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New Dynamics in the World Rice Market

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Asian Journal of Agriculture and Development (AJAD)
Vol. 21 | 20th Anniversary Issue October 2024
Complete Lineup

ABSTRACT

In the last four decades of the 20th century, the world rice market was highly unstable, with price volatility greater than that on world wheat and maize markets. In the 21st century, however, new dynamics (a thicker world rice market, more irrigation, milder export restrictions) have contributed to a reduction in price volatility that is now lower than that on world wheat and maize markets. In addition, the El Niño events that are responsible for many shocks to the world rice market are largely predictable several months in advance. The reduced volatility on the world rice market and the predictability of El Niño events make it easier to use international trade as an instrument for food security. The recent experience with rice trade liberalization by Asian rice importers has been largely positive, helping to improve food security and the affordability of healthy diets, with little impact on domestic price volatility.

Keywords: rice, El Niño Southern Oscillation (ENSO), international rice trade, world rice market
JEL codes: Q17, Q18

World cereal markets are important for food security in terms of both stability and economic accessibility. Because food production is dependent on the weather, no country is ever assured of stable supplies from its own domestic production. Indeed, since 2000, world rice production has been more stable (less volatile) than domestic production for the more than 100 countries that grow rice around the world.

Furthermore, some countries have consistently lower marginal costs of production, which means that other countries can obtain supplies at a lower price by using world markets. Obtaining food supplies at a lower price means that the cost of a healthy diet is lower for consumers, and more affordable healthy diets can lead to increased human capital (for example by freeing up income for more spending on education and healthcare). This is especially true

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for the poor, who spend a large percentage of their budget on food.

Rice is the staple food for large parts of Asia,[1] and the vast majority (84%) of world rice consumption comes from Asia. Thus, it is important to understand the extent to which the world rice market can contribute to Asian food security. This paper will investigate the stability of world rice prices compared to world wheat and maize prices and provide some reasons that might plausibly explain the differences.

The world rice market is composed of several distinct submarkets that often move in different directions. The most important are indica, aromatic, japonica, and glutinous. This paper will focus on the indica submarket, as it is by far the largest and also the most important for food security. Aromatic rice (comprised of South Asian basmati and Southeast Asian jasmine) is relatively expensive, and is consumed primarily by higher income consumers, so its price fluctuations are of less concern for food security. Japonica rice is consumed primarily in Japan, the Republic of Korea, and northern China. Much of this region is not poor, so again the food security implications of price increases are less. And the glutinous rice submarket is oriented primarily to holiday consumption, except Lao PDR (and parts of Thailand) where it is consumed as a daily staple throughout the year. Thus, again, the food security implications of price movements are of less concern than for the indica submarket.

The indica submarket will be represented in this paper by the price of Thai 5% brokens.[2] Other price series (e.g., from India or Vietnam) can also be used, but over the past 60 years or so, Thailand has been a more consistent exporter. Thus, a longer time series of data is available. Furthermore, indica prices in Thailand, India, and Vietnam tend to move in the same direction.

WORLD RICE PRICES ARE MORE STABLE THAN WORLD WHEAT AND MAIZE PRICES

In the last four decades of the 20th century, (monthly) world rice prices were generally more volatile than world wheat and maize prices (Figure 1).[3] This volatility created difficulties for Asian governments interested in maintaining domestic rice price stability. During the world food crisis in the 1970s, importing country governments had difficulty procuring supplies, as some suppliers banned exports and already-contracted shipments were diverted on the high seas if another buyer suddenly agreed to pay a higher price. Since the dawn of the new century, however, world rice prices have been more stable than world wheat and maize prices. What has changed, and why are international rice prices now more stable than international wheat and maize prices?

CHARACTERISTICS OF WORLD CEREAL MARKETS: THE WORLD RICE MARKET IS DIFFERENT

Concentration Ratios Are High for Exports and Much Lower for Imports for All Three Major Cereals

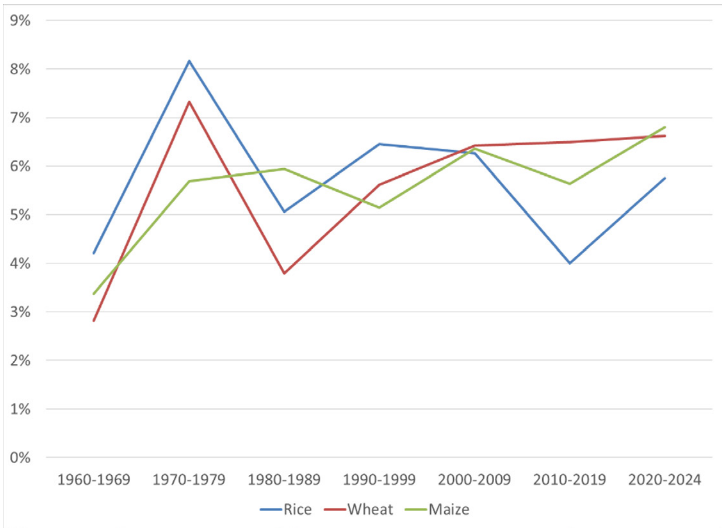
Before discussing the characteristics that make the world rice market unique, one important characteristic shared by the three major

1 Throughout this paper, Asia refers to the aggregate of East Asia, Southeast Asia, and South Asia, as these are the regions where rice is the dominant staple food and where 89 percent of world rice production takes place. Rather than repeatedly naming these three regions, the term "Asia" is used for convenience even though it is technically incorrect because Central and Western Asia are not included.

2 The Asian poor tend to consume rice with a higher percentage of brokens, so it arguably is more appropriate to use the price of Thai 25% brokens. However, the price of Thai 25% brokens is not available for as long a period as the price of Thai 5% brokens. Furthermore, the correlation between the two series (in real terms) is very high—greater than 0.98 from 2000–23. In addition, the differential between the two series is much lower than it used to be. Over the past 10 years (2014–23), the average difference was three percent or USD 18 per ton (in 2023 USD).

3 Volatility over a period is calculated as the standard deviation of the logarithm of p_{t+1}/p_t, with prices p in real terms.

Figure 1. Price volatility by decade



Source of raw data: World Bank (2024); IMF (2024)
Note: Data for 2020–24 are through April 2024

world cereal markets is that all three have high concentration ratios for exports and much lower ones for imports (Table 1).

High concentration ratios on the export side make importing countries vulnerable to export restrictions, as there are a small number of countries that can provide supplies in the event that one (or more) key exporter(s) imposes export restrictions of some sort.

Table 1. Trade concentration ratios (top 5 and top 10) for rice, wheat, and maize, 2022/23

	Exports Top 5	Exports Top 10	Imports Top 5	Imports Top 10
Rice	0.79	0.93	0.29	0.44
Wheat	0.73	0.93	0.27	0.42
Maize	0.86	0.95	0.51	0.70

Source of raw data: USDA (2024)

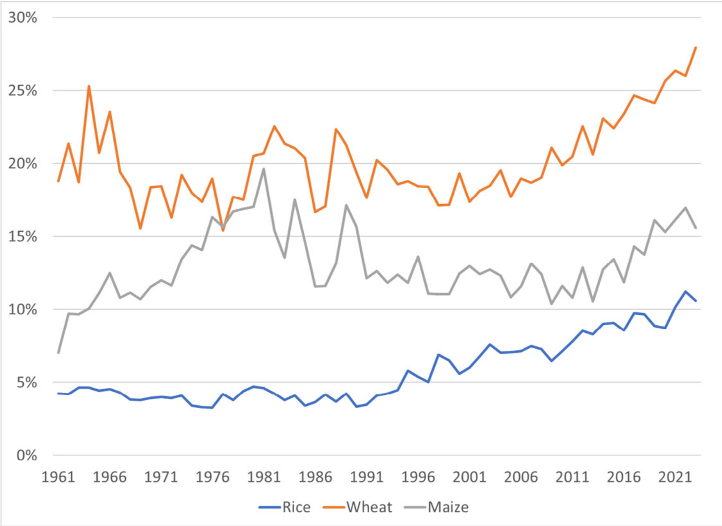
The World Rice Market Is Thin Compared to the World Wheat and Maize Markets

In the world food economy, a thin market is one where international trade is small relative to production (i.e., the ratio of world exports to world production is low). Thin markets are likely to be more volatile because when trading volumes are small, the actions of one country can substantially affect prices (see Rostek and Weretka 2008) for a discussion of thin financial markets).

Historically, the world rice market has always been relatively thin compared to world wheat and maize markets (Figure 2). That remains the case today, even as the world rice market has become substantially thicker over time. In 1990, the ratio of exports to production was about 4 percent, while today it is around 10 percent. While the world rice market remains thinner than the wheat and maize markets, it is still much thicker than it used to be, which should contribute to reducing price volatility. World wheat and maize markets today are also thicker than they were in earlier decades.

World wheat and maize markets are thicker than the world rice market probably because there are a number of large wheat and maize producers with low population density: Argentina, Australia, Brazil, Canada, Kazakhstan, Russia, Ukraine, and the United States. These countries thus tend to have large surpluses that are not needed for domestic consumption and are exported instead. Table 2 shows the top 15 countries in the world based on total area harvested of major cereals

Figure 2. World exports divided by world production, 1960–2023



Source of raw data: USDA (2024)

(i.e., rice, wheat, and maize, average 2020–22), sorted by population density. The top eight countries in the table (all with densities of less than 100 people/km^2) are those listed earlier in this paragraph, and rice constitutes 2 percent or less of total major cereal area in all of them except Brazil (where it is only 7%). On the other hand, in the seven countries with high population density, rice accounts for anywhere from 24 to 94 percent of total area harvested of major cereals. In these countries, there tends to be less surplus available for export, leading to a relatively thin world market.

World Rice Production Is Less Volatile than World Wheat and Maize Production

World rice production, nearly 90 percent of which is grown in East, Southeast, and South Asia, is much more spatially concentrated than world wheat and maize production, both of which tend to be more spread out across continents and hemispheres (Jayne 1993). Such geographical concentration seems likely to lead to higher volatility of production. There are countervailing factors to consider, however.

One important consideration is that irrigated crop production is more stable than rainfed crop production (Muller et al. 2018), and compared to wheat and maize, a greater percentage of global rice area is irrigated. Among all major crops, rice has the highest percentage of harvested area that is irrigated (62%). The corresponding percentages are much lower for wheat (31%) and for maize (20%) (Portmann, Siebert, and Döll 2010). Second, double cropping of rice (i.e., two or three rice crops per year on the same piece of land) is common in Asia because of widespread irrigation (48% of irrigated rice systems grow more than one crop of rice, while this is true for only 27% of rainfed systems) and because of long growing seasons in the tropics (Dawe, Pandey, and Nelson 2010). In contrast, only 2 percent of US cropland is double-cropped (Borchers et al. 2014). Two short duration crops should help reduce production volatility relative to one long duration crop (e.g., winter wheat), as it is generally unlikely both crops will be hit by bad weather. Double cropping in essence provides temporal diversification to counteract the spatial concentration.

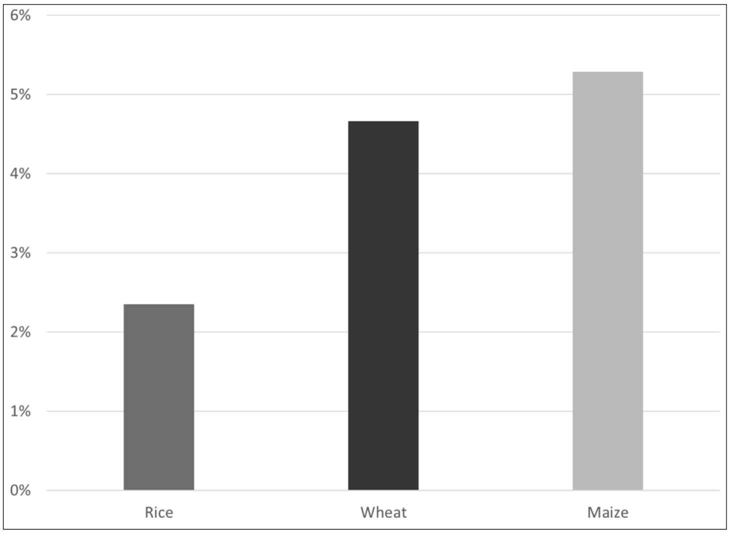
Ultimately, the magnitude of production volatility is an empirical matter, and it turns out that annual production volatility for rice is substantially lower than for wheat and maize (Figure 3). Decade by decade (since the 1960s), production volatility

Table 2. Top 15 countries in total area harvested for major cereals, with share of rice area in total area

Country	Population Density (Persons/ km²)	Area Harvested ('000 Hectares)			Rice Share
		Rice	Wheat	Maize	
Australia	3	38	11,745	45	0.00
Canada	4	0	9,766	1,438	0.00
Kazakhstan	7	96	12,555	180	0.01
Russia	8	184	28,712	2,759	0.01
Argentina	16	190	6,557	8,215	0.01
Brazil	25	1,663	2,784	19,427	0.07
USA	35	1,031	14,760	33,298	0.02
Ukraine	61	7	6,315	4,999	0.00
Thailand	140	11,198	1	1,086	0.91
Indonesia	145	10,507	0	3,345	0.76
China	149	29,817	23,489	42,551	0.31
Nigeria	249	4,365	77	6,018	0.42
Pakistan	302	3,283	8,983	1,597	0.24
India	435	46,149	30,980	9,806	0.53
Bangladesh	1,165	11,604	325	477	0.94

Sources of data: FAO (2024); https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_population_density

Figure 3. Annual production volatility, 2000–23



Source of raw data: USDA (2024)

has been declining for all three of the major cereals (mostly for rice and wheat and presumably due to irrigation investment), but rice has always had the lowest production volatility of the three. The influence of irrigation and double cropping is apparently sufficient to overcome the effects of geographical concentration of production.

The World Rice Market Has Weaker Linkages with Other Cereal Markets and with Energy Markets

The characteristics of any given commodity market can have an impact on the volatility of prices for that same commodity. Market thinness and production volatility are examples of such characteristics. But the price volatility of any commodity can also be affected by its demand and supply linkages with other commodity markets

The world maize market is linked to world energy markets (specifically, crude oil) because one of the main sources of demand for maize is ethanol, which is a substitute for crude oil in making gasoline. The US is the world's largest producer and exporter of maize, and approximately one-third of the US crop is used to make biofuels (USDA 2023). The world crude oil market is much larger than the world maize, wheat, and rice markets combined (based on gross value of trade), and it is also more volatile. Thus, volatility in world crude oil markets can spill over into maize markets and create volatility in that market as well (de Gorter, Drabik, and Just 2015).

Another key source of maize demand is for animal feed. Globally, animal feed accounts for more than 60 percent of total maize use (USDA 2024). A smaller proportion of wheat is used as animal feed (about 20%), but this is still nearly triple the percentage of rice used as feed, which is about 6.7 percent. Rice is less commonly used as animal feed because it has lower metabolizable energy than both maize and hard wheat for both poultry and swine feeds. Rice also has lower crude protein content than wheat and maize (Skorbiansky, Childs, and Hansen 2018). Thus, if maize prices increase, there will be increased demand for wheat as animal feed, and wheat prices will go up as well. Rice prices will respond less due to its relative lack of suitability as animal feed (and its higher price). On the other hand, rice and wheat are better substitutes for one another as staple foods and sources of dietary energy for humans, relative to maize, which, as noted earlier, is mainly used for animal feed and ethanol.

On the supply side, rice is a semi-aquatic plant primarily grown under flooded conditions,[4] while wheat and maize are grown on nonflooded fields, as are most crops. This means that switching between wheat and maize or other crops is more likely than switching between rice and other crops. Also on the supply side, changes in crude oil prices can affect cereal prices by raising fuel prices (which in turn raise operating costs for machinery) and by raising urea prices (which uses natural gas as a key input). Although mechanization of rice production has been increasing over time, rice production is likely much less mechanized than wheat or maize production because most rice production is concentrated in parts of the world where farm sizes are small. Lowder et al. (2021) splits the world into eight regions and provides an estimate of average farm size in 2010 for each of those regions, which split naturally into two groups. The regions where farm sizes are small are the first four entries in Table 2 of Lowder et al. (2021): East Asia and the Pacific, Middle East and North Africa, South Asia, and Sub-Saharan Africa. Across those four regions, average farm size varies from 1.4 to 3.6 ha, with the three largest of those regions all at 1.6 ha or less. The other four regions in that same table (Europe and Central Asia, Latin America and the Caribbean, high-income European countries, and other high-income countries[5]) have large average farm sizes, varying from 21 to 78 ha. While 57 and 59 percent of global wheat and maize production (respectively) was grown in regions with large farm sizes, just 5

4 Upland rice is an exception; but it accounts for a very small percentage of global rice area and an even smaller percentage of global rice production, as its yield is lower than that of irrigated rice.

5 "Other high-income countries" is dominated by Australia, Canada, New Zealand, and the US.

percent of world rice production was grown in those regions. Thus, despite the widespread use of machinery rental markets in many Asian countries, rice production is likely less mechanized than wheat and maize production.

Ultimately, the relative strength of linkages among the three major cereals (and with the crude oil market) is an empirical matter. The higher correlation coefficient between wheat and maize prices (0.79) than between wheat and rice (0.39) or maize and rice (0.49) suggest that the demand and supply linkages between wheat and maize are stronger relative to either of those with rice. The linkages between wheat and maize with crude oil are also stronger than those between rice and crude oil. The linkages between wheat and maize with crude oil became especially strong after ethanol became a major component of maize demand around 2006 (Table 3), when for the first time, more than 20 percent of the US maize crop was used to make ethanol.

Table 3. Correlation coefficients between rice, wheat, maize, and crude oil prices, 2006–24

	Rice	Wheat	Maize	Crude Oil
Rice	–			
Wheat	0.39	–		
Maize	0.49	0.79	–	
Crude oil	0.52	0.73	0.71	–

The same pattern shown in Table 3 is also clearly visible in the price movements of rice, wheat, and maize in various episodes of rising prices over the past two decades. In the 2006–08 price crisis, prices for maize and wheat rose substantially more than a year before rice prices spiked. In 2010–11, wheat and maize prices more than doubled, while rice prices increased only by 35 percent. During the COVID era, wheat and maize prices more than doubled from mid-2020 to mid-2022, a rally that started well before the war in Ukraine. During that same period, world rice prices declined. In 2023, rice prices surged while wheat and maize prices declined substantially. In summary, the global maize and wheat markets are more closely linked to one another and to global energy markets than either is to rice.

Rice Has Much Smaller Futures Markets than Wheat and Maize

Futures markets for wheat and maize exist in the US, Europe, and South America, and are particularly well-developed in the US, where they date back to 1859 (CFTC 2024). A rice futures market existed in Japan more than 100 years before that, authorized in 1730 in Osaka (ODEX 2024). But this market was closed during World War II and was not in operation again until several decades later. Over the past 20 years, rice futures markets have traded in several countries (China, India, Japan again, Thailand, the US), but they were much less well-developed than for wheat and maize and are now completely closed or inactive in all but the US.

There are currently two rice futures contracts in the US, one based on the price of Thai 5% brokens and the other based on long grain paddy prices in the US (the two prices tend not to be correlated in the short-term). The contract based on the price of Thai 5% brokens has attracted little interest, and even the long grain rough rice contract has much lower liquidity than the wheat and maize futures contracts, especially for delivery dates other than the nearby date (McKenzie 2024).

The reasons for why these futures markets are inactive is beyond the scope of this paper, but these are likely related to heavier government intervention in price formation in order to promote price stability (Dawe and Timmer 2012; Timmer 1996; 1989). Many governments also fear that futures markets will enhance the opportunities for destabilizing speculation. This is of particular concern in the case of rice as it is a staple food with limited processing required before consumption (meaning that changes in domestic rice commodity prices have a large impact on the retail price of the final product purchased by consumers). In contrast, there is more processing required to convert wheat into bread—thus, changes in wheat commodity prices have less impact on the retail price of bread. Maize is not widely consumed by humans as a staple food, except in some particular locations in Asia and Africa.

It is not *a priori* clear if the presence or absence of futures markets will affect spot price formation at all times. Nevertheless, there is concern in some quarters that uninformed speculators and/or index fund investors could have exacerbated international price movements during the world food price crisis in 2008 (Gilbert 2010). Regarding the 2006–08 food price crisis, Timmer (2010) noted that "rice prices in world markets did not follow…early price booms in oil, wheat and corn, mostly because the venues for speculation in rice price movements by 'outside' investors in futures and options markets are extremely limited." If the fears of speculation by outsiders are legitimate, the lack of actively traded rice futures markets could reduce the occurrence of price spikes in certain circumstances and contribute to lower price volatility. In any event, rice is markedly different from wheat and maize in its lack of active deep futures markets.

INSTABILITY IN THE WORLD RICE MARKET: HOW TO MAKE IT EVEN MORE STABLE AND RELIABLE

Export Restrictions

Despite the greater price stability of the world rice market, it still experiences price fluctuations that can destabilize domestic prices and/or make it difficult to access supplies. Unstable domestic prices are of great concern to Asian policymakers, who typically devote substantial political and financial resources to stabilize domestic prices in the face of shocks to domestic production or shocks from the world market (Timmer 2024). There are any number of events or policies that can lead to sharp price fluctuations, but one that causes particularly large price increases is an export restriction from one of the leading exporters.

Thailand's export restrictions in the early 1970s were an important contributing factor to the world rice crisis at that time (Timmer and Dawe 2010). The world rice price crisis of 2008 was caused by several factors, but one of the most important was India's export restrictions that began in the second half of 2007 (Dawe and Slayton 2010; Headey and Fan 2010).[6] Vietnam's very short-lived export restrictions in April 2020 caused an immediate 20 percent increase in world prices (FAO 2020). India imposed export restrictions on non-basmati non-parboiled rice in July 2023, leading to an immediate surge in prices on the world market. Thus, export restrictions have played a starring role in the major rice price fluctuations on world markets of the past 60 years.

Why are export restrictions imposed if they could create price surges on international markets? By preventing supplies from entering world markets, these export restrictions help to restrain increases in domestic prices in the exporting country relative to what they would have been otherwise. But despite the benefits for its own domestic consumers in terms of food security, there are also disadvantages to exporting countries from imposing such restrictions.

First, export restrictions result in lower domestic prices, which harm farmers and reduce incentives to produce more rice and invest in the sector. These effects will be larger for countries where exports account for a larger share of domestic production, such as Pakistan (56% on average over the past three years), Thailand (50%), and Vietnam (24%). Second, they benefit competitors on international markets. When Thailand indirectly restricted rice exports beginning in late 2011 by stockpiling a large share of domestic output, it promptly lost market share to India, Vietnam, and others. Thailand had been the world's leading rice exporter for more than 30 years, but India has been the world's leading exporter ever since. Third, export restrictions encourage importers to reduce reliance on the world market, consequently reducing confidence in international trade, and

6 Other important factors were export restrictions by Vietnam in 2008 and large tenders for imports by the Philippines that were negotiated at prices above market levels in the Mekong Delta. For more details, see Dawe and Slayton (2010).

destroying future business opportunities for all exporters. Finally, rice export restrictions could backfire by creating panic on the world market and jeopardizing food security for all countries, even those imposing restrictions.

Greater awareness of these negative effects can hopefully discourage the use of export restrictions in the future, or at least lead to restrictions that are less restrictive. For example, India's most recent restrictions imposed in 2023 allowed for exports to countries for food security purposes, under the auspices of the government. Thus, while the restrictions certainly contributed to the surge in prices on the world market (the price of Thai 5% brokens increased by 18% in less than three weeks after the restrictions were announced), it would have been worse if it was a full ban.

It is also important for the various players in the world rice market to have regular transparent consultations to avoid sudden unexpected policy shifts. ASEAN has served as a vehicle for such cooperation and has contributed to increased stability of the world rice market (Timmer 2023).

El Niño Southern Oscillation

One of the common causes of export restrictions is bad weather, which causes a drop in domestic production (for rice, drought is the greatest concern). Furthermore, a production shock can in turn affect prices even when it does not lead to export restrictions. One of the most significant causes of drought in Southeast Asia is the warm phase of the El Niño Southern Oscillation (ENSO), commonly referred to as El Niño.[7]

El Niño events recur periodically with an irregular frequency of about once every seven to 10 years. The strength and phase of ENSO is measured using the Niño 3.4 sea surface temperature anomaly (SSTA) index. The Niño 3.4 SSTA index is calculated monthly by the National Oceanic Atmospheric Administration (NOAA), using data on surface sea temperatures in an area of the Pacific Ocean bounded by 5° N and 5° S latitude and 170° W and 120° W longitude. Positive values indicate the warm phase, while negative values indicate the cold phase.

Since 1960, whenever the Niño 3.4 SSTA index reached a value of +0.6 or higher in July, the index would nearly always (9 times out of 10, top row of Table 4a) reach a peak of at least +1.45 sometime in the next nine months.[8] A peak of that magnitude is relatively high—there have been only nine such occurrences since 1960, roughly one every seven years on average. Furthermore, the converse is also true—if the July index were positive but less than +0.6, the index would not reach +1.45 in the next nine months (22 times out of 22, bottom row of Table 4a).

Table 4a. Number of cases with various July and peak SSTA values, ENSO warm phase

	Peak > 1.45 (Strong)	Peak ≤ 1.45 (Weak)
Jul >0.6	9	1
0 < Jul ≤ 0.6	0	22

Note: July SSTA value is for year t, peak is calculated over July (t) – March (t+1).

Similarly, if the Niño 3.4 SSTA index was less than -0.7 in July, the index would always reach a trough of at least 1.45 sometime in the next nine months (seven times out of seven, top row of Table 4b). And since 1960, out of 25 instances when the Niño 3.4 SSTA index in July was weakly negative (i.e., not as negative as -0.7), the trough failed to reach -1.45 on 23 occasions (92%, see bottom row of Table 4b). Thus, there have been only two instances when a strong (<-1.45) La Niña episode occurred even though the July SSTA index did not drop below -0.7 (bottom row of Table 4b).

7 The cold phase of ENSO is known as La Niña. It typically leads to greater than normal rainfall in Southeast Asia. Although increased rainfall can lead to flooding and landslides, it is usually beneficial for rice production because rice is a semi-aquatic plant.

8 Since 1960, the only exception to this pattern was in July 1963, when the Niño 3.4 index reached 0.72, but its subsequent peak was only 1.05, much less than 1.45.

Table 4b. Number of cases with various July and trough SSTA values, ENSO cold phase

	Trough < -1.45 (Strong)	-1.45 ≤ Trough (Weak)
Jul <-0.7	7	0
-0.7 ≤ Jul < 0	2	23

Note: July SSTA value is for year t, trough is calculated over July (t) – March (t+1).

Combining tables 4a and 4b (see Table 4c), the Niño 3.4 SSTA index in July has robust predictive power. A strong signal in July (either strong positive or strong negative as defined in the left-hand columns of tables 4a and 4b) leads to a strong peak or trough in the next six months 94 percent of the time (16/17). And a weak signal in July (either weak positive or weak negative) leads to a weak peak or trough in the next six months 96 percent of the time (45/47).

This strong predictive power can also be understood through a basic scatterplot of July Niño 3.4 SSTA versus the peak or trough SSTA in the subsequent nine months (July–March, Figure 4), which gives an adjusted R^2 of 0.79.

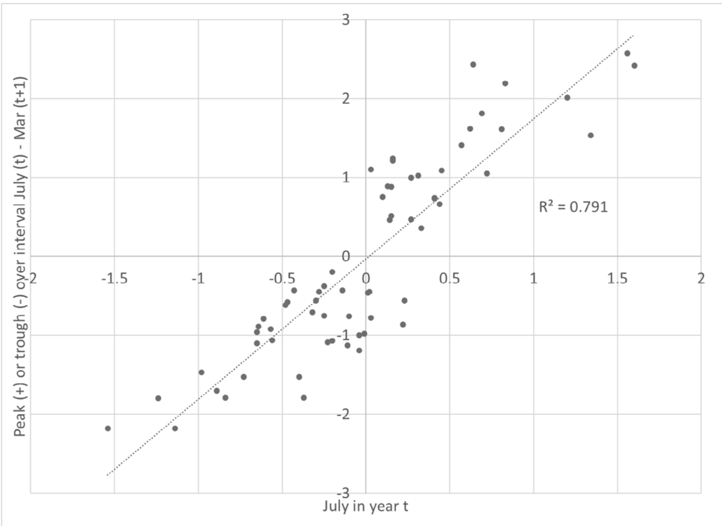
Table 4c. Number of cases with various July and peak/trough scenarios

	Peak > 1.45 or Trough < -1.45 (Strong)	-1.45 ≤ Peak ≤ 1.45 (Weak)
Jul >0.6 or Jul <-0.7	16	1
-0.7 ≤ Jul ≤ 0.6	2	45

Note: July SSTA value is for year t, peak or trough is calculated over July (t) – March (t+1)

What are the impacts of strong El Niño and La Niña events? Historically, strong El Niño events lead not only to reduced domestic rice production in several ASEAN countries (Naylor et al. 2001; Naylor et al. 2002; Roberts et al. 2009). They also tend to be associated with substantial increases in prices on the world rice market (Table 5), as importing countries demand additional supplies

Figure 4. Scatterplot of July (t) Niño 3.4 SSTA (horizontal axis) versus peak or trough Niño 3.4 SSTA during the period July (t) to March (t+1) (vertical axis), 1960–2023



Source of data: NOAA (2024)

Note: For the purposes of this scatterplot, each year (July [t] to March [t+1]) has either a peak or a trough, but not both. The decision whether each particular year reached a peak or a trough was determined by choosing the month with the highest absolute value of the Niño 3.4 SSTA in each year (July to March). If the month with the highest absolute value has a negative SSTA, that negative value is recorded as the trough for that year. If the month with the highest absolute value has a positive SSTA, that positive value is recorded as the peak for that year.

Table 5. El Niño events since 1960 (peak Niño 3.4 SSTA > 1.45)

Year t/t+1 (April to March)	SSTA July	SST Peak	Peak Month	Price Change (USD/Ton)	Price Change (%)	Period of Price Change
1965/66	0.81	1.61	Oct 1965	+269	+25	Jul 1965 – Apr 1966
1972/73	0.83	2.19	Dec 1972	+440	+51	Jul 1972 – Mar 1973
1982/83	0.64	2.43	Jan 1983	+86	+12	Oct 1982 – Mar 1983
1987/88	1.34	1.53	Sep 1987	+294	+57	Jul 1987 – Feb 1988
1991/92	0.62	1.62	Dec 1991, Feb 1992	No substantial sustained price change		
1997/98	1.60	2.42	Nov 1997, Jan 1998	+132	+28	Nov 1997 – Jun 1998
2009/10	0.69	1.81	Dec 2009	No substantial sustained price change		
2015/16	1.56	2.57	Nov 2015	+90	+19	Dec 2015 – Jun 2016
2023/24	1.20	2.01	Nov 2023	+139	+27	Jun 2023 – Jan 2024

Note: Price increases refer to inflation-adjusted (US CPI) prices of Thai 5% brokens (2023 USD).
Data sources: NOAA (2024); World Bank (2024); IMF (2024)

Table 6. La Niña events since 1960 (trough Niño 3.4 SSTA < -1.45)

Year t/t+1 (April-March)	SSTA July	SSTA Trough	Trough Month	Price Change (USD/Ton)	Price Change (%)	Period of Price Increase
1970/71	-0.98	-1.47	Jan 1971	-274	-27	Aug 1970 – Apr 1971
1973/74	-1.14	-2.18	Dec 1973	+1575	+70	Oct 1973 – Apr 1974
1975/76	-1.24	-1.80	Jan 1976	-631	-34	Sep 1975 – Mar 1976
1984/85	-0.40	-1.53	Dec 1984	-162	-22	Aug 1984 – Mar 1985
1988/89	-1.54	-2.18	Nov 1988	No substantial sustained price change		
1998/99	-0.73	-1.53	Jan 1999	-174	-29	Jul 1998 – Apr 1999
1999/2000	-0.84	-1.79	Jan 2000	No substantial sustained price change		
2007/08	-0.37	-1.79	Jan 2008	+806	+168	Oct 2007 – Apr 2008
2010/11	-0.89	-1.70	Jan 2011	+122	+20	Jul 2010 – Dec 2010

Note: Price increases refer to inflation-adjusted (US CPI) prices of Thai 5% brokens (2023 USD).
Data sources: NOAA (2024); World Bank (2024); IMF (2024)

and/or exporting countries have fewer supplies available.

Of the nine episodes in which the Niño 3.4 SSTA index reached a peak of +1.45 or more since 1960, there was a substantial sustained (over at least six months) price increase on the world market of more than 25 percent in five of the episodes, and two other episodes where the increase was greater than 10 percent (Table 5). These data show that the world rice market is vulnerable to sharp price increases during El Niño events.

The impacts of strong La Niña events are less consistent (Table 6). It seems that La Niña is more commonly associated with price decreases on the world market, although there have been several times where a strong La Niña coincided with very large price increases. However, it seems likely that La Niña played a relatively minor role in these two instances (1973/74 and 2007/08). In the former case, the world was in the midst of major geopolitical and oil crises (along with export restrictions from key suppliers and a major El Niño in between the two strong La Niña events). While in the latter case, there were export restrictions from several major exporters and no key weather-related rice production shortfalls (Dawe and Slayton 2010).

CONCLUSIONS: COUNTRY EXPERIENCE USING THE WORLD RICE MARKET TO IMPROVE FOOD SECURITY

The world rice market is more stable than it was in the past, and more stable than world wheat and maize markets. Furthermore, some (although not all) of the price shocks that the world rice market does experience are due to El Niño and are somewhat predictable months in advance. These facts suggest that the world rice market can be used as a key element of a food security strategy, both to reduce rice retail prices (in countries with high domestic rice prices) and to stabilize price fluctuations.

Several large Asian rice importers (Bangladesh, Indonesia, and the Philippines) have embraced this approach at one point or another during the past 30 years and have allowed the private sector decide on the quantity of imports. Bangladesh liberalized its international rice trade in 1994, allowing the private sector to import subject to a tariff. This regime is still in place today. In September 1998, in the wake of a strong El Niño and the Asian financial crisis, Indonesia removed Bulog's import monopoly and allowed the private sector to import rice. Those reforms lasted several years but were slowly rolled back and by 2004 had been abandoned completely. In the Philippines, a rice tariffication law (RTL) took effect in 2019, which not only allowed the private sector to import but banned the National Food Authority (NFA) from importing at all. At the time of writing, discussions in the Philippine legislature are ongoing as to whether the RTL should be modified or remain in its original form

Bangladesh allows the private sector to import as much rice as desired, subject to a tariff (Dorosh 2008). On average, since the start of the reforms, the private sector has imported approximately three-fourths of total rice imports, with the government importing the rest. The tariff placed on rice imports varies, depending upon the size of the domestic harvest and prices on the world market, with the objective of stabilizing domestic rice prices. For example, between 2022 and 2024, the tariff varied from a maximum of 62.5 percent to a minimum of 15.25 percent. The flexibility in importing channels (i.e., private sector and government) can be helpful during major emergencies. For example, during the massive "flood of the century" in 1998, the Bangladeshi private sector responded quickly by importing large amounts of rice supplies from India to stabilize domestic prices. Private sector rice imports, carried out mostly by small traders, totaled 2.5 million tons from July 1998 through April 1999 and were six times larger than government rice distribution.

Indonesia liberalized its rice trade from 1999–2003 in response to pressure from the International Monetary Fund (i.e., IMF), following the Asian financial crisis. During that time, Bulog lost its monopoly on rice imports, and private importers were allowed to import as much or as little rice as they desired, subject to paying the tariff (which was zero initially, but later increased). Despite the switch from an import monopoly to a more open system, Indonesia experienced no adverse impacts on domestic price stability. Imports averaged 2.7 million tons per year, with the private sector accounting for about two-thirds of those imports. In addition, domestic retail prices declined by 29 percent in real terms (i.e., after adjusting for inflation) from January 1999 to December 2003, benefiting poor consumers who spend a large percentage of their income on rice. Rice production continued to increase over those years. Despite the beneficial outcomes for consumers, rice farmers were harmed by the fall in prices, and eventually the reforms were rolled back.

As a result of the Philippines' RTL, which took effect in early 2019, the private sector is allowed to import rice at a tariff of 35 percent, while the state-owned enterprise NFA is only allowed to procure rice domestically (for eventual use in emergencies), not from imports. As part of the rice trade liberalization, the tariff revenues were earmarked for a Rice Competitiveness Enhancement Fund that distributed farm machinery, certified seeds, and credit and organized farmer trainings with the objective of increasing the competitiveness of domestic rice production against imports.

With the advent of RTL, imports increased from an average of 1.21 million tons per year (2014–2018) to 3.16 million tons per year (2019–2023), more than double. These additional supplies led to lower rice retail prices—in real terms, average prices were 16 percent lower from 2019–2023, compared with 2014–2018. Domestic farm prices also fell between those periods (by 20 percent); but comparing the five years before RTL (2014–2018) with the five years of RTL (2019–2023), rice area harvested increased by 1 percent, rice yield increased by 4.1 percent, and production increased by 5.2 percent. Thus, despite the large decline in prices, the COVID-19 pandemic, and shocks to world fertilizer markets that led to higher urea prices in the Philippines, production still increased. Furthermore, analysis of household survey data shows that while all quintiles of the income distribution are net consumers of rice, the poorest benefit more in percentage terms than the other quintiles (Balie et al. 2021).

Table 7. Rice price volatility, retail, and world, during episodes of government control and liberalization

	Retail	World
Indonesia		
1994-1997 (government)	0.023	0.090
1999-2003 (private)	0.019	0.056
2004-2008 (government)	0.026	0.037
Philippines		
2014-2018 (government)	0.009	0.041
2019-2023 (private)	0.017	0.050

Notes: Volatility over a period is calculated as the standard deviation of the logarithm of p_{t+1}/p_t, with monthly prices p in real terms. Results in nominal terms are similar and not shown here. World price volatility is calculated in local currency terms, i.e., the world prices in USD are converted using an average exchange rate. Bangladesh is not included as I could not locate retail price data before liberalization. All periods are of equal length (five years) except that 1998 and 2008 are not included for Indonesia as there were major shocks to the world market in those years (that were not due to Bulog).

Retail price volatility on the domestic market during episodes of trade liberalization has been roughly similar to volatility during periods of government import monopolies (Table 7). Under both regimes, at least for Indonesia and the Philippines, domestic retail price volatility has been much less than volatility on the world market. Thus, allowing the private sector to import does not appear to increase price volatility.

Hence, the Asian country experience of using the world rice market for food security (i.e., making rice more affordable at stable prices) has been largely positive. Some point to the negative impacts on farm prices (and thus, rice farmers) in importing countries to provide a countervailing perspective. This perspective has some validity in the short-term, but in the context of long-term structural transformation of the Asian economies, it is clear that rice farmers need to diversify their income sources to include more nonfarm income (FAO 2018; Timmer and Akkus 2008). As the share of rice in the overall economy continues to shrink, it is obvious that the economy cannot support as many specialized rice farmers as it did in the past. Furthermore, it is also important to note that in rice-importing countries, the poorest people are mostly net rice consumers who benefit from lower rice prices.

ACKNOWLEDGMENT

I acknowledge helpful comments and suggestions from Peter Timmer, but he is not responsible for any errors in the paper.

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