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The Role of Exchange Rates and Domestic Policies on Global Rice Food Security

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I. Introduction

The recent rice crisis has renewed the call for a second Green Revolution to feed the world in the face of growing population and shrinking land base for agricultural uses. For the second Green Revolution to be a reality, technology package needs to be combined with necessary policy support similar to what was done during the first Green Revolution.

Thailand and Vietnam are the two top exporters in the world accounting for more than 40 percent of total trade. Although Thailand's position as the largest rice exporter goes back from the 1970, Vietnam's emergence in the export market is relatively recent. In 2009, Vietnam exported 5.5 million tons of rice as compared to one million ton it exported in early 90s. While Thailand remains the most dominant player, the observed export price wedge between the two countries beginning in 2005 -- making Thailand rice relatively more expensive than Vietnam rice -- has shifted the terms of trade in favor of Vietnam. For example, in July 2009, Thailand was selling rice (5% broken) at US\$623 per ton while Vietnam was exporting rice of the same quality at US\$430 per ton – a difference of US\$193 (nearly 50% higher than the usual US\$10-20 spread).

Thailand's pledging program, a scheme in which the government buys paddy from farmers at an announced price, stores this paddy in state-owned warehouses, and then sells this as milled rice. The quantity of pledged rice at subsidized rates has been increasing in the recent years, from less than 1 million ton before 2000 to 6 million tons in 2008. This high level of intervention stocks in government buffers costs the country 65 million baht (roughly US\$2 million). In real terms, the price intervention program pushed the price of rice in the domestic market way above the market rate, thereby subsidizing the rice farmers. This policy consequently contributes to a higher export price of Thailand rice compared to that of Vietnam. Vietnamese government, on the other hand, sets a floor price for exports to protect the profits of rice farmers. While the imposition of the minimum export price is not that main culprit, there are media reported instances where some rice exports are allowed to sell at prices below the official floor price (Look At Vietnam, 2008). For example, the minimum export price in February 2009 was US\$460 per ton, lowered to US\$430 per ton in July 2009. Still, reports were surfacing saying that Vinafood 2, a state corporation, was able to sell rice at US\$406 per ton. With this unscrupulous trading, Vietnam has been implicitly pushing the prices below the market price, contributing to the price gap between Vietnam and Thailand.

The effect of the depreciating US dollar is different to countries with floating and fixed exchange rates. While de facto most of the Asian economies have adopted a 'managed float' exchange rate system (Martin, 2008), Thailand represents a country with floating exchange rates, while Vietnam has pegged its currency to the US dollar. Under a floating exchange rate, the government usually does not intervene in the foreign exchange market and the currency is left to respond to the market signals. In a pegged exchange rate system, the government avoids a currency depreciation or appreciation by intervening in

the foreign exchange market to maintain the fixed exchange rate, either by buying the domestic currency if in excess supply or selling it if in excess demand. Thus, the baht appreciated in response to the dollar appreciation, while the dong depreciated along with the dollar. To illustrate, in January 1998, the exchange rate of the baht was at 54.92 per US\$. In September 2009, it stood at 33.90 per US\$. The appreciation of the local currency of Thailand made exports less price competitive in dollar terms, consequently dampening its export market. On the other hand, the depreciation of the domestic currency of Vietnam -- at 12,292 dong per US\$ in January 1998 to 16,974 dong per US\$ in September 2009 -- made its exports more price competitive, thus encouraging more exports.

This study aims at examining the role of exchange rates and domestic policies in Thailand and Vietnam on global food security. It is motivated by the 2008 rice crisis that catapulted the price of rice in the global market and had caused alarm to major rice consuming countries in the world.

Past studies (Kemal and Qadir, 2005; Dawe, 2008; Ghosray 2008) have shown that there is an increasing role of exchange rate policy to enhance exports of export-oriented countries but the exact nature of the relationship is still not clear. The study aims to make a substantial contribution to the debate on this important issue.

II. Methodology

The IRRI Global Rice Model (IGRM) was used to estimate the impacts of the rice price wedge between Thailand and Vietnam on the global food security. The IGRM is a partial equilibrium structural econometric simulation model that includes 18 major rice producing, consuming and trading countries. The representative country model includes supply, demand, trade, ending stock and market equilibrium conditions.

For major rice producing countries, supply is modeled in a regional framework to capture different mix of crops due to climatic differences and regional heterogeneity in availability of water and other natural resources. Rice production is modeled by estimating separate area harvested and yield equations. Assuming an adaptive price expectations for both rice and competing crops prices, the area harvested is specified as a function of lagged rice farm price, lagged farm price of competing crops, and lagged area harvested. Yield is determined by fertilizer use, percent irrigated area, and technological change.

On the demand side, per capita rice consumption is specified as a function of real per capita GDP and real retail price. Individual country models are then linked through net trade equations to solve Thai FOB (5% broken, Bangkok) to appropriately link individual country to the world rice economy. Structurally, the following identity is satisfied for each country and the rest-of-the-world (ROW):

Beginning Stock + Production + Imports = Ending Stock + Consumption + Exports.

This identity is satisfied by: (1) solving the prices in most of the net exporting and net importing countries; and (2) modeling domestic price as a function of the world price with a price transmission equation, and set one of the variables as the residual to satisfy the identity. Since rice market is heavily distorted, the model tries to explicitly include policy variables in supply, demand, ending stocks, exports, imports, and price transmission equations.

The model was used to develop a ten-year baseline projections of global supply, demand, trade and prices with a set of assumptions about the general economy, agricultural policies, and technology changes in net exporting and net importing countries. In the next step, a scenario was developed by keeping the export price wedge between Thailand and Vietnam at the current level. The scenario results were compared with the baseline to quantify the effect of higher price wedge on global food security.

Data

The data sources used in the IRRI Global Rice Model (IGRM) are country statistical yearbooks, the U.S. Department of Agriculture (USDA) Foreign Agricultural Service Production, Supply, and Distribution (PS&D) data set, Food and Agricultural Policy Research Institute's macroeconomic data set, USDA attaché reports, and the Food and Agriculture Organization's farm price data set. Monthly rice export prices of Thailand and Vietnam 5% broken, exchange rates, and price indices were obtained from the World Bank and the International Monetary Fund.

III. Empirical Findings and Interpretation of the Results

We simulated the effect of (a) keeping the export price wedge between Thailand and Vietnam at the current level; (b) increasing Thailand's pledged quantity at 10%; (c) imposing Vietnam's minimum export price of US\$ 450 mt⁻¹; (d) appreciation of Thai baht by 5%; and (e) depreciating Vietnam's dong by 5%. The results are presented in Tables 1-6.

A. Simulation of a 10-year price wedge of \$180 and \$250

Setting the price wedge at US\$180 mt⁻¹ (2009 monthly average price wedge) and US\$ 250 mt⁻¹, which was the highest monthly price wedge observed in 2009, resulted in higher export price of Thailand rice, making its rice exports less competitive, and hence a slight reduction in its export volume (Table 1 and 2).

On the other hand, Vietnam's rice exports decreased given the sharp decline in its exports price. The lower prices served as a disincentive for local farmers to expand its production. It can be explained by other relevant domestic policies on procurement, storage, and taxes being implemented by the Vietnamese government.

Ghosray (2008) indicated that a long run relationship exists between rice export prices of Vietnam and Thailand. This implies that more effective transmission of market information has led to more stability in export pricing, resulting in Vietnam's export prices being closely linked to Thai prices. The authors tested for asymmetry and found that for high quality rice -- 5% and 15% broken rice -- there is a long run relationship and the underlying process of adjustment is asymmetric. When prices are decreasing, the gap between the prices decreases at a faster rate as opposed to the case when both prices are increasing.

B. Simulation of a 10-year Thailand pledged quantity of 10%

A ten percent increase in Thailand's pledged quantity pushes the price of rice in the domestic market to increase above the market price, thereby subsidizing farmer (Table 3). Thailand's pledging program seems to be an effective policy in protecting the incomes of local farmers. Exports volume, however, remained constant which shows that the impact of price intervention program is confined only in the domestic market. It has no effect on the country's trade position as well as on its trade competitor. Hence, it does not contribute to the price wedge increase between Thailand and Vietnam.

C. Simulation of a 10-year Vietnam minimum export price of \$450

The imposition of minimum export price of the Vietnamese government is effective in protecting the profits of rice farmers. If the minimum export price is retained at US \$450 mt⁻¹, Vietnam farm price will increase and this will eventually trigger an increase in export price (Table 4). The level of rice exports also increased with an increase in export price. This expansion in exports will have to come at the expense of domestic supply. Pingali et al., 1997 argued that it is highly unlikely that rice output in Vietnam will grow to the extent of satisfying rising domestic demands while at the same time leading to an expansion in exports, given limited opportunities for area expansion, the high cost of further irrigation infrastructure development, and the almost complete exploitation of technological potential in the high-potential environments.

This policy however, has no direct impact on Thailand's farm price. Unlike Vietnam, there will be a slight decrease in Thailand's rice export price, and a steady increase in export volume, with almost no substantial change in domestic consumption. As in the case of Thailand's pledging program, this policy also contributes to the decrease in the price wedge.

Dawe (2008a, b) states that there has been a marked shift from low quality to high quality rice because of the rising levels of income. The results reflect the increased competition from Vietnam in the higher quality rice market which may have resulted in the price differential narrowing over time. Another possible explanation for this asymmetry is that Vietnam is known for selling low quality rice (as it traditionally has been an exporter of low quality rice) even though in recent years, Vietnam has improved milling facilities. Besides, Vietnam entered the market when prices were steadily declining and therefore Vietnam prices in the high and medium quality rice would have to decrease at a faster

rate in comparison to Thailand to maintain its market share. This confirms the study made by Yumkella et al., 1994) that the rice market is characterized by imperfect competition in the high quality market.

D. Simulation of a 10-year Thailand baht appreciation of 5%

The appreciation of Thai baht at 5% will make the rice farm price lower and its exports less price competitive in dollar terms, consequently dampening its export market (Table 5). This decline in rice exports can be explained by the corresponding decline in rice production.

In contrast, Vietnam's farm price will continuously increase over a period of 10 years, with almost stationary increase in Vietnam's export price and no significant change in rice exports and local consumption.

In response to the appreciation, the price difference between Thailand and Vietnam also increased. It is also interesting to note that as the export price of Thailand increases, Vietnam's export price also increases which proves the results of previous studies that price transmission between the two prices exists.

F. Simulation of a 10-year Vietnam dong depreciation of 5%

The pegged exchange rate system of the Vietnamese government made the dong depreciate in response to dollar appreciation. A 5% depreciation of Vietnamese dong resulted in higher farm prices, making its exports more price competitive, thus encouraging more exports (Table 6). The increase in exports is justified by the increase in production making rice becoming more available to local consumers.

As in the case of baht appreciation, both export prices follow the same direction which suggests price transmission. Any changes in the export price of Vietnam as caused by the exchange rate policy are being reflected in the export price of Thailand and vice versa. Moreover, with the depreciation of dong, price wedge seems to further increase.

IV. Conclusion

The movement of export price of both countries due to the implementation of exchange rate-related policies is positively correlated. When export price of Thailand increases due to baht appreciation, Vietnam's export price also increases. When Vietnam's export price decreases due to dong depreciation, Thai export price decreases correspondingly. This is consistent with the results of previous studies on the existence of price transmission mechanism between the two prices. Thai export price evolves independently and the Vietnam export prices adjust to any deviation from long run equilibrium. One may conclude that the Thai export prices act as a price leader and Vietnam adjusts its export prices taking the Thai export prices as a reference point. There is some evidence at the

5% significance level that Vietnam prices Granger-causes Thai prices in the short run (Ghosray, 2008). In addition, the imposition of these policies contributes to the further increase in the price wedge between the two countries.

The existence of the more than normal price wedge may not have a negative impact on food security of both countries and the rest of the importers as the possible increase in exports due to exchange rate related policies is more than compensated by the increase in production, thereby, making rice more available to the consumers.

On the other hand, Pingali et al., 1997 raised the question about the prospects for Vietnam's expansion, or even sustaining, current levels of rice exports. The authors have drawn two clear conclusions:

1. the prospects for Vietnam substantially expanding rice exports beyond current levels are limited because of growing domestic demand and due to the physical, technological, and economic constraints to expanding supplies; and
2. the prospects for sustaining current export level are conditional on further policy and institutional reforms, infrastructural investments and technological innovations.

Future research should be geared towards understanding the co-integrating relationships between Thailand and Vietnam export prices and between exchange rates and rice prices.

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Table 1. Simulation of a 10-year price wedge of \$180 pmt.

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
	Percentage deviations from baseline											
Domestic Prices												
Thailand Farmgate	0.00	0.13	-0.07	0.03	0.11	0.15	0.16	0.16	0.17	0.21	0.21	0.21
Thailand Wholesale	0.00	0.17	-0.02	-0.01	0.05	0.09	0.09	0.11	0.12	0.14	0.15	0.15
Vietnam Farmgate	0.00	-2.30	1.04	-0.76	-1.99	-3.09	-3.71	-4.14	-4.44	-5.36	-5.77	-6.13
Vietnam Retail	0.00	-1.83	0.23	-0.24	-0.62	-1.03	-1.30	-1.70	-1.84	-2.23	-2.41	-2.62
Export Prices												
Thailand 5% Broken	0.00	0.22	-0.13	0.04	0.20	0.25	0.26	0.27	0.28	0.35	0.34	0.35
Vietnam 5% Broken	-19.82	-12.79	-21.45	-18.16	-14.15	-9.95	-7.22	-5.24	-3.81	0.33	2.77	4.75
Supply												
Thailand Area	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Thailand Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Milled Production	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Thailand Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
Vietnam Area	0.00	0.00	-0.08	0.03	-0.02	-0.06	-0.09	-0.11	-0.12	-0.13	-0.16	-0.17
Vietnam Yield	0.00	0.00	-0.08	0.03	-0.02	-0.06	-0.09	-0.11	-0.12	-0.13	-0.16	-0.17
Vietnam Milled Production	0.00	0.00	-0.11	0.01	-0.01	-0.04	-0.06	-0.07	-0.10	-0.10	-0.13	-0.14
Vietnam Beginning Stocks	0.00	0.00	0.09	-0.16	0.05	0.04	0.00	-0.04	-0.07	-0.09	-0.08	-0.11
Demand												
Thailand Exports	0.00	-0.06	0.03	-0.01	-0.05	-0.07	-0.07	-0.08	-0.08	-0.10	-0.10	-0.10
Thailand Consumption	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Thailand Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01
Vietnam Exports	0.00	-0.86	0.13	-0.20	-0.76	-1.26	-1.57	-1.76	-1.87	-2.17	-2.33	-2.44
Vietnam Consumption	0.00	0.23	-0.10	0.07	0.19	0.30	0.36	0.40	0.42	0.51	0.54	0.57
Vietnam Ending Stocks	0.00	0.09	-0.16	0.05	0.04	0.00	-0.04	-0.07	-0.09	-0.08	-0.11	-0.13
Stocks-to-Use Ratio												
Thailand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	-0.23	-0.16	-0.04	-0.11	-0.20	-0.28	-0.37	-0.44	-0.51	-0.58	-0.64
World	0.00	-0.03	0.02	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.03

Table 2. Simulation of a 10-year price wedge of \$250

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
	Percentage deviations from baseline											
Domestic Prices												
Thailand Farmgate	0.00	0.1729	-0.0485	0.0566	0.1598	0.2015	0.212	0.2207	0.2288	0.2756	0.2736	0.2758
Thailand Wholesale	-43.37	-41.837	-42.666	-42.735	-42.62	-42.506	-42.45	-42.309	-42.286	-42.093	-42.026	-41.956
Vietnam Farmgate	0.00	-3.0269	0.5185	-1.462	-2.9474	-4.2463	-5.0406	-5.6012	-6.0229	-7.1027	-7.6306	-8.101
Vietnam Retail	0.00	-2.2682	-0.0515	-0.5718	-1.0555	-1.5435	-1.8977	-2.3702	-2.5655	-3.0232	-3.2533	-3.509
Export Prices												
Thailand 5% Broken	0.00	0.29	-0.08	0.10	0.27	0.34	0.36	0.37	0.39	0.46	0.46	0.46
Vietnam 5% Broken	-33.99	-25.17	-33.26	-30.05	-25.69	-21.24	-18.22	-16.02	-14.38	-10.00	-7.37	-5.21
Supply												
Thailand Area	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Thailand Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Milled Production	0.00	0.00	0.02	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Thailand Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Vietnam Area	0.00	0.00	-0.10	0.02	-0.05	-0.09	-0.13	-0.15	-0.17	-0.18	-0.21	-0.22
Vietnam Yield	0.00	0.00	-0.10	0.02	-0.05	-0.09	-0.13	-0.15	-0.17	-0.18	-0.21	-0.22
Vietnam Milled Production	0.00	0.00	-0.14	0.00	-0.03	-0.06	-0.09	-0.11	-0.14	-0.15	-0.17	-0.18
Vietnam Beginning Stocks	0.00	0.00	0.12	-0.18	0.05	0.03	-0.01	-0.06	-0.10	-0.12	-0.11	-0.15
Demand												
Thailand Exports	0.00	-0.08	0.02	-0.02	-0.07	-0.09	-0.10	-0.10	-0.11	-0.13	-0.14	-0.14
Thailand Consumption	0.00	-0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Thailand Ending Stocks	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Vietnam Exports	0.00	-1.13	-0.14	-0.51	-1.18	-1.77	-2.15	-2.39	-2.55	-2.89	-3.10	-3.23
Vietnam Consumption	0.00	0.30	-0.05	0.14	0.29	0.41	0.49	0.54	0.58	0.68	0.72	0.75
Vietnam Ending Stocks	0.00	0.12	-0.18	0.05	0.03	-0.01	-0.06	-0.10	-0.12	-0.11	-0.15	-0.17
Stocks-to-Use Ratio												
Thailand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	-0.28	-0.25	-0.13	-0.20	-0.32	-0.42	-0.53	-0.61	-0.71	-0.79	-0.86
World	0.00	-0.03	0.01	-0.01	-0.03	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.05

Table 3. Simulation of a 10-year Thailand pledged quantity of 10%

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
	Percentage deviations from baseline											
Domestic Prices												
Thailand Farmgate	0.02	0.04	0.06	0.08	0.10	0.13	0.16	0.19	0.22	0.26	0.30	0.35
Thailand Wholesale	0.01	0.03	0.04	0.06	0.08	0.10	0.12	0.15	0.17	0.20	0.23	0.27
Vietnam Farmgate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Retail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Export Prices												
Thailand 5% Broken	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02
Vietnam 5% Broken	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Price Wedge	0.00	-0.01	-0.03	-0.04	-0.05	-0.05	-0.05	-0.06	-0.06	-0.06	-0.07	-0.07
Supply												
Thailand Area	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Thailand Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Milled Production	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Thailand Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01
Vietnam Area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Milled Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demand												
Thailand Exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Consumption	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Thailand Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
Vietnam Exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stocks-to-Use Ratio												
Thailand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
World	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4. Simulation of a 10-year Vietnam Minimum Export Price of \$450

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
	Percentage deviations from baseline											
Domestic Prices												
Thailand Farmgate	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Thailand Wholesale	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
Vietnam Farmgate	0.00	0.09	0.15	0.22	0.29	0.35	0.42	0.48	0.53	0.59	0.64	0.70
Vietnam Retail	0.00	0.04	0.08	0.11	0.14	0.17	0.20	0.23	0.25	0.27	0.30	0.32
Export Prices												
Thailand 5% Broken	0.00	-0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04
Vietnam 5% Broken	0.00	0.05	0.08	0.12	0.16	0.19	0.23	0.26	0.29	0.32	0.34	0.37
Price Wedge	0.00	-0.27	-0.97	-1.26	-1.48	-1.53	-1.61	-1.59	-1.67	-1.59	-1.59	-1.58
Supply												
Thailand Area	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Milled Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Area	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Vietnam Yield	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Vietnam Milled Production	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Vietnam Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Demand												
Thailand Exports	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Thailand Consumption	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam Exports	0.00	0.03	0.07	0.10	0.12	0.15	0.18	0.20	0.22	0.24	0.26	0.27
Vietnam Consumption	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	-0.04	-0.05	-0.05	-0.05	-0.06	-0.06
Vietnam Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Stocks-to-Use Ratio												
Thailand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.07	0.08
World	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5. Simulation of a 10-year Thailand baht appreciation of 5%

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
	Percentage deviations from baseline											
Domestic Prices												
Thailand Farmgate	-5.24	-8.69	-11.32	-14.93	-17.57	-20.17	-22.60	-24.83	-26.94	-29.17	-31.10	-32.85
Thailand Wholesale	-3.88	-6.69	-8.53	-11.13	-13.02	-14.89	-16.73	-18.48	-20.07	-21.78	-23.25	-24.64
Vietnam Farmgate	0.00	0.12	0.15	0.16	0.20	0.21	0.22	0.23	0.24	0.24	0.24	0.24
Vietnam Retail	0.00	0.06	0.08	0.09	0.11	0.12	0.10	0.11	0.12	0.11	0.12	0.11
Export Prices												
Thailand 5% Broken	0.00	0.45	0.60	0.72	0.92	1.02	1.12	1.21	1.29	1.38	1.46	1.50
Vietnam 5% Broken	0.00	0.06	0.08	0.09	0.11	0.11	0.12	0.12	0.13	0.13	0.13	0.13
Price Wedge	0.00	2.32	6.51	7.08	8.17	8.12	6.75	7.02	7.29	6.88	6.84	6.65
Supply												
Thailand Area	0.00	-0.31	-0.54	-0.69	-0.91	-1.09	-1.26	-1.43	-1.57	-1.71	-1.87	-2.01
Thailand Yield	0.00	-0.05	-0.09	-0.11	-0.14	-0.17	-0.20	-0.22	-0.25	-0.28	-0.30	-0.33
Thailand Milled Production	0.00	-0.33	-0.61	-0.76	-0.98	-1.16	-1.33	-1.50	-1.67	-1.82	-1.99	-2.14
Thailand Beginning Stocks	0.00	0.00	0.10	0.16	0.26	0.34	0.42	0.49	0.55	0.61	0.69	0.75
Vietnam Area	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vietnam Yield	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vietnam Milled Production	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vietnam Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Demand												
Thailand Exports	0.00	-0.12	-0.15	-0.18	-0.24	-0.27	-0.31	-0.34	-0.36	-0.40	-0.43	-0.45
Thailand Consumption	0.00	0.14	0.25	0.40	0.51	0.63	0.74	0.85	0.95	1.06	1.16	1.25
Thailand Ending Stocks	0.00	0.10	0.16	0.26	0.34	0.42	0.49	0.55	0.61	0.69	0.75	0.80
Vietnam Exports	0.00	0.04	0.07	0.07	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10
Vietnam Consumption	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Vietnam Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Stocks-to-Use Ratio												
Thailand	0.00	-0.04	-0.08	-0.13	-0.17	-0.21	-0.26	-0.30	-0.34	-0.37	-0.41	-0.45
Vietnam	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
World	0.00	-0.03	-0.04	-0.04	-0.04	-0.04	-0.03	-0.03	-0.02	-0.01	-0.01	0.00

Table 6. Simulation of a 10-year Vietnam dong depreciation of 5%

	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
	Percentage deviations from baseline											
Domestic Prices												
Thailand Farmgate	0.00	-0.09	-0.18	-0.14	-0.16	-0.17	-0.18	-0.19	-0.20	-0.20	-0.20	-0.20
Thailand Wholesale	0.00	-0.07	-0.15	-0.13	-0.14	-0.16	-0.13	-0.15	-0.16	-0.16	-0.16	-0.16
Vietnam Farmgate	0.00	1.67	3.57	3.09	3.74	4.14	4.53	4.92	5.30	5.53	5.83	6.15
Vietnam Retail	0.00	0.81	1.72	1.52	1.86	2.07	2.26	2.41	2.57	2.67	2.79	2.88
Export Prices												
Thailand 5% Broken	0.00	-0.16	-0.32	-0.24	-0.27	-0.30	-0.30	-0.32	-0.33	-0.33	-0.33	-0.34
Vietnam 5% Broken	-1.45	-7.27	-13.49	-13.84	-16.77	-19.51	-22.22	-24.89	-27.53	-30.26	-33.01	-35.77
Price Wedge	9.14	31.99	126.41	118.77	130.21	129.93	136.06	131.75	137.76	131.59	132.98	132.67
Supply												
Thailand Area	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Thailand Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thailand Milled Production	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Thailand Beginning Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Vietnam Area	0.00	0.00	0.06	0.11	0.10	0.12	0.13	0.14	0.15	0.16	0.16	0.17
Vietnam Yield	0.00	0.00	0.06	0.11	0.10	0.12	0.13	0.14	0.15	0.16	0.16	0.17
Vietnam Milled Production	0.00	0.00	0.05	0.10	0.09	0.11	0.12	0.13	0.14	0.15	0.15	0.16
Vietnam Beginning Stocks	0.00	0.00	-0.06	-0.04	0.08	0.06	0.07	0.09	0.10	0.11	0.12	0.12
Demand												
Thailand Exports	0.00	0.04	0.08	0.06	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.10
Thailand Consumption	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Thailand Ending Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Vietnam Exports	0.00	0.62	1.46	1.48	1.65	1.81	1.94	2.07	2.19	2.26	2.32	2.39
Vietnam Consumption	0.00	-0.17	-0.35	-0.30	-0.36	-0.39	-0.43	-0.46	-0.49	-0.51	-0.53	-0.55
Vietnam Ending Stocks	0.00	-0.06	-0.04	0.08	0.06	0.07	0.09	0.10	0.11	0.12	0.12	0.13
Stocks-to-Use Ratio												
Thailand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vietnam	0.00	0.10	0.30	0.38	0.43	0.49	0.54	0.58	0.62	0.65	0.68	0.71
World	0.00	0.02	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03