Exchange Rate Volatility and Indonesia-Japan Trade Balance Performance

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Introduction

Nowadays, not every country can avoid the global phenomenon of globalization. For Stiglitz (2002: ix) globalization is the removal of barriers to free trade and the closer integration of national economies. Indeed, this phenomenon provides some benefits, such as no more trade barriers, and to facilitate the improvement of trade balance conditions. However, reducing trade barriers is not guarantee to improve trade conditions, because exchange rates also affect trade. The trade balance will increase when the exchange rate depreciates. A specific form of observing exchange rate behavior is exchange rate volatility, which measures exchange rate risk.

Many economists have investigated the impact of the exchange rate volatility on international trade in the last two decades. Previous studies showed that increasing of exchange rate risk produced a negative impact on exports (de Vita and Abbot, 2004; Arize, 1997; Chowdhury, 1993), whereas Asseery and Peel (1991) showed positive impacts, eventhough Aristotelous (2001), and Gagnon (1993) stated there was no significant relationship between volatility and trade volume. In other words, the relationship between exchange rate volatility and international trade remains ambiguous. Some studies, using a cointegration test, mostly affirmed that there is a long run equilibrium relationship between exchange rate volatility and exports or imports

The volatility problem has occurred in Indonesia. In 1997, exchange rate volatil-

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ity was a serious problem and caused the exchange rate system to shift to a free float exchange rate that arose together with monetary crisis. During the crisis in 1997, the data showed Rupiah depreciation and exchange rate volatility had a very negative impact on Indonesian trade balance. The Rupiah depreciation could not create better trade balance conditions because Indonesian export-import composition is not structure to benefit from the depreciation. Primary export commodities domination and high demand for intermediate import goods might not be advantageous for Indonesian trade balance. Dependency on intermediate import goods would consume most of the net foreign assets. The government should be involved with the exchange rate volatility problem to create a better trade balance condition.

This study attempts to analyze the Rupiah-Yen exchange rate and its volatility, and the Indonesia-Japan trade balance. The research object is Indonesia-Japan international trade because Japan is the main trade partner of Indonesia. UNSD COM trade data showed in 2004 Indonesian exports to Japan were valued at US$ 10,273 million. In 2005 the export value increased to US$ 18,049 and was higher than either countries' export value to the USA. Japan is also the major Indonesian source of imports. The Indonesian import value from Japan in 2004 was US$ 6,081, but it decreased in 2005 due to increasing imports from Singapore.

Rooted in this bilateral trade potency, nowadays the President of Indonesia and the Prime Minister of Japan are seeking to strengthen their economic cooperation. Indonesia-Japan Economic Partnership Agreement (IJEPA) is a form of partnership that offers more benefits than the FTA (Free Trade Area). Indonesian and Japanese governments on November 24, 2006 signed thirty principles items of EPA negotiation. Although bilateral trade agreement always offers many benefits for trade, the IJEPA cannot improve Indonesian trade balance automatically without the exchange rate management.

Our contribution to this debate is to present fresh insights into the link between the exchange rate and its volatility, and aggregate trade balance. Policy makers must recognize that the exchange rate and its volatility are essential to understanding the prospects of IJEPA. It is expected that the results of this

study can be used in that regard.

The paper is organized as follows. The next section will comprehensively discuss previous research and theoretical background on the impact of exchange rate and its volatility on trade balance performance. Section 3 will elaborate on the methodology of this research, describing the model specification and the econometric method. The next section will focus on the descriptive data and empirical results. Finally, section 5 is the conclusion of this study.

Review of Related Literature

Two strands of macroeconomic theory relate to the question of how exchange rate volatility affects macroeconomic performance. The first strand observes how the domestic economy responds to foreign and domestic real and monetary shocks under different exchange rate regimes. The second strand focuses on the issue of how exchange rate volatility under flexible exchange rate regime affects international trade. There are many empirical works examining the question of how the exchange rate regime affects international trade. The general argument is that exchange rates (both in real and nominal terms) will be more variable under flexible than under fixed exchange rate regimes, and this volatility will increase risk in trade. Traditional models examined the exchange rate volatility effect on trade based on the producer theory of a firm under uncertainty, where firm profitability is related to the movement of exchange rate. A risk-averse firm would prefer to reduce risk by reducing the level of trade.

Exchange rate volatility is a form of international trade risk and barrier. Volatility issues arose when many countries moved to floating exchange rate regimes after the Breton-wood agreement (Poon, et.al, 2005). Many researchers investigated the relationship between exchange rate volatility and trade, but the results of their studies were ambiguous. De Grauwe (1988) and Giovannini (1988) found that exchange rate volatility increased trade but McKenzie (1999) showed that it would disrupt exports. Cushman (1983) indicated that in many cases there was a significant negative effect on trade quantity because of the real exchange rate risk or volatility. Wolf (1995) and Arize (1995) supported the hypothesis that increasing exchange rate volatility caused negative effects on trade

because exporters tend to take risk adverse positions when faced with the higher risk and uncertainty. Vergil (2001) found that volatility generated significant negative effect to real export in the long run for Germany, French and USA, significant negative effect for Germany in the short run, but the rest of the world real export, statistically insignificant. Lastrapes and Koray [1990] concluded that there was a statistically significant relationship between contemporaneous shocks to exchange rate volatility and trade variables. Contemporaneous shocks or changes in the state of the economy— such as a change in money supply imposing pressure on interest or a change in the level of production— could introduce downward or upward pressure on the real exchange rate. Furthermore, lagged volatility has explanatory power for imports but not for exports. The relationship between trade and volatility is smaller than other variables.

Côté (1994) offered several reasons to support this ambiguous relationship: (i) even for risk-averse businesses, an increase in risk does not necessarily lead to a reduction in the risky activity, (ii) the availability of hedging techniques makes it possible for traders to avoid most exchange risk at little cost, (iii) exchange rate volatility may actually offset some other forms of business risk, and (iv) exchange rate volatility can create profitable trading and investment opportunities.

Investigations of the link between exchange rate and its volatility and international trade have to address several technical issues. The first concerns the measurement of exchange rate itself, which can be real or nominal, bilateral or effective. Most studies focus on the real exchange rate since it is relative price of tradable (or foreign) to nontradable (or domestic) goods that influences the volume of trade (Sauer and Bohara, 2001). Real exchange rate is measured as the relative price of tradable to non tradable goods: $rer=(e.PPI^*)/CPI$ where e is the domestic currency price of foreign exchange, PPI* is the trading partner's producer or wholesale price index, and CPI is the domestic country's consumer price index. Bini-Smaghi (1991), for example, argued that the nominal exchange rate better captures the volatility driven uncertainty faced by exporters. The second issue relates to the statistical techniques to be used to generate estimates of exchange rate volatility. Some investigators are interested in the measurement of

the exchange rate volatility, which can be measured by using, for example, moving average standard deviation and ARCH approaches.

Model Specification and Measures of Volatility

In the long run, the simple export and import equation is

$$x_t = \alpha_x + \eta_x e_t \quad (1)$$

$$m_t = \alpha_m + \eta_m e_t \quad (2)$$

Where x_t is Indonesian export value to Japan, m_t is Indonesian import value from Japan, and e_t is exchange rate [defined as the price of foreign currency(Yen) in domestic currency (Rupiah) terms]. These equations can be written as trade balance (tb_t):

$$tb_t = \alpha_x - \alpha_m + [\eta_x + \eta_m - 1]e_t \quad (3)$$

$$tb_t = \alpha + \eta e_t \quad (4)$$

$$tb_t = tb\underset{+}{(e_t)} \quad (5)$$

Where $\alpha = \alpha_x - \alpha_m$ is a constant term, $\eta = (\eta_x + \eta_m - 1)$ shows real exchange rate coefficient that explains the Marshall-Lerner condition that depreciation will stimulate the trade balance.

Intended to cover the volatility phenomenon, this trade balance equation will be modified by the volatility variable as follows.

$$tb_t = tb\underset{+}{(e_t, V_t)} \quad (6)$$

If the exchange rate rises, it shows that domestic prices are cheaper than foreign prices, than the trade balance will tend to rise. However, the effect of exchange rate volatility on trade balance is ambiguous, thus it could be positive or negative depend on importer and exporter behavior.

The choice of an appropriate proxy for the unobservable exchange rate risk or uncertainty is an important issue. Most empirical studies use measures that are based on standard deviation of the level or change of the exchange rate

[Chowdury (1993), Stokman (1995)]. Moving average standard deviation (MASD) can also be used as a volatility measurement. Therefore, the exchange rate volatility (V) is measured using the following formula:

$$V_t = \left[(1/m) \sum_{i=1}^{m} (e_{t+i-1} - e_{t+i-2}) \right]^{1/2} \tag{7}$$

Where e is the nominal exchange rate and m is the order of the moving average that will be chosen based on the best smoothing pattern.

Others derive uncertainty proxies form ARCH or GARCH models (Arize (1995), Pozo (1992)). Therefore, ARCH exchange rate volatility is

$$\Delta e_t = \delta_0 + \sum_{i=1}^{n} \delta_i \Delta e_{t-i} + \mu_t \tag{8}$$

$$V_t = h_t^2 = \lambda_0 + \sum_{j=i}^{q} \lambda_j \mu_{t-j}^2 + \upsilon_t \tag{9}$$

The ARCH process estimates the volatility as a conditional variance using AR(q) process of the squared estimated residuals from (8). In this study, equations (8) and (9) are estimated using maximum likelihood method.

In economic time series analysis, cointegration approach is a requirement for short run and long run analysis. There are two main cointegration analysis proxies, such as (i) Engle and Granger (1987) two steps residual, and (ii) Johansen (1988, 1991) maximum likelihood reduced-rank approach. The limitation of these approaches is all regressors have to be integrated in I (1). When regressors are I (0) and I (1), then the statistical inference will not be valid (Thomas, 1997: Ch. 8). Harris (1995) showed that the trace and maximum eigenvalue from Johansen cointegration test is difficult to interpret. Regressors I (0) caused spurious cointegration relationships with other variables in the equation system. Pesaran and Shin (1999), and Pesaran et al (2001) showed Autoregressive Distributed Lag (ARDL) is a better choice to deal with this spurious cointegration problem. The advantage of ARDL is the ability to test cointegration relationships among variables in levels irrespective of whether the underlying regressors are I (0) and I (1) or mutually cointegrated. This method

avoids the pre testing problems associated with standard cointegration analysis, which requires the classification of variables into I (1) and I (0).

The ARDL procedures contain two stages. First, the existence of the long-run relationships between the variables under investigation is analyzed by computing the F-statistic for testing the significance of the lagged levels of the variables in the dynamic form of the underlying ARDL model. The second stage of the analysis is to estimate the coefficients of the long run relationships and make inferences about their values using ARDL. Trade balance ARDL equation is

$$\Delta tb_t = c_0 + \sum_{j=0}^{n} \eta_j \Delta e_{t-j} + \sum_{s=0}^{w} \lambda_s \Delta V_{t-s} + \alpha D_t + \pi_1 tb_{t-1} + \pi_2 e_{t-1} + \pi_3 V_{t-1} + \xi_t \quad (10)$$

Where c_0 is a drift; D_t is a dummy variable vector for extreme observation; and ξ_t, a white noise error vector.

The long run equation model is a reduced form of trade balance ARDL equation, when $\Delta tb = \Delta e = \Delta V = 0$ is,

$$tb_t = \beta_1 + \beta_2 e_t + \beta_3 V_t + \upsilon_t \quad (11)$$

$\beta_1 \neq 0$; $\beta_2 > 0 + \beta_3 \neq 0$ (it depends on exporter and importer behavior)

Where $\beta_1 = -\frac{c_0}{\pi_1}$, $\beta_2 = -\frac{\pi_2}{\pi_1}$, $\beta_3 = -\frac{\pi_3}{\pi_1}$ and υ_t is an error $IID\ (0, \sigma^2)$.

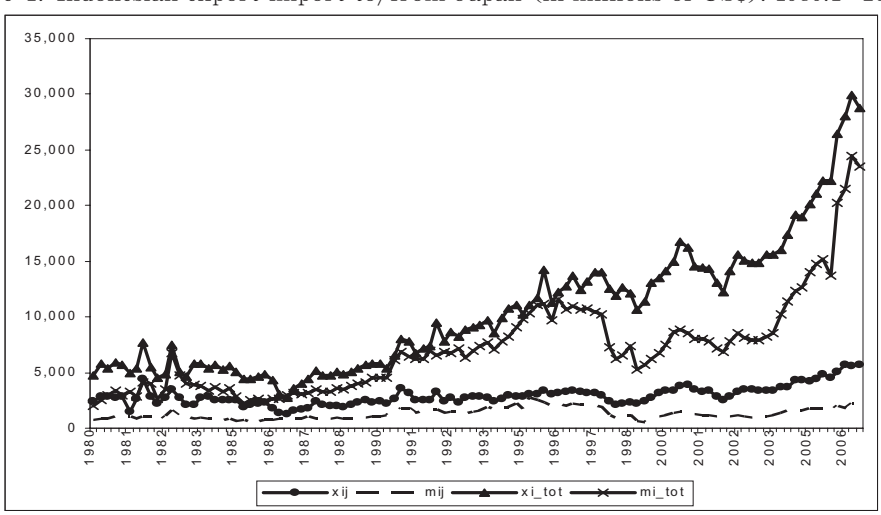
The result of ARDL regression can be used to analyze short and long run behavior.

Data Description

Figure 1 shows the total value of Indonesia's exports and imports and their exports-imports value to Japan. Indonesian trade has experienced rapid export growth during the past few decades. The rapid export growth corresponds with high imports, except in 1997 because of exchange rate problems. Indonesia had a high import dependency, especially in intermediate and machinery goods. The import dependency created a big burden for net foreign assets because of the large Rupiah depreciation in 1997. The change from a managed floating exchange rate system to a free-floating exchange rate in 1997, accompanied by economic crisis, depreciated Rupiah quickly.

Indonesian trade growth to Japan was relatively constant. Indonesia's exports to Japan were greater than its imports, so the trade balance was positive. After 1998, the highest Indonesia-Japan trade value growth (quarter to quarter) was 15.73% in the 3rd quarter of 2004 (export) and 39.12% in 4th quarter of 2004 (import). In 2006, the export value to Japan was above 5,000 million US$ per quarter and import value from Japan was about 2,000 million US$ per quarter.

Figure 1: Indonesian export-import to/from Japan (in millions of US$): 1980.1- 2006.4



Note : xij =Indonesian Exports to Japan xi-tot=Indonesian Exports
Mij=Indonesian Imports from Japan mi-tot=Indonesian Imports
Source: Bank Indonesia, Indonesian Economic and Financial Statistics, various editions.

Table 1 reports the Indonesian-Japan export-import share. Although Indonesia-Japan trade increased, the export-import share was apt to decrease. After 1998, export value to Japan was between 15.99% and 23.30% of export total value. This proportion was smaller than many previous periods. The same decrease occurred in the import proportion. After the crisis in 1999, Indonesian import proportion from Japan was between 8.91% and 16.10%. These decreases showed that Japan was not the main destination and source of trade for Indonesia. The borderless trade and regional trade agreement encouraged Indonesia to open its trade broadly.

In the structure of Indonesia-Japan bilateral trade, Indonesia was an exporter of primary commodities and importer of industrial, capital goods and machinery inputs. This situation did not always benefit Indonesia due to the characteristics

Table 1: Export-Import Share

Period	Indonesia – Japan		Period	Indonesia – Japan	
	Export Share	Import Share		Export Share	Import Share
1980	49.26%	31.50%	1994	27.39%	24.20%
1981	47.38%	30.66%	1995	27.08%	22.69%
1982	50.21%	25.88%	1996	25.91%	19.81%
1983	45.77%	23.20%	1997	23.45%	19.80%
1984	47.30%	23.86%	1998	18.85%	15.70%
1985	46.23%	25.78%	1999	21.52%	12.14%
1986	44.93%	29.19%	2000	23.30%	16.10%
1987	43.85%	29.07%	2001	23.21%	15.15%
1988	42.42%	25.55%	2002	21.18%	14.09%
1989	42.68%	23.02%	2003	22.38%	12.99%
1990	42.73%	24.27%	2004	15.99%	14.16%
1991	37.12%	24.46%	2005	21.07%	11.97%
1992	31.80%	22.04%	2006	19.42%	8.91%
1993	30.48%	22.06%			

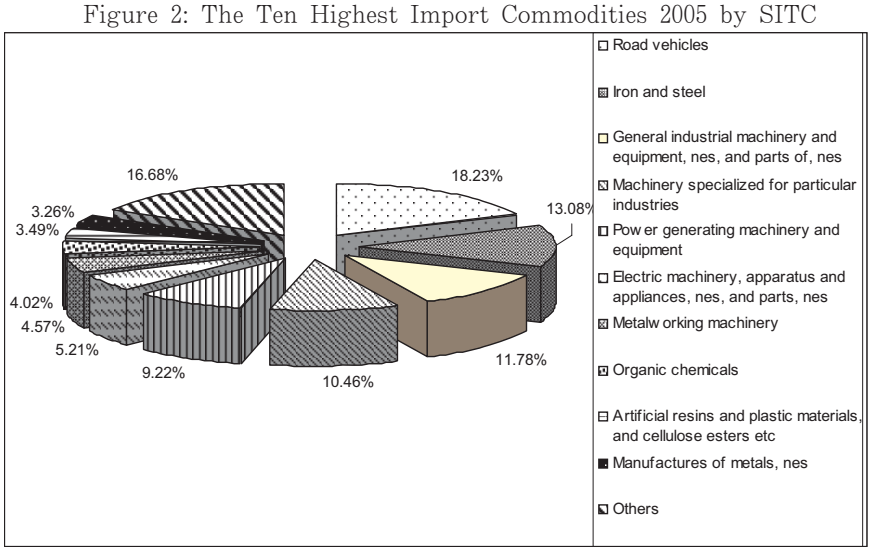
Source: UNSD COM trade database

of primary commodities, they were unpreserved, low price-low value added, and dependent on season. On the contrary, machinery inputs usually have a higher price as result of technologies attached. The ten highest import products in 2005 were road vehicles (18.23%), iron and steel (13.08%), general industrial machinery (11.78%), machinery specialized for particular industries (10.46%), power generating machinery (9.22%), electric machinery (5.21%), metalworking machinery (4.57%), organic chemicals (4.02%), artificial resins and plastics materials (3.49%), manufactures of metal (3.26%) and others (16.68%).

Among the ten highest import commodities, the share of iron and steel (the second highest import commodity in 2005) increased from 8.87% in 2000 to 9.64% in 2004 and 13.08% in 2005. The growth of iron and steel share was in line with industrial development in Indonesia. Other commodities that had significantly augmented shares from 2000 to 2005 were metalworking machinery (from 1.35% to 4.57%), general industrial machinery (from 9.80% to 11.78%) and power generating machinery (from 7.70% to 9.22%). On contrary, the share of the first highest import commodity-road vehicles declined from 20.26% in 2000 to 18.23% in 2005. Commodities shares that declined from 2000 to 2005 were artificial resins and plastic materials (from 4.02% to 3.49%), organic chemical (from 6.56% to 4.02%),

manufactures of metals (from 3.82% to 3.26%) and other products (from 23.89% to 16.68%). The growth in manufacturing imports during this period also reflected greater economic activity in Indonesia, leading to rising demand for capital, intermediate and consumer goods.

Figure 2: The Ten Highest Import Commodities 2005 by SITC



Source: see Table 1

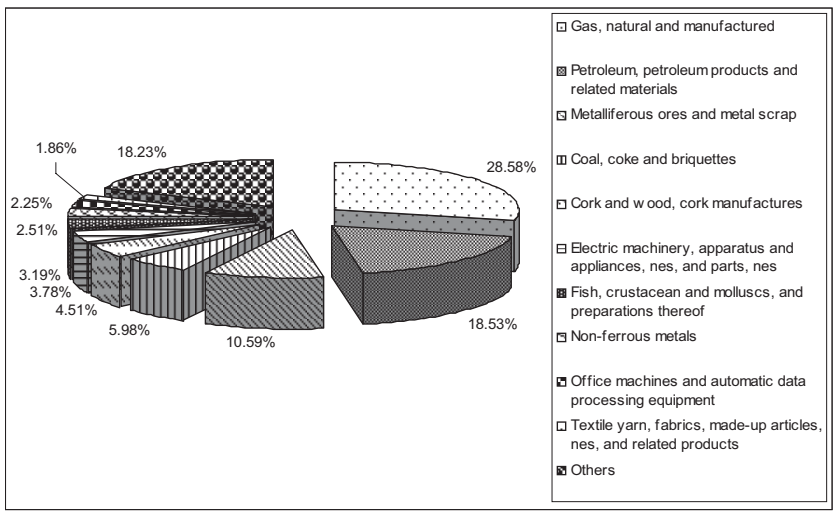
Table 2: Import Commodities, 2000-2005 (percentage)

Commodities	2000	2001	2002	2003	2004	2005
Road vehicles	20.26	24.72	21.78	23.28	18.43	18.23
Iron and steel	8.87	7.27	8.49	8.07	9.64	13.08
General industrial machinery and equipment, nes, and parts of, nes	9.80	12.21	11.96	11.06	13.02	11.78
Machinery specialized for particular industries	9.34	9.00	8.62	7.59	10.29	10.46
Power generating machinery and equipment	7.70	6.67	7.96	8.39	9.32	9.22
Electric machinery, apparatus and appliances, nes, and parts, nes	4.38	4.21	4.80	4.82	5.02	5.21
Metalworking machinery	1.35	1.95	3.05	4.09	3.42	4.57
Organic chemicals	6.56	5.68	4.53	5.30	4.57	4.02
Artificial resins and plastic materials, and cellulose esters etc	4.02	3.74	3.66	3.62	3.94	3.49
Manufactures of metals, nes	3.82	2.93	3.67	3.78	3.53	3.26
Others	23.89	21.62	21.49	20.02	18.82	16.68

Source: see Table 1

Primary products like mining, forestry, and fish dominated Indonesian exports to Japan. The disadvantages of primary product exports were relatively cheap price, and corresponding low import value, seasonal dependency for agricultural products, and continuity of resources for mining-based products. The mining export commodities in 2005 were gas and natural manufactured (28.58%), petro-

Figure 3: the ten highest export commodities in 2005 by SITC



Source: see Table 1

leum and petroleum products (18.53%), metalliferous ores and metal scrub (10.59%), and coal, cokes and briquettes (5.98%) and non-ferrous metals (2.51%). The agriculture export products were cork and woods (4.51%) and fish, crustaceans and mollusks (2.51%). The rest of ten highest export commodities were industrial outputs like electrics machinery, office machines, and automatic data processing equipments along with textiles yarn, fabrics, and related products.

Among the ten highest export commodities, share of metalliferous ores and metal scrap increased from 6.92% in 2000 to 10.59% in 2005. Other commodities whose shares tended to grow were fish, crustacean, and mollusks (from 0% to 3.19%) and coal, cokes and briquettes (from 2.51% to 5.98%). On the contrary, commodities with declining share were textiles (from 2.29% to 1.86%), office machines (from 3.04% to 2.25%), electric machinery (from 4.10% to 3.78%), and cork, wood, and cork manufactured (from 8.24% to 4.51%). A breakdown of exports by economic functions revealed that while imports of manufactured goods have shown a downward trend, the exports of primary goods have risen sharply.

The robust export performance of manufacturing, combined with growth in manufacturing imports, confirmed that Indonesia tried to pursue an outward-oriented industrialization strategy aided by trade liberalization and strategic industry policy.

The linkage between the import of intermediate goods and changes in export

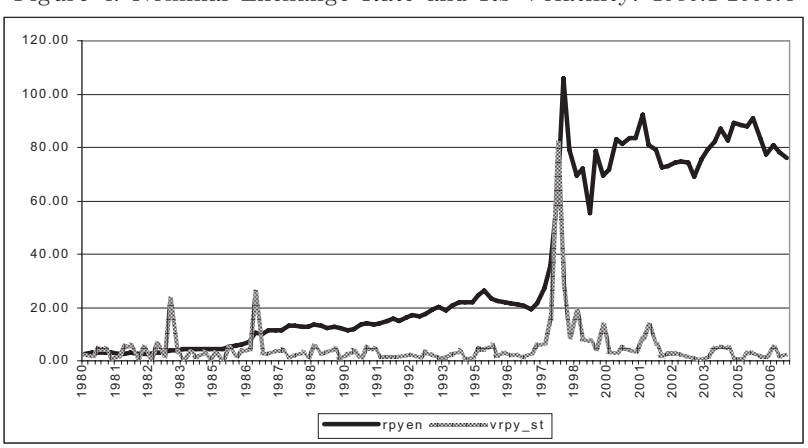
structure supports argument that: (a) import of intermediate inputs and capital goods are the major determinant of the changes in the export structure; and (b) trade liberalization measures improve firms ability to import the technology and intermediate inputs needed to adapt to changing global demand patterns. Based on structure of Indonesia-Japan trade, Indonesia should develop manufactured exports to Japan in order to find a greater value added from international trade. Because of inputs dependency from Japan, Indonesia had to keep the Rupiah-Yen exchange rate stable to maintain the prices of inputs, and the next effect kept output-manufactured prices stable.

Table 3: Export commodities, 2000-2005 (percentage)

Commodities	2000	2001	2002	2003	2004	2005
Gas, natural and manufactured	32.79	31.99	31.16	32.40	7.54	28.58
Petroleum, petroleum products and related materials	18.79	16.48	15.47	17.44	11.28	18.53
Metalliferous ores and metal scrap	6.92	5.23	5.28	5.32	12.97	10.59
Coal, coke and briquettes	2.51	3.17	3.72	3.56	6.43	5.98
Cork and wood, cork manufactures	8.24	7.71	8.03	6.30	9.22	4.51
Electric machinery, apparatus and appliances, nes, and parts, nes	4.10	3.49	3.59	4.05	6.29	3.78
Fish, crustacean and mollusks, and preparations thereof	0.00	5.81	6.02	4.75	5.74	3.19
Non-ferrous metals	2.35	2.33	2.83	2.43	3.72	2.51
Office machines and automatic data processing equipment	3.04	1.95	1.30	1.62	3.57	2.25
Textile yarn, fabrics, made-up articles, nes, and related products	2.29	2.23	2.13	2.32	3.34	1.86
Others	18.97	19.61	20.48	19.81	29.91	18.23

Source: see Table 1.

Figure 4: Nominal Exchange Rate and Its Volatility: 1980.1-2006.4



Source: see Figure 1.

Exchange rate depreciation and volatility had a different concept. Depreciation just measured exchange rate change, but volatility also measured exchange rate risk. Changing exchange rate systems carried some consequences to the Indonesian economy. When the monetary crisis appeared, the increasing of Rupiah risk affected international trade. Figure 4 shows that volatility was very low or there was no volatility before the East Asian crisis broke in June/July 1997, and after that (July 1997 to December 2002) the exchange rate volatility was very significant. This is because before the crisis in 1997 Indonesia applied a managed floating exchange rate system, while after the crisis Indonesia adopted a free exchange rate system.

Table 4: Exchange Rate Comparison 1980.1-2006.4

Indicators	RPYEN	RPUS	YENUS	VRPY_ST	VRPUS_ST	VYUS_ST
Mean	34.61519	4166.583	146.9907	4.862726	3.107358	2.632582
Median	19.18240	2098.000	125.0000	2.962670	0.335725	2.506760
Maximum	105.7863	14900.00	270.0000	81.25575	77.19522	10.19878
Minimum	2.490700	625.0000	85.00000	0.268430	0.022690	0.591200
Std. Dev.	32.58774	3726.559	49.66815	8.747166	8.830343	1.584137

When we compare exchange rate condition between Indonesia-Japan (RPYEN), Indonesia-USA (RPUS) and Japan-USA (YENUS), Table 4 shows that Indonesian exchange rate was more volatile than Japan. The average risk of Rupiah to Yen (VRPY_ST) was higher than Rupiah to US$ (VRPUS_ST) or Yen to US$ (VYUS_ST).

Empirical Results

1. Volatility Measurement

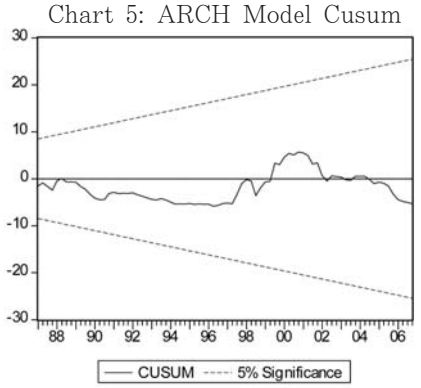
Several approaches are used to measure the exchange rate volatility (V). The three most common approaches are standard deviation of exchange rate growth, moving-average standard deviation, and ARCH. This research used minimum AIC to find the best volatility measurement in the trade balance model. The minimum AIC value shows volatility measurement choice is better than others were.

Table 5: AIC value of ARDL trade balance

Equation	AIC				
	Deviation Standard	MASD 3	MASD 4	MASD 6	Arch
ARDL trade balance	-1.220119	-0.994303	-0.852702	-0.882611	-1.469304

Empirical result in Table 5 shows that volatility measurement by ARCH has a minimum value, so this research used ARCH measurement to analyze the ARDL trade balance model. To confirm the ARCH as the best measurement, this research testes the stability model by CUSUM. The CUSUM test is based on the cumulative sum of the recursive residuals (Brown et al, 1975). This option plots the cumulative sum together with the 5% critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines. The result of CUSUM test proves that volatility measurement by ARCH model is more stable than by others models.

Chart 5: ARCH Model Cusum



2. Testing for the existence of a cointegrating vector

The first step of testing for the existence of the cointegration vector is to test for order of cointegration. This test investigates the time series properties of the variables. Table 6 reports the results of DF and ADF tests. The critical value is taken from McKinnon (1991). The Indonesia-Japan trade balance (*tbr*) and the Rupiah-Yen exchange rate (*e*) are unambiguously integrated of order 1 or I (1), whereas the volatility is integrated of order 0 or I (0).

Table 6: Order of integration

Variable	DF	ADF	Variable	DF	ADF
Tbr	-0.41	-2.44	Δtbr	-8.30	-8.32
e	-1.16	-2.18	Δe	-6.11	-6.13
V	-4.83	-4.82			

Now, we may proceed to estimation of the following cointegrating model of (12) using OLS.

$$tbr_t = \beta_1 + \beta_2 e_t + \upsilon_t \quad (12)$$

$$\beta_1 \neq 0 \ ; \ \beta_2 > 0$$

Where tbr is the Indonesia-Japan trade balance (in billion of Rupiah), and e is the Rupiah-Yen exchange rate. All of the above variables are in natural logarithm and have the same order of integration [I(1)].

The result is given in Table 7. Note that although this estimation is super-consistent (Engle and Granger, 1987), the coefficient standard errors are subject to bias. Therefore, it would be misleading to report the standard test statistics for significance. On the basis of the CRDW- and the DF- statistic, it appears that the result shows that we can not reject the hypothesis that the variables under consideration are a cointegrated vector. The exchange rate elasticity is positive which is exactly what we would expect.

Table 7: Cointgrating vectors

DependentVariable: tbr

Independent Variable	Results
Constant	12.4804
e	0.9136
R^2	0.7864
CRDW	0.38
ADF	-3.22

3. The ARDL Specification

Having achieved the suitable cointegrating set of the long run determinant of the Indonesia-Japan trade balance, our discussion is now concentrated on our ARDL specification. The 97 dummy (D97) is a proxy for the effect of the Indonesian crisis in 1997. The empirical result is presented in Table 8. The findings show that computed value of DW (Durbin-Watson) statistic, and F versions of diagnostic tests for serial correlation, heteroscedasticity and functional form (linearity) are below their critical values. In other words, it appears that the equation passes the standard range of diagnostics, namely: serial correlation, heteroscedasticity, and linearity. The latter also confirms that the model is correctly specified. The R^2 is respectable for an estimation estimated in differences. The F statistic for bounds test from the ARDL (F = 5.2821) exceeds its critical

value. This result provides strong evidence in favor of the existence of a cointegrating level relationship between the Indonesia-Japan trade balance and the regressors.

The estimated coefficients of the exchange rate are positive and significant influence on the trade balance in the short run as well as in the long run. It implies that depreciation will lead to an increase the trade balance. The sign of the volatility is positive, but insignificant. It means that we do not have any strong evidence that the variability in exchange rate imposes cost on risk-averse market participants and then induces the trade balance, or it may deteriorate the trade balance. However, the behavior of trade balance is also influenced by the Indonesian crisis in 1997 represented by negative significant for the dummy variable D97. It seems that the change in Indonesian exchange rate system in 1997 -from a managed floating to a free floating exchange rate system- deteriorates the trade balance.

Table 8: ARDL specification

DependentVariable: Δtbr

Independent Variable	Results
Constant	-4.7644 (1.0537)
Δe	1.2145 (0.2788)
e(-1)	-0.1317 (0.0616)
ΔV	0.0021 (0.0051)
V(-1)	-0.0012 (-0.0072)
D97	-0.4997 (0.1691)
tbr(-1)	0.3512 (0.0779)
R^2	0.2444
F-statistic	5.2821
Serial correlation DW F-statistic (LM test)	 2.1830 0.8780
Heteroscedasticity F-statistic (White test)	 2.2910
Linearity F-statistic (Ramsey)	 0.6438

Note : Figure in parentheses are t-ratios of Regression coefficients

Concluding Remarks

In this paper, we analyzed Indonesia-Japan international trade because Japan has been the main trade partner of Indonesia. Indonesia has enjoyed and experienced rapid growth of exports during the past few decades but its rapid export growth has also corresponded with high imports, except during the economic crisis in 1997. In general, Indonesian exports was greater than its imports, therefore its trade balance was surplus.

This paper also investigated the impact of Rupiah-Yen exchange rate and its volatility on Indonesia-Japan trade balance. There are several conclusions that can be drawn from the empirical results. First, the Rupiah-Yen exchange rate and the Indonesia-Japan balance trade (both are in logarithm) are found to be I (1), whereas the exchange rate volatility is stationary or I (0). The finding also confirms the use of the ARDL model because the variables in question are I (1) and I (0). Second, we also find a significant cointegrating level relationship between the trade balance and the exchange rate. In the long run as well as in the short run, the Rupiah depreciation will induce the trade balance to rise. Third, our empirical results can not indicate an evidence the effect of the exchange rate volatility on the trade balance. This finding might be in line with the structure of Indonesia-Japan trade. Because of inputs dependency from Japan, Indonesia has to keep the exchange rate stable to maintain the prices of inputs. Finally, we also conclude that the dummy variable (D97) has a statistically significant negative impact on the trade balance. It means that after the crisis in 1997, the trade balance has deteriorated. Actually, this is not a surprising result since before the crisis in 1997 Indonesia applied a highly managed floating exchange rate policy, while after the crisis it adopted a free exchange rate policy.

References

Aristotelous, K. (2001), "Exchange Rate Volatility, Exchange Rate Regime, and Trade Volume: Evidence from the UK-US Export Function (1989-1999)", *Economics Letters,* 72:87-94.

Arize, A.C. (1995), "The Effects of Exchange Rate Volatility on US Exports: An Empirical Investigation", Southern *Economic Journal,* 62: 34-43.

Arize, A.C. (1997), "Conditional Exchange Rate Volatility and the Volume of Foreign Trade: Evidence

from Seven Industrialized Countries", Southern *Economic Journal,* 64: 235-54.

Asseery, A. and D.A. Peel (1991), "The Effects of Exchange Rate Volatility on Exports: Some New Estimates", *Economics Letters,* 37: 73-177.

Bini-Smaghi, L. (1991), Exchange Rate Variability and Trade: Why is it so difficult to find any Empirical Relationship? *Applied Economics,* 23: 927-936.

Brown, R.L., J. Durbin and J.M. Evans (1975), Techniques for Testing the Constancy of Regression Relationships over Time, *Journal of the Royal Statistical Society,* B, 37: 149-163.

Chowdhury, A.R. (1993), "Does Exchange Rate Volatility Depress Trade Flows? Evidence From Error-Correction Models", *Review Of Economics And Statistics,* 75: 700-706.

Côté, A. (1994), "Exchange Rate Volatility and Trade, a Survey", *Bank of Canada Working Paper* 94-5:1-31

Cushman, D. O.(1983), "The Effect of Real Exchange Rate Risk on International Trade", *Journal of International Economics* 15: 45-63.

De Grauwe, P. (1988), "Exchange Rate Variability and the Slowdown in Growth of International Trade", *IMF Staff Papers,* 35: 63-84.

De Vita, G. and A.Abbott (2004), "Real Exchange Rate Volatility and US Export: An ARDL Bounds Testing Approach", *Economics Issues* Vol 9 Part I: 69-78

Engle, R.F. and C.W.J. Granger, (1987), "Co-Integration, And Error Correction: Representation, Estimation and Testing", *Econometrica,* 55: 251-76

Gagnon, J.E. (1993), "Exchange Rate Variability and the Level of International Trade", *Journal of International Economics,* 34: 269-87

Giovannini, A. (1988), "Exchange Rates and Traded Goods Prices", *Journal of International Economics* 24 (February): 45-68.

Harris, R.I.D. (1995), "*Using Cointegration Analysis in Econometric Modeling*", London: Harvester Wheatsheaf

Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control,* 12: 231-254

Johansen, S. (1991), "Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models", *Econometrica*, 59: 1551-1580.

Lastrapes, W. D. and F. Koray (1990), "Exchange Rate Volatility and U.S. Multilateral Trade Flows", *Journal of Macroeconomics* 12 (summer): 341-62.

McKenzie, M. D (1999), "The Impact of Exchange Rate Volatility on International Trade Flows", *Journal of Economic Survey,* Vol.13 no 1: 71-106.

McKinnon, J. (1991), Critical Values of Cointegration Tests, in Engle, R.F. and C.W. Granger (eds), *Long Run Economic Relationships,* Oxford University Press.

Pesaran, M. H., Y. Shin and R. J. Smith (2001), "Bounds Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics,* 16: 289-326.

Pesaran, M.H. and Y. Shin (1999), "An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis", in S. Strom (Ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*

Poon, W.C., C.K. Choong, and M.S. Habibullah (2005), "Exchange Rate Volatility and Exports for

Selected East Asian Countries Evidence from Error Correction Model", ASEAN *Economic Bulletin,* Vol. 22, No. 2: 144-159

Pozo (1992), "Conditional Exchange Rate Volatility and the Volume of International Trade: Evidence from the Early 1900s", *the Review of Economics and Statistics,* 75: 325-329.

Sauer, C. and A. K. Bohara (2001), "Exchange Rate Volatility and Exports: Regional Differences between Developing and Industrialized Countries", *Reviews of International Economics,* 9(1): 133-152.

Stiglitz, J.E. (2002), *Globalization and Its Discontents,* Penguin Group.

Stokman, A.C.J (1995), "Effect of Exchange Rate on Intra-EC Trade", *De Economist* 143: 41-45.

Thomas, R.L. (1997), Modern Econometrics, an Introduction, Addison-Wesley Longman.

Vergil, H. (2001), "Exchange Rate Volatility in Turkey and Its Effect on Trade Flows" , *Journal of Economic and Social Research,* 4 (1): 83-99.

Wolf, A. (1995), "Import and Hedging Uncertainty in International Trade", *Journal of Futures Markets* 15: 101-10.