Exogenous Shocks, Policy Responses and Stability: Some evidence from the Global Rice Market

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1. Introduction

In recent years, an old concern has resurfaced - that of rising food prices. Since the food crisis in the mid-1970s, the world enjoyed declining to stable real prices till the mid-90s. A spike in 1995/96 was followed by a return to the long-term trend. From the early part of the 2000s, however, prices have crept upwards and this culminated in sharp rises during 2006/7 to 2008/9.

Palm oil, rice and wheat doubled in price in 2007/08 relative to 1999/00. Wheat and maize prices increased by more than 75% (Gilbert, 2011).[1] What was striking was that the price spikes happened in a very short time interval. In nominal terms, world maize prices increased by 54% from August 2006 to February 2007 followed by an increase in world wheat prices of 125% from May 2007 to March 2008. The most dramatic increase occurred in rice. From April 2001 to September 2007, the gradual upward drift saw Thai 100% B rice to double from US$ 170 per ton to US$ 335 per ton (amounting to a 67% increase relative to the US consumer price index). But between October 2007 and April 2008, the price tripled to over US$ 1000 per ton (Dawe and Slayton, 2011).

Many factors have been identified as likely culprits: supply shocks to wheat and maize, low level of world stocks at the onset of the crisis, the competition from biofuels and rising energy prices, depreciation of the US $, financial speculation and a liquidity induced commodity boom owing to rapid economic growth in China. However, a clear identification of these factors has been problematic because rising prices lead governments to put in place policies to buffer the

[1] Gilbert reports these price changes after deflating the nominal prices by the US producer price index.

impact. Hence the outcomes (of price shocks) could be because of both exogenous shocks (such as crop failure) as well as endogenous shocks (because of policy responses). As a result, it is not always clear whether it is the underlying primitives (due to production shocks, supply and demand elasticities) that are fragile or is it the manner of responses that exaggerate the fluctuations?

This paper estimates the impact of exogenous shocks in rice production on rice consumption and trade over the period 1960-2010 for a cross-section of rice exporters and importers. The paper addresses the issue whether policy responses have magnified or moderated these exogenous shocks.

2. The Rice Market and Endogenous Shocks

The literature is agreed that it is the rice market that is particularly subject to endogenous policy shocks. Unlike wheat and maize, a relatively small proportion of world production (7%) enters international trade. Moreoever, wheat and maize trade is driven by surpluses from rich and large land abundant countries such as the US, Canada, Argentina and Australia. In the case of wheat, the U.S., Canada and Australia export more than 50% of their production. The biggest rice exporter, Thailand, exports close to 40% of its output. However, its share in world rice output is less than 5%. On the other hand, the large rice producing countries such as China, India, Indonesia and Bangladesh are either deficient or at best, have small surpluses (relative to consumption). All of these countries have poor populations that are severely affected when rice prices rise. Due to these food security concerns, these countries will likely reduce their net supply to the world markets in times of crisis. This can take the form of export restrictions (in

the case of exporters) or reductions in import tariffs. In either case, the attempt to increase their share of world consumption increases prices. Thus policies directed towards insulating domestic markets magnify international price volatility when all countries attempt to do it at the same time (Abbot 2011, Martin and Anderson 2011).

In the crisis of 2007/08, many scholars argued that it is likely that the spike in rice prices was due not to crop failure or low stocks but because of policy measures put in place by panicked governments. Writing as early as October 2008, Timmer (2008) argued that the rise in rice prices must be seen as different from that in wheat and maize. Low stocks, crop failure or financial speculation were not credible factors behind the price increases in rice. Nor can it be attributed in a straightforward manner to the rise in wheat or maize prices because substitution in consumption between these grains is limited. Rather the spike must be seen as due to export restrictions by some of the major exporting countries that induced panic buying by importers such as the Philippines and storage driven by hoarding instincts by governments and other agents. This has been echoed by others (Dawe and Slayton, 2011; Gilbert and Morgan, 2010; Wright, 2011).

Martin and Anderson (2011) estimate that more than 45% of the explained change in international rice price during 2005-08 is due to export restrictions (compared to 29% for wheat). If anything, the Martin and Anderson estimate is surprising that endogenous shocks accounted for only about half of the rice price increase when most of the literature seems to argue that it is significantly driven by policy shocks. The view that export policies contributed to global price volatility has also been tested by Giordani, Rocha and Rutta (2012). Using a data set on trade measures relating to the food sector, they find that the probability that a country imposes a new export restriction is positively associated with the global restrictions on the product (i.e., share of

international trade covered by export restrictions). Furthermore, during the period 2008-2010, they estimate that a 1 percent surge in the share of trade covered by export restrictions is associated to a 1.1 per cent increase in international food prices.

3. The Reliability of Rice Trade and Markets

If supply shocks are uncorrelated across countries, the global supply is essentially stable. Provided that there are no demand shocks, the global price is also stable. Importing countries would be able to import, whenever they need to do, at a stable price.[2] The logic of this argument does not require that supply shocks across all countries be completely uncorrelated. All that is required is that the correlation is less than one so that the global aggregate is a lot more stable than individual country supplies.

An integrated global market and trade therefore provides a means for price stabilization without costly investment in commodity stocks. This has been the view of many economists. However, this does not take into account the possibility of government interventions such as market insulating policies. If exporters restrict their supply fearing a shortfall, importers are deprived of food just when they need it the most. Such an experience may well persuade importers that food trade is unreliable and that they should invest in domestic stocks.

Gilbert (2011) argues that it is the rice market and rice trade that must be seen as unreliable. In an earlier work, he showed that a commonly quoted world rice price - the spot price in Bangkok - follows various national prices rather than the other way around (as it is for maize). Among the major grains, as it is the rice market that "functions least well", Gilbert

[2] This, however, need not be Pareto improving over a scenario of autarky. For an example in this regard, see Newbery and Stiglitz (??)

(2011) argues for a pragmatic approach where it is recognized that low income countries "can probably rely on being able to import additional maize or wheat if this proves necessary, but may justifiably be worried about being able to do so for rice. He argues that "this points towards the need for contingency arrangements for rice – either food security stocks, or formal trade agreements with rice exporters or, where this is feasible, a move towards rice self-sufficiency."

A related point is that the rice market has been seen to be disconnected from the markets from other cereals. Shocks to rice supply and demand are not significantly correlated with those to other grains. Global futures markets are irrelevant to rice and the crop does not have a use as a biofuel (Dawe and Slayton, 2011). It is in this sense that Gilbert and Morgan (2010) regard the rice price spike in 2007/08 as "peculiar and in some sense pre-modern". Unlike other grains, the price volatility in this market does not always depend on the fundamentals of demand and supply shocks and price elasticities. The particular problem of the rice market is the tendency of important trading countries to shield their country from external shocks. Hence `rice is different' and future course of volatility will depend on how the international community addresses the particular problems of this market (Gilbert and Morgan, 2011).

4. Global Rice Trade

Imagine a two country trade model where one of the countries is producing rice. Imagine also that there is no government intervention in either exports or imports. The production of rice is subject to stochastic yield shocks. Then higher is the yield, greater would be the volume of rice that is traded. Figure 1 plots the proportion of world output that is exported against world yields for the period 1960-2011. The world yield is a production share weighted average of individual country yields. For world yields up to 3 tons per hectare, world exports fluctuate around 4% of world output without any trend. Beyond that in the range of 3 to 3.5 tons per

hectare, the ratio of exports to world output fluctuates around a higher level of 7%. A closer look shows that the observations in the right half of the graph (involving world yields of more than 3 tons per hectare) belong to the period from 1994.

Table 1 shows that the average export to output ratio in the 1994-2011 is 7.16% - which represents an increase of 87% over the value in the pre-1994 period. The discrete jump in the export to output ratio is primarily because of increased rice exports from India. Up to the early 1990s, quantitative restrictions clamped down non-basmati rice exports from India. The removal of these restrictions in 1993 and 1994 led to non-basmati rice exports of 4.5 million tons from less than a million tons in the early 1990s (Kubo, 2011). The other factor behind the higher export to output ratio is rise of Vietnam as a major rice exporter. This has been a more gradual process starting from the country's re-entry into the world market in 1989. Export liberalization in India and Vietnam (the leading exporters after Thailand), therefore, explains why the world rice market has got `thicker' in the 1990s.

However, from Table 1 note that the pre-1994 period was characterized by low variability in the export-output ratio even as yields doubled while the post 1994 period is characterized by high variability in the export-output ratio even as yields have remained in a narrow range of 3-3.5 million tons. The coefficient of variation of the export-output ratio in the 1994-2011 period is twice that of the coefficient of variation in the pre-1994 period. Thus, it seems that while world markets are more open since the 1990s, policy interventions have made it more unstable as well. India and Vietnam were among the first countries to impose export restrictions in 2007. More generally, both these countries have domestic concerns that spill-over into international markets. This was evident even prior to the 2007 crisis.

In India, the principal domestic policy imperative is for the government to procure enough supplies to maintain its distribution channel of subsidized grain (rice and wheat). A failure to restrict procurement to distribution led India to accumulate massive stocks. In April 2001, this amounted to 51 million tons of grain including 25 million tons of rice. The subsequent unloading of stocks in the international market led to rising exports and prolonged stagnation of rice prices in the global market (Kubo, 2011). Such large scale dumping of govenment stocks on the world market ceased after 2004. By 2005, rice stocks had fallen to 13 million tons and more significantly wheat stocks had dropped to 2 million tons. A subsequent shortfall in wheat procurement that coincided with the wheat crop failures in the rest of the world panicked the government into wheat imports and a determination not to allow similar shortfalls in rice procurement. So from dumping rice stocks into the world market in the early 2000s, the government moved to restrict and finally ban rice exports in the late 2000s. With the recovery of rice and wheat stocks, the government has once again lifted the export restrictions.

Vietnam has always maintained tight control over rice exports. Initially this took the form of export quotas for registered companies. Later export quotas were abolished and now the government suspends rice exports once the total reaches the targeted level. In 2007, this happened routinely according to the export target of that year. In 2008, faced with rising domestic prices, the government did not allow new export contracts till July of that year. Like India, concern over domestic availability of rice prompts the government to tightly monitor export volumes. However, there is a difference as well. India's exports are less than 5% of its consumption while for Vietnam, they amount to more than 30% of its consumption. Global sales are more important for Vietnam - correspondingly, their regulation has been more predictable and more sensitive to the interests of exporters.

5. The Impact of Exogenous Shocks on Imports and Consumption

A systematic relationship between world yields and global rice trade is not evident in Figure 1. Within a two country model, it would be more realistic to assume that both countries produce rice. In this case, in a model of free trade, the amount of rice traded would depend on both domestic yield shocks as well as foreign shocks. For instance, the importing countries would decrease imports for positive domestic yield shocks and increase imports when there is a positive yield shock in the foreign country. In the extreme and unrealistic case of perfectly integrated markets, the source of the yield shock would not matter. A weaker hypothesis is that the imports depend positively on both domestic and foreign yield shocks. It follows that if this holds, exports would be positively related with domestic yield shocks and negatively with foreign yield shocks. As imports feed into consumption, we can also consider the consequences for this indicator of economic welfare. For both countries, consumption would be positively related to both domestic and foreign yield shocks.

Our data set on country production, area, and stocks is drawn from the USDA. To compute exogenous shocks, we smooth the yield series using the Holt-Winters double exponential method. The deviation of the smoothed series from the observation is defined as the yield shock. This is computed for every country. For every country we also compute a foreign yield shock which is a production weighted average of the yield shocks in each of the countries constituting the rest of the world.

To examine the potential of trade, it is worth considering the correlation between domestic yield and foreign yield shocks. When there are adverse shocks to both domestic and foreign yields, trade cannot be of much help. To assess the probability of such outcomes, we

slice domestic and foreign yield shocks into three categories: high negative shock when the shock is one standard deviation below the mean, a high positive shock when the shock is one standard deviation above the mean and a mid-range shock when the yield deviation is within one standard deviation of the mean. This is done for every country and for every year in the sample. The cross-tab of these shocks is displayed in Table 2 for all countries in the sample. Table 3 contains these cross-tabulations for the major countries that make up world production and trade: China, India, Indonesia, Bangladesh, Thailand, Vietnam, Philippines, Pakistan, United States, Nigeria, Iran, Saudi Arabia and Malaysia.

The results show that in only about 3% of the cases for the entire sample and in about 2% of the cases for the major countries, low domestic yields are accompanied by low foreign yields as well. This means that except for these instances, trade, in principle, should work well in the overwhelming majority of circumstances. Yet the puzzle is that the rice trade is considered unreliable relative to other grains.

Table 4 is a regression of the first difference in log of imports (as proportion of consumption) on the dummy variables for each of the categories in the cross-tabulations of Table 2 and Table 3. Column 1 is the regression for the sample of all importing countries. As expected, the percentage change in imports is negative and the least when the domestic shock is highly positive and the foreign shock is highly negative. This is the case when the demand for imports is at its minimum and the world supply is also low. Unsurprisingly, percentage change in imports is maximum when the domestic shock is highly negative and when the foreign shock is highly positive. This is the opposite case when world supply is at its maximum and so is the demand for imports. These are instances when trade works in the expected direction.

More surprising is that imports as a proportion of consumption increases even when shocks are negative at home and abroad. In this case, world supply is low but import demand is high. There is a clear pattern to the results. The percentage change in imports is the least (and negative) when domestic shocks are highly positive while they are maximum (and positive) when domestic shocks are highly negative. Conditioned on the event domestic shocks are negative, the percentage change in imports is higher when foreign shocks are highly positive. Access to imports is prized when domestic shocks are highly negative.

To see the cost of highly negative domestic shocks, consider a regression of the log change in rice consumption as a function of the dummy variables representing the combination of highly negative, mid-range and highly positive domestic and foreign yield shocks. Table 5 shows the results for the entire sample of countries (and not just importers). A second specification in the Table adds the lagged value of the dependent variable. The impact of the shocks does not vary much between the specifications.

Reading from the first specification, in the scenario of highly negative domestic and foreign yield shocks, rice consumption declines by 9%.[3] In the scenario of highly negative domestic shocks but highly positive foreign yield shocks, rice consumption declines by 4.5%. The difference in outcomes between these scenarios is a measure of the value of access to world markets. However, consumption declines in all the scenarios involving negative domestic yield shocks. Positive foreign shocks can compensate but not fully. Earlier, it was mentioned that reliance on trade could fail in 2% of the instances when negative shocks affect both domestic and rest of the world. But now it can be seen that rice consumption is vulnerable in all the scenarios

[3] All of the results are relative to the country specific fixed effect.

involving negative domestic shocks. Such instances occur 12% of the time. Perhaps this is what is meant by the `unreliability' of world markets.

The flip side of these results is that rice consumption increases by 10-13% in all the scenarios involving positive domestic shocks. Most strikingly, the increase in consumption in the scenario of positive domestic and foreign yield shocks (13%) is almost the same as in the scenario of positive domestic and negative foreign yield shock (12.5%). The failure of trade to redistribute supplies in the latter scenario seems to be the reason why trade is not able to stabilize consumption in countries hit by negative domestic shocks even though world supplies are ample.

Table 6 is the consumption regression for some of the Asian countries important in the world rice economy: China, India, Indonesia, Bangladesh, Philippines, and Vietnam. Pakistan and Thailand are excluded.[4] Once again the implied rates of consumption change do not change much in either specification. Table 7 compares the average percentage change in rice consumption in each of the shock scenarios for the entire sample and for the Asian sample. The common finding is that rice consumption declines are substantial and comparable in the scenario of negative domestic and foreign shocks. However, Asian countries seem to do better to arrest consumption declines in the other scenarios involving negative domestic yields. The most striking difference involves the positive domestic yield scenarios. The consumption growth in the Asian countries is lower than in the world sample. This could be due to build up of domestic stocks or due to exports. The former seems more likely because, like in the world sample, the difference in consumption growth between the scenarios of positive and negative foreign shocks (given positive domestic shock) is small. Domestic stocks in turn may have enabled these

[4] As seen earlier, exports as a proportion of consumption is greater than 50% in both these countries. Vulnerability of domestic consumption to yield shocks would not be a major concern here.

countries to stabilize consumption when domestic shocks are negative. Yet, even this policy has not been successful when negative domestic shocks are accompanied by negative foreign shocks.

6. Policy Response

It is clear that it is the negative domestic shocks scenario when stabilization fails to happen. Access to world markets helps but even when foreign yields are high, consumption declines. These are reduced form results and the outcome of both trade and domestic stabilization policies. To understand how exogenous shocks are modified by trade and domestic policies, we consider the following regression model for country *j* and year *t*:

$$\ln\left(\frac{C_{jt}}{C_{j,t-1}}\right) = \beta_1 + \beta_2 DY_{jt} + \beta_3 FY_{jt} + \beta_4 DS_{jt} + \beta_5 FS_{jt} + \theta_j + \varepsilon_{jt} \quad (1)$$

where *C* is consumption of rice, *DY* and *FY* are domestic and foreign yield shocks, *DS* and *FS* are the domestic and rest of the world stocks (both as proportion of domestic and rest of the world consumption respectively) at the end of year (*t* - 1) and θ is a country fixed effect. Earlier, we explained how shocks were constructed.

In our data, the policy variable is the level of stocks in each country. Clearly, trade restrictions will have a direct impact on stocks. For each country, we construct a domestic stock variable and a foreign stock (aggregate of the stocks in the rest of the world). In a second specification, we allow the coefficients of domestic and foreign yield shocks to vary with domestic stocks and foreign stocks. In particular,

$$\beta_2 = \gamma_1 + \gamma_2 DS_{jt} + \gamma_3 FS_t \quad \text{and similarly} \quad (2)$$

(3) $$\beta_3 = \delta_1 + \delta_2 DS_{jt} + \delta_3 FS_t$$

The results of both specifications are in Table 8. In the first specification, both domestic shocks and domestic stocks have positive impacts on the change in consumption and are statistically significant as well. Foreign yields and foreign stocks are not significant. In the second specification, foreign yield shocks are significant as well and in the expected direction. The interaction terms involving domestic shocks and domestic stocks and that involving foreign shocks and foreign stocks are significant as well. The former shows that domestic policies moderate the impact of domestic shocks. Similarly, the latter shows that the impact of foreign yield shocks depends on external policies.

A more revealing approach is to use the classification of shocks into negative, mid-range and positive. This allows policies to interact with shocks in a non-linear manner. In this approach, the domestic shock variable is represented by dummies representing negative, mid-range and positive shocks. Call these dummies N_d, M_d *and* P_d. The foreign shock variable is represented similarly and call those dummies N_f, M_f *and* P_f . Both sets of dummies are interacted with domestic and foreign stocks. The results can be seen in Table 9. The omitted base category in the table is the combination of mid-range domestic and mid-range foreign yield shock.

From the table, it can be worked out that when both domestic and foreign shocks are negative, the expected value of the dependent variable is -0.11 + 0.27*DS* + 0.08*FS*. Thus both domestic and foreign stocks help in stabilizing consumption in this state. However, the effect of foreign stocks and by implication, trade, is not significantly different from zero. The median value of domestic stocks (as proportion of consumption) is 0.05. This means that its contribution

in reducing the hit on consumption is about 1.3%. The 75 percentile level of stocks is 0.2 and at this level, stocks would arrest the decline in consumption by nearly 5% points. The mean level of the stock ratio when both shocks are negative is 0.14. This reduces the negative impact on consumption by 3%. The stock to consumption ratio would have to be 40% to fully wipe out the adverse impact of domestic and foreign shocks.

The median level of the foreign stock ratio is 0.21 and that can help in countering the adverse impact by 1.6%. However, as noted earlier, this effect is not precisely estimated.

7. Concluding Remarks

There is considerable literature about price volatility and the transmission of world prices to domestic prices. In this paper, we have taken a different route to assess stability and to examine the role of trade and domestic stabilization policies. We constructed for each country exogenous domestic and foreign (rest of the world) yield shocks and looked at their impact on rice imports and on rice consumption. We also considered how these impacts were modified by domestic and foreign stocks.

It is clear that for poor countries, the principal concern is to stabilize consumption when hit by negative domestic yield shocks. The frequency of such shocks is about 12%. Although trade cannot be expected to play a strong role when the major producing and consuming countries are simultaneously hit by negative yield shocks, consumption fails to be stabilized even when foreign shocks are positive even though imports do peak in this case. The flip side is that when domestic yield shocks are positive, consumption surges even when the shock in the rest of the world is negative.

Domestic policies have played a greater role in stabilizing the adverse impacts of negative shocks. This could be because of the presumed `unreliability' of rice trade. Storage is, however, expensive and countries often tend to carry too much stock either because of excessive precaution or because these policies are captured by producer interests. Furthermore, reliance on domestic policies will continue to keep rice markets thin and promote market insulation policies that led to the rice price spike in 2007/08.

The positive development in the world rice market has been the greater volumes traded since the mid-1990s due to export liberalization in India and the entry of Vietnam. Can there be another shift upwards? Surpluses in the commercial rice exporter countries such as Thailand, Pakistan and the US are already high. Exports are as high as domestic consumption in Thailand and Pakistan and the ratio is close to 60% in the US. That's why the thickening of the rice market had to depend on new exporters such as India and Vietnam.

Between 2006 and 2008, Vietnam's exports were consistently around 21% of consumption. However, Indian exports have varied between 2.5-6% of domestic consumption. Not only has India's contribution to world exports been varying, the surpluses are also small relative to domestic consumption. Negative domestic shocks together with domestic policies can shrink these surpluses quickly. Like in India, the surpluses or deficits are similarly small (relative to consumption) in the other large rice producing economies (China, Indonesia, Bangladesh) and it is not clear that they can be reliable contributors in the future. Besides climate change poses unknown perils to some of the major rice growing regions in India and Bangladesh.

In this sense, the rise of Vietnam is more reassuring to the long-term future of the world rice market although the surpluses are not as large as in Thailand. While surpluses may continue to rise in Vietnam especially with rising prosperity, we might need to see the emergence of surpluses in other countries too for the rice markets to thicken. Myanmar and Cambodia are possible candidates. It does seem that a more reliable rice trading system would have to await greater productivity increases in some of the key rice producing regions of the world.

Figure 1: World Rice Trade and World Yields

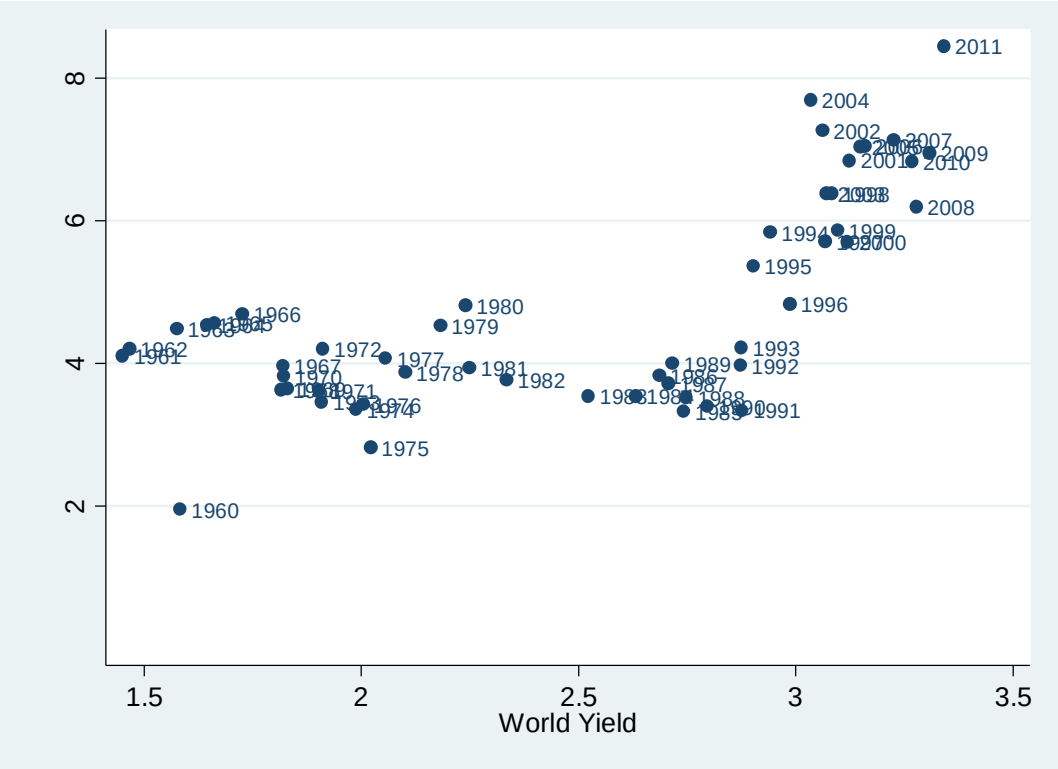

Table 1: The World Export to Output Ratio

	1960-1993	1994-2011
Mean	3.82	7.16
Standard Deviation	0.56	2.14
Coefficient of Variation	14.66	29.89

Table 2: Cross-Tab of Foreign and Domestic Yield Shocks: All Sample

	Foreign Yield Shocks			
Domestic shocks	Negative highly	Mid-range	Positive-Highly	Total
Negative highly	116	311	88	515
	2.72	7.31	2.07	12.1
Mid-range	533	2,111	550	3,194
	12.52	49.59	12.92	75.03
Positive-Highly	94	363	91	548
	2.21	8.53	2.14	12.87
Total	743	2,785	729	4,257
	17.45	65.42	17.12	100

Note: The cell entries have numbers in the numerator and frequency in the denominator.

Table 3: Cross-Tab of Foreign and Domestic Yield Shocks: Major Countries

	Foreign Yield Shocks			
Domestic shocks	Negative high	Mid-range	Positive-High	Total
Negative high	10	56	19	85
	1.48	8.3	2.81	12.59
Mid-range	91	334	76	501
	13.48	49.48	11.26	74.22
Positive-High	22	49	18	89
	3.26	7.26	2.67	13.19
Total	123	439	113	675
	18.22	65.04	16.74	100

Note: Major countries are the major importing and exporting countries. They consist of Indonesia, Bangladesh, Philippines, Iran, Saudi Arabia, Malaysia, Nigeria, India, Vietnam, Thailand, Pakistan, US, China. The cell entries have numbers in the numerator and frequency in the denominator.

Table 4: Imports Regression

Dependent Variable: First Difference of Log (Imports/Consumption)

Variables	Coefficients	Standard Errors	t-value
Dummy variable for negative domestic yield shock and negative foreign yield shock	0.39795	0.13143	3.03
Dummy variable for negative domestic yield shock and mid-range foreign yield shock	0.285619	0.1133	2.52
Dummy variable for negative domestic yield shock and positive foreign yield shock	0.635848	0.140904	4.51
Dummy variable for mid-range domestic yield shock and negative foreign yield shock	0.139587	0.108514	1.29
Dummy variable for mid-range domestic yield shock and mid-range foreign yield shock mm	0.182521	0.10234	1.78
Dummy variable for mid-range domestic yield shock and positive foreign yield shock	0.112112	0.108913	1.03
Dummy variable for positive domestic yield shock and negative foreign yield shock	-0.31658	0.138867	-2.28
Dummy variable for positive domestic yield shock and mid-range foreign yield shock	0.057045	0.111878	0.51
Dummy variable for positive domestic yield shock and positive foreign yield shock	(omitted)		
Constant	-0.18064	0.100219	-1.8

Observations: 2683, Sample of Importing Countries from 1960-2010, Country Fixed Effects

Table 5: Consumption Regression (All Countries)

Variables	Coefficients	Standard Errors	t-value	Coefficients	Standard Errors	t-value
Dummy variable for negative domestic yield shock and negative foreign yield shock	-0.222	0.032	-6.94	-0.215	0.030	-7.14
Dummy variable for negative domestic yield shock and mid-range foreign yield shock	-0.186	0.027	-6.8	-0.169	0.026	-6.55
Dummy variable for negative domestic yield shock and positive foreign yield shock	-0.176	0.034	-5.1	-0.158	0.032	-4.86
Dummy variable for mid-range domestic yield shock and negative foreign yield shock	-0.107	0.026	-4.1	-0.099	0.024	-4.04
Dummy variable for mid-range domestic yield shock and mid-range foreign yield shock mm	-0.092	0.025	-3.74	-0.085	0.023	-3.69
Dummy variable for mid-range domestic yield shock and positive foreign yield shock	-0.107	0.026	-4.11	-0.091	0.024	-3.72
Dummy variable for positive domestic yield shock and negative foreign yield shock	-0.006	0.034	-0.19	-0.009	0.032	-0.29
Dummy variable for positive domestic yield shock and mid-range foreign yield shock	-0.025	0.027	-0.92	-0.026	0.025	-1.01
Dummy variable for positive domestic yield shock and positive foreign yield shock	(omitted)			(omitted)		
Lagged Dependent variable				-0.325	0.015	-22.36
Constant	0.131	0.024	5.44	0.134	0.023	5.91

Observations: 4155, Sample of 87 countries from 1960-2010, Country Fixed Effects

Table 6: `Asian' Consumption Regression

Variables	Coefficients	Standard Errors	t-value	Coefficients	Standard Errors	t-value
Dummy variable for negative domestic yield shock and negative foreign yield shock	-0.1685507	0.0342663	-4.92	(omitted)		
Dummy variable for negative domestic yield shock and mid-range foreign yield shock	-0.0775043	0.022031	-3.52	0.0823182	0.0286003	2.88
Dummy variable for negative domestic yield shock and positive foreign yield shock	-0.1058075	0.0254515	-4.16	0.0562126	0.0311029	1.81
Dummy variable for mid-range domestic yield shock and negative foreign yield shock	-0.0496358	0.0211809	-2.34	0.1129313	0.0279067	4.05
Dummy variable for mid-range domestic yield shock and mid-range foreign yield shock mm	-0.0458182	0.0201853	-2.27	0.1185209	0.0272123	4.36
Dummy variable for mid-range domestic yield shock and positive foreign yield shock	-0.0331055	0.021503	-1.54	0.1303103	0.0280447	4.65
Dummy variable for positive domestic yield shock and negative foreign yield shock	-0.0022099	0.0245866	-0.09	0.1580646	0.0304037	5.2
Dummy variable for positive domestic yield shock and mid-range foreign yield shock	0.0172427	0.0224815	0.77	0.176476	0.0289079	6.1
Dummy variable for positive domestic yield shock and positive foreign yield shock	(omitted)			0.1617232	0.0330179	4.9
Lagged Dependent variab;e				-0.1402881	0.0494425	-2.84
Constant	0.0679587	0.0198072	3.43	-0.0906383	0.0270722	-3.35

Observations: 306, Sample of 6 countries from 1960-2010, China, India, Indonesia, Bangladesh, Philippines, Vietnam, Country Fixed Effects

Table 7: Predicted % Change in Consumption by combination of shocks

Shocks	All	Asian
Dummy variable for negative domestic yield shock and negative foreign yield shock	-0.0913665	-0.0906383
Dummy variable for negative domestic yield shock and mid-range foreign yield shock	-0.0551812	-0.0083201
Dummy variable for negative domestic yield shock and positive foreign yield shock	-0.0450598	-0.0344257
Dummy variable for mid-range domestic yield shock and negative foreign yield shock	0.0242743	0.022293
Dummy variable for mid-range domestic yield shock and mid-range foreign yield shock mm	0.0388884	0.0278826
Dummy variable for mid-range domestic yield shock and positive foreign yield shock	0.0238636	0.039672
Dummy variable for positive domestic yield shock and negative foreign yield shock	0.1245385	0.0674263
Dummy variable for positive domestic yield shock and mid-range foreign yield shock	0.1059035	0.0858377
Dummy variable for positive domestic yield shock and positive foreign yield shock	0.1308804	0.0710849

Table 8: Consumption Regression with Yield Shocks and Stocks

Variables	Coefficients	Standard Errors	t-value
Lagged Dependent Variable	-0.322	0.014	-22.33
Domestic stock/Consumption	0.104	0.015	7.07
Foreign stock/Foreign Consumption	-0.037	0.035	-1.05
Domestic yield shock	0.161	0.035	4.64
Foreign yield shock	0.500	0.212	2.36
Domestic Shock X (domestic stock/dom. Consn)	-0.070	0.021	-3.34
Domestic shock X (foreign stock /for. Consn)	0.066	0.137	0.48
Foreign Shock X (domestic stock/dom. Consn)	-0.117	0.211	-0.55
Foreign shock X (foreign stock /for. Consn)	-2.000	0.936	-2.14
Constant	0.034	0.009	3.76

observations: 4068, 87 countries, fixed effects at country level

Table 9: Consumption Regression with Yield Shocks and Stocks

Variables	Coefficients	Standard Errors	t-value
Lagged Dependent Variable	-0.32	0.01	-22.36
Domestic stock/Consumption	0.09	0.02	5.05
Foreign stock/Foreign Consumption	-0.05	0.05	-1.00
Negative domestic shock	-0.13	0.03	-4.51
Neg. dom. shock X (dom. Stock/consumption)	0.10	0.03	2.87
Neg. dom. Shock X (for. Stock/for. consn)	0.09	0.11	0.84
Positive dom. Shock	0.07	0.03	2.48
Positive dom.shock X (dom. Stock/consn)	-0.05	0.03	-1.56
Positive dom. Shock X (for. Stock/consn)	0.04	0.11	0.37
Negative For. Shock	-0.03	0.02	-1.44
Neg. For. Shock X (dom.stock/consn)	0.08	0.03	2.41
Neg. For. Shock X (for.stock/for. consn)	0.04	0.10	0.41
Positive for. Shock	0.04	0.02	1.66
Positive for. Shock X (dom.stock/consn)	0.01	0.02	0.42
Positive for. Shock X (for. Stock/for. Consn)	-0.23	0.11	-2.09
Constant	0.05	0.01	3.67

observations: 4068, 87 countries, fixed effects at country level

References

Abbot, Philip C., (2011), "Export Restrictions as Stabilization Responses to Food Crisis", *American Journal of Agricultural Economics*, 94(2): 428-434.

Dawe, David and Tom Slayton, (2011), The World Rice Market in 2007/08, in *Safeguarding Food Security in Volatile Global Markets*, ed., Adam Prakash, FAO.

Gilbert, Christopher L., (2011), "Food Reserves in Developing Countries: Trade Policy Options for Improved Food Security", Issues Paper No. 37, International Center for Trade and Sustainable Development. http://ictsd.org/i/publications/114284/?view=document

Gilbert C. L., and C. W. Morgan, (2010), "Food Price Volatility", Philisophical Transactions of The Royal Society B, 365, 3023-3034.

Giordani, Paolo E., Nadia Rocha and Michele Ruta, "Food Prices and the Multiplier Effect of Export Policy", Staff Working Paper ERSD-2012-08, Economic Research and Statistics Division, World Trade Organization.

Martin W., and K. Anderson (2011), Export Restrictions and Price Insulation During Commodity Price Books, American Journal of Agricultural Economics, 94 (2): 422-427.

Karp, Larry S. and Jeffrey M. Perloff (2002), A Synthesis of Agricultural Trade Economics, Handbook of Agricultural Economics, Vol. 2., Ed., B. Gardner and G. Rausser, Elsevier.

Kubo, Kensuke, (2011), India: The Burden of Domestic Policy, in Shinichi Shigetomi, Kensuke Kubo, and Kazunari Tsukada, eds. "The World Food Crisis and the Strategies of Asian Rice Exporters", Spot Survey No.32, Institute of Developing Economies, Japan External Trade Organization, February 2011.
http://www.ide.go.jp/English/Publish/Download/Spot/32.html

Timmer, C. P., (2008), Causes of High Food Prices, ADB Economics Working Paper Series, 128, Asian Development Bank, Manila.

Wright, B., (2011), The Economics of Grain Price Volatility, *Applied Economic Perspectives and Policy*, 33 (2): 32-58.