

# **THE FOOD PRICE CRISIS OF 2007/2008:**

## **EVIDENCE AND IMPLICATIONS<sup>1</sup>**

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## **1. Introduction**

The food price crisis of 2007/2008 triggered widespread concern over the volatility experienced in agricultural commodity prices, and perhaps more worrisome, concerns that the world had entered a new grain market regime in which such volatility will persist unless strong policy measures are adopted. Several reports claim that grain prices have been drastically inflated by manipulative financial speculation. The fear is that such trading has undermined the price-smoothing capacity of agricultural futures markets, and increased the price risks encountered by consumers, producers and governments. Consumers in many developing countries, alarmed by increases in the cost of their staple foods, demanded policy responses from their political leaders.

The FAO Secretariat's contribution to defining the objectives and possible decisions of the World Summit on Food Security of November 2009 proclaims the need "to address the issue of speculation in agricultural markets given the serious implications it can have for world food security." They note that "some studies suggest that speculation in food markets played a certain role in the increasing level and volatility of world food prices in 2007-2008" and call upon the World Bank, the IMF, UNCTAD, FAO and other relevant intergovernmental organizations "to conduct in-depth and comprehensive studies to analyze the causal links between speculation and agricultural commodity price movements, with a view to fostering a coherent and effective policy response in the context of food security." The 2009 UNCTAD Trade and Development Report (p. IV) has stated that "Recognizing the lack of economic logic of these [financial and commodity] markets is key to understanding the roots of the current crisis, and should be the basis for further policies and reforms aimed at stabilizing the financial system."

Are we witnessing the beginning of a new regime characterized by more volatile, if not higher, commodity prices? Is the recent turmoil in prices an aberration, involving emergence of new, irrational bubbles, unconnected to market fundamentals? Is it the fruit of purposeful manipulation by global financial forces moving on to disrupt agricultural commodity markets after contributing to a financial bubble that wreaked havoc in the international macro economy? Has a lack of regulation of futures and options markets, and/or global international financial

flows contributed to the emergence of this new era of market chaos? How significant is the role of expansion of biofuels supply in destabilizing grain markets?

The answers to many of these questions could have important policy implications. Unfortunately, answers are difficult to find, given the state of the art in modeling commodity and financial markets. For the major grains, wheat, maize and rice, which are so important in feeding the population of the world, progress can be made by examining the available market data at an aggregate level.

The question we ask in this paper is whether the recent price spikes appear to be qualitatively different from previous episodes observed over the past four decades. Are they new phenomena indicative of a new market regime? Or are they consistent with the operation of commodity of inter-grain substitution in use for food and feed, and of storage as intertemporal arbitrage, as reflected in market movements over the past several decades?

This paper addresses this issue as a necessary first step in evaluating the merits of “corrective” actions being discussed regarding policies affecting futures markets, agricultural markets, and the markets for inputs.

It seems particularly appropriate to discuss this topic at this conference. The arguments hinge crucially on the reliability of the data available to us, and on their interpretation. We hope to elicit useful responses and guidance from this uniquely qualified audience on these difficult issues.

## **2. The price behavior of the major grains.**

Consider first the recent price behavior in the markets for the major grains. Figures 1 through 3 show the price histories of the three major grains wheat, maize and rice, in United States dollars deflated by the Consumer Price Index.

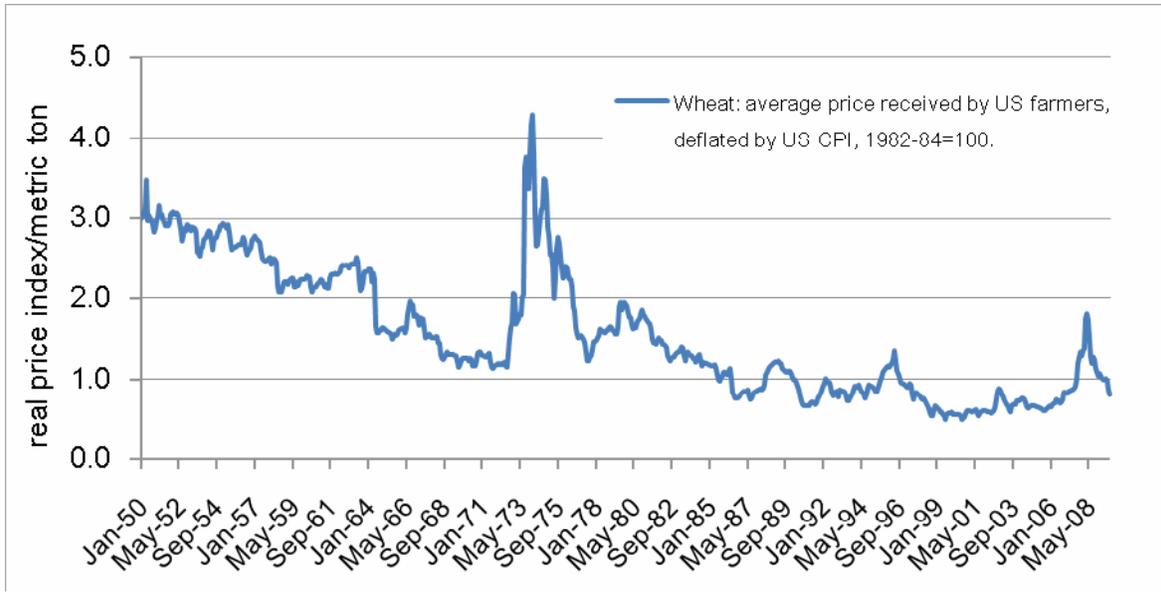


Figure 1.

Wheat, average price received by US farmers in dollars per metric ton deflated by U.S. CPI  
(1982-84=100).<sup>2</sup>

Source: USDA Wheat Yearbook.

<sup>2</sup> The original wheat price data is measured in dollars per bushel, which is then converted to dollars per metric ton based on 1 Mt equals 36.74 bushels for wheat.

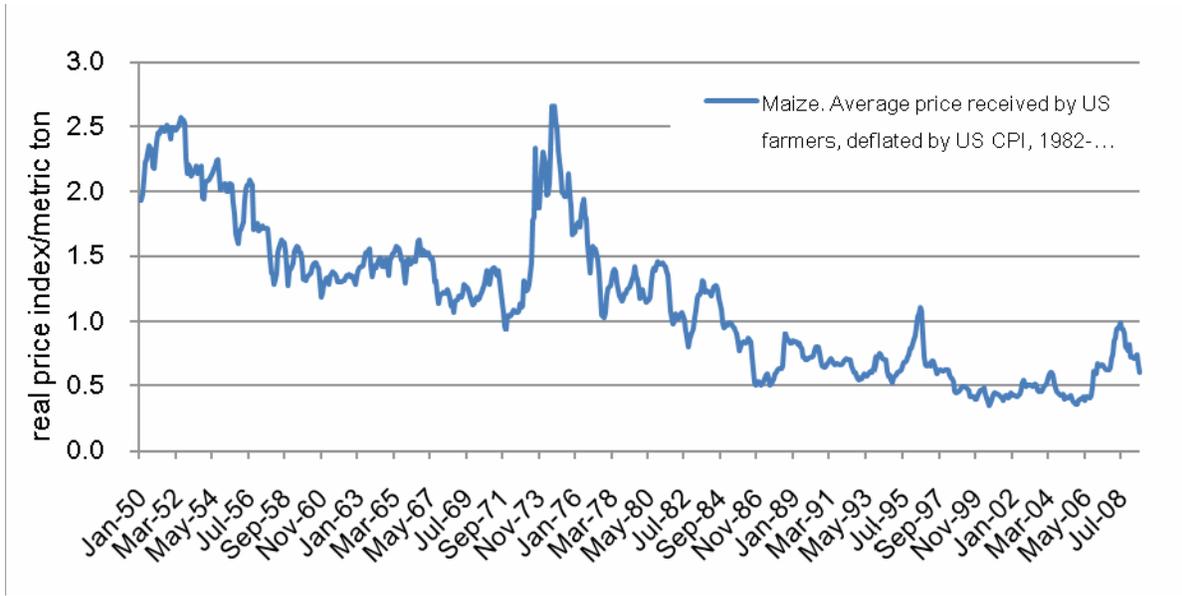


Figure 2.

Maize, average price received by US farmers in dollars per metric ton deflated by U.S. CPI (1982-84=100).<sup>3</sup>

Source: USDA Feed Grain Database.

<sup>3</sup> The original maize price data is measured in dollars per bushel, which is then converted to dollars per metric ton based on 1 Mt equals 39.37 bushels for maize.

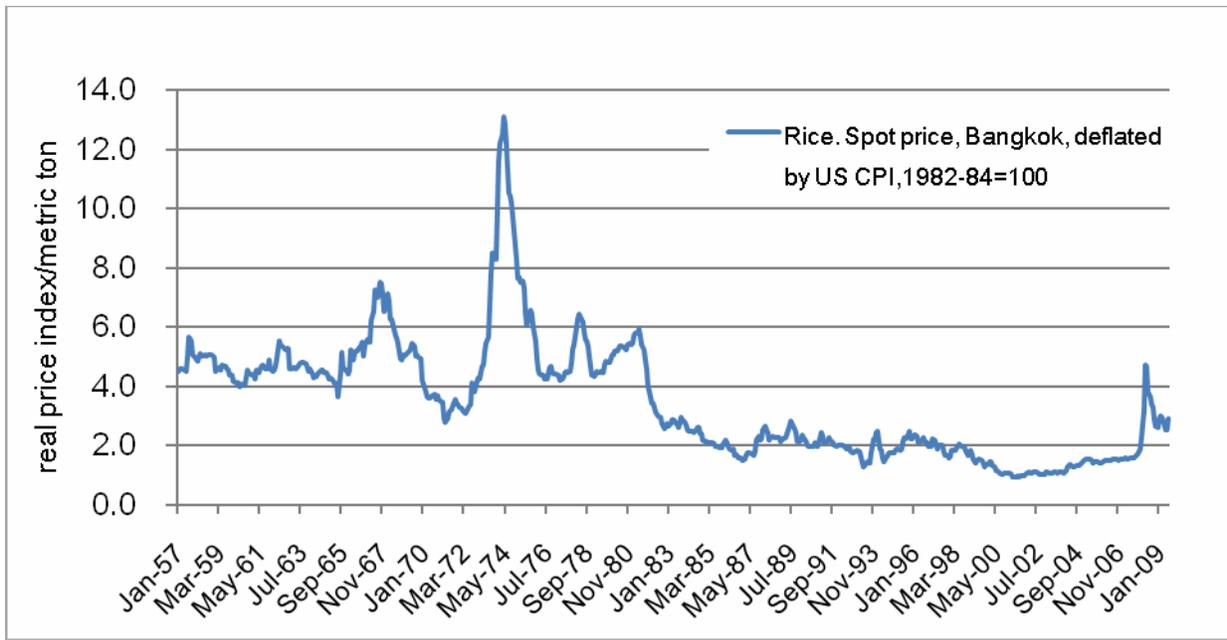


Figure 3.

Rice spot price, Bangkok, deflated by US CPI (1982-84=100).

Source: Global Financial Data.

In each case the price shows a notable downward trend, and fluctuations usually within a fairly narrow range. This downward trend is no doubt related to the remarkable success of plant breeders and farmers in generating crop yields that outpaced the demand shifts generated by worldwide income increases and by population growth in the third world.

Occasional steep spikes in price followed by equally precipitous falls are another prominent feature of the data. It is clear that when price is locally high it is also highly volatile, and when price is low it is also more stable. Figure 4 shows the prices of these three grains along with the prices of soybeans, crude oil and all food, from January 1970. It is clear that all of these commodities had very sharp price increases in the period between 1973 and 1975, and between 2007 and 2008 spikes again occurred in the price of each of these commodities.

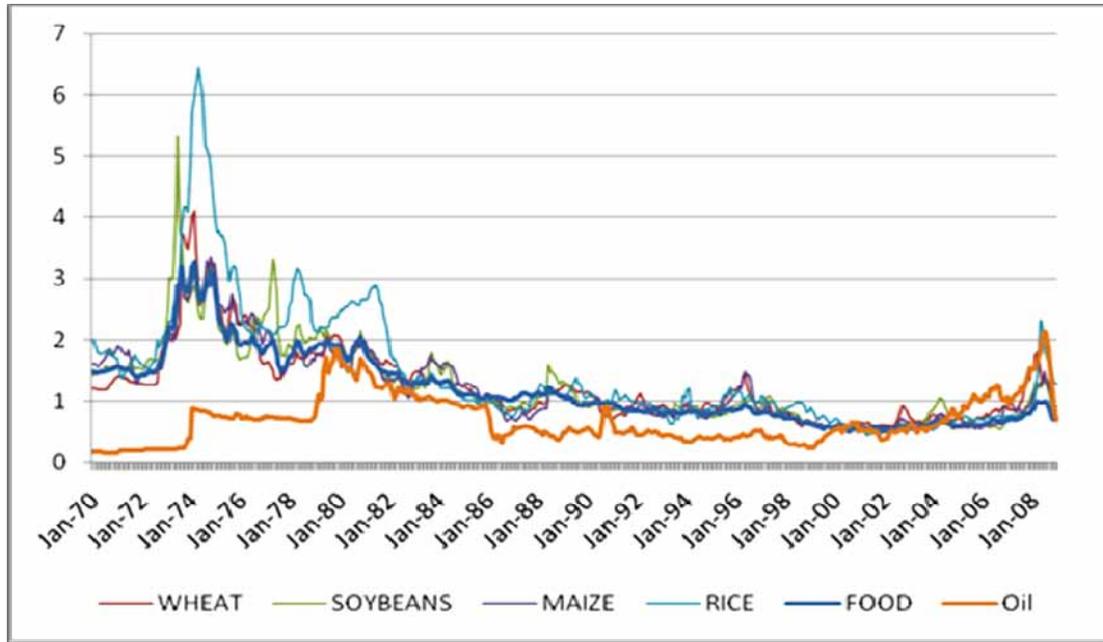


Figure 4.

Long run movements of prices

IMF Commodity price indexes deflated by the U.S. CPI

Some observers saw in the recent history of prices a recurrence of the events of the early 1970s. However figure 4 shows that the recent episode of price spikes was far less dramatic in real terms than the episode in the 1970s. Moreover, as others noted, the international economic situation in the last few years has been very different from that of the 1970s. Many market participants and observers have identified huge international financial flows, low interest rates and the recent creation of a bewildering array of markets in financial derivatives as new and powerful sources of market volatility, which they claim must be controlled by new regulations on financial and commodity markets.

An important question, then, is whether the international grain markets are behaving in ways recognizable from a history of the last four decades. Or have these markets entered a new and more volatile regime and require new and different regulations or other interventions to prevent a continuation of the kind of chaos we have seen of the last several years?

### **3. Consumption, stocks and their responses to price.**

Focusing on the world market as a whole, it is important to understand that storage activity is asymmetric. When an abundant supply is on hand after a good harvest, excess supplies can always be placed in storage to be consumed in later years. A subsequent shortfall in production or shock to demand can be cushioned by drawing down the accumulated stocks to maintain reasonable levels of consumption. However if current stocks are at minimal levels, a production shortfall must be accommodated by a corresponding adjustment in aggregate consumption.

For grains such as maize and to a lesser extent wheat that are used as feed for animals and for food for humans, it has generally been true that most of the adjustment to negative shocks is made in the consumption of animal feed, which entails the short run benefit of a surge in supply of meat to consumers. If the shortfall cannot be met by adjustments in non-food uses, consumers must be forced by increased price to absorb the shortfall by reducing their own consumption. Rich and middle-class consumers typically make little or no adjustment, absorbing the price shock by reducing their savings or adjusting their consumption of less necessary goods. So the burden falls on consumers who are poor. They attempt desperately to cover the increased cost of their normal diet by adjusting their savings or nonessential consumption, so a large increase in price is needed to achieve a relatively small reduction in their consumption.

At the aggregate level, the relation between the available supply and price has been difficult to model and to estimate, due to challenges in accurately measuring consumption and its response to price variations. However substantial progress has been made in estimating the price response even when adequate data distinguishing consumption and stocks are not available.<sup>4</sup> The results indicate that at very high prices, when stocks are minimal, the consumption response to price is very inelastic. Although the data on global stocks are notoriously unreliable, the available information is nevertheless informative about interpreting recent market events in the context of the history of the last four decades. Figures 5 through 7 show stocks to use ratios for wheat, maize and rice.

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<sup>4</sup> See Cafiero et al., (forthcoming).

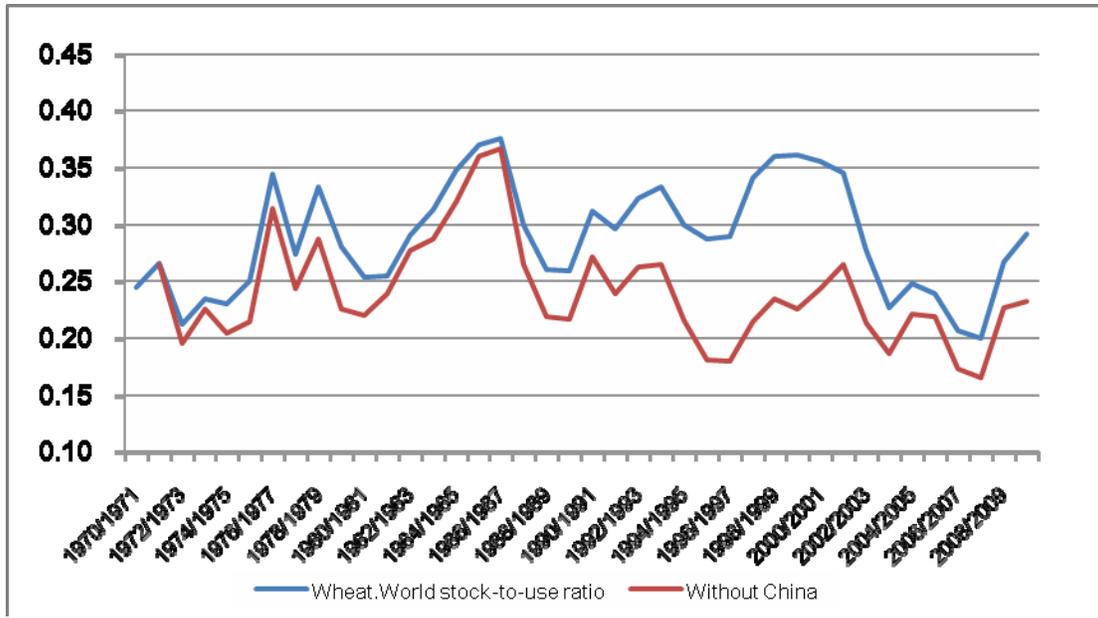


Figure 5.

World wheat stock-to-use ratios.

(Source: USDA Foreign Agricultural Service – Production Supply and Distribution)

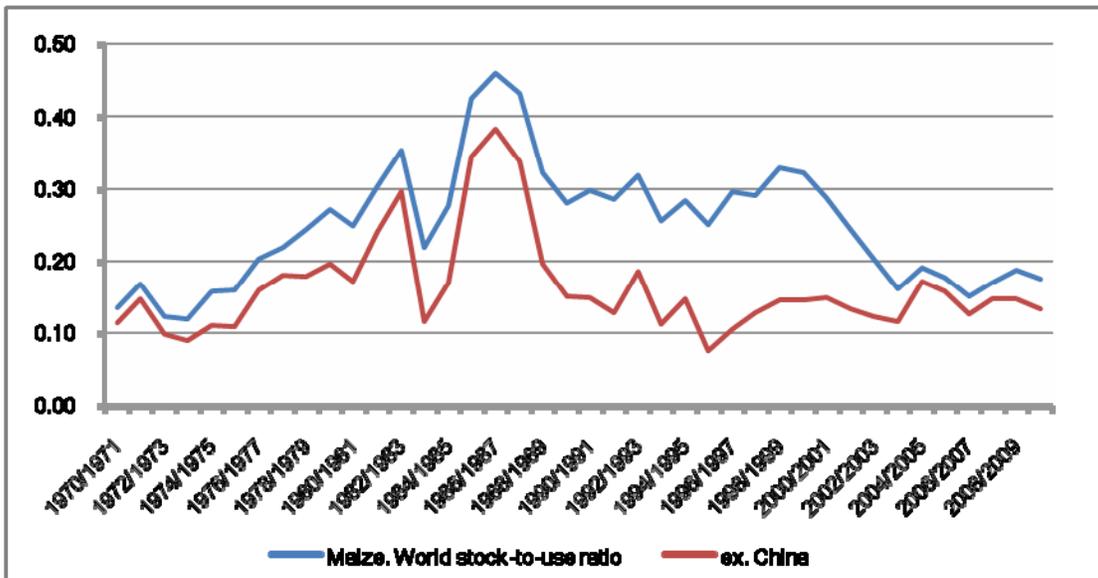


Figure 6.

World maize stock-to-use ratios.

(Source: USDA Foreign Agricultural Service – Production Supply and Distribution)

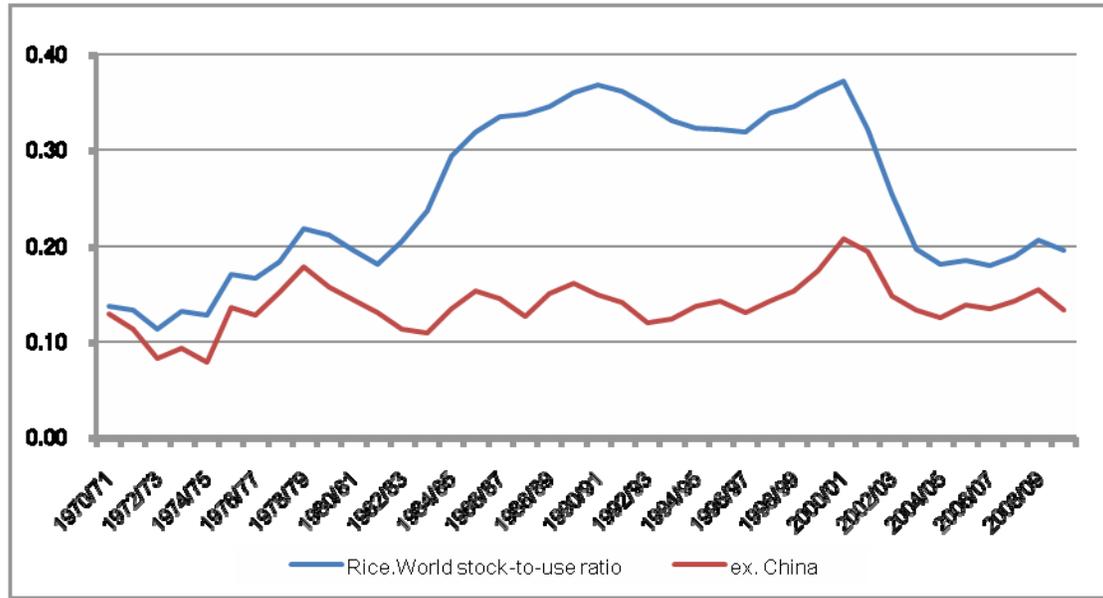


Figure 7.

World rice stock-to-use ratios.

(Source: USDA Foreign Agricultural Service – Production Supply and Distribution)

The ratios are reported for the global market, and for the market excluding China. Chinese policies have in some periods, for example the 1990s, meant that China's grain economy has been essentially independent of the rest of the world, and stocks have been difficult to measure and verify. Note that, excluding China, the minimum ratio of stocks to use appears to be similar in different decades, with the exception of rice, for which the reported 1972-1974 ratio is a low outlier. This reflects the fact that operation of a grain market entails use of a virtually irreducible minimal level of stocks is necessary for the efficient operation of transport, marketing and processing of grains. For maize the minimum reported ratio was in 1995/1996, while for wheat it occurred in 2007/08, when rice stocks were only moderately low.

The demands for the three major grains are not independent, because each is an important supplier of calories for food and feed uses. On the other hand it is obvious to any consumer that they are not on average perfect substitutes. However, their price series are highly correlated. We

aggregate the calories in the three major grains and examine them as if calories were traded on one unitary global market.<sup>5</sup>

The World and China total consumption and ending stocks data we use are from USDA PSD Online. In order to conduct the conversion, calorie data from the USDA National Nutrient Database are used. Losses in calories between the harvest and the consumer are ignored. For meaningful inferences the crucial assumptions are that food loss ratios are roughly the same for wheat, maize and rice, and do not vary too much over time.

The result is presented in Figure 8 below:

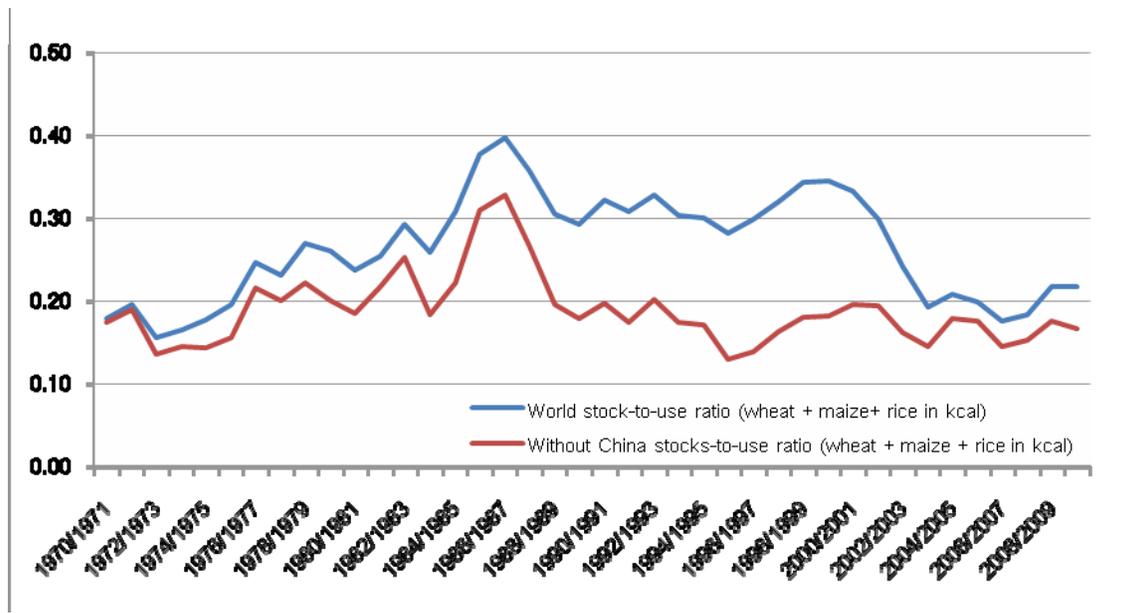


Figure 8.

World stock-to-use ratios for calories from wheat, maize and rice

Note that aggregate stocks were very low in the early 1970s, and similarly low in 1996/1997, 2002/2003, and 2007/2008. These are indeed the epochs with lowest aggregate reported stocks since 1960. It is clear that the minimal aggregate stocks to use ratio is around 12 to 14%.

<sup>5</sup> Roberts and Schlenker (2009) also address the global market for calories from grains, but they include calories from soybeans.

Next we construct a price index for calories. The price is United States dollars per metric ton. Wheat price is for all wheat, US, average from USDA. Rice price is for Thai, 5% broken, fob. Bangkok. Maize price is average cash price of Maize No. 2 Yellow. For each grain, we can roughly estimate the content of calories per metric ton using data from US National Nutrient Database. Dividing the observed price by the amount of calories per metric ton, we can obtain the price of calories as dollars/kcal contained in wheat, maize and rice, respectively. The prices of calories from each grain are presented in Figure 9 below:

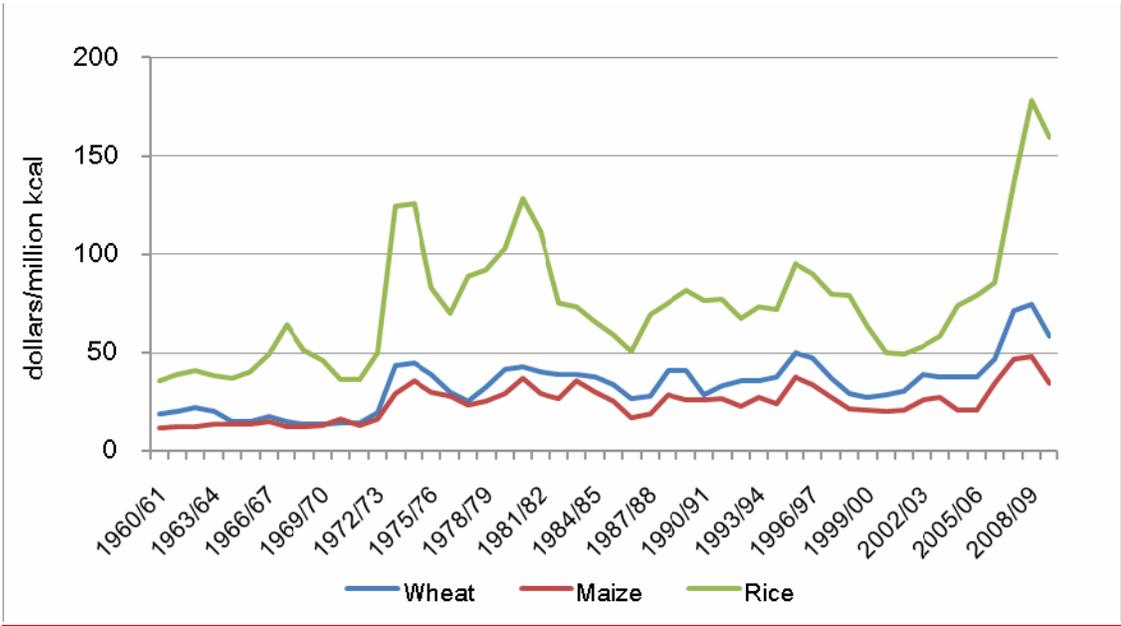


Figure 9.

Price of calories from wheat, rice and maize

Calorie data are also used to convert export measured in metric tons into calories. Share of calorie consumption of each grain out of the total calorie consumption is used as weight. Note the very close relationship between the maize and wheat prices per calorie, and the strong co-movement of the rice price, at a higher level.

To get an aggregate real price index for calories from 3 grains, we weight the share of each grain by its current aggregate consumption, and deflate by the United States Consumer Price Index.<sup>6</sup> Figure 10 combines the plot of the stocks to use ratio for calories with the plot of the aggregate calorie price index, both excluding data for China.

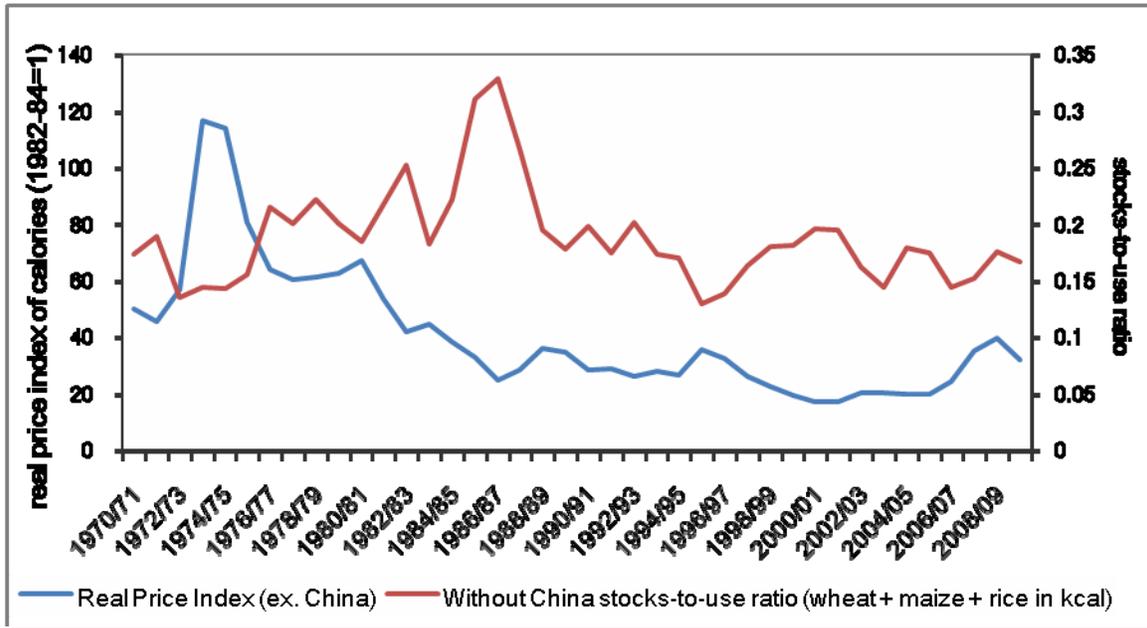


Figure 10.  
World grain calorie prices and stock-to-use ratios

<sup>6</sup> When export share is used as weight, the two price indices are almost indistinguishable.

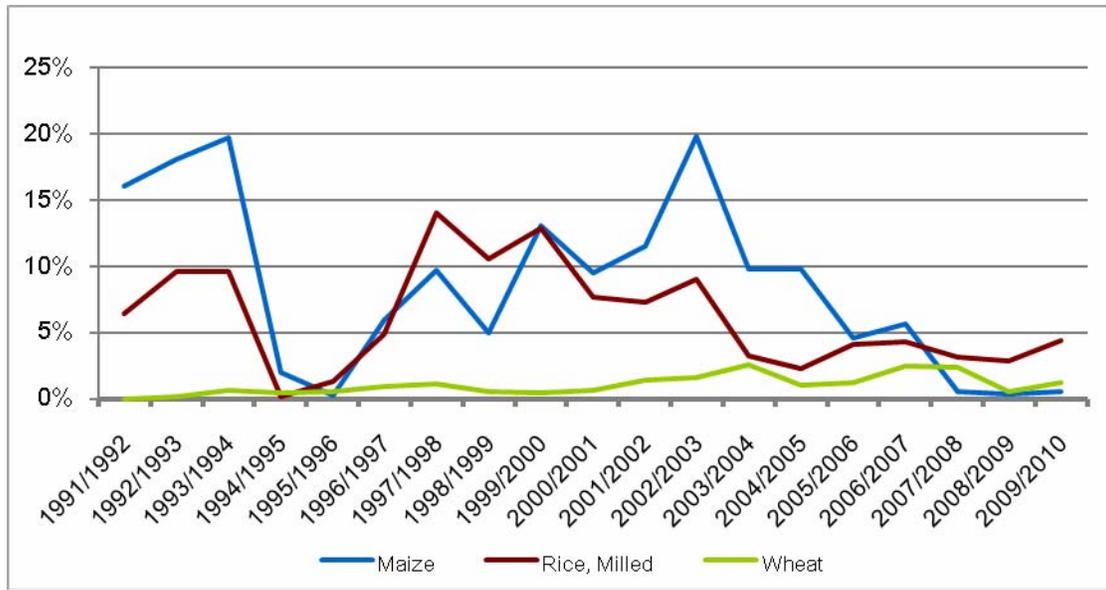


Figure 11.

China's cereal export shares.

(Source: USDA Foreign Agricultural Service – Production Supply and Distribution)

Note that the periods when aggregate stocks are very low, the early 1970s, 1996/1997, and 2007/2008, are all years of sharp upward spikes in the price index from a generally decreasing trend. The exception is 2002/2003, and the reason is clear from Figures 8 and 11. Around that time China exported massive amounts of cereal stocks. In particular, as Figure 11 shows, China exported an unusually large amount of maize from its huge accumulated stocks, as well as a very substantial amount of wheat, cushioning the market in the rest of the world. It did not do this in any other of the high price periods mentioned above.

Readers might be surprised at the claim that 1996 was a high price year for aggregate calories from the major grains. A glance at figures 1 through 3 shows that the price of maize was actually higher in 1996 than any time more recently. The price of wheat was also high, though not quite as high as in early 2008.

The point of this discussion is that, in the last few decades, periods in which the stocks to use ratio was near its minimum have been associated with a high price of calories, with the exception

of one instance early in this decade when a price spike was prevented by unusually large exports from China. Given the recent low level of stocks of grain calories, the high price of aggregate calories is no surprise at all.

Note that this conclusion is sharply opposed to the argument that the price crisis was generated by speculators who entered grain markets with large amounts of cash, and caused prices to spike through their speculative activity.<sup>7</sup> To increase price, speculation must have reduced consumption, causing a move up the consumer demand curve. (In the short run production is fixed, and speculation certainly did not cause consumption demand to shift to the right. No one was claiming the problem was that consumers were eating more than usual due to speculation.) To reduce consumption, with production predetermined in the short run, speculation must have increased stocks beyond equilibrium levels. The difficulty with the argument is that stocks of aggregate calories were at minimum levels relative to use. In other words, the facts of the market are at odds with the argument that speculation was a major disruptive influence. In fact, the market appears to have reacted to a shortfall of aggregate grain calories much as it has done for at least the last four decades, including the last similar crisis in 1996, when there was no serious claim that speculation was a major disruptive element in need of tighter regulation.

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<sup>7</sup> Claims of speculative behavior are highly heterogeneous, and hence difficult to evaluate. For example, Caballero, Farhi and Gourinchas (2008) state that the crisis involving the crash of the real estate market “exacerbated the shortage of assets in the world economy, which triggered a partial recreation of the bubble in commodities and oil markets in particular.”

On the other hand, the 2009 UNCTAD Trade and Development Report states (p. IV):

It is true that deteriorating global economic prospects after September 2008 dampened demand for commodities; but the downturn in international commodity prices was first triggered by financial investors who started to unwind their relatively liquid positions in commodities when the value of other assets began to fall or became uncertain.

We further note that the quoted UNCTAD report (p. IV) apparently sees the above observation as evidence that “the signals emanating from commodity exchanges are getting to be less reliable as a basis for investment decisions and for supply and demand management by producers and consumers.”

Given that low aggregate stocks of calories have been a major factor in the price volatility of the last several years, it makes sense to focus on the reasons for the unexpectedly low level of stocks observed in 2007 and 2008. The next section briefly addresses this question.

#### **4. Why were aggregate stocks low in 2007/2008?**

The first point to note is that rice stocks were not unusually low in 2007/2008. Wheat production was lower than anticipated, due to an unprecedented extension of a severe Australian drought, and to production problems elsewhere. Maize production was high. However stocks were low (but not as low as observed in 1996 or in the early 1970s). One important reason is the large surge in diversion of maize to biofuels. United States plans to increase biofuels use were clear several years earlier, and no doubt influenced the decline in stocks and increase in prices starting early in the current decade. However revisions increasing the mandates, and a surge in petroleum prices that encouraged processors to exceed the mandates, were important, and at least partly unanticipated, negative shocks to supplies available for consumption or storage that were. Other shocks that helped run down global stocks were the unprecedented income surges in China and India, which fostered a rapid expansion in meat demand and in turn in the demand for maize (and a substitute in production, soybeans) as feed. To the extent that the extensions of these surges were unexpected, they caused unanticipated reductions in supplies available to consumers, causing prices to spike high enough to reduce consumption sufficiently to meet the shortfall that remained after accessible stocks had been depleted.

Ironically, the largest relative price surge was in the grain least subjected to recent shocks in production or demand, and the least involved in futures and options trading. Rice harvests were not unusually small, in aggregate. Rice demand is also least affected by increased income, as it has a low income elasticity as a food, and is not used significantly as a feed for animals. The shock to demand for rice was largely generated by demand to make up shortfalls in wheat available to consumers. Important factors in this wheat shortage include low harvests and substitution of wheat for maize diverted from animal feed to biofuels in the United States. As

discussed elsewhere, (Wright, 2009) the subsequent surge in the price of rice was exacerbated by a panic among exporter governments which progressively reduced access to rice export markets in 2007/2008, initiated by the announcement by India in October 2007 of an export ban, as part of a plan to increase domestic rice consumption to make up for a disappointing wheat harvest. Panic meant the meager global calorie stocks were not be efficiently allocated to those most in need

## **Conclusion**

The grain price spikes of the 2007/2008 are not unusual, if viewed in the context of the history of grain prices over the last several decades. Indeed, excluding the role of China in world cereal exports, the behavior of calorie prices for maize, rice and wheat during 2007/2008 are not qualitatively different from those of the early 1970's and 1996/1997: the upwards price spikes occurred systematically in periods of unusually low levels of aggregate stocks. The data show no evidence of a new market regime or of perverse effects from international financial speculation. Trends in demand due to income effects from China and India, and from biofuel mandates exacerbated by price increases in petroleum prices all have their part in explaining low stocks during 2007/2008. Consistent with recent empirical estimates of low consumption demand price elasticities for major grain, the high prices of 2007/2008 reflect the magnified effects of low harvests and unexpected shocks related to biofuels demand, in the context of nearly irreducibly low levels of stocks. Furthermore, export restrictions rendered the small remaining discretionary stocks less effective in stabilizing the market as a whole.

For the long run prospect of food prices, identification of the implications for price behavior of production and demand trends, including biofuels demands, poses delicate methodological challenges for further research. Generation of improved data on production, consumption, prices and stocks is equally important. The good news is that the available evidence offers no reason to embark on the more daunting and hazardous task of developing regulatory or other policies to confront a purported new and different regime in global grain markets. Regulatory efforts can instead be focused on the obvious problems in global financial markets.

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