On the Determinants of Export Prices: History vs. Expectations [*]

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November 22nd, 2005

Abstract

The purpose of this paper is to investigate the choice of invoice currency under exchange rate uncertainty. The analysis is motivated by the fact that the U.S. dollar has been the dominant vehicle currency in developing countries. The theoretical analysis is based on an open economy model of monopolistic competition. The export prices are set before exchange rates are known. When the market is competitive enough, the exporting firms tend to set their prices not to deviate from those of the competitors. As a result, a coordination failure can lead the third currency to be an equilibrium invoice currency. Since multiple equilibria are Pareto ranked, it implies that the equilibrium choice of the invoice currency may lead to a less efficient equilibrium. The role of expectations is important in the static framework. However, in the staggered price-setting framework, history becomes another key determinant of the equilibrium currency pricing. The role of history becomes conspicuous when the firms discount future profits, particularly in the competitive local market. The result suggests that both history and expectations explain why the firm tends to choose the US dollar as vehicle currency.

Key Words: invoice currency, export price, exchange rate, monopolistic competition

JEL classification number: F12, F31, F33

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[*] Fukuda's research is supported by Japanese Government, Ministry of Education Aid for Science Research on Priority Area #12124203.

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1. Introduction

The purpose of this paper is to investigate the choice of invoice currency in developing countries. In previous literature, several theoretical studies investigated the choice of invoice currency in international trade. Baron (1976) and Giovannini (1988) are their early attempts. The authors such as Bacchetta and van Wincoop (2002), Devereux and Engel (2001), and Devereux, Engel, and Storegaard (2004) use a general equilibrium setup. Recent studies that investigate pricing behavior of international trade with developing countries include Frankel, Parsley and Wei (2004). Most of previous studies analyzed the case where the exporting firm sets prices either in the exporters' currency (producer's currency pricing) or in the importers' currency (local currency pricing). It is, however, well known that some of international trades are invoiced in a third currency, that is, vehicle currency (vehicle currency pricing). Over most of the past hundred years, first the pound sterling and then the U.S. dollar have played a special role as vehicle currency in international trade.

Except for primary commodities, the role of vehicle currency is relatively limited in international trade among developed countries (see McKinnon [1979] and Magee and Rao [1980]).[1] The U.S. dollar, however, tends to be the dominant vehicle currency in international trade with developing countries. In these countries, the U.S. dollar is chosen as the vehicle currency even when the other developed countries are important trade partners.

The following theoretical analysis is based on an open economy model of monopolistic competition. Since the export prices are set in advance, the exporting firms face uncertainty of exchange rates. If necessary, the exporting firm set prices in its own currency or in the currency of the importing country. However, when the market is competitive enough, the exporting firms tend to set prices not to deviate from those of the competitors. As a result, when the other exporters are expected to set their prices in the third currency, the exporting firms tends to invoice in the third currency. The tendency becomes conspicuous in the staggered price-setting framework where history becomes a key determinant of the invoice currency.

Our model follows a partial equilibrium model in Bacchetta and van Wincoop (2002). It, however, has three distinctive features that the previous study did not have. First, we allow the exporting firms to choose the third currency as an invoice currency. In developing countries, the exporting firms are under competition because of less differentiated products. It is thus a natural choice for the exporting firm to set prices in the third currency when the competitors are expected to set their prices in the third

[1] There are numerous empirical studies that explore the choice of invoice currency. Some of recent studies include Donnenfeld and Haug (2003) for Canadian experience, Fukuda and Ono (2005) for

currency. The result explains the role of the US dollar as vehicle currency that prevails in many developing countries. Second, we consider a dynamic Nash equilibrium where players move sequentially. The model is in the tradition of Taylor (1980), in that price-setting is staggered. Firms that adjust their price in a given period set their price to maximize the present discounted value of profits over the periods that the price will be charged. Even in the dynamic Nash equilibrium, the expectations determine the equilibrium currency pricing when the discount rate is negligible. However, history becomes the key determinant of the equilibrium currency pricing when future profits are discounted, particularly in the competitive local market. Third, we show that a coordination failure can lead the third currency to be an equilibrium invoice currency. Since multiple equilibria are Pareto ranked, it implies that the equilibrium choice of the invoice currency may lead to a less efficient equilibrium. The risk averse exporters are always better off under the exporters' currency pricing than under any other currency pricing. It would be more efficient for the exporters to change their invoice currency from the vehicle currency to their own currency. To improve the welfare, changing their expectations is an important factor. However, when history does matter, reducing the discount rate and increasing their competitiveness would be the other important factors.

In previous literature, some studies explored the role of vehicle currency in international trade. Krugman (1980) and Rey (2001) show that transaction costs might make vehicle currency a dominant medium of exchange in international trade. These studies are, however, successful only in explaining the role of vehicle currency as a medium of exchange, through which transactions between currencies are made. In contrast, our approach tries to explain the role of vehicle currency as a unit account in terms of which prices of commodities are set. A unit account is another important function of vehicle currency. Friberg (1998) and Goldberg and Tille (2005) are two exceptional studies that investigated the role of vehicle currency as a unit account. Assuming that the exporter commits to sell the demanded quantity at the ex post realized price, they explored under what conditions the monopolistically competitive exporter chooses the third currency as vehicle currency. None of these studies, however, explored the case where the vehicle currency tends to be a dominant invoice currency. The result thus cannot explain why the vehicle currency tends to be a dominant invoice currency in developing countries. We will show that the exporters' pricing behavior is consistent with our model in developing countries.

The paper proceeds as follows. After providing some empirical evidence on the invoice currency in section 2, section 3 describes our basic model structure. Section 4 drives its Nash equilibria in the static framework. Section 5 extends the model to the staggered price setting. Section 6 summarizes our results and refers to their implications.

Korean experience, Fukuda and Ji (1994), Oi, Otani, and Shirota (2004) for Japanese experience, and

2. Some Empirical Evidence

During the past decades, the U.S. dollar has been the dominant vehicle currency in international trade with developing countries. The Bank of Thailand reports various data sets that support this view. Table 1 shows in which currencies Thai exports have been invoiced since 1993. It states that nearly 90% of Thai exports have been invoiced in the US dollar and that only 10% have been invoiced in the Japanese yen. The percentages are almost stable throughout the period, although the ratios of the U.S. dollar show marginal declines after 1998.

The view is more strongly supported by Table 2 that reports the invoiced ratios of Thai exports classified by major trade partners. The table indicates that the U.S. dollar tends to be the dominant vehicle currency in Thai exports to various countries. When the United States, Canada, or Mexico are trade partners, almost all of the exports are invoiced in the US dollar. Even when Japan, Europe, or the other East Asian countries are trade partners, majority of the exports are invoiced in the US dollar. For example, in the exports to Japan, more than 70% are invoiced in the US dollar and only 20% are invoiced in the Japanese yen. The invoiced ratio in the U.S. dollar is relatively modest in the exports to Germany. However, most of exports are invoiced in the US dollar in the exports to the other European countries, particularly to Denmark, France, Ireland, United Kingdom, and Finland. The dominance of the US dollar also prevails in the exports to other East Asian countries.[2] In particular, in the exports to Singapore, Malaysia, and Vietnam, more than 90% are invoiced in the US dollar. Except for the exports to the United States, the US dollar is a third currency in the Thai exports. This implies that the U.S. dollar tends to be chosen as the dominant vehicle currency in invoicing most of Thai exports.

The result is essentially the same for the invoiced currency ratios in Korean exports. Table 3 reports in which currencies Korean exports have been invoiced since 1976. It shows that the invoiced ratios of the US dollar were over 90% in visible exports and over 80% in invisible exports. The dominant ratios of the US dollar declined during a past decade years. However, even in recent years, the ratios of the US dollar still lied between 85% and 90% in Korean visible exports and around 75% in Korean invisible trades.

Table 4 summarizes the amount shares of various export destinations from Korea and Thailand. We can see that Japan and Western Europe as well as other Asian countries have been the other important trade partners for Thai and Korean exports. The evidence indicates that the U.S. dollar was

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Wilander (2004) for Swedish experience.

[2] Exceptions are the exports to Cambodia, Laos, and Myanmar. In the exports, Thai Baht is equally important invoice currency. This is probably because the Thai economy has a strong influence to these countries.

chosen as the dominant vehicle currency even in the case where the United States is not a dominant trade partner. It is noteworthy that Japan has been the second biggest partner for both Thai exports and Korean exports. This implies that Thai and Korean exporters choose the U.S. dollar as the vehicle currency even in the exports to one of the most important trade partners.

One may argue that these countries choose the U.S. dollar as the dominant invoice currency because their exchange rates are stable against the U.S. dollar. The argument may have been relevant before the Asian crisis when they effectively pegged their currencies to the U.S. dollar (see, for example, Frankel and Wei [1994]). However, after the crisis, these countries shifted the exchange rate regime from de facto dollar peg to float. As a result, there is no longer a natural reason for them to choose the U.S. dollar as the dominant invoice currency to stabilize their export prices in terms of domestic currencies.

One may also argue that the U.S. dollar is the dominant invoice currency because trading companies are in charge of exports and imports at the same time. When the amount of exports is equal to the amount of imports, the exchange rate risk can be perfectly diversified. Therefore, if trading companies invoice both exports and imports in the US dollar, they would make a partial diversification of exchange rate risk. Table 5 reports components of Thai export receipts in 2001 and 2002. It shows that about 30% of export receipts are deposited to foreign currencies in both years. The percentages indicate that Thai exporters may keep some of their foreign exchange receipts for reducing exchange risk in future import payments. The table, however, also reports that about 65% of export receipts are exchanged from foreign currencies to Thai Baht directly. This implies that more than two thirds of export receipts are still exposed to exchange risk in Thailand.

3. A Model of Export Pricing Behavior under Exchange Rate Uncertainty

The purpose of the following sections is to present our theoretical framework that discusses pricing behavior under exchange rate uncertainty. The pricing behavior we study in the following analysis is that of exporters who produce only in their home country. For simplicity, we assume that all exporting firms sell all of their products in a single foreign market. There are three countries: an exporting country, an importing country, and a third country. For analytical simplicity, we assume that the third country has no international trade with the other two countries.

Each exporter sets its export price before the exchange rates are known. In setting the export price, it has the choice among its own currency pricing (i.e., producer's currency pricing), the importers' currency pricing (i.e., local currency pricing), and the third currency pricing (i.e., vehicle currency pricing). The exchange rates s_0, s, and s/s_0 are exogenous and are assumed to be the only source of

uncertainty. Selling s_0 units of the third currency leads to one unit of the importers' currency on the spot market and selling s units of the exporters' currency leads to one unit of the importers' currency on the spot market. By definition, the exchange rate between the exporters' currency and the third currency is given by the relation s/s_0. For simplicity, we assume that each exchange rate is independently identically distributed with constant mean over time. We also assume that s is uncorrelated with s_0, so that $E\,(s - E\,s)(s_0 - E\,s_0) = 0$.

In the following analysis, each exporter is under monopolistic competition and firm j faces the demand function $D(p_j, P^*)$, where p_j is the price set by the firm j measured in the importers' currency. P^* is the aggregate price index in the importers' local market denominated in the importers' currency. The aggregate price index P^* depends on the exchange rate unless all exporting firms set their prices in the importers' currency. We assume that the total number of firms is large enough so that an individual firm does not affect the price index P^*.

The objective of each exporter is to maximize the expected profits in terms of his (or her) home currency. The central assumptions are that the exporter has to set price before the exchange rates are known and that demand is a function of the price that importers face after exchange rate uncertainty is resolved. Suppose that each exporter chooses p^E under the exporters' currency pricing, p^I under the importers' currency pricing, and p^0 under the third currency pricing. By definition, the unit price of imports in terms of the importers' currency is p^E/s when invoiced in the exporters' currency, p^I when invoiced in the importers' currency, and p^0/s_0 when invoiced in the third currency. Let Π^E, Π^I, and Π^0 denote the exporter's profit under the exporters' currency pricing, under the importers' currency pricing, and under the third currency pricing respectively. The profit from each currency pricing is then respectively given by

$$(1)\ \Pi^E = p^E\, D(p^E/s, P^*) - C[D(p^E/s, P^*)],$$
$$(2)\ \Pi^I = s\, p^I\, D(p^I, P^*) - C[D(p^I, P^*)],$$
$$(3)\ \Pi^0 = (s/s_0)\, p^0\, D(p^0/s_0, P^*) - C[D(p^0/s_0, P^*)],$$

where $C[\cdot]$ is cost function that is strictly increasing and strictly convex. The costs are assumed to be incurred in terms of the exporters' currency.

In the following analysis, we assume that the firms are risk averse and maximize the expected utility from the profits. The utility function of each firm is $U\,(\Pi)$, which is strictly increasing and strictly concave in Π.

4. The Static Analysis

(i) The model structure

We first consider the static case where the price is fixed only for a period. In equilibrium, each exporter chooses the exporters' currency pricing if $EU(\Pi^E) \geq EU(\Pi^I)$ and $EU(\Pi^E) \geq EU(\Pi^o)$, the importers' currency pricing if $EU(\Pi^I) \geq EU(\Pi^E)$ and $EU(\Pi^I) \geq EU(\Pi^o)$, and the third currency pricing if $EU(\Pi^o) \geq EU(\Pi^I)$ and $EU(\Pi^o) \geq EU(\Pi^E)$. For analytical simplicity, we consider the following set of constant elasticity demand and cost functions:

(4) $D(p_j, P^*) = A\,(p_j/P^*)^{-\mu}$,

(5) $C(D) = B\,D^{\eta}$,

where $\mu > 1$ and $\eta > 1$. If the importers have CES preferences with elasticity $\mu > 1$ among the different products, we can specify the demand for goods from firm j as (4). Larger μ implies higher (smaller) degree of substitutability among the products. The aggregate price index in the importers' local market P^* is given by

(6) $$P^* = \left(\frac{1}{N} \sum_{i=1}^{N} p_i^{\,1-\mu} \right)^{1/(1-\mu)}$$

where N is the number of firms in the importers' local market and p_i is a price set by exporting firm i in the importers' currency.

Under (4) and (5), the representative exporter's expected utility for each currency denomination is respectively written as

(7) $EU(\Pi^E) = EU\{A\,p^E\ [(p^E/s)/P^*)]^{-\mu} - A^{\eta}B\ [(p^E/s)/P^*)]^{-\mu\eta}\}$,

(8) $EU(\Pi^I) = EU\{A\,s\,p^I\ (p^I/P^*)^{-\mu} - A^{\eta}B\,(p^I/P^*)^{-\mu\eta}\}$,

(9) $EU(\Pi^o) = EU\{A\,(s/s_0)\,p^0\,[(p^0/s_0)/P^*)]^{-\mu} - A^{\eta}B\,[(p^0/s_0)/P^*)]^{-\mu\eta}\}$.

Since the choice of currency is irrelevant under certainty, it holds that $EU(\Pi^E) = EU(\Pi^I) = EU(\Pi^o)$ near $s_0 = E\,s_0$ and $s = E\,s$. We can also show that $p^E = p^I\,E\,s = p^0\,(E\,s/E\,s_0) = A^{\eta-1}B\,\mu\eta/(\mu-1)$. It is easy to see that the optimal price is a constant markup $\mu/(\mu-1)$ over the marginal cost B.

By using the envelop theorem, a second order Taylor expansion near $s_0 = E\,s_0$ and $s = E\,s$ leads to

(10) $EU(\Pi^j) \approx U(\Pi^j) + (1/2)\,U'(\Pi^j)\,(\Pi_{11}^{\,j}\,\sigma_0^{\,2} + \Pi_{22}^{\,j}\,\sigma^2)$, for $j = E, I$, and 0,

where $\Pi_{11}^{j} \equiv d^2\Pi^j/d\,s_0^2$ and $\Pi_{22}^{j} \equiv d^2\Pi^j/d\,s^2$ at $s_0 = E\,s_0$ and $s = E\,s$. After some tedious calculations shown in Appendix, we therefore obtain that near $s_0 = E\,s_0$ and $s = E\,s$,

$$(11)\quad [E\,U(\Pi^0) - E\,U(\Pi^I)]/\,U'(\Pi^i) = (1/2)\,[\partial^2\Pi^0/\partial\,s_0^2 + 2\,(\partial^2\Pi^0/\partial\,P^*\partial\,s_0)(\partial P^*/\partial\,s_0)]\,\sigma_0^2,$$
$$= -\,\{(1/2)\,(1/s_0)^2\,[\mu(\eta-1) + 1] + (1/p_0)(\eta-1)\mu\,(\partial P^*/\partial\,s_0)\}\,p^E\,A\,(\mu-1)\sigma_0^2,$$

$$(12)\quad [E\,U(\Pi^0) - E\,U(\Pi^E)]/\,U'(\Pi^i) = (1/2)\,\{[\partial^2\Pi^0/\partial\,s_0^2 + 2\,(\partial^2\Pi^0/\partial\,P^*\partial\,s_0)(\partial P^*/\partial\,s_0)]\,\sigma_0^2$$
$$- (1/2)\{\partial^2\Pi^E/\partial\,s^2 + 2[(\partial^2\Pi^E/\partial\,P^*\partial\,s) - (\partial^2\Pi^I/\partial\,P^*\partial\,s)](\partial P^*/\partial\,s)\}\,\sigma^2,$$
$$= -\,\{(1/2)\,(1/s_0)^2\,[\mu(\eta-1) + 1] + (1/p_0)(\eta-1)\mu\,(\partial P^*/\partial\,s_0)\}\,p^E\,A\,(\mu-1)\sigma_0^2$$
$$+\,\{(1/2)\,(1/s)^2\,p^E\,[\mu(\eta-1) - 1] + (\eta-1)\mu\,(\partial P^*/\partial\,s)\}\,A\,(\mu-1)\,\sigma^2,$$

$$(13)\quad [E\,U(\Pi^I) - E\,U(\Pi^E)]/U'(\Pi^i)$$
$$= -\,(1/2)\{\partial^2\Pi^E/\partial\,s^2 + 2[(\partial^2\Pi^E/\partial\,P^*\partial\,s) - (\partial^2\Pi^I/\partial\,P^*\partial\,s)](\partial P^*/\partial\,s)\}\sigma^2,$$
$$= \{(1/2)\,(1/s)^2\,p^E\;\;[\mu(\eta-1) - 1] + (\eta-1)\mu\,(\partial P^*/\partial\,s)\}\,A\,(\mu-1)\,\sigma^2.$$

where we denote the variances as $\sigma^2 \equiv E\,(s - E\,s)^2$ and $\sigma_0^2 \equiv E\,(s_0 - E\,s_0)^2$ respectively.

(ii) Nash equilibrium

Based on (11)-(13), we investigate which currency the exporters denominate their product in a Nash equilibrium. Focusing on a symmetric Nash equilibrium, both the importers' currency pricing and the third currency pricing are a Nash equilibrium under the same condition, that is, if

$$(14)\quad \mu(\eta-1) > 1.$$

This is because when the importers' currency pricing is a Nash equilibrium, it holds that $P^* = p^I$, so that equation (11) is always negative. Therefore, the importers' currency pricing is a Nash equilibrium only if equation (13) is positive, that is, $\mu(\eta-1) > 1$. Similarly, when the third currency pricing is a Nash equilibrium, it holds that $P^* = p^0/s_0$. Since $\partial\,P^*/\partial\,s_0 = -\,p^0/s_0^2$ when $P^* = p^0/s_0$, equation (12) is always positive if equation (11) is positive. Therefore, the third currency pricing is a Nash equilibrium only if equation (11) is positive, that is, $\mu(\eta-1) > 1$.

In contrast, the exporters' currency pricing is a Nash equilibrium under more general environments. When the exporters' currency pricing is a Nash equilibrium, it holds that $P^* = p^E/s$. Since $\partial\,P^*/\partial\,s = -\,p^E/s^2$ when $P^* = p^E/s$, both equations (12) and (13) are negative if

$$(15)\quad \mu(\eta-1) + 1 \geq 0,$$

The exporters' currency pricing is therefore a Nash equilibrium if (15) holds. It is noteworthy that the exporters' currency pricing is the only Nash equilibrium if $\mu(\eta-1) < 1$. However, the model has multiple Nash equilibria where any currency pricing is an equilibrium if both (14) holds. Under the multiple Nash equilibria, the choice of the currency denomination becomes arbitrary depending on the exporters' expectations on which currency the other exporters will choose.

In our model, the multiple Nash equilibria occur when μ is large because the exporting firms keep their prices not to deviate from those of the competitors under monopolistic competition. Because of the less differentiated exporting products, the exporters in developing countries tend to face competition in the importers' local markets. The above result thus indicates that the exporters' expectations lead to arbitrary price setting, especially when the market is competitive in developing countries.

It is worthwhile to note that multiple equilibria are Pareto ranked. This implies that the equilibrium choice of invoice currency may be a less efficient equilibrium. The expected utility in the Nash equilibrium is $E\ U\ (A\ s\ p^{I} - A^{\eta}B)$ under the importers' currency pricing, $E\ U\ [A\ (s/s_0)\ p^{0} - A^{\eta}B]$ under the third currency pricing, and $E\ U\ (A\ p^{E} - A^{\eta}B)$ under the exporters' currency pricing respectively. Noting that $p^{E} = p^{I}\ E\ s = p^{0}\ (E\ s\ /E\ s_0)$, the risk averse exporters are therefore always better off under the exporters' currency pricing than under any other currency pricing. The exporters' utility is higher (lower) under the importers' currency pricing than the third currency pricing when the variance of s is smaller (larger) than the variance of s/s_0. In our model, a coordination failure may make the equilibrium choice of invoice currency less efficient.

5. The Dynamic Analysis

(i) The model framework

In this section, we consider a dynamic Nash equilibrium where players move sequentially. As in the previous section, each exporter sets price before the exchange rates are known and the demand is a function of the price that importers face after exchange rate uncertainty is resolved. However, the price contract is long-term so that the exporters cannot change the prices for period H. The model is in the tradition of Taylor (1980), in that price-setting is staggered: each firm sets its price for H periods.[3] In each period, a fraction $1/H$ of firms can choose their new price but a fraction $1-1/H$ of firms cannot. Firms that adjust their price in a given period set their price to maximize the present discounted value of profits over the H periods that the price will be charged.

[3] It has been more common in recent work with sticky-price models to use the Calvo framework, in which firms face an exogenous, constant probability of being able to adjust their price. The following results essentially hold even in the Calvo framework.

In equilibrium, each exporter chooses the exporters' currency pricing if $\sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^E) \geq \sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^I)$ and $\sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^E) \geq \sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^0)$, the importers' currency pricing if $\sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^I) \geq \sum_{t=1}^{T}\beta^{t-1}EU(\Pi_t^E)$ and $\sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^I) \geq \sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^0)$, and the third currency pricing if $\sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^0) \geq \sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^I)$ and $\sum_{t=1}^{H}\beta^{t-1}EU(\Pi_t^0) \geq \sum_{t=1}^{T}\beta^{t-1}EU(\Pi_t^E)$, where β is a discount factor.

If the initial expectations remain the same, all of $EU(\Pi^E)$, $EU(\Pi^I)$, and $EU(\Pi^0)$ would be constant over time in our model. The dynamic analysis therefore degenerates into the static case discussed in the last section. In this case, to the extent that (14) holds, the currency exporters initially choose continues to be the equilibrium denomination currency as inertia. However, even in the dynamic framework, a change of expectations may affect the choice of currency denomination.

To see this, suppose that all of the exporters had fixed their prices in the third currency until period 0. Suppose also that the new price setting exporters changed their expectations at period 1 so as that all of the new price setters would fix their prices in the exporters' currency after period 1. To the extent that the expectations are self-fulfilling, switching from the third currency pricing to the extorters' currency pricing at period 1 would be a Nash equilibrium.

Let p_j denote a price set by the new price setting firm j at period 1. The overall price index the new price setting exporters face at period 1 is then

$$(16)\quad P_1^* = \left[\frac{1}{N}\sum_{j=1}^{N/H} p_j^{\,1-\mu} + (1-\frac{1}{H})(p^0/s_0)^{1-\mu}\right]^{1/(1-\mu)}$$

where p_j is a price set by firm j at period t. In the staggered price setting, only a fraction $1/H$ of firms can change the price at period 1. Therefore, even when the new price setters changed their expectations, a fraction $1-1/H$ of firms still keep denominating the price in the third currency at period 1.

Similarly, when all of the new price setters fixed their prices in the exporters' currency after period 1, the overall price index at period t ($t = 2, 3, \ldots, H$) is

$$(17)\quad P_t^* = \left[(\frac{t}{H})(p^E/s)^{1-\mu} + (1-\frac{t}{H})(p^0/s_0)^{1-\mu}\right]^{1/(1-\mu)}.$$

After period 2, a fraction 1 - t/H of firms still keep denominating the price in the third currency at period t (t = 2, 3, …, H) in the staggered price setting. However, the weight of firms that keep denominating the price in the third currency declines over time.

Under some reasonable conditions, it holds that $EU(\Pi_t^E) < EU(\Pi_t^o)$ for $t < T$ and that $EU(\Pi_t^E) > EU(\Pi_t^o)$ for $t \geq T$, where $1 < T < H$. This is because the third currency pricing is still dominant among the exporters when t is small but the exporters' currency pricing becomes dominant when t is large. To fulfill the expectations that all of the new price setters would fix their prices in the exporters' currency after period 1, it is thus necessary that

$$(18)\quad \sum_{t=T}^{H} \beta^{t-1}\left[EU(\Pi_t^E) - EU(\Pi_t^0)\right] \geq \sum_{t=1}^{T-1} \beta^{t-1}\left[EU(\Pi_t^0) - EU(\Pi_t^E)\right].$$

The above condition is a necessary condition for the exporters' currency pricing to be a new Nash equilibrium.

(ii) Calibration

To understand under what conditions (18) holds, we specified the utility function of the exporters as $U(\Pi) \equiv \sqrt{\Pi}$ /2 and calculated the utility of the profit for 10,000 random samples of exchange rates, assuming that the changes of the exchange rates follow standard normal distribution with zero mean. In the calibration, we set that H = 48, η = 3, A = 1, and B = 10.

Figures 1-a, 1-b, and 1-c draw the calibrated values of $EU(\Pi_t^E)$, $EU(\Pi_t^o)$, and $EU(\Pi_t^I)$ from t = 1 to $t = H$ for three alternative values of μ: μ = 5, 7.5, and 10. The calibrated values are based on the assumption that all of the exporters had fixed their prices in the third currency until period 0 but that all of the new price setters would fix their prices in the exporters' currency after period 1. Regardless of the choice of μ, $EU(\Pi_t^o)$ exceeds both $EU(\Pi_t^E)$ and $EU(\Pi_t^I)$ when $t < 24$, while $EU(\Pi_t^E)$ exceeds both $EU(\Pi_t^o)$ and $EU(\Pi_t^I)$ when $t \geq 24$.

Therefore, when the discount factor β is small (that is, when the future profits are discounted enough), it is costly to change the denomination currency, so that the exporters' currency pricing will not be a new Nash equilibrium. For example, when β = 0.98, the condition (19) does not hold for any of the three alternative values of μ. Since the exporters have no incentive to change its denomination currency from the third currency to the exporters' currency, they continue the third currency pricing as inertia when the future profits are discounted enough.

However, when β is very close to one, the changed expectations can lead the exporters' currency pricing to be a new Nash equilibrium. In our parameter set, $\sum_{t=1}^{H} \beta^{t-1} EU(\Pi_t^E)$ always exceeds

both $\sum_{t=1}^{H} \beta^{t-1} EU(\Pi_t^0)$ and $\sum_{t=1}^{H} \beta^{t-1} EU(\Pi_t^I)$ when $\beta = 1$. The exporters have an incentive to change its denomination currency from the third currency to the exporters' currency when the exporters do not discount the future profits. In changing the equilibrium currency pricing, the expectations play the essential role. When all of the new price setters are expected to fix their prices in the exporters' currency after period 1, the exporters' currency pricing becomes a new Nash equilibrium after period 1. When all of the new price setters are expected to fix their prices in the third currency after period 1, the third currency pricing remains a Nash equilibrium after period 1.

Some intermediate case arises when β is around 0.99. When $\beta = 0.991$, the exporters have an incentive to change its denomination currency from the third currency to the exporters' currency if $\mu = 5$ or 7.5 but do not if $\mu = 10$. When $\beta = 0.9875$, the exporters have an incentive to change its denomination currency from the third currency to the exporters' currency if $\mu = 5$ but do not if $\mu = 10$ or 7.5. Since the parameter μ becomes small when the importers' local market is less competitive, the denomination in the exporters' currency is a Nash equilibrium when the local market is less competitive. Because of differentiated products, less competitive local market would be more relevant for exporters in developed countries. However, it would be less relevant for exporters in developing countries. Under the competitive local market, it is likely that the exporters continue the third currency pricing as inertia.

Like the static model, the risk averse exporters are always better off under the exporters' currency pricing than under any other currency pricing in the long-run. Therefore, even in the dynamic Nash equilibrium model, a coordination failure may make the equilibrium currency pricing less efficient. However, unlike the static model, not only expectations but also history plays a key role in determining the equilibrium currency pricing. The exporters know that moving from the third currency pricing to the exporters' currency pricing is desirable in the long-run. However, they also know that majority of the other exporters will not change the past currency pricing rule in the short-run. History therefore discourages their incentive to change the currency pricing role. The role of history becomes particularly important when the future profits are discounted and when the local market is competitive.

In most developing countries, the US dollar has historically been the dominant vehicle currency. This has been true even when the other developed countries are another trade partners for the developing countries. Once a country's currency is established as an invoice currency, a large change in economic environment is necessary to replace it, even if the relative economic power of that country has declined in world trade. However, in the long-run, it would be more efficient for the exporters to change their invoice currency from the vehicle currency to their own currency. To achieve the long-run goal, changing their expectations is an important factor. When history does

matter, reducing the discount rate and increasing their competitiveness would be the other important factors to improve their welfare.

6. Concluding Remarks

This paper investigated the choice of invoice currency under exchange rate uncertainty. The analysis was motivated by the fact that the U.S. dollar has been the dominant vehicle currency in developing countries. Our theoretical analysis was based on an open economy model of monopolistic competition. When the market is competitive enough, the exporting firms tend to set their prices not to deviate from those of the competitors. As a result, when the other exporters are expected to set their prices in a third currency, the exporting firm tends to choose the third currency as an equilibrium invoice currency. The tendency becomes particularly conspicuous in the staggered price-setting framework. In the staggered price-setting framework, history becomes a key determinant of the equilibrium currency pricing when the firms discount future profits, particularly in the competitive local market. The result may explain why the firm tends to choose the US dollar as the vehicle currency when history does matter.

One of the motivations of the paper was based on the fact that the US dollar has been the dominant invoice currency in several East Asian countries. However, the dominant role of the US dollar had also prevailed in Japanese exports until very recently. As Japanese economy showed remarkable growth, the role of Japan's exports in international trade increased substantially in the 1960s and the 1970s. The share of the Japanese Yen's denomination in the Japan's exports, however, had been negligible until the early 1970s. Table 6 reports time-series data of invoice currency data in Japan's exports. The Yen's invoice ratios were close to zero in the early 1970s and were less than 20% throughout the 1970s. It was 1983 when the Yen's share exceeded 40% in the Japan's exports to the world. But the Yen's invoice ratios were not far above 40% even in the early 1990s and declined below 40% throughout the 1990s. The Yen's ratios were not high even in the exports for East Asia, although they were slightly higher than those for the world.

In explaining the determinants of invoice currencies in Japan's exports, we may point out several factors on why the US dollar was the dominant invoice currency. The first is the heavy reliance of Japan's exports on the United States. Since only a small fraction (16 percent in 1991) of Japanese exports to the United States are invoiced in the yen and since a large fraction of Japanese exports go to the United States, the structure of Japan's exports leads to relatively low yen-denominated invoice currency ratios in Japan's total exports. The second is the relatively small size of the short-term capital market in Japan. Although its volume has been increasing recently, the size of the treasury bill market in Japan is still much smaller than in the United States. Since the short-term capital market would be where foreign investors would park their yen-denominated funds, its limited size reduces the invoice

currency ratio of the yen in trade. The third is the role of Japan's large trading companies, which handle the bulk of Japanese exports and imports. Since these companies have a relative advantage in avoiding foreign exchange risks, their existence may lead to relatively low yen-denominated invoice currency ratios in Japan's total exports. However, in addition to these factors, it is likely that both history and expectations have been the important factors. Due to the previous economic power, the U.S. dollar still plays an important role in Japan's international trade. The expectations support the inertia. Thus, although Japan's economic power in world trade has risen, it will take a long time for the yen to become the key currency in world trade.

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Appendix: Derivations of (11)-(13).

Equations (1)-(3) and (6) imply that $\partial \Pi^E/\partial P^* = \partial \Pi^I/\partial P^* = \partial \Pi^0/\partial P^*$, $\partial \Pi^I/\partial P^* \partial s = \partial \Pi^0/\partial P^* \partial s$, and $\partial^2 \Pi^E/\partial^2 P^* = \partial^2 \Pi^I/\partial^2 P^* = \partial^2 \Pi^0/\partial^2 P^*$ at $s_0 = E\, s_0$ and $s = E\, s$. It thus holds that when $\partial P^*/\partial s = 0$,

(A1) $\Pi_{11}{}^E = \Pi_{11}{}^I = (\partial^2 \Pi^E/\partial^2 P^*)(\partial P^*/\partial s_0)^2 + (\partial \Pi^E/\partial P^*)(\partial^2 P^*/\partial^2 s_0)$,

(A2) $\Pi_{11}{}^0 = \Pi_{11}{}^E + \partial^2 \Pi^0/\partial s_0{}^2 + 2\,(\partial^2 \Pi^0/\partial P^* \partial s_0)(\partial P^*/\partial s_0)$,

(A3) $\Pi_{22}{}^I = \Pi_{22}{}^0 = 0$,

(A4) $\Pi_{22}{}^E = \partial^2 \Pi^E/\partial s^2$,

at $s_0 = E\, s_0$ and $s = E\, s$. Similarly, when $\partial P^*/\partial s_0 = 0$,

(A5) $\Pi_{11}{}^E = \Pi_{11}{}^I = 0$,

(A6) $\Pi_{11}{}^0 = \partial^2 \Pi^0/\partial s_0{}^2$,

(A7) $\Pi_{22}{}^I = \Pi_{22}{}^0 = (\partial^2 \Pi^I/\partial^2 P^*)(\partial P^*/\partial s)^2 + (\partial \Pi^I/\partial P^*)(\partial^2 P^*/\partial^2 s) + 2\,(\partial^2 \Pi^I/\partial P^* \partial s)(\partial P^*/\partial s)$,

(A8) $\Pi_{22}{}^E = \Pi_{22}{}^I + \partial^2 \Pi^E/\partial s^2 + 2\,[(\partial^2 \Pi^E/\partial P^* \partial s) - (\partial^2 \Pi^I/\partial P^* \partial s)](\partial P^*/\partial s)$,

at $s_0 = E\, s_0$ and $s = E\, s$.

Equations (4) and (5) lead to

(A9) $E\Pi^0 - E\Pi^I = (1/2)\,[(\Pi_{11}{}^0 - \Pi_{11}{}^I)\,\sigma_0{}^2 + (\Pi_{22}{}^0 - \Pi_{22}{}^I)\,\sigma^2]$,

(A10) $E\Pi^0 - E\Pi^E = (1/2)\,[(\Pi_{11}{}^0 - \Pi_{11}{}^E)\,\sigma_0{}^2 + (\Pi_{22}{}^0 - \Pi_{22}{}^E)\,\sigma^2]$,

(A11) $E\Pi^I - E\Pi^E = (1/2)\,[(\Pi_{11}{}^I - \Pi_{11}{}^E)\,\sigma_0{}^2 + (\Pi_{22}{}^I - \Pi_{22}{}^E)\,\sigma^2]$.

We can therefore derive that when $\partial P^*/\partial s = 0$,

(A12) $E\Pi^0 - E\Pi^I = (1/2)[\partial^2 \Pi^0/\partial s_0{}^2 + 2\,(\partial^2 \Pi^0/\partial P^* \partial s_0)(\partial P^*/\partial s_0)]\,\sigma_0{}^2$,

(A13) $E\Pi^0 - E\Pi^E = (1/2)\,\{[\partial^2 \Pi^0/\partial s_0{}^2 + 2\,(\partial^2 \Pi^0/\partial P^* \partial s_0)(\partial P^*/\partial s_0)]\,\sigma_0{}^2 - (\partial^2 \Pi^E/\partial s^2)\,\sigma^2\}$,

(A14) $E\Pi^I - E\Pi^E = -(1/2)\,(\partial^2 \Pi^E/\partial s^2)\,\sigma^2$.

and that when $\partial P^*/\partial s_0 = 0$,

(A15) $E\Pi^0 - E\Pi^I = (1/2)\,(\partial^2 \Pi^0/\partial s_0{}^2)\,\sigma_0{}^2$,

(A16) $E\Pi^0 - E\Pi^E = (1/2)\,((\partial^2 \Pi^0/\partial s_0{}^2)\,\sigma_0{}^2$

$- \{\partial^2 \Pi^E/\partial s^2 + 2\,[(\partial^2 \Pi^E/\partial P^* \partial s) - (\partial^2 \Pi^I/\partial P^* \partial s)](\partial P^*/\partial s)\}\ \sigma^2)$,

(A17) $E\Pi^I - E\Pi^E = -(1/2)\ \{\partial^2 \Pi^E/\partial s^2 + 2\,[(\partial^2 \Pi^E/\partial P^* \partial s) - (\partial^2 \Pi^I/\partial P^* \partial s)](\partial P^*/\partial s)\}\ \sigma^2$.

Equations (A12)-(A14) and (A15)-(A17) lead to the first part of equations (11)-(13).

Equations (7), (8), and (9) lead to

(A18) $\partial \Pi^E/\partial s = A\ \mu\ p^{E\ 1-\mu}\ s^{\mu-1}\ P^{*\ \mu} - \mu\eta\ A^{\eta} B\ s^{\mu\eta-1}\ (P^*/p^E)^{\mu\eta}$,

(A19) $\partial \Pi^I/\partial s = A\ p^{I\ 1-\mu}\ P^{*\ \mu}$,

(A20) $\partial \Pi^0/\partial s_0 = A\ (\mu-1)\ s\ p^{0\ 1-\mu}\ s_0^{\mu-2}\ P^{*\ \mu} - \mu\eta\ A^{\eta} B\ s_0^{\mu\eta-1}\ (P^*/p^0)^{\mu\eta}$,

Since $P^*\ E\ s = p^E = p^I\ E\ s = p^0 (E\ s\ /E\ s_0) = A^{\eta-1} B\ \mu\eta/(\mu-1)$ at $s_0 = E\ s_0$ and $s = E\ s$, it holds that

(A21) $\partial^2 \Pi^0/\partial s_0^{\ 2} = (\mu-1)\ (\mu-2)\ A\ \ s\ p^0\ \ s_0^{-3}\ (P^*\ s_0/p^0)^{\mu} - \mu\eta(\mu\eta-1)\ A^{\eta} B\ s_0^{-2}\ (P^*\ s_0/p^0)^{\mu\eta}$,

$= (1/s_0)^{\ 2}\ [(\mu-1)\ (\mu-2)\ A\ \ p^0\ (s/s_0) - \mu\eta\ A^{\eta} B\ (\mu\eta-1)]$,

$= -(1/s_0)^{\ 2}\ p^E A\ (\mu-1)[\ \mu(\eta-1) + 1] < 0$

(A22) $\partial^2 \Pi^E/\partial s^2 = \mu\ (\mu-1)\ A\ p^E\ \ s^{-2}\ (P^*\ s/p^E)^{\mu} - \mu\eta\ A^{\eta} B\ (\mu\eta-1) s^{-2}\ (P^*\ s/p^E)^{\mu\eta}$,

$= (1/s)^{\ 2}\ [\mu\ (\mu-1)\ A\ p^E\ \ s^{-2} - \mu\eta\ A^{\eta} B\ (\mu\eta-1)]$,

$= -(1/s)^{\ 2}\ p^E\ A\ (\mu-1)[\ \mu(\eta-1) - 1]$,

(A23) $\partial^2 \Pi^0/\partial P^* \partial s_0 = A\ \mu\ (\mu-1)\ \ (s/s_0)\ (P^*\ s_0/p^0)^{\mu-1} - (\mu\eta)^{\ 2}\ A^{\eta} B\ (1/p^0)\ (P^*\ s_0/p^0)^{\mu\eta-1}$,

$= (1/p^0)\ [A\ \mu\ (\mu-1)\ (p^0\ s/s_0) - (\mu\eta)^{\ 2}\ A^{\eta} B]$,

$= -(p^E/p_0)\ A\ (\mu-1)\ \mu(\eta-1) < 0$,

(A24) $\partial^2 \Pi^E/\partial P^* \partial s = A\ \mu^2\ (P^*\ s/p^E)^{\mu-1} - (\mu\eta)^{\ 2}\ A^{\eta} B\ (1/\ p^E)\ (P^*/\ s\ p^E)^{\mu\eta-1}$,

$= A\ \mu^2 - (\mu\eta)^{\ 2}\ A^{\eta} B\ (1/\ p^E)$,

$= -A\ \mu[\mu(\eta-1) - \eta]$,

(A25) $\partial^2 \Pi^I/\partial P^* \partial s = A\mu\ (P^*/p^I)^{\ \mu-1} = A\ \mu$.

These equations lead to the second part of equations (11)-(13).

Table 1. Structure of Export Receipts in Thailand (Percent share)

Currencies						
	1993	**1994**	**1995**	**1996**	**1997**	**1998**
US dollar	91.8	90.5	91.0	91.7	92.0	90.6
baht	0.9	1.6	2.4	1.3	2.1	2.6
Japanese yen	3.9	4.7	4.1	4.5	3.3	3.7
Deutsche mark	1.0	0.8	0.5	0.5	0.4	0.7
Pound sterling	0.8	0.6	0.3	0.4	0.3	0.4
Euro	0.0	0.0	0.0	0.0	0.0	0.0
Singapore dollar	0.8	0.7	0.5	0.4	0.4	0.3
Others	0.8	1.1	1.2	1.2	1.5	1.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Currencies					
	1999	**2000**	**2001**	**2002**	**2003**
US dollar	87.6	87.0	85.7	84.7	84.4
baht	3.7	3.9	4.0	4.3	5.0
Japanese yen	5.2	5.7	5.6	6.0	5.9
Deutsche mark	1.5	1.2	0.8	0.0	0.0
Pound sterling	0.3	0.2	0.3	0.3	0.3
Euro	0.2	0.6	2.0	3.2	2.7
Singapore dollar	0.3	0.2	0.3	0.3	0.3
Others	1.2	1.2	1.3	1.2	1.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Sources）The Bank of Thailand.

Table 2. Structure of export receipts from major trading partners classified by currency in Thailand (Percent share)

Partner Country	2001			2002		
	USD	JPY	THB	USD	JPY	THB
Japan	71.8	20.5	7.3	71.0	20.9	7.4
	USD	JPY	THB	USD	JPY	THB
NAFTA						
- USA	97.1	0.3	2.6	96.4	0.4	3.2
- Canada	97.3	0.0	0.2	97.3	0.2	0.3
- Mexico	99.7	0.0	0.2	98.1	0.0	0.2
Total	**97.1**	**0.3**	**2.5**	**96.4**	**0.4**	**3.0**

Partner Country	2002					
	USD	GBP	DEM	THB	EURO	Others
European Union						
- Belgium	74.5	2.0	0.0	1.8	21.4	0.3
- Denmark	92.8	0.0	0.0	2.6	2.6	2.0
- France	87.2	0.0	0.0	0.8	11.4	0.6
- Germany	50.1	0.0	0.2	1.1	47.8	0.8
- Greece	81.7	0.0	0.0	0.6	17.6	0.1
- Ireland	96.6	0.0	0.1	0.0	2.2	1.1
- Italy	83.4	0.0	0.0	0.5	15.4	0.7
- Luxembourg	16.7	0.0	0.0	0.0	83.1	0.2
- Netherlands	61.4	0.0	0.0	0.3	37.4	0.9
- Portugal	74.1	0.0	0.7	0.2	24.9	0.1
- Spain	81.4	0.2	0.1	0.4	17.7	0.2
- United Kingdom	88.5	6.8	0.0	2.1	2.4	0.2
- Austria	41.2	0.0	0.2	7.5	50.9	0.2
- Sweden	88.7	0.1	0.0	4.3	1.2	5.7
- Finland	91.2	0.0	0.0	0.8	6.5	1.5
Total	**73.0**	**2.1**	**0.1**	**1.3**	**22.9**	**0.6**

Partner Country	2002					
	USD	JPY	THB	SGD	MYR	Others
ASEAN						
- Singapore	91.6	2.2	3.3	1.3	0.0	1.6
- Indonesia	79.2	2.8	10.3	0.2	0.0	7.5
- Philippines	84.2	1.9	5.9	6.8	0.0	1.2
- Malaysia	93.3	1.1	3.8	0.4	0.8	0.6
- Brunei Darussalam	64.5	0.4	9.3	25.2	0.0	0.6
- Cambodia	47.0	0.2	52.0	0.4	0.0	0.4
- Laos	49.3	0.2	49.9	0.0	0.0	0.6
- Myanmar	65.6	0.2	33.7	0.0	0.1	0.4
- Vietnam	95.9	0.5	3.5	0.0	0.0	0.1
Total	**89.0**	**1.9**	**6.1**	**1.3**	**0.1**	**1.6**

Sources) The Bank of Thailand.

Table 3. The Shares of Payment Currencies in Korean Exports

(1) Visible Trade

(Unit: %)

	US Dollar	Yen	Mark	Pound
1976	99.08	0	0.25	0.37
1980	95	2.15	1.58	0.45
1985	94.24	3.84	0.76	0.38
1990	88.21	7.44	2.2	0.87
1992	88.78	6.25	2.82	0.85
1994	88.86	6.41	2.58	0.50
1996	89.1	5.13	2.21	0.98
1997	89.21	5.02	1.76	0.85
1998	88.54	4.95	2.66	0.97
1999	85.61	5.96	2.39	0.95
2000	84.76	5.39	1.8	0.67
2001	87.42	5.39	1.47	0.71

(2) Invisible Trade

(Unit: %)

	US Dollar	Yen	Mark	Pound
1976	83.86	5.73	2.09	0.29
1980	83.45	4.60	0.98	0.39
1985	87.78	8.86	0.97	0.41
1990	65.58	25.67	2.99	2.81
1992	67.79	22.51	3.65	2.06
1994	70.08	22.09	3.11	0.91
1996	75.48	17.18	2.40	0.80
1997	77.22	15.77	2.35	0.99
1998	77.79	16.32	1.79	0.67
1999	74.52	18.96	1.12	1.03
2000	75.87	16.27	0.65	1.23
2001	74.38	14.06	0.47	1.37

Sources) The Bank of Korea, Monthly Statistical Bulletin, various issues.

Table 4. Korea and Thailand's exports by destination
(ratio: exports to an area/exports to the world)

	Destination	1997	1999	2001
Korean exports	Industrial countries	41.6%	50.5%	48.6%
	United States	15.2%	20.6%	20.9%
	Japan	10.3%	11.0%	11.0%
	Western Europe	13.5%	15.8%	13.7%
	Canada, Australia, New Zealand	2.8%	3.0%	3.0%
	Eastern Europe	4.4%	2.7%	2.7%
	East Asia	35.1%	32.9%	33.6%
	China:Mainland	9.4%	9.5%	12.1%
	China:Hong Kong	8.1%	6.3%	6.3%
	Indonesia	2.5%	1.8%	2.2%
	Malaysia	3.0%	2.5%	1.8%
	Philippines	1.8%	2.2%	1.7%
	Thailand	1.6%	1.2%	1.2%
	Vietnam	1.1%	1.0%	1.2%
	Singapore	4.0%	3.4%	2.7%
	Others	3.6%	4.9%	4.4%
	South Asia	1.8%	1.8%	1.8%
	Middle East, Afganistan	3.4%	4.2%	4.6%
	Western Hemishere	5.8%	5.9%	6.4%
	Africa, N. Korea, & Area not specified	7.9%	2.0%	2.3%
	DOTS World Total	100.0%	100.0%	100.0%
Thai exports	Industrial countries	54.4%	57.4%	56.5%
	United States	19.4%	21.7%	20.3%
	Japan	15.2%	14.1%	15.3%
	Western Europe	16.9%	17.9%	17.3%
	Canada, Australia, New Zealand	2.9%	3.7%	3.6%
	Eastern Europe	1.0%	0.9%	0.9%
	East Asia	36.4%	32.0%	33.7%
	China:Mainland	3.0%	3.2%	4.4%
	China:Hong Kong	5.9%	5.1%	5.1%
	Indonesia	2.4%	1.7%	2.1%
	Korea	1.8%	1.6%	1.9%
	Malaysia	4.3%	3.6%	4.2%
	Philippines	1.2%	1.6%	1.8%
	Vietnam	0.9%	1.0%	1.2%
	Singapore	11.1%	8.7%	8.1%
	Others	5.7%	5.7%	5.0%
	South Asia	1.3%	1.5%	1.7%
	Middle East + Afganistan	3.4%	3.5%	3.3%
	Western Hemishere	1.1%	1.3%	1.7%
	Africa, N. Korea, & Area not specified	2.4%	3.3%	2.3%
	DOTS World Total	100.0%	100.0%	100.0%

Source: IMF DOTS(Direction of trade statistics)
Note: South Asia includes Pakistan, Nepal, Indea, Sri Lanka, Bhutan, Bangladesh, and Maldives.

Table 5. Components of Export Receipts in Thailand

(Percent share)

	2001	2002
FX reciepts exchanged to baht	63.9	66.8
Baht receipts through non-residents baht.	4.2	4.7
Payment to foreign creditors	1.0	0.8
Deposit to foreign currency A/C	30.9	27.7
Total	**31.9**	**28.5**

Sources) The Bank of Thailand.

Table 6. Invoice Currency Ratios in Japan's Exports

For Total World

	1969	1970	1971	1972	1973	1974	1975	1976
Yen	0.6	0.9	2.0	8.6	11.3	15.0	17.0	19.4
US dollar	90.1	90.5	90.4	82.8	81	77.7	78.5	76.3

	1977	1978	1980	1981	1982	1983	1984	1985
Yen	18.8	19.8	28.9	31.8	33.8	40.5	39.5	39.3
US dollar	76.9	75.4	66.3	62.8	60.9	50.2	53.1	52.2

	1986	1987	1988	1989	1990	1991	1992	1993
Yen	35.5	33.4	34.3	34.7	37.5	39.4	40.1**	39.9**
US dollar	53.5	55.2	53.2	52.4	48.8	46.7	46.6**	48.6**

3

	1994	1995	1996	1997	1998	2000	2001	2002
Yen	39.7	36.0	35.2	35.8	36.0	36.1##	35.6##	36.7##
US dollar					-	-	-	-

For East Asia

	1981	1983	1985	1987	1988	1989	1990	1991
Yen	29.8	48	47.3	41.1	41.2	43.5	48.9	50.8
US dollar	68.9	-	51.3	56.5	56	53.6	48.1	45.9

	1992	1993	1994	1995	1996	1997	2000	2002
Yen	52.3	52.5	49.0	44.3	46.3	47.0	50.0##	51.3##
US dollar	-	-	-	-	-	-	-	-

NOTES 1) Unless specified, the data are averaged annually.

2) The data with * show figures for fiscal year.

3) The data with ** show those of September.

4) The data with ## show those of the second half ot the year.

SOURCES 1) Exports: Until 1982, Yushutsu Shinyojyo Toukei by Bank of Japan; between 1983 and 1991, Export Confirmation Statistics by MITI. For 1992, Kessai Tuka Douko by MITI.

2) Imports: Until 1980, Yushutsu Syonin Todokede Houkokusho by MITI; Between 1981 and 1985, Houkokusyorei Ni Motoduku Houkoku by Ministry of Finace; Between 1986 and 1991, Import Reporting Statistics by MITI.
For 1992, Kessai Tuka Douko by MITI. For 1993, Yusyutu (Yunyu) Houkokusyo Douko by MITI.

Figure 1-a. Comparison of Each Expected Utility: μ = 5

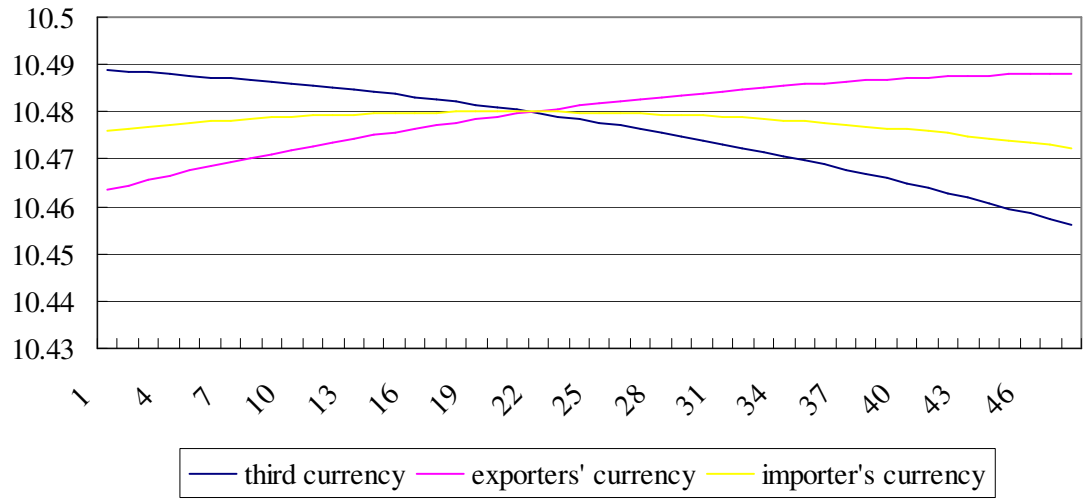

Figure 1-b. Comparison of Each Expected Utility: μ = 7.5

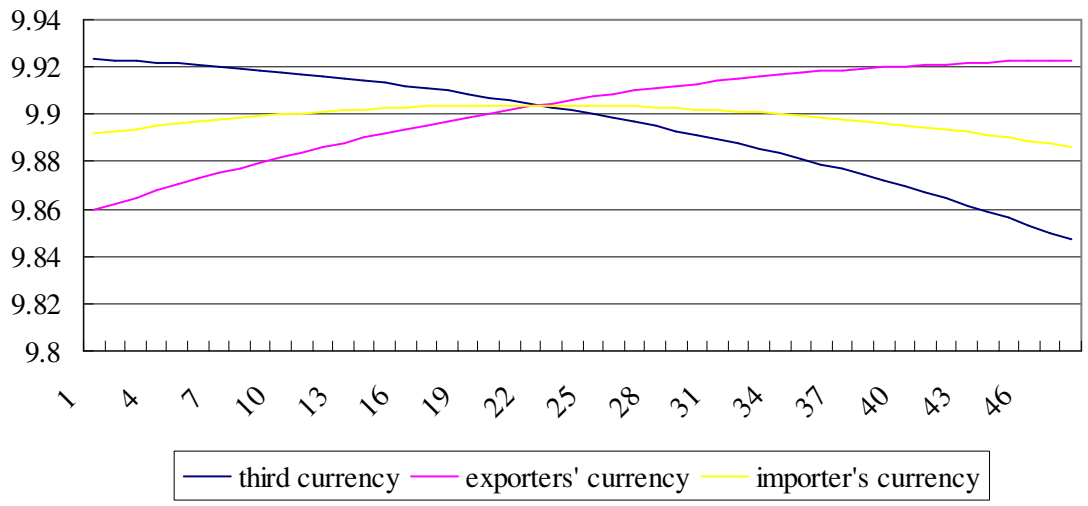

Figure 1-c. Comparison of Each Expected Utility: μ = 10