Rice Trade and Price Volatility:
Implications on ASEAN and Global Food Security

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1. Introduction

Two key observations about rice trade are that it has the thinnest among the top three cereals and that most import dependent rice consuming countries have adopted self-sufficiency programs in the food staple. Estimated at 6 to 7 % of global rice output, trade in this staple is about a third of wheat trade and half of maize trade in the world market. Critics have argued that all that need to be done is for rice importing countries to open up their markets to rice trade in order to expand rice trade globally, and enhance food security.

This paper takes an alternative perspective. It argues that a self-sufficiency program in rice is a self-insurance measure against this risk: a rice importing country finds itself in a situation wherein the available rice in the market is inadequate for the global rice requirements of deficit countries, and whatever rice there is gets priced at an unaffordable price for its population. Rice deficit countries regard relying on rice trade as taking too much risk for food security. Should there be a simultaneous rice crop failure in one or two large rice producing countries, the current level of global rice trade, in their view, is inadequate to absorb the supply shock, resulting in speculative market behavior and rice price spikes.

Even the top net rice exporting countries, like Vietnam and India, have recently expressed reservations regarding giving to much of their supply to the global market. Facing high world prices of rice in 2008, these countries restricted rice exports to ensure they have adequate rice stocks for their domestic market. If net importing countries strive to be self-sufficient, net surplus countries have been observed to guard losing their self-sufficiency status to trade.

We then get to the paper's key argument that rice price spikes tighten import and export restrictions in support of self-sufficiency programs. They signal higher risk, and calls for higher insurance premia, namely more restrictive import and export policies, causing rice trade to be thin, rather than the other way around. We test this claim using a Granger causality test between trade and extreme price volatility.

We first assess the relative trade to output ratios of the top 3 cereals in the following section. Rice is shown to be the least tradable among the top cereals. We follow this up in the third section with a calculation of the relative price volatilities of the same food items and correlate their tradability indices with their corresponding price volatility measures. It is shown in the correlation analysis that there is an inverse relationship between rice tradability and price volatility. In section four, we sketch an analytical model of trade protection as an insurance measure against the risk of price spikes, and test empirically that price spikes causes, rather

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than are caused by, thin trade. We conclude the paper with the policy implications of our analysis.

2. Profile of output and trade in selected cereals

We first take up the recent trends of outputs and relative importance of these cereals globally and in Southeast Asia, before assessing their relative tradability. In assessing the tradability of the top 3 cereals, we use export to output and import to output ratios in assessing the relative tradability.

Production trends

The world's total output of maize was 840.31 mln. tons in 2010, up from 592.48 mln. tons in 2000 (see Table 1). Of the three cereals in the Table, it has the largest amount of output. Its production level was slightly 4 times that in 1961. Its expansion over the past half a century is largely explained by a significant increase in yields, particularly over the past two decades. In 2010, the average yield of maize in the world was estimated to be about 5.19 tons, up by 41 % compared to its figure in 1990.

Southeast Asia is not a major producer of maize in the world. It accounted for only 4.4% of the world's maize output in 2010, growing the crop in an area, which was 6.08% of the world's total maize area. The 2010 figure is even 1.04 percentage points lower compared to 1990. The American continent has been the top producer of maize in the world, followed by Asia. However, it is China that has the largest output of corn in Asia. In Southeast Asia, Indonesia and the Philippines are responsible for nearly two-thirds of the region's production.

The region produces corn to be used primarily as feeds for swine and poultry, and secondarily as food. In the Philippines for example, white corn is grown and milled as corngrits, which are consumed in the Southern provinces of the country. For most of the Philippines and throughout the Southeast Asian region, rice is the top staple food.

The world's rice output[1] was slightly over 696 million tons in 2010, more than three times its size nearly half a century ago (Table 1). Southeast Asia has accounted for 28.87% of this output, up by a multiple 1.35 from its level in 1961. Like in maize, the expansion of rice output in the world is largely driven by increases in yields rather than area harvested.

Two of the world's largest rice exporters, Thailand and Vietnam, are in the region, although Indonesia has a larger output than either of the two. Another important producer in the region is Myanmar, which may have untapped potential for increasing its output and export of rice. The region likewise has two of the world's largest importers of rice, Indonesia and the Philippines, although both look at trade as a last resort, making each of them off and on rice importers depending upon their local production levels.

In 2010, total output of wheat in the world was nearly 654 mln. tons. This figure is nearly threefold that in 1961. The area harvested for this crop had actually fallen over the period from 1990, in contrast to rice and maize. However, a 17 % increase of farm yields pulled up

[1] The use of the word "rice" in this paper generally refers to milled rice except in the discussion on production where rice paddy is the one referred to. Milled rice is roughly 67 % of rice paddy. In terms of milled output, global rice production was 466 mln. tons in 2010.

the world's wheat output in the same period. Wheat is least grown in Southeast Asia among the three cereals. The region had only the share of 1.9 % of the world's production of wheat.

Table 1. Output, area harvested and yield of three cereals: selected years, 1961 – 2010

Cereal/Item/Region	1961	1970	1980	1990	2000	2010
Maize						
Output (in mln. tons)						
World	205.03	265.83	396.62	483.37	592.48	840.31
% ASEAN of World	2.30	2.74	2.74	3.40	3.62	4.40
Area Harvested (in mln. has.)						
World	105.56	113.08	125.78	131.32	137.00	161.77
% ASEAN of World	4.95	5.78	6.39	7.04	6.10	6.08
Yield (in tons per ha.)						
World	1.94	2.35	3.15	3.68	4.32	5.19
ASEAN	0.90	1.11	1.35	1.78	2.57	3.76
Rice, Paddy						
Output (in mln., tons)						
World	215.65	316.35	396.87	518.57	599.36	696.32
% ASEAN of World	21.34	20.08	21.29	21.48	25.43	28.87
Area Harvested (in mln. has.)						
World	115.37	132.87	144.41	146.96	154.06	159.42
% ASEAN of World	24.69	23.70	24.22	24.92	27.93	30.43
Yield (in tons per ha)						
World	1.87	2.38	2.75	3.53	3.89	4.37
ASEAN	1.62	2.02	2.42	3.04	3.54	4.14
Wheat						
Output (in mln. tons)						
World	222.36	310.74	440.19	592.31	585.69	653.65
% ASEAN of World	0.00	0.01	0.02	0.02	0.02	0.03
Area Harvested (in mln. has.)						
World	204.21	207.98	237.25	231.26	215.44	217.22
% ASEAN of World	0.01	0.03	0.03	0.06	0.04	0.04
Yield (in tons per ha.)						
World	1.09	1.49	1.86	2.56	2.72	3.01
ASEAN	0.31	0.56	1.11	0.95	1.15	1.90

Source of Data: FAOstat

Trends in Cereal Trade

Over the past fifty years, cereal trade has expanded by at least a multiple of 3.67 in the case of wheat (see Table 2). In 2010, wheat imports or exports reached 145 mln. tons each, up from about 39.53 mln. tons in 1961. The largest expansion of trade was in maize, whose imports or exports grew by nearly 400%. Maize trade came in second with imports or exports reaching 107 mln. tons in 2010. Rice is the least traded among the top 3 cereals. In

2010, the total imports in the world in rice were only about 31 mln. tons, while total exports amounted to 32 mln. tons These levels are roughly 30% of that of maize and a fifth of the 2010 import figures for wheat.

Table 2. Trends in trade in selected cereals in the world and Southeast Asia: Selected years, 1961 to 2010

Cereal/Item/Region	1961	1970	1980	1990	2000	2010
Maize						
Imports (in mln. tons)						
World	14.25	28.98	79.84	73.51	82.10	107.23
% Southeast Asia to World	1.21	1.64	1.86	2.75	5.55	6.33
Exports (in tons)						
World	14.00	29.68	80.30	72.04	82.35	107.86
% Southeast Asia to World	5.22	6.00	2.91	2.12	0.28	0.75
Rice						
Imports (in mln. tons)						
World	6.57	8.81	12.77	12.27	22.84	31.19
% Southeast Asia to World	32.69	33.80	21.52	10.38	13.60	14.33
Exports (in tons)						
World	6.31	8.40	12.94	12.46	23.55	32.77
% Southeast Asia to World	59.44	23.21	29.23	47.03	41.97	48.97
Wheat						
Imports (in mln. tons)						
World	39.53	50.15	90.18	98.60	117.19	145.16
% Southeast Asia to World	0.71	2.51	4.02	4.69	7.49	8.24
Exports (in tons)						
World	39.53	50.15	90.18	98.60	117.19	145.16
% Southeast Asia to World	0.00	0.04	0.01	0.03	0.00	0.03

Source of Data: FAOstat

The decade from 1970 to 1980 appears to have the largest expansion of cereal trade over the past fifty years. Imports or exports in maize expanded the highest in 1980, when it roughly more than doubled their respective levels in 1970. The pattern likewise applies to wheat, whose trade expanded from about 50 mln. tons to 90 mln. tons in the same period. In the case of rice, the decade likewise added trade, although the gain in the same period was only third after that of maize and wheat.

Trade volumes fell in 1990 for maize in particular and slightly for rice. Maize lost about 8 mln. tons of exports, while rice imports or exports fell by about half of mln. ton. The relatively low decline in rice trade could be attributed by Vietnam's coming into the group of the world's largest rice exports. From1980 to 1990, Vietnam's exports rose from 0.26% of world exports in the commodity to 13.04%.

Table 2 likewise shows the share of Southeast Asia in the total imports or exports of the world in the three cereals. The figure shows that the region's share in the world's trade in rice exceeded the corresponding shares in maize or wheat. In 2010, the region's rice exports accounted for 48.97% of global rice exports, indicating it to be a major player in the world's rice market. Imports of the region in rice were only 14.33%, indicating that it is a net rice exporter in the world. The figures also imply significant local production in the key major rice deficit countries such as Indonesia or the Philippines is tapped to meet the growing rice consumption of these countries.

In the case of maize and wheat, Southeast Asia has become a net importer. From the Table, it is observed that in the 3 decades from the 1960s to 1980, the region however was a net exporter. Likely because maize is more used as feeds, and the livestock industries in the region producing hogs, chicken broilers and layers have exhibited vibrant growth, the region's marketable surplus of maize to the rest of the world had significantly shrunk. From 1990s to the present, the region has become a net maize importer. In wheat, the region's share in total world imports rose from 0.71% to 6.33% in 2010.

Maize Trade. In Table 3, Vietnam (24.43%) and Malaysia (45.31%) are the top importers of maize in Southeast Asia. In 2010, the region's total imports amounted to 6.79 mln. tons, or about 6.33% of the world's total (Table 2). in 2010. Indonesia and Thailand came next with their respective shares at 22.49% and 6.14%. Malaysia is a consistent maize importer. Apart from her, the respective maize imports of the other countries in the region have changed over the past fifty years. Indonesia and Thailand have recently been importing significantly compared to before 2000. The Philippines has the reverse pattern, importing relatively less 2000 onward, likely the result of feed wheat substitution of yellow corn. Vietnam used to be a significant importer before the 1980s, then had hardly any imports in the 1980s and 1990s, and picked up again its maize importation after 2000.

Table 3. Maize Trade of Selected Countries in ASEAN: Selected Years, 1961 to 2010

Item/Region/Countries	1961	1970	1980	1990	2000	2010
Imports (in mln. tons)						
Southeast Asia (SEA)	0.17	0.47	1.48	2.02	4.55	6.79
% Cambodia-SEA	0.00	0.00	0.00	0.00	0.00	0.01
% Indonesia-SEA	0.00	0.00	2.28	0.45	27.77	22.49
% Lao PDR-SEA	0.00	0.00	0.00	0.00	0.01	0.01
% Malaysia-SEA	31.12	45.95	44.66	73.12	49.39	45.31
% Myanmar-SEA	0.00	0.00	0.00	0.00	0.05	0.00
% Philippines-SEA	0.05	0.21	16.85	16.94	9.84	1.30
% Singapore-SEA	58.21	29.21	35.83	8.95	0.77	0.24
% Thailand-SEA	0.00	0.02	0.01	0.04	7.48	6.14
% Vietnam-SEA	10.15	24.55	0.00	0.10	4.34	24.43
Exports (in mln. tons)						
Southeast Asia (SEA)	0.73	1.78	2.34	1.53	0.23	0.81
% Cambodia-SEA	14.17	1.88	0.00	0.36	0.03	3.85
% Indonesia-SEA	0.41	16.06	0.64	9.28	12.07	5.18
% Lao PDR-SEA	0.00	0.00	0.00	0.00	0.39	27.82
% Malaysia-SEA	0.17	0.01	0.02	0.23	8.04	0.26
% Myanmar-SEA	3.46	0.58	0.82	1.31	63.60	3.83
% Philippines-SEA	0.85	0.00	0.00	0.01	0.15	0.00
% Singapore-SEA	2.74	4.38	5.49	5.59	1.43	0.00
% Thailand-SEA	77.58	77.08	93.04	80.85	10.51	59.04
% Vietnam-SEA	0.62	0.00	0.00	2.36	3.79	0.01

Source of Data: FAOstat

As shown in Table 3, the region is a net importer of maize. Its exports in 2010 amounted to only 810,000 tons, or roughly ¾ of a percent of the world's total exports of the crop. The region had exported significantly more in the 1980s and 1990s. However, the rising demand for corn for animal feeds virtually cut down the export performance of the region since 2000. Thailand and Lao People's Democratic Republic are the largest exporters of maize in the region.

Rice Trade. Southeast Asia has increasingly become the world's top exporter of rice in the last half a century. In 2010, the region exported 16.05 mln. tons of rice, which was nearly 49% of the world's total rice exports. This performance is attributed to Thailand and Vietnam, which expanded their joint share of world's exports from 46.83% in 1961 to 97.73% % in 2010, as shown in Table 4. Thailand topped the list of rice exporters not only in the region but also in the world, accounting for 27.28% of total world exports in 2010.

Table 4. Rice Trade of Selected Countries in ASEAN: Selected Years, 1961 to 2010

Item/Region/Countries	1961	1970	1980	1990	2000	2010
Imports (in mln. tons)						
Southeast Asia (SEA)	2.15	2.98	2.75	1.27	3.11	4.47
% Cambodia-SEA	0.00	0.04	5.04	2.03	2.05	1.50
% Indonesia-SEA	49.50	32.10	73.22	3.89	43.64	15.35
% Lao PDR-SEA	4.10	2.33	0.04	0.33	0.44	0.96
% Malaysia-SEA	19.71	11.93	6.10	25.95	19.18	20.83
% Myanmar-SEA	0.00	0.00	0.00	0.00	0.33	0.04
% Philippines-SEA	8.74	0.00	0.00	46.56	20.68	53.19
% Singapore-SEA	15.61	9.85	6.86	17.32	11.44	6.95
% Thailand-SEA	0.00	0.00	0.00	0.00	0.02	0.12
% Vietnam-SEA	0.86	42.30	7.33	0.15	0.00	0.02
Exports (in mln. tons)						
Southeast Asia (SEA)	3.75	1.95	3.78	5.86	9.88	16.05
% Cambodia-SEA	6.38	9.12	0.00	0.00	0.06	0.32
% Indonesia-SEA	0.00	0.00	0.26	0.03	0.01	0.00
% Malaysia-SEA	0.55	0.01	0.01	0.00	0.00	0.00
% Myanmar-SEA	42.44	32.88	17.27	3.65	2.54	0.76
% Philippines-SEA	0.00	0.06	6.90	0.00	0.00	0.00
% Singapore-SEA	3.80	2.40	0.71	0.03	0.04	0.28
% Thailand-SEA	41.97	54.57	73.96	68.57	62.15	55.71
% Vietnam-SEA	4.86	0.95	0.88	27.72	35.19	42.92

Source of Data: FAOstat

Vietnam accounted for 21% of global rice exports in the same year. Her performance picked up significantly in 1990, when she had 27.72% up from 0.88% in 1980. Another interesting potential large exporter of rice from the region is Myanmar. In the 1960s through the 1980s, she had been a significant rice exporter. However, her exports declined substantially in 1990, so much the reverse of Vietnam's performance. While her 2010 share of the region's

rice exports was insignificant, analysts have bet on her to be the next major rice exporter. Cambodia appears to reflect a similar pattern of performance as Myanmar. Lately there had been significant investments towards modernizing her rice mills, and building up her energy and transportation infrastructure, which would likely give a boost to the country's rice exports.

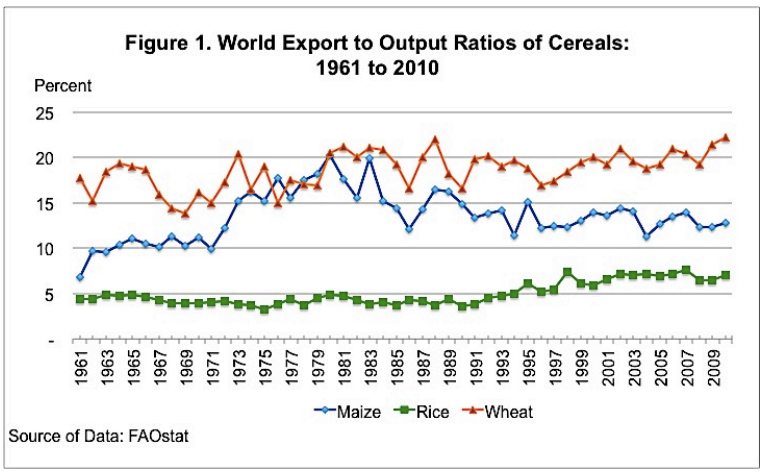
The region remains to be a significant net rice exporter despite the fact that it hosts two of the world's largest rice importers, Indonesia and the Philippines. The region imported a total of 4.47 mln. tons in 2010, or 14.33% of the world's total imports of rice, The region's rice imports has had a very flat growth over the past fifty years. An off-and-on pattern of rice imports can be observed from the data. The region's imports slightly grew to 2.98 mln. tons in 1970, dropped to a low of 1.27 mln. tons in 1990, and recovered to 4.47 mln. tons in 2010. Indonesia, for example, accounted for 73.22% in 1980, 3.89% in 1990, 43.64% in 200, and finally 15.35% in 2010. The same pattern appears to apply to the Philippines until 1990. Beyond this year, she had accounted for about half of the region's imports, except in 2000 when she imported only a fifth of the region's total.

3. Tradability and price volatility of cereals

In this section, we assess the price volatility of the three cereals and correlate their respective volatility indices with their corresponding tradability. We explore from the data if price volatility is inversely correlated with tradability.

Tradability of Cereals

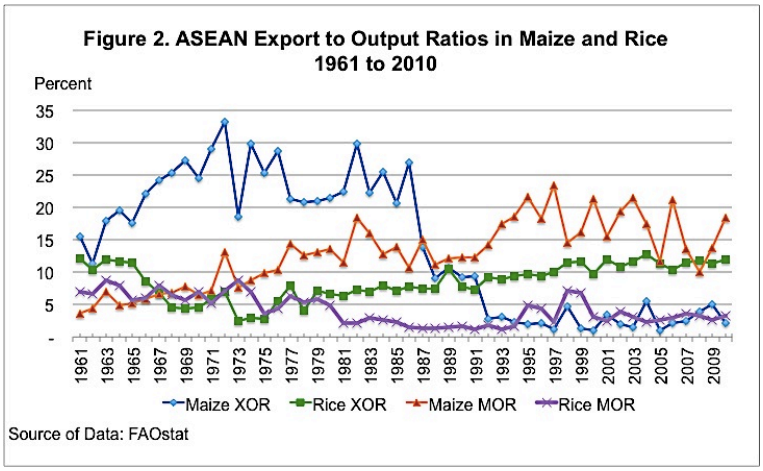
Figure 1 shows the export to output ratio (XOR) of three cereals, rice, maize and wheat, from 1961 to 2010. Wheat is the most tradable with an average XOR was 18.63%. Maize comes next with an average XOR of 13.57%. Rice has the lowest average XOR, equal to 4.98%.



Rice and wheat exports as a percent of their respective output levels steadily increased through the years, while the tradability of maize had declined after it peaked in the 1970s. In the 1960s and 1970s, the average XOR for rice was 4.22%, while wheat export was 17.19% of output. Their respective XORs increased to 5.49% and 19.58% in the 1980s and 1990s, and expanded further in the period from 2000 onwards to 6.96% and 20.19%. The corresponding ratios for maize slightly increased and declined in the same period. In the 1960s and 1970s, the earlier decades until the 1970s, maize had increasingly been exported. However, starting in the 1980s, its XOR declined and stabilized at about its average XOR.

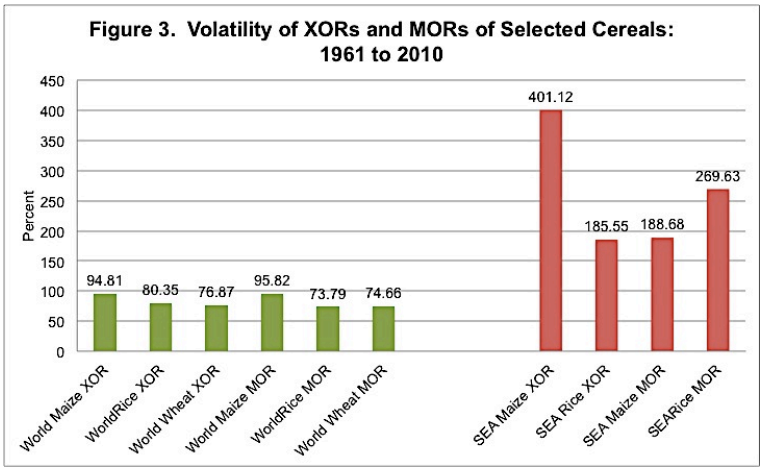
Until the 1990s, the ASEAN was a net exporter of maize as shown in Figure 2. After the 1990s, the pattern got reversed. The XORs for maize fell significantly since the middle of the 1980s because of the increasing use of maize in the region and expansion of the region's

output. In contrast, the region's XOR in rice had steadily increased after reaching bottom levels in the middle of the 1970s, which likely reflected the decline of rice exports from Myanmar. The MORs for rice had steadily declined since the 1960s to the middle of the 1990s, and gradually increased through to the present. Figure 2 clearly shows that the region has increasingly become a net rice exporter.



It is worth noting the off-and-on pattern of the MORs of maize in particular and to some extent for rice. Although in the 1980s, the MORs for rice were lowest, they nonetheless exhibited a stable pattern unlike that in the 1990s. It may be observed that the XORs for maize had also been unstable in earlier years, and in the more recent period as well. When the MOR for maize fell, its XOR rose, which apparently indicates that the source of this instability is the fluctuations of the region's output in rice. Furthermore, that at least in maize and perhaps also in rice, trade is clearly a last resort. If there is marketable surplus because of a good harvest, then XORs rise and MORs fall. The reverse occurs when harvests turned out to be lower than expected.

The import to output ratios (MOR) follow a similar pattern as the corresponding indicators for tradability in the case of exports, in the same period. Rice had the average MOR of 4.89%, while wheat and maize had 18.47% and 13.46%, respectively. In the second half of the 1970s, maize imports reached the levels of the MOR of wheat. Since 1990, maize importability gradually declined and settled at 13%, still exceeding that of rice, 6.75%. In ASEAN, which does not have any significant export potential in maize, the difference in importability between rice and maize is more pronounced compared to the case of exports wherein rice exports surpassed maize.



The volume volatility indices of world XORs and MORs for the 3 cereals in the world and those for Southeast Asia for the 2 cereals, rice and maize, were estimated for the period from 1961 to 2010.[2] Figure 3 shows the estimates. World XORs and MORs tended to be less stable compared to those of ASEAN. The respective volume volatility indices of the XORs for maize, rice, and wheat are respectively 94.81%, 80.35% and 76.87%. As for MORs, the corresponding estimates are 95.82%, 73.79% and 74.66%. The ASEAN region exhibits more instability of their respective

[2] The index is the standard deviation of the annual percentage changes of the tradabilitiy indices multiplied by the square root of 49 or the total number of observations.

tradability indices. It is interesting to note that the region's MOR for rice has exceeded that for maize.

Price volatility

Figure 4 shows how monthly prices of the 3 cereals had fluctuated since the February 1960 to May 2012. The top panel in the Figure is for maize prices, followed by rice prices, then those of wheat. The range of price fluctuations for maize is from -0.25 to +0.3, the narrowest and relatively the lowest among the 3 cereals. In contrast, rice and wheat had price spikes exceeding +0.3, as in the first half of 1970s. Rice had another one in the first half of 2008. Maize however had sharper price slumps compared to rice and wheat. There were two months where its price had declined from the immediately preceding month at the rate of at least 0.20%.

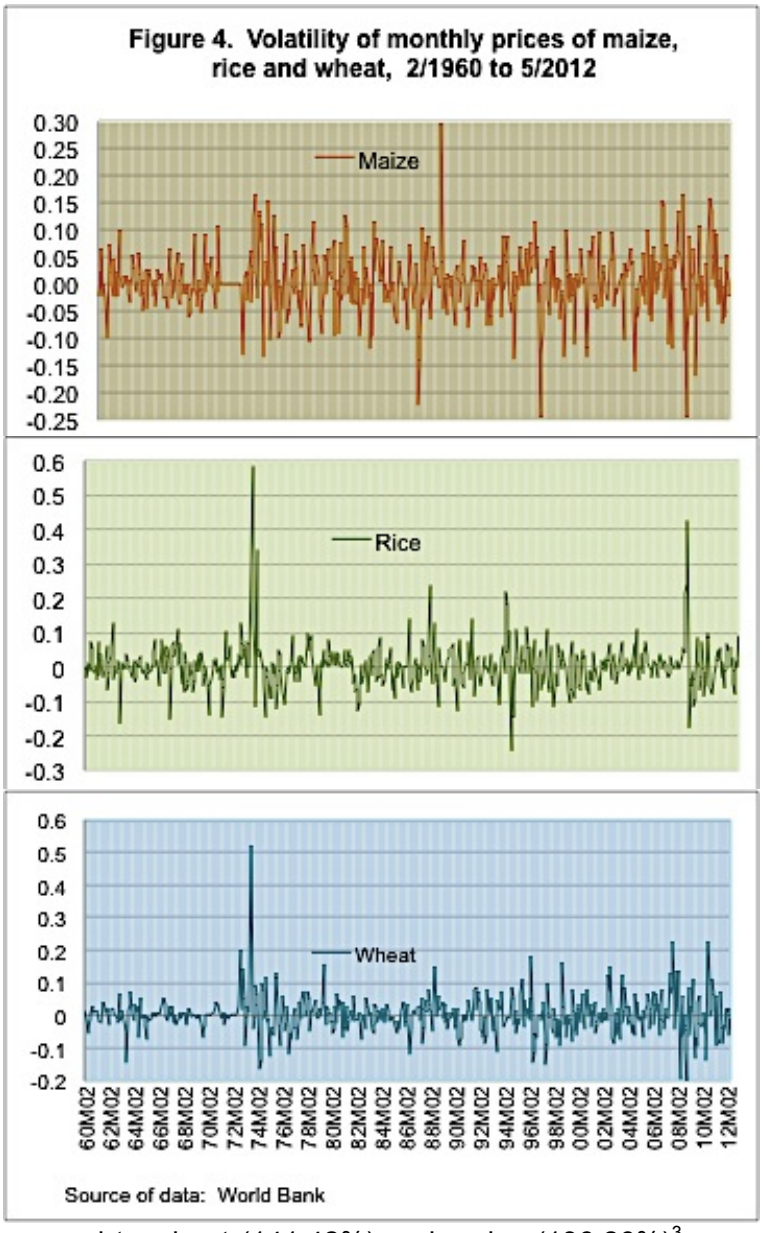


Figure 4. Volatility of monthly prices of maize, rice and wheat, 2/1960 to 5/2012

As shown in Table 5, at least 95% of these price fluctuations are roughly between -0.1 and +0.2. In the case of maize, 95.38% of the observations are in this range, 96.50% for rice, and 96.02% for wheat. Rice has the highest number of observations of price changes exceeding +0.3, having registered 1.11% compared 0.16% for maize and 0.80% for wheat. It would appear from these numbers that rice prices have tended to be most prone to spikes.

For the entire period from Feb 1960 to May 2012, rice had the largest price volatility at 153.73% compared to wheat (141.42%) and maize (136.26%)[3], as shown in Figure 5[4]. This ranking of the three cereals in terms of price volatility did not change in each decade, except for the 1980s. Rice prices came second to wheat prices, in the 1980s, 64.78% and 56.02%, respectively. Maize prices and wheat prices had been virtually as volatile, except in the 1970s.

[3] Price volatility is measured as the standard deviation of the natural logarithm of yearly changes in prices, multiplied by the square root of the total number of observations.

[4] These numbers are larger compared to the average price volatility of each of the five decades since the 1960s, attributable to the scaling done on the standard deviation by the square root of the number of observations.

Table 5. Frequency distribution of monthly cereal price fluctuations, Feb 1960 - May 2012 (in percent)

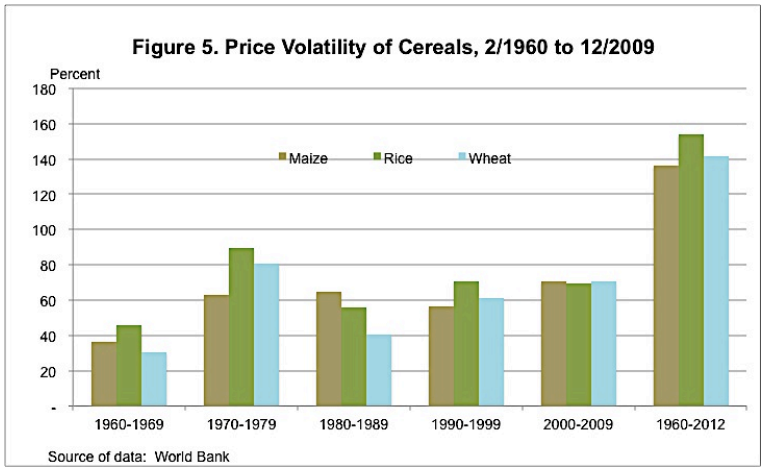
Categories of rates of monthly price changes	Maize	Rice	Wheat
>-0.3 or <=-0.2	-	-	-
>-0.2 or <=-0.1	0.48	0.16	0.16
>-0.1 or <=0	3.34	3.50	2.55
>-0 or <=0.1	48.09	45.70	49.84
>0.1 or <=0.2	43.95	47.29	43.63
>0.2 or <=0.3	3.98	2.23	3.03
>0.3 or <=0.4	0.16	0.64	0.64
>0.4 or <=0.5	-	0.16	-
>0.5 or <=0.6	-	0.16	-
>0.6 or <=0.7	-	0.16	0.16
0.7	-	-	-
Total	100	100	100

Source of data: World Bank

The ten-year price volatility indices indicate that cereal prices had become increasingly unstable through the years. They dropped in the 1980s, from their historical peak levels in the 1970s, but since 1980s then gradually increased.

Price volatility and tradability

Table 6 compares the estimated price volatility indices and the export to output ratios for the three cereals by decades since the 1960s. In three of the decades, except 1980s and 2000s, the numbers for rice appear to support the claim that price volatility is inversely related to tradability, i.e. rice, which had been the least tradable of the three cereals, registered having the highest price volatility. However, the volatility of rice prices came in second to that of maize prices in the 1960s, and to that of wheat prices in the 2000s. Throughout the period from the 1960s to 2010, rice prices had the highest price volatility (152.28%), followed by wheat (139.08%), and maize (133.72%).



As for maize and wheat prices, that price volatility is inversely related to tradability has not consistently held up. The price volatility of maize, which is less traded than wheat, was slightly lower than that of wheat prices throughout the period from 1961 to 2009, and in all of the decades except the1960s and 1980s.

Figure 6 gives the plot of export to output ratios of the 3 cereals against their respective average annual price volatilities. The top panel is for maize. Most of the observations are

clustered between 10% to 20% price volatility. An upward sloping trend may be observed, which is inconsistent with the claim that price volatility is inversely related with tradability. In the case of wheat, the second panel, a similar pattern of direct correlation between tradability and price volatility is observed. The plot of observations has a wider range of price volatility from 5% to nearly 40%. Wheat is shown also in this Figure as having the highest XORs.

Table 6. Average Cereal Price Volatility and Export to Output Ratios: 1961 to 2010 (in percent)

	Maize		Rice		Wheat	
	Price Volatility	XOR	Price Volatility	XOR	Price Volatility	XOR
1961-1969	32.64	9.99	44.97		29.40	16.95
1970-1979	62.72	14.88	89.45		80.86	17.07
1980-1989	64.78	16.20	56.02		40.73	19.97
1990-1999	56.19	13.29	70.69		61.46	18.64
2000-2010	74.52	13.18	71.41		80.22	20.18
1961 - 2010	133.72	13.57	152.28		139.08	18.63

Source of Data: FAO for trade data; WB for prices

The plot of observations for rice, in contrast, has a discernible downward sloping line, indicating some support to the claim that price volatility is inversely correlated with tradability. As expected, the XORs of rice are relatively low and its price volatility indices have the largest span, from less than 10% to as high as over 60%.

The case of rice deserves closer scrutiny. It has the thinnest level of trade among the 3 cereals and it appears from the foregoing analysis that its average XOR is going to remain at the level of between 6 to 7%. In the remainder of this paper, we focus on this issue, and ask what can be done in order to expand rice trade.

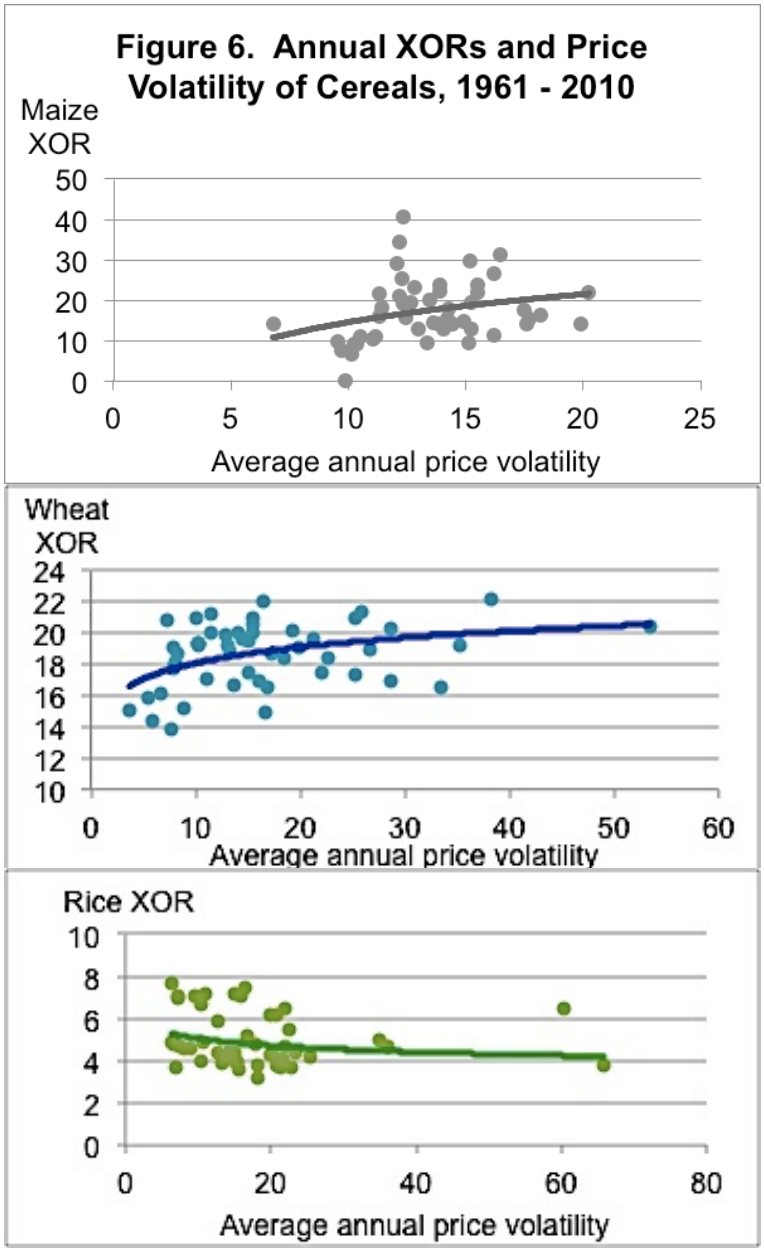
4. Self-perpetuating thin trade in rice?

In the aftermath of the 2008 rice price crisis, the rice importing countries revitalized their respective programs to become self-sufficient in rice[5]. These programs comprise a significant amount of public outlay for agriculture, which stunts the growth of the non-rice industries of the sector, where these countries may have the comparative advantage. Part of the menu of measures for self-sufficiency includes those designed to protect local producers from import competition, penalizing rice consumers in these countries.

The region's thin trade in rice can be self-perpetuating. Large rice deficit countries in ASEAN, Indonesia and the Philippines, adopt self-sufficiency programs apparently to insure themselves against the risk of relying on thin trade for their rice requirements each year. Their stochastic performance in implementing the programs had shaped their "stop and go"

[5] In Malaysia, the government is targeting an increase in yield from 2.47 to 4.48 tons per hectare with public support. Sabah and Sarawak are identified as the new frontiers for production. In April 2008, the Philippine government launched its FIELDS program, targeting the country to be capable of producing at least 98 % of its rice consumption in two years' time. This program continued under the present government, in which the Philippines seeks to be 100 % self sufficient in 2013. Indonesia has been working for full self-sufficiency, devoting public resources to increasing rice production. Even Brunei-Darussalam, which easily obtains its rice requirement from trade, launched in September 2009 its rice hybrid development program, targeting 1,344 hectares to help attain 26 per cent self-sufficiency in rice.

behavior in rice importation. The situation does not encourage long-term investments to attain higher rice productivity in rice exporting countries, particularly in Cambodia and Myanmar, both of which have the potential of increasing their exportable rice surpluses.



By restricting exports the top rice exporters in the region contribute to stunting the growth of rice trade, which in turn only helps in strengthening the resolve of rice deficit countries to stay away from rice trade or at least look at rice trade as their last resort for food security. In 2008, Vietnam had restricted rice exports to avoid importing excessive price fluctuations overseas into the country. In 2011, Thailand started its rice-pledging program, under which it procures rice paddy at about 100 % subsidy rate. The program had already reduced Thailand's exports of rice this year by 50%.

It is important to expand regional rice trade if only to help deepen global rice trade and avoid extreme rice price volatility. Two of the top rice exporters and two of the top rice importers in the world are in ASEAN. The shallow level of rice trade in the region has kept global rice trade from rising. And when rice price spikes occur in the region, they will tend to be transmitted to the global market.

But are importing countries in ASEAN pursuing self-sufficiency programs in rice for the sake of protecting their rice farmers from import competition or because they want to insure themselves against the risk of being without rice if they overly depend on rice trade?

Rice is the top source of livelihood for the majority of the rural population in places where the crop is grown. Policy makers have viewed the commodity as politically sensitive and have accorded their producers special treatment. Rice imports are regarded as undermining the objective of increasing farmers' incomes and making rice farming profitable for food security.

Alternatively, the thin trade in rice may reflect the degree of confidence of importing countries in the capacity of rice trade to assure them of rice supply if and when they need to access world supply of the commodity. Rice is a staple food in Southeast Asia. Indeed, rice provides about 20 percent of the global average calorie intake[6]. Given that rice trade is relatively thin and unstable, member states have tended to self-insure by implementing national self-sufficiency programs in rice.

Excessive price volatility of rice reflects the concern that rice trade is not dependable. If the insurance hypothesis about self-sufficiency programs is correct, one can attribute the direction of causality that excessive price volatility causes trade to be thin. If however, the trade protection motivation for self-sufficiency programs is valid then the direction of causality ought to be the reverse. Thin trade causes excessive rice price volatility.

We test with our data whether the insurance or the trade protection motivation explains self-sufficiency programs. In undertaking the test, we use extreme instead of average rice price volatility.

Extreme rice price volatility

Food price crises involve sharp changes of food prices that are largely unexpected by both consumers and producers. Accordingly, they cause substantial adjustment costs in the economy including reallocations in household spending, hunger, and financial losses. In their report (G20, 2011), the G20 leaders had argued that excessive volatility will not only undermine the access to food particularly of the poor, but also weaken the incentives of farmers to produce food. The World Bank (1986) had identified food price fluctuations to be an important cause of transitory food insecurity. Moreover, every food crisis tends to undermine the trust of stakeholders of food markets in international food trade.

Extreme food price volatility refers to the set of rates of changes of food prices with the likelihood of realization equal to no more than some low level of chance. To consumers, extreme price volatility refers to high order surges of periodic rice prices. In the case of farmers, unexpected slumps of rice prices may inflict financial losses, perhaps leading to business closures. In either situation, their likelihood of happening is low.

Martins-Filho et. al. (2010) suggested a likelihood of no more than 2.5 % of the time for extreme price volatility. Following this convention, the rice price crises that consumers are concerned of involve rates of changes of periodic rice prices in the upper tail end of the frequency distribution.[7]

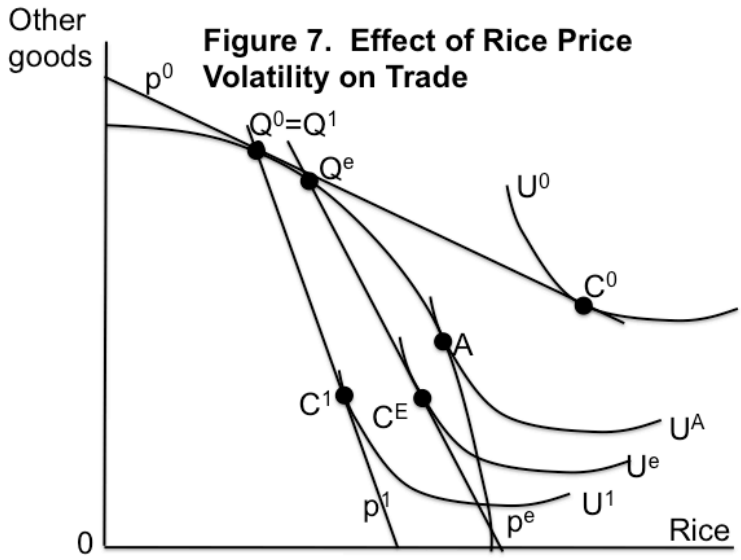
As we showed in Table 5, most of the rates of change of monthly rice prices since the 1960s are no more than the absolute value of 10 %. Thus, these rates are very likely to occur, and are likely to be expected by the market stakeholders. Such fluctuations are regarded as part of the normal operations of the rice market. However, the high order rates of change, at least equal to the absolute value of 15 %, are very unlikely to happen. If one assumes that these rates of price changes are distributed normally, then the extreme rice price volatility is located in the upper or lower tail of that frequency distribution.

[6] FAO (2005). "Rice: what do analytical model results tell us" FAO Trade Policy Technical Notes No. 12

[7] Martins-Filho et al. (2011) used a non-parametric generalized-additive-model of commodity price movements estimated using the spline-backfitted-kernel (SBK) estimator in computing the higher-order quantiles.

There are several approaches in the literature in measuring excessive price volatility. Labao (2011) reviewed 3 approaches for estimating conditional high-order quantiles used in determining if price volatility is extreme. The first one assesses extreme price volatility using a trend represented by the mean of the incrementally increasing dataset. The spline–backfitted-kernel high-order quantile threshold (Martins-Filho et al., 2010) makes use of a generalized pareto distribution of extreme value theory to identify tail-end extreme price fluctuations. The Generalized Auto Regressive Conditional heteroskedasticity or GARCH (Bollerslev, 1986) is the third approach. According to Labao, the most flexible conditional high-order quantiles., in that these thresholds behave gradually and address the problem of volatility-clustering.

Figure 7. Effect of Rice Price Volatility on Trade



Causality tests

In Figure 7, we show the possible welfare effects of rice price volatility on trade. Let p^0 represent the relative world price of rice to other goods with a π probability of occurring, while p^1 happening with a probability equal to $1-\pi$. p^e is the expected world price ratio. Let there be an adjustment cost such that at price p^1, local rice farmers cannot respond and rice production remains at Q^0. Such costs may be short run in nature, but nonetheless U^e can be less preferred to U^A. From the analysis, the country is better off investing in a program that takes it to full self-sufficiency, and attain U^A.

The expected price p^e is drawn such that there is higher probability that the volume of trade may not be adequate to meet the import requirements of the country. In the limit if $\pi=0$, then the expected welfare level, U^1, would even be less preferred than U^e. In order for this result to occur, adjustment costs on the production side cannot be ignored, otherwise at the higher price p^1, local rice production can increase.

In contrast, the alternative hypothesis that a given country protects its rice farmers for reasons other than arising from its lack of confidence in trade, e.g. to provide livelihood to rice farmers in a situation where other means of livelihood are not yet readily available, will have trade causing price volatility. The trade protection will tend to reduce overall trade, which in turn results in excessive price volatility.

Table 6 shows the results of the Granger causality tests of whether extreme rice price volatility causes trade to be thin or is caused by the thin trade. In the first level of the test, the quantity of rice exports is regressed against lagged quantities of rice exports and extreme rice price volatility variables. The extreme price volatility is the number of months in a given year that exceed the threshold value for excessive price volatility. In Test 1, the lagged price volatility variable, exconstlag is estimated to be significantly reducing rice exports. The other price volatility variable (exconstlag2) was however insignificant. The test as to whether

extreme price volatility causes rice exports to decline is significant at 10% level of confidence.

In Test 2, it is excessive price volatility that is regressed against lagged export values (quantlag and quantlag2). Both are statistically insignificant. The test as to whether exports Granger cause rice price volatility is rejected. These results apparently support that self-sufficiency programs are implemented as a virtual national self-insurance against the risk of excessive rice price volatility.

5. Policy implications

An immediate implication of the results of this study is that it is imperative that collectively ASEAN manages the risk of extreme price volatility of rice in order to develop the confidence of Member States on rice trade. This appears to be the first order of business of regional policy makers in order to strengthen the confidence of Member states on trade. With rice price volatility kept within normal levels, the ASEAN member states can focus on measures that truly integrate rice into the region's economic community. These reforms will eventually foster enhanced and more cost-effective food security in the region. These reforms are particularly important for the global rice market considering that the world's top players in the global rice industry and trade are in the region.

The G20 report (G20 2011) identified the following measures to reduce price volatility, namely provision of market information, food stocks, trade facilitation, futures markets, and reduction of post harvest losses. Torero (2011) reviewed several proposed mechanisms to determine their relative implementation cost and contribution towards managing volatility.

Of the actions recommended by numerous analysts for governments to take in the aftermath of the recent rice crisis, which have great potential of reducing excessive price volatility? Three broad categories of actions have the potential of reducing excessive price volatility in rice markets. These are food stocks, market information and trade facilitation.

Food stocks

Wright (2009) stressed the importance of food stocks in explaining the recent food crises in 2007/08. A low level of food stocks makes markets vulnerable to excessive price volatility even with only low levels of supply or demand shocks. Timmer (2011) had prioritized policy actions designed to prevent extreme price volatility over those meant to cope with its impact, particularly on the poor. In the case of rice, he advocated for reserves in Asia. Dawe (2009) and Wright (2009), after controlling for the relatively large holding of rice stocks of China not a major exporter, gave an even lower level of stock to use ratio just before the 2008 rice crisis.

Several versions of food reserves had been proposed including international coordinated grains reserves (ICGR) (Lin, 2008). Timmer (2010) proposed the same for rice in Asia at four levels, private, public stocks in small importing countries, public stocks in large importing and exporting countries, and international stocks. Regional reserves, such as what the ASEAN has with the Plus 3 countries in the case of rice (APTERR) illustrate a multi-country effort of coordinating publicly held rice reserves

International stocks run a high risk of coordination failure and incur a high cost. Lin's proposal for example costs about $1.05 B per year. Although APTERR's regional reserves system, which is presently capitalized at over $3 million and may likely have a lower operating cost than the ICGR, its managers would need to pay attention to the coordination failure that had marked previous efforts in the past.[8] The investment by APTERR in developing its standard operating procedures and in a capability to anticipate rice shortages is noteworthy.

Designed as a social protection measure, emergency reserves have very little role in reducing food price volatility. These reserves however are important in meeting the food need of the population in a given area hit by calamities or where the normal functioning of food markets are temporarily suspended due to the emergency. The proposal sets up a physical reserve, amounting to about 5 % of current levels of food aid or about 300,000 metric tons of food in wheat units. The World Food Program (WFP) is recommended to manage these food reserves, strategically located throughout the world. The Group of 8 Plus 5 countries are tapped for food stock contributions to the reserves and financing (von Braun and Torero, 2008),

Each of the member states in ASEAN maintains country rice reserves. Timmer (2010) stressed the need to expand these reserves particularly for the large importing and exporting countries in Asia. In ASEAN, these countries would be two of the largest rice importing countries in the world, Indonesia and the Philippines, and two of the largest rice exporters, Vietnam and Thailand.

Other proposals focus on the operation of food reserve system. Wright (2009) suggested creating a system for information sharing regarding food stocks to improve policy responses to food shortages as they develop, and allay the fears of stakeholders. Very useful for assessing as correctly as possible the impact of supply shocks on the market, this information nonetheless is difficult to obtain. Incentives for disclosing information about food stocks need to be developed. An international food agency (IFA) is thought as needed to coordinate the operations of the reserves, to gather and disseminate information about food stocks.[9]

Market information

Wright (2009) had pointed out the importance of sharing information about food stocks. Generating and interpreting correctly market information is needed in order to nip in the bud any herding process towards a self-fulfilling crisis. Headey's (2011) point that trade shocks had a very important role to play in explaining the 2008 rice crisis may not comprise a fundamental explanation to the crisis. Trade shocks are the outcome of decisions of market stakeholders. Even the policy actions of India, Vietnam and the Philippines responded to abnormal market behavior of households in response to developing information of a possible shortage in rice.

[8] Most of the international commodity agreements (ICAs) that were established after the second world war, to stabilize global commodity prices collapsed by the early 1960s.

[9] Evans (2009) called for some international agency to manage the food reserves, which he identified as for "emergency purposes", and not for stabilizing rice prices. It may be an existing international body such as the World Food Programme. But this would confine the meaning of emergency and the actions taken in response of it as for humanitarian purposes instead of helping reducing price volatility.

Timmer (2009) argued that speculative behavior destabilized rice price formation in 2007 and early in 2008. Instead of being driven by financial speculation, the price spikes in 2008 may be traced to "the psychology of hoarding behavior … by millions of households, farmers, traders and some governments…"

Herd behavior is anchored on the notion of information cascades where succeeding stakeholders ascribe greater weight on the actions taken by their predecessors. It involves a simple follow-the-leader process where followers respond to the signals derived from the action of the leader. If one starts to stock up rice in order to avoid future rice prices, the rest of the market buyers follow suit, and as the information sets into a larger group of participants then the tipping point for a crisis is reached. This typically happens when the followers possess only a "rough" idea of their own private information, which can easily be overshadowed by previous agents' actions. Accordingly, one would rather be part of a "consensus", because it may be more costly for them to gather information about the true state of the market (Bikhchandani and Sharma, 2000). Banerjee (1992) extensively discussed this type of action and established that the resulting equilibrium is normally inefficient.

The G20 report (2011) sees the importance of investment in information about the food market system. This is only one part of the equation, the other part being the interpretation of such information. And the latter may be met in having a regular forum of policy makers that go over the market situation to further share and interpret information as accurately as possible, and to coordinate policies in response to developing events that have the potential of causing excessive volatility in the market.

Complementing this effort is having a vibrant regional futures trading in rice. Aside from reducing market risk, futures trading provides a convenient platform for market information. The participation of many traders in this market, in turn guided by the market information and interpretation that they may have, provides signals to other participants as to where the market is moving. Like its counterpart in financial securities or other commodities, rice futures trading would need to be regulated well in order to keep and improve its integrity.

Rice trade liberalization and facilitation

Sarris (2009) proposed the creation of a food import financing facility (FIFF) and an international grains clearance arrangement (IGCA). The FIFF is a financing facility for net food importing developing countries. Although in place since 1981, the FIFF was hardly used because of the policy conditions attached to its access. What is proposed is a facility without the IMF conditions to facilitate trade. Wiggins and Keats (2009) look at the IGCA as capable of providing guarantees for grain forward trade contracts to reduce counterparty risks.

It is worth noting that level of imports, not exports, constrains regional rice trade in ASEAN as shown in Figure 2. The expansion of the capacity of the ASEAN region to export rice was due to the entry of Vietnam in the league of the world's top five rice exporters. In the 2000s, ASEAN rice imports hardly increased unlike its exports. Regional rice exports have increasingly been sold to markets outside.

Exporting countries have the capacity to expand their exports if there is added demands for rice in the world market. Like Vietnam, Myanmar and Cambodia have the potential to augment the regional supply of rice. With adequate rice demand and investments in the

supply chain in and out of these countries, the rice export supply capacity of the region can increase. In Cambodia, investments to modernize its road infrastructure, logistics, and its rice mills have the potential of increasing the country's marketable surplus to the world. However, if the rice self-sufficiency objective dominates food policy in the region, then rice-deficit countries only prove the obvious result that rice trade is thin and unreliable.

Trade restrictions. But are the rice-importing member states ready to make their rice trade policies more open? Preferential rice tariff rates in AFTA do not suggest they are. The Philippines, Indonesia and Malaysia have agreed to reduce their respective preferential import tariffs to 30%, 25 % and 20 % respectively – rates that are significantly higher than what free trade area tariff rates ought to be. In addition, the Philippines is negotiating with the WTO to extend its special treatment on rice. Indonesia on the other hand since 2004 has re-introduced a rice import licensing system.

Article 24 of the Agreement recognizes an earlier protocol agreement on providing special considerations for rice. The purpose of the protocol is to allow a member state to request to temporarily raise its import duties on rice. As matters on the protocol stand now, it may be productive to put more structure in the decision making process in ASEAN with respect to requests for waiver under this protocol. Trade remedies under the WTO had gone through this process. In their earlier pronouncements providing for these measures, contracting parties of the former GATT realized gaps, and had to agree on implementing rules and regulations in order to reduce possible diminution of predictability on trade rules brought about by the invocation of these remedial measures.

Large exporting countries in the region, Vietnam and Thailand, have likewise contributed to reducing rice trade. In 2008, Vietnam had restricted rice exports to avoid importing excessive price fluctuations overseas into the country. ASEAN's trade in goods agreement (ATIGA) requires member states to avoid and desist from imposing prohibition or quantitative restriction on the exportation of goods destined for the region. However, the agreement does not prevent member states from maintaining export restrictions in situations when the domestic price of an exportable product is held below the world price by the exporting member state implementing a price stabilization program. Export restrictions may likewise be imposed in situations when the exportable product like rice is in short supply.

Unilateral export restrictions need not come in the form of minimum export prices, export tax or outright prohibitions. The rice-pledging program of Thailand, without an export subsidy, is virtually a rice export limiting policy. At the rate it is announced to be operating, the farm price subsidy is about $500 per metric ton. Assuming there are adequate fiscal resources to pay for the cost of this subsidy, all rice in Thailand is priced twice that of the world market. While Thailand may be able to pass some of that subsidy cost to the world market, its capacity is limited. Other large rice exporters like Vietnam, India and Pakistan, do not need to make world rice consumers pay beyond the production cost of rice. Thus, some of these rice stocks get diverted to the domestic market or to the warehouses as rice stocks. As of the middle of 2012, Thailand's rice exports had already been cut by half.

Wright (2009) called for the strengthening of international trading rules on export restrictions. Stronger disciplines at the multilateral or regional level may provide a counterweight to pressures from the urban population of exporting countries to divert exports towards the domestic market.

Negotiating for multilateral rules on export restrictions or even reduction in import restrictions on rice is likely to be very difficult. However, one promising area of cooperation is for importing countries to agree to reduce their level of self-sufficiency in exchange for commitments of exporting countries in the region to stay away from unilateral export restrictions. This has the potential of deepening the regional rice trade and makes the region to be better prepared for supply or demand shocks.

Regional cooperation

The extreme rice price volatility in 2008 brought with it a unique opportunity for the region to break out of its food insecurity particularly in rice. After the crisis, the ASEAN heads of states came up with the ASEAN Integrated Food Security (AIFS) Framework and its implementing Strategic Action Plan for Food Security (SPA-FS). The plan involves establishing regional and national food reserves, expanding food trade, strengthening market information, and increasing food productivity.

The decision of ASEAN in 2011 to institutionalize regional emergency rice reserves in partnership with China, Japan and South Korea is a much welcome development. Designed to complement existing national reserves of member states and their partners, these reserves help absorb the adverse effects of supply shocks. They comprise quick response systems to supply shocks. Using forward contract arrangements and streamlined release procedures, the ASEAN and its Partners using these reserves have the capability to quickly respond to supply shocks.

However, rice reserves cannot take the role that rice trade plays in stabilizing regional rice markets and ensuring rice security. Regional cooperation needs to be tapped and strengthened to find innovative ways of addressing the problem of extreme volatility of international rice prices and finding doable ways of deepening rice trade in the region.

Another positive move In 2011 was the decision of the ASEAN Ministers of Agriculture and Forestry to undertake a pilot activity of the ASEAN Rice Trade Forum. Convened by the ASEAN Food Security Reserve Board, the forum provides a platform for Member States to share and collectively analyze rice market information to come up with evidence-based coordinated policy actions to at least mitigate the adverse effects of extreme price volatility.

The gathering and sharing of market-related data and information; using the data and an appropriate model of the regional rice market to infer the situation of the market or to analyze the impact on the market of economic shocks and policy developments; and disseminating the generated results from such analyses of the data, can significantly help avoid and reduce extreme price volatility in the regional rice market. Facing stable rice prices, Member States gain more trust in regional rice trade and thus pave the way for its sustained development.

Through the Rice Forum, Member states can collectively discuss measures aimed at making regional rice trade more open in a conducive manner, increase the incentives for increased participation of the private sector in the regional rice value chain, and finding ways how to improve rice productivity.

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