How to Manage a World Food Crisis: A Viewpoint

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As this is written in mid-September 2022, the world is facing a potential food crisis worse than any since World War II. With a devastating war in Ukraine launched by Russia in late February 2022, a historic drought and heat wave in China, and an uneven monsoon in South Asia, food supplies from several of the world's largest granaries are highly uncertain at best, and genuinely scary at worst. What should we do?[1]

First, we must expect China and India to act in their own self-interest to protect the food security of their two billion citizens. The key historical lesson from previous food crises is that **food security is necessary for national sovereignty.** A sense of food security among a country's citizens provides a powerful stabilizing force to the nation's political economy, which permits the government and the private sector to make investments with long time horizons, such as infrastructure, education, agricultural research, and the industrial sector. By necessity, food consumers must access their daily food needs from local markets at prevailing prices (except for subsistence farmers, and even they purchase much of their food). By contrast, investors make decisions based on expectations about the future, and instability clouds these expectations and shortens the time horizon for investment decisions, thus reducing the rate of economic growth. The role of public policy is to be sure that these two time horizons do not conflict with each other. The critical issue for such a policy is to dampen expectations that financial resources devoted to speculative hoarders of staple grains will be highly profitable. Such investments are destabilizing and do not contribute to economic growth.

1 This viewpoint builds on two earlier articles in the *Asian Journal of Agricultural Development*. See Timmer 2008 and 2010.

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Because world food markets have been quite unstable, countries seeking domestic food price stability have restricted food trade, exports, and imports, to keep that instability outside their borders. This violation of free trade is staunchly opposed by most trade economists, who rightly point out that trade restrictions **increase** price instability in world grain markets, which are a global public commons. Like all public commons, they can be destroyed from too many private incursions that claim their benefits. But trade interventions (barriers and subsidies) to defend **national security** are legitimate even under World Trade Organization (WTO) rules. The key lesson from world food crises since the mid-20th century is that domestic food security is identified with national sovereignty. In short, food security equals national security. How can the global public commons be defended against such legitimate incursions? The first part of the answer is to pay far more attention to the true value of grain reserves held by individual countries in preventing price panics in world grain markets. The second part of the answer is to understand the role that ASEAN (Association of Southeast Asian Nations) has played since 2008 in stabilizing the world rice market.

THE ROLE OF GRAIN RESERVES IN FOOD PRICE VOLATILITY

What explains volatility in world food prices? Can national or international policies toward food grain reserves help to stabilize food prices? In a world facing widespread food shortages and hunger, knowing the answers to these two questions has profound economic, political, and humanitarian implications. The basic assumption driving this analysis is that excessive food price volatility is harmful to farmers and consumers, and reasonably stable food prices are a widely perceived preference of most citizens.[2]

There are three basic models the economics profession uses to address these questions: (1) supply and demand, (2) supply of storage, and (3) behavioral models of price expectations. The first is second nature to economists, who use basic supply and demand models as the fundamental explanation of price formation. The "fundamentals" approach uses these models to generate an equilibrium price, where the global level of stocks is an **exogenous** factor that influences the probability of a price spike when there are shocks to supply or demand.

The second approach explicitly introduces the storability of the commodity into price formation. The supply of storage model brings in expectations and makes stock levels **endogenous with price formation**. To be empirically useful, reasonably accurate and timely data on levels of stocks held by commercial trade are critical. These models have a long history (Working 1949)

The third approach recognizes that such stock data are often not available for commodities, where individuals and small firms hold a major share of stocks between harvest and consumption, a factor that is especially important for the world rice market. To cope with the industrial organization of some commodity markets, a **behavioral model adds hoarding by individuals**, with levels of stocks in the hands of these agents largely unobserved but important for short-run price formation. In this approach, "non-traditional speculation" in financial and commodities markets can also impact price formation without having a visible impact on **measured** stock levels (Timmer 2009).

A fourth approach moves outside basic economics. A political economy model adds the behavior of policymakers (and other market participants) to explain changes in trade restrictions for grain (especially rice). "Confidence

2 This section is a non-technical and updated summary of Timmer (2014). The macroeconomic and dynamic perspective incorporated in this analysis is not included in microeconomic analyses of the welfare impact of unstable food prices on poor farmers and consumers, as in the pathbreaking analysis by Bellemare, Barrett, and Just (2013).

in trade" is a critical driver of political behavior and from there to volatility. Domestically held stocks contribute directly to confidence in trade, in a positive manner. In this model, levels of grain stock held domestically are an important factor in explaining price volatility, above and beyond their impact via the supply of storage model.

The purpose of this section is to convey the intuition behind each model without getting bogged down in the mathematical details, which are available in Timmer (2014).

Basic Supply and Demand Models

Even a simple supply and demand model is not so simple when both short-run and long-run responses from producers and consumers are considered. In the short run, perhaps a year for agricultural commodities, the responses of producers and consumers to changes in the price of the commodity under consideration are generally quite limited. In the long run, many adjustments are possible and responses are much more robust. Thus, the "price elasticities of supply and demand" in the short run are small, but in the long run, these elasticities are much larger. Only careful empirical analysis of historical data can quantify these elasticities with any precision.

That said, this simple model can be quite powerful in explaining both short-run and long-run price behaviors. For example, there are four key drivers in a fully specified model:

1. the relative size of changes in factors **shifting** the demand curve relative to factors **shifting** the supply curve
2. the relative size of short-run supply and demand elasticities
3. the relative size of long-run supply and demand elasticities
4. price levels in earlier time periods, to which producers and consumers are responding with a lag

Assume, as seems to be the case since the early 2000s, that demand drivers have been larger than supply drivers, with demand shifting out by 3.0 percent per year (driven by population and income growth) and supply shifting out just 1.5 percent per year. Assume reasonable short- and long-run elasticities, and that prices in the past have been "low". What do these parameters mean for current price change? The answer is very dramatic: the imbalance between "current" supply and demand drivers causes the price to rise by 10 percent, but historically low prices in the past cause current prices to be about 50 percent higher, as the long-term, lagged response from producers and consumers to these earlier low prices has a very large quantitative impact. **Much of the slow run-up in food prices in the early 2000s was caused by producers and consumers gradually responding (i.e., reflecting their "long-run" responses) to earlier episodes of low prices, especially from the late 1990s until about 2003.** For example, between 1996 and 2001, the real price of rice declined by 14.7 percent **per year** in world markets!

The analytical model of price formation makes a sharp and important distinction between factors that shift the demand and supply curves and the r**esponsiveness of farmers and consumers to changes in the market price**, which show up as movements along the supply and demand curve. Analytically, the distinction is very clear, but, empirically, it is often hard to tell the difference. If farmers use more fertilizer in response to higher prices for grain, should this count as part of the supply response or as a supply shifter? If governments and donor agencies restrict their funding of agricultural research because of low prices for grain, is the resulting lower productivity potential a smaller supply shifter a decade later or a long-run response to prices? Whatever the labels, it is important to understand the causes.

In a world modelled by the fundamentals of supply and demand, price volatility is driven by exogenous shocks—bad weather on the supply side, for example, or a biofuel mandate to convert corn to ethanol on the demand side. The price response to such shocks then depends on the structural parameters of the model—the short-run and long-run price elasticities of supply and demand—**and on the potential for stocks to mitigate shortfalls or surpluses.** The size of

these stocks, and thus their potential to mitigate price volatility, is exogenous to the model. The next section brings decisions about stock levels into the supply and demand framework via the supply of storage model.

The Supply of Storage Model and Short-Run Price Behavior

Almost by definition, the role of stocks in commodity price formation is restricted to short-run influences. In the long run, food demand cannot exceed the amount of food supplied. Still, much of the concern about volatile food prices reflects short-run issues. Price spikes, for example, tend to last only a year or two. Food prices can be depressed for decades at a time—from 1985 to 2005, for example, but they are not volatile during these periods because stocks tend to accumulate during periods of low prices.

Large stocks and low prices are, of course, linked. The link between the supply of grain held in storage and prices in both spot and futures markets has long been the subject of analytical attention. The basic "supply of storage" model that has emerged from this theoretical and empirical work is the foundation for understanding short-run price behavior for storable commodities. It stresses the inter-related behavior of speculators and hedgers as they judge inventory levels in relation to use. **The formation of price expectations is the key to this behavior.**

The relationship between current inventories and current price helps explain price expectations, and vice versa. These price expectations can then be expressed in prices on futures markets. The actual working out of this theory empirically requires a close understanding of the behavior of market participants—farmers, traders, processors, and end users (consumers)—in their role as hedgers or speculators. The controversy over the role of "outside" speculators—investors who are not active participants in the commodity system—has many precursors in the history and analysis of commodity price formation on futures markets (Williams and Wright 1991).

The empirical difficulty in using the supply of storage model to understand short-run price behavior is having current information on inventory levels. This is not such a severe problem when virtually all the commodity storage is in commercial hands, as with cocoa or wheat, and stock levels for such commodities can be estimated fairly accurately. For a commodity such as rice, however, which is mostly grown by smallholders, marketed by a dense network of small traders and processors and purchased by consumers in a readily storable form (bags of milled rice), stock levels can change at any or all levels of the supply chain. There are virtually no data available on these inventory levels. To make matters worse, a number of countries (especially China) regard the size of publicly held stocks of grain as a state secret. It is thought that China holds as much rice in storage as the rest of the world combined.

For the purposes here, the main advantage of the supply of storage model is its ability to build conceptual links between long-run supply and demand trends, where basic models of producers and consumers provide operational guidelines to decision making about price formation, and very short-run movements in prices that often seem totally divorced from supply and demand fundamentals. Because long-run trends are gradually built up from short-run observations, these links are essential for understanding price behavior even in the long run. The key, then, to making the supply of storage model operational in the short run is to use it to gain insight on formation of price expectations.

Typically, commodities for which inventory data are reasonably reliable tend to have their prices driven by unexpected supply behavior. Commodities with poor data on inventories, especially where significant inventories can be in the hands of millions of small agents—farmers, traders, consumers—tend to have their extremes in price behavior generated by rapidly changing price expectations themselves, and **consequent hoarding or dis-hoarding.** The short-run price dynamics for rice thus look significantly different from those for wheat or corn, partly because of the different industrial organization of the respective commodity systems.

Behavioral Dimensions of Food Security: Herd Behavior and Hoarding

Experience with world rice prices since the early 2000s illustrates the importance of behavioral factors in short-run price dynamics (see Dawe 2010 for a comprehensive review). The actual production/consumption balance for rice has been relatively favorable since 2005, with rice stocks-to-use ratios improving slightly. This stock buildup was a rationale response to the very low stocks seen then and to gradually rising rice prices—exactly what the supply of storage model predicts. The lack of a deeply traded futures market for rice made financial speculation difficult.

As concerns grew in 2007 that world food supplies were limited and prices for wheat, corn, and vegetable oils were rising, several Asian countries reconsidered the wisdom of maintaining low domestic stocks for rice.[3] The Philippines, in particular, tried to build up their stocks to protect against shortages going forward. Of course, if every country—or individual consumer—acts the same way, the hoarding causes extreme shortage in markets, leading to rapidly rising prices.

After an acceleration started in September 2007, in the gradual price increases seen for half a decade, concern over the impact of higher rice prices in exporting countries, especially India, Vietnam, and Thailand led to export controls. Importing countries, especially the Philippines, started to scramble for supplies. Fears of shortages spread, and a cumulative price spiral started that fed on the fear itself, the ingredients for a panic.

The psychology of hoarding behavior is important in explaining why rice prices suddenly shot up starting in late 2007. Financial speculation played only a small role. Instead, decisions by millions of households, farmers, traders, and some governments sparked a sudden surge in demand for rice and changed the gradual increase in rice prices from 2002 to 2007 into an explosion.

A rough calculation of the effect of household hoarding of rice shows the potential. Assume that one billion households consume 1 kg of rice a day (for a total consumption of 365 million metric tons [mmt] for the year, which is the right magnitude). Assume they keep a one-week supply in their household, or 7 kg per household, which is 7 mmt of household stocks in total. This quantity probably varies by income class, with the very poor buying hand to mouth, and better off households storing more just for convenience. When prices start to rise, or the newspapers or TV start talking about shortages of rice, each household, **acting independently**, decides to double its own storage, thus buying an additional 7 kg per household. This means rice markets need to supply an additional 7 mmt of rice over a short period (a month or so). This quantity is about one quarter of total annual international trade in rice, which would be the only short-run source of supply to meet such an increase in demand.

To determine the impact on prices, short-run supply and demand parameters from the analytical model developed above can be inserted into the price determination mechanism: -0.1 for demand and 0.05 for supply. With a 25 percent increase in short-run demand on the world market (suddenly), the world price will have to rise by 167 percent to get a new equilibrium. That is what happened—**panicked hoarding caused the rice price spike.**

Fortunately, a speculative run can be ended by "pricking the bubble" and deflating expectations. Once the price starts to drop, the psychology reverses on hoarding behavior by households, farmers, traders, and even governments. When the government of Japan announced in May, after considerable international urging, that it would sell 300,000 tons of its surplus "WTO rice stocks" to the Philippines, prices in world rice markets started to fall immediately. By late August, medium quality rice for export from Vietnam was available for half what it sold for in late April, as dis-hoarding gained momentum. Japan never sold any of its surplus rice.

3 What follows is a very brief overview of the "fire" in the world rice market from late 2007 until mid-2008. See Slayton (2009) for a detailed analysis and chronology.

Grain Reserves and the Behavior of Policymakers

The political economy of export restrictions is pretty obvious. Most leaders understand they have a mandate to provide reasonably stable food prices to their citizens and retaining more domestically produced food at home when prices are spiking in world markets is easy, visible, and politically popular.

History demonstrates that rice prices within many Asian countries **can** be kept reasonably stable with respect to world prices. The problem is that there are often spillovers from the actions undertaken by countries to stabilize their domestic prices, and these spillovers increase price instability in world markets. How can the impact of these spillovers be minimized, rather than following the standard policy advice, which is to avoid the actions altogether, and thus avoid the spillovers in the first place. **The standard policy advice is politically impossible in times of turbulent markets.** Is there a better alternative, i.e., is there a way to keep borders more open to trade in basic food commodities, in both directions, but still allow large countries to address their domestic food security interests?

As a start, we need to understand **how to build political confidence in trade** as a step toward more open trade policies. Recent confidence-building measures have helped renew trust in the world rice market, which has been more stable since 2009 than world wheat and maize markets—a very significant reversal of historical patterns of food price volatility. A retreat into autarky comes at a very high price to economic efficiency and the welfare of poor consumers. It makes the world market even more unstable and less reliable. By understanding the behavioral foundations of food security and its political economy, it should be possible to re-build confidence and trust in international trade in general and in the world rice market in particular.

COPING WITH THE CURRENT CRISIS

The world faces two dilemmas at the moment: (1) the real possibility of serious shortages of physical grain supplies; and (2) the reluctance of major players in the world food economy to trust international grain markets as a reliable source of supply for their domestic food security needs. The two are related, of course, but once we recognize that domestic political economy concerns override global rules, we can begin to formulate realistic solutions. We are not looking for long-run solutions to improve productivity on subsistence farms and to make them more inclusive and sustainable, important as those are. We are not looking for nutrition interventions to improve the dietary quality of women and children, important as those are. We are trying to keep people from starving and that objective should focus our thinking. What can be done over the next year or so to forestall a global food disaster? An effective answer to **that** question will then open up all the longer term issues.

Fortunately, the world community is mobilizing around the current food crisis in promising ways. In particular, proposals are being generated for collective action that might be possible at the G20 Summit Meeting in November in Bali, chaired by the President of Indonesia.[4] It must be recognized that the track record of G20 initiatives on food security has not been promising, despite the fact that initiatives were agreed to at almost every summit since 2006. Sometimes, the agreements were ambitious and never funded or implemented; sometimes, reality kept the agreements quite modest.

For example, the initiative that created AMIS (Agricultural Market Information System) in 2013 was led by Kym Anderson of Australia and Joe Glauber of the United States, two of the world's leading agricultural policy analysts. AMIS

4 The elements of a possible G20 Communique of Food Security were outlined in Timmer (2022).

is far and away the most visible and successful G20 initiative in the field of food security.[5]

And yet the fact that "strengthening AMIS" is being discussed as an agenda item at this years' G20 Summit is a clear signal that AMIS has not worked as hoped. The reporting is slow and cumbersome, and countries incur no penalties for inaccurate reporting of their grain stocks and policies, or not reporting at all. This is a sobering lesson and a daunting challenge. G20 commitments have no teeth; **to work, they must be in each country's self-interest.**

When in "crisis management mode", it is important not to seek "blue sky" solutions, to stay away from diplomatic niceties, and to focus on actions and language that even large, vulnerable, and food insecure countries can sign onto in the belief that the world community has the potential to help stabilize food, fertilizer, and energy markets by avoiding panicked actions. This is not a zero-sum game, but the collective gains from an agreement to protect the global public commons—the resilience and depth of world grain markets need to be clarified and emphasized for all parties.

Fortunately, we already have a forum that recognizes those collective gains and has a track record of stabilizing the world price of an important food commodity: rice. Since 2008, ASEAN leaders have met regularly to discuss national policies on food security, and how changes in those policies might affect the world rice market. A brief summary of how ASEAN has operated in this arena points the way forward to a broader agenda for G20 countries and others.

5 The other visible achievement has been the Global Agricultural and Food Security Program (GAFSP), dating from the food crisis in 2007/08, and established in 2009. With over USD 2 billion in funding over the years from both public and private sources, GAFSP is managed by a coordination unit hosted by the World Bank. But it is emphatically not a crisis management program. Its goal is to build resilience, sustainability, and higher agricultural productivity among disadvantaged groups in developing countries.

ASEAN Learned Important Lessons from the 2008 Episode

1. Build up rice stocks in importing countries, so they do not get caught in a rising price spiral.
2. Don't panic! Talk through the food security issues at ASEAN Summit Meetings held twice a year.
3. As evidence: the food price spike in 2011 included wheat, corn, and soybeans/ vegetable oils, but **not rice.** World rice prices have been relatively stable since, despite considerable fluctuations in the prices of other staple foods on world markets.

Lessons for 2022

1. The COVID-19 pandemic had already stressed global supply chains and local economies. These disruptions caused widespread shortages of food in vulnerable and conflict-affected areas. World food prices were at historic highs.
2. Russia's invasion of Ukraine changed the food supply situation in fundamental ways: not just wheat—
    - Vegetable oils and maize were also directly impacted in the short run.
    - Fertilizer shortages emerged for the medium run, and crop productivity will be reduced in 2023 just as bumper crops are needed to rebuild grain reserves.
    - Energy supplies have been badly disrupted in the short run and seem likely to be affected in all time horizons, but the long run impact will be to spur development of renewable energy technologies and investments. The short- and medium-run impacts will be to raise the costs of food all along the supply chain, from farm inputs to farming activities, to processing and transportation to retail outlets, and even to the household costs of shopping for food and getting it home. Food price inflation will only slow gradually.

3. What to do now?
    - *Substitute rice and maize for wheat.* Such substitution is relatively easy in a number of countries where rice consumption has been falling in favor of wheat products and grain-fed meat (Timmer, Block, and Dawe 2010).
    - *Reduce the use of grain and vegetable oils to make biofuels.* In particular, the United States could free several million tons of maize for direct human consumption by reducing its mandates for ethanol use in gasoline blends.
    - *Reduce grain-feeding to livestock.* This would cause higher meat prices in countries that use intensive feeding operations to supply their high levels of meat consumption but would free up very large quantities of feed grains for human consumption. An added bonus would be the positive health consequences stemming from reduced meat intake in wealthy populations (as well as in China).
    - *Avoid "food protectionism"*, as much as possible, but recognize that governments have an existential interest in food security for their citizens. Help minimize the spill-over damage to the "global public commons", i.e., world agricultural commodity markets, by limiting trade barriers, if unavoidable.

A SPECIAL ROLE FOR ASEAN

ASEAN has a special role to play in the next year or so in keeping the world rice market reasonably stable. There are now special risk factors at play that might cause rice prices to rise sharply, and ASEAN will play a pivotal role in trying to keep the world rice economy from spiraling out of control. If rice prices can be kept reasonably stable, there will be hope for the rest of the world food economy.

1. ASEAN is the center of the world rice market, with large exporters and importers, although India, China, and Nigeria are also very important players.
2. The lessons learned during the 2008 world food crisis have had a deep impact on the behavior of ASEAN rice importers and exporters. They will be careful not to panic, even if the world rice market starts to heat up.
3. The risks of a significant rise in world rice prices are becoming clear:
    - A spotty monsoon in India and Pakistan might induce a reduction in rice exports from the sub-continent, or even outright export bans. India has been very careful so far, announcing a partial ban on broken rice in order to control food prices domestically. The world market was not unsettled by this limited action.
    - Heat and drought in south China are reducing rice harvest prospects quite significantly, and China might turn to increased imports rather than draw down stocks (China is already the world's largest rice importer, although it also exports some rice).
    - Bad weather in the Philippines and a new government might prompt large import tenders to a very nervous world rice market. Fortunately, several very experienced technocrats hold senior ministerial positions, so the government is not likely to act rashly.
    - Russia might bomb grain facilities and ports in Ukraine as a "knee jerk" response to the Moscow car bombing. New disruptions to grain exports from Ukraine would likely cause sharp price spikes in world commodity markets, as "outside" financial speculators return to the markets they started to flee after the Russia-Ukraine agreement to permit food exports via the Black Sea began to seem likely in late June 2022.

ASEAN has no enforcement mechanisms if individual countries want to do something that will adversely affect world rice prices, but the forum and dialogue have proven remarkably successful. Compare historical world rice prices with world prices for wheat and maize. Rice prices used to be **much** more unstable than wheat and maize, because of the very thin world rice market. The opposite has been true since 2008, despite the fact that the world rice market is still quite thin. Thank ASEAN.

Establishing such a neutral forum more globally, where potential actions that could panic world food markets would be discussed and possibly defused, has the potential to be a big step toward preventing an even worse food crisis than is already on our doorstep. Indonesia would be a credible chair of such a forum, and the World Bank has both the financial resources and technical skills to help make it work.

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