

Lessons from Recent Stocks Adjustments, and their Measurement

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Introduction

Prior to the 2007-08 food crisis, best practices recommendations for risk management related to agricultural commodities emphasized liberal trade regimes, use by farmers of private risk management strategies such as futures and options or crop insurance, and safety nets to protect poor consumers (Byerlee, Jayne and Meyers, 2005; CRMG, 2008). Movement toward these recommendations has since the early 1990s led to both policy reforms and diminished research on other options, including public and private stockholding. Stocks interventions were not part of those best practices.

Policy responses to the agricultural commodity price spikes in 2007-08 by developing country governments deviated substantially from those recommendations as countries sought to isolate themselves from developments in world markets (Abbott, 2009 & 2010; Pinstup Andersen, 2011). Variable levy-like tariff reductions, export taxes and bans, and complementary domestic policies were pursued to stabilize domestic markets. According to an FAO survey by Demeke, Pangrazio and Maetz (2008), 35 of the 81 countries examined used public stocks releases as part of that strategy. Stocks adjustments were part of observed reactions to mitigate domestic consequences in virtually all countries, although those often reflected private agent decisions (e.g. in FAOSTAT or USDA's PS&D data). Subsequently, many countries have pursued greater self-reliance, rebuilding stocks and resurrecting old institutions and policy regimes that are contrary to the best practice recommendations (Watson, 2013). Reestablishment of parastatal marketing boards and greater public control where parastatals and private traders coexist are undoing reforms driven by the WTO and by IMF structural adjustment reforms (Abbott, Andersen and Tarp, 2010). Use of stocks and subsidies for food security has become one of the more controversial debates in the WTO Doha round negotiations (Galtier, 2009 & 2013; Hoda and Gulati, 2013).

Causes of the price spikes, which would inform future expectations and revised policy recommendations, remain controversial (Heady and Fan, 2010). One aspect that received considerable attention was the poor quality of market information, and especially global stocks data (UNHLTF, 2008). In the absence of good stocks data, a debate has persisted on whether low prior global stocks to use ratio's contributed significantly to the price spikes (Wright, 2011; Abbott, Hurt and Tyner, 2008, 2009 and 2011; Wiggins and Keats, 2009). One recommendation from the G8/G20 examination of these events was for improved market information, with emphasis on stocks data (FAO et al, 2011), This led to the creation of AMIS (Agricultural Marketing Information Systems, 2013), an FAO led initiative of many international organizations to improve market information and increase data collection capacity in developing countries (FAO, 2013). A recent survey of current and best practices in stocks estimation funded by AMIS/FAO highlights the poor quality of available stocks data (Abbott, 2013).

The dramatic changes in market circumstances and future market expectations as a result of the 2007-08 food crisis have given impetus to renewed interest in stocks behavior and stocks as a policy instrument. Lesson can be learned from examination of both the evolving market perspective and from country experience in response to a world price shock. That experience shows stocks to be an integral part of policy regimes and private behavior, impacting linkages between domestic and world markets. Stocks were used to stabilize domestic markets as part of strategies to disconnect from world market events and protect consumers. Understanding those linkages is problematic in light of poor data quality. But the various actions taken to stabilize domestic markets surely helped to destabilize world markets (Martin and Anderson, 2012), as was well understood in old theory (Bale and Lutz, 1979; Tyers and Anderson, 1992). Public stockholding to stabilize may act according to that theory, but private stockholding in open trade regimes well integrated with world markets has helped (somewhat) to mitigate world price variability. Low stocks outcomes around 2008 and afterwards may well have limited the role of private stockholding as a global public good, however.

This paper seeks to identify lessons from research on stabilization policy responses following the 2007-08 food crisis (Abbott, 2010) and from research on current and best practices in estimating stocks data (Abbott, 2013). Three sets of questions are explored below:

- Why is existing stocks **market information** problematic? What is needed to improve information?
- What do recent market characteristics, events and government responses suggest for the role of stocks in **domestic agricultural policy**?
- What role might stocks play in solutions for **international market instability**?

The following section examines both background on stockholding and the basis for recommendations to improve global stocks data. Then I explore the role of stocks in domestic agricultural policy, with implications for modelling and stabilization policy. The role of stocks in international market instability is then considered, with conclusions following for each of these three topics.

Improving Agricultural Market Information

Background – Why stocks data matter

The UN High Level Task Force on the Global Food Security Crisis (UNHHTF, 2008) and a consortium of international organizations (FAO et al, 2011) both highlighted poor stocks data when recommending that better market information was needed to insure global food security. The Agricultural Marketing Information System (AMIS, 2013) was created by that consortium to address this concern, in response to recommendations established by the G8 and G20 (2011). GIEWS (2013) now makes available market information from FAO, USDA, IGC and national governments, including the FAO-CBS dataset that is on a crop year rather than calendar year basis. The new FAO dataset reports stocks data that are more meaningful to market outcomes

than the calendar year stocks data from FAOSTAT. AMIS is also working to strengthen data collection capabilities in developing countries (FAO, 2013g). A Gates funded project works with Bangladesh, India, and Nigeria while a project funded by the Japanese government looks at Thailand and the Philippines. One effort supported by those projects is identification of current and best practices in stocks data estimation, and development of a set of guidelines for improved stocks data estimation (Abbott, 2013). CountryStat (FAO, 2013c) is a framework similar to FAOSTAT that facilitates reporting agricultural market information from 24 countries. The focus of that effort, hence priority given to grain and oilseed stocks, reflected the concern with functioning and instability of world commodity markets as a result of the events in 2008. Emphasis on these tradeables put international trade ahead of food security. Some of the commodities impacted by the food crisis through consumption substitution effects include non-tradeables such as millet, sorghum, cassava and yams, however. Stocks of interest were those that best reflected market performance – annual carry-out stocks that are measured just prior to harvest and that can link prices across two crop years.

Stocks can play several roles influencing market and food security outcomes. Market performance is a consequence of links between prices over time due to storage costs (Wright, 2001; Williams and Wright, 1991), although that link can break down when a poor year is followed by a bumper harvest. While stocks over time capture use that occurs continually from a harvest that may be only once per year, annual carry-out stocks link crop years when storage takes some of earlier production into a new crop year. Stocks may reflect the behavior of risk averse private agents and their expectations, but they may also be the consequence of public policy. Stocks accumulation (or release) may resolve the disequilibrium when incentives encourage supply in excess of (below) demand. Economic agents, both public and private, may hold stocks in response to policy incentives, to ensure food security, or to achieve business objectives such as continuous needs for processing. Stocks are also an indication of national food availability, hence food security, and may be held to insure supplies for food aid operations. Understanding the roles of stocks is key to analyzing their use and market impacts, and better data enhances each of these functions.

Alternative stock's definitions must be considered for both data collection and analysis. One distinction is between public stocks and private stocks. Public stocks may be held by government agencies or parastatals for a variety of specific purposes. Emergency reserves are working stocks held to insure supplies for public distribution or food aid programs. Strategic reserves may be held to influence market outcomes, and public stocks may also be accumulated as a consequence of agricultural policy. In principle, information on these stocks can easily be drawn from public records. Policy may be implemented by the government acquiring stocks or by providing incentives to private actors. And private actors may hold stocks on behalf of the government (Oryza, 2013). But even with public stockholding, farmers, traders and end users may hold significant stockpiles (Jabbar, 2009). Private stocks may be held as a consequence of policy incentives, as a risk management agent, or as working stocks to insure continuous operation of a plant or feedlot. While the distinction between working and buffer stocks may be evident in definitions, levels may be ambiguous in the eyes of agents holding stocks. Stocks surveys do not ask market participants to make this distinction.

As noted above, the stocks that most influence market performance are expected annual carry-out stocks held by private plus public agents, the quantity carried into a new crop year (or season) as harvest begins. These stocks reflect expected supplies for the new crop year and determine price linkages across crop year following the theory of storage (Williams and Wright, 1991). They influence food security across years, and may accumulate due to policy incentives influencing inter-annual equilibrium. Stocks estimates may be reported for shorter periods, but the focus is often on expectations of these annual carry-out stocks. Stocks to use ratios based on this definition are among the more practical elements of market information used in forming private price expectations.

That public stocks accumulate due to policy incentives while private stocks expectations influence expected, future prices complicates understanding causality between stocks and prices. Artificial policy set prices that bring disequilibrium, and procurement practices that complement policy, should cause stocks to accumulate in good years. Private stocks cause market prices, so stocks expectations in this case lead rather than lag prices. When public and private stocks coexist, this becomes a more complicated, simultaneous relationship. That relationship is likely to change as policies are reformed. In the U.S., for example, the relationship between stocks and prices is quite different before the early 1990s, when stocks and stock incentives were an instrument of policy, relative to afterwards when government pursued a less activist role and sought to delink policy from stocks. This complicates assessment of the stocks-price relationship, suggesting a focus on private stocks, and may explain why U.S. stocks may better explain prices in agricultural commodity markets than global stocks.

Whether stocks to use ratios during the 2007-08 food crisis adhered to this relationship, and what role low stocks played in the price spikes, is somewhat controversial. Wright (2011) uses annual data after the fact to argue that this relationship held up and provided guidance to price formation. Abbott, Hurt and Tyner (2008, 2009 and 2011) argue that this relationship is less apparent in short term data, and that stocks expectations at the time prices spiked eventually proved incorrect. Figure 1 plots expected futures prices (e.g. December futures contracts for corn) against expected stocks to use ratios from corresponding monthly expected carry-out stocks found in USDA's WASDE reports (WAOB, 2013 and earlier). It shows the expected L-shaped stocks demand function characteristic of storage theory, where stocks demand is very elastic when supplies are abundant and becomes inelastic at a level of minimum working stocks, when supplies are short. But outliers in those graphs can be identified as months during the food crisis when extremely high prices were associated with larger than normal stocks. This is most evident for rice, and analysts argued that the spike in rice prices was due to other factors (such as export bans) and not low stocks or tight supplies (e.g. Timmer, 2008).

Another explanation may lie in data on nearby versus distant futures prices. Figure 2 plots nearby futures prices for the upcoming December contract, and prices for December a year later for corn and soybeans. When nearby futures and so spot prices peak, usually expected futures prices rise much less. For both corn and soybeans in 2008 there appears to be an anomaly, as expected future prices rose along with spot prices. This may be because new persistent demands rather than production shortfall induced the price increase, which was at the time expected to persist for

several years. In that situation incentives to carry into the new crop year would be stronger than normal. When production shortfall is the cause an expected future bumper crop would bring down future prices, but this was not the expectation in early 2008. This behavior is consistent with storage theory, but only if demand expectations are properly taken into account.

Why stocks data is poor

The discrepancy between stocks to use data and the timing of price spikes during the food crisis is one reason why the quality of market information has been questioned. There were numerous, competing explanation's for the crisis, seeking to explain the anomalies, but data was perceived to be inadequate so some analysts did not try to sort among potential causes (Trostle, 2009). Abbott's (2013) detailed examination of stocks data estimation practices highlights concerns that were most likely already understood by many experts.

Only a few countries survey farmers, traders and end users to determine the extent of stocks over time. The U.S. and Canada run quarterly surveys of both on-farm stocks and commercial stocks, and results inform national commodity balance estimates. Brazil surveys for commercial stocks, based on the belief that on-farm stocks there are not large. Australia surveyed farmers, traders and end user, and did the most comprehensive job of estimating stocks held by livestock producers, but has discontinued that effort as of 2013. Among developing countries, we found evidence of stocks surveys only in the Philippines, who has been running monthly rice and corn stocks surveys for 30 years. There was a brief flurry of activity around the time of the G8 recommendation in 2008, with a couple of surveys found in Great Britain and evidence of an effort to start surveying in Nigeria, but these were not sustained. The countries who persist in estimating stocks are large exporters, and the stocks are held in private hands. Stocks data there is treated as a public good, and benefits foreigners as well as domestic market participants.

Most countries estimate stocks as a residual in supply-utilization equilibrium (food or commodity balances). This is also the method that FAO and USDA must rely on to estimate stocks for all but the few countries where stocks are surveyed. That approach begins with the following equilibrium condition:

$$\text{Carry-in stocks} + \text{production} + \text{imports}$$

$$= \text{food use} + \text{feed use} + \text{industrial use, waste, losses and seed use} + \text{exports} + \text{carry-out stocks}$$

There are numerous problems with using this residual approach to estimating stocks. The most fundamental is that there are several unknowns to be identified by this one equation, an algebraic impossibility. Production and trade data are most likely reasonably well know. But data on uses is as problematic to obtain as stocks data. Human consumption may be revealed in household surveys, but those are only conducted roughly every three to five years. Any annual adjustments due to income growth, availability or price changes must be guessed by the analysts creating the balance, and appear to often be ignored in practice. Feed use and industrial use may be even more difficult. USDA uses this balance to estimate feed use, treating it explicitly as the residual and surveying stocks (NASS/USDA, 2013). Seed use, waste and loss must also be taken into account, typically by assuming some share of production or use, although those share estimates

may not be frequently updated. Since stocks are typically a small fraction of production and use, relative errors in stocks are magnified by errors in these other terms. Hence, the empirical basis for several components of the agricultural supply-utilization balance is weak, and several variables are candidates to serve as the residual found from this relationship.

The errors in Chinese stocks around 2001 is a famous case of the breakdown of this relationship (GIEWS, 2001; Hsu and Gale, 2001), necessitating large corrections in both FAO and USDA data. But problems are evident in differences across data sets for many countries. Figure 3 plots annual stocks to use ratios from 1990 to 2013 (where available) from four competing datasets for Thailand and the Philippines. AMIS (2013) now provides the FAO-CBS data used in outlook work by the FAO's Markets and Trade Division. FAOSTAT reports calendar year data on stocks changes from the Statistics Division, which were used to estimate levels by equating beginning stocks with those from USDA in 1990. USDA's Foreign Agricultural Service (FAS, 2013) provides the PS&D dataset. For these two countries AMIS (2013) also provides data maintained by national governments. It is apparent that these series, intended to represent the same variable, show very different results. What is somewhat surprising is that only AMIS has until recently respected the national data from the Philippines where stocks estimates come from surveys. The food crisis did bring some convergence to those numbers once stocks estimation became a more critical concern, and deviations in 2013 may be due to those data still being expectations. The wide discrepancies in data for Thailand are even more concerning, since it has historically been the world's largest rice exporter.

While some asserted that the recommendation for better stocks data was unwarranted because of existing internationally available data, the international entities who estimate global commodity balances (FAO and USDA) suffer from the same limited data availability, and from the same issues in estimating stocks as a residual from that balance, as do national governments.

What is recommended to improve data

If the goal of better agricultural market information is to be achieved, more data collection is required. Our recommendation is that both on-farm and commercial stocks be measured, so farmers, trader and end uses who hold stocks need to be surveyed. Best practices are those in the U.S. and Canada for developed countries and in the Philippines for developing countries, where separate on-farm and commercial stocks surveys are conducted at least quarterly. This method is preferred because errors are likely when stocks are estimated as a residual from commodity balance. If stocks surveys of private agents are not conducted, the empirical basis for other components of supply-utilization balance needs to be strengthened.

Stocks surveys are costly, so most countries do not conduct such surveys. If that rationale requires that fallback strategies be pursued, those strategies need to improve other information in the commodity balance. One fallback is the strategy of Brazil, who only surveys commercial agents. That approach might suffice if commercial and on-farm stocks are shown to be highly correlated, and in places where on-farm stocks are shown to be small. But even when large public stocks are held, farmers and traders often hold stocks. Alternatively, use might be surveyed more frequently. Consumption and feed use surveys would be needed at least once per

year. Countries mostly survey neither stocks nor use, but stocks are sometimes surveyed and use, especially feed used is seldom surveyed. Stocks can be measured by observing what is on hand, but use involves recall and/or estimation of future use, so is likely to be less accurate. The various rules of thumb on seed use, waste, losses and industrial use need to be updated more frequently, and based on data collection. Also, the expertise in national governments needs to be strengthened if reliance on that approach is to continue, as these estimates rely now on expert judgment.

There are not best practices methodologies that extract better market information from non-existent data. Collecting stocks data via on farm and commercial surveys is likely the most cost effective alternative to gather better market information that informs both policy and market performance.

Stocks and Trade in Domestic Agricultural Policy

Stocks versus Trade to Stabilize?

Both public stockholding and policy created incentives affecting private stocks are used to stabilize domestic markets, and were used in 2007-08 to isolate from world price spikes. One of the debates has been whether trade or stocks are better instruments to address instability. Criticism of policy responses during the food crisis reflected the best practices perspective and earlier research on stabilization policy.

Research examining stabilization policy early on advocated for trade policy rather than stocks (Bigman and Reutlinger, 1979; McIntire, 1981). A variable levy was recommended such that a stable domestic price could be maintained while world prices varied. If an open economy were well integrated with world markets, imports would then compensate for production shortfalls. If markets are poorly integrated with world markets, this analysis breaks down however. That early work relied on small country models in which the Law of One Price (LOP) held, and annual models that did not take into account either lags in price transmission, import delivery or seasonality.

Stockholding has been seen as costly, in part because stocks might need to be held for long periods. Trade policy alternatives require sufficient foreign exchange to finance imports. While both the IMF and European Union have established lending facilities for trade in commodities, these funds have been seldom used. Variable levies were also banned in the 1995 WTO agreement, as they prevented stabilizing countries from sharing in the task of accommodating shocks to world markets. The spillover or beggar-thy-neighbor character of domestic stabilization was recognized in the WTO debate, with emphasis on EU participation in world market stabilization. But countries, and the EU, can and do mimic variable levies with rapid changes of fixed tariffs.

Most countries in 2007-08 used a combination of trade and stocks to stabilize/isolate domestic markets. According to Demeke, Pangrazio and Maetz (2008), of 81 developing countries surveyed, 35 released public stocks and 43 reduced import tariffs. Their results suggest many

countries were using both strategies, along with complementary domestic interventions. In an earlier study of responses to production shocks, Abbott, Patterson and Young (1998) found from USDA's PS&D data that all countries would use both trade and stocks to stabilize consumption in response to production shortfalls, and this pattern persisted after structural adjustment reforms. These regimes prevented domestic markets from fully or quickly internalizing world price spikes, protecting urban consumers more so than farmers. Rural consumers, where poverty is highest, were protected somewhat from higher prices by imperfect transmission of world prices, but incentives for greater production were muted. While there are clearly differences across countries, the policies adopted by developing country governments clearly reflected a preference for domestic stabilization, and a willingness to pay the cost to achieve that.

One of the most heavily researched aspects of the food crisis was transmission of world prices to domestic markets in developing countries (Minot, 2011; Dawe, 2008; Abbott and Borot di Batisti, 2012, Daviron et al 2008). Price transmission elasticities measure the extent to which world price and exchange rate changes are reflected in domestic prices, hence whether LOP holds. Highly variable domestic price impacts from the world price spikes of 2007-08 have been observed. While a few countries were closely linked to world markets, transmission was imperfect with elasticities below one in most cases, and lags were evident as long run transmission was stronger than short run responses. Studies examined both world to domestic transmission and urban to rural transmission by looking at several domestic markets. Wholesale market (within country) transmission was stronger than international price transmission. The extent of transmission varied across countries, but also across commodities for a given country. High import dependence, such as for rice in West Africa led to greater transmission, while home good (non-tradeable) status such as for millet and sorghum led to much weaker transmission. Imperfect, lagged transmission is consistent with findings of earlier studies (Baffes and Gardner, 2003; Rapsomanikis et al 2004).

There are two causes of imperfect price transmission. Stabilizing trade policy, such as variable-levy like tariff cuts as observed in 2007-08, reduce the link between world and domestic prices. Such policies seek to isolate domestic markets from world price shocks. But tariffs were not large enough, and cuts not deep enough, to address the large price spikes of that period. A second factor behind imperfect price transmission is weak market integration. High transactions costs, oligopolistic traders and imperfect markets also isolate domestic market outcomes from world price shocks. Both importation and domestic commerce may be imperfect, and lead to weak, lagged price transmission. High transactions costs to isolated farmers also result in imperfect market integration. In such cases, outcomes depend more strongly on domestic factors like production shortfalls, and prices can move more independently of world prices. If world price shocks were the more important force behind instability, weak integration would implicitly stabilize, but best practices prior to 2007-08 held that production shocks were more important, and a more stable integrated import market was preferred.

In analysis of stocks and stability, imperfect price transmission needs to be taken into account. Price transmission is more compatible with partial equilibrium modeling, while the Armington assumption that allows domestic and imported goods to be imperfect substitutes also allows for

weak market integration. Empirical evidence suggests parameters needed to implement either approach are not stable over time, and the lags observed for price transmission are not captured in the Armington approach. A better approach to domestic market share more strongly rooted in econometric evidence and observed market behavior is needed. That approach needs to reflect the imperfect market integration found by price transmission studies.

Volatility: Nature and Sources

Another issue that arose from policy debates following the recent food crisis was whether world prices had become more volatile. Was world price volatility now more important than domestic production volatility, a presumption that had informed best practice risk management recommendations?

World prices in 2008 spiked to nominal levels much higher than in recent history, and there was an episode of considerable variability, particularly in daily futures prices in early 2008. The language of the debate turned at one point from a discussion of high prices and their impacts to one focused on more volatile commodity prices (e.g. Delgado, 2009). But evidence does not support well that perspective (Abbott, 2013). One issue in this debate is the proper measure for volatility. Most adopt coefficients of variation, since it would be expected that higher prices would be accompanied by proportionally higher standard deviations. The coefficient of variation for U.S. (hence world) corn prices changed from 0.11 in 2000 to 2006 to 0.31 from 2007 to 2012, but that included a decline to 0.22 after 2009. These measures also were driven more by regime changes and trends than by short run variations, with variability fully evident in annual prices.

A related issue is that price distributions do not appear to be simple normally distributed random processes, but rather exhibit long periods of low prices but with occasional high prices. Stocks contribute to significant serial correlation in those series. One's perspective on price volatility depends strongly on how far back one looks, hence the time period investigated. Figure 4 shows graphs of indices for corn wheat and rice world prices over time. The top graph starts in 1998, and appears to show the deviation after 2006 from low volatility beforehand. The longer perspective shown below highlights that the outcomes in 2007-08 were not unprecedented. A coefficient of variation on the longer series, from 1960 to 2012, is 0.41.

A more informed assumption on world price distributions needs to account for relative stability but occasional spikes. Balcombe (2009) argues that such a perspective should consider conditional variances. Variables like oil prices and other commodity prices, due to underlying macroeconomic factors (Gilbert 2009), influence the distribution of agricultural commodity prices. In our view one of the key conditioning variables would be annual carry-out stocks position in countries well integrated with world markets. The extent to which this is observed depends on our ability to identify which stocks positions are related to world prices, and which are not. Poor data, weak market integration and isolationist policies are why U.S. stocks are more strongly related to world prices, even when Chinese stocks are excluded from global stocks measures. Since public stocks may be held entirely to meet domestic objectives, private stocks are critical to global pricing.

The initial question on volatility considered relative effects of production volatility relative to world price volatility. Hazell, Shields and Shields (2005) showed that domestic production volatility mattered more at the time of their study. That result in part depended on the time period examined, and included the relative stability since 1998 of world prices. It was the basis for the World Bank's recommendation to leave borders open (Byerlee, Jayne and Meyers, 2005). A presumption has been that this perspective has changed, but in many countries even during the 2007-08 food crisis, it was domestic shocks as much as world price shocks that destabilized domestic prices (Pinstrup-Andersen, 2011). Few countries accepted the recommendation that open borders and liberal trade policy sufficed, but domestic shocks remained very relevant.

The lags in price transmission are in part due to the fact that weakly integrated markets with poor storage infrastructure exhibit high seasonal volatility. When storage is poor prices may collapse after a good harvest, will peak just prior to that upcoming harvest when stocks are at their lowest levels, and may spike when a poor new harvest is anticipated. Seasonal price volatility may be much greater than volatility of annual (average) prices, but that effect diminishes as storage institutions develop. Imports arrive with a lag, possibly of several months, in response to expected needs, and also exhibit a seasonal pattern related to when harvests occur and the extent to which consumption is supplied by domestic production. Managers of parastatal grain boards asserted that one goal was to have adequate stocks as imperfect information on the upcoming harvest became available (Abbott et al, 1993.). Sufficient stocks prior to harvest could prevent domestic prices from spiking. This was strongly dependent on expected annual carry-out stocks.

Seasonal variability is critical to stocks management by parastatals and private behavior determining annual carry-out stocks. But most models examining stabilization policy are annual, abstracting from seasonal factors and timing of behaviors. The lags in price transmission make evident the importance of short run behavior, which needs to be incorporated in stabilization policy modeling. Limited data, especially on inter-temporal stocks, have made such an approach difficult, but experimentation is warranted.

Institutions and Objectives

Seasonal price volatility is a consequence of immature agricultural marketing institutions, including storage, market information, transportation infrastructure, insurance and credit. The lack of adoption of private risk management tools, such as futures and options or crop insurance, is in large part due to weak institutional frameworks (CRMG, 2008). These weak institutions can also contribute to instability and limit a countries capacity to address instability.

In an examination of the political economy of policy responses to the food crisis, Watson (2013) summarized the results of 13 case studies that found implementation failure a serious constraint to effective food policy. The differences between responses and their effectiveness in Africa versus Asia to the food crisis were due more to the ability to implement policy, not the role of state institutions or differing policy objectives. In the Asian countries examined public management of markets kept domestic prices very stable, while implementation failures in Africa meant at times public interventions exacerbated price variability (Jayne and Tschirley, 2009). Good governance is one of the keys to food security (Poulton et al, 2006).

The kinds of public institutions found in Asia had been eliminated from many countries elsewhere as a consequence of structural adjustment reforms. Nigeria is one case where reinstating such institutions now is being considered as a consequence of food crisis impacts. One often adopted recommendation had been coexistence of public and private trade as these institutions were reformed. But in some instances the public sector asserted a stronger role in response to the crisis. Public-private coexistence only works when there are credible, transparent and predictable interventions by the state. Some of the implementation problems noted by Jayne and Tschirley (2009) reflected this governance failure.

The criticism most often levied against state trading has been its high cost (e.g. Cummings and Gulati, 2009 for India), but governments have exhibited a willingness to pay this cost for stability. Hence, one of the ways in which policy analysts and policymakers talk cross-purposes is because they do not share the same objective function. Any evaluation of stabilization policy requires identification of the appropriate policy goals.

Research has examined whether stabilization is a legitimate goal (e.g. Tiimner, 1989 & 2001). Early work sought to show whether specific agents and nations would benefit from stabilization (see Newberry and Stiglitz, 1981). Simulations typically showed that stabilization came at a cost, and benefits from stabilization have been difficult to measure, so economists argue they are low. There is a revealed preference for stability in the policy choices of developing country governments, and also by farmers and consumers, however.

Literature has also examined what should be stabilized. While policy can most easily impact prices, and political decisions may be easier to reach for prices, income and expenditures are more relevant concerns of farmers and consumers. Price stabilization is easier to implement, if the wrong policy target. Whether this stabilization should be over the short or long run, hence the relevance of production incentives, has also been examined. Short run price stabilization appear to be strongly preferred, and prices are more easily administered than income or expenditure. Expenditure stabilization also should be targeted at the poor. National governments use higher poverty thresholds than the World Bank's \$1.25 per day extreme poverty threshold, and responses showed a desire to protect urban consumers.

Parastatal managers also expressed a desire to avoid extreme outcomes. This preference is reflected in the adoption of price bands regimes, where interventions only occur for very high or very low prices, while letting prices vary within the bands. Developed country policies prior to the 1995 WTO agreement also reflect this preference to avoid the tails of price distributions. Price bands have been criticized by theorists, as speculative attacks could mean prices are mostly at the bands (Salant, 1983). Speculative attacks are most relevant where large, well-financed traders participate in markets. This regime probably best reflects the preferences of policy makers, to avoid the extremes that bring either very low farm income or severe food insecurity, so reconsideration of ways to implement something that does so is warranted.

Modeling and Policy Implications

Evidence on market outcomes and policy responses during and after the 2007-08 food crisis informs both policy recommendations and strategies to model and so evaluate stabilization policy.

If the former best practice risk management strategies are to work, institutional development along the marketing chain is required. The market failures that have prevented adoption of these strategies in the past must be directly addressed. Safety nets that might protect the poor better than price interventions (Wodon and Zaman, 2008) need to be established before crises occurred. They were used effectively in some countries (e.g. Brazil and Ethiopia) where they were already operating, but creating distribution networks is not a short run activity. Domestic production variability remains important, and especially so in markets weakly integrated with world prices. It may well continue to be the case that countries can rely on trade to stabilize, except in the infrequent period when world price shocks occur. Policy needs to adapt to realistic price distribution expectations, but needs to respond in transparent and predictable ways when world price spikes reoccur. Ad hoc price interventions for infrequent spikes are appropriate to avoiding extreme outcomes, if they meet transparency requirements. A more realistic empirical assessment needs to be made of speculative attacks on price band regimes to see if and where they occur in developing countries. That regime better reflects policy objectives, so strategies that address those objectives – to avoid extreme outcomes – need to be developed. Short term strategies that utilize stocks will complement trade policies to address seasonality, lags in price transmission and delays in receiving imports. Stocks are also appropriate when markets are not well integrated with world trade. Trade and stocks in most instances are complementary.

More empirical evaluation of stabilization policy is now called for, but must be done with more realistic modelling assumptions. Properly capturing price and production distributions that reflect infrequent spikes and persistent production uncertainty are critical. Short run (quarterly) models that capture seasonality are required to reflect trade stocks/complementarity. Data constraints need to be overcome to do so. Markets that are imperfectly integrated with world markets need to be modeled accordingly. Small economy models have yielded incorrect policy prescriptions, but Armington specifications may be overly rigid in the face of big shocks and do not reflect changing responses over time and under differing market conditions. Spatial models with high transportation costs and incorporating parity bounds may better represent imperfect integration. Price transmission elasticities also must reflect imperfect integration as well as policy adjustments. Finally, the objective function used to evaluate alternatives must be more relevant to national interests.

International Market Spillovers

Exporting Instability

By isolating from world markets and stabilizing in the face of world price shocks, countries exacerbated world price instability (Martin and Anderson, 2012). That domestic policies are

beggar thy neighbor and spill over onto international markets has been well understood (by academics – Bale and Lutz, 1979; Tyers and Anderson, 1992). The exports bans by Asian countries leading to the largest spikes in world rice prices, when supply-utilization data suggested there were no shortages, is strong evidence of such spillovers (Timmer, 2008). Martin and Anderson argue that import tariff reductions also destabilized world markets. Stocks effects have not been assessed, and depend on the extent of market integration, just as tariff and export policy impacts depend on price transmission.

WTO commitments made in 1995 were in part driven by the goal to have countries share the adjustment burdens in world markets, hence the restriction against using variable levies. But both export and import policy adjustments were within weak WTO commitments. Tariffs are prohibited from increasing beyond bound rates, but countries are free to reduce tariffs below bounds, and presumably restore tariffs up to bounds later. Export taxes and bans are largely undisciplined. If one of the objectives of the 1995 agreement was to improve international market stability, the policy responses and outcomes of 2007-08 suggested it failed in that effort. Stabilization policy was a stumbling block in recent Doha round negotiations, as countries asked for flexibility from URAA disciplines that would treat spending for public stocks and distribution like the old policies that stabilized domestic markets with stocks (as in the U.S.). This stems in part from WTO policy debates and analytical methods to explore proposals that take a very static perspective, and haven't taken into account how or why stocks matter. The models most often employed to evaluate WTO proposals (CGE models) don't include stocks in their specifications (Piermartini and Teh, 2005). Moreover, it may now be the case that old self-sufficiency objectives are reemerging and countries trust less reliance on trade for food security. Countries that liberalized and opened borders to trade were hardest hit by the 2007-08 world price spikes.

With the spillovers of domestic stabilization onto world markets, and concerns with the impacts of the price spikes on world food security, policies to stabilize world markets that have been largely ignored for decades are now regaining attention.

Internationally Interventions?

International stockpiling strategies were abandoned in the early 1990s based on logic similar to that for domestic stockpiling. Given world price distributions it would be likely that stocks would need to be held for extended periods, raising costs. It is unlikely that international stocks interventions would raise global welfare, and it is domestic welfare that matters to national governments. If stabilization per se is valued as an objective, it is not international stability but domestic stability for which that is the case. Impacts will differ by country, as do objective functions. Some countries (e.g. India and China) appear to desire very stable domestic markets, while others either tolerate greater stability or cannot afford it.

Experiments with international stabilization via stocks have been tried in the form of commodity agreements. These institutions eventually failed, although some may disagree with that assessment, as some agreements lasted substantially longer than others. Costs issues were in part driven by price distributions that resulted in agreements holding stocks for long periods, but most

agreements could not resist trying to move mean prices, exacerbating stocks accumulation. Gilbert (1996) argues that problems stemmed as much from political failure, as parties to the agreement held conflicting objectives. The same objective function issues that lie behind domestic policy assessment have been key to why it is so difficult to implement international solutions.

Given the cost of holding stocks, virtual reserves or insurance based approaches that did not rely on stockholding were proposed in the mid-1980s (Huddleston et al, 1984) and emerged again in the 2007-08 food crisis (von Braun and Torrero, 2009). This logic reinforced IMF and EU initiatives to provide lending for commodity imports that were seldom used. For world prices to adjust, quantities traded must change or expectations altered. Von Braun and Torrero justify their approach as a strategy on the logic that small international interventions could prick bubbles by altering expectations. But the experts who might serve as managers for the board overseeing this activity feared the kind of speculative attacks that plague price bands in domestic markets. Moreover, speculative bubbles are difficult to identify, even after the fact (Caifero et al, 2010).

To solve the conflicting objective issue, some have proposed regional stabilization, including regional reserves (Baidaine and Resnick, 2005). The technical requirements for such a strategy may hold, in that in some regions production across countries is not highly correlated (Byerlee, Jayne and Myers, 2005). International market shocks impact all countries in a similar manner, however. Conflicting objectives and policy coordination will likely remain as issues even in adjacent regions, and spillovers onto other regions would remain problematic. As an illustration, consider the extent to which large Asian countries successfully stabilized in 2008, but these actions raised prices for African rice importers. Domestic stabilization has remained the policy goal, even if it exports instability.

Domestic Stocks and International Stability

Even when public entities no longer hold stocks or manage markets, private agents will hold stocks (and they do so even when there are public stocks). The theory of storage suggests annual carry-out stocks are based on expected prices, hence expected harvests. If the L-shaped stocks demand function is accurate (and evidence suggests it is – Caifero et al 2010), private stocks achieve a degree of stabilization on the markets they influence. To the extent that stocks and trade are related, these private stocks may also stabilize international markets to an extent. U.S. private stocks have certainly contributed to more stable world markets, if hardly perfectly. They are more effective at establishing a floor, at the expected future price of private agents, than at a ceiling. While stocks releases occur during bad years and share supplies across year, in bad years (or possibly several consecutive bad years) stocks essentially run out and demand become more inelastic, leading to price spikes. In the absence of this private stockholding supplies would be lower and price peaks higher.

If borders are open and stocks influence trade, they also impact world market stability. The extent depends on whether domestic and international markets are integrated. Since U.S. markets are well integrated with world trade, stocks behavior is also transmitted to world markets. If domestic markets are not integrated with world markets, stocks do not influence trade. The

extent to which Chinese food grain markets are not integrated, as revealed by near zero world price transmission during the food crisis, suggests their domestic stocks play no role in world price formation nor world market stability (Huang et al, 2013). Evidence on price transmissions from the food crisis suggests that some countries are well integrated with trade, while others are not. The global stocks that matter to world prices are those found in countries open to trade, hence showing significant price transmission. As the cases of China and India show, when those stocks are held by public entities, for domestic food security goals, price transmission is low and so those stocks are disconnected from (even contributed to) world market instability. Both better market integration and elimination of policy regimes that decouple domestic prices from world prices would enhance world market stability, and private stocks would play a role in that.

The price floors set by private agents are unlikely to be the same as those chosen by national governments, but may better reflect long run mean prices. Private stocks also may be released well ahead of thresholds corresponding with maximum desired world prices. But private stocks are likely to play a greater role for international markets than will public stocks, which will clearly reflect the domestic objectives of the entity managing those stocks.

Conclusions

Conclusions address each of the three aspects of the relationships between stocks, market performance, and policy effectiveness, drawing on lessons from events during and following the recent global food crisis. Both public and private stocks must be considered, because policy determines incentives for stocks accumulation, stocks are an instrument of policy implementation, and market price determination is influenced by the combined annual carry-out of public and private stocks.

Market outcomes during the 2007-08 food crisis highlighted the inadequacy of existing market information, and led to calls for improvements. As a result of G8 and G20 attention to this issue, AMIS (2013) was created with efforts to both make widely available existing information and enhance capacity to collect information. Abbott (2013) examined current and best practices in stocks estimation, providing recommendations to establish guidelines for improved data collection and exploring the problems with current methods. The fundamental recommendation was that better data requires more data collection. The method used in most instances to estimate stocks as a residual from supply-utilization equilibrium is under-identified and magnifies errors in stocks from errors in other components of that balance. These errors are evident in discrepancies across competing data sources. Uses and stocks are both less well known than production or trade. If stocks are not surveyed, more use data needs to be collected, and that may be more difficult or expensive. Separate surveys of on-farm stocks and commercial stocks are called for to complement records on public stockholding. Fallbacks to conducting these surveys require stronger empirical foundations for the other components of commodity balance. Quality data is needed to inform market performance, to evaluate stocks policy alternatives, and to conduct agricultural policy research.

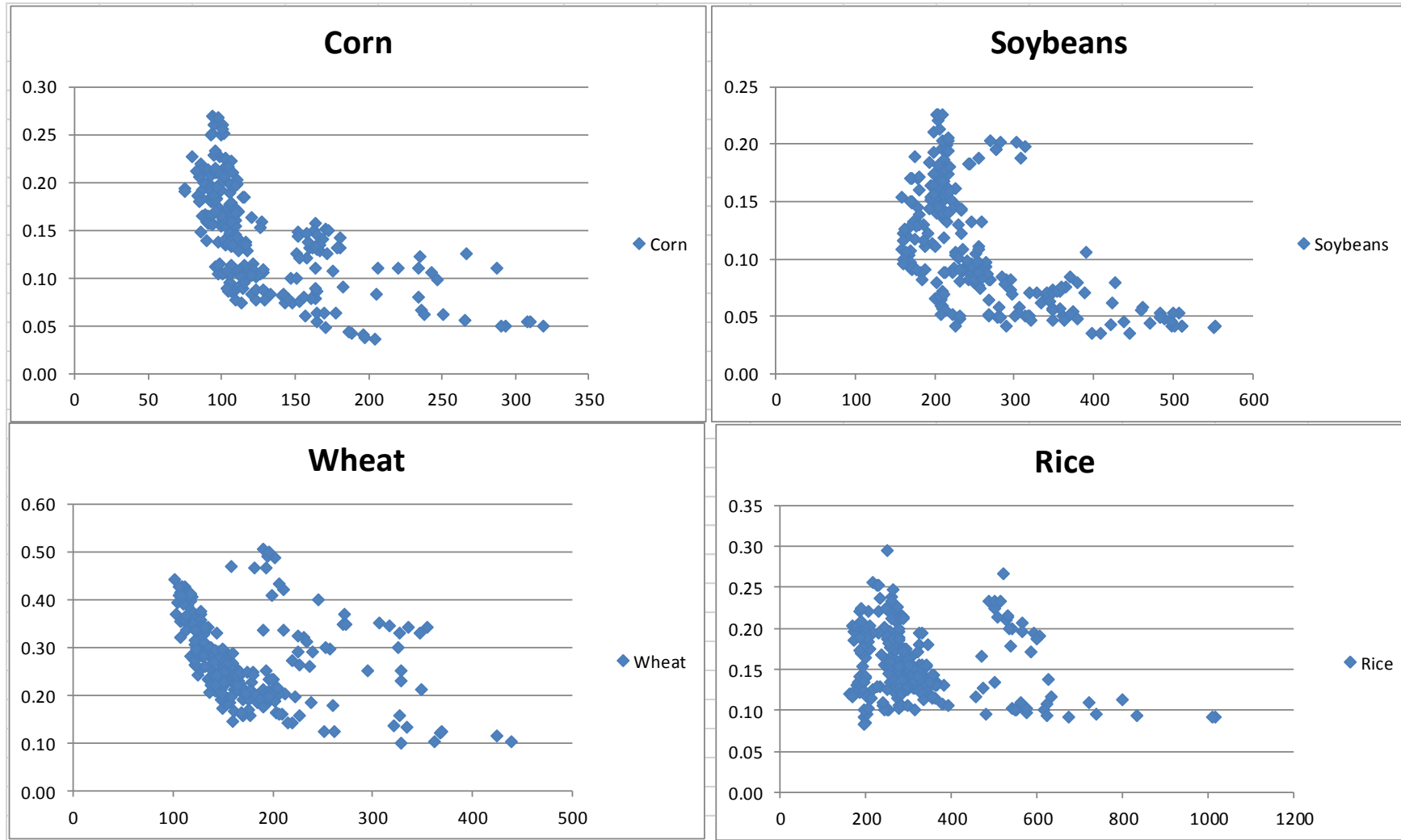
Stabilization was a key objective evident in developing country responses to the 2007-08 food crisis. Countries appear to be willing to pay significant costs to achieve that objective. One of the problems with past assessments of stabilization policies is that the objectives focused on by economists may not reflect well national priorities. A key aspect of policy responses is the need to avoid extreme outcomes - both low farm income and extreme food insecurity. But policies reflected a desire to stabilize expenditure of urban consumers, not just the extreme poor mostly found in rural areas.

Modeling and analysis of stocks policy needs to begin with more realistic price distributions reflecting more accurately the nature of world price volatility. Distributions need to include periods of relative stability with infrequent spikes, and persistence in prices related to private stocks positions. Short run volatility and seasonality call for short run modelling and give rise to lags in observed price transmission and the complementarity between stocks interventions and stabilizing trade policy. Price transmission evidence also highlights the needed to address imperfect integration of world and domestic markets. Interpretation of, and reliance on, model predictions needs to be done in light of existing market institutions, and especially the ability of governments to implement policy. Differences in market outcomes during the food crisis depended more on implementation success or failure than on the role of the state or on differences in national policy objectives.

Domestic stabilization efforts clearly spilled over onto international markets in 2007-08, making them more unstable. WTO commitments made in the 1995 Uruguay Round Agreement on Agriculture were largely ineffective in maintaining international stability, or in getting countries to share the adjustment burden required in international markets to quantity shocks. International solutions, including global stocks, virtual reserves and regional strategies, resemble strategies that have largely failed in the past. Commodity agreements held costly stocks for long periods, accumulated excessive stocks as they sought to alter mean prices, and could not solve the problem of resolving conflicting objectives among members. The need to arrive at a common objective is probably the most difficult issue, whether stocks are held for international or regional market interventions. Nevertheless, domestic private stocks that are integrated with world markets offer limited international stabilization. Private stocks are more likely to address international price variability than public stocks. Private stocks would be better at maintaining price floors than ceilings. Those floors may not be where governments want them set, but may be closer to long run mean prices. Testing this proposition, and understanding where stocks are related to world market outcomes, requires better stocks data than is now available.

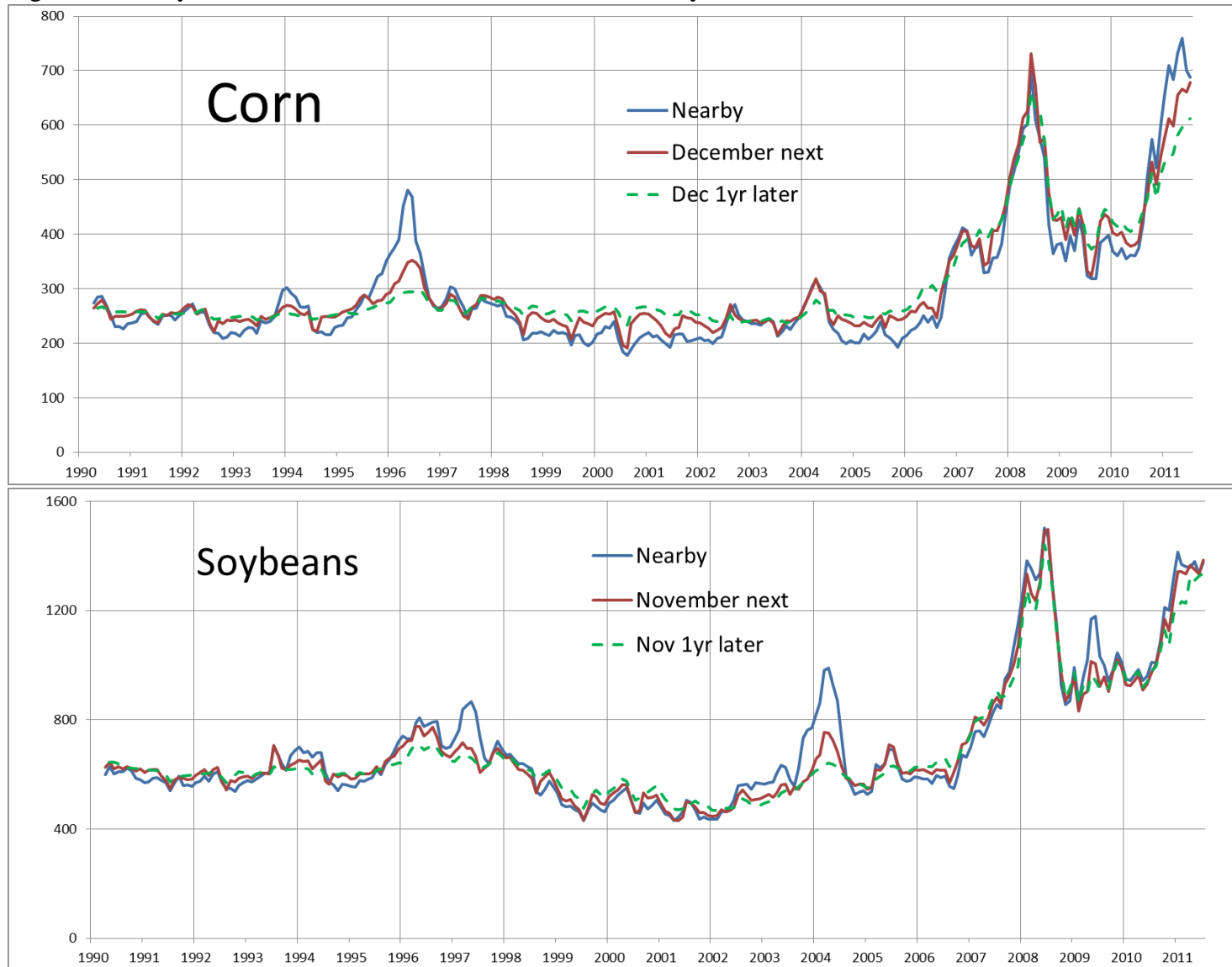
Figures

Figure 1. Expected Carry-out Stocks to Use Ratios from WASDE Reports versus Futures Prices in the U.S.



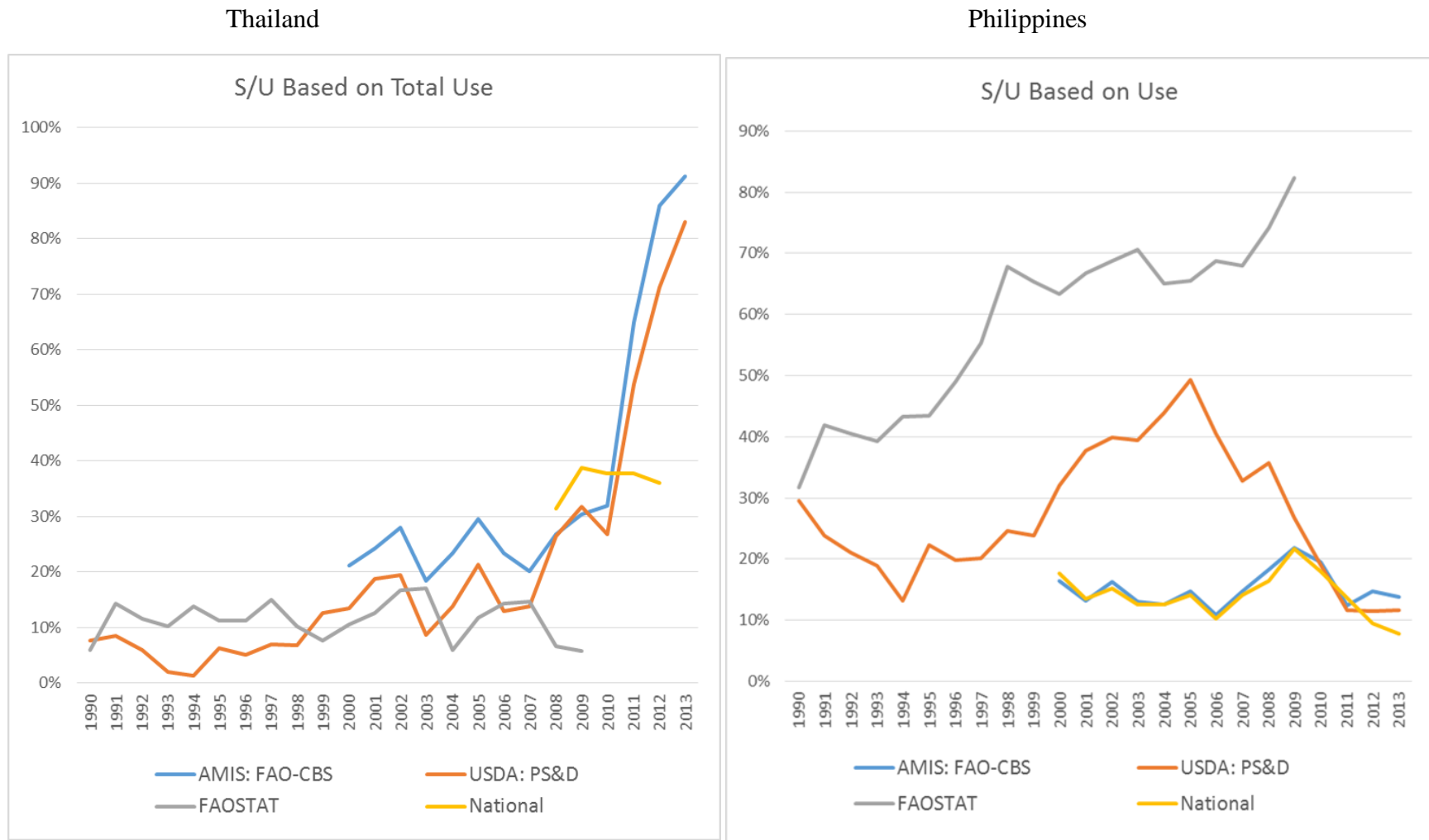
Sources: WASDE (WAOB, 2013) reports for stocks and use data. CBOT data from DataStream (2013) for futures prices.

Figure 2. Nearby versus Distant Futures Prices for Corn and Soybeans in the U.S



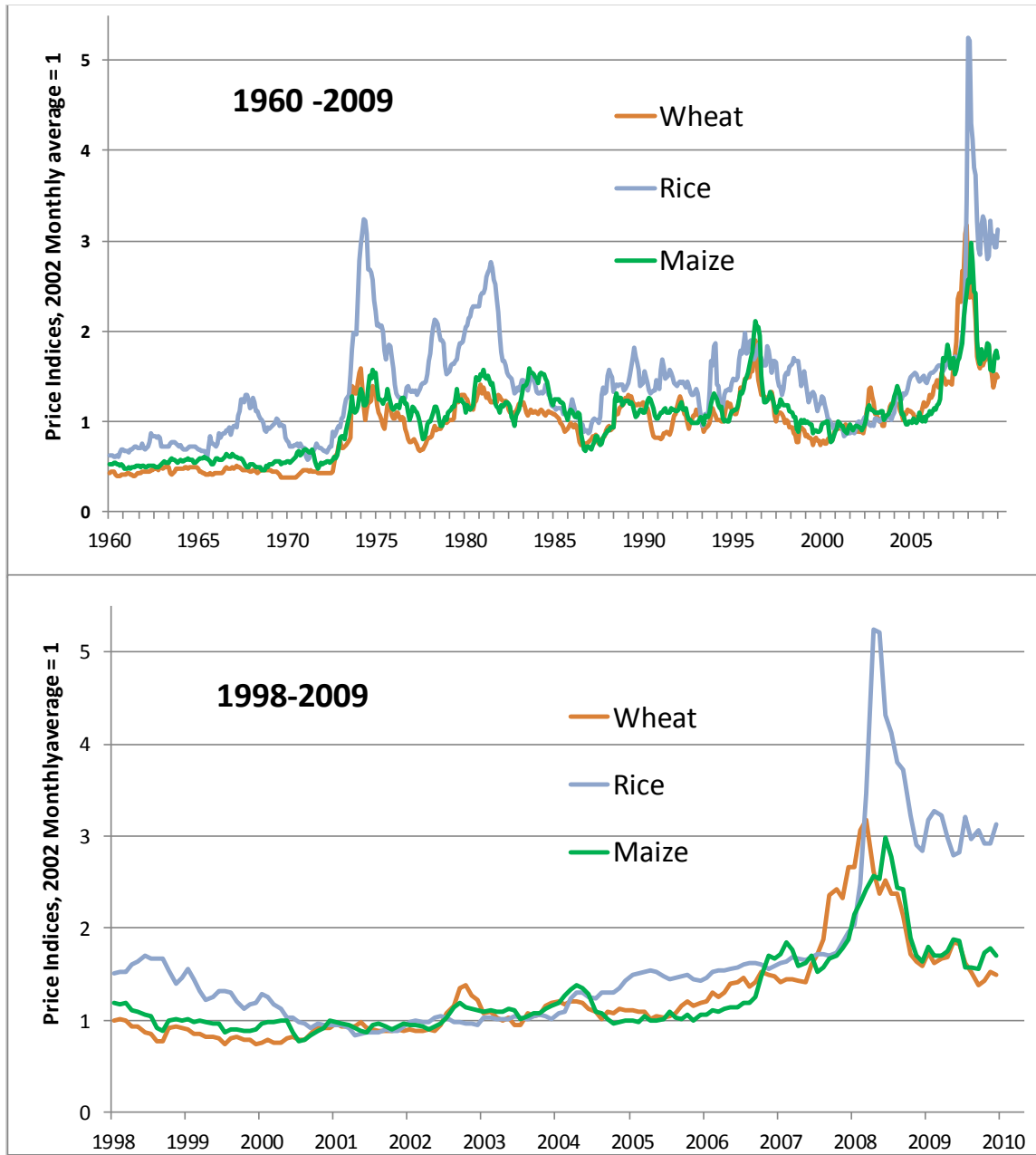
Sources: CBOT data from DataStream (2013).

Figure 3. Stocks to Use Ratios from various Sources in Thailand and the Philippines



Sources: AMIS (2013): FAO-CBS data available from GIEWS (2013); USDA data from PS&D (FAS, USDA, 2013); FAO data available from FAOSTAT (FAO, 2013,s); National data as reported in AMIS/GIEWS.

Figure 4. International Agricultural Prices: 1998 to 2009 versus 1960 to 2009.



Source: IMF (2013) Commodity Price data.

References

- ABBOTT, P. 2009. Development Dimensions of High Food Prices. Paris: OECD.
- ABBOTT, P. 2013. Biofuels, Binding Constraints and Agricultural Commodity Price Volatility, NBER Working Paper 18873, Cambridge MA.
- ABBOTT, P. 2013. Improving Methodology for Estimation of Food Stocks, Rome: Food and Agriculture Organization of the United Nations.
- ABBOTT, P. 2010. Stabilization Policies in Developing Countries after the 2007-08 Food Crisis. *OECD Working Paper TAD/CA/APM/WP(2010)44*. Paris: OECD.
- ABBOTT, P., ANDERSEN, T. B. & TARP, F. 2010. IMF and economic reform in developing countries. *The Quarterly Review of Economics and Finance*, 50, 17-26.
- ABBOTT, P. & BOROT DE BATTISTI, A. 2011. Recent Global Food Price Shocks: Causes, Consequences and Lessons for African Governments and Donors. *Journal of African Economies*, 20, i12-i62.
- ABBOTT, P., KONANDREAS, P. & BENIRSCHKA, M. 1993. A Model for Assessing Food Security Policy Alternatives. In: BIGMAN, P. B. A. D. (ed.) *Food Security and Food Inventories in Developing Countries*. Wallingford, UK: CAB International.
- ABBOTT, P. C., HURT, C. & TYNER, W. E. 2008. What's Driving Food Prices? Oak Brook, IL: Farm Foundation.
- ABBOTT, P. C., HURT, C. & TYNER, W. E. 2009. What's Driving Food Prices? March 2009 Update. Oak Brook, IL: Farm Foundation.
- ABBOTT, P. C., HURT, C. & TYNER, W. E. 2011. What's Driving Food Prices in 2011? Oak Brook, IL: Farm Foundation.
- ABBOTT, P. C., PATTERSON, P. & YOUNG, L. 1998. Plans and Adjustment: A Structural Approach to Modeling Grain Importer Behavior. In: YILDIRIM, T., SCHMITZ, A. & FURTAN, W. H. (eds.) *World Agricultural Trade: Implications for Turkey*. Boulder, CO: Westview Press.
- AMIS. 2013. *Stocks and utilization* [Online]. Rome: FAO. Available: <http://www.amis-outlook.org/amis-monitoring/indicators/stocks/en/> [Accessed].
- BADAINE, O. & RESNICK, D. Year. Regional Trade Liberalization and Domestic Food Market Stabilization in African Countries. In: *Managing Food Price Instability in Low-Income Countries*, February 28 - March 1, 2005 2005 Washington, DC. World Bank.
- BAFFES, J. & GARDNER, B. 2003. The Transmission of World Commodity Prices to Domestic Markets under Policy Reforms in Developing Countries. *Policy Reform*, 6, 159-180.
- BALCOMBE, K. Year. The Nature and Determinants of Volatility in Agricultural Prices: An Empirical Study from 1962-2008 In: *Workshop on Institutions and Policies to Manage Global Market Risks and Price Spikes in Basic Food Commodities*, October, 2009 2009 Rome. FAO.
- BALE, M. D. & LUTZ, E. 1979. The effects of trade intervention on international price instability *American Journal of Agricultural Economics* 61, 512-516.
- BIGMAN, D. and S. REUTLINGER, 1979. Food Price Stabilization: National Buffer Stocks and Trade Policies. *American Journal of Agricultural Economics*, 61(4): 657-667.
- BYERLEE, D., JAYNE, T. S. & MYERS, R. 2005. Managing Food Price Risks and Instability in an Environment of Market Liberalization. Washington DC: World Bank.
- CAFIERO, C., BOBENRIETH H, E. S. A., BOBENRIETH H, J. R. A. & WRIGHT, B. D. 2010. The empirical relevance of the competitive storage model. *Journal of Econometrics*, In Press.

- COMMODITY RISK MANAGEMENT GROUP (CRMG) WORLD BANK 2008. The International Task Force on Commodity Risk Management in Developing Countries: Activities, Findings and the Way Forward. Washington, DC: World Bank.
- CUMMINGS, R. & GULATI, A. 2009. Grain Price Stabilization Experiences in Asia: What Have We Learned? *Workshop on Institutions and Policies to Manage Global Market Risks and Price Spikes in Basic Food Commodities*. Rome: FAO.
- DATASTREAM, 2013. Thompson Reuters, New York.
<https://forms.thomsonreuters.com/datastream/>
- DAVIRON, B., AUBERT, M., BRICAS, N., DAVID-BENZ, H., DURY, S., EGG, J., LANÇON, F. & VÉRONIQUEMEURIOT 2008. Les mecanismes de Transmission de la Hausse des prix Internationaux des Produits Agricoles dans les Pays Africains. Paris: Fondation pour l'Agriculture et la Ruralité dans le Monde (FARM), CIRAD.
- DAWE, D. 2008. Have Recent Increases in International Cereal Prices Been Transmitted to Domestic Economies? The experience in seven large Asian countries. *ESA Working Paper No. 08-03*. Rome: Agricultural Development Economics Division, Food and Agriculture Organization.
- DELGADO, C. Year. Driven by Increased Price Volatility, the Global Food Crisis is Not Over. *In: Policy Dialogue on High Food Prices: Outlook and Donor Mid-term Responses*, February 12-13, 2009 2009 Paris. OECD.
- DEMEKE, M., PANGRAZIO, G. & MAETZ, M. 2008. Country responses to the food security crisis: Nature and preliminary implications of the policies pursued. Rome: Agricultural Policy Support Service, FAO.
- FAO. 2013c. *CountrySTAT* [Online]. Rome: FAO. Available:
<http://www.fao.org/economic/ess/countrystat/en/> [Accessed].
- FAO 2013f. FAOSTAT database. Rome: FAO.
- FAO. 2013g. *Global strategy to improve agricultural and rural statistics* [Online]. Rome: FAO. Available: <http://www.fao.org/economic/globalstrategy/en/> [Accessed].
- FAO, IFAD, IMF, OECD, UNCTAD, WFP, WORLD BANK, WTO, IFPRI & UNHLTF 2011. Price Volatility in Food and Agricultural Markets: Policy Responses. Rome and Paris: FAO and OECD.
- FAS/USDA 2013. PS&D Online database. Washington DC: USDA.
- G8-G20 FRANCE 2011. Official Website of the French Presidency of the G20 and G8
- GALTIER, F. 2009a. How to manage food price instability in developing countries? Montpellier F-34000, France: CIRAD, UMR MOISA.
- GALTIER, F. 2009b. The need for public intervention to stabilise prices. *Perspective: Food Security*. Montpellier, France: CIRAD.
- GALTIER, F. 2013. The need to correct WTO rules on public stocks. Paris: CIRAD.
- GIEWS, 2001. Food Outlook. Rome, Global information and early warning system on food and agriculture, FAO.
- GIEWS 2013. Crop Prospects and Food Situation. Rome: FAO.
- GILBERT, C. L. 1996. International Commodity Agreements: An obituary notice. *World Development*, 24, 1-19.
- GILBERT, C. L. 2010. How to understand high food prices. *Journal of Agricultural*
- HAZELL, P., SHIELDS, G. & SHIELDS, D. 2005.. The Nature and Extent of Domestic Sources of Food Price Instability and Risk. *In: Managing Food Price Instability in Low-Income Countries*, February 28 - March 1, 2005 2005 Washington, DC. World Bank.

- HEADEY, D. & FAN, S. 2010. *Reflections on the Global Food Crisis*, Washington, DC, IFPRI.
- HODA, A. & GULATI, A. 2013. India's Agricultural Trade Policy and Sustainable Development. Geneva: ICTSD.
- HSU, H.-H. & GALE, F. 2001. USDA Revision of China Grain Stock Estimates. *China: Agriculture in Transition*.
- HUNAG, J., J. YANG & S. Rozelle, 2013. The political economy of food pricing policy in China, UNU-WIDER working paper 2013/038, Helsinki, Finland, April.
- HUDDLESTON, B., JOHNSON, D. G., REUTLINGER, S. & VALDES, A. 1984. *International Finance for Food Security* Baltimore, Johns Hopkins University Press.
- INTERNATIONAL MONETARY FUND (IMF). 2013. *International Commodity Prices* [Online]. Washington DC: International Monetary Fund. Available: <http://www.imf.org/external/np/res/commod/index.aspx> [Accessed].
- JABBAR, M. 2009. Estimation of Private Stock of Rice in Bangladesh: In Search of a Practicable Methodology. Dhaka, Bangladesh: The National Food Policy Capacity Strengthening Program (NFPCSP), implemented by the Food and Agriculture Organization of the United Nations (FAO) and the Food Policy Monitoring Unit (FPMU), Ministry of Food and Disaster Management, Government of the People's Republic of Bangladesh.
- JAYNE, T. S. & TSCHIRLEY, D. 2009. Food Price Spikes and Strategic Interactions between the Public and Private Sectors: Market Failures or Governance Failures? *Institutions and Policies to Manage Global Market Risks and Price Spikes in Basic Food Commodities*. Rome: FAO.
- MARTIN, W and K. ANDERSON, 2012. Export restrictions and price insulation during commodity price booms, *American Journal of Agricultural Economics* 94(1), January.
- MCINTIRE, J. 1981. Food security in the Sahel: Variable import levy, grain reserves, and foreign exchange assistance. (*Research Report 26*. Washington, DC: International Food Policy Research Institute (IFPRI).
- MINOT, N. 2011. Transmission of world food price changes to markets in Sub-Saharan Africa, IFPRI, Washington, DC.
- NASS/USDA. 2013c. *Surveys: Off-Farm Grain Stocks* [Online]. Washington DC: NASS, USDA. Available: http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Off-Farm_Grain_Stocks/ [Accessed].
- NEWBERRY, D. M. G. & STIGLITZ, J. E. 1981. *The Theory of Commodity Price Stabilization*, London, Oxford University Press.
- ORYZA. 2013. India Hopes Private Warehouses Will Reduce Food Grain Storage Problem - See more at: <http://oryza.com/print/13243#sthash.2DLg32EW.dpuf>. *Oryza*, March 12, 2013.
- PINSTRUP-ANDERSEN, P. 2011. The Political Economy of Food Price Policy. Helsinki, Finland: UNU WIDER
- PIERMARTINI, R & R.TEH, 2005. Demystifying Modeling Methods for Trade Policy, WTO Discussion paper no. 10, WTO, Geneva.
- POULTON, C., KYDD, J., WIGGINS, S. & DORWARD, A. 2006. State intervention for food price stabilisation in Africa: Can it work? *Food Policy*, 31, 342-356.
- RAPSOMANIKIS, G., HALLAM, D. & CONFORTI, P. 2004. Market Integration and Price Transmission in Selected Food and Cash Crop Markets of Developing Countries: Review and Applications. *Commodity Market Review, 2003-2004*. Rome: Food and Agriculture Organization of the United Nations.

- SALANT, S. W. 1983. The Vulnerability of Price Stabilization Schemes to Speculative Attack. *The Journal of Political Economy*, 91, 1-38.
- TIMMER, C. P. 1989. Food price policy: The rationale for government intervention. *Food Policy*, 14, 17-27.
- TIMMER, C. P. 2000. The macro dimensions of food security: economic growth, equitable distribution, and food price stability. *Food Policy*, 25, 283-295.
- TIMMER, C. P. 2008. Causes of High Food Prices. *ADB Economics Working Paper Series 128*. Manila: Asian Development Bank.
- TROSTLE, R. 2009. Fluctuating Food Commodity Prices: A Complex Issue With No Easy Answers. *Amber Waves*, 6, 11-17.
- TYERS, R. & ANDERSON, K. 1992. *Disarray in World Food Markets: A Quantitative Assessment*, Cambridge, Cambridge University Press.
- UN HIGH LEVEL TASK FORCE ON THE GLOBAL FOOD SECURITY CRISIS (UNHLTF) 2008. Comprehensive Framework for Action. New York: United Nations.
- VON BRAUN, J. & TORERO, M. 2009. Implementing Physical and Virtual Food Reserves to Protect the Poor and Prevent Market Failure. *IFPRI Policy Brief 10*. Washington DC: IFPRI.
- WATSON, D. 2013. Political economy synthesis: The food policy crisis. Helsinki: UNU-WIDER Working paper 2013/050, May.
- WIGGINS, S. & KEATS, S. 2009. Grain stocks and price spikes. London: Overseas Development Institute.
- WILLIAMS, J. C. & WRIGHT, B. D. 1991. *Storage and Commodity Markets*, Cambridge, Cambridge University Press.
- WODON, Q. & ZAMAN, H. 2008. Rising Food Prices in Sub-Saharan Africa: Poverty Impact and Policy Responses. *Policy Research Working Paper 4738*. Washington DC: World Bank.
- WORLD AGRICULTURAL OUTLOOK BOARD (WAOB) 2013. World Agricultural Supply and Demand Estimates (WASDE). Washington DC: United States Department of Agriculture.
- WRIGHT, B. 2001. Storage and Price Stabilization. In: RAUSSER, B. G. A. G. (ed.) *Handbook of Agricultural Economics*. Baltimore, MD: Hopkins University.
- WRIGHT, B. D. 2011. The Economics of Grain Price Volatility. *Applied Economic Perspectives and Policy*, 33, pp. 32-58.