 8.78450

- $\alpha_2 = -1.65154$

  The sign is negative, it means that if FOREX Rate increases (Appreciated) by 1US$, the volume of oil export will decrease by 1.65154

- $\alpha_3 = 4.36524$

  The sign is positive, it means that if USA Real Total GDP increases by 1US$, the volume of oil export will increases by 4.36524

- α_4=0.933617

  The sign is positive, it means that if price of coal increases by 1US$, the volume of oil export will increases by 0.933617.

- α_5= 4.63948

  The sign is positive, it means that if export of oil at previous period is significant, it potentially explained the demand of Indonesian oil export to USA.

4.4.4.2. Analysis Elasticity Short run and Long Run.

Table 4.2. Table Coefficients of Short Run and Long Run

Independent Variable	Elasticity	
	Short Run	Long Run
LnX1	-1.557677	-8.7845
LnX2	-0.269267	-1.65154
LnX3	0.577405	4.36524
LnX4	0.165565	0.933617
LnYt-1	0.822679	4.63948

1) Oil price (LnX_1)

The elasticity of oil Price (α_1) is greater than 1 for both Short Run and Long Run. This result shows that the demand of Indonesia's oil is elastic, and becomes more elastic if we compare short run and long run. The demand of Indonesia's oil is elastic. It means that Indonesia's oil is less important to the USA and has more substitute from others oil producer countries. Moreover,

oil is a non-renewable goods. This fact shows that Indonesia can not rely on oil income.

2) Foreign Exchange Rp/USD (LnX_2)

This variable is not analyzed since the finding shows it has no effect on the dependent variable.

3) Real Total GDP (LnX_3)

Income elasticity of USA (α_3) is in positive sign for both Short Run and long Run. But, in the Short run the elasticity is below 1. It means that Indonesia's oil for USA in the short run period is categorized as necessity goods. In the Short run, the income of USA has more influence on the demand of Indonesia's oil than Price of oil. The elasticity in the Long run is greater than 1, meaning that Indonesia's oil for USA in the long run period is categorized as non-necessity goods (luxurious goods). In the long run, income of USA and price of oil do not have effect on the volume of Indonesia's oil export to the USA because there is substitution.

4) Price of coal (LnX_4)

Cross Elasticity of coal is in the positive sign for both short run and long run, it means that coal is a substitute goods of oil. Because Indonesia in the future can not rely on its income on oil, the rule of coal as a substitution of oil is expected to be increased.

5) Volume export oil at previous year (LnY_{t-1})

The elasticity of volume export oil at previous year is in the positive sign for both short run and long run, it means that the more export in the current year, the more export in the future. The USA oil import from Indonesia continue every year, so Indonesia as exporter countries should keep the trade with USA.

4.4.5. Violation on Classic Assumption

4.4.5.1.Multicollinearity

Multicollinearity refers to the existence of more than one exact linear relationship or a linear relationship among some or all explanatory variable X1, X2, X3, X4.

The way to detect multicollinearity is by comparing the value of partial coefficient determination (r^2) with multiple coefficient of determination (R^2).

If (r^2) < (R^2) .....there isn't multicollinearity.

Table 4.3. Test of Multicollinearity (Klein Test)

Regression Model	r^2	R^2	$R^2 > r^2$
LNX1-LNX2	0.082007	0.93396	No Multicollinearity
LNX1-LNX3	0.002016	0.93396	No Multicollinearity
LNX1-LNX4	0.148194	0.93396	No Multicollinearity
LNX1-LNYT-1	0.432907	0.93396	No Multicollinearity
LNX2-LNX3	0.017113	0.93396	No Multicollinearity
LNX2-LNX4	0.372601	0.93396	No Multicollinearity
LNX2-LNYT-1	0.488632	0.93396	No Multicollinearity
LNX3-LNX4	0.017196	0.93396	No Multicollinearity
LNX3-LNYT-1	0.050817	0.93396	No Multicollinearity
LNX4-LNYT-1	0.004451	0.93396	No Multicollinearity

From the result above the value of $R^2 > r^2$ means no multicollinearity.

4.4.5.2. Heteroscedasticity[3]

An important assumption of heteroscedasticity is heteroscedasticity shows the conditional of Yi increases as X increases. Here, the variances of Yi are not the same. Heteroscedasticity assumption wants variance from disturbance term μt is constant for each explanatory variable (X) which means $E(\mu t^2) = \sigma t^2$. If there are differences at disturbance term it means heteroscedasticity. In another word, homoscedasticity wants for each explanatory variables pair with dependent variable which has same distribution and variance.

[3] See thesis by Risep Triaswaty " Analisa Marshall Lerner dalam perdagangan komoditas tembaga, alumunium dan timah hitam di Indonesia dengan jepang"2001.

Hereoscedasticitas happen if value between one independent variableand others independent variables pair with the value of dependent variable which is distributed from different variance. In this thesis heteroscedasticity will be tested by Spearman ladder correlation test. Xt and Et will be tested in this test.

In Spearman's rank correlation test:

$$Rs = 1- \frac{6 \Sigma di^2}{n(n-1)}$$

Where:

di = difference in the ranks assigned to two different characteristics of the *i*th individual or phenomenon and n = number of individuals or phenomena ranked. The preceding rank correlation coefficient can be used to detect heteroscedasticity.

The significance of the sample rs can be tested by using the T-Test as follows:

$$t = rs \frac{\sqrt{n-2}}{\sqrt{1-rs^2}}$$

if the computed t value exceeds the critical t value, the hypothesis of heteroscedasticity is accepte; otherwise it is rejected. If the regression model involves more than one X variable, rs can be computed

between |û | and each of the X variables is separated and can be tested for statistical significance by the t-test.

Table 4.4.Testing of Heteroscedasticity

Variable	rs	T-Test	T-Table	T-Test< T-Table
LnX1	0.0891	0.4899	2.479	No Heteroscedasticity
LnX2	0.3893	2.3140	2.479	No Heteroscedasticity
LnX3	-0.14	-0.772	2.779	No Heteroscedasticity
LnX4	0.2259	1.2702	2.473	No Heteroscedasticity
LnYt-1	-0.2250	-1.265	2.779	No Heteroscedasticity

4.4.5.3. Autocorrelation

The term autocorrelation may be defined as correlation between residual of one observation ordered in time (as in time series data) or space (in cross sectional data). If there is autocorrelation in the model, it will raise the value of residual and the impact is the number of t-test and R^2 will decline.

The tool of analysis is used to detect autocorrelation is using LM Test (Lagrange Multiplier Test). This test use the level of degree (χ^2), Ho expressing that there is no autocorrelation, with the guidance if χ^2 statistic bigger than value of χ^2 tables, hence Ho denied, and also the contrary[4].

[4] See Insukindro, Maryatmo, Aliman. Ekonometrika Dasar dan Penyusunan Indikator Unggulan Ekonomi.2001. P.199

Autocorrelation Test

Table 4.5. Autocorrelation Test with LM Method

Test	χ^2Stat	χ^2(2) 0.05 table	Autocorrelation
Obs *R-Squared	3.304	3.84146	No Autocorrelation

Result of autocorrelation test at tables 4.5 shows that there is no autocorrelation.

4.4.6. Proof of Hypotheses

1). Hypothesis is proven. The price of oil (X_1) has a negative and significant influence on the export volume of Indonesia to the USA.

2). Hypothesis is not proven. The rate of Rp/USD (X_2) has negative and significant effect on the oil export volume of Indonesia.

3). Hypothesis is proven. The Real Total GDP of importing country (X_3) has a significant and positive effect on the oil export volume of Indonesia to the USA.

4). Hypothesis is proven. The price of coal (X_4) has a positive and significant impact on the oil export volume of Indonesia.

5). Hypothesis is proven. The previous year oil export (Y_{t_1}) has a significant and positive effect on the oil export volume of Indonesia.

6). All independent variables on the model have joined impact on the Dependent Variable.

CHAPTER V

CONCLUSION and IMPLICATION

5.1. Conclusion

There are some conclusion that we can get:

1. From the regression of time series data from 1970-2001 with volume of Indonesian oil export to the USA as the dependent variable (LnY) and price of oil (LnX_1), FOREX rate (LnX_2), USA Real Total GDP (LnX_3), price of coal (LnX_4), and volume of export oil Indonesia at previous period (LnY_{t-1}) as independent variables, the R^2 value is 0.933960 (93%). It means that 93% of the variability of the dependent variable is explained by the independent variables chosen in this research. Only 7% is explained by variables from outside of model.
2. From classical assumption, there aren't multicollinearity, heteroscedasticity, and Autocorrelation.
3. From F-Test we can conclude that all of independent variables has effect on the volume of oil export Indonesia to USA.
4. Price of oil (X_1) has a negative and significant effect on the volume of oil export.
5. FOREX Rate (X_2) has a significant and negative effect on the volume of oil export.

6. Real Total GDP USA (X_3) has a significant and positive effect on the volume of oil export.
7. Price of coal (X_4) has a significant and positive effect on the volume of oil export.
8. Oil export at previous year (Y_{t-1}) has a significant and positive effect on the volume of oil export.
9. The uses of PAM in this research is valid to explained Indonesia's crude oil export to the USA.

1.2. Implication

From the long run coefficient of PAM regression model we can conclude that:

1. The finding X1 has influence on the volume of Indonesia's oil export to USA. The result shows that the demand of Indonesia's oil is elastic and is becoming more elastic in the future. It means that Indonesia's oil is less important to the USA and has more substitute from other oil producer countries. In the future Indonesia can not rely on their income from oil. So, to increase national income Indonesia should shift its domination from oil sector to others sectors.
2. the finding X_2 has no influence. This fact shows that the fluctuation of Rupiah exchange rate does not influence the volume of oil export.

3. The decision of buying Indonesia's oil is more induced by income decision. In the short run the commodity is necessity, however, in the long run it becomes non-necessity.
4. Coal as a substitute goods has a good future in USA's market so as coal exporter countries Indonesia should increase its coal volume export.
5. The USA oil import from Indonesia continue every year, so Indonesia, as exporter countries, should keep the trade with USA.

REFERENCES

Anggito, Abimanyu. (1988). *Minyak bumi dan bantuan luar negri dalam perekonomian Indonesia.* Yogyakarta: STIE YKPN Press.

BPS.(1997). *Statistik pertambangan minyak dan gas bumi .*

BPS.(2000). *Statistik pertambangan minyak dan gas bumi.*

BPS. (Various Edition). *Indonesia Statistic Year Book*

Bisnis Indonesia. (1997). *Indonesia Economic Almanac.*

BPS. (95/96). *Nota Keuangan dan Rancangan Anggaran Pendapatan dan Belanja Negara.*

BPS. (89/90). *Nota keuangandan rancangan Anggaran Pendapatan dan Belanja Negara.*

BPS. (2000/2001). *Nota keuangandan rancangan Anggaran Pendapatan dan belanja Negara*

BPS.(Various Edition). *Indonesian National Income Year Book.*

Chacholiades. Miltiades. (1990). *International Economics.* United States: McGrawHill.

Dept of Mining. (1988). *Indonesian Annual Book of Mining.*

Gujarati,Damodar. (1999). *Essentials of Econometric.* 2nd Edition. Singapore: Irwin McGraw-Hill, Inc

Gujarati,Damodar.(1995). *Basic Econometrics.* 3rd Edition. Singapore: McGraw-Hill. Inc.

Hill,.R,Carter .and William.E.Griffith, and George G.Judge.(1997).*Under Graduated Econometrics.* United States of America: John willey &sons, Inc.

Hyman. N. David. (undated). *Microeconomics.* (4th Edition). North Carolina State University: Mc Graw Hill.

http:// www.eia.doe.gov/wmaster @eia.doe.gov.

http://www.eia.doe.gov/oiaf/aeo/

http://www.eia.doe.gov/oiaf/aeo/results.html

http://mwhodges.home.att.net/energy/energy-a.htm

http://mwhodges.home.att.net/energy/table.htm

http://pages.ca.inter.net/

http://www.bp.com

http://www.odci.gov/cia/publications/factbook.

http://www.energy.cr.usgs.gov/energy

http://www.peakoil.net

http://www.netspace.net.au/~pecker/media.htm.

http://www.nla.gov.au/oz/npapers.html#ozn

http://www.afr.com.au

http://www.advertiser.com.au

http://www.theage.com.au

http://smh.com.au.

http://www.worldoil.com

http://www.usembassyjakart.org

http://www.statistic.gov.au

http://www.abs.gov.au

http://www.rba.gov.au

http://www.bp.com

http://www.r/bnoew.at/opec

http://www.ceednet.org.

http://www.energy.gov/engine/content.do

http://www.gu;fpub-com/energylink

http://www.energy.gov/engine/content.do?BT_code=oil

http://www.scaruffi.com/politics/oil.html

http://www.eia.doe.gov/emeu/cabs/usa.html

http://www.eia.doe.gov/emeu/steo/pub/contents.html

http://mwhodges.home.att.net/energy/energy-a.htm

http://www.gravmag.com/oil.html

http://www.endgame.org/oil-info.html

http://www.api.org/_12k

http://www.nef1.org/ea/eastats.html-22k

http://www.mwhodges.home.att.net/energy/energy-a.htm-55k

http://www.unomaha.edu/peterson/funda/sidebar/oilconsumption.html-8k

http://www.poec.com/-79k-29

http://www.mwhodges.home.att.net/energy/energy.htm-12k

http://www.eia.doe.gov/emeu/cabs/usa.html

http://cslforum-org/press_usa.htm-47k

http://europeoildaily.com/s/usaenergy-161k

http://www.nipa.com

http://pertamina.com/migas info domestic trading.html

http://wtrg.com

http://www.APERC.com

http://www.kompas.com

http://www.nationmaster.com

http://www.bi.go.id

http://www.imf.org

http://www.worldbank.org

http://wikipedia.com

http://www.petromatrix.com

http://www.snopes.com

http://www.grida.no

Insukindro., Maryatmo, dan Aliman. (2001). ***Modul Ekometrika dasar dan Penyusunan Indikator Unggulan ekonomi. disampaikan pd lokakarya (woprkshop) ekonometrika dalam rangka penjajakan leading indicator export di KTI Hotel Sedona,Makassar 03-06September 2001.***

Leemigas Pertamina. (Various Edition). *Annual Year Book.*

Lubis.Hamsar. (2002). *"Volatilitas nilai tukar dan volume export studi kasus export non-migas Indonesia ke AS". Jurnal Ekonomi dan Bisnis.* Gajah Mada University Press.

Michaelly, Michael. (1984). *Trade, Income Levels and Dependence.* Amsterdam: Elsevier science published.

Samuelson, and Nordaus. (1979). *Microeconomy.* New York:.Mc Graw Hill

Schiller. R. Bradley. (1983). *The micro Economy Today* (3rd Edition).Random House.

Thomas.RL. (1997). *Modern Econometrics (an Introduction).* Essex England: Addison Wesley Longman .

OPEC Bulletin. Various edition

_____(1990). *Industry in Indonesia and trade in Indonesia.* Gajah mada University Press.

APPENDICES

APPENDIX 1

bs	LNY	LNX1	LNX2	LNX3	LNX4	LNYT_1
)70	8.288580	0.728050	5.934894	2.415800	2.394252	NA
)71	8.432550	0.733760	6.028279	2.323300	2.487404	8.288580
)72	8.848650	0.735970	6.028279	2.326000	2.607124	8.432550
)73	9.106790	0.738290	6.028279	2.237200	2.784394	8.848650
)74	9.578840	0.831530	6.028279	2.160900	3.180551	9.106790
)75	9.745580	0.814160	6.028279	2.198000	3.648838	9.578840
)76	9.987110	0.820370	6.028279	2.206200	3.813969	9.745580
)77	10.05954	0.822740	6.028279	2.137400	3.759804	9.987110
)78	9.993370	0.815150	6.437752	2.061300	3.814851	10.05954
)79	9.778900	0.835170	6.440947	2.017100	3.780547	9.993370
)80	9.649070	0.940900	6.440628	2.054600	3.813528	9.778900
981	9.540290	0.912380	6.467699	2.228500	3.954316	9.649070
982	9.259750	0.891630	6.540308	2.288500	4.037598	9.540290
983	9.540050	0.870970	6.901737	2.417000	3.894266	9.259750
984	9.461640	0.858340	6.979145	2.589900	3.810876	9.540050
985	9.456430	0.846480	7.025538	2.394000	3.686877	9.461640
986	9.534270	0.774550	7.403061	2.260200	3.670461	9.456430
987	9.345630	0.792370	7.408531	2.105600	3.554776	9.534270
988	9.186760	0.771340	7.456455	2.181500	3.591542	9.345630
989	9.194130	0.782980	7.493874	2.180500	3.728341	9.186760
990	8.658240	0.801870	7.550135	2.061800	3.754667	9.194130
991	8.653680	0.781850	7.596894	2.053000	3.776432	8.658240
992	8.266040	0.778030	7.631432	2.133800	3.723376	8.653680
993	8.178580	0.766430	7.654443	2.198000	3.673766	8.266040
994	8.474450	0.760900	7.696213	2.138100	3.620601	8.178580
995	8.143340	0.764510	7.744137	2.045900	3.691127	8.474450
996	7.952620	0.775460	7.776115	2.091800	4.379649	8.143340
997	7.934330	0.769160	8.444622	2.195800	4.338989	7.952620
998	8.077570	0.744510	8.990317	2.167900	4.235989	7.934330
999	8.166560	0.762070	8.865735	2.629800	4.064744	8.077570
)00	7.563770	0.796260	9.168997	2.353900	3.986759	8.166560
)01	7.682390	0.780500	9.249561	2.384600	4.120012	7.563770

Where;

Y = Volume of oil export of Indonesia, Million tones

X_1 = Price of oil, USD/barrel

Price oil/barrel (X_2) is weighted by CPI of USA based year 1990.

X_2 = Foreign Exchange Rate, Rp/USD

X_3 = US Real Total GDP , Bill of USD

USA Real Total GDP is weighted by average Real Total GDP of G4 (Japan, UK, Germany, France).

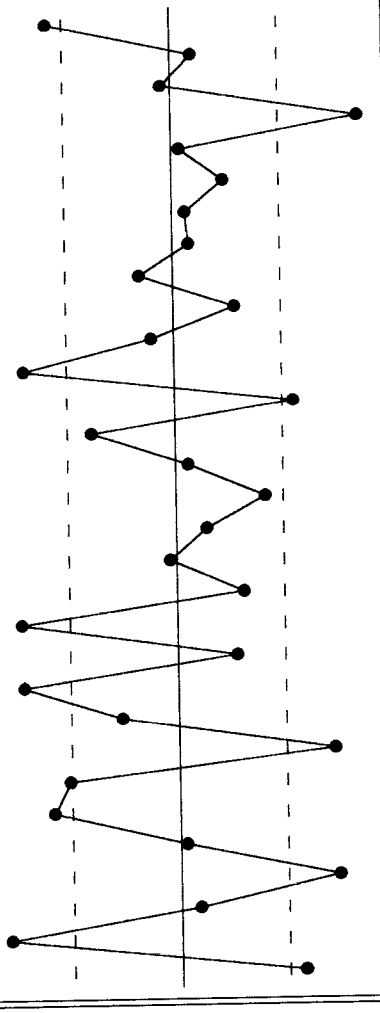
X_4 = Price of coal USD/Metric

Y_{t-1} = Volume of oil export of Indonesia in the previous year.

Dependent Variable: LNY
Method: Least Squares
Date: 05/01/04 Time: 21:58
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.866506	1.284834	2.231032	0.0349
LNX1	-1.557677	1.253332	-1.242829	0.2255
LNX2	-0.269267	0.089659	-3.003224	0.0060
LNX3	0.577405	0.279567	2.065356	0.0494
LNX4	0.165565	0.167477	0.988585	0.3323
LNYT_1	0.822679	0.099458	8.271598	0.0000

R-squared	0.933960	Mean dependent var	8.950030
Adjusted R-squared	0.920752	S.D. dependent var	0.749862
S.E. of regression	0.211095	Akaike info criterion	-0.101036
Sum squared resid	1.114023	Schwarz criterion	0.176510
Log likelihood	7.566058	F-statistic	70.71126
Durbin-Watson stat	2.449713	Prob(F-statistic)	0.000000

obs	Actual	Fitted	Residual	Residual Plot
1971	8.43255	8.67248	-0.23993	
1972	8.84865	8.80886	0.03979	
1973	9.10679	9.12564	-0.01885	
1974	9.57884	9.21430	0.36454	
1975	9.74558	9.72865	0.01693	
1976	9.98711	9.88823	0.09888	
1977	10.0595	10.0345	0.02499	
1978	9.99337	9.96087	0.03250	
1979	9.77890	9.84319	-0.06429	
1980	9.64907	9.52925	0.11982	
1981	9.54029	9.58330	-0.04301	
1982	9.25975	9.55501	-0.29526	
1983	9.54005	9.30955	0.23050	
1984	9.46164	9.62500	-0.16336	
1985	9.45643	9.43283	0.02360	
1986	9.53427	9.35896	0.17531	
1987	9.34563	9.28535	0.06028	
1988	9.18676	9.19992	-0.01316	
1989	9.19413	9.06309	0.13104	
1990	8.65824	8.96040	-0.30216	
1991	8.65368	8.53665	0.11703	
1992	8.26604	8.56742	-0.30138	
1993	8.17858	8.28925	-0.11067	
1994	8.47445	8.17127	0.30318	
1995	8.14334	8.35459	-0.21125	
1996	7.95262	8.19702	-0.24440	
1997	7.93433	7.92325	0.01108	
1998	8.07757	7.76650	0.31107	
1999	8.16656	8.12888	0.03768	
2000	7.56377	7.89496	-0.33119	
2001	7.68239	7.44170	0.24069	

Heteroscedasticity

Heteroscedasticity Test (LNX_1)

Years	LNX_1	Residual	The Order of LNX_1	The Order of Residual	di	di^2
1970	0.72805	0	1	1	0	0
1971	0.73376	-0.23993	2	23	-21	441
1972	0.73597	0.03979	3	10	-7	49
1973	0.73829	-0.01885	4	5	-1	1
1974	0.83153	0.36454	25	32	-7	49
1975	0.81416	0.01693	21	4	17	289
1976	0.82037	0.09888	23	14	9	81
1977	0.82274	0.02499	24	7	17	289
1978	0.81515	0.03250	22	8	14	196
1979	0.83517	-0.06429	26	13	13	169
1980	0.94090	0.11982	32	17	15	225
1981	0.91238	-0.04301	31	11	20	400
1982	0.89163	-0.29526	30	26	4	16
1983	0.87097	0.23050	29	22	7	49
1984	0.85834	-0.16336	28	19	9	81
1985	0.84648	0.02360	27	6	21	441
1986	0.77455	0.17531	12	20	-8	64
1987	0.79237	0.06028	18	12	6	36
1988	0.77134	-0.01316	11	3	8	64
1989	0.78298	0.13104	17	18	-1	1
1990	0.80187	-0.30216	20	28	-8	64
1991	0.78185	0.11703	16	16	0	0
1992	0.77803	-0.30138	14	27	-13	169
1993	0.76643	-0.11067	9	15	-6	36
1994	0.76090	0.30318	6	29	-23	529
1995	0.76451	-0.21125	8	21	-13	169
1996	0.77546	-0.24440	13	25	-12	144
1997	0.76916	0.01108	10	2	8	64
1998	0.74451	0.31107	5	30	-25	625
1999	0.76207	0.03768	7	9	-2	4
2000	0.79626	-0.33119	19	31	-12	144
2001	0.78050	0.24069	15	24	-9	81
						4970

$$rs = 1 - \frac{6 \Sigma di^2}{n (n^2 - 1)} = 1 - \frac{6 (4970)}{32 (32^2 - 1)} = 1 - 0.9109 = 0.0891$$

$$t = rs \frac{\sqrt{(n-2)}}{\sqrt{1-(rs)^2}} = 0.0891 \frac{\sqrt{(32-2)}}{\sqrt{1-(0.0891)^2}} = 0.4899$$

So, Computed t-value = 0.4899

Critical t-value = 2.479 α= 1% Critical t-value > Computed t-value

No Heteroscedasticity

Heteroscedasticity Test (LNX_2)

Years	LNX_2	Residual	The Order of LNX_2	The Order of Residual	di	di^2
1970	5.934894	0	1	1	0	0
1971	6.028279	-0.23993	2	23	-21	441
1972	6.028279	0.03979	3	10	-7	49
1973	6.028279	-0.01885	4	5	-1	1
1974	6.028279	0.36454	5	32	-27	729
1975	6.028279	0.01693	6	4	2	4
1976	6.028279	0.09888	7	14	-7	49
1977	6.028279	0.02499	8	7	1	1
1978	6.437752	0.03250	9	8	1	1
1979	6.440947	-0.06429	11	13	-2	4
1980	6.440628	0.11982	10	17	-7	49
1981	6.467699	-0.04301	12	11	1	1
1982	6.540308	-0.29526	13	26	-13	169
1983	6.901737	0.23050	14	22	-8	64
1984	6.979145	-0.16336	15	19	-4	16
1985	7.025538	0.02360	16	6	10	100
1986	7.403061	0.17531	17	20	-3	9
1987	7.408531	0.06028	19	12	7	49
1988	7.456455	-0.01316	18	3	15	225
1989	7.493874	0.13104	20	18	2	4
1990	7.550135	-0.30216	21	28	-7	49
1991	7.596894	0.11703	22	16	6	36
1992	7.631432	-0.30138	23	27	-4	16
1993	7.654443	-0.11067	24	15	9	81
1994	7.696213	0.30318	25	29	-4	16
1995	7.744137	-0.21125	26	21	5	25
1996	7.776115	-0.24440	27	25	2	4
1997	8.444622	0.01108	28	2	26	676
1998	8.990317	0.31107	30	30	0	0
1999	8.865735	0.03768	29	9	20	400
2000	9.168997	-0.33119	31	31	0	0
2001	9.249561	0.24069	32	24	8	64
						3332

$$rs = 1 - \frac{6 \Sigma di^2}{n (n^2 - 1)} = 1 - \frac{6 (3332)}{32 (32^2 - 1)} = 1 - 0.6107 = 0.3893$$

$$t = rs \frac{\sqrt{(n-2)}}{\sqrt{1-(rs)^2}} = 0.3893 \frac{\sqrt{(32-2)}}{\sqrt{1-(0.3893)^2}} = 2.314$$

So, Computed t-value = 2.314

Critical t-value = 2.479 α= 1% Critical t-value > Computed t-value

No Heteroscedasticity

Heteroscedasticity Test (LNX_3)

Years	LNX_3	Residual	The Order of LNX_3	The Order of Residual	di	di_2
1970	2.4158	0	29	1	28	784
1971	2.3233	-0.23993	24	23	1	1
1972	2.3260	0.03979	25	10	15	225
1973	2.2372	-0.01885	21	5	16	256
1974	2.1609	0.36454	12	32	-20	400
1975	2.1980	0.01693	18	4	14	196
1976	2.2062	0.09888	19	14	5	25
1977	2.1374	0.02499	10	7	3	9
1978	2.0613	0.03250	5	8	-3	9
1979	2.0171	-0.06429	1	13	-12	144
1980	2.0546	0.11982	4	17	-13	169
1981	2.2285	-0.04301	20	11	9	81
1982	2.2885	-0.29526	23	26	-3	9
1983	2.4170	0.23050	30	22	8	64
1984	2.5899	-0.16336	31	19	12	144
1985	2.3940	0.02360	28	6	22	484
1986	2.2602	0.17531	22	20	2	4
1987	2.1056	0.06028	8	12	-4	16
1988	2.1815	-0.01316	15	3	12	144
1989	2.1805	0.13104	14	18	-4	16
1990	2.0618	-0.30216	6	28	-22	484
1991	2.0530	0.11703	3	16	-13	169
1992	2.1338	-0.30138	9	27	-18	324
1993	2.1980	-0.11067	17	15	2	4
1994	2.1381	0.30318	11	29	-18	324
1995	2.0459	-0.21125	2	21	-19	361
1996	2.0918	-0.24440	7	25	-18	324
1997	2.1958	0.01108	16	2	14	196
1998	2.1679	0.31107	13	30	-17	289
1999	2.6298	0.03768	32	9	23	529
2000	2.3539	-0.33119	26	31	-5	25
2001	2.3846	0.24069	27	24	3	9
						6218

$$rs = 1 - \frac{6 \Sigma di^2}{n (n^2 - 1)} = 1 - \frac{6 (6218)}{32 (32^2 - 1)} = 1 - 1.1396 = -0.1396$$

$$t = rs \frac{\sqrt{(n-2)}}{\sqrt{1-(rs)^2}} = -0.1396 \frac{\sqrt{(32-2)}}{\sqrt{1-(-0.1396)^2}} = -0.7721$$

So, Computed t-value = -0.7721

Critical t-value = 2.779 α= 1% Critical t-value > Computed t-value

No Heteroscedasticity

Heteroscedasticity Test (LNX_4)

Years	LNX_4	Residual	The Order of LNX_4	The Order of Residual	di	di^2
1970	2.394252	0	1	1	0	0
1971	2.487404	-0.23993	2	23	-21	441
1972	2.607124	0.03979	3	10	-7	49
1973	2.784394	-0.01885	4	5	-1	1
1974	3.180551	0.36454	5	32	-27	729
1975	3.648838	0.01693	9	4	5	25
1976	3.813969	0.09888	22	14	8	64
1977	3.759804	0.02499	17	7	10	100
1978	3.814851	0.03250	23	8	15	225
1979	3.780547	-0.06429	19	13	6	36
1980	3.813528	0.11982	21	17	4	16
1981	3.954316	-0.04301	25	11	14	196
1982	4.037598	-0.29526	27	26	1	1
1983	3.894266	0.23050	24	22	2	4
1984	3.810876	-0.16336	20	19	1	1
1985	3.686877	0.02360	12	6	6	36
1986	3.670461	0.17531	10	20	-10	100
1987	3.554776	0.06028	6	12	-6	36
1988	3.591542	-0.01316	7	3	4	16
1989	3.728341	0.13104	15	18	-3	9
1990	3.754667	-0.30216	16	28	-12	144
1991	3.776432	0.11703	18	16	2	4
1992	3.723764	-0.30138	14	27	-13	169
1993	3.673766	-0.11067	11	15	-4	16
1994	3.620601	0.30318	8	29	-21	441
1995	3.691127	-0.21125	13	21	-8	64
1996	4.379649	-0.24440	32	25	7	49
1997	4.338989	0.01108	31	2	29	841
1998	4.235989	0.31107	30	30	0	0
1999	4.064744	0.03768	28	9	19	361
2000	3.986759	-0.33119	26	31	-5	25
2001	4.120012	0.24069	29	24	5	25
						4224

$$rs = 1 - \frac{6 \Sigma di^2}{n(n^2-1)} = 1 - \frac{6(4224)}{32(32^2-1)} = 1 - 0.7741 = 0.2259$$

$$t = rs \frac{\sqrt{(n-2)}}{\sqrt{1-(rs)^2}} = 0.2259 \frac{\sqrt{(32-2)}}{\sqrt{1-(0.2259)^2}} = 1.2702$$

So, Computed t-value = 1.2702

Critical t-value = 2.479 α= 1% Critical t-value > Computed t-value

No Heteroscedasticity

Heteroscedasticity Test (LNY_{t-1})

Years	LNY_{t-1}	Residual	The Order of LNY_{t-1}	The Order of Residual	di	di^2
1970	-	0	1	1	0	0
1971	8.43255	-0.23993	11	23	-12	144
1972	8.84865	0.03979	15	10	5	25
1973	9.10679	-0.01885	16	5	11	121
1974	9.57884	0.36454	26	32	-6	36
1975	9.74558	0.01693	28	4	24	576
1976	9.98711	0.09888	30	14	16	256
1977	10.05954	0.02499	32	7	25	625
1978	9.99337	0.03250	31	8	23	529
1979	9.77890	-0.06429	29	13	16	256
1980	9.64907	0.11982	27	17	10	100
1981	9.54029	-0.04301	25	11	14	196
1982	9.25975	-0.29526	19	26	-7	49
1983	9.54005	0.23050	24	22	2	4
1984	9.46164	-0.16336	22	19	3	9
1985	9.45643	0.02360	21	6	15	225
1986	9.53427	0.17531	23	20	3	9
1987	9.34563	0.06028	20	12	8	64
1988	9.18676	-0.01316	17	3	14	196
1989	9.19413	0.13104	18	18	0	0
1990	8.65824	-0.30216	14	28	-14	196
1991	8.65368	0.11703	13	16	-3	9
1992	8.26604	-0.30138	10	27	-17	289
1993	8.17858	-0.11067	9	15	-6	36
1994	8.47445	0.30318	12	29	-17	289
1995	8.14334	-0.21125	7	21	-14	196
1996	7.95262	-0.24440	5	25	-20	400
1997	7.93433	0.01108	4	2	2	4
1998	8.07757	0.31107	6	30	-24	576
1999	8.16656	0.03768	8	9	-1	1
2000	7.56377	-0.33119	3	31	-28	784
2001	7.68239	0.24069	2	24	-22	484
						6684

$$rs = 1 - \frac{6 \Sigma di^2}{n (n^2 - 1)} = 1 - \frac{6 (6684)}{32 (32^2 - 1)} = 1 - 1.2250 = -0.2250$$

$$t = rs \frac{\sqrt{(n-2)}}{\sqrt{1-(rs)^2}} = -0.2250 \frac{\sqrt{(32-2)}}{\sqrt{1-(-0.2250)^2}} = -1.2648$$

So, Computed t-value = -1.2648

Critical t-value = 2.779 α= 1% Critical t-value > Computed t-value

No Heteroscedasticity

Autocorrelation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.863085	Probability	0.103579
Obs*R-squared	3.304000	Probability	0.069111

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/01/04 Time: 22:44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.687119	1.304305	-0.526808	0.6032
LNX1	-0.484405	1.242518	-0.389857	0.7001
LNX2	0.026340	0.087884	0.299710	0.7670
LNX3	0.076622	0.273473	0.280182	0.7817
LNX4	-0.016123	0.161845	-0.099622	0.9215
LNYT_1	0.086125	0.108612	0.792955	0.4356
RESID(-1)	-0.385193	0.227646	-1.692065	0.1036

R-squared	0.106581	Mean dependent var	1.44E-15
Adjusted R-squared	-0.116774	S.D. dependent var	0.192702
S.E. of regression	0.203643	Akaike info criterion	-0.149219
Sum squared resid	0.995289	Schwarz criterion	0.174584
Log likelihood	9.312896	F-statistic	0.477181
Durbin-Watson stat	2.105729	Prob(F-statistic)	0.818537

Multicollinearity

Dependent Variable: LNY
Method: Least Squares
Date: 05/01/04 Time: 22:51
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.866506	1.284834	2.231032	0.0349
LNX1	-1.557677	1.253332	-1.242829	0.2255
LNX2	-0.269267	0.089659	-3.003224	0.0060
LNX3	0.577405	0.279567	2.065356	0.0494
LNX4	0.165565	0.167477	0.988585	0.3323
LNYT_1	0.822679	0.099458	8.271598	0.0000

R-squared	0.933960	Mean dependent var	8.950030
Adjusted R-squared	0.920752	S.D. dependent var	0.749862
S.E. of regression	0.211095	Akaike info criterion	-0.101036
Sum squared resid	1.114023	Schwarz criterion	0.176510
Log likelihood	7.566058	F-statistic	70.71126
Durbin-Watson stat	2.449713	Prob(F-statistic)	0.000000

Dependent Variable: LNX1
Method: Least Squares
Date: 05/01/04 Time: 22:55
Sample: 1970 2001
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.907080	0.066057	13.73177	0.0000
LNX2	-0.014936	0.009124	-1.637068	0.1121

R-squared	0.082007	Mean dependent var	0.799959
Adjusted R-squared	0.051407	S.D. dependent var	0.052535
S.E. of regression	0.051167	Akaike info criterion	-3.046989
Sum squared resid	0.078541	Schwarz criterion	-2.955381
Log likelihood	50.75182	F-statistic	2.679992
Durbin-Watson stat	0.393971	Prob(F-statistic)	0.112065

Dependent Variable: LNX1
Method: Least Squares
Date: 05/01/04 Time: 22:57
Sample: 1970 2001
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.834343	0.139996	5.959757	0.0000
LNX3	-0.015445	0.062743	-0.246164	0.8072

R-squared	0.002016	Mean dependent var	0.799959
Adjusted R-squared	-0.031250	S.D. dependent var	0.052535
S.E. of regression	0.053350	Akaike info criterion	-2.963441
Sum squared resid	0.085385	Schwarz criterion	-2.871833
Log likelihood	49.41506	F-statistic	0.060597
Durbin-Watson stat	0.374046	Prob(F-statistic)	0.807232

Dependent Variable: LNX1
Method: Least Squares
Date: 05/01/04 Time: 23:00
Sample: 1970 2001
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.647360	0.067361	9.610288	0.0000
LNX4	0.041601	0.018210	2.284574	0.0296

R-squared	0.148194	Mean dependent var	0.799959
Adjusted R-squared	0.119800	S.D. dependent var	0.052535
S.E. of regression	0.049288	Akaike info criterion	-3.121820
Sum squared resid	0.072879	Schwarz criterion	-3.030211
Log likelihood	51.94911	F-statistic	5.219280
Durbin-Watson stat	0.426398	Prob(F-statistic)	0.029582

Dependent Variable: LNX1
Method: Least Squares
Date: 05/01/04 Time: 23:08
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.380258	0.089976	4.226228	0.0002
LNYT_1	0.047050	0.010000	4.705105	0.0001

R-squared	0.432907	Mean dependent var	0.802278
Adjusted R-squared	0.413352	S.D. dependent var	0.051711
S.E. of regression	0.039607	Akaike info criterion	-3.557293
Sum squared resid	0.045492	Schwarz criterion	-3.464777
Log likelihood	57.13803	F-statistic	22.13801
Durbin-Watson stat	0.725239	Prob(F-statistic)	0.000058

Dependent Variable: LNX2
Method: Least Squares
Date: 05/01/04 Time: 23:10
Sample: 1970 2001
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.251050	2.663686	1.971348	0.0580
LNX3	0.862793	1.193807	0.722724	0.4754

R-squared	0.017113	Mean dependent var	7.171785
Adjusted R-squared	-0.015650	S.D. dependent var	1.007224
S.E. of regression	1.015074	Akaike info criterion	2.928262
Sum squared resid	30.91128	Schwarz criterion	3.019871
Log likelihood	-44.85220	F-statistic	0.522329
Durbin-Watson stat	0.063147	Prob(F-statistic)	0.475447

Dependent Variable: LNX2
Method: Least Squares
Date: 05/01/04 Time: 23:12
Sample: 1970 2001
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.532673	1.108379	2.285024	0.0296
LNX4	1.264705	0.299626	4.220951	0.0002

R-squared	0.372601	Mean dependent var	7.171785
Adjusted R-squared	0.351687	S.D. dependent var	1.007224
S.E. of regression	0.810995	Akaike info criterion	2.479352
Sum squared resid	19.73138	Schwarz criterion	2.570960
Log likelihood	-37.66963	F-statistic	17.81642
Durbin-Watson stat	0.168522	Prob(F-statistic)	0.000207

Dependent Variable: LNX2
Method: Least Squares
Date: 05/01/04 Time: 23:14
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.86345	1.648705	9.621765	0.0000
LNYT_1	-0.964567	0.183235	-5.264092	0.0000

R-squared	0.488632	Mean dependent var	7.211685
Adjusted R-squared	0.470999	S.D. dependent var	0.997835
S.E. of regression	0.725750	Akaike info criterion	2.259118
Sum squared resid	15.27467	Schwarz criterion	2.351633
Log likelihood	-33.01633	F-statistic	27.71066
Durbin-Watson stat	0.169184	Prob(F-statistic)	0.000012

Dependent Variable: LNX3
Method: Least Squares
Date: 05/01/04 Time: 23:15
Sample: 1970 2001
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.377292	0.210333	11.30253	0.0000
LNX4	-0.041195	0.056859	-0.724506	0.4744

R-squared	0.017196	Mean dependent var	2.226184
Adjusted R-squared	-0.015564	S.D. dependent var	0.152715
S.E. of regression	0.153899	Akaike info criterion	-0.844576
Sum squared resid	0.710549	Schwarz criterion	-0.752967
Log likelihood	15.51321	F-statistic	0.524910
Durbin-Watson stat	0.766307	Prob(F-statistic)	0.474368

Dependent Variable: LNX3
Method: Least Squares
Date: 05/01/04 Time: 23:17
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.642851	0.340371	7.764620	0.0000
LNYT_1	-0.047135	0.037828	-1.246026	0.2227

R-squared	0.050817	Mean dependent var	2.220068
Adjusted R-squared	0.018086	S.D. dependent var	0.151203
S.E. of regression	0.149829	Akaike info criterion	-0.896301
Sum squared resid	0.651015	Schwarz criterion	-0.803786
Log likelihood	15.89267	F-statistic	1.552580
Durbin-Watson stat	0.809206	Prob(F-statistic)	0.222727

Dependent Variable: LNX4
Method: Least Squares
Date: 05/01/04 Time: 23:19
Sample(adjusted): 1971 2001
Included observations: 31 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.068410	1.000584	4.066037	0.0003
LNYT_1	-0.040044	0.111204	-0.360096	0.7214

R-squared	0.004451	Mean dependent var	3.709231
Adjusted R-squared	-0.029878	S.D. dependent var	0.434015
S.E. of regression	0.440451	Akaike info criterion	1.260304
Sum squared resid	5.625905	Schwarz criterion	1.352819
Log likelihood	-17.53471	F-statistic	0.129669
Durbin-Watson stat	0.199994	Prob(F-statistic)	0.721384

Appendix 2

THE STEPS ON CALCULATIONS DEPENDENT AND INDEPENDENT VARIABLES

THE ANALYSIS OF FACTORS EFFECTING INDONESIA'S CRUDE OIL EXPORT TO USA (1970-2001)

Y = Volume of oil export of Indonesia, Million Tonnes
X1 = Price of Oil USD/Barrel
X2 = FOREX Rp/USD
X3 = Real GDP USA
X4 = Price of Coal USD/Barrel

Years	Y	LnY
1970	3978.20	8.28858
1971	4594.20	8.43255
1972	6965.00	8.84865
1973	9016.30	9.10679
1974	14455.70	9.57884
1975	17078.50	9.74558
1976	21744.30	9.98711
1977	23377.80	10.05954
1978	21881.00	9.99337
1979	17657.30	9.77890
1980	15507.40	9.64907
1981	13909.00	9.54029
1982	10506.50	9.25975
1983	13905.60	9.54005
1984	12857.00	9.46164
1985	12790.20	9.45643
1986	13825.50	9.53427
1987	11448.70	9.34563
1988	9767.00	9.18676
1989	9839.20	9.19413
1990	5757.40	8.65824
1991	5185.80	8.55368
1992	3889.50	8.26604
1993	3563.80	8.17858
1994	4790.80	8.47445
1995	3440.40	8.14334
1996	2843.00	7.95262
1997	2791.50	7.93433
1998	3221.40	8.07757
1999	3521.20	8.16656
2000	1927.10	7.56377
2001	2169.80	7.68239

Source : Statistical Year Book, BPS

The calculation of X1 and LnX1

Years	X1 Price/Barrel [1]	CPI USA(Based year 1990) [2]	New X1 (X1/CPI of USA) [1]/[2] [3]	[3]+2 [4]	LnX1 Ln[4] [5]
1970	2.11	29.70	0.0710	2.0710	0.72805
1971	2.57	31.00	0.0829	2.0829	0.73376
1972	2.80	32.00	0.0875	2.0875	0.73597
1973	3.14	34.00	0.0924	2.0924	0.73829
1974	11.22	37.80	0.2968	2.2968	0.83153
1975	10.60	41.20	0.2573	2.2573	0.81416
1976	11.83	43.60	0.2713	2.2713	0.82037
1977	12.84	46.40	0.2767	2.2767	0.82274
1978	12.95	49.90	0.2595	2.2595	0.81515
1979	16.97	55.60	0.3052	2.3052	0.83517
1980	35.48	63.10	0.5623	2.5623	0.94090
1981	34.12	69.60	0.4902	2.4902	0.91238
1982	32.45	73.90	0.4391	2.4391	0.89163
1983	29.66	76.20	0.3892	2.3892	0.87097
1984	28.56	79.50	0.3592	2.3592	0.85834
1985	27.31	82.40	0.3314	2.3314	0.84648
1986	14.23	83.90	0.1696	2.1696	0.77455
1987	18.15	87.00	0.2086	2.2086	0.79237
1988	14.72	90.50	0.1627	2.1627	0.77134
1989	17.84	94.90	0.1880	2.1880	0.78298
1990	22.97	100.00	0.2297	2.2297	0.80187
1991	19.33	104.20	0.1855	2.1855	0.78185
1992	19.03	107.40	0.1772	2.1772	0.77803
1993	16.82	110.60	0.1521	2.1521	0.76643
1994	15.90	113.40	0.1402	2.1402	0.76090
1995	17.16	116.00	0.1479	2.1479	0.76451
1996	20.42	119.00	0.1716	2.1716	0.77546
1997	19.27	122.00	0.1580	2.1580	0.76916
1998	13.07	124.00	0.1054	2.1054	0.74451
1999	17.98	126.00	0.1427	2.1427	0.76207
2000	28.24	130.00	0.2172	2.2172	0.79626
2001	24.28	133.00	0.1826	2.1826	0.78050

Source : IFS

The calculation of X2 and LnX2

Years	X2	LnX2
1970	378.0	5.934894
1971	415.0	6.028279
1972	415.0	6.028279
1973	415.0	6.028279
1974	415.0	6.028279
1975	415.0	6.028279
1976	415.0	6.028279
1977	415.0	6.028279
1978	625.0	6.437752
1979	627.0	6.440947
1980	626.8	6.440628
1981	644.0	6.467699
1982	692.5	6.540308
1983	994.0	6.901737
1984	1074.0	6.979145
1985	1125.0	7.025538
1986	1641.0	7.403061
1987	1650.0	7.408531
1988	1731.0	7.456455
1989	1797.0	7.493874
1990	1901.0	7.550135
1991	1992.0	7.596894
1992	2062.0	7.631432
1993	2110.0	7.654443
1994	2200.0	7.696213
1995	2308.0	7.744137
1996	2383.0	7.776115
1997	4650.0	8.444622
1998	8025.0	8.990317
1999	7085.0	8.865735
2000	9595.0	9.168997
2001	10400.0	9.249561

Source :IFS

The calculation of X3 and LnX3

rs	GDP USA (Bill US$)	JAPAN			UK		
		GDP (Bill of Yen)	exch (ae) Yen/US$	GDP Japan (Bill US$)	GDP (Bill of Pounsterling)	exch (ag) US$/Pound	GDP UK (Bill US$)
	[1]			[2]			[3]
0	1039.70	73.345	357.65	0.21	51.77	2.3937	123.922
1	1128.60	80.701	314.80	0.26	57.75	2.5525	147.407
2	1240.40	92.394	302.00	0.31	64.66	2.3481	151.828
3	1385.50	112.498	280.00	0.40	74.26	2.3232	172.521
4	1501.00	134.244	300.95	0.45	83.86	2.3485	196.945
5	1635.20	148.327	305.15	0.49	105.85	2.0235	214.187
6	1823.90	166.573	292.80	0.57	125.25	1.7024	213.226
7	2031.40	185.622	240.00	0.77	145.98	1.9060	278.238
8	2295.90	204.404	194.60	1.05	168.53	2.0345	342.874
9	2566.40	221.547	239.70	0.92	198.22	2.2240	440.841
0	2795.60	240.176	203.00	1.18	231.77	2.3850	552.771
1	3131.30	257.963	219.90	1.17	254.93	1.9080	486.406
2	3259.20	270.601	235.00	1.15	279.04	1.6145	450.510
3	3534.90	281.767	232.20	1.21	304.46	1.4506	441.650
4	3932.70	300.543	251.10	1.20	325.85	1.1565	376.846
5	4213.00	320.419	200.50	1.60	357.34	1.4445	516.178
6	4452.90	334.609	159.10	2.10	384.84	1.4745	567.447
7	4742.50	348.425	123.50	2.82	423.38	1.8715	792.356
8	5108.30	371.429	125.85	2.95	471.43	1.8095	853.053
9	5489.10	396.197	143.45	2.76	515.96	1.6055	828.374
0	5803.20	424.537	134.40	3.16	551.12	1.9280	1062.559
1	5986.20	451.297	125.20	3.60	575.32	1.8707	1076.251
2	6318.90	463.145	124.75	3.71	597.24	1.5120	903.027
3	6642.30	465.972	111.85	4.17	630.71	1.4812	934.208
4	7054.30	469.240	99.74	4.70	667.37	1.5625	1042.766
5	7400.50	497.739	102.83	4.84	719.18	1.5500	1114.729
6	7813.20	510.802	116.00	4.40	762.21	1.6980	1294.233
7	8318.40	521.862	129.95	4.02	811.07	1.6538	1341.348
8	8781.50	515.835	115.60	4.46	859.81	1.6635	1430.294
9	9274.30	512.530	102.20	5.01	901.27	1.6164	1456.813
0	9824.60	511.836	114.90	4.45	944.91	1.4922	1409.995
1	10082.20	511.987	131.80	3.88	989.25	1.4504	1434.808

s : USA National Income and Prroduct Account (NIPA)
IFS

GERMANY			FRANCE		
GDP f Deusche)	Exch (ae) Deutsche Mark/US$	GDP Germany (Bill US$) [4]	GDP (Bill of Franc)	exch (ae) Francs/US$	GDP France (Bill US$) [5]
375.3	3.6480	185.115	793.5	5.5542	142.865
749.8	3.2685	229.402	884.2	5.1157	172.840
323.1	3.2015	257.098	987.9	5.1157	193.111
917.3	2.7030	339.364	1129.8	4.7085	239.949
983.9	2.4096	408.325	1303.0	4.4445	293.171
026.6	2.6223	391.488	1467.9	4.4855	327.254
120.5	2.3625	474.286	1700.6	4.9698	342.187
195.3	2.1050	567.838	1917.8	4.7050	407.609
283.6	1.8280	702.188	2182.6	4.1800	522.153
388.4	1.7315	801.848	2481.1	4.0200	617.189
470.9	1.9590	750.842	2808.3	4.5160	621.856
535.5	2.2548	680.992	3164.8	5.7480	550.592
586.9	2.3765	667.747	3626.0	6.7250	539.182
367.1	2.7238	612.049	4006.5	8.3475	479.964
749.6	3.1480	555.781	4361.9	9.5920	454.744
326.1	2.4613	741.925	4700.1	7.5610	621.624
927.9	1.9408	993.353	5069.3	6.4550	785.329
991.2	1.5815	1259.058	5336.6	5.3400	999.363
094.2	1.7803	1176.319	5735.1	6.0590	946.542
223.6	1.6978	1309.695	6159.7	5.7880	1064.219
429.4	1.4940	1626.104	6509.5	5.1290	1269.156
647.6	1.5160	1746.438	6776.2	5.1800	1308.147
813.0	1.6140	1742.875	6999.6	5.5065	1271.152
853.7	1.7263	1653.073	7077.1	5.8955	1200.424
977.7	1.5488	1922.585	7389.7	5.3460	1382.286
523.0	1.4335	2457.621	7759.9	4.9000	1583.653
586.0	1.5548	2306.406	7955.2	5.2370	1519.038
666.6	1.7921	2045.980	8206.9	5.9881	1370.535
769.9	1.6730	2253.377	8564.4	5.6221	1523.345
969.4	1.9954	986.970	1349.5	1.9954	676.306
025.0	1.0747	1884.247	1408.4	1.0747	1310.505
076.1	1.1347	1829.647	1459.6	1.1347	1286.331

erage GDP G4 3]+[4]+[5])/4 [6]	X3 [1]/[6] [7]	[7]+2 [8]	LnX3 Ln[8] [9]
113.028	9.19861	11.19861	2.4158
137.477	8.20936	10.20936	2.3233
150.587	8.23710	10.23710	2.3260
188.058	7.36739	9.36739	2.2372
224.723	6.67934	8.67934	2.1609
233.355	7.00735	9.00735	2.1980
257.567	7.08126	9.08126	2.2062
313.614	6.47739	8.47739	2.1374
392.066	5.85590	7.85590	2.0613
465.200	5.51677	7.51677	2.0171
481.662	5.80407	7.80407	2.0546
429.790	7.28565	9.28565	2.2285
414.647	7.86018	9.86018	2.2885
383.718	9.21223	11.21223	2.4170
347.143	11.32877	13.32877	2.5899
470.332	8.95751	10.95751	2.3940
587.057	7.58512	9.58512	2.2602
763.399	6.21235	8.21235	2.1056
744.716	6.85939	8.85939	2.1815
801.262	6.85057	8.85057	2.1805
990.245	5.86037	7.86037	2.0618
1033.609	5.79155	7.79155	2.0530
980.191	6.44660	8.44660	2.1338
947.969	7.00688	9.00688	2.1980
1088.084	6.48323	8.48323	2.1381
1290.211	5.73588	7.73588	2.0459
1281.019	6.09921	8.09921	2.0918
1190.471	6.98749	8.98749	2.1958
1302.869	6.74012	8.74012	2.1679
781.275	11.87073	13.87073	2.6298
1152.299	8.52608	10.52608	2.3539
1138.666	8.85439	10.85439	2.3846

The calculation X4 and LnX4

Years	X4	LnX4
1970	10.96	2.394252
1971	12.03	2.487404
1972	13.56	2.607124
1973	16.19	2.784394
1974	24.06	3.180551
1975	38.43	3.648838
1976	45.33	3.813969
1977	42.94	3.759804
1978	45.37	3.814851
1979	43.84	3.780547
1980	45.31	3.813528
1981	52.16	3.954316
1982	56.69	4.037598
1983	49.12	3.894266
1984	45.19	3.810876
1985	39.92	3.686877
1986	39.27	3.670461
1987	34.98	3.554776
1988	36.29	3.591542
1989	41.61	3.728341
1990	42.72	3.754667
1991	43.66	3.776432
1992	41.42	3.723764
1993	39.4	3.673766
1994	37.36	3.620601
1995	40.09	3.691127
1996	79.81	4.379649
1997	76.63	4.338989
1998	69.13	4.235989
1999	58.25	4.064744
2000	53.88	3.986759
2001	61.56	4.120012

Source :IFS

.INEAR

Years	Y	X1	X2	X3	X4	Yt-1	Yt-2
1970	3978.20	0.0710	378.0	9.19861	10.96	-	-
1971	4594.20	0.0829	415.0	8.20936	12.03	3978.20	-
1972	6965.00	0.0875	415.0	8.23710	13.56	4594.20	3978.20
1973	9016.30	0.0924	415.0	7.36739	16.19	6965.00	4594.20
1974	14455.70	0.2968	415.0	6.67934	24.06	9016.30	6965.00
1975	17078.50	0.2573	415.0	7.00735	38.43	14455.70	9016.30
1976	21744.30	0.2713	415.0	7.08126	45.33	17078.50	14455.70
1977	23377.80	0.2767	415.0	6.47739	42.94	21744.30	17078.50
1978	21881.00	0.2595	625.0	5.85590	45.37	23377.80	21744.30
1979	17657.30	0.3052	627.0	5.51677	43.84	21881.00	23377.80
1980	15507.40	0.5623	626.8	5.80407	45.31	17657.30	21881.00
1981	13909.00	0.4902	644.0	7.28565	52.16	15507.40	17657.30
1982	10506.50	0.4391	692.5	7.86018	56.69	13909.00	15507.40
1983	13905.60	0.3892	994.0	9.21223	49.12	10506.50	13909.00
1984	12857.00	0.3592	1074.0	11.32877	45.19	13905.60	10506.50
1985	12790.20	0.3314	1125.0	8.95751	39.92	12857.00	13905.60
1986	13825.50	0.1696	1641.0	7.58512	39.27	12790.20	12857.00
1987	11448.70	0.2086	1650.0	6.21235	34.98	13825.50	12790.20
1988	9767.00	0.1627	1731.0	6.85939	36.29	11448.70	13825.50
1989	9839.20	0.1880	1797.0	6.85057	41.61	9767.00	11448.70
1990	5757.40	0.2297	1901.0	5.86037	42.72	9839.20	9767.00
1991	5185.80	0.1855	1992.0	5.79155	43.66	5757.40	9839.20
1992	3889.50	0.1772	2062.0	6.44660	41.42	5185.80	5757.40
1993	3563.80	0.1521	2110.0	7.00688	39.4	3889.50	5185.80
1994	4790.80	0.1402	2200.0	6.48323	37.36	3563.80	3889.50
1995	3440.40	0.1479	2308.0	5.73588	40.09	4790.80	3563.80
1996	2843.00	0.1716	2383.0	6.09921	79.81	3440.40	4790.80
1997	2791.50	0.1580	4650.0	6.98749	76.63	2843.00	3440.40
1998	3221.40	0.1054	8025.0	6.74012	69.13	2791.50	2843.00
1999	3521.20	0.1427	7085.0	11.87073	58.25	3221.40	2791.50
2000	1927.10	0.2172	9595.0	8.52608	53.88	3521.20	3221.40
2001	2169.80	0.1826	10400.0	8.85439	61.56	1927.10	3521.20

rces: IFS (International Financial Statistic) various edition

NON-LINEAR (DOUBLE LOG)

Years	LnY	LnX1	LnX2	LnX3	LnX4	(LnY)t-1	(LnY)t-2
1970	8.28858	0.72805	5.934894	2.4158	2.394252	-	-
1971	8.43255	0.73376	6.028279	2.3233	2.487404	8.28858	-
1972	8.84865	0.73597	6.028279	2.3260	2.607124	8.43255	8.28858
1973	9.10679	0.73829	6.028279	2.2372	2.784394	8.84865	8.43255
1974	9.57884	0.83153	6.028279	2.1609	3.180551	9.10679	8.84865
1975	9.74558	0.81416	6.028279	2.1980	3.648838	9.57884	9.10679
1976	9.98711	0.82037	6.028279	2.2062	3.813969	9.74558	9.57884
1977	10.05954	0.82274	6.028279	2.1374	3.759804	9.98711	9.74558
1978	9.99337	0.81515	6.437752	2.0613	3.814851	10.05954	9.98711
1979	9.77890	0.83517	6.440947	2.0171	3.780547	9.99337	10.05954
1980	9.64907	0.94090	6.440628	2.0546	3.813528	9.77890	9.99337
1981	9.54029	0.91238	6.467699	2.2285	3.954316	9.64907	9.77890
1982	9.25975	0.89163	6.540308	2.2885	4.037598	9.54029	9.64907
1983	9.54005	0.87097	6.901737	2.4170	3.894266	9.25975	9.54029
1984	9.46164	0.85834	6.979145	2.5899	3.810876	9.54005	9.25975
1985	9.45643	0.84648	7.025538	2.3940	3.686877	9.46164	9.54005
1986	9.53427	0.77455	7.403061	2.2602	3.670461	9.45643	9.46164
1987	9.34563	0.79237	7.408531	2.1056	3.554776	9.53427	9.45643
1988	9.18676	0.77134	7.456455	2.1815	3.591542	9.34563	9.53427
1989	9.19413	0.78298	7.493874	2.1805	3.728341	9.18676	9.34563
1990	8.65824	0.80187	7.550135	2.0618	3.754667	9.19413	9.18676
1991	8.65368	0.78185	7.596894	2.0530	3.776432	8.65824	9.19413
1992	8.26604	0.77803	7.631432	2.1338	3.723764	8.65368	8.65824
1993	8.17858	0.76643	7.654443	2.1980	3.673766	8.26604	8.65368
1994	8.47445	0.76090	7.696213	2.1381	3.620601	8.17858	8.26604
1995	8.14334	0.76451	7.744137	2.0459	3.691127	8.47445	8.17858
1996	7.95262	0.77546	7.776115	2.0918	4.379649	8.14334	8.47445
1997	7.93433	0.76916	8.444622	2.1958	4.338989	7.95262	8.14334
1998	8.07757	0.74451	8.990317	2.1679	4.235989	7.93433	7.95262
1999	8.16656	0.76207	8.865735	2.6298	4.064744	8.07757	7.93433
2000	7.56377	0.79626	9.168997	2.3539	3.986759	8.16656	8.07757
2001	7.68239	0.78050	9.249561	2.3846	4.120012	7.56377	8.16656

Source :IFS