Jurnal Ekonomi Malaysia 48(1) 2014 49 - 61

Trade Variety and Export Performance of ASEAN-5

(Kepelbagaian Perdagangan dan Prestasi Eksport ASEAN-5)

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ABSTRACT

ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, and Thailand) exports have grown rapidly over the last few decades. This speedy growth of exports may adversely affect economic welfare if it is followed by deterioration in the terms of trade. However, increases in the variety of products traded and improvements in technology will move a country up the value chain and halt the terms of trade deterioration. Another important characteristic of ASEAN-5 exports is the heavy reliance on imported intermediate components; thus import variety may also be an important factor that affects the growth of ASEAN-5's exports. This study measured the dynamics of the export and import varieties of ASEAN-5 for the period from 1991-2008 using variety indexes based on Shannon's entropy. It then determined whether expansion in the varieties of products exported and imported, if any, have helped to explain the rapid growth of exports.

Keywords: Export variety; import variety; unrelated variety; related variety; export growth.

ABSTRAK

Eksport negara-negara ASEAN-5 (Indonesia, Malaysia, Filipina, Singapura, dan Thailand) telah berkembang dengan amat pesat sejak beberapa dekad yang lalu. Namun pertumbuhan pesat eksport boleh menjejaskan kebajikan rakyat sesebuah negara jika ia diikuti dengan kemerosotan terma perdagangan (terms of trade). Peningkatan jenis-jenis produk yang didagangkan dan teknologi dapat menggerakkan negara ke arah yang lebih tinggi dalam rantaian nilai dan menghentikan kemerosotan terma perdagangan. Satu lagi ciri penting bagi eksport Negara-negara ASEAN-5 adalah kebergantungan pada pengimportan komponen pengantara; dengan itu kepelbagaian import juga merupakan faktor penting yang dapat memberi kesan kepada pertumbuhan eksport ASEAN-5. Kajian ini mengukur dinamik untuk kepelbagaian eksport dan import bagi negara-negara ASEAN-5 bagi tempoh 1991-2008 menggunakan indek-indek kepelbagaian berdasarkan entropi Shannon. Ia kemudian menentukan sama ada perkembangan kepelbagaian dalam jenis produk yang dieksport dan diimport dapat menerangkan pertumbuhan pesat eksport di negara-negara ASEAN-5.

Kata kunci: Kepelbagaian eksport; kepelbagaian import; kepelbagaian tidak berkaitan; kepelbagaian berkaitan; pertumbuhan eksport.

INTRODUCTION

ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, and Thailand) exports' have been growing rapidly over the last few decades (the exception is the period of time during the East Asian financial crisis). Their exports of high-technology products, a measure frequently used to capture a country's technological intensity, account for more than 40 percent of their total merchandise exports, which is among the highest rate in the world (World Development Indicators 2009 - the average export was from 1996-2006). However, the standard Armington differentiation model (1969) (see also Bhagwati (1958), Singer (1950), and Prebisch (1950)) demonstrated that rapid export growth can be associated with deteriorations in the terms of trade, which negatively affect economic welfare. Indeed, standard international macroeconomic models predict that productivity and/or labor supply shock affect exports through changes in the terms of trade (Gagnon, 2008), which may lead to the "immiserizing growth" problem. The link between deterioration in the terms of trade and export growth in developing countries has also been supported by UNCTAD (2002). While the share of developing countries in world manufacturing exports, including those of rapidly growing high-tech products, has been expanding rapidly, the income earned from such activities by these countries does not seem to share in this dynamism. Although developed countries have a lower share in world manufacturing exports, they have actually increased their share in world manufacturing value added over this period. Developing countries, by contrast, have achieved a steeply rising ratio of manufacturing exports to gross domestic product (GDP), but without a significant upward trend in the ratio of manufacturing value added to GDP. Few of the countries that pursued rapid liberalization of trade and investment and experienced a rapid growth in manufacturing exports over the past few decades achieved a significant increase in their shares in world manufacturing income (UNCTAD 2002).

In contrast, Krugman (1989) and Gagnon (2008) claimed that fast-growing countries tend to experience rapid export growth without any problems related to the terms of trade deteriorations. They argued that the rapid growth of exports was due to expansion in the variety of products exported, which prevents the terms of trade deterioration. Thus, the rapid growth of exports will not affect economic welfare negatively. The large share of high-technology products in ASEAN-5 exports may also be an indication that the fear of terms of trade deterioration is not warranted for the ASEAN-5 countries, as their exports are of high quality and consequently highly priced. Yet, Srholec (2007) showed that while indigenous technological capabilities were associated with export performance in electronics, the propensity to import electronic components accounted for a large proportion of cross-country differences in electronic exports. Thangavelu and Rajaguru (2004) observed that for nine rapidly developing Asian countries, trade had an important impact on productivity and output growth in the economy; however, imports provided the important "virtuous" link between trade and output growth. Both exports and imports have qualitatively different impacts on labor productivity, but imports tend to have a greater positive impact on productivity growth in the long run. Meanwhile, Saure (2012) argued that per capita income and the number of imported varieties were correlated positively.These findings supported Srholec's (2007) contentions that imported intermediate components were responsible for the growth of exports and the large share of high-technology products. Thus, imported components may mask the real technological level of ASEAN-5 countries.

Therefore, the objective of this paper is to measure the dynamics of ASEAN-5 countries'export and import varieties and determine whether expansions in the trade variety, if any, have contributed to ASEAN-5's rapid export growth. A positive relationship between export variety and export performance would indicate that export growth is not followed by the adverse terms of trade effect. A positive relationship between import variety and export growth would suggest that import is an important component of export and that the increase in the share of high-technology export should be interpreted more carefully.

In order to measure trade variety, we used the Frenken (2004) and Straathof (2007)'s product variety index, which is based on Shannon's entropy (Shannon, 1948). The indexes enabled us to differentiate trade variety into related variety (*RV*), unrelated variety (*UV*), semi-related variety (*SV*), and total variety (*TV*). These measures of variety capture different aspects of variety, where *RV* refers to the variety that exists within each sector, *UV* is the variety of the main sectors in the economy, and *TV* is the overall variety. As argued by Saviotti and Frenken (2008), these varieties may affect productivity, and therefore export growth, differently. The product variety indexes used differ from Funke and Ruhwedel (2001) study on East Asia which was based on Feenstra (1994) variety index.

If trade variety is important in explaining export growth, the standard aggregate export equation based on a scale variable representing foreign demand and price competitiveness may be mis-specified (Funke and Ruhwedel, 2001b; Gagnon, 2008). In order to examine the importance of trade variety on export growth, we augmented the standard export equation with the indexes of the trade variety. We showed that when indexes of export variety were augmented to the standard export function, *SV*, *RV* and *TV* were not significant in explaining export performance. However, there was a negative relationship between exports and *UV*. The negative relation for *UV* also existed when indexes for import variety replaced the indexes for export variety. There was also a significantly positive coefficient for import *RV*; this relationship corroborated the importance of the imported intermediate components for ASEAN-5's export growth. The results indicated that ASEAN-5 export growth cannot be explained by the increase in the variety of products traded; therefore, the ASEAN-5 need to consider the problem of terms of trade deterioration in their development policy.

LITERATURE REVIEW

Studies have found evidence of the commoditization of manufactured products, particularly at the less-sophisticated end of the production spectrum. This trend is true especially as the manufacturing of products of the low-tech and labor-intensive variety has come to constitute a major share of developing countries' exports (Kaplinsky 1993). Commoditization signifies that developing countries will need to adopt measures to move up the technological ladder if they want to avoid competing through lowering prices.

The discussion on ASEAN-5's export growth also needs to be located in the broader context of the possible existence of an adding-up constraint or the fallacy of composition due to the simultaneous pursuit of export-led growth policy by a number of developing countries. Cline (1982) concluded that the generalization of the East Asian export-led growth model across developing countries was not tenable. It would result in an increased market penetration by developing countries into the industrial countries' markets and may lead to protectionist reactions from industrial countries. However, while the emphasis was on protective responses, it did not account for the possible changes in the terms of trade and changes in the variety and quality of products exported as the developing countries sought to export their way to growth. Faini et al (1992) and Blecker and Razmi (2008) showed that for developing countries, competition with other developing country exporters was a more important consideration than that with industrial country exporters. Their simulations revealed that the benefits of currency devaluation to a country largely vanished when competing developing country exporters followed a similar policy. These results support the existence of a fallacy of composition in developing country manufacturing exports. However, Ghani (2006a) showed that there was no significant crowding-out effect due to the export-led growth policies in many developing countries. Athukorala (2008) argued that China's global economic integration has deepened production fragmentation in East Asia, countering fears of crowding out other countries for international specialization.

If the fallacy of composition in the export-led growth model, the terms of trade deterioration problems, and commoditization of low-end manufactured products do hold true, developing countries will need to improve their product offerings to provide more variety and higher-quality products instead of competing based on lower prices in order to export their way to growth.

TERMS OF TRADE DETERIORATION

At the end of World War Two, it was expected that developing countries' terms of trade would increase because of the fast improvement in their technological progress (Kaplinsky 2006). Instead, Prebisch (1950), Singer (1950), and Bhagwati (1958) argued that developing countries' terms of trade would decline and consequently reduce economic welfare, as the increase in export volume was not able to offset the decrease in price. There are multiple reasons for the decline in developing countries' terms of trade. Many developing countries' exports are inputs or raw materials used in the production of manufactured goods. Hence, a fall in the price of a primary commodity, which is an input in manufacturing products, would have different implications for the producer of the commodity as well as the purchaser of the manufactured product. Cheaper inputs from developing countries reduced manufacturing costs in industrial countries, consequently increasing their profits. However, the cheaper input also lowered developing countries' income.

The income elasticity of demand for products produced by developing countries was less than the income elasticity for products produced by industrial countries as the industrial countries' products embodied higher technology. Similarly, price elasticity of demand for primary products exported by developing economies was price inelastic. Hence, an increase in demand for the output of a low-income country would only come from a large and disproportionate fall in prices. Many of the commodities exported by developing countries were also subjected to synthetic substitution and hence to declining demand. This substitution also meant that the output of developing economies generally embodied products with greater competition and low barriers to entry; consequently, prices will be cheaper, and margins are smaller (Kaplinsky 2006).

Indeed, developing countries' terms of trade for manufactured products have showed signs of weaknesses rather than improvement (Sarkar and Singer 1991; Chakraborty 2012). Kaplinsky (1993) found that the Dominican Republic, which tried to diversify its output by moving into unskilled labor-intensive products, had suffered from 'immiserizing' employment growth, that is, "employment growth which is contingent upon wages falling in international purchasing power." With an increasing number of developing countries specializing in unskilled labor-intensive products, the most practical way to compete is by keeping prices low and therefore by paying low wages. This intense competition will further reduce developing countries' terms of trade, and in this sense, unskilled labor-intensive manufactured products are being 'commoditized', behaving similar to primary commodities, which are experiencing a downward trendin terms of trade (Ghani 2006b).

Erturk (2001/2002) argued that one of the causes of the East Asian crisis was the investment boom in East Asia in the early 1990s. As these countries exited from their niche in producing labor-intensive products, they created overcapacity in more skilled and capital-intensive goods; consequently, export prices for East Asian manufactured productswere reduced, which ultimately lead to the crisis (the East Asian financial crisis has also weakened most of the East Asian countries' currencies; hence their real effective exchange rate depreciated). The oft-cited case suggesting that East Asian countries' export prices may be deteriorating is the price of 16-megabyte dynamic random-access memory (DRAM) chips (see World Bank 2000), one of the East Asian countries' main exports in the 1990s. The price had slumped from US$54 at the end of 1995 to US$13 in 1996 and then to US$3 by mid1997.The World Bank and the IMF also recognized that primary commodities' terms of trade were declining (Sapsford and Singer 1998), so developing countries were advised to diversify their exports. However, in the attempt to diversify their product offerings, developing countries can only produce products that are commensurate to their level of technological development as diversification is much harder in unrelated sectors compared to similar sectors. For example, a country can progress from exporting basic textiles to more refined textiles more easily than from textiles to nuclear power generation (Saviotti and Frenken 2008). Consequently, the only way for developing countries to diversify their exports was to produce low-technology manufactured products using a standardized production process. The prices for these low-technology standardized manufactured products have shown signs of weaknesses rather than improvement, similar to primary commodities, which further complicated the matter. Indeed, during the period from 1970-1987, the price of manufactured product exports from developing countries had fallen by an average of 1 percent a year relative to the price of industrial countries' manufactured exports (Sarkar and Singer 1991). Athukorala (1993) criticized this study in that non-ferrous metal should be treated as a primary product because its value-added is small. However, further studies have shown that prices for non-ferrous metal behaved in a similar way as manufactured products (Rowthorn 1997).

The fact that developing countries were producing unskilled labor-intensive products also meant that the value addition from exports was low. UNCTAD (2002) found that developing countries were producing low value-added products. It reported that even though policy makers in many developing countries had moved to rapidly liberalize trade and foreign direct investment (FDI) in the early 1980s, the exports of developing countries had grown faster than the world average, and many developing countries appeared to have succeeded in moving into technology-intensive manufactured exports. The picture is slightly different because developing countries are often involved in low-skill assembly stages of international production chains organized by multinational corporations (MNCs). Most of the technology and skills are embodied in imported parts and components, and much of the value added accrues to the producers in more advanced countries where these parts and components are produced and to the MNCs that organize such production networks, while little improvement is seen in developing countries.

TRADE VARIETY AND ECONOMIC PERFORMANCE

Growth in exports can be due to decreases in the price level. It can also result from the introduction of new products or product varieties, which shift the demand curve to the right and consequently lead to an increase in the price level. In explaining the high income elasticities of demand for exports and the absence of long-term negative trends in the terms of trade of countries with rapidly growing exports, Gagnon (2007, 2008) argued that the puzzling differences in estimated income elasticities of imports and exports across countries, as pointed out by Houthakker and Magee (1969), can be attributed to the omission of the variety effects in import and export demand. He generalized the monopolistic competition trade model of Helpman and Krugman (1985) by augmenting the import and export demand functions with indexes that measure the variety of products traded. Imbs and Wacziarg (2003) showed that for low- and middle-income countries, economic growth is a result of productive diversification and the process of creating new varieties and/or higher-quality versions of previous exports. If the "discovery" process were to stop, declining terms of trade and rates of return on capital would constrict accumulation and growth. Hummels and Klenow (2005) posited that if exporting countries expanded more on extensive margin or exported higher quality products, the adverse terms of trade effects should not be a concern.

Empirical studies on the relationship between export variety and economic performances have shown a positive relationship. These studies have used panel data of countries by regressing measures of performance, such as total factor productivity and/or growth of export on indexes of product and/or export variety. Two different measures of export variety indexes have been generally used: the Shannon's entropy-based index and the extensive and intensive margin from Feenstra (1994). Studies have also used investment, output, profitability, research and development (R&D) expenditures, and patents as indicators of product variety when estimating import and/or export equations (Funke and Ruhwedel 2001b).

Frenken (2007) and Straatof (2007) demonstrated that Shannon's entropy can be used to measure product and export variety. The export variety index measures the distribution of sectors in a country export portfolio. Regressing economic growth on the indexes of *UV*, *SV*, and *RV*, Saviotti and Frenken (2008) showed that export variety simulated economic growth in the OECD countries for the period from 1964-2003. However, unlike *RV* variety, which simulates growth simultaneously, *UV* promotes economic growth with a time lag. Frenken, van Oort, and Verburg (2007) investigated the relationship between employment, unemployment growth, and the varieties of products produced for the Dutch regions. *RV* was found to increase employment, while *UV* decreased unemployment. Boschama and Iammorina (2009) measured the contribution of export variety on Italian region economic growth and showed that there was a positive relationship between variety and productivity.

In a series of papers, Funke and Ruhdenwel (2001a, 2001b, 2005) used the Feenstra (1994) index (extensive margin) for export variety to reveala positive relationship between economic performance and the variety of products exported by the OECD, East Asian, and East European transition economies. The same index was also used by Hummels and Klenow (2005) for explaining why larger economies export more products. They classified the reasons into extensive, intensive, and quality margins. Hummels and Klenow (2005) argued that larger economies export more products due to the availability of a higher variety of goods for export, and that richer countries export more due to the increase in the quality of exports. Broda and Weinstein (2006) used the Feenstra index to measure the gains from trade due to the increase in variety. Feenstra and Kee (2008) showed that export variety was associated with a 3.3% average productivity improvement in 40 selected countries from 1980-2000. Using panel data covering 31 executive districts, Chen (2011) determined that export variety positively affected China's productivity growth. Kang (2006) reportedthat the expansion of export variety had helped South Korea avoid the adverse terms of the trade effect. Chen (2010; 2011), Boschama and Iammorina (2009) and Rebelo and da Silva (2013) showed that export variety improved productivity for regions in Canada, China, Italy, and Portugal.

MEASURING TRADE VARIETY

The process of creating new variety or higher-quality versions of previous products may destroy older activities; therefore, the net contribution of the new variety will be zero. We assumed that the creation of newer variations will not have a one-to-one relationship with the destruction of the older variety. That destruction of the old product will be gradual, i.e., there is a time lag for its share to decrease to zero.

In constructing the indexes for export and import variety, we followed Frenken (2007) and Straatof (2007), while the indexes used were constructed based on Shannon's entropy. The variety indexes used the entropy measure applied to the distribution of sectors in a country's export and import portfolio. The indexes increased with an increase in the number of sectors and with the evenness of the distribution of shares. Overall, the total variety index was computed as follows (Straatof (2007) used the natural log instead of log base two):

$$\textit{Total variety} = \sum_{i=1}^{G} p_i \log_2\left(\frac{1}{p_i}\right), \tag{1}$$

where p_i is the share of the product/sector i in the total exports or imports and G is the total amount of the product/sector. The minimum possible value for the index is zero, which corresponds to the case where there is only one product/sector exported or imported (i.e., $G = 1$). When the export or import shares of all products/sectors are the same, the index value is at its maximum (see Theil (1972) for proof), and the maximum value of the index will increase with the addition of new products.

Frenken (2007) showed that the index can be decomposed into each sectoral Standard International Trade Classification (SITC) digit level. Letting all sector i at some level of aggregation fall under an aggregate sector, S_g, which is at a higher level of aggregation where $g = 1,\ldots,G.$, we can obtain the shares of P_g at the higher level of aggregation by summing the shares of p_i at the lower level of aggregation, i.e.:

$$P_g = \sum_{i\in s_g} p_i \tag{2}$$

The *total variety* index (1) can be decomposed into the following:

$$\begin{aligned}
\textit{Total variety} &= \sum_{i=1}^{G} p_i \log_2\left(\frac{1}{p_i}\right) \\
&= \sum_{g=1}^{G} \sum_{i\in s_g} p_i \log_2\left(\frac{1}{p_i}\right) \\
&= \sum_{g=1}^{G} P_g \sum_{i\in s_g} \frac{p_i}{P_g}\left(\log_2\left[\frac{1}{P_g}\right] + \log_2\left[\frac{P_g}{p_i}\right]\right) \\
&= \sum_{g=1}^{G} P_g \left(\sum_{i\in s_g} \frac{p_i}{P_g}\right) \log_2\left(\frac{1}{P_g}\right) \\
&\quad + \sum_{g=1}^{G} P_g \left(\sum_{i\in s_g} \frac{p_i}{P_g} \log_2\left[\frac{P_g}{p_i}\right]\right) \\
&= \sum_{g=1}^{G} P_g \log_2\left(\frac{1}{P_g}\right) \\
&\quad + \sum_{g=1}^{G} P_g \left(\sum_{i\in s_g} \frac{p_i}{P_g} \log_2\left[\frac{1}{p_i/P_g}\right]\right).
\end{aligned} \tag{3}$$

Simplifying the last line of (3), we have *total variety* $= H_0 + \sum_{g=1}^{G} P_g H_g$. Theil (1972) and Frenken (2007) showed that entropy at the three digit level (*total variety*) was equal to the sum of unrelated variety, semi-related variety, and related variety, where unrelated variety is as follows:

$$H_0 = \sum_{g=1}^{G} P_g \log_2\left(\frac{1}{P_g}\right), \tag{4}$$

i.e. the first term on the right side of the last line of (3). The second term is the summation of the *SV* and *RV*, where the entropy at the lower level is the weighted average of the within group entropy values:

$$\sum_{g=1}^{G} P_g H_g, \tag{5}$$

and H_g is:

$$H_g = \sum_{i\in s_g} \frac{p_i}{P_g} \log_2\left(\frac{1}{p_i/P_g}\right), \tag{6}$$

Given that we are using export and import data at the SITC three-digit level, the *UV* for each country is the entropy of the one-digit distribution of export/import shares (i stands for one-digit classes). *SV* is the weighted sum of the entropy at the two-digit level within each one-digit class (i stands for two-digit classes, and g stands for one-digit classes). Finally, *RV* is the weighted sum of the entropy at the three-digit level within each two-digit class (i stands for three-digit classes, and g stands for two-digit classes).

DYNAMICS OF EXPORT AND IMPORT VARIETY

The data to calculate the index for export and import variety were extracted from the UN COMTRADE database.

SITC revision 3 was used because the data from SITC revision 4 are limited. The data are from 1991-2008 (see Appendix).

Figures 1.1-1.5 and 2.1-2.5 present the dynamics of trade varieties for the ASEAN-5 countries. For export, the dynamics of unrelated variety are similar for Malaysia, the Philippines, and Singapore, as are the dynamics of total variety. That is, they initially went down but increased toward the end of the 1990s. There was not much change in the total variety for Indonesia and Thailand during this period. The indexes for semi-related and related variety did not show significant differences during the period, except for Singapore, where related variety decreased for the whole period. Compared to export variety, the values of indexes for import variety were much larger, meaning that the varieties of imported products were much greater than those of exported products (see Appendix A and

FIGURE 1.3. Philippines: Export Variety (1991-2008)

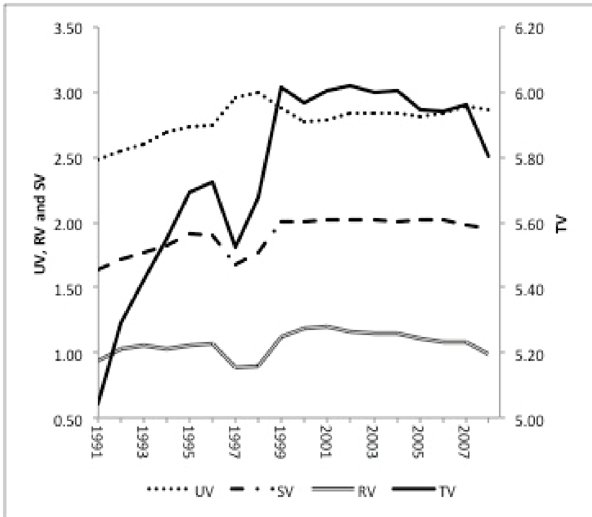

FIGURE 1.1. Indonesia: Export Variety (1991-2008)

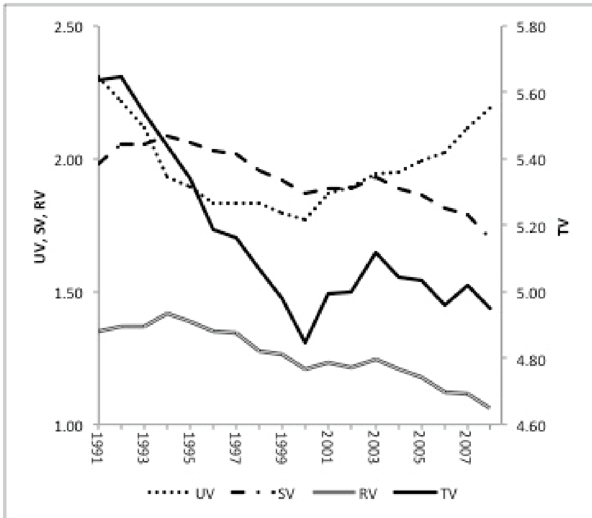

FIGURE 1.4. Singapore: Export Variety (1991-2008)

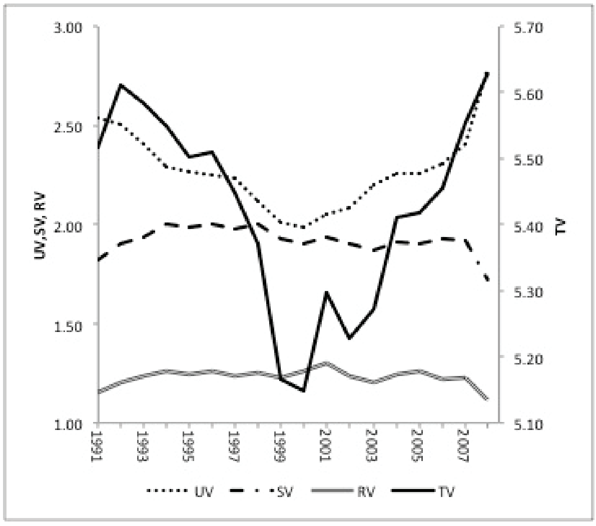

FIGURE 1.2. Malaysia: Export Variety (1991-2008)

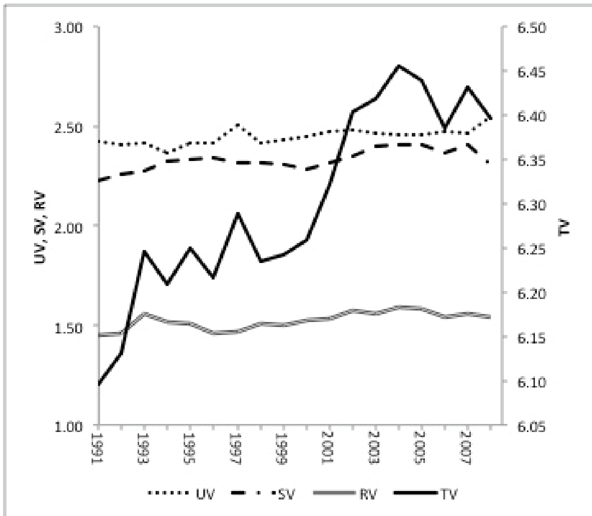

FIGURE 1.5. Thailand: Export Variety (1991-2008)

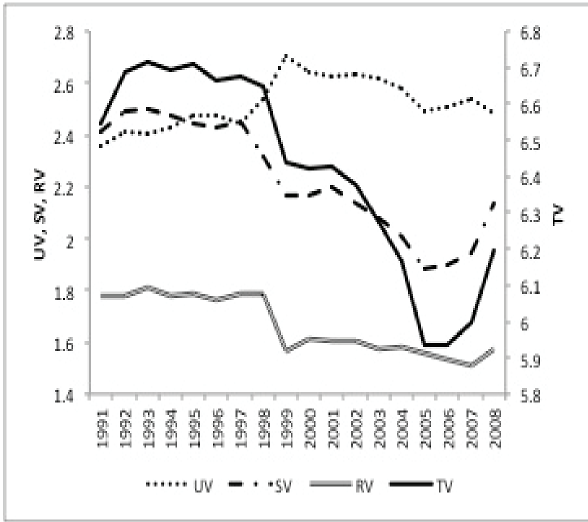

FIGURE 2.1. Indonesia: Import Variety (1991-2008)

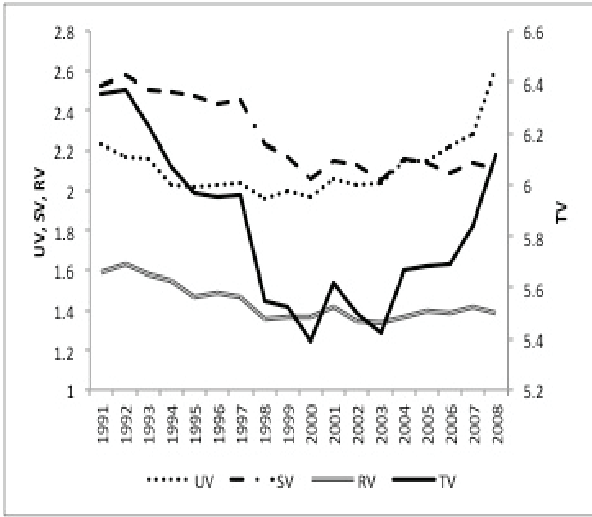

FIGURE 2.2. Malaysia: Import Variety (1991-2008)

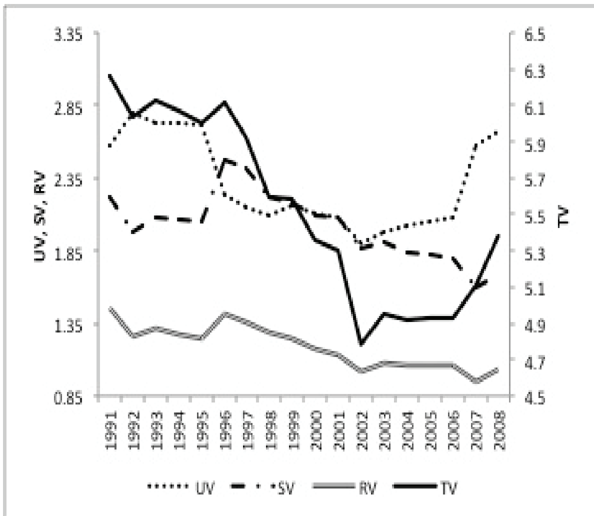

FIGURE 2.3. Philippines: Import Variety (1991-2008)

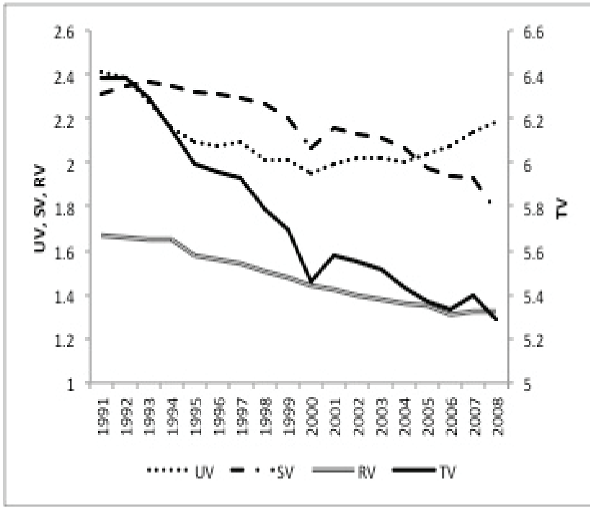

FIGURE 2.4. Singapore: Import Variety (1991-2008)

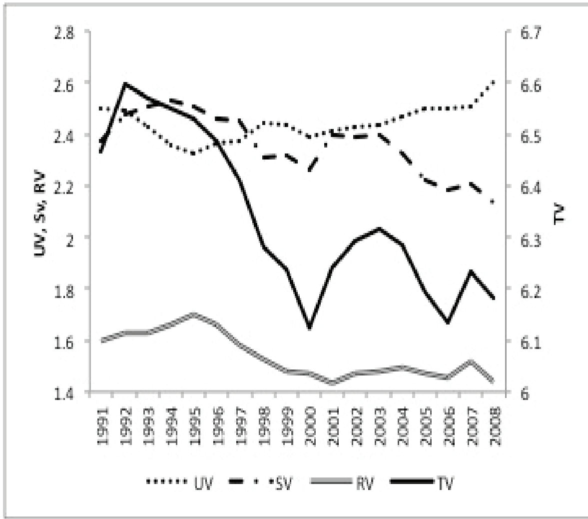

FIGURE 2.5. Thailand: Import Variety (1991-2008)

B). However, there seemed to be a trend of decreasing import variety for *TV*, *SV*, and *RV*, except for Malaysia where there was a rebound in the variety of imported products after 1998.

EMPIRICAL SPECIFICATIONS AND REGRESSION RESULTS

In order to formally examine whether export and import variety are important in explaining ASEAN-5's rapid export growth, we augmented the standard export function with the four indexes of variety (*UV*, *SV*, *RV*, and *TV*). The export function was estimated in log first difference. The function is as follows:

$$\Delta X_{it} = \beta_0 + \beta_1 \Delta Y^w_{it} + \beta_2 \Delta REER_{it} + \beta_3 \Delta PV_{it} + \beta_4 Crisis_{it} + \varepsilon_{it}, \quad (7)$$

where ΔX_{it} is the log first difference of real exports for country i at time t, ΔY^w is the log first difference of foreign GDP volume (foreign GDP volume = World GDP – Country i GDP), $\Delta REER$ represents the log first difference of the real effective exchange rate, ΔPV is the log first difference of the variety indexes, and *Crisis* is the dummy for the 1997/98 East Asian financial crisis. The data were collected from the World Bank World Development indicators online and UN COMTRADE from 1991-2008.

Table 1 reports the regression results when the indexes for export variety were augmented to the standard export function. Column one shows the result for the standard export function, while columns two through five display the results for export functions augmented with the four different indexes of export variety. Overall, the coefficient for foreign GDP volume, real effective exchange rate, and the crisis dummy were consistently significant, and, as expected theoretically, positive for income and negative for the 1997/98 East Asian financial crisis dummy and the real effective exchange rate.

TABLE 1. Fixed Effect Estimation: Export Variety

	Traditional	*UV*	*SV*	*RV*	*TV*
ΔY^w	3.347**	4.566**	4.677**	4.635**	4.605**
	(1.00)	(1.09)	(1.12)	(1.12)	(1.12)
$\Delta REER$	-0.577**	-0.582**	-0.573**	-0.576**	-0.570**
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Crisis	-0.140**	-0.144**	-0.126**	-0.126**	-0.130**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ΔPV		-0.280*	0.047	0.032	-0.190
		(0.15)	(0.13)	(0.09)	(0.28)
Constant	-0.000	-0.045	-0.051*	-0.049*	-0.048
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
R^2	0.40	0.47	0.45	0.45	0.46

Notes: ** and * indicate that the estimated coefficient is statistically significant at 5%, 10%. Standard error in parenthesis.

TABLE 2. Fixed Effect Estimation: Import Variety

	UV	*SV*	*RV*	*TV*
ΔY^w	3.342**	3.557**	3.530**	3.357**
	(0.95)	(1.02)	(0.98)	(1.02)
$\Delta REER$	-0.539**	-0.589**	-0.542**	-0.576**
	(0.12)	(0.12)	(0.12)	(0.12)
Crisis	-0.132**	-0.130**	-0.119**	-0.141**
	(0.03)	(0.03)	(0.03)	(0.03)
ΔPV	-0.580**	0.275	0.552**	-0.071
	(0.19)	(0.22)	(0.22)	(0.38)
Constant	-0.002	0.006	-0.004	0.002
	(0.03)	(0.03)	(0.02)	(0.03)
R^2	0.44	0.41	0.45	0.41

Notes: ** and * indicate that the estimated coefficient is statistically significant at 5%, 10%. Standard error in parenthesis.

However, the income elasticities of demand for exports were between 3.3 and 4.7, which were relatively high; in fact, the addition of the export variety indexes increased the magnitude of the income elasticities.

For the coefficients of interest, the *SV*, *RV,* and *TV* indexes were not significant; however, the coefficient for *UV* was negative and statistically significant. These findings did not support Funke and Ruhwedel's results (2001b), which showed a positive relationship between export variety and the East Asian countries' export performance for the period from 1989-1997. However, unlike Funke and Ruhwedel (2001b), this study used real export; the time period used was longer, and it included the period after the crisis. The export variety indexes used also were different, and the group of countries was the ASEAN-5 instead of East Asia. The negative coefficient for *UV* was in agreement with Saviotti and Frenken (2008), who showed that *UV* was negatively related to economic growth.

The negative relationship between *UV* and export growth can be explained by the difficulty faced by countries in diversifying and producing products from different sectors. The costs and risks of diversifying into unrelated sectors is much higher than diversifying into related sectors because the technological capabilities and institutional requirements needed to produce unrelated varieties are different from those of the existing technologies; therefore, a longer time period is needed to witness the success of improvement in *UV*. It is much easier to increase the variety in similar sectors in the short run than it is to increase variety in different sectors. In the short term, a development path that attempts to jump long-distance in product space is likely to fail (Saviotti and Frenken 2008).

One of the characteristics of ASEAN-5 exports is the heavy reliance on imported intermediate components. Table 2 shows the result when the import variety indexes replace the export variety indexes. As with the export function, the coefficient for foreign income, the real effective exchange rate, and the crisis dummy are consistently significant, as expected theoretically. However, the additions of the import variety indexes consistently reduced the magnitude of income elasticity of demand for exports, suggesting the importance of import variety in explaining export growth for these countries.

Unlike the export function augmented with export variety indexes, the coefficient for the *RV* index was positive here, and the coefficient for *UV* was negative; however, the coefficients for *SV* and *TV* were not statistically significant. A positive *RV* supported the contention that imported intermediate components are an important determinant of ASEAN-5's export growth and, consequently, economic growth. The increase of related imported components aided in the production of exported products. The negative coefficient for *UV* was similar to that of the export variety augmented function.

CONCLUSION

Overall, for the time period studied, the varieties of products exported by ASEAN-5 countries have not shown similar dynamics as their exports, and the regression results revealed that on average the coefficients for PV were not significant. This finding suggests that export variety is not important in explaining the rapid growth of exports for the ASEAN-5 countries. At the same time, values of the indexes for import variety were much larger than those of the export variety, indicating that the varieties of imported products were much greater than the variety of exported products.

The dynamics of unrelated variety for exports were similar between Malaysia, the Philippines, and Singapore as they were with the total variety; that is, they went down initially but increased toward the end of the 1990s. There was not much change in the total variety for Indonesia and Thailand. The indexes for semi-related and related variety also did not show a significant difference during the period, except for Singapore, where related variety decreased for the whole period. However, there seemed to be a trend of decreasing import variety for *TV*, *SV* and *RV*, except for Malaysia where there was a rebound in the variety of imported products after 1998.

Results from the panel regressions showed that for the export function augmented with the export variety indexes, *SV*, *RV,* and *TV* were not significant in explaining exports; however, there was a negative relationship between exports and *UV*. There also was a negative relationship between exports and *UV* for import variety augmented export functions. Unlike export variety, the coefficient for *RV* was positive, supporting the contention of the importance of imported intermediate components for ASEAN-5 exports.

The lack of significance of the export varieties in explaining export contradicted Krugman (1989) and Gagnon's (2008) contention that the rapid increase in exports of East Asian countries was due to expansion in the variety of products exported. Consequently, it can be argued that the decreasing terms of trade is a phenomenon that the ASEAN-5countries need to consider while implementing their economic and development policies. It is vital that ASEAN-5 improve their level of technological intensity, as the current rapid growth will not be sustainable without improvement in product quality and variety.

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APPENDIX

Export Variety: Indonesia

Year	UV	SV	RV	TV
1991	2.47843	1.63018	0.93337	5.04198
1992	2.54805	1.71090	1.03220	5.29115
1993	2.60397	1.76790	1.05121	5.42309
1994	2.69723	1.82146	1.03309	5.55178
1995	2.73104	1.90950	1.05195	5.69249
1996	2.75015	1.90747	1.06625	5.72387
1997	2.96315	1.67263	0.88636	5.52214
1998	3.00229	1.76957	0.90279	5.67465
1999	2.88072	2.01222	1.12411	6.01706
2000	2.76903	2.00967	1.18850	5.96720
2001	2.78191	2.02052	1.20031	6.00275
2002	2.83670	2.02511	1.15887	6.02068
2003	2.83520	2.02241	1.14198	5.99959
2004	2.84148	2.00929	1.15170	6.00248
2005	2.81812	2.01856	1.11217	5.94885
2006	2.83702	2.02186	1.08217	5.94105
2007	2.89106	1.98560	1.08413	5.96079
2008	2.86054	1.95004	0.99376	5.80435

Export Variety: Philippines

Year	UV	SV	RV	TV
1991	2.54025	1.72437	1.29480	5.55942
1992	2.76708	1.23263	0.81672	4.81643
1993	2.62812	1.27703	0.78199	4.68714
1994	2.57453	1.25837	0.79213	4.62504
1995	2.51819	1.16093	0.72362	4.40274
1996	2.02685	1.73712	1.11314	4.87710
1997	1.80461	1.67201	1.04324	4.51986
1998	1.50052	1.50401	0.99086	3.99538
1999	1.27868	1.42992	0.91650	3.62510
2000	1.34854	1.50865	0.97815	3.83534
2001	1.39596	1.63525	1.02607	4.05729
2002	1.33451	1.57637	0.99245	3.90333
2003	1.42405	1.58213	0.91131	3.91749
2004	1.38903	1.61155	1.14439	4.14497
2005	1.47047	1.64274	1.16444	4.27765
2006	1.68622	1.61964	1.12544	4.43130
2007	2.25355	1.21008	0.76837	4.23200
2008	2.33701	1.32407	0.82022	4.48130

Export Variety: Malaysia

Year	UV	SV	RV	TV
1991	2.53828	1.82062	1.15763	5.51653
1992	2.50233	1.90236	1.20565	5.61035
1993	2.40748	1.93515	1.24007	5.58270
1994	2.29108	2.00012	1.25692	5.54813
1995	2.26333	1.98917	1.24847	5.50097
1996	2.25035	2.00226	1.25777	5.51038
1997	2.23283	1.97731	1.23739	5.44753
1998	2.11765	2.00522	1.24905	5.37192
1999	2.01295	1.92776	1.22583	5.16654
2000	1.98332	1.90026	1.26484	5.14842
2001	2.05308	1.93886	1.30383	5.29577
2002	2.08887	1.90446	1.23490	5.22824
2003	2.19869	1.87162	1.20089	5.27120
2004	2.25768	1.90867	1.24553	5.41188
2005	2.25656	1.90089	1.26066	5.41811
2006	2.30434	1.92819	1.22389	5.45643
2007	2.40436	1.92253	1.22767	5.55456
2008	2.78875	1.72358	1.11522	5.62754

Export Variety: Singapore

Year	UV	SV	RV	TV
1991	2.30694	1.97782	1.35176	5.63653
1992	2.21716	2.05779	1.37120	5.64615
1993	2.11732	2.05592	1.36714	5.54037
1994	1.93222	2.08574	1.41966	5.43762
1995	1.89182	2.06209	1.38809	5.34201
1996	1.83034	2.03311	1.34948	5.18606
1997	1.83505	2.01788	1.34130	5.16401
1998	1.83486	1.95415	1.27709	5.06610
1999	1.79803	1.91748	1.26541	4.98092
2000	1.76882	1.86808	1.20807	4.84498
2001	1.87161	1.88857	1.23495	4.99513
2002	1.89613	1.89028	1.21191	4.99832
2003	1.94121	1.93122	1.24368	5.11611
2004	1.94917	1.88733	1.20900	5.04550
2005	1.99505	1.86137	1.17958	5.03599
2006	2.02111	1.81555	1.12035	4.95701
2007	2.11410	1.79124	1.11491	5.02025
2008	2.19015	1.69902	1.06062	4.94978

Export Variety: Thailand

Year	UV	SV	RV	TV
1991	2.42069	2.22663	1.44811	6.09543
1992	2.40860	2.26164	1.46155	6.13179
1993	2.41348	2.27482	1.55752	6.24582
1994	2.36459	2.32549	1.51853	6.20861
1995	2.41623	2.32840	1.50417	6.24880
1996	2.41866	2.33726	1.45961	6.21554
1997	2.50570	2.31426	1.46839	6.28834
1998	2.41316	2.31362	1.50845	6.23523
1999	2.42883	2.30879	1.50395	6.24157
2000	2.44675	2.28488	1.52794	6.25957
2001	2.47240	2.31493	1.53493	6.32225
2002	2.47883	2.35108	1.57297	6.40287
2003	2.46356	2.40055	1.55520	6.41931
2004	2.45527	2.40615	1.59349	6.45491
2005	2.45768	2.40293	1.57877	6.43938
2006	2.47405	2.36770	1.54380	6.38556
2007	2.46452	2.40884	1.55718	6.43054
2008	2.54920	2.30792	1.53990	6.39702

Import Variety: Malaysia

Year	**UV**	**SV**	**RV**	**TV**
1991	2.23093	2.52737	1.59277	6.35108
1992	2.16609	2.57608	1.62844	6.37061
1993	2.15674	2.50047	1.57470	6.23190
1994	2.02985	2.49066	1.54843	6.06894
1995	2.01876	2.47755	1.47016	5.96648
1996	2.02907	2.43101	1.49090	5.95099
1997	2.03796	2.45171	1.47045	5.96012
1998	1.95707	2.23297	1.35525	5.54529
1999	1.99570	2.16675	1.36498	5.52744
2000	1.96270	2.05988	1.36767	5.39026
2001	2.06009	2.14794	1.41391	5.62195
2002	2.02298	2.13000	1.34878	5.50177
2003	2.03298	2.05106	1.33716	5.42120
2004	2.14388	2.15734	1.36233	5.66356
2005	2.14832	2.13757	1.39422	5.68011
2006	2.21878	2.08857	1.38305	5.69040
2007	2.28414	2.13704	1.41941	5.84059
2008	2.61877	2.11174	1.38519	6.11571

Import Variety: Indonesia

Year	**UV**	**SV**	**RV**	**TV**
1991	2.35517	2.41397	1.77849	6.54762
1992	2.41539	2.49016	1.78304	6.68859
1993	2.40568	2.49794	1.81271	6.71632
1994	2.43108	2.47852	1.78270	6.69230
1995	2.47617	2.44408	1.79035	6.71060
1996	2.47279	2.42628	1.76394	6.66300
1997	2.44112	2.45029	1.78341	6.67482
1998	2.54153	2.31604	1.78959	6.64716
1999	2.70307	2.16690	1.56891	6.43888
2000	2.64342	2.16731	1.61123	6.42195
2001	2.62788	2.19559	1.60364	6.42711
2002	2.63039	2.13609	1.60836	6.37484
2003	2.61991	2.07785	1.57483	6.27259
2004	2.58015	2.00620	1.57851	6.16487
2005	2.49397	1.88306	1.55622	5.93326
2006	2.50926	1.89542	1.53289	5.93757
2007	2.54085	1.94841	1.50846	5.99773
2008	2.48439	2.13808	1.57509	6.19756

Import Variety: Philippines

Year	**UV**	**SV**	**RV**	**TV**
1991	2.57771	2.22489	1.46016	6.26275
1992	2.79237	1.98260	1.25861	6.03358
1993	2.72612	2.08192	1.32027	6.12830
1994	2.72330	2.07003	1.27663	6.06996
1995	2.71513	2.05232	1.23993	6.00738
1996	2.22687	2.47426	1.41706	6.11818
1997	2.15362	2.41938	1.35589	5.92889
1998	2.09016	2.21498	1.28981	5.59495
1999	2.16420	2.17083	1.25108	5.58610
2000	2.10010	2.08885	1.17315	5.36211
2001	2.08395	2.08097	1.13277	5.29769
2002	1.89940	1.86664	1.01901	4.78505
2003	1.97489	1.90177	1.07114	4.94780
2004	2.02004	1.83769	1.06470	4.92243
2005	2.05130	1.82195	1.05956	4.93281
2006	2.08102	1.79199	1.05771	4.93071
2007	2.57763	1.59092	0.94402	5.11257
2008	2.66597	1.68050	1.03347	5.37994

Import Variety: Singapore

Year	UV	SV	RV	TV
1991	2.40879	2.30908	1.66823	6.38609
1992	2.38044	2.34545	1.66130	6.38718
1993	2.27615	2.36760	1.65149	6.29525
1994	2.15397	2.35024	1.64602	6.15023
1995	2.09235	2.31871	1.58123	5.99228
1996	2.07994	2.31308	1.56260	5.95561
1997	2.09263	2.29216	1.54236	5.92715
1998	2.01602	2.26353	1.51009	5.78964
1999	2.01182	2.20141	1.48291	5.69614
2000	1.95194	2.06912	1.43971	5.46077
2001	1.99339	2.15640	1.42590	5.57568
2002	2.01922	2.13086	1.40083	5.55091
2003	2.02269	2.11515	1.38042	5.51826
2004	2.00098	2.07048	1.35996	5.43141
2005	2.03744	1.97664	1.35320	5.36728
2006	2.07688	1.94195	1.31062	5.32945
2007	2.13743	1.92640	1.32899	5.39282
2008	2.18067	1.77847	1.32665	5.28579

Import Variety: Thailand

Year	UV	SV	RV	TV
1991	2.50144	2.36878	1.59705	6.46727
1992	2.49418	2.47205	1.63249	6.59871
1993	2.42592	2.51064	1.63250	6.56906
1994	2.35892	2.52886	1.66070	6.54848
1995	2.32129	2.50918	1.69859	6.52906
1996	2.36634	2.45801	1.66176	6.48611
1997	2.37528	2.45279	1.58349	6.41155
1998	2.44508	2.30955	1.52564	6.28027
1999	2.43925	2.32009	1.47774	6.23708
2000	2.39218	2.26226	1.46972	6.12416
2001	2.41042	2.39679	1.43419	6.24140
2002	2.42633	2.39157	1.47387	6.29178
2003	2.43751	2.39922	1.48105	6.31777
2004	2.46884	2.32162	1.49599	6.28645
2005	2.49870	2.22333	1.47026	6.19229
2006	2.50012	2.18358	1.45161	6.13532
2007	2.50791	2.20374	1.52027	6.23193
2008	2.60557	2.13298	1.44269	6.18123