

Sarris, Alexandros

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Options for Developing Countries to Deal with Global Food Commodity Market Volatility*

Alexander SARRIS

➔ Alexander SARRIS is professor in the department of economics, University of Athens, Greece. Between 2003 and 2010 he was Director of the Trade and Markets Division, of the United Nations Food and Agriculture Organization (FAO). His professional and research interests include development economics, commodity market and price analysis, food and agriculture policy. He is Senior Fellow at Ferdi.

Abstract

The paper first reviews several issues relevant to global food commodity market volatility as it pertains to food security, and food importing developing countries, and then discusses international and national policies and measures to prevent or manage this volatility and related risks. It is shown that market volatility relates to unpredictability of market fundamentals, and price spikes occur when unpredictability increases excessively. The behavior of commodity prices and market volatility is reviewed and it is concluded that the exact modeling of these is difficult, making predictions of market volatility uncertain. The risks faced by food import developing countries are discussed and it is highlighted that the major risks involve not only large and unpredictable price variations but also trade finance as well as import contract enforcement. The problem of identifying a price spike is analyzed and it is seen that, despite difficulties in commodity modeling, there are empirical techniques that allow the assessment of the probabilities of price spikes, and could facilitate the triggering of responses. There appear to be few cost effective ways to prevent market upheavals, but there seem to be some ways, reviewed in the paper, to instill more confidence in markets and hence reduce the chances of such abnormal events. Most effective appear to be ways to actively manage food market volatility and risks of excessive price spikes. A range of appropriate market and non-market based measures are reviewed and some new ideas are offered in this context.

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1. Introduction

The period since 2006 has seen considerable instability in global agricultural markets. Between September 2006 and February 2008, world agricultural commodity prices rose by an average of 70 percent in nominal dollar terms, with prices in some products rising by much more than that. The strongest price rises were observed in wheat, maize, rice, and dairy products. Prices fell sharply in the second half of 2008, although in almost all cases they remained above the levels of the period just before the sharp increase in prices started. In 2010 sharp price rises of food commodity prices were observed again, and by early 2011, the FAO food commodity price index was again at the level reached at the peak of the price spike of 2008. Figures 1-6 illustrate the above observations with data for the FAO index as well as its five component indices. In other words within the past four years many food commodity prices increased very sharply, subsequently declined equally sharply, and then again increased rapidly to reach the earlier peaks. Such rather unprecedented volatility in world prices creates much uncertainty for all market participants, and makes both short and longer term planning very difficult.

The sudden and unpredictable increases in many internationally traded food commodity prices in late 2007 and early 2008 caught all market participants, especially governments of net food importing developing countries, by surprise and led to many short term policy reactions that may have exacerbated the negative impacts of the price rises. Given that several such interventions were in many cases inadequate or inappropriate, many governments, think tanks, and individual analysts called for improved international mechanisms to prevent and/or manage sudden food price rises. Similar calls for improved disciplines of markets were made during almost all previous food market price bursts, but were largely abandoned after the spikes passed, largely because they were deemed difficult to implement. However, the fact that the recent price rebound followed soon after the 2007-8 spike, and the fact that the period of spike then downturn and then rebound in global agricultural prices have coincided with a global financial crisis, which in itself has contributed to increasing levels of poverty and food insecurity, appears to have galvanized attention on the issues facing governments, especially those in developing countries (DCs), facing unstable global food markets. The purpose of this paper is first to review several issues relevant to global food commodity market volatility as it pertains to food security, and then to discuss international and national policies and measures to prevent or manage this volatility and related risks, mainly, albeit not exclusively, from the perspective of food commodity dependent developing countries.

Staple food commodity price volatility, and in particular sudden and unpredictable price spikes, creates considerable food security concerns, especially among those, individuals or countries, who are staple food dependent and net buyers. These concerns range from possible inability to afford increased costs of basic food consumption requirements, to concerns about adequate supplies, irrespective of price. Such concerns can lead to reactions that may worsen subsequent instability. For instance excessive concerns about adequate supplies of staple food in exporting countries'

domestic markets may induce governments to take measures to curtail or ban exports, thus inducing further shortages in world markets and higher international prices. The latter in turn may induce permanent shifts in production and/or consumption of the staple in net importing countries, with the result that while subsequent global supplies may increase, import demands may decline permanently altering the fundamentals of a market.

The recent food market spike occurred in the midst of another important longer term development, that highlights additional developing country concerns. Over the last two decades there has been a shift of developing countries from the position of net agricultural exporters - up to the early 1990's - to that of net agricultural importers (Bruinsma, 2003, FAO, 2006). Growing dependence on food commodity imports implies growing vulnerability to external commodity shocks. Projections to 2030 and 2050 indicate a deepening of this trend (ibid.), which is due to the projected decline in the exports of traditional agricultural products, such as tropical beverages and bananas, combined with a projected large and growing deficit of basic foods, such as cereals, meat, dairy products, and oil crops.

According to the latest FAO figures (FAO, 2010), in 2009/10 global imports of all cereals were 266.4 million metric tons (mmt), 207.6 mmt of which were imports of developing countries. Net imports of cereals of developing countries were 134.1 mmt. Within developing countries, those classified as Least Developed Countries (LDCs) have witnessed a fast worsening of their agricultural trade balance in the last fifteen years. Since 1990, the food import bills of LDCs have not only increased in size, but also in importance, as they constituted more than 50 percent of the total merchandise exports in all years. In contrast, the food import bills of other developing countries (ODCs) have been stable or declined as shares of their merchandise exports (FAO 2004). These trends were reinforced during the 2007-8 food crisis (Prakash, 2011). Table 1 illustrates the current dependence of countries on cereal imports, and shows that while the most acute dependence is for the high income small island developing states (SIDs), there are many low income countries that have very high cereal import dependence.

The medium term food outlook indicates that developing countries will increase their net food imports by 2018 in all products except vegetable oils (OECD-FAO 2010). Similarly LDCs are projected to become an increasing food deficit region in all products and increasingly so. Clearly this suggests that as LDCs become more dependent on international markets, they will become more exposed to international market instability, and hence more vulnerable.

The above suggests that the problem of managing the risks of food imports has increased in importance, and is already a major issue for several LDCs and low-income food deficit countries (LIFDCs)². The major problem of LIFDCs is not only price or quantity variations *per se*, but rather

² LIFDCs are a FAO classification. The latest list of May 2009 includes 77 countries. The list of LDCs is one used by the United Nations (UN) and as of May 2009 includes 50 countries. All but 4 LDCs are also included in the LIFDC list. The list of NFIDCs is a World Trade Organization (WTO) group, which as of May 2009 includes all 50 LDCs and another 25 higher income developing countries, for a total of 75 countries. Of the 25 extra countries in this list only 8 are in the FAO list of

major unforeseen and undesirable departures from expectations, that can come about because of unanticipated food import needs due to unforeseen adverse domestic production developments, as well as adverse global price moves. In other words, unpredictability is the major issue. This is also the gist of the argument of Dehn (2000) and Cavalcanti, et. al. (2011) who argued that the negative impacts on growth of commodity dependent economies come from unanticipated or unpredictable shocks, rather than from ex-post commodity instability per se.

Apart from the problem of unpredictability of food import bills for LIFDCs, another problem that surfaced during the recent food price spike was the one of reliability of import supplies. Several net food importing developing countries (NFIDCs) that could afford the cost of higher food import bills, such as some of the middle income oil exporting countries and small island states, during the 2007-8 period faced problems of not only unreliable import supplies but also the likelihood of unavailability of sufficient food import quantities to cover their domestic food consumption needs. This raises a different problem for these countries, namely the one of assurance of import supplies. Several of these countries, e.g. those surrounding the Arab Peninsula and the Persian Gulf, have unfavorable domestic production conditions and rely on imports for a substantial share of their domestic consumption, as indicated in table 1. Unavailability of supplies creates large food security concerns for these countries.

The issue of food import risk for LIFDCs has been discussed extensively for some time, especially after the commodity crisis of the early 1970s. Several proposals for international food insurance schemes were put forward in that period (for an early review see Konandreas, et. al, 1978). The issue of financing of food imports by LIFDCs featured prominently in the discussions leading to the World Trade Organization (WTO) Uruguay Round Agreement on Agriculture (URAA), and gave rise to the *“Decision on measures concerning the possible negative effects of the reform programme on least-developed and net food-importing developing countries”*, also known as the *“Marrakesh Decision”* (article 16.1 of the URAA). However, no progress relating to this decision has been made since then.

The rest of the paper proceeds as follows. In the next section the issue of market volatility and its importance are examined. In section 3 the structure of food commodity prices and their volatility are reviewed. Section 4 considers the issue of the types of risks faced by food importing developing countries. The following section takes up the issue of identifying a market crisis and a price spike. In section 6 the issue of how to prevent or lower the occurrence of market volatility and crises is considered. Section 7 reviews measures to manage market volatility, in view of the fact that it is very difficult to reduce it. Section 8 summarizes what is deemed as cost-effective measure that can be pursued by the international community to assist developing food importing countries to cope with market volatility. The final section concludes.

LIFDCs, the others being higher income countries. The Low Income Countries (LICs) is a World Bank classification of 53 countries that overlaps significantly with the UN list of LDCs

2. What is market volatility and why it matters

Market volatility normally refers to variations of market prices from period to period. As such it is an ex-post concept, in the sense that everyone can observe the market variations. However, what matters for both market participants as well as policy makers are not the market price variations per se, but their unpredictability, and the risks they create. According to Clements and Hendry (1998) unpredictability of a variable x with respect to an information set S , is the inability of the information set to make a difference in any estimate of the variable. More formally, this implies that the conditional probability distribution of the variable, given the information set, is exactly the same as the unconditional probability distribution of the variable. In other words knowledge of the information in S , does not improve prediction, and does not reduce any aspect of uncertainty about the variable x . This notion of unpredictability does not imply that various market agents do not have or do not use information about the future variable. It just implies that despite all the previous knowledge and information about the variable and the process governing it, there are some elements of the process determining x , that cannot possibly be known ex-ante.

Uncertainty of the variable x , when looked at from some period before its realization, is basically a summary measure of the unpredictable elements in the process determining x , that are likely to occur between the time of the prediction and the time of realization of the variable x . For instance if a producer is contemplating producing a crop, he/she may know the basic process (the model) that determines the yield and the price of the commodity, but he also knows that there are elements of this process, such as rainfall and future price, that cannot possibly be predicted say one year ahead. These unpredictable elements are what create the uncertainty about the outcome of his action to produce the crop. Uncertainty then depends on how far into the future one is interested in the variable of interest.

Risk, in turn is generated by uncertainty. In other words risk is generated by actions whose outcomes are subject to uncertainty. In the case of the producer, he knows that production of a crop is uncertain. As long as he does not produce the crop he is not at risk. If, however, he decides to produce it, he places himself at risk, as the outcome of the crop affects his income and welfare. Thus it is unpredictability that defines uncertainty, and it is the actions that have uncertain outcomes that create the attendant risks. In the face of uncertain outcomes and prices, agricultural producers, for instance, tend to reduce the risks facing them, by diversification, namely by producing a less uncertain mixture of products.

Prices normally fluctuate in commodity markets in response to new and continuously changing information about the state of the markets. Similarly the underlying uncertainty about future events gives rise to expectations about future market outcomes, such as prices, and difference degrees of confidence about these expectations. Hence at any point in time one can talk about the underlying uncertainty of the market about a future outcome. The level of information and the actions of the various market participants based on this information determine the probability distribution of expectations as well as actual market outcomes. It is normal in commodity markets

that actual prices vary from period to period, and also that expectations of market outcomes, such as prices, also vary.

Volatility is normally associated with two concepts. The first is variability of the observed prices, and as such it is a concept that can be readily quantified ex-post through some a measure of observable market prices. The second concept is that of unpredictability, and this, at any one time, refers to the conditional probability distribution of some subsequent market outcome, given current information. Such a concept cannot be readily and objectively quantified, as there is no corresponding market variable. It can only be inferred from observed market variables through some appropriate model.

The principal concern of market participants and policy makers alike is not large variations in observed prices per se, but large shifts in the degree of unpredictability of subsequent prices. Such large shifts normally also cause large changes in observed market prices and are associated with what has been termed “excess volatility” (Shiller, 1981, Prakash, 2011b), a rather elusive concept referring to variations of prices outside what maybe inferred or predicted on the basis of expectations of rational efficient markets.

A very popular measure of ex-post or realized or historical market volatility, used extensively in finance, is the annualized historic volatility, computed as the standard deviation of the logarithmic returns of prices over a given period of time multiplied by the square root of the frequency of observations.

$$v = \sigma\sqrt{T}, \text{ where } \sigma = \sqrt{\sum_{i=1}^n (r_i - \mu)^2 / (n-1)} \quad (1)$$

where $r_t = \ln(P_t) - \ln(P_{t-1})$ is the logarithmic return of price, P is the (detrended) price of the commodity, n is the number of observations, μ is the average of the logarithmic returns, and T is the frequency of the observations on a yearly basis (252 if daily, 12 if monthly, etc.).

Unpredictability in turn is not easily measured as indicated above. One relatively objective measure of unpredictability is “implied volatility”, which is a measure of the market estimate of the ex-ante or conditional variance of subsequent price, based on current observations of values of options on futures prices in organized exchanges, and using the Black-Scholes model for the computations.

To illustrate the fact that the two concepts may point in different directions, depending on data, figure 7 exhibits estimates of realized volatilities of cereals, based on observed spot prices in major international markets, such as Gulf (as compiled by FAO), while figure 8 exhibits estimates of implied volatilities of some of the same cereal prices, as inferred from option prices in the major exchange trading these derivative instruments, namely Chicago Mercantile Exchange (CME). The interesting observation is that while the realized annualized volatility trends, based on international market data, suggest that actual ex-post market volatilities in cereals have exhibited

only a mild upward trend in the past 50 years, interrupted only during some periods of high prices such as the mid 1970s and the recent high price period, implied volatilities seem to have exhibited a marked upward trend in the past 22 years, namely since options contracts started trading in CME. This suggests that there maybe different determinants of the ex-post and the ex-ante volatilities of food commodities depending on the market where prices are measured.

Unfortunately there are not many organized commodity options markets, and hence implied volatilities cannot be estimated from readily observed option prices for most commodities. However, there are other ways to measure unpredictability. A popular measure is an estimate of the conditional variance of future price, based on a time series model of the price. Models of prices that allow direct estimation of such conditional variances are the class of Generalized Autoregressive Conditional Heteroscedastic time series models (GARCH), introduced by Bollerslev (1986).

The detrimental effects of uncertainty or unpredictability on both private agents, as well as governments are not hard to understand, and have been the object of both discussion as well as research for a long time. For instance, Keynes (1942) argued that commodity price fluctuations led to unnecessary waste of resources, and, by creating fluctuations in export earnings, had a detrimental effect on investment in new productive capacity, and tended to perpetuate a cycle of dependence on commodities, what we may call in modern growth terminology a “commodity development trap”.

While Keynes viewed the issues largely from a macro perspective, in recent years his argument has been refined and applied to the microeconomics of households facing risks, but the concepts can easily be adapted to the problems of commodity dependent developing countries. All the recent literature is based on the idea that poor households are liquidity constrained, in the sense that they cannot easily borrow to smooth out any major income shocks (for the definitive paper on consumption and saving behavior under liquidity constraints, see Deaton, 1991). This is the major and realistic departure from earlier work on commodity stabilization, which assumed that commodity markets could be costlessly stabilized, and/or that agents (governments or households) could borrow to smooth shocks.

The basic insight of all the recent literature is that the presence of uncertainty when there is inability to borrow to smooth negative income shocks, leads agents to accumulate liquid precautionary reserves, much like earlier analysts such as the economists cited above suggested that governments should do to deal with the undesirable commodity shocks. The difference from earlier research is first that on average the level of buffer stocks that must be carried is positive, even if the probability distribution of future outcomes is known with certainty. The second difference is that in poor country environments, these reserves must be liquid enough, in order to be readily accessible in times of need. This positive and liquid level of reserves implies that the resources devoted to buffer stocks or what has been termed “consumption smoothing” cannot be

used for productive but illiquid investments, and it is this that leads to the negative impact on overall growth (Dercon and Christiaensen, 2007).

The responses of credit constrained low income households to unexpected high food commodity prices may include effects such as reducing the diversity of diets, reducing calories consumed, reducing non-food consumption expenditures, or reducing investment expenditures, such as children's education, health outlays, or expenditures on fertilizers or farm machinery. Some of these adjustment responses may have permanent effects, and it is these that may reduce subsequent income opportunities. There has been some evidence of these adjustments in the recent food crisis (Rapsomanikis, 2009).

Similar effects can occur at the macro level as liquidity and foreign exchange constrained governments of countries that have large food import bills may limit food commodity imports, or reduce imports of other essential expenditures in response to high costs of essential food imports.

The above discussion implies that mere variability of outcomes does not constitute uncertainty, and may not be detrimental. This issue of uncertainty versus mere ex-post variability is important in the discussion of this paper, as compensatory schemes like STABEX, as well as the IMF's Commodity Compensatory Financing Facility (CFF) have adopted a notion of uncertainty that is related to the mere ex-post variability or fluctuations of outcomes such as export earnings or import costs, rather than to their predictability. More recently, there have been efforts to construct indices that correspond more closely to the theoretical notion of uncertainty, namely the notion of unpredictability. Dehn (2000), constructed an index of price instability that distinguishes between negative and positive shocks, and finds, as expected theoretically, that negative commodity price shocks have a significant negative effect on overall economic growth. This was the first study to establish a strong negative empirical link between negative unanticipated shocks and overall economic growth. Recently Cavalcanti et. al. (2011) also estimated that negative terms of trade shocks (which include high food import costs) have stronger negative growth impacts than positive terms of trade shocks for developing countries.

That unpredictability rather than instability is the main problem in agricultural production is one of the oldest, but apparently forgotten or not appreciated, issues in agricultural economics. In fact one of the earliest classic works in agricultural economics considered exactly the issue of agricultural price unpredictability and the benefits of establishing forward prices for producers (D.G. Johnson, 1947). By establishing forward prices for agricultural producers, one basically eliminates one of the most troublesome and potentially damaging sources of income unpredictability, and makes producers able to plan better their activities.

Establishing predictability in agriculture has been one of the earliest institutional developments of the modern era in developed countries. In fact the modern US agricultural marketing system realised very early the benefits of a market based system of forward prices, and through the simple system of warehouse receipts, emerged one of the most sophisticated and useful marketing institutions in modern agriculture, namely the institution of futures markets. It is not perhaps

coincidental that futures markets developed independently in several countries and long time ago. In more recent years, the development and globalisation of financial markets has led to the proliferation of many other risk management commodity related instruments, notably options, and weather related insurance contracts. While in some developed countries the marketing system response to unpredictability has been the establishment of sophisticated forward markets, in most other countries, both developed and developing, the response of producers, and through their pressure of governments, has been the institution of fixed or minimum price marketing arrangements. The major problem, however, of most such schemes is not that they are in principle wrong, but that they have most often been transformed to price support or taxation instruments that have veered off their purpose of providing forward signals and minimum prices based on proper predictions.

It, therefore, appears that a major issue in post adjustment agriculture in most developing countries, with respect to market volatility, is how to establish some forward pricing or insurance system for agricultural producers and governments without distorting the markets. Once such forward mechanisms can be established then one can talk about systems of insurance or systems of compensation.

Considerable literature has been devoted to understanding the costs of market volatility. Prakash (2011) offers a thorough survey. While some literature (Lucas, 2003) suggested that the cost of market volatility is quite small in developed countries with efficient capital markets, other literature, that took into account credit constraints and imperfect transmission from international to domestic markets, showed that the cost of market volatility can be substantial for low income developing countries exposed to commodity shocks (Guillaumont, et. al., 1999, Prasad and Crucini, 2000, Subervie, 2008, Rapsomanikis and Sarris, 2008, Bellemare, et. al. 2010).

3. The nature of agricultural commodity market prices and the determinants of volatility

Proper policy response to unanticipated commodity shocks must be based on correct assessment of the type of shock experienced. The causes and nature of the recent food commodity market crisis have been analyzed by a series of papers and monographs (e.g. Abbott, Hurt and Tyner, 2008, 2009, Headey and Fan, 2010). While no one factor has emerged as the main fundamental cause of the price shock, causes that have received prominence and have some empirical support include, sustained demand growth in emerging economies, demand of some agricultural products such as maize and vegetable oils for biofuel production, the weak US dollar, low interest rates, high petroleum prices, low commodity stocks, climate change induced supply shocks, increased speculative activity on commodity exchanges and the rise of commodity funds, and government destabilizing policies. Most of these factors were also prominent in the previous big food shock of 1973-75.

It has already been indicated above that there seems to be a negative link between unanticipated shocks and economic growth by developing economies, implying first that unpredictable negative shocks are detrimental to growth, and moreover, that past unpredictability has been dealt with inadequately by the governments of affected countries. The point has to do with the policy responses to a negative shock. If the shock is permanent, then a policy response that is based on the assumption that the shock is temporary is clearly inadequate. Similarly a policy response that is based on an assumption that a shock is permanent, is clearly wrong if in fact the shock is temporary. There has been a series of such inadequate policy responses to wrongly perceived shocks in many developing countries in the past that have proven very costly (see for instance Bevan, et. al., 1990, Collier and Gunning, 1999, Deaton, 1999).

There are several issues that concern agricultural commodity markets, and especially prices, that are crucial in this respect. The first is whether commodity prices have trends. The second concerns the degree to which commodity price shocks are temporary or permanent. The third has to do with the persistence of commodity booms and busts. The fourth involves the co-movement of commodity prices. The fifth concerns the changing nature of unanticipated shocks. A brief review of what is known on these issues is given below, largely based on the more extensive reviews of Cashin and McDermott (2006), Gilbert (2006), and Stigler (2011).

There is a long history of attempts to discern negative long-term deterministic trends in real commodity prices, spurred by the Prebisch-Singer finding of declining terms of trade for commodity exporting developing countries. Grilli and Young (1988) confirmed that there exist downward trends that in fact accelerated after 1921. Further work by Ardeni and Wright (1992), Leon and Soto (1995) and Cashin and McDermott (2001) have strengthened these findings, and suggested that there indeed seem to be negative overall real commodity price trends, but which are quite small compared to the overall price variability. In other words the so-called signal to noise ratio in commodity prices is too small to be able to make firm empirical assessments of trends. The empirical resolution of the issue seems to depend on the period that is utilized, and the type of data (aggregate or individual commodity data), but overall most studies point out that there is a weak long-term negative trend.

The issue of permanent or temporary shocks is very important for the design of appropriate stabilization policies. If a shock results, for instance, in a permanent price decline, then a policy or trying to stabilize (namely raise) this price by maintaining for instance buffer stocks is bound to go bankrupt. There have been a series of empirical papers that have tried to assess whether commodity prices are stationary or not and to estimate the permanent component of commodity price series (Deaton and Laroque, 1992, Ardeni and Wright, 1992, Leon and Soto, 1995, Gilbert, 2006). Stationarity of a (price) series implies that any shock will eventually die out, and the series will revert to its long-term trend. The opposite holds for non-stationarity, namely if the series has a "stochastic" trend. The empirical difficulty lies in the fact that the underlying trends are not easy to estimate, and that the existing statistical tests do not have much power to distinguish between a

stochastic trend and a deterministic trend with or without breaks. Thus most studies are inconclusive on this score.

However, one general conclusion is that trends seem to be variable and changing and hence entail a large measure of uncertainty. This is particularly relevant to the current agricultural market situation, which some analysts suggest have changed in fundamental structural ways from their behavior of their recent past, implying that the negative price trends have stopped (Prakash and Gilbert, 2011, OECD-FAO, 2010).

Irrespective of whether shocks are permanent or temporary, most studies consistently point out to another fact about commodity prices. They exhibit irregular booms and slumps, each of which lasts a long time. In other words there is considerable persistence in commodity shocks. This is of particular policy concern as it is related to the duration of policies designed to deal with commodity booms and slumps. Although intuitively clear, it is not easy to define precisely what is meant by a boom and a slump. Cashin, et. al. (2002) made a comprehensive study of booms and slumps in commodity prices and have concluded the following:

- The duration of slumps exceeds the duration of booms by about a year.
- The magnitude of price falls in a slump is slightly larger than the magnitude of price rises in a subsequent boom.
- The rate of change of prices in a boom is typically faster than the rate of change of prices during a decline.
- The severity of price boom and slumps is unrelated to their duration.
- The probability of ending a commodity slump or a boom is independent of the time already spent in the slump or boom for most commodities.

In another recent study Cashin et. al. (2000) examined the persistence of commodity shocks. They found that on average, shocks to commodity prices, while eventually reverting to long run trends, last a long time. Typically they found that it takes more than five years for half the effect of the initial shock to dissipate. These results are consistent with earlier results of Deaton and Laroque (1992). Furthermore, they found that the shocks vary considerably in persistence. In other words the durations of shocks, while finite, seem highly uncertain.

The issue of co-movement of commodity prices was popularized by Pindyck and Rotemberg (1990). It involves the notion that prices of unrelated commodities have a tendency of moving together even after accounting for the effects of common macroeconomic variables, such as inflation, industrial production, interest and exchange rates. If this is true, then it suggests an irrational “herd” behavior on the part of market participants, and a refutation of the competitive model of commodity price formation. The issue has been the subject of some research and Cashin

et. al. (1999), using a robust measure to test co-movement, showed that co-movement is largely absent in unrelated commodity prices.

The final issue concerns the changing nature of commodity price volatility. Given that the variability of commodity prices is much larger than any underlying trend, it is interesting to understand the changing nature of this volatility. In other words do commodity markets exhibit constant or changing patterns of price instability around their underlying trends? This issue has not been researched very much. Early analyses by Cashin and McDermott (2001) found that over a long period (from before 1900 to the 1990s), aggregate commodity price indices seem to exhibit rising variability. This has not, however, been the case in the analysis of Sarris (2000), who utilized individual cereal world prices, and concluded that empirically it was impossible to reject the hypothesis of unchanging price variability.

Another study by Dehn (2000b) utilized country specific commodity terms of trade indices over a long period, and applied a GARCH econometric technique to assess the changing nature of instability. He found that there are several distinct patterns of variability over time. Some countries' commodity terms of trade exhibit low uncertainty with sharp and short-lived increases. Others exhibit a non-stationary pattern of instability. Yet other countries exhibit stationary but persistent price instability changes. He also found that price instability seems to become larger after a commodity boom. Gilbert (2006) found that agricultural commodity market volatility peaked during the 1973-75 crisis but declined after the crisis and continued declining until 2002.

More recently Gilbert and Morgan (2010) examined the price volatility of 19 internationally traded agricultural commodities over the period 1970-2009, and when they compared the two twenty year periods in this range, they found that volatility had statistically significantly increased in only three of these (rice, sorghum and bananas), while it had significantly fallen for 9 commodities (cocoa, sugar, soybeans, groundnut oil, palm oil, soybean oil, beef, lamb, fishmeal) and had insignificant changes one way or the other in the others. Balcombe (2011) also found that there is conflicting evidence on the trend of volatility of agricultural commodities.

Apart from the above questions, the key issue of what type of model can reproduce commodity price movements best, has occupied the literature for more than two decades. The discussion has revolved around the relevance of the so-called competitive storage model (CSM) (Wright and Williams, 1982), and has included contributions by Deaton and Laroque (1992) and more recently by Cafiero et. al. (2010). The basic conclusion of this literature is that prices of storable agricultural commodities tend to behave in ways largely predicted by the CSM, which suggests high autocorrelation of prices, sudden price spikes, and skewness of the price distribution.

Theoretically volatility of commodity prices should be larger when the commodity price level is larger (implying shortage of the commodity and hence larger reaction to any news about fundamentals) and when stock levels are smaller (implying that there is smaller buffer against any short term supply/demand disturbances). Empirical analysis indicates indeed that volatility in the most representative international market for wheat, namely the Chicago Mercantile Exchange

(CME), seems to have increased over time, and that higher nominal prices are normally but not always associated with higher volatility, as expected from theory, and that higher volatility is associated with lower levels of global end of season stocks (European Commission, 2009).

The determinants of agricultural price volatility is a topic that is distinct from the topic of explaining a single episode of price spike. Balcombe (2011) recently made an empirical estimate of the factors affecting the volatility of agricultural commodities, as measured by the conditional variance of prices. His main conclusions are the following :

1. Past volatility is a significant predictor of current volatility for nearly all commodities
2. There is evidence that there is transmission of volatility across agricultural commodities for nearly all commodities (except pigmeat).
3. Oil price volatility is a significant predictor of volatility in the majority of agricultural commodities.
4. As with oil prices, exchange rate volatility impacts on the volatility of most agricultural commodity prices.
5. Stock levels have a significant (downward) impact on price volatility.
6. A number of commodity prices have significant deterministic trends. These trends are positive for some series and negative for others.
7. While some agricultural prices may have recently been relatively volatile, it does not follow that this reflects an overall growth in ex ante volatility.

A topic that has gained considerable prominence during the recent crisis is whether speculative activity in organized exchanges has increased general volatility. There are conflicting views on this. Gilbert (2010), for instance, argues that speculative activity has exaggerated price changes of food commodity prices, and the same has been argued by von Braun and Torrero (2009), as well as Masters and White (2008). On the other hand Irwin et. al. (2009), as well as Wright (2009) argue that speculation in organized exchanges accounts for a small part of market volatility. In this context it is important to distinguish between speculation in organized exchanges and speculation in the actual markets. Both of them are important, and needed for proper operation of the markets. As prices in organized markets are related to prices in physical markets, because of various types of hedging and other risk management related operations of physical market participants, the main issue is whether "excessive speculation" has led to a breakdown of the traditional relations between futures and physical markets, thus distorting price signals and disorienting market participants. This, however, is difficult to assess, and has not been investigated conclusively to date.

Concerning prospects for future volatility, Gilbert and Morgan (2010) examined the price volatility of 19 internationally traded agricultural commodities over the period 1970-2009, and when they compared the two twenty year periods in this range, they found that volatility had statistically

significantly increased in only three of these (rice, sorghum and bananas), while it had significantly fallen for 9 commodities (cocoa, sugar, soybeans, groundnut oil, palm oil, soybean oil, beef, lamb, fishmeal) and had insignificant changes one way or the other in the others. Concerning prospects for future volatility, Gilbert and Morgan assessed a range of factors and judged that three were likely to have a positive impact on volatility (demand for food crops for biofuel feedstocks, futures market speculation, underinvestment in agriculture), while other factors, such as inventory levels, climate change, price transmission, etc. were likely to have minimal influence on future volatility. Balcombe (2011) also found that there is conflicting evidence on the trend of volatility of agricultural commodities. Since he found that volatility depends on the volatility of several explanatory variables, such as petroleum price and the US dollar exchange rate, the prospects for future volatility of agricultural commodities will depend on the volatility of these underlying determinants.

Others also agree that we have entered a new era characterised by much more unstable food prices on the international markets due to new factors, most of which (biofuels and oil prices, exchange rates, speculation, macroeconomic factors) are external to the food economy (Mitchell and Le Vallée 2005; Masters and White 2008; Sarris 2009, 2010). A high level of food price instability in developing countries may, then, have serious consequences on food security both in the short term (consumer access to food) and in the long term (incentive for producers to invest and increase production). Food market instability can also lead to various undesirable short and long term impacts, especially for vulnerable households, as several studies have documented (Ivanic and Martin, 2008, and several other studies in the same special issue of the journal *Agricultural Economics*).

Another issue that is very important from the viewpoint of global volatility is transmission of world prices to domestic markets. It is well known that many countries insulate their domestic food markets from international market variations through a variety of trade and other policy interventions. This has the tendency to make global markets more unstable. There is substantial literature on the topic (for two very recent additions relevant to the recent food crisis see Gilbert, 2011 and Rapsomanikis, 2011). Most of the literature finds that there is imperfect price transmission, with international prices taking some time before being reflected in domestic market prices, and this depends a lot on the specific country policies pursued. This is especially true for developing countries.

4. Volatility risks faced by food importers

Policies for the effective management of price booms or general market volatility depend on the proper identification and assessment of the risks facing each country. These differ by country, and involve the identification of the parts of a country's economy and inhabitants that are vulnerable to food commodity market shocks, as well as the types of market uncertainties which affect these agents. In other words one must outline a "risk profile" of the country to food commodity shocks. In the sequel risks that depend on upheavals in international food markets are discussed.

Proper response to a food commodity shock differ depending on whether the shock affecting the country is transitory or permanent. Factors to consider are the following: (i) Does the price shock have its origins in factors external to the country, such as world markets, or in domestic production supply imbalances in the markets concerned? (ii) How transitory are the factors that have led to the price shock? (iii) What is the level of uncertainty concerning the factors that may influence the future course of prices? The answers to these questions are not easy, and there may be legitimate differences of opinion among analysts concerning such assessments.

The second issue concerns the possible impacts of the price shock on the country's economy and its citizens. The impact of increasing prices on the wider economy is determined by a number of structural characteristics, such as the structure of production and food consumption, and the types and income-consumption profiles of households. Any adopted policy measure should not try to protect or benefit one vulnerable group by damaging the benefits to another poor constituency. In this context, it is important to ascertain the extent to which price signals are transmitted to the domestic markets, the identification of vulnerable population groups that can be targeted for support, as well as the agricultural sector's ability to respond to increasing prices.

The third issue that is imperative before a country adopts specific policy measures is to ascertain and be clear about the objective of the policy. Too often policy measures are adopted with a very narrow objective, and may end up affecting negatively other areas of equally important domestic concern. Also if the objective is known and generally agreed upon, then any policy measure can be judged against others that may offer similar benefits, but with smaller side effects or negative secondary consequences. Finally, if there are more than one policy objectives, it may well be that a combination of measures is necessary to simultaneously achieve all of them.

The reactions to the recent price boom, suggest that policy reactions to the food price surge have been prompt, with governments in many developing countries initiating a number of short-run measures, such as reductions in import tariffs and export restrictions, in order to harness the increase in food prices and to protect consumers and vulnerable population groups. Other countries have resorted to food inventory management in order to stabilize domestic prices. A range of interventions have also been implemented to mitigate the adverse impacts on vulnerable households, such as targeted subsidized food sales (Rapsomanikis, 2009).

Demeke, et. al. (2011) made a review of policies adopted in response to the recent food price spike and they indicate that the responses of developing countries to the food security crisis appear to have been in contrast to the policy orientation most of them had pursued over the last decades as a result of the implementation of the Washington consensus supported by the Bretton Woods Institutions. This period had been characterized by an increased reliance on the market – both domestic and international – on the ground that this reliance would increase efficiency of resources allocation, and by taking world prices as a reference for measuring economic efficiency. The availability of cheap food on the international market was one of the factors that contributed to reduced investment and support to agriculture by developing countries (and their development

partners), which is generally put forward as one of the reasons for the recent crisis. This increased reliance on markets was also concomitant to a progressive withdrawal of the state from the food and agriculture sector, on the ground that the private sector was more efficient from an economic point of view.

The crisis has shown some drawbacks of this approach. Countries depending on the world market have seen their food import bills surge, while their purchasing capacity decreased, particularly in the case of those countries that also had to face higher energy import prices. This situation was further aggravated when some important export countries, under intense domestic political pressure, applied export taxes or bans in order to protect their consumers and isolate their prices from world prices.

As a result, several countries changed their approach through measures ranging from policies to isolate domestic prices from world prices; moving from food security based strategies to food self sufficiency based strategies; by trying to acquire land abroad for securing food and fodder procurement; by trying to engage in regional trade agreements or; by interfering with the private markets through price controls, anti-hoarding laws, government intervention in output and input markets, etc.

Before one discusses any mechanism to manage food import risks it is important to ascertain the types of risks that are relevant to food importers. Food imports take place under a variety of institutional arrangements in developing countries. A study by FAO (FAO, 2003) contains an extensive discussion of the current state of food import trade by developing countries. It notes that while in some LIFDCs state institutions still play a very important role in the exports and imports of some basic foods, food imports have been mostly privatized in recent years, although with some exceptions, and in some countries, state agencies operate alongside with private importers.

A public sector food importer, namely a manager of a food importing or a relevant food regulatory agency each year faces the problem of determining the requirements that the country will have to satisfy the various domestic policy objectives. Such objectives may include domestic price stability, satisfaction of minimum amount of supplies, demands to keep prices at high levels to satisfy farmers, or low to satisfy consumers and many others relevant to various aspects of domestic welfare. For instance if the government of the country needs to keep domestic consumer prices of a staple food commodity stable at some level p_c then an estimate of domestic requirements in a year t could be given by a simple formula such as

$$R_t = D(p_{ct}) - Q_t \quad (2)$$

Where R denotes the yearly requirements, $D(.)$ the total domestic demand of the commodity (which will, of course, depend on other variables than just price), and Q denotes the domestic production. Private stockholding behavior would be part of the demand estimates in (2).

The problem of the manager of the food agency is four-fold. First there needs to be a good estimate of the requirements, which is not easy given uncertainties in estimations of domestic production and demand. Secondly, the public sector food agency manager, must decide how to fulfill them, namely through imports, or by reductions in publicly held stocks, if stock holding is part of the agency's activities. A related problem is the risk of non-fulfillment of the estimated requirements which may cost domestic social problems and food insecurity. The third problem of such an agent is how to minimize the overall cost of fulfilling these requirements, given uncertainties in international prices and international freight rates, and to manage the risks of unanticipated cost overruns. For instance, if the agency imports more than is needed, as estimated by ex-post assessment of the domestic market situation, then the excess imports will have to be stored or re-exported and these entail costs. Finally, but not least, and related to the overall cost of fulfilling the requirements, the agent must finance the transaction, either through own resources, or through a variety of financing mechanisms.

In many countries the State has withdrawn from domestic food markets, and it is private agents who make decisions on imports. The problem, however, of private agents, is not much different or easier than that of public agents. A private importer must assess with a significant time lag, the domestic production situation, as well as the potential demand just like a public agent, and must plan to order import supplies so as to make a profit by selling in the domestic market. Clearly the private importer faces risks similar to those of the public agent, as far as unpredictability of domestic production, international prices, and domestic demand are concerned, and in addition faces an added risk, namely that of unpredictable government policies that may change the conditions faced when the product must be sold domestically. During the recent food price crisis, surveys by FAO documented the adoption of many short-term policies in response to high global staple food prices, which must have created considerable added risks for private sector agents. Furthermore, the private agent maybe more credit and finance constrained than the public agent. In fact the study by FAO (2003) indicated that the most important problem of private traders in LIFDCs is the availability of import trade finance. The main external uncertainty facing food importers is international price variability and hence unpredictability.

Once the level of imports needed is determined, there are two additional risks faced by import agents, apart from the price risk. The first is the financing risk, namely the possibility that import finance may not be obtainable from domestic or international sources. This is the risk identified as most crucial by the FAO (2003) study for agents in LIFDCs. The second risk is counterparty performance risk, namely the risk that a counterparty in an import purchase contract will default and fail to deliver. This latter risk is one that came to the fore during the recent price spike, and is can be due to both commercial and non-commercial factors. Commercial factors may include the inability for the supplier to secure the staple grain at the amount and prices contracted because of sudden adverse movements in prices. Non-commercial factors includes things such as export bans, natural disasters or civil strife, in the sourcing country that may render it impossible to export an agreed upon amount of the staple.

5. Defining market crises and excessive volatility that may cause problems for developing countries

Market and price variability in agricultural commodities is a fact of everyday life. The previous section outlined the types of vulnerabilities that developing food importing countries face in light of global market volatility. The recent food crisis, as well as the one of 1973-75 highlighted the fact that there are occasionally significant departures from what maybe termed “normal market volatility” that create problems for market participants. How can such episodes be identified, and more importantly anticipated? Generally the various recent calls for policy intervention to “stabilize markets” have been motivated by assessments that “excessive volatility” in agricultural markets is not in the interest of producers or consumers, and must be controlled. It is, however, by no means easy to define “excessive” volatility or a related “crisis”.

The finance literature has identified excessive volatility as the situation where market prices are above what can be predicted on the basis of the Efficient Market Hypothesis (EMH) (see Prakash and Stigler, 2011 for a review). The excessive volatility in these cases is related to excessive speculation. These assessments, however, are difficult to implement empirically. The ideas can be applied to organized commodity markets to assess the degree of excessive speculation, but again the lack of appropriate data, makes it difficult to make easy assessments. In any case excessive volatility can be caused by factors other than mere speculative activity in organized exchanges. During the recent food crisis in fact, there were several commodities for which no organized exchange exists, that experienced the same type of price changes as those that were also traded in organized exchanges. Hence one must resort to simpler types of assessments.

Conceptually excessive volatility in a commodity should refer to movements of price outside some bounds that are deemed to occur infrequently and are deemed to be undesirable. How can one define these bounds? A useful approach is to refer to the concept of risk layering which is well known in the field of risk management and insurance (see for instance World Bank, 2005). The idea applied in this context is to start by considering the probability distribution of prices or price changes. This could be a distribution based on historical observations. Then one could try to split the range of all possible prices into three intervals defined by a floor and a ceiling price level P^f and P^c . The choice of these upper and lower bounds could be made with the idea that markets would fail for prices above or below these bounds, and that occurrence of prices outside the bounds would be infrequent. This is what maybe termed the “market failure” risk layer. Prices in some range around the mean could be considered to define a “retention layer”, namely price variations that can be handled by agents without any additional measures or risk management instruments. The remaining intermediate price ranges could be termed the “market insurance” risk layer, and the idea is that within these price ranges, there is a variety of market based risk management instruments that can be used to manage market risk. Figure 9 illustrates the concept.

While the choice of these bounds is not easy, and subject to arbitrariness, the idea is that whatever intervention is envisioned to deal with excessive market volatility, it would not be triggered unless

the price moved outside the prespecified bounds of the market failure layer.

In this context, there seem to be three types of useful indicators that are relevant and could be utilized by the international community as well as individual countries to monitor and define excessive market price instability in the above sense. The first is based on nominal prices of relevant commodities in some specific market(s) and involves a price band. An indicator could be designed around specific price ceilings and/floors which, when breached, or expected to be breached, could call for either market intervention, or for some special measure to be taken at international or country levels. This is the simplest type of indicator for action and it is the one utilized in the past by many countries for domestic market interventions. It is illustrated in figure 10. However, it has the weakness that someone must specify the relevant price bands, and this is invariably political, albeit technically not difficult.

Under such a system, in order to have an index or measure on the basis of which to provide a trigger for actions to manage commodity market volatility, one would want to have an estimate of the underlying equilibrium average market price for a commodity for a current or future period, conditioned on information up to and including that period, and a conditional probability distribution of prices around such an average also for the same periods. One could then design an appropriate price band that would be expected to be breached once every so many periods, depending on the probability distribution. For instance a band could be specified to lie between one or two standard deviations (based on the unconditional or conditional variance of price in a given period) around the conditional or unconditional mean price. The band could change over time as the underlying average equilibrium price changed and also as the probability distribution changed. Excessive volatility could be defined as the situation where price in some future period is expected to be outside the band with a probability level above a "tolerable risk level". This risk level could be agreed to be something like 5 or 10 percent. It must be emphasized that what is discussed here is a monitoring system for deciding whether excessive volatility is likely, or to trigger some policy interventions, and not a system to keep prices between prespecified bands.

There are many ways to estimate the above conditional means and variances of prices, some easier than others. For instance, one could consider a simple or weighted moving average of past prices in a given market as an estimator of the underlying expected equilibrium price in a subsequent period, and a measure of variance of past prices over a given interval as an estimate of the underlying conditional variance of that price. If a given previous time interval is specified, that changes the data for the estimation of mean and variance from period to period, then any estimate of subsequent market volatility would change over time.

Given, estimates of a conditional mean and variance of a subsequent price, one could define excessive volatility as the situation where the ceiling or floor price levels are likely to be surpassed with a given level of probability, say 5 or 10 percent, over a given time period.

More specifically if the price at time $t+1$ is denoted by p_{t+1} and if I_t denotes the information set at time t , then excessive price volatility could be considered to exist at time t , when the following

condition is satisfied

$$\text{Prob}[p_{t+1} \geq P^c | I_t] \geq \alpha \quad \text{or} \quad \text{Prob}[p_{t+1} \leq P^f | I_t] \geq \beta \quad (3)$$

where P^i for $i=c,f$ denotes the ceiling and floor price respectively, and α, β denote probability levels such as 0.05 or 0.1 (α and β could be different).

Such simple indicators have the great advantage of transparency and ease of calculation, albeit they may not reflect accurately the underlying market expectations or market estimates of volatility. Alternatively one could specify a more sophisticated time series or structural model to estimate the conditional mean and conditional variance of the subsequent price. For example a GARCH model could be used to estimate the conditional mean and the conditional variance of subsequent prices. In cases where organized commodity exchanges exist, one could consider the futures price as an estimate of the market expectation of subsequent price, and an estimate of implied volatility as the market assessment of the underlying variability of that estimate. There are also more sophisticated methods that have been proposed (Martins-Filho, et. al, 2010a,b), to do basically the same, namely to estimate the probability of a price falling outside a certain range.

A second type of useful market indicator could be one based on estimates of market price changes. This indicator could be built around observed changes in the prices of certain basic commodities in given markets relative to changes observed in the past. Large and persistent observed deviations of the observed changes from past averages could be used as triggers for intervention. Of course one would have to define the frequency of price observations (daily, weekly, etc.), the period of time over which changes must be observed before intervention is triggered, the way changes are measured, and the amount of deviation beyond which some measures could be taken. Such indicators have not been utilized in the past but they seem relevant for the issue of dealing with market volatility.

Given that many commodity price series are integrated of order one, namely exhibit stochastic trends, and hence are consistent with a model of stationarity of price differences, the above indicator could be built around estimates of the expected price change and the conditional variance of that price change. The same ideas as discussed above for the levels of prices apply here but for the differences. In other words the assessment of whether a market is exhibiting excess volatility could be based on whether the value of the conditional price difference at some future period surpasses a certain bound (for instance 20 percent above the expected price difference). If the relevant price series is not integrated of order one, a model in price difference can also be estimated and the analysis can be carried through as above.

The third type of market indicator could combine assessments of price levels as discussed earlier above, with assessments of price changes as indicated in the previous paragraph. In other words one could stipulate that large and sudden changes in prices may reflect market disorientation about the fundamentals, and hence erratic and potentially wasteful reactions to unpredictability. In such case intervention maybe aimed at restoring market confidence in fundamentals and

reducing unpredictability in the subsequent period.

Concerning the issue of what may be termed “excessive”, it appears that for most price variations countries as well as farmers and consumers have a range of options to deal with normal market fluctuations, within the “market insurance” layer. It is unusual market events, for instance market upheavals that may occur once every twenty years or so, that are quite unpredictable, that may need additional policies. Such infrequent events may be characterized by “cognitive failure” namely the inability of private or public agents to identify the true risks and hence make plans that do not take into account low probability but rather high consequence events. It is such events, which may justify emergency public interventions. This, then relates to the issue of what values to place on the upper and low ceilings of a price band that monitors the state of the market, and on the magnitude of price changes that may signal abnormal market behavior.

6. Can excessive global food commodity market volatility and price spikes be prevented or reduced and how?

The earlier discussion suggests that a desirable outcome of any policy measure or other system of intervention should be to prevent the markets from going into what was termed earlier market failure layers. To do this, one must first question under what conditions the market goes into such market failure layers. Secondly one must analyze the types of measures that are likely to prevent the market from veering onto one of the market failure layers.

Apart from the basic fundamentals of supply and demand that determine market prices in any commodity market, such as the distribution of supply and demand, the elasticities of supply and demand, market structure, etc., market volatility, namely unpredictability, depends on the following factors. First it depends on the various uncertain exogenous shocks that may affect supply and demand. Such shocks include the normal production shocks, and demand shocks such as unanticipated demand surges or slumps. The second set of factors concerns the various passive and active policies that are in place by countries that affect a market. Passive policies include those that do not change frequently such as trade policies, producer subsidies and other support measures, etc. Such policies affect the transmission of given national shocks to international markets. Active policies include variable trade policies, active public stock management policies, and other public state dependent policies. Such policies, as they are state dependent, tend to also affect the way in which a given domestic shock is transmitted internationally, but as they variable over time, they create uncertainties about the nature of the transmission of national shocks and hence add to the uncertainty of the market, and can lead to excessive volatility. It is such policies that were a major driver of the recent price spike (Headey and Fan 2010).

The third type of factors involves the behavior of stocks. Private stocks interact with public stocks, and the totality of each country's stocks influence the nature in which a given commodity shock can be dissipated. It is well known that the availability of adequate physical stocks is one of the best ways to avert subsequent price spikes (Stigler and Prakash, 2011, Wright, 2009). The final set of

factors involve the behavior of market agents as speculators in both physical as well as organized futures markets. This is important because of the interaction between futures and physical markets. All proposals that have been made to reduce market volatility involve actions on one or more of the above factors.

It should be clear that in the short run there is little one can do about the occurrence of random production or demand shocks. While of course long term research could alter the susceptibility of production to, for instance, rainfall failures and pest attacks, these are factors that a system to prevent price spikes cannot alter in the short term. Similarly while the probability of excessive market volatility can be influenced by stable policies, such as for instance tariffs, it is difficult to change these in a coordinated fashion, so as to lessen the probability of spikes. Nevertheless, there are international fora, such as the World Trade Organization (WTO), the OECD, and the United Nations, where coordinated efforts for changes of volatility enhancing policies can be discussed and agreed upon. This process is also very slow and uncertain as to its outcomes, as many of the policies that increase volatility have been put in place for other purposes, and their modification runs against the political economy factors that imposed them in the first place.

This leaves short-term state dependent public policies and the behavior of the private sector as speculators or stockholders as the main two areas where intervention could prevent or lessen excessive volatility and price spikes. It is quite difficult to prevent governments of concerned countries from taking short-term actions they consider in their own country's interest. However, when many governments take such measures simultaneously, the consequence maybe worse for all, what is known in economics as the fallacy of composition. In 2007-08 as well as in 1973-75, the world food markets were subject to such phenomena, that created hoarding behavior and herd effects and invited physical and future market speculators to take advantage of the situation. Such behavior of market participants is very hard to control, or prevent. In other words once the market breeches one of the market failure levels, then it is very difficult to prevent market participants from behaving in a hoarding or speculative or other seemingly irrational mode. Preventing such occurrences then is akin to instilling a system of confidence in the market that allows participants to reduce their expectations of a market failure.

One of the problems any food crisis similar to that of 2007-08 is that many importers are shut out of the international markets not only for lack of resources, but for lack of physical supplies available for purchase. Also many international contracts are not honored. This clearly creates a crisis of confidence, and it is maintenance of confidence in world markets that is needed to avert spikes.

Among the above factors the one that has the most significant effect at reducing the chances of a price spike is the availability of adequate physical stocks. It is, therefore, no wonder that most proposals in the past have concentrated on the build-up of stocks as a buffer against price spikes. Given that in almost all food commodity markets there is a number of countries that are significant suppliers and demanders of the commodity, the past pre 2006 proposals have concentrated on the build up and management of global stocks through coordination of national stocks. A variety of

International Commodity Agreements (ICAs) were negotiated in the aftermath of the 1973-75 global food crisis, but none of them was ever implemented successfully and none of them currently survives. The major reasons have to do with high costs of carrying stocks in excess of what the market fundamentals and the private sector would warrant, and coordination problems among participating countries (Gilbert, 1996).

The recent crisis also brought forth stock related proposals. The ones that have received most attention are the proposals for an emergency reserve of von Braun and Torrero (2008), and the proposal for an international coordinated grain reserve (Lin, 2008, Von Braun, Lin and Torrero, 2009). The physical emergency reserve of about 300,000 to 500,000 tonnes of basic grains, would be decentralized and located at strategic points in or near developing country regions. It would serve to smooth out the flows of food aid, which currently amount to 6-7 million metric tons annually. The World Food Program (WFP) would manage this reserve and use it solely for humanitarian and emergency response. To cover the cost of restoring the reserve to its initial level, an emergency fund would be created and maintained by participating countries. The fund would be accompanied by a financing facility that the WFP could draw upon to cope with excess costs of maintaining the reserve. This proposal is not meant to reduce excessive volatility in commercial markets but only to support humanitarian food aid assistance.

One of the main causes of the recent food price spike was the low ratio of stocks to use. Von Braun, Lin and Torero (2009) have proposed that there be a UN agreement internationally where countries would hold public stocks, in addition to any private storage, as a percentage of annual use. The proposal would be an agreement by a group of a few important world grain market participants that would include members of the G8+5 as well as major grain exporters such as Argentina, Thailand and Vietnam. The members would commit to hold specified amounts of publicly owned grain reserves, in addition to those held by the private sector.

These stocks would then be released onto the world market when a price spike was forming, and according to directions by a "high level technical commission" appointed by the group on a permanent basis.

The proposal structure in principle looks similar to the principle of the International Monetary Fund (IMF), which collects monetary reserves from its members and releases them to financially stressed members when needed. The IMF members have agreed on rules of release and replenishment, and it is the credibility of these rules that have maintained confidence in the financial markets over time. Would it be possible to obtain such an agreement for basic food commodity markets? Rules that could be considered involve the amounts of reserves contributed by members, the types of situations or events when reserves would be available to participating members, the types of members that would participate and would be eligible to draw supplies from the system, the rules for replenishment of supplies withdrawn, etc. For instance it could be stipulated that withdrawals would have to be made by a country to meet emergency domestic food market problems, and not to any private market participant. All of these issues could be resolved at a technical level, as they

have been resolved at a financial level for the IMF.

The idea is quite different than the idea of commodity agreements which were much in fashion during the 1970s and 1980s, and which have been plagued by the problems of agreeing on price bands for market stabilization, as well as on the rules of operation of the attendant buffer stocks. The idea of internationally coordinated basic commodity stocks could evolve into a global food security stock, that could be utilized to supply some extraordinary needs of members under some extreme but well specified circumstances. It needs to be further studied from this perspective.

With respect to the global coordination of reserves and regional reserves, in addition to high costs of storage there are several additional concerns that need to be taken into account. The key challenge in order to boost global confidence in a time of crisis is to develop a governance structure among the member countries sponsoring the global coordinated reserves that will be honored when markets are under stress. Second, the global or regional reserves will clearly require trigger mechanisms to make decision of release stocks to calm markets in times of stress. Such triggers could be built upon the ideas discussed earlier. In addition, it is important that any mechanism agreed upon is based on transparency.

A third requirement is to agree on how the stocks will be released in the markets. For instance if the stocks are released through international tenders then the prices at which they are sold could well be higher than those triggering the releases. On the other hand if they are released at a prespecified trigger price, and the underlying equilibrium price is above the trigger prices, then those who have access to the stocks released at the trigger price would in essence receive a rent equal to the difference between the underlying market price and the release price. This, then implies that the allocation of the stocks from such a reserve during a period of release must be agreed, so as to benefit those countries or groups most in need, or most affected by the price spike.

Several other proposals have been made in the few two years or so in response to the 2007/08 food price spikes, and with the view to preventing or mitigating excessive speculation and price spikes.

Von Braun and Torero (2009) proposed the institution of virtual reserves, to avert speculative bubbles caused by hoarding and speculation in basic food commodity markets, namely to avoid price spikes of the type that occurred in 2007-8, or earlier.

The basic motivation is first that the actual trading in a commodity is influenced by the price signals in organized exchanges. This is because many of the physical traders utilize the exchanges for pricing decisions based on the prices of futures contracts, or hedge their physical transactions with futures and options in the organized exchanges. The second motivation is that a lot of the price spikes in commodity markets are the result of speculative long trading in organized commodity exchanges, especially with the recent advent of commodity funds, and may lead the market prices to be "irrationally" high. The proposal is to counteract such long speculative trading with "naked" short selling (namely not backed up by any physical commodity stocks) by an outside

agency, so as to prevent prices from spiking.

The virtual reserve would be implemented as a coordinated commitment by the member countries (the Club), which may consist, for instance, of the G8+5 plus some other major grain-exporting countries (such as Argentina, Thailand, and Vietnam).. Each country would commit to supplying funds, if needed, for intervention in the futures market. The fund would normally consist not of actual budget expenditures, but of promissory financing by the members. These funds would be drawn upon by a high-level “Technical Commission” only when needed for intervention in the futures market. At that stage they would become actual budget expenditures.

The innovative concept behind the virtual reserve is the signal that it gives to markets, including speculators, with its presence alone being likely to divert speculators from entering this market. Nonetheless, the commission must be ready to trade grain when necessary and to assume the costs if in the future it must buy back contracts at a higher price than it sold them for.

The proposal has the advantage, that if successfully implemented, it may avert global speculative bubbles in basic commodity markets. However, it has several shortcomings. The first concerns the underlying assumptions of the idea. The first assumption is that the prices in the futures markets cause the prices in the spot market, in the sense that spot markets follow the signals in the futures markets. It is true that spot and futures markets move together, and that many market participants use the futures markets to price their spot transactions. Both types of prices are affected by the same fundamentals. However, when the futures markets go into some kind of speculative bubble, much as the one of the recent period, many operators in actual markets cease to utilize the futures market signals for their transactions, or for hedging, as they may regard the futures prices as outside the range of what the fundamentals dictate. In such a case the important link that forms the basis of the logic of the proposal is broken. While it is quite difficult to examine empirically this issue, informal information from market participants suggests that this situation occurred during 2007-8.

The second assumption is that the price spikes are due to irrational speculation. It is impossible to distinguish between rational investment behavior based on expected price changes and irrational speculation. Any logical market participant who anticipates a price increase would strive to increase his/her long position, and this would drive both spot and futures prices up and this can hardly be called “greedy speculator” behavior. The consequence of this is that it may be very difficult if not impossible to specify price limits at which any futures market intervention should start. Basically the only remedy against a commodity bubble is to make available physical amounts to satisfy the excess demand. Such stocks, if available in the private sector will become available when prices rise enough to justify sales now rather than later. A bubble in fact may induce some release of existing stocks. When such supplies are not available, then it is expectations that are destabilized in response to available shortage information, and prices tend to increase without limit, and no manipulation of the futures market can bring them down.

The second shortcoming is that the proposal pertains only to commodities that are traded in

organized exchanges with futures. However, the recent price bubble, as well as previous ones, were not limited to commodities with organized futures markets, or to organized markets that exhibited investments by commodity funds, which have allegedly caused many of the recent spikes. For instance a commodity like rice is not traded in organized exchanges, so this proposal could not be implemented for rice. In any case the recent rice price bubble was mostly induced by government policies, rather than speculation.

Another issue is the amount of money needed in case of intervention. Braun and Torero estimate that the funds to be committed would amount to 12-20 billion USD. This is a substantial sum, which when called for may not be available. For instance, if such a system was in place at the time of the recent 2007-8 commodity bubble, it is not clear that the governments of the club of member countries would commit the money and fast, given the concurrent financial crisis. However, if the money is not available rapidly, the virtual reserve would not be able to counteract any speculative bubble, and the system would become ineffective. In addition, even if the money was available, it may not be able to withstand a speculative attack, that may consume the available funds in a short period of time. For the money to be available when needed, it would have to be precommitted, and it is hard to see how the various club member countries would precommit such large sums of money. The proposal has also been criticized on its technical merits by analysts such as Wright (2009).

Virtual reserves, nevertheless, may be useful in another way, namely in increasing physical stocks, rather than managing futures markets. The idea would be to interfere in organized commodity markets when the stocks and prices are low, to obtain a long position, much like the commodity funds do. Such positions would mimic the establishment of a physical stock, but with much lower cost, could be rolled over to maintain a given size of stock, and could be liquidated when prices exceeded certain limits. The advantage would be that they would be much more economical than a physical stock. Nevertheless, a stock of this type, just as any other stock, would have to be combined with specific purposes, such as for instance to ensure export commitments to vulnerable importing countries, to make it effective. A proposal incorporating these ideas is made later in this paper.

As uncontrolled speculation in organized commodity exchanges has been accused to be one of the main culprits for the recent price surge, it is natural that proposals have emerged concerning the better functioning of these markets. The most common of these proposals calls for smaller market order limits in any given contract and in any given period, so as to avoid large sudden price changes when markets are not very dense. However, other proposals have been made. Examples include the banning of High Frequency Trading (HFT), namely the probing of the exchange order book, and the consequent illegal practice of "front running", namely placing orders ahead of those in the exchange order book. Another proposal is to apply the spot month position limits to months earlier than the expiration month of a contract. Another proposal calls for settling futures contracts every month rather than only at delivery months. Another calls for allowing shipping certificates to warehouse receipts to expire within a year of issuance, so as to avoid holding such certificates for

long periods and making them instruments of financing and speculation, rather than instruments of the physical trade. Finally suggestions have been made for increased margins on futures trading accounts (for a review and analysis of these see Berg, 2011a). These are all regulatory proposals that need to be examined in detail by the relevant public authorities before they are implemented by law.

One of the lessons of the recent commodity price bubble was that many governments and private agents acted in response to imperfect information, and overreacted, causing a bubble over and above what could be justified by the fundamentals. This seems to have been the case in past commodity upheavals. Hence it would appear that enhanced information could help all agents in making more rational decisions, and thereby averting price spikes and crises. Proposals along these lines have been made by Wright (2008,9) Evans (2009), and Martins-Filho et. al. (2010a,b)

There are three kinds of information that are relevant in this context. The first refers to information about physical supplies and stocks. While information on production and trade is available, albeit imperfectly, information on available stocks is not. It is this latter information, however, which may make a difference in agents' responses to the market developments. This is however, an area that has been neglected. While stock information is imperfect, given the large number of market agents holding inventories, it may be possible to make reasonable estimates, at least for major market participants. Given the global public good nature of this information, the natural agency to collect and disseminate such information should be an international multilateral one. In addition, countries should make a commitment to provide timely such information, which would be to the benefit of all. This is clearly an area that merits further support, and in addition it maybe very cost effective, as it may make all market participants more aware of a more comprehensive market picture.

Wright (2009) argued that confidence in markets could be increased if there was more and better information on stocks. Similarly, Evans (2009) and Wright (2008) propose the creation of an agency, modeled after the International Energy Agency (IEA)), which would report on stock levels and develop protocols for international collaboration to improve the global response to shortages and help prevent the onset of market panic. Torrero (2009) has brought up the criticisms that, first, it is not clear whether better information on existing stocks and their evolution over time can be generated without considerable effort, international coordination and costs. Second, it is not clear how protocols for emergency response could be agreed with such level of asymmetry of information. While resolving both of these problems could be costly, it seems correct that just the availability of information on physical stocks at the global level would help to reduce price volatility.

The second type of information refers to domestic market developments in a range of commodity trading countries. Such information is relevant as it dictates the countries demand for import or supplies of export quantities. However, apart from some developed countries, such information is not generally widely available, sometimes not even to the governments of the countries

concerned, with the consequence that these governments may make decisions about their domestic markets and policies that maybe destabilizing. The recent rice crisis is a clear case in point, as it was induced to a large extent by policy responses to inadequate information.

The third type of information that seems underprovided is information on public commodity related policies. Again such information may help governments make more rational decisions by considering the types of policies applied or envisioned by others and avoiding costly overreactions.

A proposal has been made by Martins-Filho et. al. (2010) on instituting a system of early warning of impending price spikes. They have proposed appropriate indices for this, much like those in the discussion earlier about the trigger points that may constitute excessive volatility. It seems that such a system is not only quite cost effective, but also may promote the provision of impartial information concerning the probability of any impending crises. If the early warning has appropriate lead time, then market agents may be able to adjust so as to prevent a spike. It is not clear whether enough lead times can be built into such a system, and whether the publicly available information thus generated would prevent or feed a price spike, but it seems that, given its cost effectiveness, such a system is worth investing into.

7. Policies to manage market volatility and price spikes

If all or most of the above policy proposals are adopted, then it is likely that the probability of excessive speculation and price spikes would become lower. The adoption, however, of costly policies, especially those requiring extensive international cooperation and coordination, and involving stocks may not be possible in the short to medium term. This then brings forth the question of how individual countries and the international community can manage excessive market volatility.

There are basically two ways in which individual countries can manage their domestic food markets in the face of excessive international market volatility. One involves trade actions, and the other involves public stockholding. If countries or other agents can be assured their commodity supplies through trade, then they would need to carry lower levels of security stocks. Hence trade can be an important substitute for carrying costly physical inventories. Trade, however, can be impeded by a variety of problems. Policies aimed at facilitating commodity trade, may therefore obviate the need for policies to carry costly security or emergency physical stocks, both nationally and internationally. In the recent as well as previous food crises, there were three major trade facilitation related problems that caused governments to examine carrying larger security stocks. The first concerned unexpected and uncoordinated export bans by key exporters, which tend to increase international prices. The second was the unavailability of import financing for several lower income food importing countries, and the third was the uncertainty about international contract enforcement in a time of rising prices. The sequel discusses proposals to deal with these problems.

Can export bans be prevented?

Export bans are very disruptive to international markets, as they disturb established trade flows and cause significant losses to traditional trading partners of the countries that import from those imposing export bans. As export bans are a trade measure, the appropriate international forum to discuss this is the World Trade Organization (WTO). Currently export bans are not forbidden by the WTO agreement, as the concern of WTO members in the past was with low prices and hence import restriction measures, rather than high prices, which are reinforced by export bans. It would cost little to implement such an agreement among WTO members, once they agreed to it, and it would involve a small change in existing WTO rules. This, however, is not assured, as some members may not want to abandon the flexibility to control their domestic commodity markets via such an instrument. Clearly the developed countries would have a large role to play in revising the WTO rules in this direction.

A fund for the establishment of an internationally coordinated “Global Financial Food Reserve” (or GFFR) of basic food commodities

The only sure way to avoid excessive market upheavals is to have some amounts of previously accumulated stocks, but every proposal along these lines runs up against coordination and financing problems. The idea of the proposal here is to combine the best parts of the two proposals on reserves that have been discussed considerably, namely the establishment of a coordinated global physical reserve and a virtual reserve aimed at calming futures market speculation. The idea is to have a market based global safety net which would create physical or financial resources in times of price spikes.

The major problem with all proposals that have been proposed and deal with market volatility is that they purport to try to prevent the occurrence of a price spike. This, however, is very difficult to accomplish within a globalized market system, and may need very large and uncertain amounts of financial resources, that rightly makes donors uneasy and unwilling to consider. However, if the major objective of a system to deal with market volatility is to prevent the weakest members of the international community from paying the price for an upheaval, which for the most part is not their fault, then one could consider a limited and much cheaper safety net system to ensure support only for those countries.

The proposal made here would be an agreement by a group of a few important world grain market participants that would include members of the G8+5 as well as major grain exporters and other donors, to commit funds that could be utilized to hold specified amounts of publicly owned long positions in organized exchanges. In other words the proposal calls for the establishment of an international publicly held “global commodity fund” specifically targeted to basic foods. Given low margin requirements, this fund could assure, with relatively modest financial resources, control over a considerable amount of physical reserves. This could then be considered to be a “virtual commodity reserve”, but in its concept it is very different from what has been proposed before by

Braun and Torrero (2009a,b), as the fund would consist of actual and committed long positions, and would basically act a dormant physical reserve. The fund's positions would be rolled over from period to period, much like the commercial commodity funds do.

The fund's positions would be dormant and passive when markets are operating in normal conditions. Hence its resources would not be used for any "stabilization operations". However, when markets go into an unusual spike, which could be signaled by either the breaching of some prespecified price upper ceiling, or an estimate of a large probability of such an occurrence, as outlined earlier, the fund would have the option to either take physical delivery, so as to utilize the physical stocks for prespecified purposes, or to sell off the long positions. In either case the fund would command at a time of a price spike either physical stocks or financial profits from its long positions, if liquidated under market spike conditions. These physical stocks or profits could be utilized to promote a global safety net to assist most affected poor countries in obtaining food commodity imports at lower than spiking market prices. In other words the fund and the stocks it could support would not be utilized for market or price stabilization but rather for supporting assistance to needy countries.

Given that the fund's purpose would not be to stabilize markets, but rather to assure market weak participants that their excess food import costs would be covered, the GFFR could be restricted in size to what is estimated as needed for additional or extraordinary assistance to needy food importing countries in times of a food crisis.

The cost of such a reserve would be modest. For instance between 2006 and 2008 the total cereal import bill of LDCs increased by roughly 20 percent or about 4 billion US\$. If 10 percent of that could have been considered as extraordinary cost of vulnerable poor countries that would be compensated by developed countries as extraordinary aid under some global safety net, then this would amount to 400 million US\$. This is much smaller than the funds that were committed in support of developing countries in the context of the global food crisis by developed countries. If the fund before the crisis was of a size of 100 million US\$, and it was all invested in cereal stocks via long future positions, then at 5 percent margin it would have commanded physical amounts, worth about 2 billion US\$. The profits from a 20 percent increase in prices during the spike (and the actual increase during a spike would have been much larger than this) would then have been around 400 million US\$, which would have allowed the fund to compensate some low income developing countries for the extraordinary costs of the import bills. Needless to say that these calculations are very quick and simple but are intended to give an order of magnitude to the amounts involved.

The GFFR would act as a global market based safety net. As its major market operation would be to roll over positions in each period if needed, it would not interfere in the normal functioning of the commodity markets. The allocation of the proceeds or the profits of the GFFR from any price spike to needy developing countries could be a separate process, that would entail allocation according to some prespecified development criteria.

Food import financing and a dedicated food import financing facility (FIFF)

A major problem facing least developed countries (LDCs) and some net food importing developing countries (NFIDCs) is financing for both private and parastatal entities of food imports, especially during periods of excess commercial imports. The financing constraint arises from the imposition, by both international private financial institutions and domestic banks that finance international food trade transactions, of credit (or exposure) limits for specific countries or clients within countries. These limits can easily be reached during periods of needs for excess imports, or periods of high prices, thus constraining the capacity to procure finance for food imports and as a result, food import capacity. To this end a FIFF was proposed in 2005 to the WTO by FAO and UNCTAD and recently elaborated further by Sarris (2009b), to overcome this problem.

The purpose of a food import financing facility (FIFF) would be to provide financing to importing agents/traders of LDCs and NFIDCs to meet the cost of excess food import bills. The FIFF is not intended to replace existing financing means and structures; rather it is meant to complement established financing sources of food imports when needed. The financing will be provided to food importing agents. It will follow the already established financing systems through central and commercial banks, which usually finance commercial food imports using such instruments as letters of credit (LCs). The extra contribution of the FIFF would be to provide guarantees to these financial institutions so that they can increase their exposure to the importing countries. It will do so by inducing the exporters' banks to accept the LCs of importing countries in hard currency amounts larger than their credit ceilings for these countries. A key aspect of the FIFF is that it will not finance the whole food import bill of a country, but only the excess part induced by a food crisis. In this way "co-responsibility" will be established, so that only real and likely unforeseen needs will be financed, and the cost of excess financing will be kept at a low level.

The basic feature of the proposed FIFF is to provide the required finance at a very short notice, and exactly when needed, once the rules of operation are agreed upon in advance. Thus, the delays common to past ex-post insurance or compensation schemes that rely on ex-post evaluation of "damages" can be avoided. The proposed FIFF will operate in real time. Its financial strength would be based on guarantees provided to the FIFF by a number of countries or international financial institutions.

The costs of a FIFF would be minimal through risk pooling for a large number of countries and food products, and low operational costs owing to its risk management activities. The principal risk for the FIFF is that the guarantees that it provides will be called to finance non-repayments. This risk could be managed actively. As the facility would not set out to disturb the normal functioning of international food trade, there is a "non-zero" risk that the local or central banks cannot be reimbursed by their local food importing clients. This would primarily be the concern of the domestic and central banks of each country, and not the FIFF. Nevertheless, lack of reimbursement by the ultimate beneficiaries of the finance may lead commercial banks to default on their obligations (or delay repayment) to the FIFF.

The FIFF would benefit from guarantees from a number of countries. Ideally, this would include a number of OECD countries, which would enable the FIFF to borrow at AAA terms, when needed. But any group of countries could provide guarantees; the risk rating of the FIFF is then likely to be that of the best-rated among these countries.

A food import financing facility has existed in the IMF since 1981 under the Compensatory Financing Facility (the IMF CFF). The objective of that was not food import financing, but rather compensatory financing to countries facing balance of payments problems, and hence could not import food. Despite its availability it has been utilized very little, largely owing to the conditionalities imposed on borrowers by the IMF. The proposed FIFF would be different from the CFF in the sense that it would provide guarantees for normal food import finance, and would act in a much more timely fashion, namely before the undesirable event, rather than after.

While the FIFF envisioned in the current proposals is an international initiative, it could operate also as a policy of major food exporters, such as the EU, Canada and others. The US already operates a system very similar to this under its GSM-102 program of the Commodity Credit Corporation. The EU does not have a system of this type, despite the fact that many major agricultural commodity exporting firms and financial institutions operate in the EU.

A drawback of the FIFF, as mentioned by Gilbert and Tabova (2011), would be the fact that potential donors would have to count the guarantees provided to the FIFF as part of their public debt, even though the guarantees may not be exercised, something that may not be easy for some donors. To this end it is helpful to make rough estimates of the types of amounts of guarantees needed. Sarris (2009b) made some empirical estimates for the yearly guarantee needs that LDCs and LIFDCs would require under such a system and given the data for years up until 2007. The computations suggest that average yearly FIFF guarantee financing for LDCs would be in the vicinity of 200-430 million US\$, while the financing needs in an exceptional year may reach as much as 2,400 million US\$. To put these figures in perspective the average yearly LDC commercial food import bill for all foods between 2000 and 2007 was 10.7 billion US\$. Hence the FIFF average annual financing and hence guarantee needs would constitute about 2-4 percent of yearly LDC combined commercial food imports. In a year of exceptional needs, the value of FIFF guarantee financing needed could rise to as much as 23 percent of the total LDC food import bill.

If all LIFDCs were to be covered by the FIFF, then the annual guarantee financing needed would be in the range of 960-1937 million US\$, and this constitutes around 1.8-3.7 percent of the average LIFDC food import bill for the period 2000-2007. In an exceptional year the maximum financing needed could rise to as much as 10 billion US\$, which would be about 19 percent of the total LIFDC average food import bill of the same period. The above amounts are very small compared to the debt levels of the major donors, which, for instance for the US currently stands at around 14 trillion US\$, for France to 2 trillion US\$, for Germany to near 2 trillion US\$, etc. The G7 group of most developed countries currently has a level of public debt in the neighborhood of 20 trillion US\$.

A system to guarantee food import contracts

A problem that is acute during food crises is counterparty performance risk, namely the risk of reneging on a delivery contract, faced by many food importers. In other words, the problem in this case is not so much unpredictability of food import costs, or high food import prices, or financing, but rather assurance that supplies will be delivered. This does not only pertain to short term contracts but also longer term contracts. The basic reason for non-performance of international staple food import contracts is adverse price movements or adverse financial events that prevent a food exporter or trader to fulfill an import contract. There seems to be no contract enforcement mechanism in international staple food grain transactions.

Contracts in organized commodity exchanges are enforced because there is a clearing house which is responsible for making sure that all transactions are executed. Similarly contracts within one national legal jurisdiction can be enforced as there is a legal system to ensure contract enforcement, albeit a court based legal enforcement system is quite slow. Most international contracts are very similar to Over the Counter (OTC) contracts in the sense that it is only the financial and reputation status of the two parties that instills confidence in contract enforcement. There is no mechanism for international contract enforcement, and whatever juridical procedures exist are slow, uncertain, and costly, and cannot deal with the immediate risk of contract cancellation.

The basic missing institution is an international contract together with an international clearing house type of arrangement similar to the clearing houses that are integral parts of the organized commodity exchanges, which ensure that all contracts are executed. The key question is whether an international contract along with a clearing type of mechanism can be envisioned to ensure the performance of staple food type of import contracts. A proposal for an international grain contract has recently been made by Berg (2011b), while Sarris (2009b) proposed the institution of an International Grain Clearing Arrangement (IGCA). These are complementary proposals, as they aim at the same objective namely global contract enforcement. The objective of an IGCA would be to guarantee or insure performance of grain import trade contracts (short, medium and long term) between countries or private entities based in different countries.

A major function of a commodity exchange clearing house, apart from the settlement of the financial contracts, which amount to the bulk of settlements, is to ensure that physical delivery can take place, if needed. This is for instance one of the functions of the Chicago Mercantile Exchange (formerly the Chicago Board of Trade), and to ensure this a variety of rules and regulations with respect to delivery obligations are adopted by the exchange and the clearing house. In most organized exchanges physical delivery is a very small portion of all transactions, but if a trader insists on delivery then this must be arranged by the exchange. Many exchanges have arrangements with warehouses so that physical deliveries can be made against a futures contract, and there are severe penalties for anyone with an open contract who either does not fulfill the financial terms or does not deliver a physical commodity on it. It is these properties that would

need to be emulated by an envisioned international contract and a IGCA, in order to it to be viable as a guarantee institution in international staple food transactions.

A global contract, according to Berg, (2011b) rather than tracking prices in one geographical region, would track “cheapest to deliver” commodities, by designating delivery points in several places in the world. The traders who could deliver on such a contract would be those with relatively low prices.

There are precedents to this type of global contract, namely the global sugar futures contracts of the Intercontinental Exchange and the Euronext Liffe. In these cases the ports able to provide the cheapest sugar are the first to deliver against the contract. This provides a global signaling system of both price and regional availabilities of sugar ready to export. Given that the contracts are provided through organized international exchanges, the delivery on a given contract is guaranteed through the clearing houses of the relevant exchange. The only potential drawback is the logistical difficulty of having the supplies delivered in some part of the world, which maybe unknown at the time of contracting, and different from the location of the desired place of delivery. However, it would not be difficult to envision that transport services would be readily available in all major delivery points.

If a global contract is not instituted by an international exchange then the next best way to implement something on an international scale resembling the functions of an international contract and the clearing house of existing organized exchanges would be to link existing or envisioned commodity exchanges, with their respective clearing houses, or to have international exchanges list contracts with several international points of delivery. In other words, it maybe appropriate to think of how parts of contracts bought in on one exchange could be guaranteed not only by the clearing house of the exchange in question but by clearing houses of other linked exchanges.

The problem is that delivery at a recognized warehouse, e.g. near Chicago where the CME delivery locations are, may not be what the importer wants, and may need to incur considerable cost to transport those amounts to his desired import location. Hence what would be desirable is to have the possibility of taking delivery of the same amount of grain but at a location much closer to the importer’s desired destination. One way to do this would be to establish links between various commodity exchanges around the world, so that the price difference between grain stocks in different locations would be equal to the relevant cost of transport and other transactions charges.

The IGCA could be envisioned as a branch of the linked commodity exchanges which would in essence consist of some parts of the underlying clearing houses of the exchanges. The IGCA would try to guarantee that physical supplies around the world at various exchanges are available to execute the international contracts in its member exchanges. This could be done, for instance, if part of the financial reserves of the clearing houses that are members of the IGCA could be transformed into a physical reserve, via for instance holding warehouse receipts in various reliable locations around the world. The advantage of transforming part of the financial reserves into

physical reserves would be two fold. First, the value of the underlying reserves would fluctuate with the price of the underlying commodity. This is like marking the underlying assets to market. This would obviate the need by contracting parties to post additional margins in case the price of the commodity increases suddenly.

Second, and this is perhaps a major positive aspect, if some of the financial reserves of the IGCA were to be transformed into warehouse receipts, the physical execution of the underlying contracts, and not only their financial settlement, could be guaranteed. The commitments in futures or warehouse receipts of the IGCA could be liquidated once the actual deliveries on the relevant contract were executed. The liquidation of the physical positions or futures holdings of the IGCA would provide the funds to return to the contracting parties their posted insurance margins. In fact, since the liquidation of the IGCA margins would result in a variable amount as prices fluctuate on the underlying warehouse receipts or futures contracts, the restitution to the contracting parties of their initial margins would be variable and close to a fixed share (minus some transactions cost) of the underlying transaction value. Hence the true cost to the two parties to an international contract would be the interest foregone or paid for the posted good faith margin. Given all the other transactions costs in an international staple food import contract this may not be too high.

The IGCA would guarantee the execution of contracts by pooling the resources of several exchange related clearing houses. This would ensure that there would be liquidity in terms of physical reserves to honor individual contracts in case of non-performance by a participant. In fact, the major underlying benefit of the IGCA would be that by investing a small part of its reserves into physical warehouse receipts or deliverable futures contracts, it would create a global physical commodity reserve stock that could be utilized to execute international staple food contracts in case of non-performance of the exporting party to a transaction. The major difference, however, of such a stock and stocks envisioned in previous discussions on global price stabilization would be that this reserve stock would be used only to make the market work, namely ensure physical delivery and not to change the fundamentals of the market, as most of the other stock holding ideas envision. In the words, the stocks held in the form of warehouse receipts or other physically executable contracts, would perform the function normally done by so-called pipeline stocks, which are held by various market participants to ensure that there is uninterrupted performance of the normal market functions of the agent. Their function would not be to stabilize or speculate, but simply to ensure liquidity in the market, much as the financial reserves of the commodity clearing houses ensure liquidity to execute all underlying financial contracts. The necessity for an international arrangement to have such stocks is that there is no such physical liquidity mechanism internationally. In other words one of the main functions of the IGCA would be to ensure global physical grain liquidity. The IGCA could spread the risk of non-performance or country problems by holding its commodity reserves in several geographic locations, as well as several organized exchanges.

A major risk of such a IGCA would be that a sovereign country in whose territory, the warehouses

of the underlying stocks in which the IGCA has invested are physically located, could impose export restrictions or bans that may make the physical release of stocks impossible. Here, however, is where appropriate export related disciplines could be formulated in the context of the World Trade Organization (WTO), or another regional arrangement, to prevent exactly this type of phenomenon, as discussed above. Also if major IFIs, such as the World Bank, the IMF, and other IFIs are financiers of such a IGCA, then the type of sovereign type of default could be guaranteed by these IFIs, perhaps in the same manner they provide sovereign guarantees and insurance for other investment projects. In other words, default on any of the contracts insured with the IGCA would entail default with the IFIs behind it, and this may make it harder to default. On the downside, the relevant IFIs may be required to devote part of their sovereign guarantee capacity to this.

Another major risk of the IGCA maybe the possibility of default by a party. This does not have to be only a supplier (in case for instance of increased prices), but could also be the buyer (in case of suddenly decreased prices), who may not be interested in a contract at some prices that may now be considered too high. In such a case the seller would be losing a portion of the value of the contract due to the decrease in price. Given that the IGCA would be an extended arrangement among viable commodity clearing houses, it could compensate the seller by the difference in the original and current value of the contract insured through the relevant exchange or clearing house.

An essential element then of the proposed IGCA is the internationalization and linkage of commodity exchanges. This implies that the additional performance guarantees that are envisioned here can be obtained if two conditions exist. First appropriate exchanges must exist in different geographic locations around the world. Such locations should most likely be near the major production areas for the commodity in question. Second most importers of the food commodity would hedge their subsequent purchases in such exchanges. This can become part of most food importers trading practices, and it probably is already a practice by many importers. The existence of more exchanges would probably reduce the basis risks and hence make trade more efficient.

Clearly this idea needs more thinking and analysis as there are many details that need to be elaborated. This could be done by a group of knowledgeable market analysts, but if implemented it could go some way to instill more confidence in global food commodity markets.

Market based approaches to managing market volatility

The idea of this approach is to utilize existing market instruments to anticipate food price spikes and insure against their adverse consequences. The major way to do this is via futures and options contracts or similar “over the counter” (OTC) instruments. The problem to dealt with is whether the use of organized or OTC futures and options markets can reduce the unpredictability of the food import bill, and at what cost.

Consider an agent who needs to plan imports of some basic food and desires to protect himself against a price spike. By buying a futures contract or a call option contract (namely the right to

purchase at a future date an amount of the commodity at a prespecified strike price), the agent hedges the risk of a price spike, by locking in a maximum price for the subsequent transaction. When the subsequent transaction in the cash market is executed, the agent can lift the hedge by executing an opposite transaction in the futures or option market (namely sell the futures contract or exercise the option contract if prices have moved above the strike price), so as to counteract any price variation that was not anticipated at the time of planning³. While, on average this type of hedge will not make or lose money, there will be a significant reduction in the conditional volatility of both price and subsequent purchases. The major advantage to the hedger is that the subsequent price for the transaction is known much better than if the agent waited until the time the supplies need to be ordered. In other words predictability is enhanced.

Sarris, Conforti and Prakash (2011) as well as Dana, Gilbert and Shim (2006) have examined in detail cases of food importers using futures and options in organized markets and have shown that indeed there are substantial reductions in unpredictability.

A drawback of using these types of instruments in a developing country context is that credit requirements arising from the need to manage on a daily basis the exchange margin calls (in the case of futures), may run up against credit constraints. Another drawback is that if the futures market moves in an opposite direction from the one that the hedge anticipated, the agent (which could be a government agency) may have to lose money, which may be unacceptable to the financing authorities. Call options lessen these problems as they basically act as price insurance, by allowing an agent to lock a maximum price for subsequent imports. The cost is that on average the reduction in unpredictability is smaller than when futures are utilized (Sarris, et. al. 2011). On the other hand options are more flexible and with known ex-ante costs. They are also less costly than physical stocks.

Compensatory finance systems

These systems arose in the 1970s and 1980s from the need to assist developing commodity exporting countries to deal with sudden drops in export commodity prices. The main ones that have been instituted are the IMF Compensatory Financing Facility (CFF), and the European Union's STABEX, which was replaced by the FLEX.

The IMF's CFF (for more extensive recent discussions see Gilbert and Tabova, 2011, and Konandreas, 2011) was created in 1963 and the cereal import element was added in 1981, following the food crisis of 1973-75. Its primary purpose was to help IMF members cope with temporary export shortfalls and high cereal import costs which create balance of payments problems. IMF arrangements and conditionalities applied to such borrowing. The main benefit to the countries that used it was an additional IMF window. However, while the trigger for disbursements was tied to commodity prices, the schedule for repayments was not tied to export

³ The hedge will be affected by "basis risk", namely the imperfect correlation between the border price of the country where the agent operates, and the price at the exchange where the hedge is placed.

recovery or import cost declines. This tended to undermine its unique function. Strict eligibility requirements and costly financial terms led to it not being used very much by countries, and it was officially abolished in 2009. A smaller IMF scheme named the “Exogenous Shock Facility” (ESF) was established in 2006 to provide quick and easy access to concessional financing for low income countries facing exogenous shocks such as food commodity price spikes, natural disasters, or other exogenous crises. Conditionalities under this scheme are restricted to measures needed to adjust to the shock. The system is currently active.

The EU’s STABEX was active between 1975 and 2000 as part of the Conventions signed between the EU and its former colonies in the Asian Caribbean and Pacific (the ACP countries), many of which were dependent of commodities for the bulk of their external income. The idea was to compensate the governments of the ACP countries, on a grant basis, for export income shortfalls due to variations in export prices or export quantities. The funds were given, ex-post to the governments, which used them during early periods in a flexible way as balance of payments support, while later they were targeted mostly to the sector affected by the shock. The compensation was given for earnings shortfalls in individual commodities rather than a group of commodities. There were several shortcomings of the STABEX, such as delays in fund disbursements that tended to making them procyclical rather than countercyclical, its tendency to not stabilize export earnings, and others, that led the EU to replace the scheme in 2000 by the Fluctuations of Exports (FLEX) scheme. The FLEX had many of the principles of the STABEX, but was designed for faster disbursement, and triggers based on overall export income losses rather than on commodity specific losses.

The basic problem of all compensatory finance schemes is that they are of necessity backward looking, and hence slowly disbursing. This does not help with smoothing of the export income fluctuations. Food import bill variations have not been part of the STABEX or FLEX schemes, albeit the balance of payments and other impacts maybe similar. If, however, they were to be made part of the existing compensatory finance schemes they would be plagued by similar problems as the existing instruments. They have been viewed by most analysts as additional development assistance tools, rather than commodity risk management schemes.

Safety nets

The idea of a food related safety net is to have a system whereby sudden erosion of the capacity of food insecure households or countries to maintain food consumption, can be dealt with by rapid access to financial resources and food commodities targeted to those most vulnerable to food price spikes. Several developing countries have such quick reaction programs, and international assistance could help the affected countries keep the cost of such programs reasonably low in times of crisis. An example of such a global safety net program is the World Bank’s Global Food Crisis Response Program (GFCRP) that became operational in 2008. The program aims to reduce the negative impact of high food prices on the poor, help countries in the design of policies to

mitigate the adverse impacts of volatile food prices, and support food producers to enhance productivity and reduce vulnerability to future crises.

The GFRP envisages policy instruments to reduce consumer prices (such as food taxes and import tariffs), safety nets in the form of funds to provide cheap food to targeted poor, and financing and technical assistance to increase agricultural supply. Its major advantage is that it is quick disbursing. According to Gilbert and Tabova, as of January 2011, the GFCRP has approved 1443.6 million US\$ in projects and 75 percent of that has been disbursed. The facility, however has a fixed time limit and may end in 2011. The facility depends considerably on donor support, which has been substantial. The main issue with such programs is their sustainability in the future. The GFFR proposed above could be a way to enhance sustainability in a cost effective way.

8. What can the international community do to help developing countries to deal with continuing food market volatility?

The above discussion highlighted many facets of the global food market volatility problem and ways to deal with it. In this section we summarize the measures that seem most appropriate and cost effective, and which the international community could support to assist vulnerable countries to deal with food market volatility and price spikes.

8.1 Measures to lower the probability of food market upheavals

It must be realized at the outset that preventing food market price upheavals and spikes, or lowering their probability of occurrence, involves changing the fundamentals of the market. This can be done either directly, by for instance making the public sector take positions in the actual market, or giving incentives and information to the private sector to modify their positions and market strategies. From the review of what has been learned in the past, it seems that direct market interventions on a global scale to alter the fundamentals of the market via public stock holding policies are too costly and of doubtful success. Therefore, what is mentioned below relates to measures that would affect market incentives indirectly.

Support the establishment or enhancement of existing systems for the availability of national and global market information and monitoring.

As was discussed earlier a better information and market monitoring system, especially as it pertains to stockholding, government trade and market related policies, including short term policies, would go a long way towards preventing the build-up of expectations based on wrong signals, as well as unnecessary destabilizing short term private and public hoarding and speculative behavior.

Establish a global early warning system of impending food price spikes.

The basic role of such a system would be technical, namely to analyze and publish the best estimates of the probability of a price spike in the near future. This could be done by an appropriate and impartial team of analysts hosted in some international organization.

Provide technical assistance to vulnerable food dependent developing countries to analyze the food risks they face in the global food market system.

Such analysis could include both market and sectoral information on the different degrees of exposure of the country and vulnerable segments of the population to international food related risks. It could also provide policy options to deal with the relevant risks.

Revise the WTO rules to prevent export bans of basic food commodity products.

The ban of exports does not have to be done for all products, but only for some basic food staple commodities, such as wheat, maize, rice, etc. This could go a long way to instill confidence in the markets about sudden government actions that may destabilize the normal commercial flows of the commodity.

Revise the rules of existing organized commodity exchanges in developed countries to prevent excessive speculation

This has been called for by many analysts, as well as market participants, and could help prevent situations where the organized exchanges lose their relevance and connections to the physical commodity markets.

8.2 Proposals to help needy food importing developing countries to manage the impacts of a price spike

Many ideas were discussed in the body of the paper in this context, and below we indicate those that seem cost effective and most beneficial.

Create a fund for the establishment of an internationally coordinated “Global Financial Food Reserve” (or GFFR) of basic food commodities

The idea presented above would create a permanent market based global safety net geared to the needs of most vulnerable developing countries. As it would basically be a financial fund, that could conditionally be transformed into either physical commodities or extra financial resources, it would provide international safety net resources to deal with a spike in a timely fashion. Its cost would be small if it is managed actively and rolled over continuously.

Create a dedicated Food Import Financing Facility (FIFF) to increase trade finance for low income countries in times of food price spikes

This is one of the easiest to implement measures and one that can readily be accommodated by the International Financial Institutions (IFIs) as well as commercial banks. The FIFF could be

patterned along existing systems instituted by some food exporters like the US, and could be implemented by individual bilateral donors in case international agreement on it is not forthcoming. Given that it would finance only excess import costs due to a food price spike, and only for some vulnerable countries, its cost would be modest. Also it would not increase but by miniscule amounts the existing levels of public debt of donor countries.

Support the establishment of a physical emergency reserve of about 300,000 to 500,000 tonnes of basic grains

As elaborated earlier the purpose of these reserves would be to assure the smooth flow of humanitarian food related aid. The World Food Program (WFP) would manage this reserve and use it solely for humanitarian and emergency response.

Assist food importing developing countries to develop market based strategies to manage the risks of their food imports.

Developing countries can go a long way in managing the risks of their food import needs by engaging in market based risk management strategies. However, they lack the expertise, and also may face credit and other financial constraints in dealing with the institutions that are available. This offers considerable opportunity for developed countries to assist them in this technically and financially demanding area. Apart from technical assistance, developed countries could offer to share part of the cost of engaging in modern risk management strategies, as a way of facilitating adoption.

Promote the organization of appropriate commodity exchanges in developing countries

The use of market based risk management strategies by developing countries would be facilitated considerably if appropriate commodity exchanges existed in several geographic locations, closer to developing country markets, so as to lessen the basis risk for many food importing poor countries. Such exchanges can promote market development and also facilitate the linkage of developing country markets with those of more developed markets.

Promote the establishment of international standardized commodity contracts in basic food commodities

As discussed earlier, such contracts would enhance confidence in the international performance of cross border contracts.

Promote the linkage of various country commodity exchanges or the establishment of an International Grain Clearing Arrangement (IGCA).

This new institution would be designed to substitute for the non-existence of a single organized commodity exchange that operates internationally and with international contracts. Its purpose would be to ensure the physical delivery on import contracts across borders.

Promote the creation of permanent global safety nets relating to food price spikes

As was seen earlier, considerable funds were committed to developing countries in the three year period following the food crisis. However, these funds, useful as they have been are not scheduled to continue. This will leave the countries most vulnerable to food price shocks vulnerable to the continuing gyrations of the international food markets. What is needed are safety nets that act as insurance against global food price spikes. What was suggested above in the form of a GFFR is a case in point, but other country based safety nets could be considered.

9. Concluding remarks

The problem of food market volatility and intermittent crises and price spikes, does not seem likely to go away in the future, and in fact appears likely to become more acute. The most vulnerable countries are those who normally have little part in creating the food crisis. If growth opportunities of these countries are not to be stalled by occasional food crises, the international community must provide appropriate systems to prevent or manage the spikes. The paper has reviewed several facets of the global food market volatility problem, and the proposals that have been made to deal with it, and has made proposals for what maybe deemed as most cost effective and appropriate policy measures.

The first major conclusion is that the major problem that creates undue market volatility and price spikes is excessive unpredictability of the market. When the degree of unpredictability or uncertainty about the market outcomes becomes large, market agents (both public and private) tend to overreact to underlying information, and take destabilizing actions to hedge possible information gaps. In such cases the markets tend to fail, and prices tend to spike. It is these market outcomes, which are rather infrequent, that need to be prevented or controlled.

It was seen that food price spikes are possible to define and monitor, and even estimate their probability of occurrence. Hence, it seems that there can be an empirical base on the basis of which the international community can base action.

It was argued that direct interventions to prevent price spikes via market manipulation, for instance in the form of physical or virtual stocks, are expensive and of doubtful value, but also unnecessary, as they may not tackle the vulnerability of the poorest food importers. There are several indirect ways to affect the behavior of market participants, such as better information, an early warning system, and WTO rules to prevent export bans, which could go some way to instill more predictability and hence market confidence. It is these that should receive emphasis and resources by the international community.

It appears that there are several ways to manage (rather than prevent) market volatility and spikes for the benefit of low-income food importing countries, and there have been several proposals along these lines. The paper has reviewed all these proposals and made some new ones. The ones that seem most cost effective and least distorting of international markets are those that are

market based. Among those, utilizing existing systems of commodity risk management, such as futures and options is the easiest, and could be enhanced by the support of new exchanges in developing countries as well as technical assistance on how to exploit the various instruments available.

A new proposal for a new system of a Global Financial Food Reserve (GFFR) was made, in the form of a fund to finance long positions or food commodities in organized exchanges. Such a fund could constitute a dormant virtual physical reserve that could generate physical and financial resources in times of a spike, so as to benefit highly negatively affected developing countries. In other words the GFFR would be a market based global safety net. Apart from the GFFR, the proposal for a Food Import Financing Facility (FIFF) was also deemed cost effective and an appropriate mechanism to ensure the continuous flow of food imports in times of a spike.

It was seen that there are ways to guarantee the performance of international food import contracts, through the promotion of standardized international food contracts in existing international commodity exchanges or the linking of existing exchanges and their clearing houses, through an International Grain Clearing Arrangement (IGCA). These could be explored further with the collaboration of existing exchanges.

The final set of measures that could be taken involve global safety nets. The GFFR proposed in the paper is one form of such a global safety net, and a physical emergency reserve to smooth out flows of food aid is another. However, others in the form of permanent funds or technical assistance to help needy countries maintain their local food safety nets can also be envisioned.

In summary it appears that there are quite a few cost effective and non-distorting measures and options to lower the probability of food price spikes, and help food importing low-income developing countries to manage the attendant risks. Given that food security is of paramount concern to all countries, especially those that are at low levels of food intake, it appears that the international community has a major role to play in ensuring global food security in a world of growing uncertainty.

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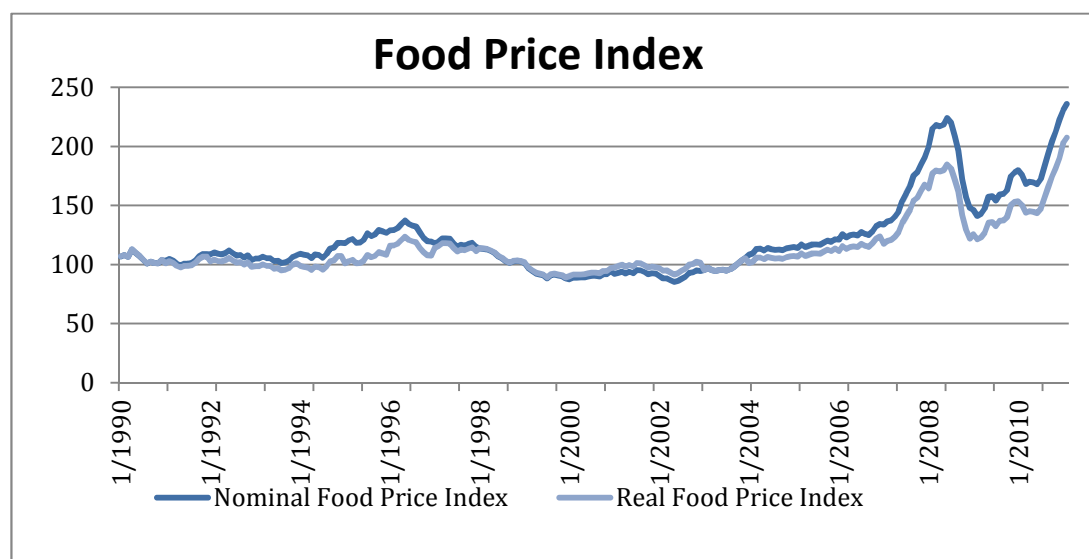
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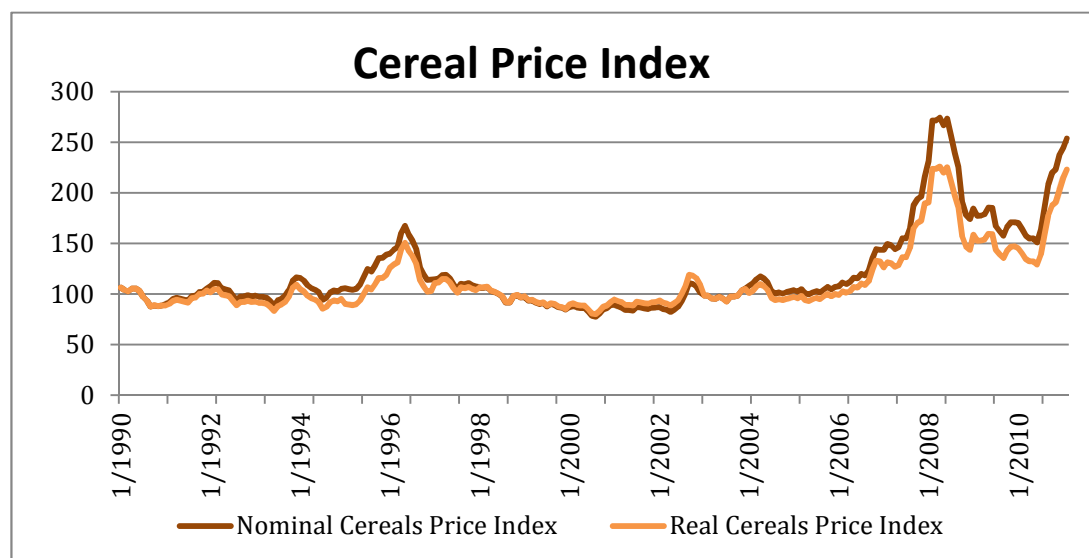
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Figure 1. Nominal and real FAO food commodity price index 1990-1 to 2011-2



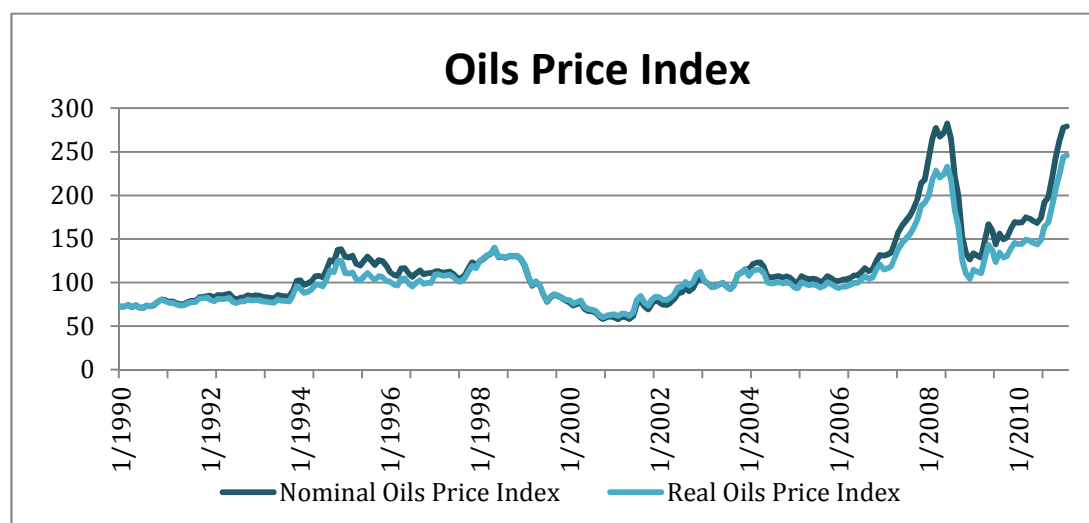
Source: FAO Markets and Trade Division

Figure 2. Nominal and real FAO cereal price index 1990-1 to 2011-2



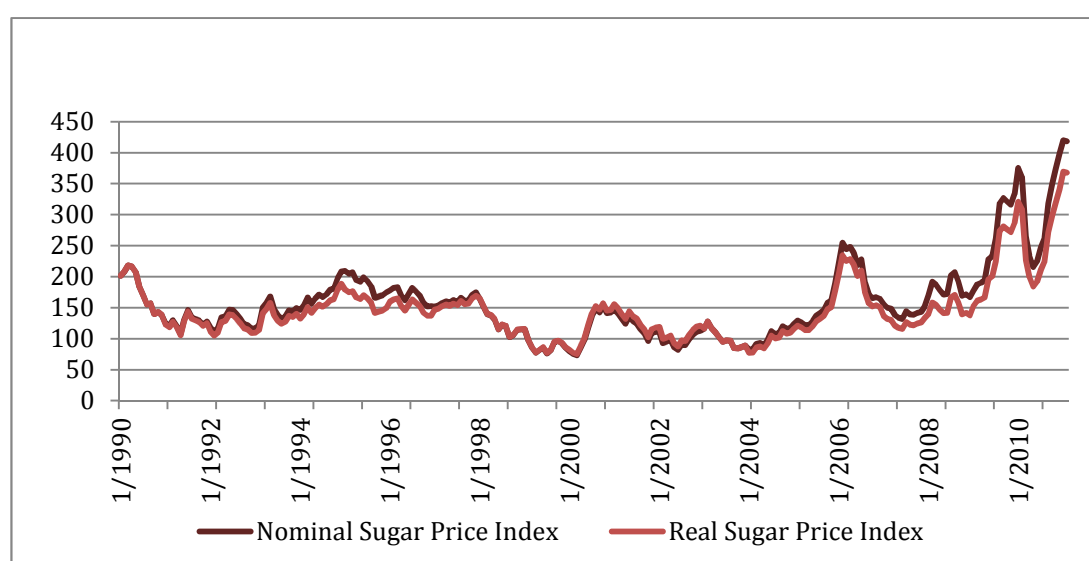
Source: FAO Markets and Trade Division

Figure 3. Nominal and real FAO vegetable oils price index 1990-1 to 2011-2



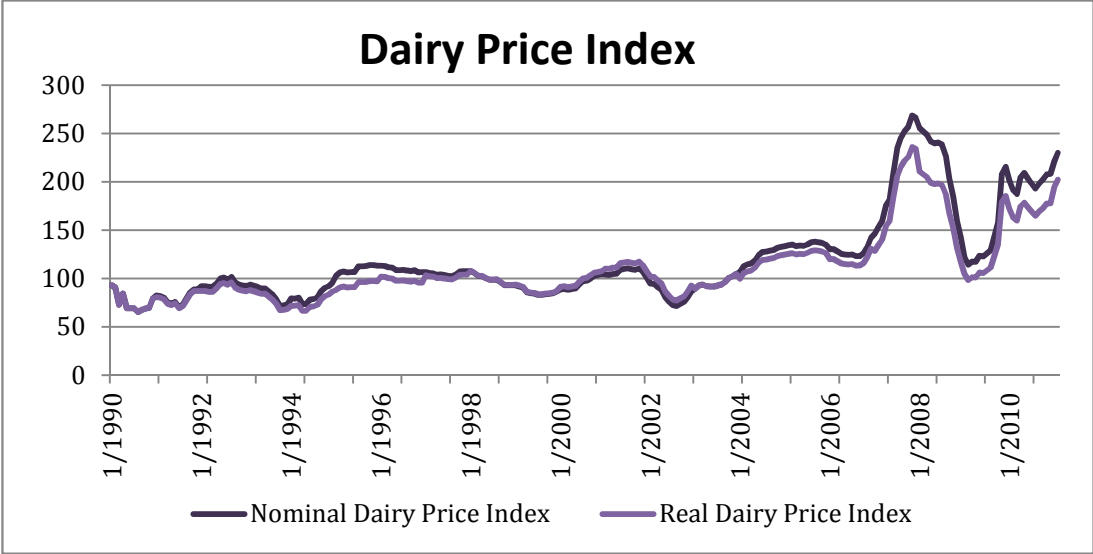
Source: FAO Markets and Trade Division

Figure 4. Nominal and real FAO sugar price index 1990-1 to 2011-2



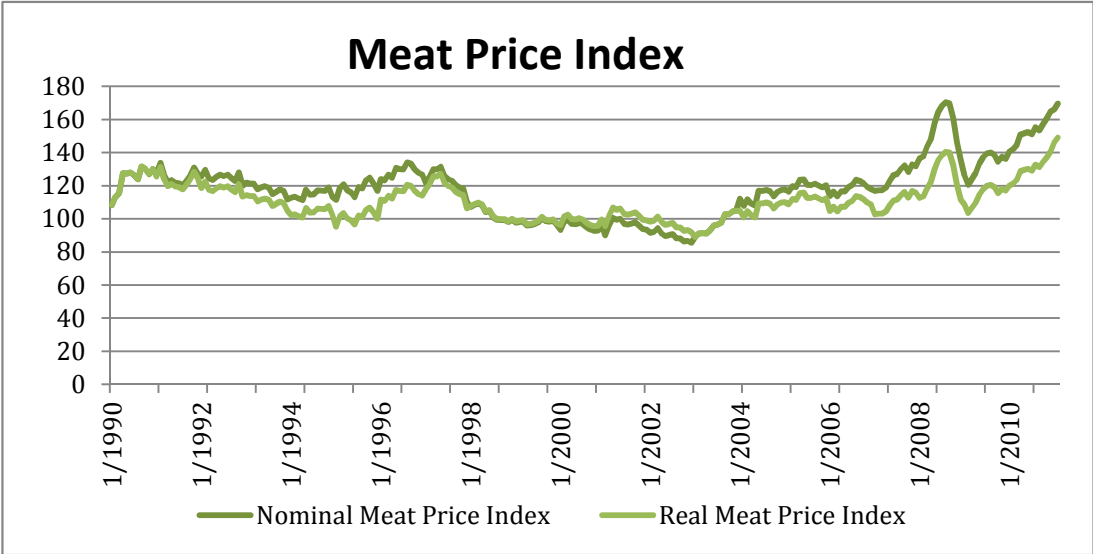
Source: FAO Markets and Trade Division

Figure 5. Nominal and real FAO dairy price index 1990-1 to 2011-2



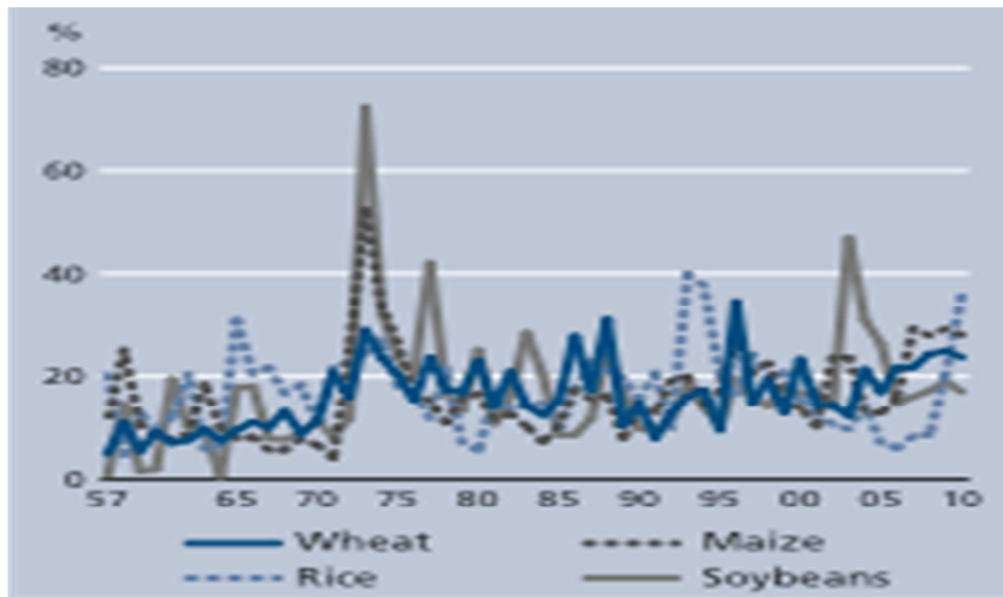
Source. FAO Markets and Trade Division

Figure 6. Nominal and real FAO meat price index 1990-1 to 2011-2



Source. FAO Markets and Trade Division

Figure 7. Annualized real historic volatility of cereals (1957-2010) based on international market price data compiled by FAO.



Source. Prakash (2011)

Figure 8. Implied volatilities of cereal prices in the Chicago Mercantile Exchange (CME) (1987-2010)



Source. Prakash (2011)

Figure 9. "Risk layers" of market prices

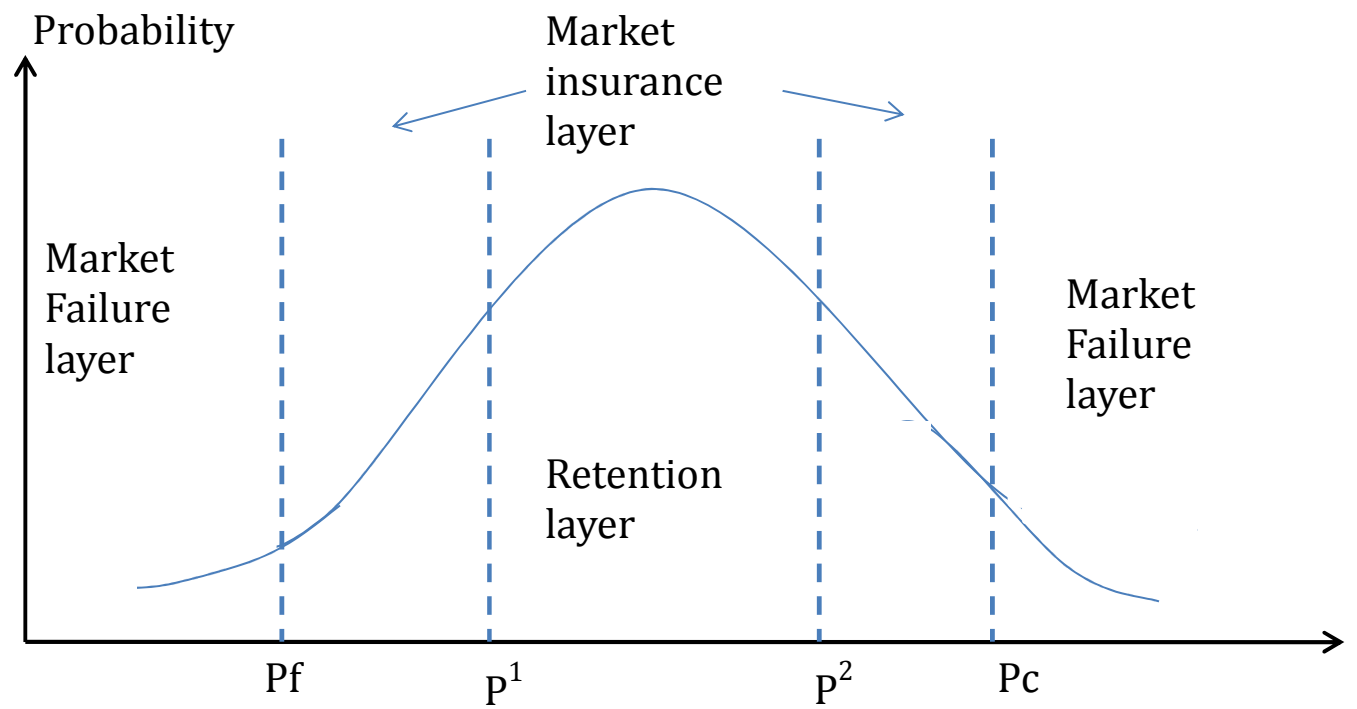


Figure 10. Defining price spikes

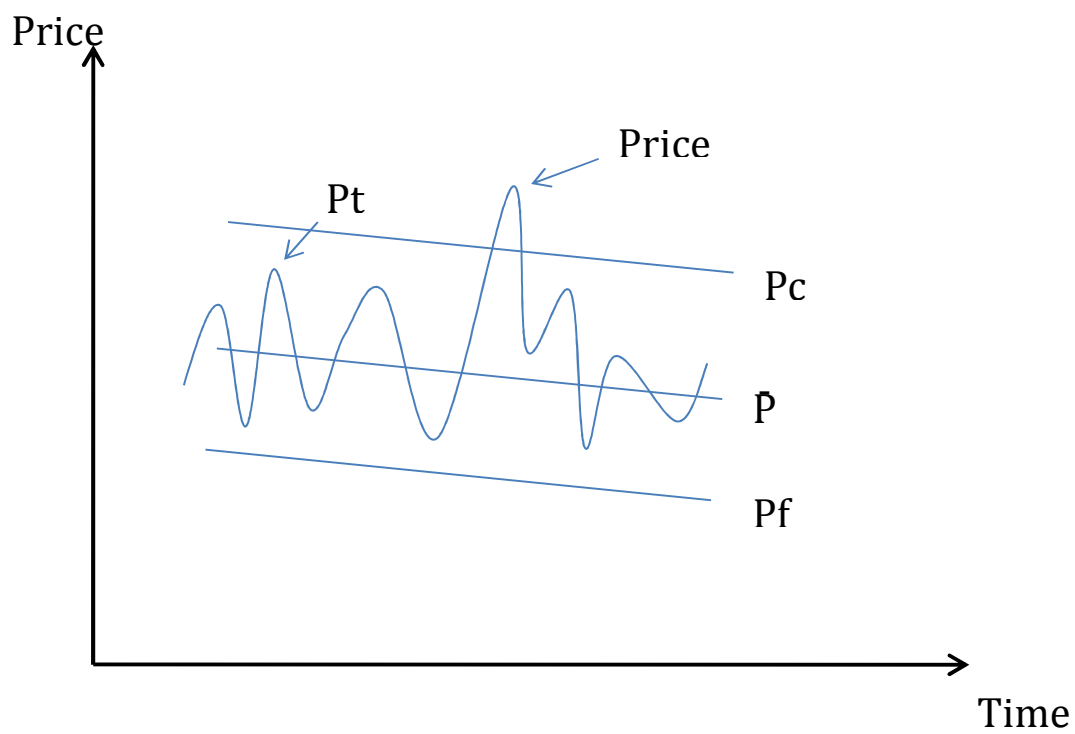


Table 1. Cereal import dependence 2007-9 (number of countries with percentage share of imports to total domestic supply in given range)

	0-10	10-20	20-50	50-75	75-100	Total No of countries in group
HIC	5		3	6	22	36
LDC	16	6	12	9	6	49
LIC	18	6	16	8	1	49
MIC	16	6	28	14	20	84
OIL EXPORTERS	3	1	6	1	4	15
SIDS		1	4	6	31	42
Total No of countries	58	20	69	44	84	275

HIC-High income countries, MIC-middle income countries, LIC-low income countries,(World Bank definitions), SIDS=small island developing states, LDC-least developed countries (UN definitions). Some countries in the LDC, Oil exporter and SIDS groups are included in the other categories as well.

Source. Author's computations from FAO data.

“Sur quoi la fondera-t-il l’économie du monde qu’il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l’ignore.”

Pascal



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Contact

www.ferdi.fr

contact@ferdi.fr

+33 (0)4 73 17 75 30