Trade Responses to Prices and Exchange Rates: Evidence from Sectoral Differentials in Thailand*

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I. INTRODUCTION

The economic turmoil that began toward the end of the 1990s forced Thailand to adopt a floating exchange rate regime. Currently, Thailand is moving toward economic recovery, with GDP growth estimated to be about 6.8 percent in 2003 and approximately 6-7 percent in 2004. One of the main components supporting recent GDP growth has been an improvement in the trade balance through the expansion of exports. In addition, followed by the dual-track policy under the Thaksin administration, a goal has been set to create linkages and strategically enhance the country's competitiveness in the global arena. This includes a number of trade liberalization agreements, both at the bilateral and multilateral levels, signed with a number of trade counterparts. Technically, a reduction in trade barriers should accelerate growth, provide stimulus to new forms of productivity-enhancing specialization, and lead to a more rapid pace of job creation and poverty reduction in Thailand. Conceptually and generally, tariff reduction of exported (imported) items pass-through traded price should encourage foreign (domestic) customers to purchase more goods, in line with the law of demand. Therefore, expansion of trade volumes, at least in the short run, is created by demand.[1] Therefore, the first concern of the demand-side approach, whether or not trade creation will be significant, also depends somewhat on how the law of demand would be significant in terms of Thailand's trade issues, or, whether or not foreign (domestic) customers will respond to Thailand's exported (imported) prices, the so-called export/import price elasticity. A low degree of export/import price elasticity indicates a lower likelihood of trade creation.

Second, the exchange rate is always another determinant for Thailand's international trade in terms of how prices respond to currency appreciation/depreciation. A percentage change in the exchange rate to percentage change in the traded price, called the degree of exchange rate pass-through, is therefore another effective factor of concern for a number of economic policies. Since there were huge fluctuations in the value of the Thai baht after the 1997 financial crisis (see Figure 1), export volumes, for the first time, were greater than the import volumes, indicating positive numbers in Thailand's trade balance. Intuitively, without statistically proof, it may be stated that the depreciation of the baht currency since July 1997 made the prices of exported items more competitive, while making imported items relatively more expensive. If the law of demand holds in this case, export volumes rose while import volumes fell with respect to relative price changes. The trade balance then improved according to this argument. Figure 2 shows the improvement of Thailand's trade balance since 1998, following the floating of the baht in July 1997.

According to Bank of Thailand data, the export volume, as of the year 2003, totaled 3,326 billion baht, or about a 14 percent increase compared with the end of the year 2002. The expansion of Thailand's exports is due to the recovery of the global economy, especially recovery in those countries that are Thailand's major trading partners. Another stimulating factor is the increasing price of Thailand's export products in the global market; for example, agricultural exports increased about 5 percent in volume and 24.5 percent in value (price). The growth in export volume has been more dramatic than the growth in imports as far as Thailand's trade balance is concerned. The import volume in year 2003 totaled about 3,078 billion baht, or about a 13 percent increase over that of the same period in 2002. The recent improvement in the trade balance therefore supports internal business growth, higher employment nationally, and additional income through export promotion.

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* *Paper presented at the Annual Economic Seminar 2004 on "International Trade Policy: Thailand's Direction in the Global Context," co-organized by the Office of the National Research Council of Thailand and the School of Development Economics, National Institute of Development Administration, September 17, 2004, Bangkok, Thailand.*

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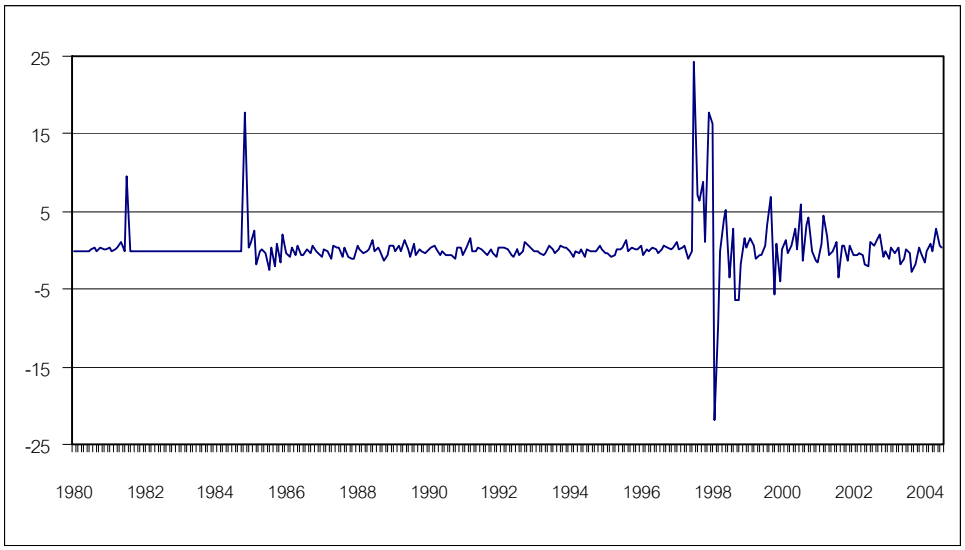
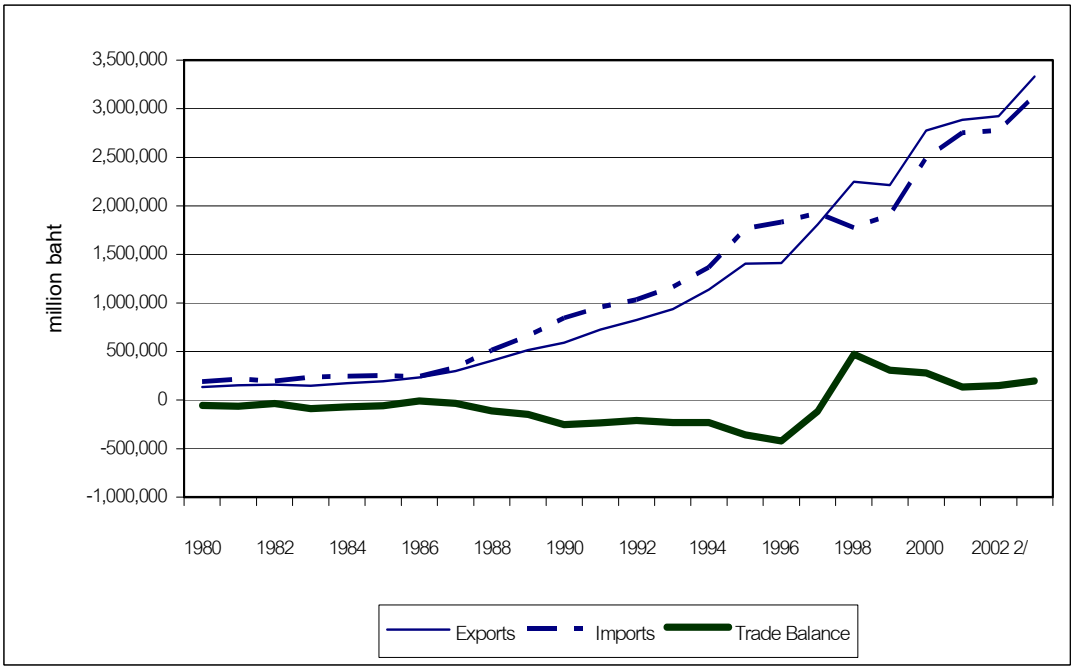
Figure 1 Monthly Percentage Change of the Baht/US$ Exchange Rate: January 1980 – July 2004



Source: Author's calculation. Data collected from Bank of Thailand.

Figure 2 Export and Import from/to Thailand to/from U.S.: 1980-2003



Source: Author's calculation. Data collected from Bank of Thailand.

Nevertheless, Thailand's economic recovery, which has led to increased aggregate demand, and consumer and investor confidence, has been a cause of worry; some fear that the baht might appreciate in the future. Because the baht currency has been appreciating recently and is anticipated to become even stronger in the future, this could harm the business sector and exporters by adversely affecting the sales volume of exports and the revenue generated by them.

Nevertheless, the movement of the exchange rate not only affects exporters' decisions at the micro-level, but also reflects the larger scale of each industry's terms

of trade. In formulating commercial policy or exchange rate policy, the responsiveness of trade flows to relative price changes is an important consideration. In addition, the responsiveness of causes varies among sectors, which are differences in terms of the market structure of exported/imported items, government rules and regulations, and business conditions.

The effects of the baht's appreciation or depreciation on Thailand's trade balance traditionally and theoretically have been analyzed by examining the Marshall-Lerner Condition (MLC). MLC represents the conditions under which a change in the exchange rate of a country's currency leads to an improvement or worsening of the country's balance of payments. Under a floating exchange rate regime, a balance of payments disequilibrium should automatically be restored to equilibrium without the need for government intervention. In the case of a fixed exchange rate, the currency's devaluation or appreciation may be used to restore disequilibrium.[2] Therefore, MLC suggests that appreciation (devaluation) of the currency will worsen (improve) the country's trade balance in the long run if the sum of absolute value of import and export demand price elasticity exceeds "unity." See, for example, Bahmani-Oskooee (1986, 1998) and Bahmani-Oskooee and Niroomand (1998).[3]

The aims of this paper are threefold. First, how sensitive are the price of traded goods compared with changes in export and import volume by sector? The answer to this question would help exporters to determine their international markup decisions that would affect loss of export volume, considered by the degree of "export price elasticity." Also, domestic firms that may compete with importers should consider the degree of "import price elasticity" as "degreed indicators" of their competitiveness outcomes. Let's say the higher (lower) the degree of import price elasticity is, the higher (lower) is the level of competitiveness that domestic firms should attain. Besides, in the view of policy makers, the degree of traded price elasticity can be used to determine how trade volumes adjust from trade liberalization caused by a tariff reduction.[4] The higher (lower) is the degree of traded price elasticity, the more (less) is trade creation likely to be presented owing to a tariff reduction that would pass-through to exported prices. For the imported side, the lower (higher) is the degree of import price elasticity, the less likely are domestic firms to lose as a result of the reduction of the import tariffs from the
effects of trade liberalization.

Second, besides own-price elasticity, cross-price elasticity can be estimated to observe the cross-correlation between the global (domestic) price and Thailand's export (import) volumes. The cross-price elasticity coefficients indicate how Thailand's international trade should be influenced by the prices for related goods. It also represents, among sectors, the degree of substitution (with positive sign) of export/import volumes.

Third, this paper also aims to estimate income elasticity. Intuitively, with the normal goods assumption, the higher is the positive degree of coefficients, the greater is the degree of Thailand's exports (imports) that should be linked to the status of the global (Thai) economy. The higher is the degree of income elasticity, the more Thailand's export (import) volumes should be able to spur growth in the global (domestic) economy.

Lastly, for policy purposes, the paper considers how the trade balance, by sector, should be improved or the deficit reduced by the devaluation of the baht. Many empirical analyses, both multi-country and individual countries, have been conducted in order to show how exchange rate changes affect the trade balance of countries. The premise is that there is no clear resolution – neither analytical and empirical perspectives – regarding the effectiveness of the baht's effective devaluation as a tool for increasing Thailand's trade balance, or, on the contrary, whether or not the "J-curve" condition exists in Thailand's trading industries.[5] In general case studies of various countries, the J-curve and MLC have been neglected in sectoral analysis, but have been considered at the national level to observe overall how the trade balance should be affected by the exchange rate.[6]

This paper therefore attempts to answer two questions. First, how sensitive are changes in the price of traded goods, reflected in changes in the exchange rate, to the volume of exports and imports? This would at least answer questions that business persons or exporters may have in trying to determine the sensitivity of the volume of their exports/imports to changes in the exchange rate. Second, for policy purposes, it is important to know the determinants of Thailand's export/import demand. How should trade balances be improved or the deficit subjected to exchange rate volatility through study of MLC? What is the effect of a change in domestic prices on exports/imports? Further, how do exports/imports behave when there is economic growth?

Section II starts with a basic econometrical approach to export and import demand. Section III interprets the estimated coefficients and intuitively explains the results. Section IV contains the conclusion.

II. ECONOMETRICAL MODEL AND DATA

Theoretical considerations should be employed. The standard import and export demand functions, in which both functions are determined from their own price, substitute price, and income level, are shown in the following equations:

$$X_t = f(PX_t, PW_t, YW_t) \quad (1.1)$$

$$M_t = f(PM_t, PD_t, YT_t) \quad (1.2)$$

By considering both the export and import sides, first, let X_t represent Thailand's export volume in time *t*, with *PX* being the export price in time *t*, *PW* the global price in time *t*, and *YW* the proxy of global income in time *t*. With regard to the import side, let M_t represent Thailand's import volume in time *t*, PM_t the import price in time *t*, PD_t the domestic price in time *t*, and YT_t the proxy for Thailand's national income.

Both equations (1.1) and (1.2) are known as absolute price formulations; they have been used extensively in a number of studies in the literature.[7] However, in choosing between both forms of export and import demand, either linear or log-linear formulations can be specified.[8] For this paper, the log-linear model has been chosen for estimating the key coefficients of prices and income elasticity, followed by calculation of the MLC.[9] The log-linear form of partial adjustment models for export demand can be specified as follows:

$$\Delta ln\, X_t = a(ln\, X_t^* - ln\, X_{t-1}),\ 0 < a < 1 \quad (2.1)$$

$$ln\, X_t^* = b_0 + b_1 ln\, PX_t + b_2\, ln\, PW_t + b_3\, ln\, YW_t + e_t \quad (2.2)$$

where Δ is a first-difference operator and *a* is the coefficient of adjustment. X_t^* is the desired level of exports. Models for import demand function can be specified as follows:

$$\Delta ln\, M_t = c(ln\, M_t^* - ln\, M_{t-1}),\ 0 < c < 1 \quad (3.1)$$

$$ln\, M_t^* = d_0 + d_1 ln\, PM_t + d_2\, ln\, PD_t + d_3\, ln\, YT_t + e_t \quad (3.2)$$

Substitute (2.2) for (2.1) in terms of exports and substitute (3.2) for (3.1) in terms of imports and rearrange both the export and import demand functions in the following forms:

$$ln\, X_t = ab_0 + ab_1 ln\, PX_t + ab_2\, ln\, PW_t + ab_3\, ln\, YW_t + (1-a) ln\, X_{t-1} + ae_t \quad (4.1)$$

$$ln\, M_t = cd_0 + cd_1 ln\, PM_t + cd_2\, ln\, PD_t + d_3\, ln\, YT_t + (1-c) ln\, M_{t-1} + ce_t \quad (4.2)$$

Henceforth, both the export and import demand functions can be rewritten as:

$$ln\, X_t = \alpha_0 + \alpha_1 ln\, PX_t + \alpha_2\, ln\, PW_t + \alpha_3\, ln\, YW_t + \alpha_4\, ln\, X_{t-1} + \varepsilon_t \quad (5)$$

$$ln\, M_t = \beta_0 + \beta_1 ln\, PM_t + \beta_2\, ln\, PD_t + \beta_3\, ln\, YT_t + \beta_4\, ln\, M_{t-1} + \mu_t \quad (6)$$

where $\alpha_0 = ab_0$, $\alpha_1 = ab_1$, $\alpha_2 = ab_2$, $\alpha_3 = ab_3$, $\alpha_4 = ab_4$, $\beta_0 = cd_0$, $\beta_1 = cd_1$, $\beta_2 = cd_2$, $\beta_3 = cd_3$, $\beta_4 = cd_4$, $\varepsilon_t = ae_t$, and $\mu_t = ce_t$. The coefficients in (5) and (6) provide the short-run own-price (α_1 and β_1), cross-price (α_2 and β_2), and income elasticity (α_3 and β_3) of export and import demand functions respectively. In considering the long-run adjustment or long-run elasticity, the results can be calculated directly from the coefficients by dividing those coefficients by $1 - \alpha_4$ for the export demand function and by a $- \beta_4$ for the import demand function.[10] Nevertheless, by generally employing the log-linear model, it is assumed from the beginning that the log-linear models must be parametric with constant coefficients.[11]

The export and import demand functions are henceforth categorized into the following nine major trading industries based on Bank of Thailand data: 1) food, 2) beverages and tobacco, 3) crude materials, 4) mineral fuels and lubricants, 5) animal and vegetable oils and fats, 6) chemicals, 7) manufactured goods, 8) machinery, and 9) miscellaneous manufactured goods. In other words, items 1-2 are consumer goods, items 3-6 are raw materials and energy goods, and items 7-9 are manufactured and capital goods.

Let X_t represent export (f.o.b.) volume in thousands of baht and M_t the import (c.i.f.) volume in thousands of baht for each industry. *PX* and *PM* are the export price index and import price index respectively (1995 = 100) for each industry. *PD* is defined as the domestic price or the consumer price index (CPI) (1995 = 100) denoted for each industry. *YT* is the productivity index, defined as the proxy for Thailand's national income. These variables were collected from the Bank of Thailand's database. *PW* is the proxy for the global price index of each industry and *YW* is the global productivity index. Both of these variables were collected from the International Financial Statistics (IFS) database. Monthly data from January 1992 to December 2002 have been used.

The data are based on time-series analysis, in which assessing the persistence of shocks is important. Therefore, failure to account for the presence of a permanent shock such as unit roots and other non-stationary processes may lead to a spurious regression result (Granger and Newbold 1974). The Augmented Dickey-Fuller (ADF) unit-root test (Enders 1995) has been used to test this condition (the results of testing the unit-root test is shown in the appendix section). Based on the derivation of the export and import demand equations above, the empirical results will be discussed in the next section. Short-run and long-run price elasticity, cross-price elasticity, income elasticity, and the Marshall-Lerner Index will be presented to analyze which sector would be benefited (or harmed) in terms of its current account based on exchange rate appreciation (devaluation). The theoretical condition of MLC is proved in Appendix B.

III. RESULTS AND INTERPRETATIONS

Table 1 presents the export and import demand of Thailand's trading industries. Negative signs for *PX* or *PM* represent short-run own-price elasticity under which the law of demand condition holds. Short-run own-price

elasticity for export industries ranges from –0.082 for manufactured goods to –0.509 for mineral fuels and lubricants of the products exported globally from Thailand. The own-price elasticity of imported items ranges from –0.055 for machinery to –0.501 for mineral fuels and lubricants. The small value of own-price elasticity exports implies the markup condition and market power that Thai exporters in those sectors may have in the global market. On the contrary, the small value of own-imported prices coefficients indicates what less competitive domestic firms may face compared with importers. Nevertheless, the estimated coefficients still neglect some factors that should influence price elasticity, such as different market structures and government policies, including some other external shocks.[12]

Table 1 Export and Import Demand Estimated Functions of Nine Industries

Export function			Import function		
Variable	**Coefficient**	**T ratio**	**Variable**	**Coefficient**	**T ratio**
Food					
ln PX	–0.343***	3.51	ln PM	–0.479***	–3.77
ln PW	0.175*	1.64	ln PD	0.468***	2.66
ln YW	1.133***	4.05	ln YT	0.669***	3.64
ln X_{t-1}	0.493***	6.56	ln M_{t-1}	0.386***	4.65
Constant	–0.925	–0.78	Constant	–2.335***	–3.37
Adjusted R^2	0.87		Adjusted R^2	0.79	
D.W.	2.16		D.W.	2.02	
Beverages and tobacco					
ln PX	–0.482***	–2.15	ln PM	0.012	0.051
ln PW	0.119	1.18	ln PD	0.408	0.436
ln YW	1.545***	2.52	ln YT	1.762***	4.082
ln X_{t-1}	0.253***	2.79	ln Mt-1	0.324***	3.709
Constant	–4.426**	–1.96	Constant	–2.025	–0.37
Adjusted R^2	0.49		Adjusted R2	0.36	
D.W.	1.95		D.W.	2.18	
Crude materials					
ln PX	–0.326***	–2.87	ln PM	0.001	0.01
ln PW	0.132*	1.88	ln PD	0.293	1.38
ln YW	1.196***	3.498	ln YT	0.744***	5.02
ln X_{t-1}	0.600***	7.91	ln Mt-1	0.469***	6.38
Constant	–4.091***	–2.36	Constant	–0.059	–0.12
Adjusted R^2	0.85		Adjusted R2	0.75	
D.W.	1.96		D.W.	2.23	
Mineral fuels and lubricants					
ln PX	–0.509***	–2.28	ln PM	–0.501***	–3.89
ln PW	0.115	1.07	ln PD	0.175***	2.94
ln YW	3.702***	2.99	ln YT	1.345***	5.02
ln X_{t-1}	0.469***	5.36	ln Mt-1	0.252	1.56
Constant	–15.522***	–2.93	Constant	–3.386***	–3.585
Adjusted R^2	0.77		Adjusted R2	0.82	
D.W.	2.11		D.W.	2.05	
Animal and vegetable oils and fats					
ln PX	–0.443*	–1.83	ln PM	–0.206	–1.26
ln PW	0.288	0.96	ln PD	0.878***	2.28
ln YW	2.746***	2.02	ln YT	1.051***	2.19
ln X_{t-1}	0.234***	8.474	ln Mt-1	0.121	1.24
Constant	–10.573*	–1.671	Constant	–3.248***	–1.59
Adjusted R^2	0.82		Adjusted R2	0.32	
D.W.	2.03		D.W.	1.98	
Chemicals					
ln PX	–0.292*	–1.79	ln PM	–0.257***	–2.67
ln PW	0.169*	1.64	ln PD	0.380*	1.92
ln YW	2.938***	4.47	ln YT	0.434***	3.83
ln X_{t-1}	0.671***	10.78	ln M_{t-1}	0.617***	8.98
Constant	–11.428***	–4.81	Constant	–1.270***	–2.85
Adjusted R^2	0.96		Adjusted R^2	0.92	
D.W.	2.18		D.W.	2.19	

(Continued on page 18)

Table 1 (Continued)

Export function			Import function		
Variable	Coefficient	T ratio	Variable	Coefficient	T ratio
Manufactured goods					
ln PX	–0.082*	–1.81	ln PM	–0.075*	–1.79
ln PW	0.136	0.79	ln PD	0.331	1.28
ln YW	1.042**	2.05	ln YT	0.475***	4.22
ln X_{t-1}	0.663***	9.78	ln M_{t-1}	0.562***	8.14
Constant	–2.487	1.52	Constant	0.402	0.76
Adjusted R^2	0.89		Adjusted R^2	0.88	
D.W.	2.34		D.W.	2.25	
Machinery					
ln PX	–0.178***	2.23	ln PM	–0.055*	–1.65
ln PW	0.517***	3.12	ln PD	0.146	0.67
ln YW	1.166***	2.47	ln YT	0.678***	4.91
ln X_{t-1}	0.573***	7.88	ln M_{t-1}	0.59***	8.81
Constant	–4.049***	–2.69	Constant	0.507	0.65
Adjusted R^2	0.97		Adjusted R^2	0.87	
D.W.	2.19		D.W.	2.19	
Miscellaneous manufactured goods					
ln PX	–0.205**	–1.98	ln PM	–0.199	1.14
ln PW	–0.056	–0.39	ln PD	0.101	0.15
ln YW	0.446	0.96	ln YT	0.728***	3.69
ln X_{t-1}	0.591***	7.79	ln M_{t-1}	0.405***	5.01
Constant	1.280	0.77	Constant	0.148	0.08
Adjusted R^2	0.78		Adjusted R^2	0.75	
D.W.	2.18		D.W.	2.13	

Note: ***, **, * represent significance at the 0.01, 0.05, and 0.10 levels.

In addition, the tariff reduction as a result of trade liberalization causing lower export prices should benefit sectors with higher own-price elasticity of exports, shown by ranking, as follows: 1) mineral fuels and lubricants, 2) beverages and tobacco, 3) animal and vegetable oils and fats, 4) food, 5) crude materials, 6) chemicals,
7) miscellaneous manufactured goods, 8) machinery, and 9) manufactured goods. For the import side, reduction of Thailand's import tariffs may not harm domestic suppliers in the sectors with lower own-price elasticity of imports shown, by ranking, as follows: 1) machinery, 2) manufactured goods, 3) miscellaneous manufactured goods, 4) animal and vegetable oils and fats, 5) chemicals, 6) food, 7) mineral fuels and lubricants.[13] Nevertheless, own-price elasticity alone is not enough to justify the sectoral gains or losses. More market assessment, including cost structure, technology of production, and quality of goods, should be done for a clear-cut analysis. Nevertheless, own-price elasticity is not the only indicator measuring gain/loss of those nine major sectors from tariff reduction. The degree of substitution between exported (imported) products and global (domestic) products can be considered another indicator leading to the estimation of "cross-price elasticity." The global price (*PX*) of export demand and the domestic price (*PD*) of import demand lead to the estimation of cross-price elasticity, in which a positive sign denotes the degree of substitutability between domestic goods and traded goods. A higher positive value of the long-run coefficients means higher substitutability among items exported from Thailand and those sold to other countries. In terms of imported items, a higher positive value of cross-price elasticity indicates a higher degree of substitution of imported items and domestic items sold in Thailand, implying the degree of substitution between the demand for domestic products and imported products.

Furthermore, the tariff reduction framework may benefit (harm) Thailand's export items, which have a higher (lower) degree of cross-price elasticity of export, and should benefit (harm) Thailand, which has a lower (higher) degree of cross-price elasticity of imports. Nevertheless, based on the estimated coefficients, the own-price and cross-price elasticity of exports and imports seems to be less elastic (inelastic), which indicates absolute values less than unity. Intuitively, this implies less sensitivity between prices and the quantities traded in the global context.

The inelastic price range can be explained by the fact that the bulk of Thailand's exported items not only are goods essential globally, but also those imported items are necessary domestically, such as exported and imported manufactured goods and

machinery. It may also be observed that the absolute value between short-run and long-run own-price elasticities is usually higher than that of cross-price elasticities, which
indicates that Thailand's exported (imported) items are more sensitive to changes in the prices of its own goods than to the prices of global (domestic) products.

In addition, in Table 2, a positive sign of long-run income elasticity for exports and imports means that those items are normal goods (positive value). The higher are the estimated coefficients, the more likely it is that the traded items from Thailand will be more sensitive to global income in the case of exports, and domestic income in the case of imports.

Income elasticity of both exported and imported items are found in the "elastic" range (greater than unity). Based on this concept, global economic growth should lead to higher exported volumes in, by ranking, chemicals, mineral fuels and lubricants, animal and vegetable oils and fats, and manufactured goods. Vice-versa, economic growth in Thailand should lead to more imported items in, by ranking, beverages and tobacco, mineral fuels and lubricants, machinery, and crude materials. Besides, the elastic range of long-run income elasticity of the import demand function indicates that, other things being equal, economic growth in Thailand, measured by increased domestic income, is likely to increase Thailand's imports and worsen of the balance of payments. However, as for the range of long-run income elasticity of export demand, Thailand's export volume should also be substantially affected by increased global economic growth. Therefore, with relatively higher coefficients of income elasticity of exports than those of imports, Thailand is more likely to obtain a positive balance of payments should economic growth in Thailand as well as in global market exist.

Nevertheless, to explain how exchange rate policy or currency devaluation should benefit trade balance for each industry, MLC must hold. That is when the summation of the absolute value of export price elasticity and import price is greater than "unity." Table 3 presents MLC for the long-term basis.

The MLC shown in Table 3 indicates that devaluation of the Thai baht may harm the trade balance in some industries. The Marshall-Lerner Index, with a value greater than 1, can be applied to the industries that improve (harm) the trade balance once the baht currency depreciates or devalues (appreciates). The industries that should have positive (negative) effects on the trade balance from the currency's depreciation or devaluation (appreciation) are food; mineral fuels and lubricants; and chemicals.

Table 2 Long-run Cross-Price and Long-Run Income Elasticity

	Export		Import	
Industry	Cross-price	Income	Cross-price	Income
Food	0.345	2.235	0.762	1.090
Beverages and tobacco	0.159	2.068	0.604	2.607
Crude materials	0.177	2.990	0.433	1.401
Mineral fuels and lubricants	0.217	6.972	0.234	1.798
Animal and vegetable oils and fats	0.376	3.585	0.999	1.196
Chemicals	0.514	8.930	0.992	1.133
Manufactured goods	0.404	3.092	0.756	1.084
Machinery	1.742	2.731	7.293	1.654
Misc. manufactured goods	–0.137	1.090	0.170	1.224

Source: From author's calculation.

Table 3 Long-run Export/Import Price Elasticity and Marshall-Lerner Index

Industry	Export	Import	Marshall-Lerner
Food	0.677	0.780	1.457***
Beverages and tobacco	0.645	0.018	0.663*
Crude materials	0.815	0.002	0.817*
Mineral fuels and lubricants	0.959	0.670	1.628***
Animal and vegetable oils and fats	0.578	0.234	0.813**
Chemicals	0.888	0.671	1.559***
Manufactured goods	0.243	0.171	0.415***
Machinery	0.417	0.134	0.551***
Misc. manufactured goods	0.501	0.334	0.836**

Note: ***, **, * represent significance at the 0.01, 0.05, and 0.10 levels based on joint statistical tests.
Source: From author's calculation.

The MLCs are therefore less likely to hold in a number of sectors. And, the exchange rate policy vis-à-vis currency devaluation may not succeed in improving an industry's trade balance in the long run, which occurs when the Marshall-Lerner Index is less than unity.[14] Those sectors are beverages and tobacco, crude materials, animal and vegetable oils and fats, manufactured goods, machinery, and miscellaneous manufactured goods. Nevertheless, criteria of Marshall Lerner Index also depend on a number of factors such as an industry's cost structure, use of resources, and efficiency in production, which are not explained in this paper.

However, the summation between short-run exports and imports own-price elasticity shows coefficients of all sectors at levels less than "unity." This means that the trade balance of all sectors deteriorated in the short run after the currency devaluation, which implies the relevance of the J-curve condition in food, mineral fuels and lubricants, and chemicals.

CONCLUSION

This paper estimates the export and import demand functions of Thailand's trading industries categorized into nine major industries. The own-price and cross-price elasticity of Thailand's exported and imported items are in an inelastic range, indicating the degree of competitiveness of the country's products in the global market and the import necessity of each item. A higher degree of own-price elasticity of exports indicates the sectors that should benefit from trade liberalization through exports, and a lower degree of own-price elasticity of imports also indicates the sectors in which domestic firms may not be harmed by tariff reduction. In addition, higher (lower) positive coefficients of long-run cross-price elasticity of exports indicate a higher (lower) degree of substitution between Thailand's exported items in the global market, while higher (lower) positive coefficients of long-run cross-price elasticity of imports also present the same argument.

In addition, the elastic range presented by the long-run income elasticity of the import demand function indicates that economic growth may worsen Thailand's balance of trade position. However, as for the elastic range of long-run income elasticity of export demand, the volume of Thailand's exports should also be substantially affected by increased global economic growth. Nevertheless, MLCs of each of the industries argue that only some industries have positive (negative) effects on the trade balance from the depreciation or devaluation (appreciation) of the baht, and it implies the relevance of the J-curve condition on those sectors. It can be intuitively concluded that those items may not be globally competitive by their own structure and rather sensitive to the volatility of currencies.

APPENDIX A
TESTING THE UNIT ROOT AND STATIONARY CONDITIONS

This section tests the unit-root conditions based on time-series variables used in the above estimation. A variety of methods can be used to test the unit root. This section utilizes the ADF test as the measurement, by estimating the following regression equation:

$$\Delta x_t = \phi + \beta\tau + \alpha x_{t-1} + \sum_{i=1}^{p} \delta_i \Delta x_{t-i} + e_t$$

The usual t-statistic associated with the estimated coefficient of x_{t-1}, (α) is employed for testing the null hypothesis (H_0) that the series (x_t) at level is non-stationary (H_0: $\alpha = 0$) while the alternative hypothesis (H_1) set for testing stationarity requires that α be less than 0 (H_1: $\alpha < 0$). If the unit root cannot be rejected, higher order differences are tested until stationarity can be found, which can be tested by running the following regression:

$$\Delta^{d+1} x_t = \phi + \beta t + \alpha \Delta^d x_{t-1} + \sum_{i=1}^{p} \delta_i \Delta x_{t-i} + e_t$$

where Δ^d is the dth difference of that time series. By general test, x_t must be differenced until the *dth* difference contains the unit root. It is stationary. Then x_t is said to be integrated of order *d*, denoted as $x_t \sim I(d)$. Table A1 presents some variables of the unit-root tests.

Table A1 presents the estimation of the ADF test for time series concerning unit-root problems. The results presented in Table A1 show that all time series variables at level are also unit roots, which means that the null hypothesis of a unit root cannot be rejected. When all series' variables are characterized as unit roots at level, "first difference" of those series must be tested. The results show that the null hypothesis of non-stationarity was rejected, so that all variable time series in this study are characterized as integrated of order 1 or I(1).

Besides, we also tested co-integration and found that error terms of all import and export equations estimated by ordinary least squares (OLS) are stationary or integrated of order zero I(0). It follows the linear relationship condition of both estimated export and import demand equations. Thus, the regressions on the levels in this study are meaningful (not spurious) and do not lose any long-term information.

Table A1: Result of Unit-root Test

Industry	Variable	ADF Test			
		Level	Lag	First Diff.	Lag
Food	PM	–3.00	1	–7.12***	1
	PX	–1.92	1	–5.00***	3
	M	–2.16	1	–4.36***	1
	X	–1.36	1	–3.73**	1
Beverages and tobacco	PM	–1.68	3	–11.70***	2
	PX	–2.51	2	–7.67***	1
	M	–2.23	4	–6.32**	2
	X	–1.23	1	–7.11**	1
Crude materials	PM	–2.73	2	–6.99**	1
	PX	–2.75	1	–6.34**	1
	M	–2.60	2	–12.89***	1
	X	–1.25	2	3.45*	2
Mineral fuels and lubricants	PM	–2.37	1	–5.46***	1
	PX	–2.2	2	–4.86***	1
	M	–1.23	1	–3.47**	2
	X	–1.27	1	–4.47*	1
Animal and vegetable oils and fats	PM	–1.78	3	–6.17***	2
	PX	–2.63	1	–7.65***	1
	M	1.50	2	–5.40*	2
	X	1.20	1	–4.79**	1
Chemicals	PM	–2.76	3	–7.17***	2
	PX	–1.43	1	3.43*	1
	M	–3.00	1	–9.08***	1
	X	–2.78	1	–10.44***	1
Manufactured goods	PM	–2.75	1	–7.53***	1
	PX	–2.09	2	–8.37***	1
	M	–3.26	2	–10.29***	1
	X	–2.84	1	–3.18*	1
Machinery	PM	–2.87	1	–4.21***	3
	PX	–2.39	1	–6.76***	1
	M	–2.13	2	–12.73***	1
	X	–1.42	1	2.23*	2
Miscellaneous manufactured goods	PM	–2.27	1	3.27**	1
	PX	–1.23	2	3.23*	1
	M	–2.75	2	3.27**	1
	X	–2.10	1	–10.68**	1

Notes: *** Significance at level 99%
** Significance at level 95%
* Significance at level 90%

APPENDIX B
THE MARSHALL-LERNER CONDITION

The validity of MLC depends on the response of export and import volume to real exchange rate changes. This condition states that a real depreciation of currency would improve the current account if export and import volumes were sufficiently elastic with respect to exchange rate change. Named after the two economists who formulated it, Alfred Marshall and Abba Lerner, MLC can be derived from the current account as the difference between exports and imports of goods and services as follows:

$$CA(EP^*/P, Y^d) = EX(EP^*/P) - IM(EP^*/P, Y^d) \qquad \text{(B1)}$$

The above equation shows that export demand is a function of relative prices EP^*/P but import demand is

a function of EP^*/P and domestic income Y^d. Now to define import demand, *IM:* it is equal to the exports from a foreign country EX^* and denoted as $q = EP^*/P$

$$CA(q, Y^d) = EX(q) - q \times EX^*(q, Y^d) \quad \text{(B2)}$$

Now to denote EX_q and EX^*_q: they differentiate EX and EX^* with respected to q. Thus, EX_q is positive and EX^*_q is negative. The current account will improve owing to a currency change if the change in the current account with respect to the change in the real exchange rate must be greater than zero, so that

$$\Delta CA/\Delta q = EX_q - (q \times EX^*_q) - EX^* > 0 \quad \text{(B3)}$$

Now to define the elasticity of export demand with respect to q,

$$\eta = (q/EX)EX_q \quad \text{(B4)}$$

and the elasticity of import demand with respect to q,

$$\eta^* = -(q/EX^*)EX^*_q \quad \text{(B5)}$$

Substitute the elasticity of export demand η and the elasticity of import demand η^* in the current account function. Returning to the equation $\Delta CA/\Delta q$, we multiply it with (q/EX) to express the right-hand side in terms of trade elasticity. The positive sign of trade elasticity implies that the current account will improve from an exchange rate depreciation shown as the following equation:

$$(\Delta CA/\Delta q)(q/CA) = \eta + \eta^* - 1 > 0 \quad \text{(B6)}$$

MLC implies that

$$\eta + \eta^* > 1$$

The condition states that, if the current account is initially zero, real currency depreciation causes a current account surplus, if the sum of both export price elasticity and import price elasticity exceeds "one."

ENDNOTES

1 The dynamism to the supply side from trade liberalization, for example, productivity enhancement, economies of scale, etc., is considered a longer run factor.

2 However, this is based on certain key assumptions, which some economists argue do not apply to certain less developed or developing countries.

3 The decision whether or not to use price elasticity in trade in the short run or in the long run to form MLC is quite vague. However, this paper uses long-run price elasticity for forming the conditions of the Marshall-Lerner Index.

4 Note that non-tariff barriers or liberalization in services will be neglected in this case; the reduction of the tariff barrier is just the main concern of what we mean by trade liberalization.

5 The J-curve depicts the circumstances under which the trade balance may not improve following the devaluation of a domestic currency. It is sometimes observed that a country's current account worsens immediately after real currency depreciation and begins to improve only some months later.

6 See, for example, Wilson (2001) on Malaysia, Korea, and Singapore; Akbostanci (2002) on Turkey; Piriya (2003) on Thailand; Hsing and Savvides (1996) on Korea and Taiwan; Bahmani-Oskooee (1985) on India, Korea, Thailand, and Greece; Himarios (1989) on 15 LDCs; Miles (1979) on 14 LDCs including the Philippines and Sri Lanka; Leonard and Stockman (2001), Bahmani-Oskooee and Brooks (1999) , Rose (1990, 1991), Krugman and Baldwin (1987), and Rose and Yellen (1989) on U.S.; Marwah and Klein (1996) on the U.S. and Canada; Lal and Lowinger (2001), Guptar-Kapoor and Ramakrishnan (1999), and Noland (1989) on Japan; Boyd, Caporale, and Smith (2001), Onafowora (2003) on East Asia countries, and Bayoumi (1999) on various countries.

7 Relative price formulation, in which prices are in relative terms of PM_t/PD_t, is also wildly used.

8 See Goldstein and Khan (1985) for summarized implications of using both formulations.

9 The Box-Cox transformation procedure can be used to justify a suitable model for each type of work. For details, see Sinha (1997).

10 It is both acceptable to implement the traded price elasticity in the short run or in the long run to form the MLC. However, this paper implements the long-run price elasticity as forming the condition of the Marshall-Lerner Index.

11 However, it is well known that if the parametric model is not correctly specified then the estimates become biased and may give misleading results of estimated coefficients. The non-parametric technique can then be implemented. See, for example, Mahmud, Ullah, and Yucel (2004) for more details.

12 Also, some imported items, for example, crude materials and machinery are globally produced by a small number of global firms that have own market power. Those sectors (crude materials and machinery) are also considered the factors of production for final products. Therefore, imports of those items are still

necessary, even though the estimated figures imply the loss of competitiveness of domestic firms in Thailand.

[13] Own-price elasticity of imported items is not significant on the categories "beverages and tobacco" and "crude materials."

[14] Because the estimated data are based on monthly data, the long-run coefficients in this case are based on a monthly period lag. More than one such lag may generate different results.

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