

Causes and Implications of the Food Price Surge

By William H. Meyers and Seth Meyer*

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Abstract

This paper analyzes the food price surge of 2005 to 2008 in order to better understand the factors causing higher and more volatile food prices during this period, to ascertain the relative importance and possible persistence of the different factors, and to suggest possible implications for future market behavior and policy reactions. Given the highly uncertain outlook for petroleum price and its increasing impact on agricultural and food prices, the near-term outlook for major grains and oilseeds is generated from the latest USDA crop estimates and the FAPRI stochastic analysis of early 2008. Price projections to 2010/11 crop year are generated for major grains and oilseeds, given petroleum prices that average \$48, \$67, and \$95 per barrel.

Keywords: food prices, price volatility, biofuels, food supply and demand, price projections

Contents

Introduction.....	2
Preamble to the price surge.....	5
The Perfect Storm	12
Possible persistence of factors	29
Implications for the future	31
Near-term outlook 2008-09 to 2010-11	34
References.....	42
Annex Tables	47
Annex Figure	54

*The authors are Professor of Agricultural Economics and Research Assistant Professor of Agricultural Economics, Food and Agricultural Policy Research Institute, University of Missouri-Columbia. The authors are grateful to Marva Corley and Keiji Inoue at UNDESA and Pat Westhoff at FAPRI for very helpful comments on a preliminary draft.

Introduction

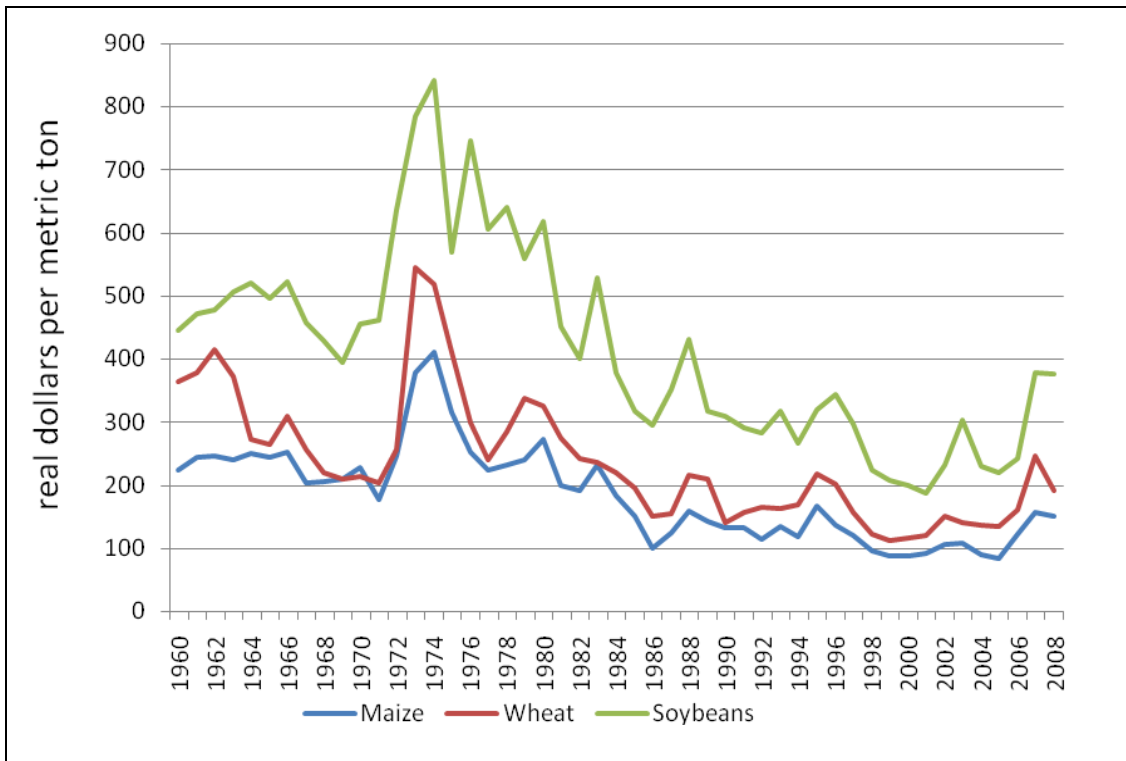
Since 2005, the rising level and increased volatility of commodity prices, especially food prices, have captured headlines and stimulated a wide range of analytical activity and policy discourse. It has caused hardship in many developing countries, led to social unrest in scores of these countries and, according to the Food and Agriculture Organization (FAO) of the United Nations (UN), added 75 million people to the number of undernourished and reversed progress toward the UN Millennium Development Goal (MDG) hunger target. Although monthly prices of grains and oilseeds have declined substantially since mid-2008, they are still 50-100 percent higher than in 2005 with no guarantee that this price surge will not be repeated in the future. Therefore, it is important to have a comprehensive understanding of the factors leading to the food price surge in order to better analyze the market and policy implications for the near and long-term.

Agricultural markets are traditionally very volatile due to weather variation and inelastic (short run) supply and demand. Also, rapid technological change since the end of World War II has combined with inelastic demand for food to generate declining real agricultural prices. Consumers have been the ultimate beneficiaries of agricultural technology while farmers have had to continually grow in size, as well as improve technological and financial practices, to offset price declines. Governments in high income countries adopted various support and protective trade policies to safeguard their farmers from these price declines, which often contributed further to low prices. This long-term decline in real prices has periodically been interrupted by price spikes that were mostly caused by yield declines due to poor weather.

The largest and most prolonged price surge since the end of WWII (figure 1) was largely driven by macroeconomic shocks, including the first and second oil price shock in the 1970s, high inflation, dollar depreciation and the collapse of the Bretton Woods currency system, which regulated international monetary relations. In real terms, the price surge in the early 1970s was more severe than the recent one and was more persistent than the weather induced price shocks that came in subsequent years. One important question now being widely discussed is whether the current price surge will ultimately lead back to the long run declining real price path or will it leave real prices on a higher long-term path?

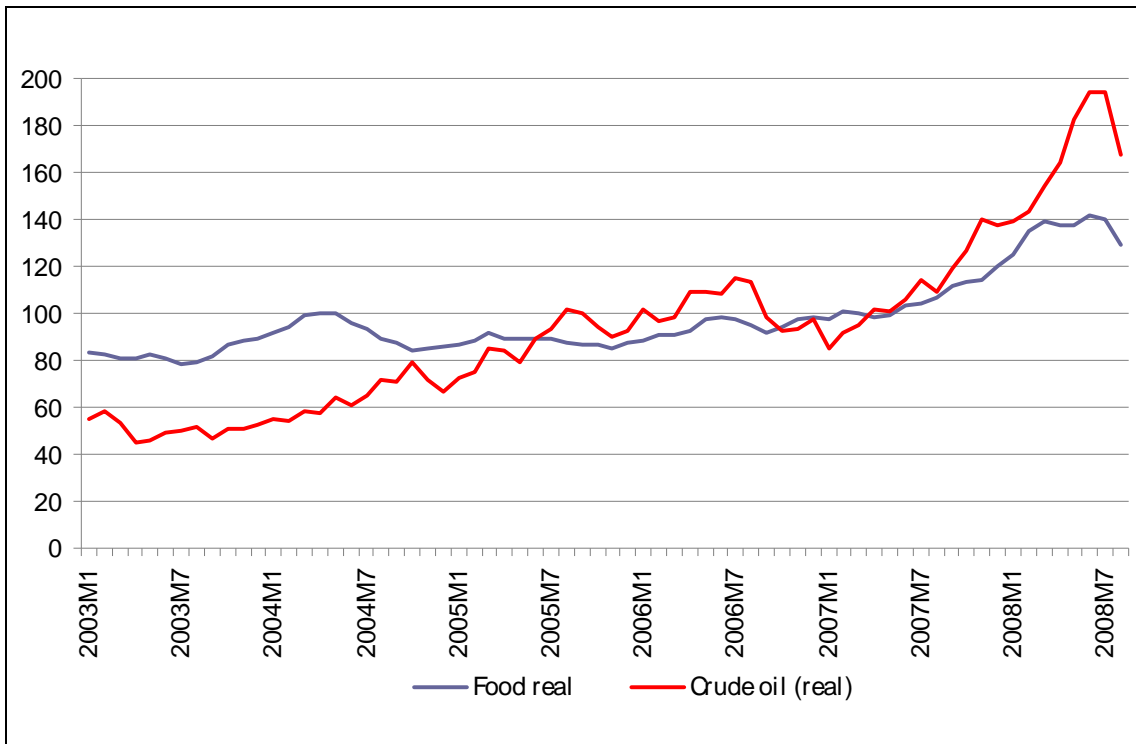
Part of understanding the recent price surge is to recognize that while having some common roots, the price developments have also differed from commodity to commodity in terms of the scale, timing and duration of the price surge (figures 2, 3 and 4). The rise of crude oil prices (West Texas Intermediate monthly average), which reached and stayed above \$40/barrel beginning in July 2004 and continued to increase, started earlier, lasted longer and rose much higher than most of the food commodity price surges. Most of the food price surges became noticeable in 2006, although rice prices were rather calm until late 2007 and had a far more rapid and severe price rise and fall than other grains and oilseeds. These patterns suggest some common themes but also some distinct factors for different commodities.

Figure 1. Declining real prices of grains and soybeans, 2000 US\$



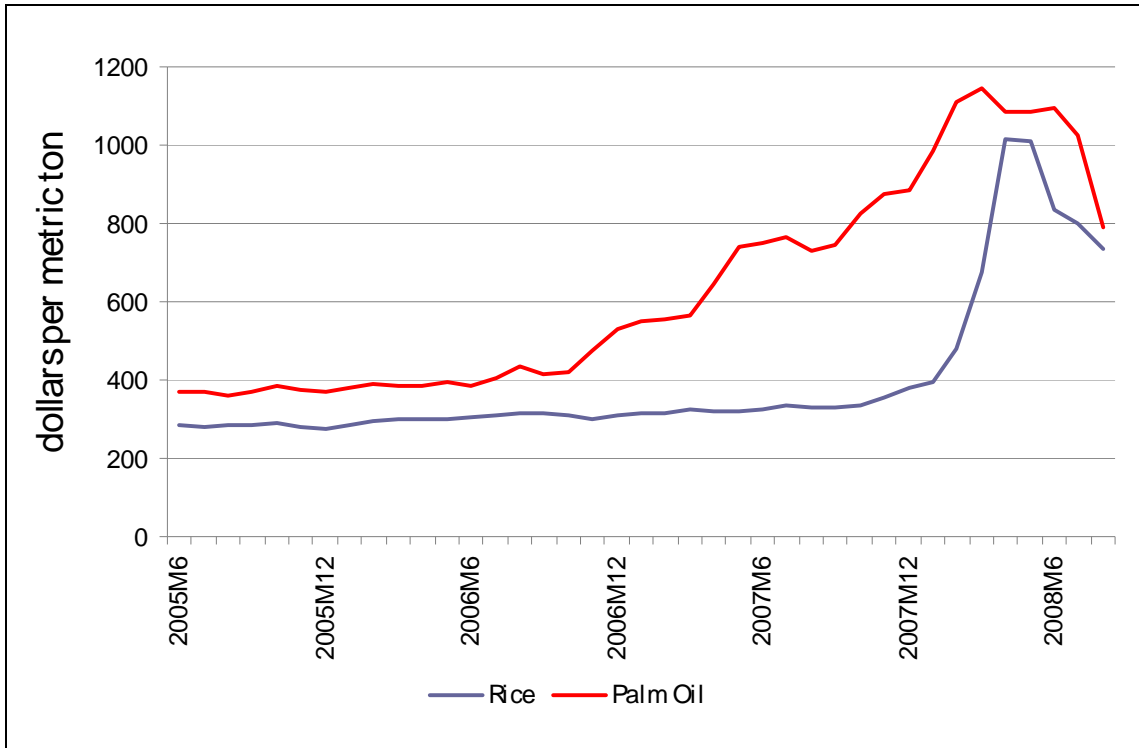
Source: USDA prices deflated by gross domestic product deflator.

Figure 2. Real food and crude oil price developments, Jan. 2003-Aug. 2008, 2005=100



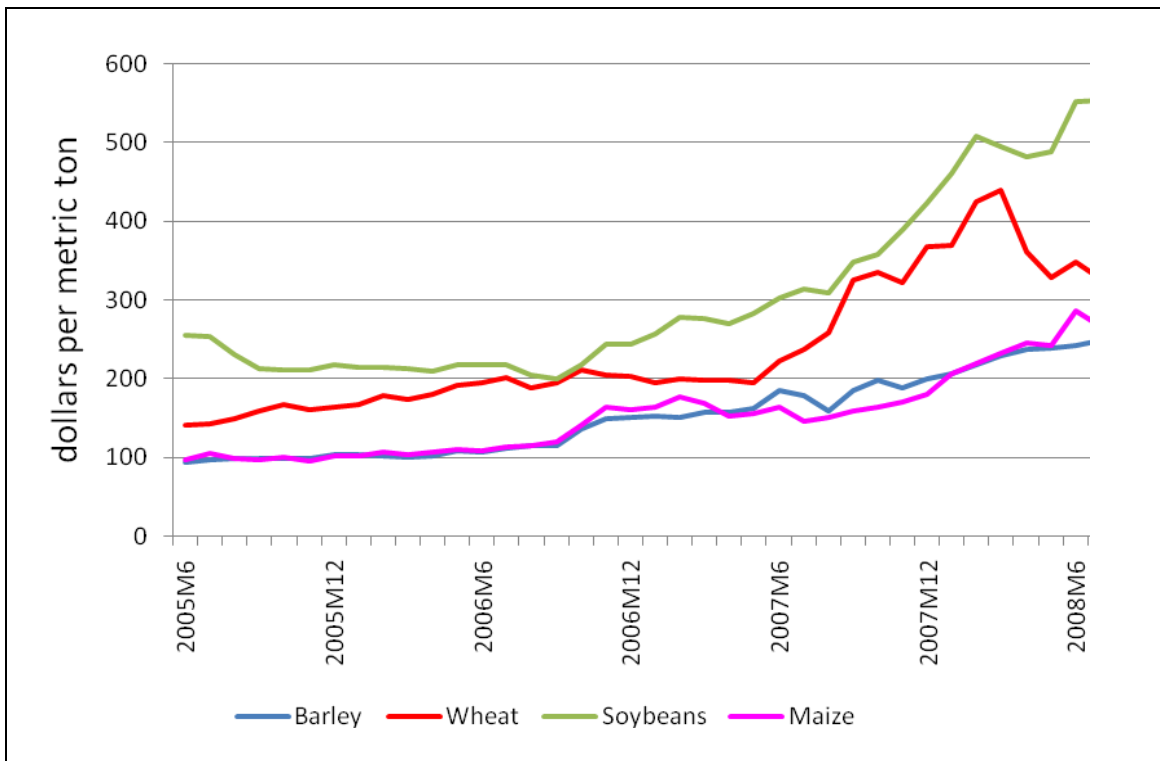
Source: UN/DESA (DPAD), based on IMF databases.

Figure 3. Nominal Rice and Palm Oil prices, June 2005 to Aug 2008



Source: IMF commodity price database.

Figure 4. Nominal Grain and Soybean Prices, June 2005 to Aug 2008



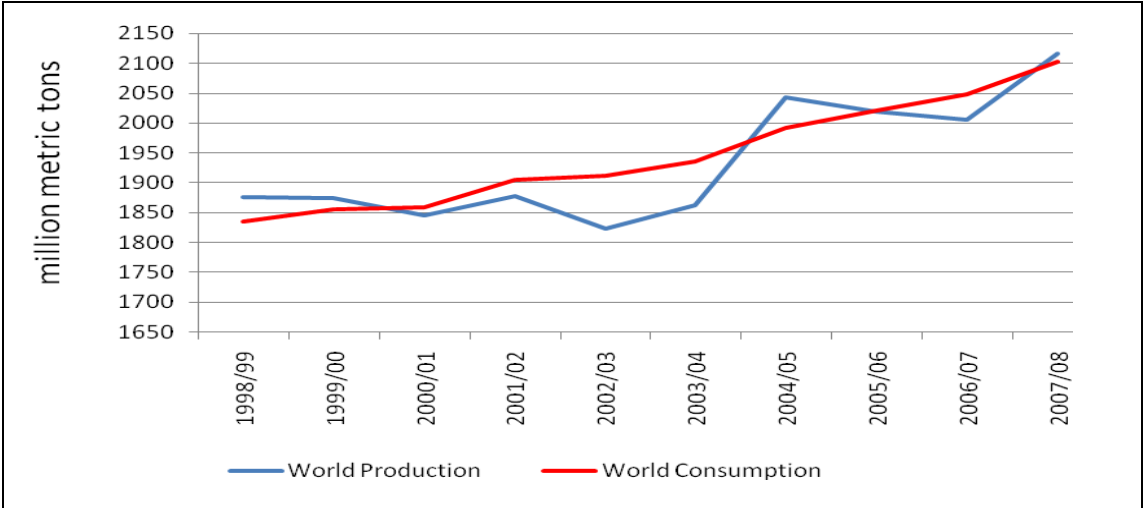
Source: IMF commodity price database.

First the setting for the price surge is analyzed, then a series of numerous supply, demand and macroeconomic factors that interacted in various ways and contributed in some degree to the price surge are evaluated. The increasing interdependence of food and energy markets is explored in more depth in terms of its long-term influence on commodity market behavior as the role of biofuels and energy prices continue to be an important and growing factor in food markets. The next section explores these factors further in the context of possible future developments and assesses whether each factor is expected to be a persistent influence on markets and prices, a temporary or a very uncertain one. The results of this analysis have implications for future challenges and opportunities that are discussed in the next section. Finally, the near-term outlook prospects are discussed using the most recent USDA, FAO and FAPRI analyses for 2008/9–2010/11.

Preamble to the price surge

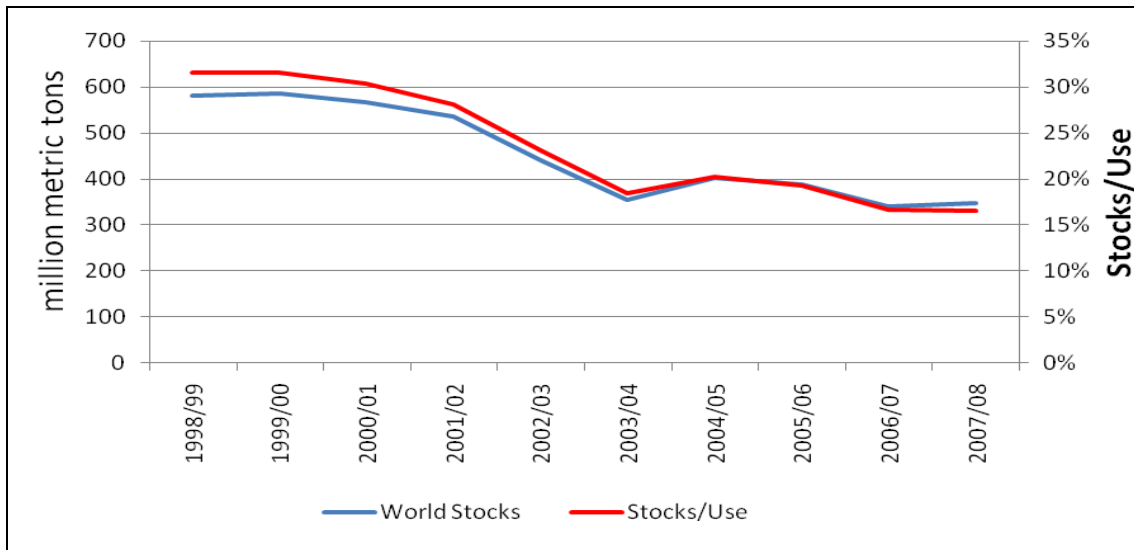
In the years leading up to the price surge, consumption of the five major grains exceeded production and by large amounts in three of those years (figure 5). As a consequence, ending stocks of grain were drawn down to 40 percent of 1998/99 levels. The stock-to-use ratio reached record low levels (figure 6) for total grains, coarse grains and wheat. It was also the lowest since the 1972 price surge for maize (Schnepf, 2008). Likewise, the vegetable oil stock-to-use ratio reached the lowest level since 1972, though for oilseeds in general the stocks situation was not as dire.

Figure 5. World production and consumption of maize, wheat, rice, sorghum and barley



Source: PSD database, USDA.

Figure 6. Grain ending stocks and stocks-to-use ratio



Source: PSD database, USDA.

A longer run contributor to the tightening conditions in the early part of this decade was the slowing rates of grain production growth. The international research investments of the 1960s were deliberate policy actions to enhance agricultural productivity in developing countries and resulted in the high yielding Green Revolution wheat and rice varieties that spurred yield growth and enhanced multiple cropping opportunities with shorter growing seasons. Along with continuing public and private agricultural research and development (R&D) in industrial countries, these improved technologies supported grain yield growth of 2.4 percent and production growth of 3.1 percent annually from 1960-1980. Yield growth in the 1980s remained relatively high, but grain area declined. From 1990 until 2007 world grain production only grew an average of one percent annually and yields a mere 1.3 percent per annum (table 1).

Table 1. Exponential growth rates in area, yield and production of grains and oilseeds

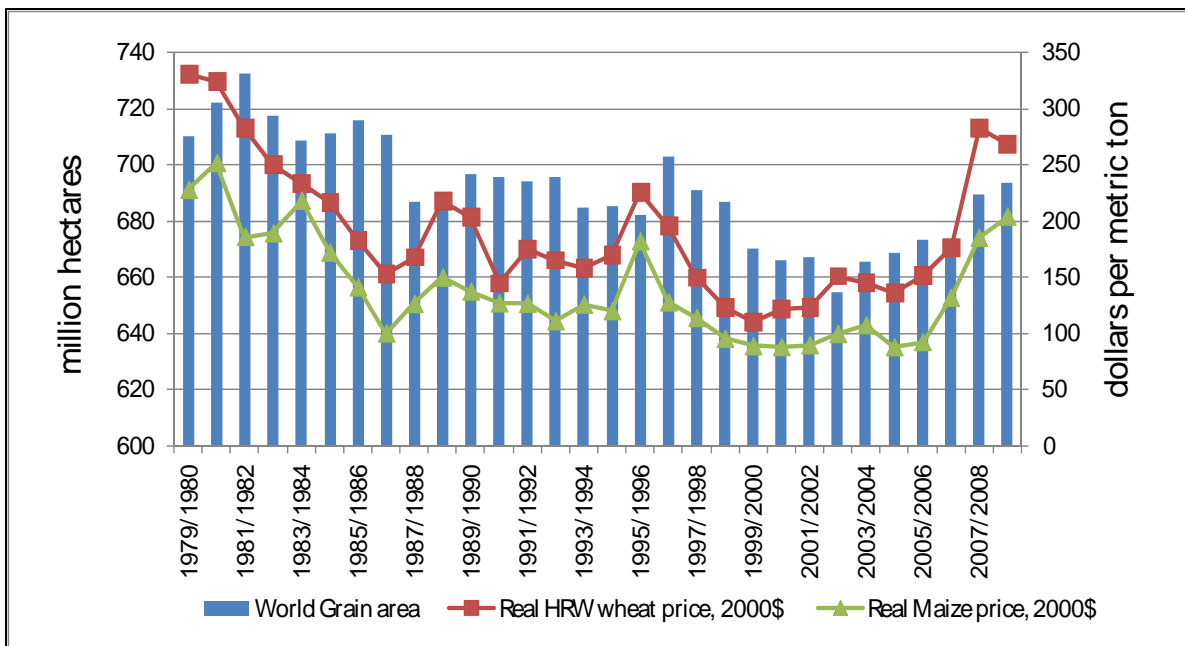
	1960-70	1970-80	1980-90	1990-07
Grains				
Yield	2.8	1.9	2.4	1.3
Area	0.5	0.9	-0.5	-0.2
Production	3.3	2.8	1.6	1.0
Consumption	3.3	2.6	1.7	1.2
Grains and Oilseeds				
Area	1.6	1.3	-0.03	0.2
Production	4.0	3.0	2.0	1.4
Consumption	4.1	2.9	2.0	1.5

Source: Calculated from PSD database, USDA.

Grain area peaked in 1981 and some of that land moved into oilseeds, but total land in grains and oilseeds grew by less than 0.2 percent per annum from 1981-2007. So, at least since 1990, yield and production growth have been slowing for both grains and oilseeds. For both grains and the total of grains and oilseeds, consumption growth rates also declined over time. Declining growth in population has been dominating the effect of income growth on consumption (Alexandratos). Nevertheless, consumption growth rates still exceeded production growth rates from 1990 onward, and for grains this was also true for the 1980-90 decade.

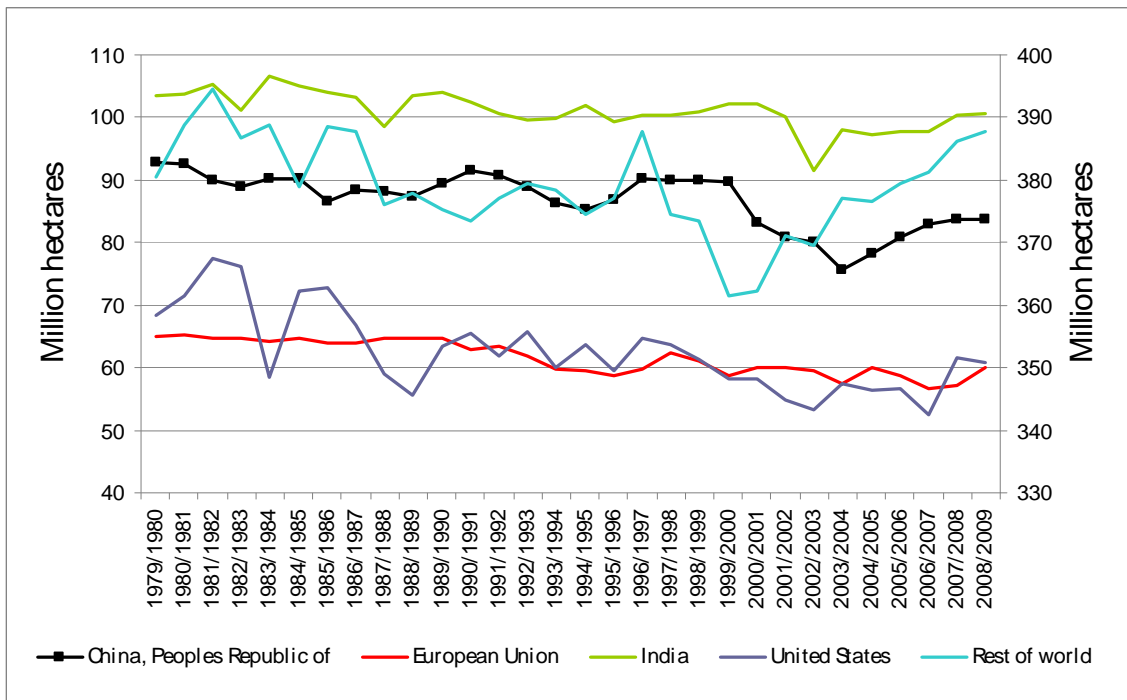
Several factors contributed to the relatively slow production growth and stocks decline in the last two decades. The key market factor was declining real prices for an extended period that reduced market incentives to invest and produce. It was interrupted only by short-lived price surges in short crop years in 1988/89 and 1995/96. So, grain area declined (figure 7) while yield growth was also slowing. The most dramatic recent example was China, where grain area was reduced by 14 million hectares or nearly 16 percent of grain cropland between 1999 and 2003 (figure 8), and production dropped well below consumption levels (figure 9). A little more than half of this land came back into grain production by 2006/07 in response to government support policies, but several years of shortfall caused the government to reduce stocks by 66 percent from their 1999 levels in order to avoid higher imports (figure 10). This decline in China's grain stocks accounted for 87 percent of the global grain stocks decline during the same period.

Figure 7. World grain area relative to nominal price of wheat



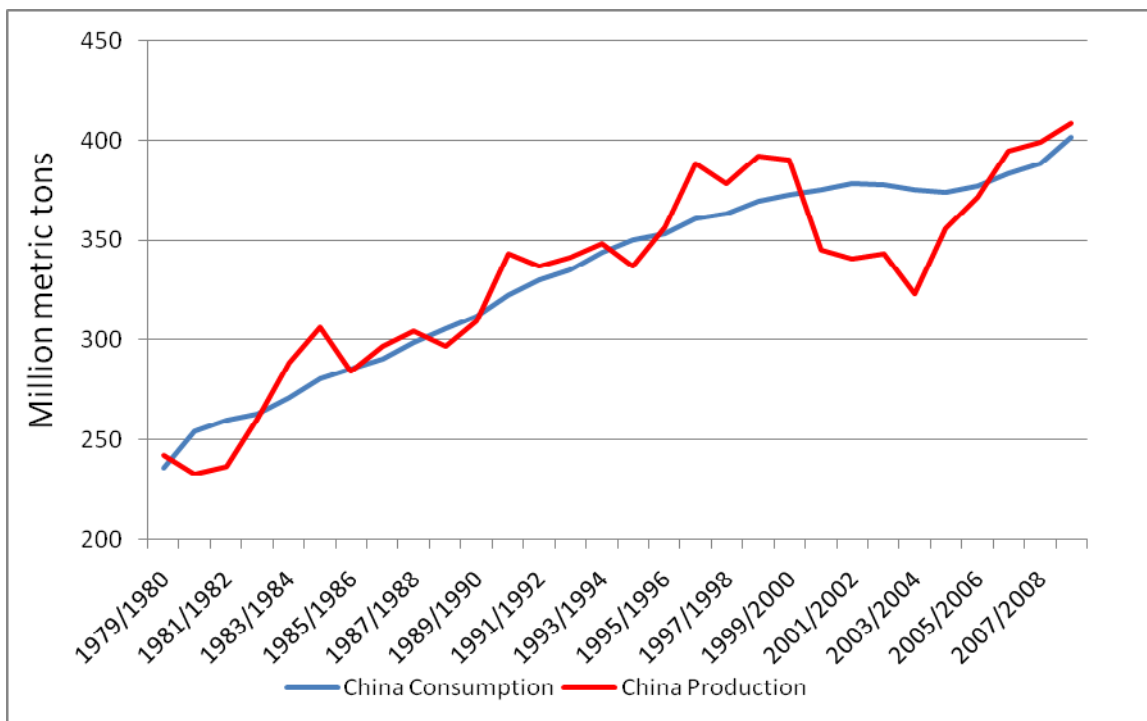
Source: PSD database, USDA.

Figure 8. Grain harvested area, ROW on right axis



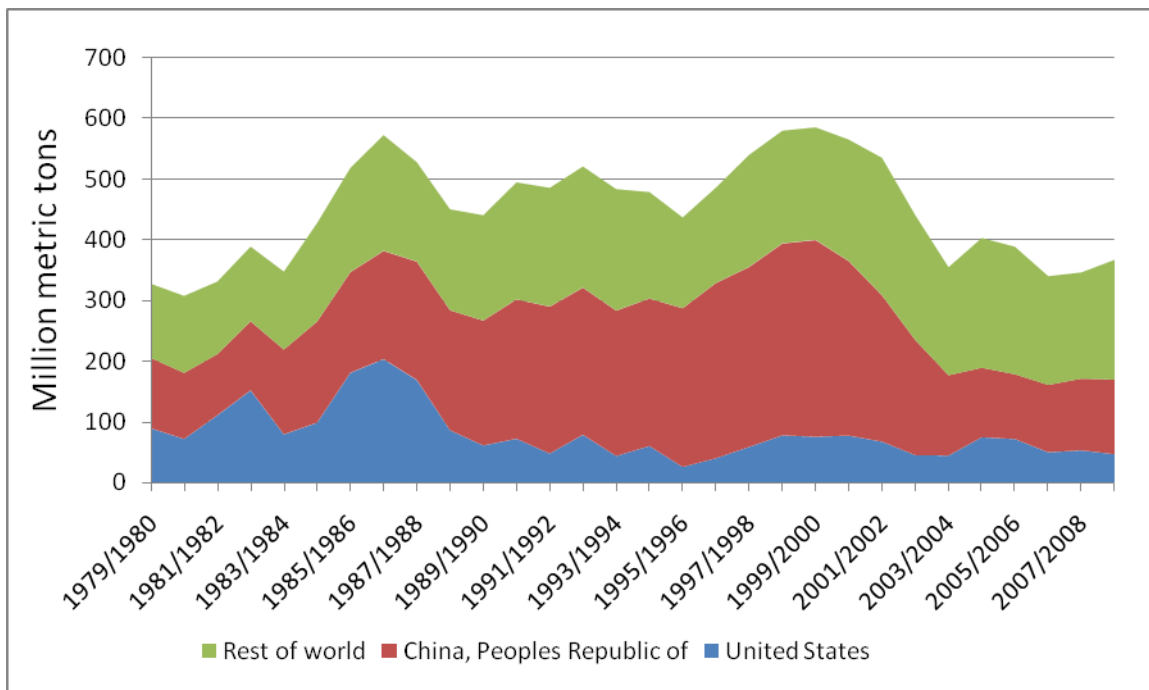
Source: PSD database, USDA.

Figure 9. China's total grains production and consumption



Source: PSD database, USDA.

Figure 10. World grain ending stocks

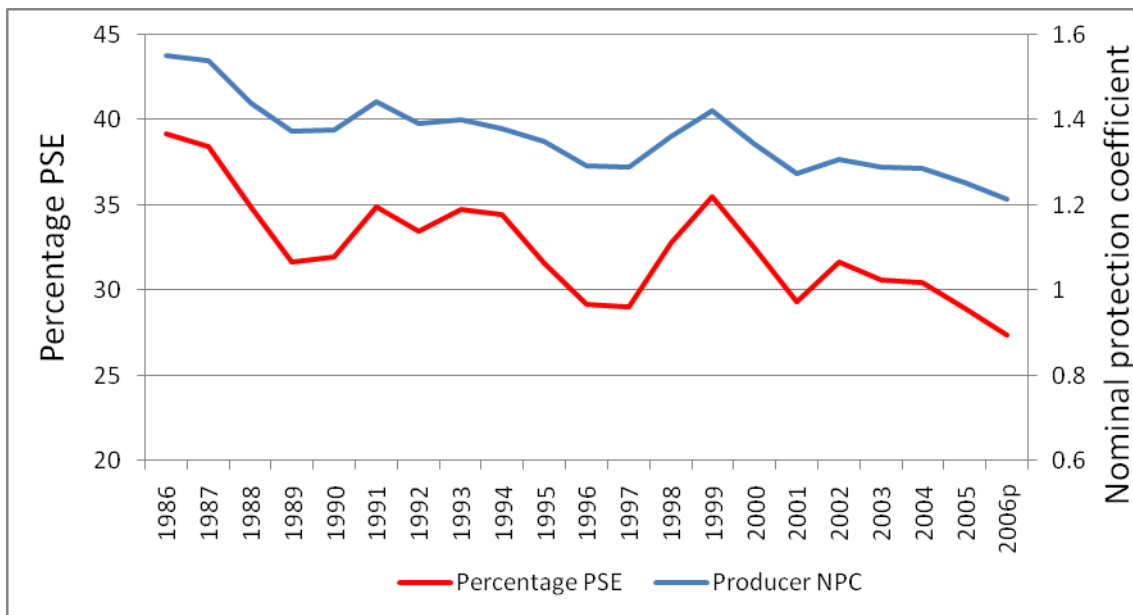


Source: PSD database, USDA.

On the policy side, production support and trade barriers in some developed countries insulated these producers from world price fluctuations and stimulated more production than market signals would justify. For example, domestic price supports in the European Union (EU) resulted in export subsidies for grains that further depressed world market prices. The United States (US) also had wheat export subsidies that were discontinued in the 1980s. These support levels (especially support tied to production) as measured by the Organization for Economic Co-Operation and Development (OECD) producer support estimate (PSE) have been gradually declining (figure 11) during negotiations for the Uruguay Round Agreement on Agriculture (URAA) and since its adoption in 1994.

Furthermore, national stocks policies and price support stocks also were reduced or disbanded in the pre and post-URAA era. The large decline in US grain stocks after 1986/87 was primarily due to elimination of the Farmer-Owned Reserve Program and other policy changes that essentially eliminated government owned stocks as well (figure 10). One may conclude that even if agricultural and food trade liberalization was progressing slowly after the URAA, many countries have seen less need for price support or buffer stocks or to build national food security reserves, as trade was expected to offer an improved alternative for offsetting domestic shortfalls.

Figure 11. Producer Support Estimate and Nominal protection coefficient, average of OECD members



Source: OECD Statistics.

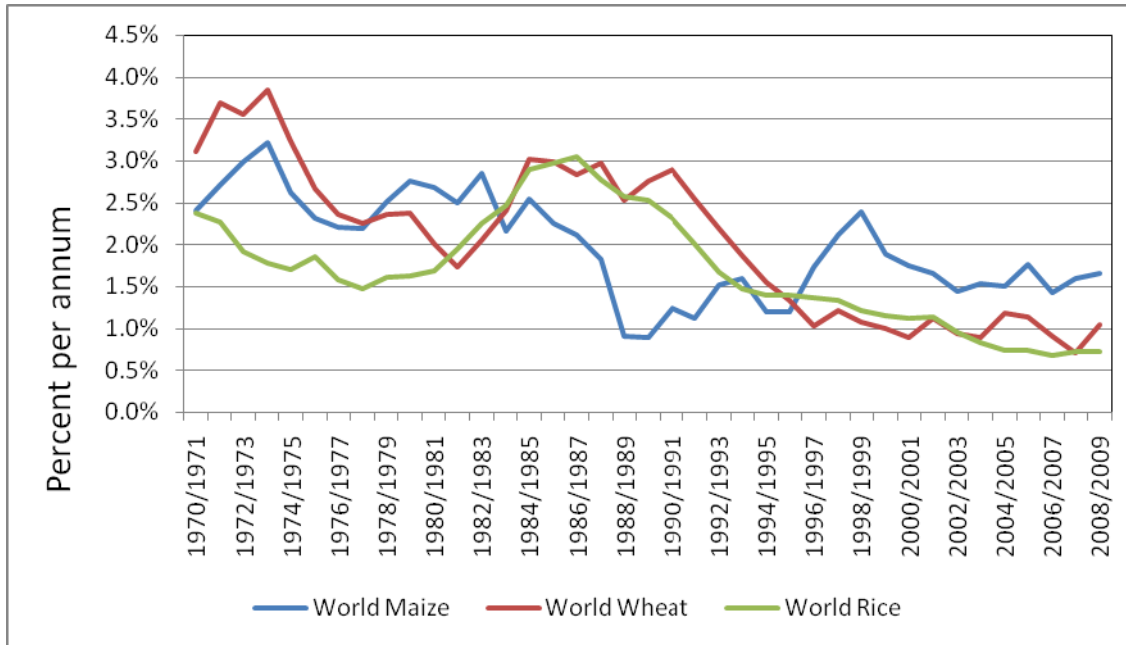
An important policy factor in slowing yield growth rates, especially for rice and wheat (figure 12), is that national and international public investment support for agricultural R&D has slowed in developing countries and even in developed economies since the 1990s (Van Braun et al., 2008). It has been well established in numerous documents of the World Bank, FAO and IFPRI that investment in agriculture has been lagging in developing countries especially. The World Bank Development Report 2008 states that the developing countries have “suffered from neglect and underinvestment over the past 20 years. While 75 percent of the world’s poor live in rural areas, a mere four percent of official development assistance goes to agriculture in developing countries. In Sub-Saharan Africa, a region heavily reliant on agriculture for overall growth, public spending for farming is also only four percent of total government spending”.

Pardey et al. found that growth in public agricultural R&D spending, which was critical to the Green Revolution, declined by more than 50 percent in most developing countries from 1980 onward and even turned negative in high-income countries from 1991 onward. There were important exceptions in China and India (World Bank, 2007), but national governments and international organizations mainly have neglected these investments, despite the high rates of return that have been demonstrated in past R&D projects.

Finally, it is part of the normal behavior of commodity markets that a shortfall in production results in a drawdown of stocks and more volatile price behavior. In this regard, the relatively modest price increases and stock declines of 2002/3-2003/4 are similar to those of 1988/89-1989/90 and 1995/96 (figure 13); but unlike the two previous periods, production in subsequent years was not sufficient to meet growing consumption and also rebuild stocks. So when the next shortfall occurred in

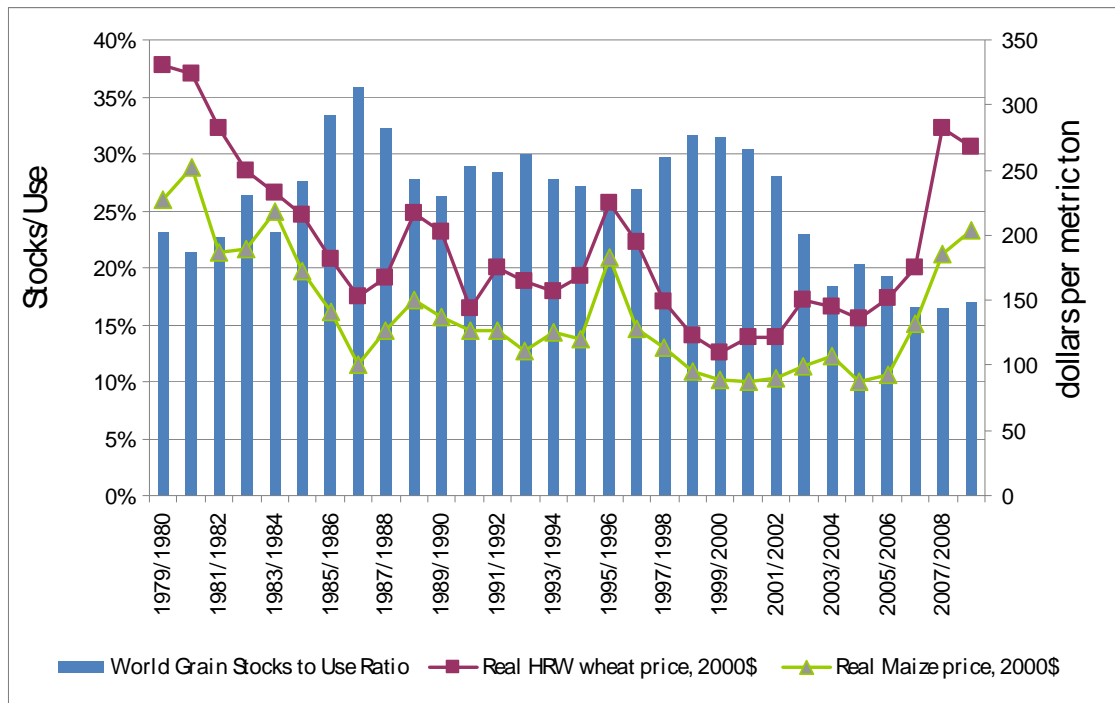
2006/7, stocks were not adequate to buffer it. As already noted, the demand for agricultural commodities is very price inelastic, so even in the face of rising prices, consumption growth remained strong.

Figure 12. Exponential growth rates for yields the previous 10 years



Source: PSD database, USDA.

Figure 13. World grain stocks to use ratio and real wheat and maize prices

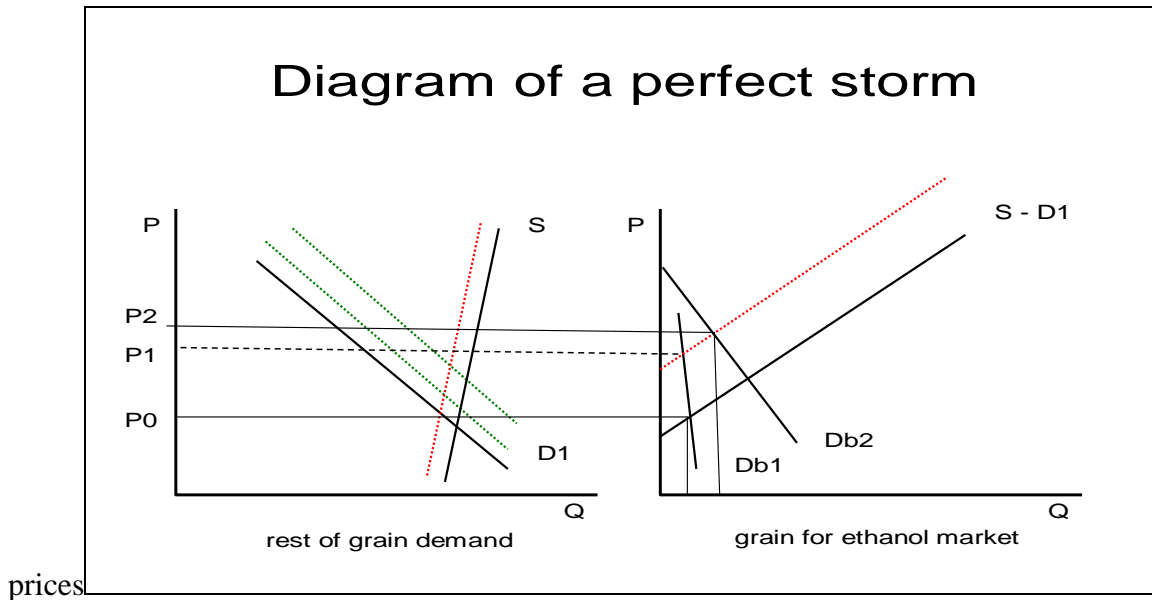


Source: PSD database, USDA.

The Perfect Storm

Given the tight market situation in the middle of this decade as represented by low stock levels, there was no possibility for the market to absorb, without substantial price increases, a series of developments that all worked to increase demand or limit supply. This combination of events is illustrated in the conceptual model of figure 14, where there were several factors that shifted demand to

Figure 14. Illustration of all factors moving together to raise

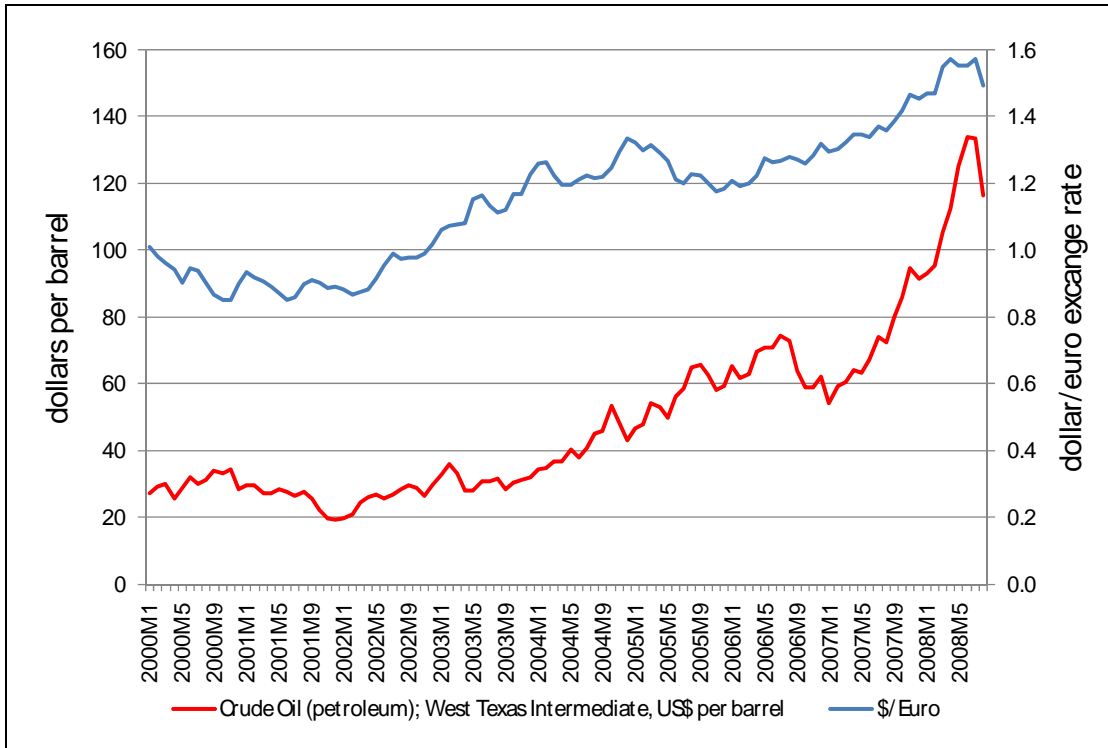


the right, while supply shifts to the left were caused by bad weather in some countries and rising petroleum prices that were increasing production and transport costs. By itself, these supply and demand shocks would increase price from P^0 to P^1 , but then the shift in biofuel demand (Db1 to Db2) added another shift in demand raising price from P^1 to P^2 . These shifts are enumerated below:

- Depreciation of the US dollar (figure 15) increased purchasing power of many importing countries and drove up the US\$ price of commodities.
- Rising petroleum prices (figure 15) not only increased production costs and transport costs for commodities; but combined with policies in a number of countries to stimulate increased biofuels production related to environmental and farm support objectives, they increased profitability of investments in biofuel capacity and stimulated the increased use of existing capacity resulting in more grains and oilseeds being used as feedstock for biofuel production.
- Grain production shortfalls occurred in Australia and the EU two years in a row and to a lesser extent in Ukraine and Canada, while India produced more but exported less (figure 16). Normally, these would not be such big market shakers, especially since world production actually increased slightly more than consumption. But in the face of record

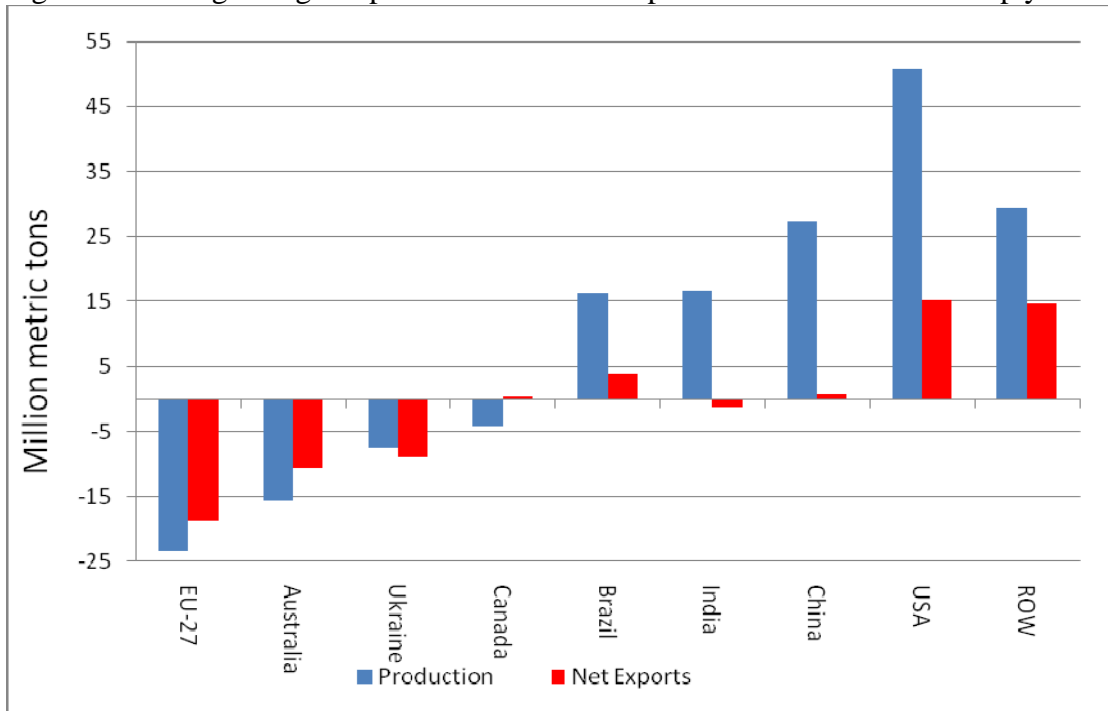
low stocks and continuing strong demand (figure 5), the price response in grains was dramatic (figures 17 and 18).

Figure 15. Pattern of Crude oil and US\$ moving in similar pattern since 2000



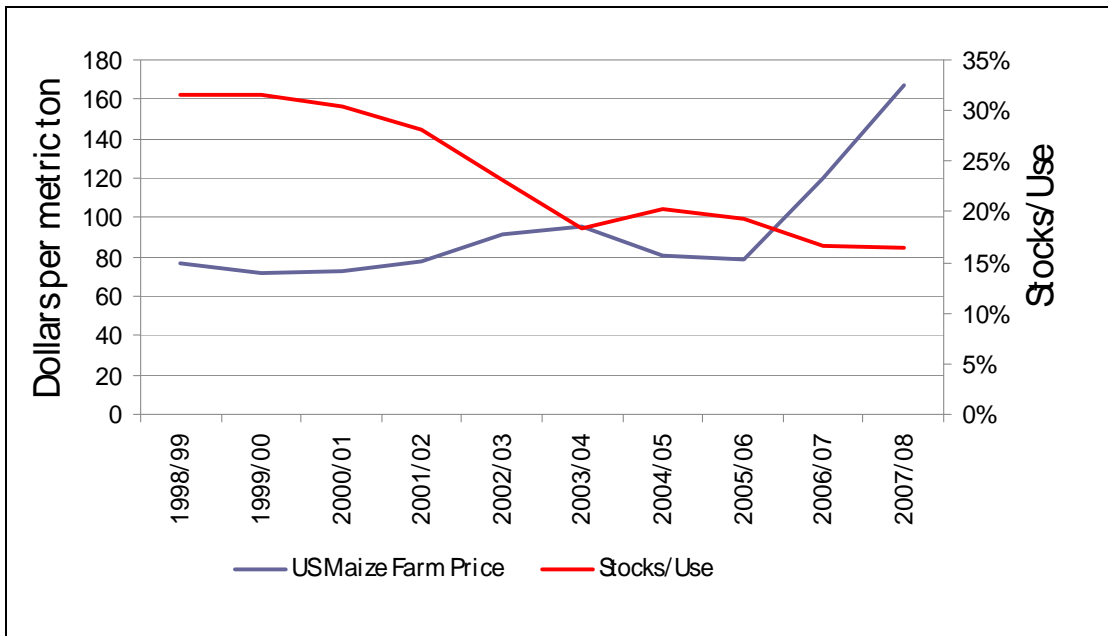
Source: IMF commodity price database; Euro from Global Insight, Inc.

Figure 16. Changes in grain production and net exports for 05/06 to 07/08 crop years



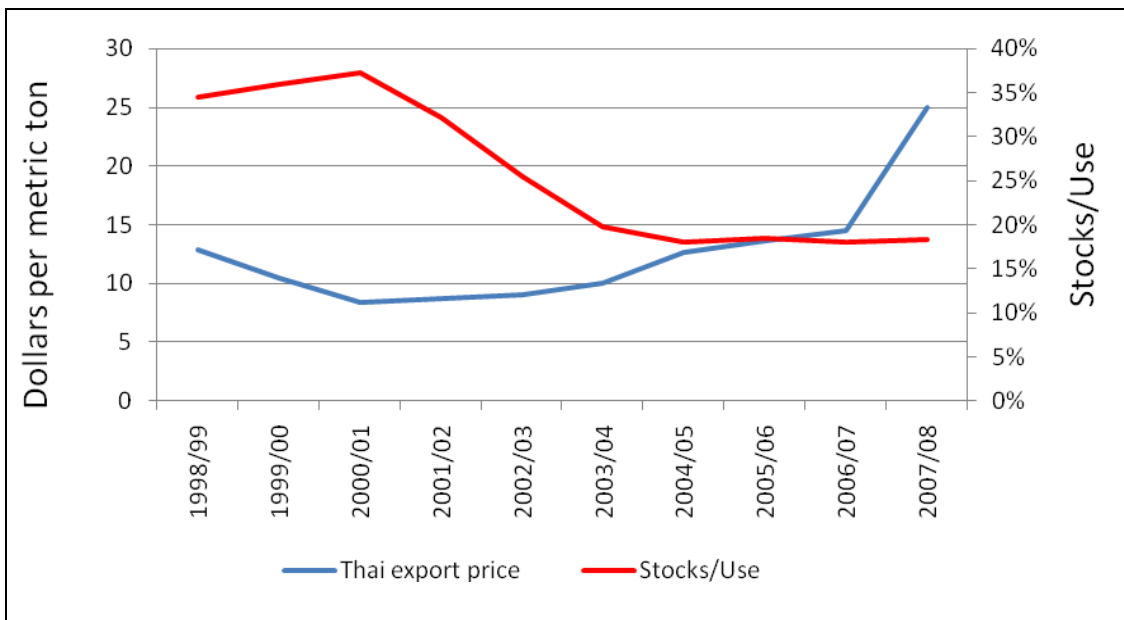
Source: PSD database, USDA.

Figure 17. US maize price and world stocks-to-use ratio



Source: PSD database, USDA.

Figure 18. Thai rice price and world stocks-to-use ratio



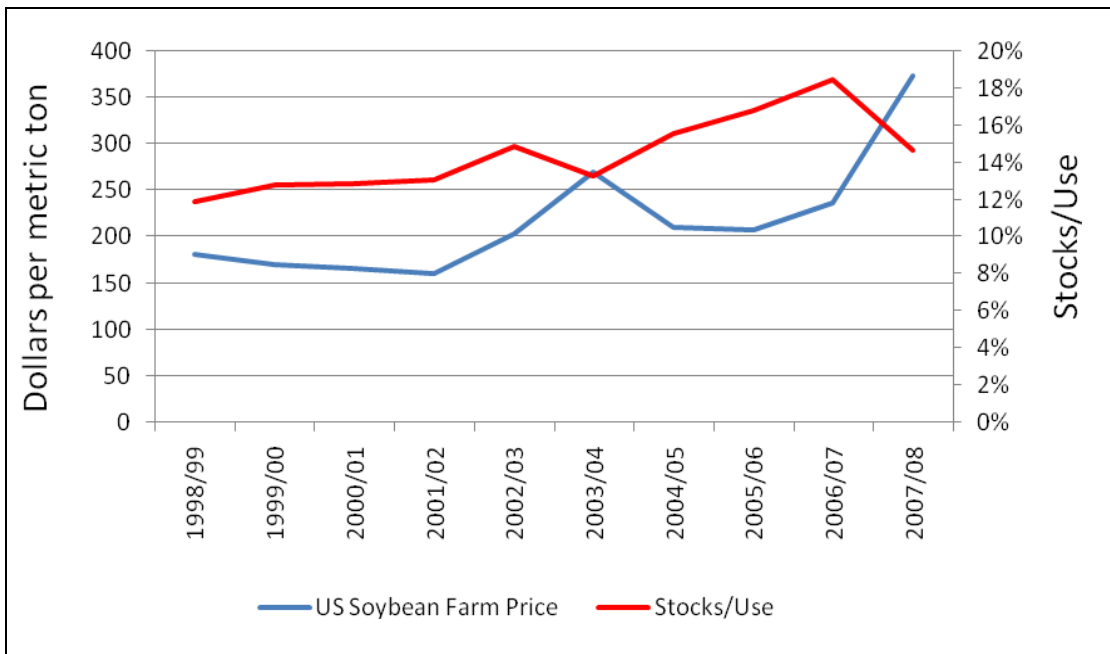
Source: PSD database, USDA.

- There was not a similar shortfall in oilseeds markets, but shifting of cropland from oilseeds to grains, especially in the US, quickly brought the price boom to oilseeds (figure 19).
- In reaction to the rising international prices and in order to safeguard domestic consumers, numerous exporting countries banned, taxed or otherwise limited exports of

grains and oilseeds and numerous importing countries reduced import tariffs, subsidized consumers or increased imports as precautionary measures (Trostle, FAO). These policy interventions, of course, increased the pressures on world market prices, and even some emergency food aid purchases by the World Food Program were delayed by these measures.

- During this time period there was increased activity in futures markets by financial investors (non-commercial traders), who may have been diversifying their portfolios or expecting greater returns than in alternative investments. It may well be the case that noncommercial trading (e.g. institutional investors or index funds) drove futures contract prices higher than they would otherwise have been and later contributed to their rapid decline, but there is no clear evidence that these investors had or will have any net impact on season average price levels (CFTC, Irwin et al., Good et al.). These investors are buying and selling contracts but never take ownership of the product, so the argument is that they may increase short term volatility but there is still no evidence that they have influenced season average price by moving supply or demand.
- Long-term demand growth driven by population and income growth is also important in this story, especially in cases where demand is growing faster than supply (table 1). However, demand is seldom a factor that is a market shock, because it develops in a more predictable manner. A fast emerging new demand component, such as biofuels, could be an exception. But even in this case, plant construction takes time and is well known by market agents, so it was no surprise to the market.

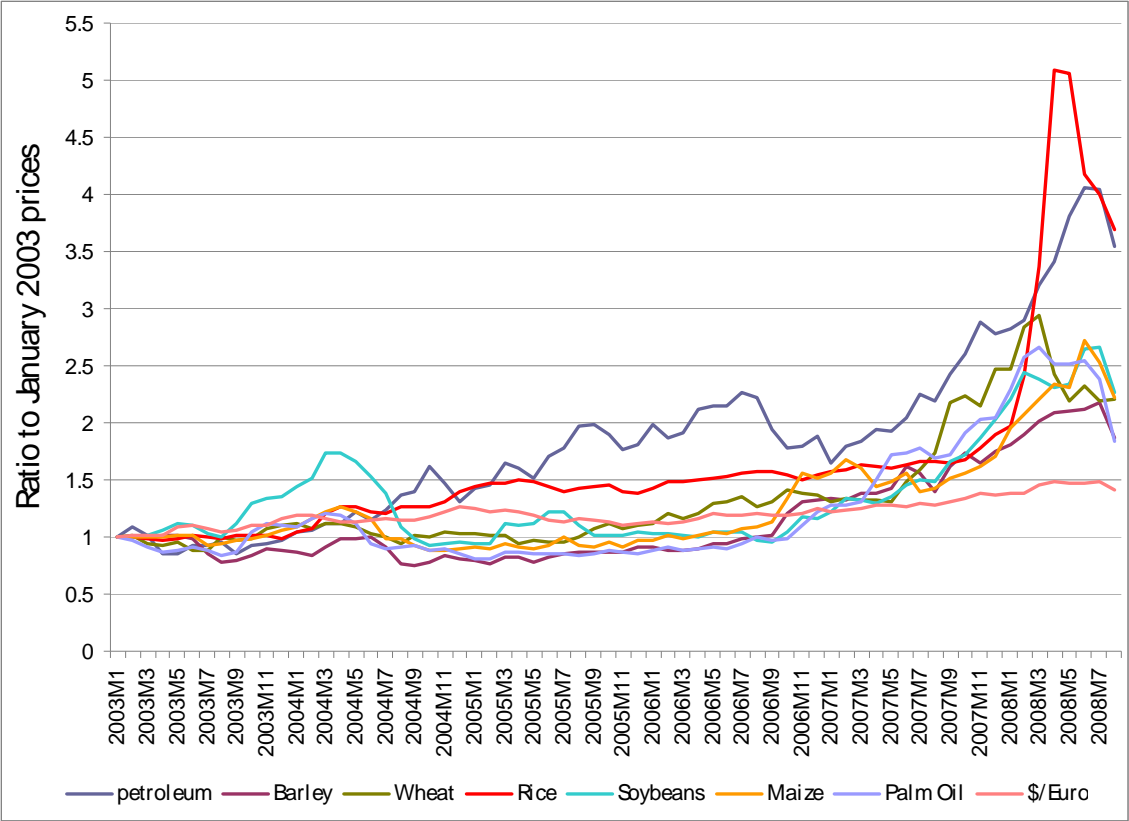
Figure 19. US soybean price and world stocks-to-use ratio



Source: PSD database, USDA.

As already noted above, there are differences and similarities in how the price surges played out for different commodities, which are compared in figure 20. In particular, a starting point in January 2003 is used to indicate when a monthly price increased by more than a certain percentage of the January 2003 level. Crude oil first hit the 50 percent increase level in late 2004 while rice reached that level of increase six months later, then remained stable for nearly three years (table 2). Maize reached the 50 percent increase level in late 2006 but did not have another major increase until early 2008. Oilseeds, palm oil and wheat prices started the surge a bit later in mid 2007 and continued to increase to their peaks in early to mid 2008. Barley price also began to rise in mid 2007 but did not go as high nor increase as quickly as others. Maize and soybeans were last in getting to more than 150 percent above January 2003 levels and barley never got that high. The maximum increase in the monthly average of crude oil price (306 percent in July 2008) was much higher than for most agricultural commodities, though rice had an even higher and slightly earlier (408 percent in April 2008) peak.

Figure 20. Differing patterns of monthly price developments among commodities



Source: Calculated from IMF commodity price database.

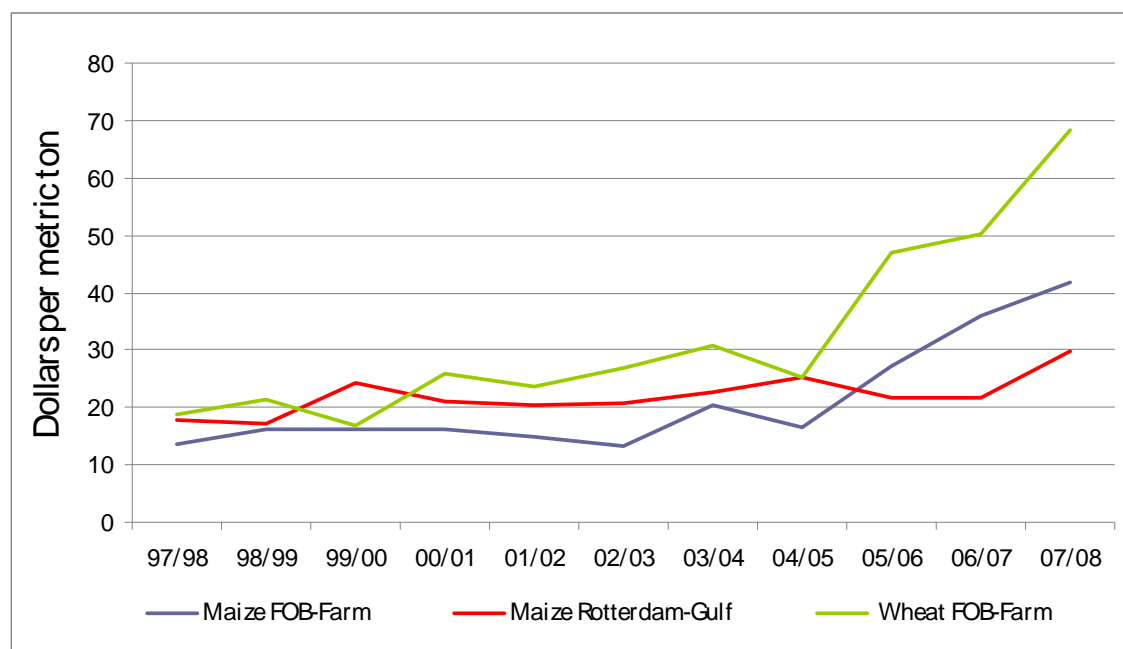
Table 2. Differences in speed and level of monthly price increases from January 2003

Price greater than X percent over January 2003	Crude oil	Rice	Maize	Barley	Palm Oil	Soybeans	Wheat
Greater than 50%	10/04	04/05	11/06	06/07	04/07	07/07	07/07
Greater than 100%	04/06	02/08	02/08	03/08	11/07	12/07	09/07
Greater than 150%	10/07	03/08	06/08	None	02/08	06/08	02/08
Greater than 200%	03/08	03/08	None	None	None	None	None
Maximum % over January 2003	306%	408%	171%	118%	166%	166%	194%
Month of maximum	07/08	04/08	04/08	07/08	03/08	07/08	03/08

Source: Calculated from IMF commodity price database.

Looking at this main period of the price surge from crop year 2005/06 to 2007/08, we can make a few conclusions on some of these differences in price developments and factors behind them. All these price surges occurred after the crude oil price increases and US\$ depreciation were already well underway, and we know from the impacts they have on demand and supply that both of these factors contributed to the price surges of all these products. At least these two factors are common to all cases, though the impacts would certainly have different magnitudes. The US\$ depreciation is quickly translated into increased purchasing power in all currencies that appreciated relative to the US\$ and into higher US\$ prices of traded commodities; but petroleum price has more impact on maize and vegetable oil prices, since higher petroleum prices stimulate greater biofuel investment and production. As demand for maize and vegetable oils increase, it raises the prices of maize and oilseeds, induces shifts in cropland from other crops to these as well as substitution on the demand side for feed and food and thereby increases prices of other crops. Petroleum price increases also raise production costs of all crops; and increased crop prices raise production cost for livestock and dairy, so over the period of two years or more these impacts permeate throughout the agricultural industry. Likewise, the higher petroleum prices increase processing and transport costs (figure 21), and over time this raises the farm to retail margins and the cost of food.

Figure 21. Rising levels of transport costs reflected in farm to FOB and Gulf to Rotterdam margins



Source: FAPRI, 2008a.

The trade restrictions also had differential impacts. The main export policy reactions were those listed below (FAO, July 2008):

- Argentina increased export taxes on soybeans (27.5-35 percent), maize (20-25 percent), wheat (20-28 percent) and vegetable oils (8-10 percent).
- Russia introduced a 10 and 30 percent tax, respectively, on wheat and barley exports.
- Ukraine established quantitative restrictions on wheat exports and banned exports for a short time.
- China introduced a 20 percent export tax on wheat, barley and oats and a 5 percent tax on maize, sorghum and rice and eliminated rebates on value-added taxes on grain exports.
- Kazakhstan banned wheat and vegetable oil exports.
- Indonesia raised the palm oil export tax from 10 to 20 percent.
- Egypt, Vietnam, Cambodia and Indonesia, and India (except basmati) banned rice exports.

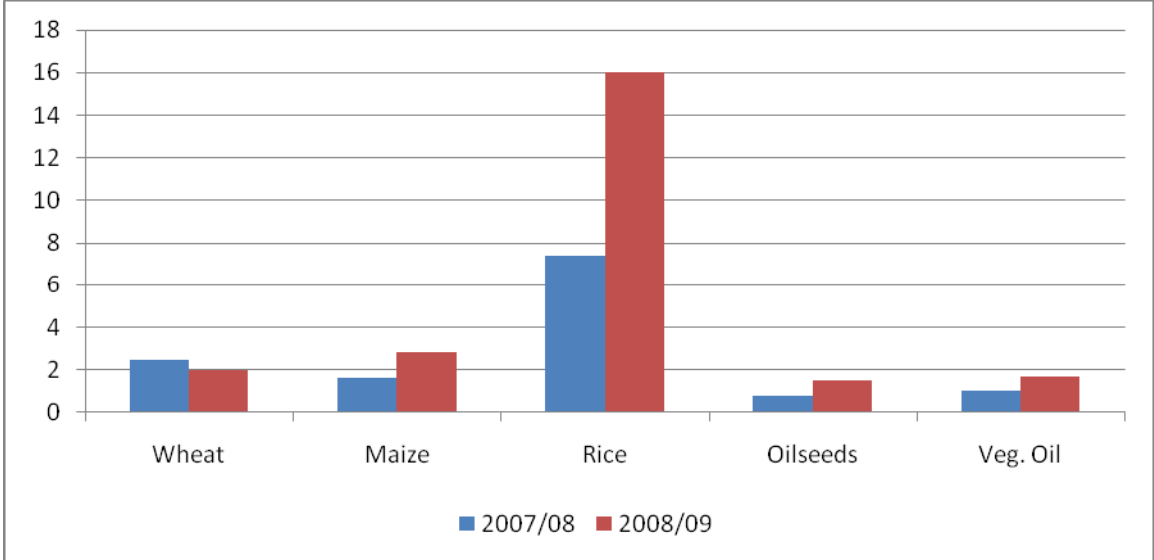
A quantitative assessment of the market impacts of these interventions was done by Agriculture and Agri-Food Canada with the OECD-FAO model¹ and indicates that the impacts on season average prices were relatively small except for the case of rice (figure 22), though all of them likely had a greater impact on daily and monthly prices than on the season average price that is normally used in commodity models. Considering that it was an annual price analysis, Ukraine was not included in the analysis, since the export restrictions were removed after only a few months. However, it reduced Ukraine's exports substantially in 2007/08, occurred during a critical time of the season and left the market with only the

¹ The OECD/COSIMO model is a multi-market, partial equilibrium model.

US and the drought impacted EU as alternative sources for wheat. It means this analysis likely underestimated the wheat and maize trade and price impacts. IFPRI used the MIRAGE model² to analyze impacts of a stylized set of export restrictions, and estimated higher grain price impacts of up to 30 percent (von Braun, 2008). This is a very difficult question to analyze, which may explain rather large differences in the results from different models. However, the cumulative price impacts of these policy reactions are likely to be significant both in terms of real effects and the expectation effects that increase short run volatility.

Rice prices got a bump in early 2005, as consumption was exceeding production and stocks were declining for four years in a row (figure 18). But they remained rather steady until early 2008 when rice price surged rapidly for two months before starting to retreat. Since world rice production exceeded consumption in 2007/08 as well as in the previous year, there were no apparent market fundamentals that would generate such price behavior. Therefore, it seems more likely that the rice price surge was primarily due to the generally tight market/low stock conditions for grains in general and the rice export restrictions imposed by several countries (Abbott et al 2008). Rice trade is very thin, being between 6 and 7.5 percent of consumption during the last ten years, so such trade restrictions can have very large price impacts. The rapid price escalation also generated a kind of market panic that probably added public and private hoarding to the contributing factors.

Figure 22. Estimated impact of export restriction policies on world prices



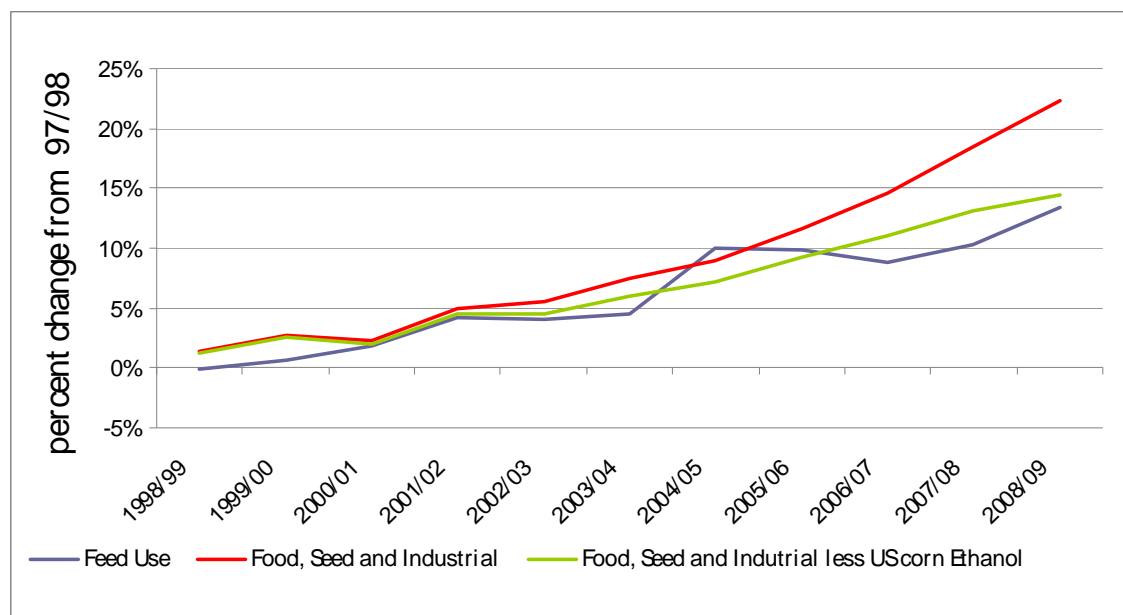
Source: Study conducted by Pierre Charlebois from Agriculture and Agri-Food Canada using the OECD/FAO AGLINK/COSIMO model.

Maize price started moving upward late in 2006, as production lagged consumption and stocks fell even lower (figure 17). Some analysts point to rapid income growth and dietary transition towards meats, especially in Asia, as a reason for rapid growth in maize demand. However, we have seen in table

² MIRAGE is a multi-region, multi-sector computable general equilibrium model.

1 that grain consumption growth is slowing despite these dietary changes. Evidence over the last ten years indicates continued growth but not an acceleration of growth in feed use or of food, seed and industrial use excluding maize for ethanol, but does show that the annual increases in maize used for ethanol production in the US have been accelerating (figure 23). In the period 2005/06 to 2007/08, US use of maize for ethanol production accounted for 31 percent of total grain consumption growth³, while increased grain consumption in China and India together account for 33 percent (figure 24). So these are contributing nearly equally to the growth in grain use in this period, though use of maize as a biofuel feedstock is a relatively new component in this market and therefore is often viewed differently from normal growth in food and feed demand. As already noted, China's grain production declines in the first few years of this decade had a major impact on global grain stocks (figures 9 and 10), which was probably a more important contributor to tight market conditions than was their consumption growth.

Figure 23. Percent change in total world grain use by category*

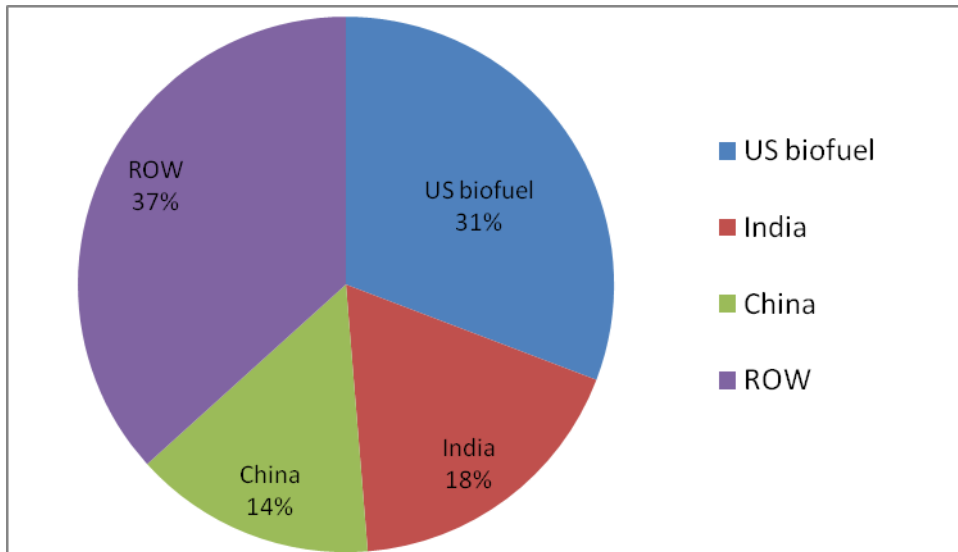


Source: Calculated from PSD database, USDA.

* 30 percent of the maize for ethanol volume is the byproduct distiller's dried grains (DDGs), which is used for feed. We count 70 percent of the volume as used for ethanol (industrial use of maize) and 30 percent for feed.

³ When maize is used for ethanol production, 30 percent of the volume is the by-product distiller's dried grains (DDGs), which is used for feed. Thus in order to correctly reflect feed and other uses, we count 70 percent of the volume as used for ethanol (industrial use of maize) and 30 percent for feed.

Figure 24. Shares in growth of grain consumption, 2005/06-2007/08

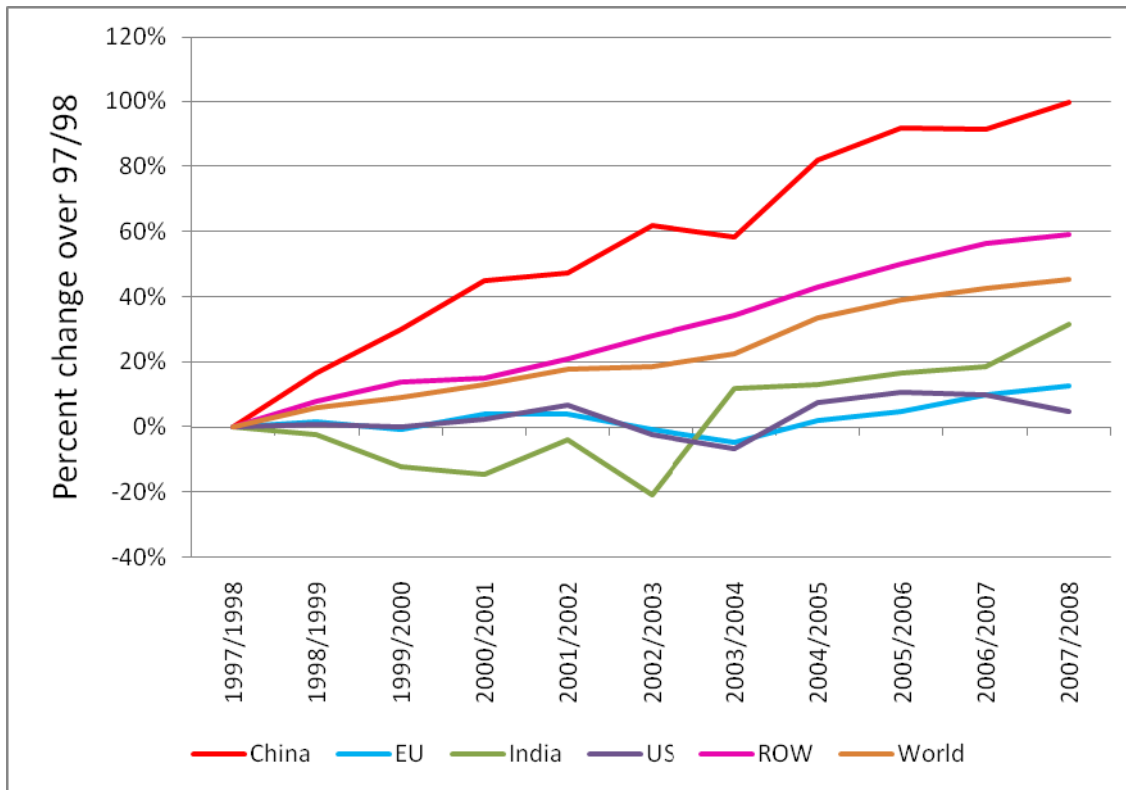


Source: Calculated from PSD database, USDA.

Palm oil, soybean, wheat and barley prices began rising in the middle of 2007. For soybeans, there was a clear impact from the shift of 5.5 million hectares from soybean to maize production in the US as a reaction to the rise in maize prices in 2006/07. This shift reduced US oilseed production by 16.6 million tons, while world oilseed production declined only 14.6 million tons. This acreage shift could be considered a kind of “shock”, since its magnitude was unprecedented in the United States. Oilseed stocks/use had not declined until then, and most of the decline came in the United States. Meanwhile, world oilseed consumption growth was still strong, and China was a significant factor. In terms of oilseeds use, it is by far the fastest growing region (figure 25). India’s use, by contrast was down for several years before increasing the last five years. Vegetable oil consumption grew by more than 9 percent but so did production.

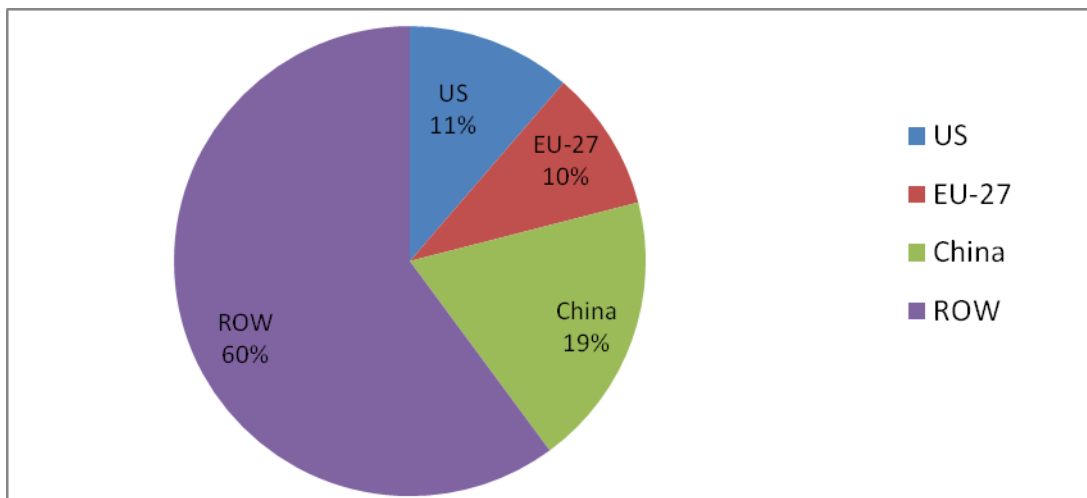
While food use grew by 7 percent, industrial use grew by 23 percent, though from a much smaller base (annex table 6). All growth in the EU and most in the US is for industrial use, most of which would be associated with biodiesel production. Use of vegetable oil for biodiesel production is much larger in the EU than in the US, but both are growing in response to higher petroleum prices and government support measures. Together these accounted for 21 percent of the growth in vegetable oil consumption, while China accounted for 19 percent (figure 26). Export taxes on palm oil introduced by Malaysia and Indonesia, export taxes by Argentina on soybeans and products, and export bans by Kazakhstan on export of oilseeds and vegetable oils were other contributing factors, though the Canadian analysis found its impact to be rather small (figure 22).

Figure 25. Percent change in total total oilseed use by region



Source: Calculated from PSD database, USDA.

Figure 26. Shares in growth of vegetable oil consumption, 2005/06-2007/08



Source: Calculated from PSD database, USDA.

Wheat was the hardest hit among the grains in terms of production shortfalls, and though the price surge started later than for maize, it increased faster and further and also peaked sooner. Two years of low production due to bad weather in Europe, Ukraine, Australia and Canada and declining stocks

took its toll, and the market pressures were exacerbated with export restrictions by exporters and import enhancing measures by importers starting in the fall of 2007 (Trostle). India reduced import tariffs on wheat flour and Indonesia, Serbia, and the EU reduced tariffs on imported wheat. Morocco and Venezuela introduced subsidies on imported foods. Such interventions are designed to limit domestic market disruptions but have the effect of increasing market disruptions in the world market, driving up prices further. Some of these interventions were rescinded later in 2008, starting with Ukraine's export restrictions, while the high prices pulled in more wheat area, and the return of favorable weather increased yields for the 2008 crop.

While each of these commodities have their own stories, all of the grain and oilseed prices have been influenced by the common factors of rising petroleum prices and the depreciating US dollar. Their influence is a kind of "double whammy" in that they have been moving almost in lock step (figure 15). This is not to attribute causality of one price on the other, but it has been evident in this commodity cycle that they are at least driven by common factors. The most careful study of the exchange rate effect on the commodity price surge was conducted by Abbott et al. and they attribute more influence in this price surge to the weak dollar than to other market supply and demand fundamentals. Their method was to compare the recent price surge to the last one in the mid 1990s. They found that real foreign currency prices of grains moved in lock step with nominal dollar prices in the mid 1990s, suggesting that these price movements were mainly due to supply-utilization shocks, such as bad crop yields. By contrast, analysis of the recent price surge showed that US\$ price increases for grains and soybeans were "typically more than three times equivalent changes in other, deflated currencies." They concluded that exchange rates are far more important in the recent price surge, but did not attempt to quantify that. As they correctly concluded, the complex interactions of numerous factors make it impossible to ascribe shares of causality to different factors with any degree of confidence. We do, however, report some results on the price impacts of eliminating biofuel support measures in the United States, which are often mentioned as a significant factor in the grain price surge.

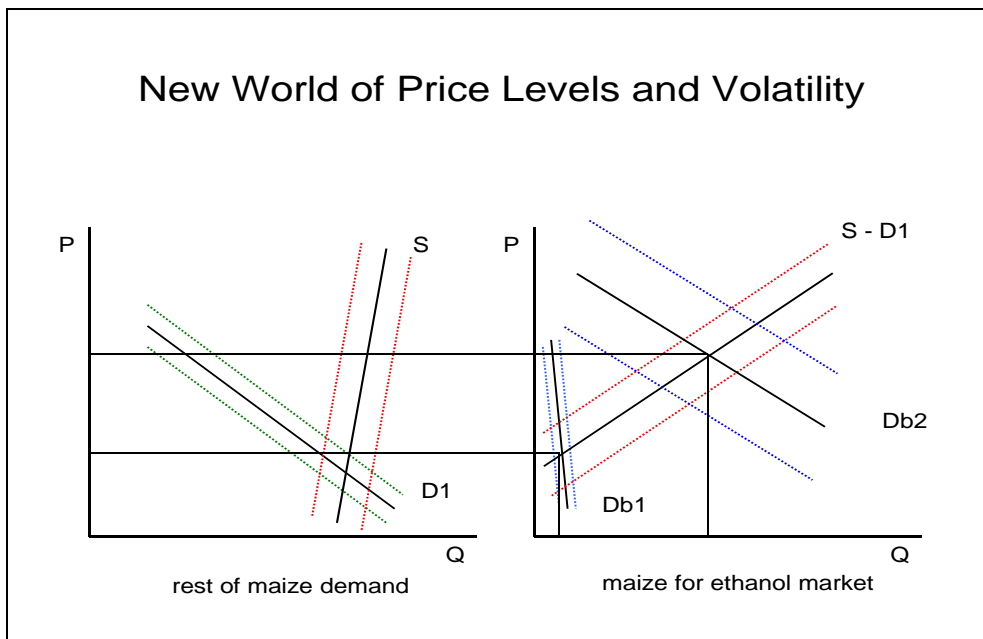
Much attention has been given in various food price analyses to the role of biofuels policies, especially those in the US and the EU. In fact, the use of crops for biofuel and more generally bioenergy production has been on the rise in recent years in response to both increased energy prices and rising concern about green house gas emissions arising from fossil fuel consumption. Many countries have biofuel production activities, including Argentina, Canada, and China; but the US and Brazil are the largest producers of ethanol; and the EU is the largest producer of biodiesel, though still at a much smaller scale than the ethanol industry in the US and Brazil (Trostle).

Since the US is the largest ethanol producer and has been the focus of most of these studies, we look primarily at the US maize ethanol industry. Maize ethanol is not a new product in the US market nor a new area of economic research, but until recently it was a very small and stable component of grain market demand. In this initial phase of development, maize based ethanol production had only a minor impact on commodity market behavior. However, the maize market has gone through a remarkable behavioral transformation in the past few years.

The main growth in this market began in 2005/06, the “golden year” of maize biofuel profits, when the combination of a new biofuel use mandate, the continued ethanol blenders’ tax credit of \$0.51 per gallon (\$0.130/liter) and import tariff on ethanol of \$0.54 per gallon (\$0.138/liter), the rapid phase-out of MTBE as a fuel oxygenate and rising petroleum prices guaranteed high profits and stimulated a rapid expansion of the industry. The next phase was inaugurated through the effects of the 2007 Energy Independence and Security Act (EISA), which introduced a much higher maize biofuel mandate and will change the fundamental behavior of the market if and when the new mandate becomes a binding constraint. The mandate has not yet been binding, because oil prices have been high; but at lower oil prices it could be binding in the near future.

Ethanol production from maize boomed in response to increased incentives, guaranteed demand levels and increased profitability. Petroleum prices became a very important demand shift variable for maize because of its effect on ethanol prices. This introduced a new and significant source of price volatility into the maize market and any other crop and livestock markets that are closely linked to maize. The growth in the biofuel sector, which has drawn agriculture and energy markets more closely together, raised commodity prices, and injected energy market volatility into agriculture markets as seen in figure 27. An additional stochastic element is added through the larger role of maize used for ethanol and the impact of oil price on that demand. Over certain ranges, and in the long run, demand for feedstocks to produce biofuels may be highly elastic and stabilize maize prices with respect to shocks that originate in agricultural markets. But the price level at which the commodity is stabilized is dependent on the price of petroleum and therefore subject to its fluctuations. The net effect on commodity price volatility remains uncertain. This long run representation also fails to explain observed fluctuations in the relationship over a shorter time frame. Factors relating to supply and demand are more constrained in the short run, and thus the linkages of petroleum to commodity prices may be quite different.

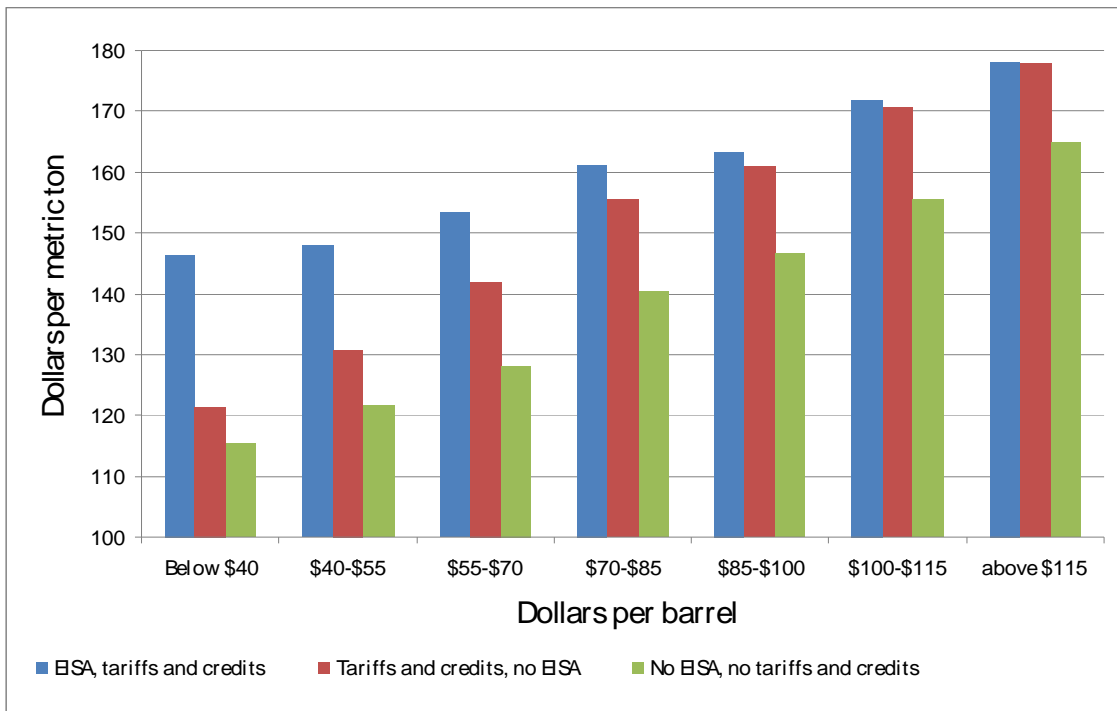
Figure 27. Increased market volatility due to biofuel/energy nexus



EISA added a set of layered mandates to the existing tax credit given to biofuel blenders. The mandates extend out to 2022 for four classes of biofuels to be used in the motor fuel supply and are broken out primarily based on feedstock and green house gas reduction characteristics. At high enough oil prices or low enough feedstock prices, the mandates have little effect, as the market will clear at volumes above mandated levels. This has so far been the case, since mandates have not yet been binding. However, at lower oil prices or higher feedstock prices, the mandates may become binding. In these situations the blenders' tax credit induces no additional production, and the mandate largely disconnects the link biofuels generate between commodity markets and energy price movements. Because feedstock demand for maize becomes invariant to ethanol and commodity prices when mandates are binding, the price effect of any significant supply shock also will be amplified.

An examination of biofuels policies under alternative petroleum prices (figure 28), shows the possible effects on commodity price volatility (Thompson et al 2008). The blenders' tax credit and tariff increase the size of the ethanol industry and raise commodity price levels at all petroleum prices but have greater impacts at higher prices. When the mandate provisions in the EISA are added, the partial unlinking of petroleum and ethanol prices occurs. At low petroleum prices, the mandates support ethanol production and therefore maize prices, when compared to other scenarios where mandates are absent. At high petroleum prices, the mandate is not binding and the maize price is nearly invariant with respect to existence of the mandates. The mandates then may be thought of as limiting the downside effects of petroleum price variation on commodity prices or a kind of buffer against low oil prices. This may be important in the near future, since declining oil prices may lead to binding mandates as early as 2009.

Figure 28: Maize price by oil price, 2015/16 crop year



Source: Thompson, Meyer and Westhoff.

Many analysts attempted to calculate the contribution of biofuel use of grains and/or oilseeds to the food price increases that have occurred. Since the growth of the biofuels industry is driven by the energy market as well as by policies, the most reliable approach is to ask what biofuel production and grain prices would be if there were no supporting measures. That is, what if the use of crops for biofuel production were driven only by energy prices in the market? FAPRI ran scenarios at different petroleum prices (FAPRI, 2008) to see the price impacts of removing the US support policies from a “full policy” base or adding them to a “no policy” base. What is clear from the results is that the blenders’ tax credit of \$0.51 per gallon of ethanol and the \$0.54 per gallon import tariff on ethanol have less impact than the mandate when oil prices are low, and a greater impact than the mandate when oil prices are high (table 3). This is because at high oil prices, the mandate has little impact on the level of maize use for ethanol production.

These results cannot be extended to all ranges of possible prices, because clearly the market behaviors are quite different depending on the starting point or context. However, it is clear that with low petroleum prices, supporting policies can increase or decrease maize prices by 5-15 percent by stimulating the level of maize use for ethanol. It impacts prices of other commodities by a lesser amount through supply and demand linkages such as competition for land and substitution in feed use. It is also clear that the impacts are different and generally smaller at higher levels of petroleum prices. Finally, one can conclude from this analysis that simply eliminating these support policies would not eliminate biofuel production and would reduce maize or grain prices by 15 percent or less, which is significant, but does not represent a major part of the price surge. Note that all model analyses are looking at the

season average price, which in volatile years moves about half as much as the monthly prices (Annex Figure).

Table 3. Impact on maize price of US policy change under different oil prices

Petroleum price	percent change in maize price, average 2008-2017	
	\$67/bbl	\$107/bbl
<i>Start from current policy</i>		
Credit and tariff expire	-3.6	-6.0
Mandate expires	-6.2	-0.4
All policies expire	-14.1	-9.4
<i>Start from no support</i>		
Add credit and tariff	9.2	9.9
Add mandate	12.2	3.8
Add all policies	16.4	10.4

Source: FAPRI, June 2008.

Another analysis of removing subsidies and tariffs (but not mandates and targets) was conducted for ethanol and biodiesel in all producing countries (FAO, 2008h). These policies include ethanol import tariffs of the US (\$0.138/liter) and of the EU (0.26 \$/liter), and the blender's tax credit in the US. Brazil has no subsidies, and other producers are quite small in comparison with these three. Removal of all these tariffs, subsidies and tax credits, leads to more than 13 billion liters reduction in ethanol production and consumption (10-15 percent) and 3.3 billion liters reduction in biodiesel production and consumption (15-20 percent) and a reduction of about 5 percent in maize and vegetable oil prices. These magnitudes of price impact, though they include biodiesel and other countries as well as the US, are similar to the results of FAPRI in removing the ethanol tax credit and tariff in the US only.

An analysis by OECD (August 2008) approached this analysis differently by holding biofuel production in all countries constant from 2007 to 2017. Such an assumption does not reveal how that freeze would be achieved but resulted in maize and vegetable oil prices about 15 percent lower and wheat five percent lower than in the unconstrained projection. The other model-based analysis of this question was by IFPRI, which compared actual biofuel production from 2000-2007 to a scenario where biofuel production in all countries grew as slowly as it had up to 2000. This scenario resulted in cereal prices that were about 10 percent lower in real terms (Rosegrant, 2008). IFPRI also analyzed a freezing of biofuel production worldwide, similar to the OECD scenario, which reduced projected maize prices by six percent in 2010 and 14 percent by 2017. Its effect on wheat and vegetable oils was estimated to be less than half of these percentages.

So the IFPRI, FAO, FAPRI and OECD model analyses suggest that the price impacts of biofuel production growth or of biofuel support policies could change maize prices 15 percent or less and other

crops to a lesser extent, though IFPRI is the only one of the three studies that was conducted over the actual historical time period. FAPRI and FAO are the only analyses that focused on eliminating support policies, while the others postulated alternative biofuel production paths. These scenarios do not eliminate biofuel production completely, since biofuel production is also driven by rising petroleum prices. Also, if there had never been biofuel support policies, the impact likely would have been greater, since the policies surely encouraged investment in expansion of the industry in the first place. To assess the outer bound of biofuel impacts, IFPRI estimated the price impacts of eliminating biofuels production around the world and found a price reduction for maize of about 20 percent, and half that for wheat and sugar.⁴ Finally, it should be noted that the significant declines in short run commodity prices since July 2008 seem more related to movements of crude oil prices and exchange rates than to biofuel policies, which have not changed at all in this period.

Possible persistence of factors

We now turn our attention to the task of looking ahead. If this was a perfect storm, it has passed, short run commodity prices have been declining; and the question is whether and how the future may be different or similar to this volatile period. By definition, a perfect storm is a rare event; and that also seems to be the case here. It does not mean such a price surge cannot happen again, but it is not the norm. Since early to mid 2008, monthly and daily petroleum and agricultural commodity prices have fallen from their peaks to levels that existed in mid 2007, so is it time to exhale or will the slightest weather event or market shock send them into orbit again? We address this by looking at each of the major factors and assessing whether it is likely to be persistent, temporary, or completely uncertain.

Yield and production shortfalls—Poor weather and disease are generally considered to be temporary setbacks and have usually been a one year phenomenon and very seldom more than two. The natural disasters may be more frequent and extreme now and in the future due to climate change according to IPPC (IPPC 2007, page 299), but this factor is expected to be sporadic and short-lived even if the frequency of production setbacks were to be higher than in the past. In 2007/08 world grain production increased more than a five percent split almost evenly between area growth and yield growth. Projections for 2008/9 anticipate nearly a four percent grain supply increase (eight percent for wheat) and a very modest increase in stocks. However, this is not the type of increase in stocks that would be enough to calm markets or significantly moderate another demand or supply shock. High prices are already doing their work of inducing increased planting and higher yields, though they are being partially offset by production costs, such as fertilizer and fuel that rose with energy costs.

Export restrictions and import barrier reductions—Most of the export restrictions have already been removed or reduced. It is anticipated that most of these export and import measures were seen as temporary safeguard measures and would not be maintained for a long time. China has kept export

⁴ The highest reported estimate of biofuel impacts on commodity prices increases was 70-75 percent (Mitchell, 2008), but this was not a model-based estimate and moreover was not only the impact of biofuels, but as the author states “was due to biofuels and the related consequences of low grain stocks, large land use shifts, speculative activity and exports bans”. All of these “consequences” cannot be attributed solely to biofuels or biofuel policies.

restriction measures mostly by eliminating the value added tax rebate, which has the effect of charging the same VAT on export and domestic sales. Argentina also maintains its export taxes, though further increases were successfully blocked by farmer protests. Most of the other export restrictions were temporary in nature and are now suspended. Argentina and other exporters who tax or restrict exports to dampen domestic grain prices have thereby also constrained the incentives for their producers to increase production. The same holds for importers who tried to dampen the transmission of rising internal prices to their domestic markets. In the past, WTO has focused mainly on measures which depress world prices, such as export subsidies and import tariffs or restrictions; and the disciplines regarding limiting exports or enhancing imports are weak or non-existent. There is weak language discouraging export restrictions in Article 12 on *Disciplines on export prohibition and restrictions* of the URAA, so it is not likely that any of the recent measures could be successfully challenged (Sharma and Konandreas 2008). Thus, in the event of another food price surge, there is little except diplomatic pressure to prevent similar disruptions from happening again.

Dollar depreciation, petroleum price and the financial crisis—The dollar recently has been appreciating and oil prices are weakening substantially, continuing the parallel movement that we have seen during most of this decade (figure 15). As emphasized in the foregoing analysis, these are very important factors in determination of commodity prices and in explaining the price surge. However, we put them in the “uncertain factor” category, because it would be difficult to predict which way they may move and when. The growing crisis in financial markets is just adding another level of risk and uncertainty to this highly volatile mixture and is adding trade financing to the list of market disruptions. The widespread slowdown in economic activity around the world certainly reduces the likelihood of higher oil prices; but in our price projections reported below, we show alternative commodity price developments under differing oil price scenarios.

“Speculative” activity—The participation of noncommercial traders may be as erratic or uncertain as currency and petroleum prices, so it is likely that this aspect of market behavior will continue as in the recent past. Their participation has diminished recently as oil and commodity prices have declined, but it is equally likely that they could increase again in the future.

Low stocks and stock/use ratios—The current outlook for the 2008/09 harvest of grains and oilseeds in the temperate countries shows good production increases, so we have already seen a softening of prices and expectations of a slightly larger stock carryover at the end of this year. However, even if this projection proves to be correct, it would take several good years like this one to make a significant increase in levels of carryover stocks. So this likely to be is a medium-term issue that may take years of average or better than average production or some as yet unexpected drop in consumption growth.

Investment deficit in agriculture —As already mentioned, declining real prices may have contributed to the investment deficit even in developed countries. Though the market incentives are clearly better in the current situation, this investment deficit will be a long-term problem. It takes decades to see the returns to agricultural R&D, because part of the deficit is the lack of institutional

capacity that takes time to build. Short-term response to higher prices will be limited, meanwhile, to increased land and input use and expanded exploitation of currently existing technologies.

Long-term demand growth—Clearly a persistent factor, the rate of growth in demand for feed, food, seed and industry (excluding biofuels use) will depend upon population and income growth rates and is the most stable part of the market picture. The main uncertainty will be the possible downturn in economic performance due to the current financial market crisis, which would further reduce pressures on commodity prices.

Biofuel production and support measures—The existence and growth of this industry is a persistent factor, since there is every expectation that it will continue to grow over time and its growth will be strongly linked to the price of petroleum as well as to various support measures. The only recent policy change in the US was to reduce the blenders' tax credit from \$0.51 to \$0.45 per gallon. While the highly elastic demand for biofuel feedstocks might be thought of as a price stabilizer, the tighter linkages between highly volatile petroleum price and commodity prices as well as short run structural and policy constraints may add to commodity price volatility. Determining which factor is playing the primary role is highly dependent on the short run market context, such as the level of petroleum prices and whether or not the mandate is binding. While the effect on commodity price levels may be clearer, the net effect on price volatility remains uncertain. The EU also has not changed biofuel policies, but they are under review and it is not yet clear yet how current targets would be achieved or how strictly they will be enforced.

Implications for the future

We have described a rather rapid transition from the decades-long period of falling real prices of grains and food more generally to a new market environment in which commodity and food prices are, higher, more volatile and more tightly linked to petroleum prices. Much of the market behavior seen during the past few years is linked to the growing interdependence of energy and agricultural markets. This market behavior and the conditions surrounding it are likely to continue, and the prospects of returning to the patterns of the previous decades are less likely.

We have seen world markets turn around in recent months and many commodity prices have declined significantly from their peaks. However, this evidence of price retreat has yet to appear or is appearing more slowly in many developing countries, as seen in FAO's regional food price update (FAO, Oct 2008). It means that markets that are insulated from or not well integrated with world markets may not in the near-term see the benefits of increased world production or reduced prices in the world market. Moreover, it is clear that rising commodity prices have more impact on food prices of consumers in low income countries than on those in high income countries. Aside from the higher share of income spent on food, the commodity price itself is a larger share of the household food cost in a low income country. An example in table 4 illustrates how a 50 percent increase in a commodity price would translate into an increase from 10-10.6 percent in the share of income spent on food in a high income country, while the same commodity price increase in a low income food deficit country (LIFDC) leads to an increase from 50-60.5 percent in the share of income spent on food in a low income country.

Likewise, the food import bills have grown faster in developing countries (FAO 2008i). The food import bill of developing countries is estimated to increase by nearly 35 percent from 2007-2008 and 32 percent for LIFDCs. This is after another sharp rise the previous year. The scarcity of trade financing during the current financial crises only compounds this problem.

The market conditions that have developed since 2005 and that seem likely to continue, even if food price increases have abated somewhat, raise challenges and offer opportunities. The challenge is how to provide safety nets for the most vulnerable populations that have been thrust into a much more desperate financial situation because of sharply higher food prices. The opportunity is that higher prices offer a chance to increase incomes from food production in many rural areas where agriculture is the main source of income and employment. To meet these challenges and exploit the opportunities, national and international policy actions are being recommended (FAO 2008a, World Bank 2008, von Braun et al 2008).

Table 4. Impact of Food Commodity Prices on Consumers' Food Budgets

	High-income countries	Low-income food-deficit countries
I. Base Scenario		
Income	\$40,000	\$800
Food expenditure	\$4000	\$400
Food costs as % of income	10%	50%
Disaggregate retail food spending (staples vs. non-staples)		
Staples as % of total food spending	20%	70%
Expenditures on staples	\$800	\$280
Expenditures on non-staples	\$3200	\$120
II. Scenario: 50% price increase in staples, partial pass through on staples		
Assumed % pass through	60%	60%
Increase in cost of staples	\$240	\$84
New cost of staples	\$1020	\$364
New total food costs	\$4240	\$484
Food costs as % of income	10.6%	60.5%

Source: Trostle, 2008, page 25.

Recommended short run measures include:

- humanitarian assistance, and expansion of early warning and rapid response capacities
- targeted food production programs with inputs, credit and extension education packages
- international consultations on policy adjustments to relieve food price pressures, such as reduction or elimination of export restrictions
- reconsider subsidies, tariff protection and mandates for biofuel production in view of food security effects

Recommended long-term measures include:

- undertake processes or adopt measures to calm markets and restore trust in the international trading system either through improved multilateral or plurilateral rules and agreements
- complete the Doha Round of trade negotiations and improve disciplines on trade distortions created by export restrictions
- improve existing or create new systems for emergency food-import financing
- develop risk management systems that are accessible to farmers in developing countries
- invest in social protection to protect vulnerable populations
- improve local adaptation and dispersion of currently existing technology
- mobilize investment in agriculture and agricultural R&D
- improved market-oriented regulation of market institutions such as CFTC

It may well be that new international coordination or governance architecture needs to be developed based on knowledge gained during this food price crisis. It is clear that the trading system did not always function well during this crisis and that trust in the market was undermined by the behavior of many market participants. Lessons learned during this crisis can be used to improve institutions or mechanisms or to develop new ones.

Near-term outlook 2008-09 to 2010-11

The near-term outlook was conducted by FAPRI using the latest crop and crop supply, demand and price estimates for the 2008/09 crop year from USDA (USDA 2008) and for the next two years a distribution of FAPRI outlook results around the January 08 oil price forecast of Global Insight, Inc. The USDA supply and demand estimates are issued each month for the current marketing year, and are now showing a significant increase in wheat supply (8.2 percent) and lower but still positive growth in the 1-5 percent range for other grains and oilseeds (table 5). FAO also issued a similar outlook in November, which is slightly more optimistic for rice and coarse grains and less optimistic for soybeans, but has a similar overall picture. These supply increases allow ending stocks to grow only slightly, so there would only be a small improvement in the tenuous market conditions.

The FAPRI model used in the analysis of the next two years is a global, non-spatial, multi-market model covering crops and livestock and the analytical processes have a 25 yearlong history of analysis of agricultural markets and policy. The model is non-spatial in that it does not differentiate products by their origin and is multi-market in its broad coverage of crop and livestock markets as well as biofuel markets and policy coverage. The crops sector is modeled through behavioral equations representing crop acreage, domestic feed, food industrial and biofuel feedstock uses as well as stock holding and trade. Similarly, the livestock sector is modeled through behavioral equations determined by animal numbers, production of meat and dairy products, consumption, stock holding and trade.

Equations in the biofuels sector tie into feedstock demands for grains and oilseeds, and behavioral equations determining ethanol and biodiesel production, consumption and trade (FAPRI, 2008). The model solves for the set of prices that brings annual supply and demand into balance in all markets and across all countries. Because the biofuels industry is rapidly growing and very little data is available for the period of rapid expansion, many of these equations are synthetically derived by using knowledge of the technical relationships in the industry, making elasticity assumptions and calibrating to recent history. To be able to analyze alternative proposals, the FAPRI baseline assumes a continuation of current policies and then modifies those assumptions for scenario analysis.

Given the highly uncertain outlook on petroleum prices in the outlook and the important linkages between oil and commodity prices, these commodity price projections are provided from the stochastic model so that alternative price paths could be provided for three different petroleum price scenarios. The stochastic model is a simplification of the larger FAPRI deterministic model and adds ‘uncertainty’ to the model by drawing on the historical ‘misses’ of the behavioral or yield equations. In this way there is

a selective distribution of possible outcomes under different settings, be they yields, energy prices, or other factors. This uncertainty is important in understanding many agricultural policies and market

Table 5. USDA estimates for world supply and use changes 07/08 to 08/09⁵

	Million units		07/08 to 08/09		FAO
	2007/08	2008/09	change	% change	% change
Wheat					
Area (hectares)	217.5	223.7	6.2	2.9%	
Beginning stocks (metric tons) 3	127.0	119.4	-7.7	-6.0%	-3.0%
Production (metric tons)	610.6	682.4	71.8	11.8%	10.9%
Supply (metric tons)	737.6	801.7	64.1	8.7%	8.0%
Exports (metric tons) 1	115.4	124.0	8.6	7.5%	7.0%
Consumption (metric tons) 2	618.2	658.5	40.3	6.5%	4.5%
Ending stocks (metric tons) 3	115.4	145.3	25.9	21.7%	20.3%
stocks to use ratio	0.19	0.22			
Coarse grains					
Area (hectares)	316.9	312.8	-4.1	-1.3%	
Beginning stocks (metric tons) 3	138.6	154.1	15.5	11.2%	4.3%
Production (metric tons)	1077.9	1091.7	13.8	1.3%	3.3%
Supply (metric tons)	1216.5	1245.9	29.3	2.4%	3.5%
Exports (metric tons) 1	123.6	110.5	-13.2	-10.7%	-11.9%
Consumption (metric tons) 2	1062.4	1095.0	32.5	3.1%	3.3%
Ending stocks (metric tons) 3	154.1	150.9	-3.2	-2.1%	1.9%
stocks to use ratio	0.15	0.14			
Rice, milled					
Area (hectares)	155.0	156.9	1.9	1.2%	
Beginning stocks (metric tons) 3	75.4	78.4	3.0	4.0%	4.5%
Production (metric tons)	431.0	434.3	3.3	0.8%	2.4%
Supply (metric tons)	506.3	512.7	6.3	1.3%	2.8%
Exports (metric tons) 1	30.4	29.9	-0.5	-1.7%	-1.6%
Consumption (metric tons) 2	427.9	432.1	4.1	1.0%	1.8%
Ending stocks (metric tons) 3	78.4	80.6	2.2	2.8%	5.6%
stocks to use ratio	0.18	0.19			
Total grains					
Area (hectares)	689.4	693.4	4.0	0.6%	
Beginning stocks (metric tons) 3	341.0	351.9	10.9	3.2%	1.6%
Production (metric tons)	2119.5	2208.4	88.9	4.2%	5.3%
Supply (metric tons)	2460.5	2560.3	99.8	4.1%	4.7%
Exports (metric tons) 1	269.4	264.3	-5.1	-1.9%	-3.0%
Consumption (metric tons) 2	2108.6	2185.5	77.0	3.6%	3.3%
Ending stocks (metric tons) 3	347.9	376.8	24.9	7.1%	9.4%
stocks to use ratio	0.16	0.17			
Soybeans					
Beginning stocks (metric tons) 3	62.7	53.0	-9.6	-15.4%	
Production (metric tons)	220.9	235.7	14.9	6.7%	
Supply (metric tons)	283.6	288.8	5.2	1.8%	
Total Use (metric tons)	230.0	234.0	4.0	1.7%	
Exports (metric tons)	79.4	77.9	-1.6	-2.0%	
Ending stocks (metric tons)	53.0	54.1	1.0	1.9%	

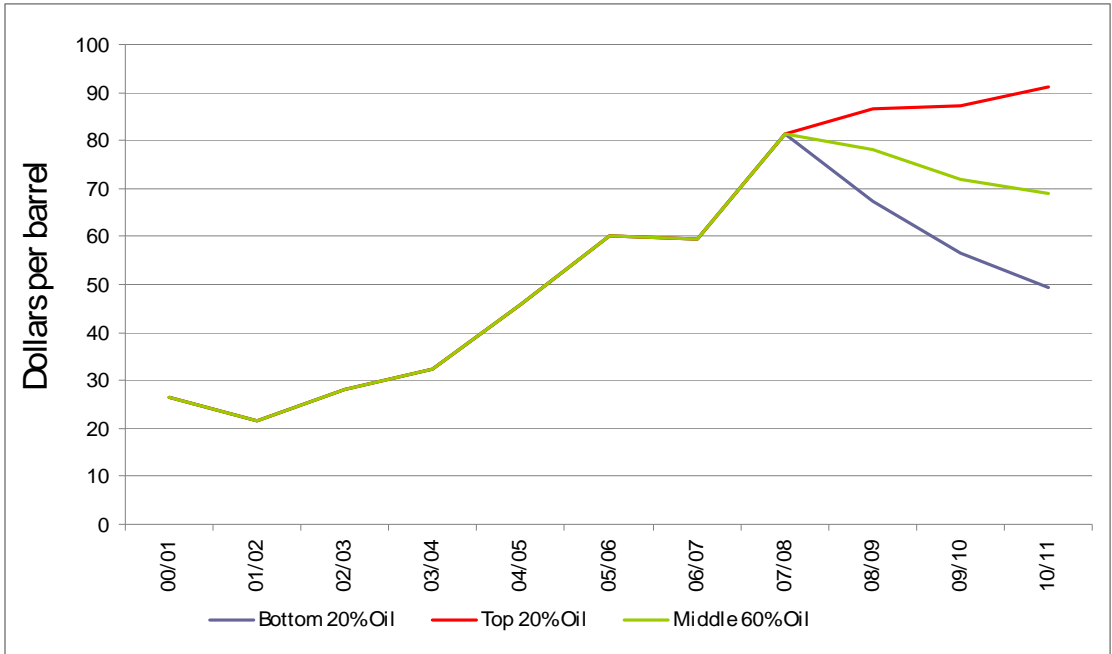
⁵ WASDE, USDA, November 10, 2008 and Food Outlook, FAO, November 2008.

stocks to use ratio	0.23	0.23
---------------------	------	------

behaviors which have non-linear responses (Westhoff, 2006). World prices are estimated from US farm price by taking into account historical relationships in the marketing chain and the increased transport costs associated with rising energy prices (figure 22).

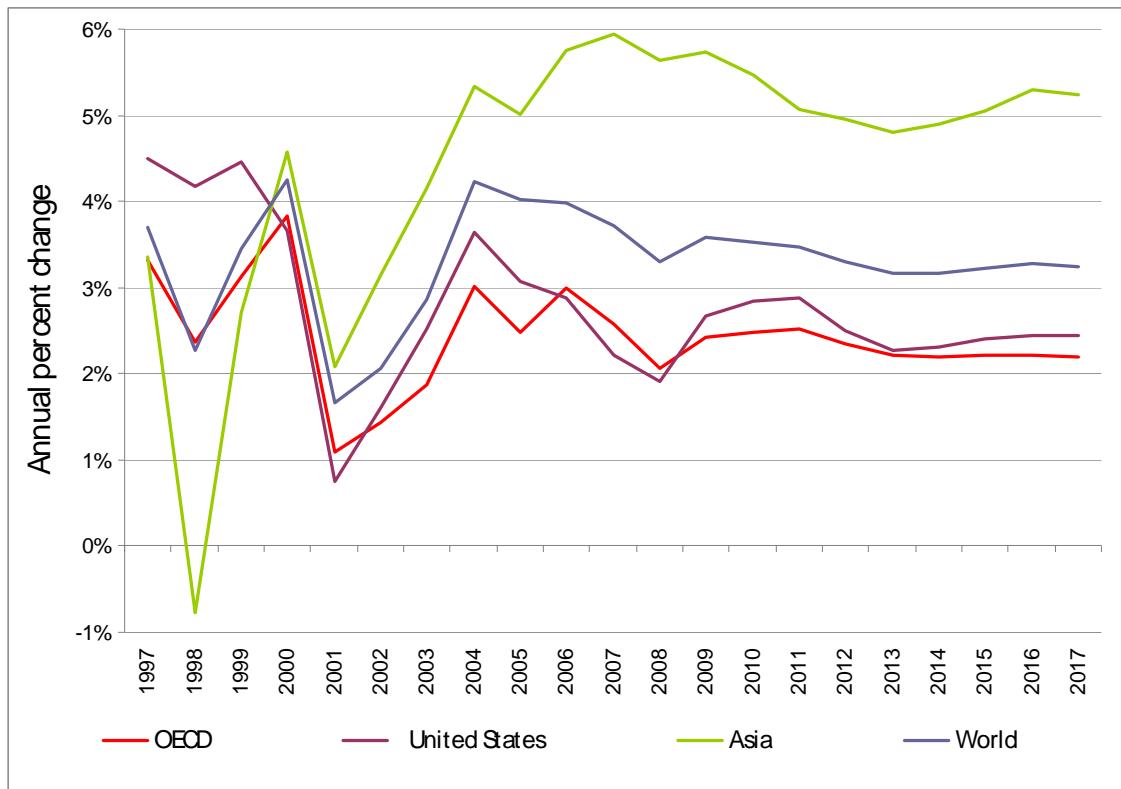
The stochastic analysis provides 500 solutions to the model based on random selections from the error distributions. We report results which are the average of those outcomes generated over the next 10 years by the top 20 percent of petroleum prices, the middle 60 percent and the bottom 20 percent, which average \$95, \$67 and \$48, respectively. Over the three years 2008 to 2010, the refiners acquisition price averages diverge from a low of \$49 to a high of \$91 (figure 29), which are close to the 10-year averages for the whole projection period. Given recent developments in petroleum prices, this seems a reasonable range to use. The macroeconomic outlook assumed in the baseline that generated these price results are clearly optimistic now that the global economy has slowed and may slow further (figure 30). Given these assumptions, we can briefly review some key prices of grains and oilseeds.

Figure 29. Refiners acquisition price of oil assumptions for alternative price projections



Source: Derived from FAPRI 2008a.

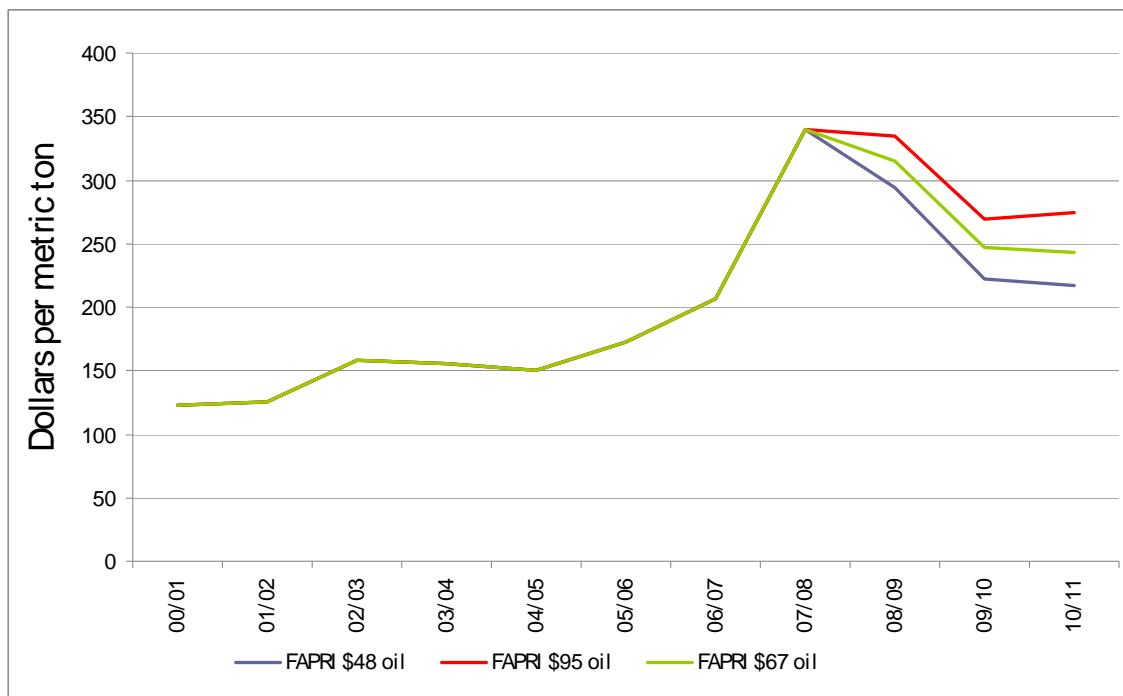
Figure 30. Real GDP growth assumptions for the 2008 Baseline, selected countries



Source: Global Insight, Inc. January 2008.

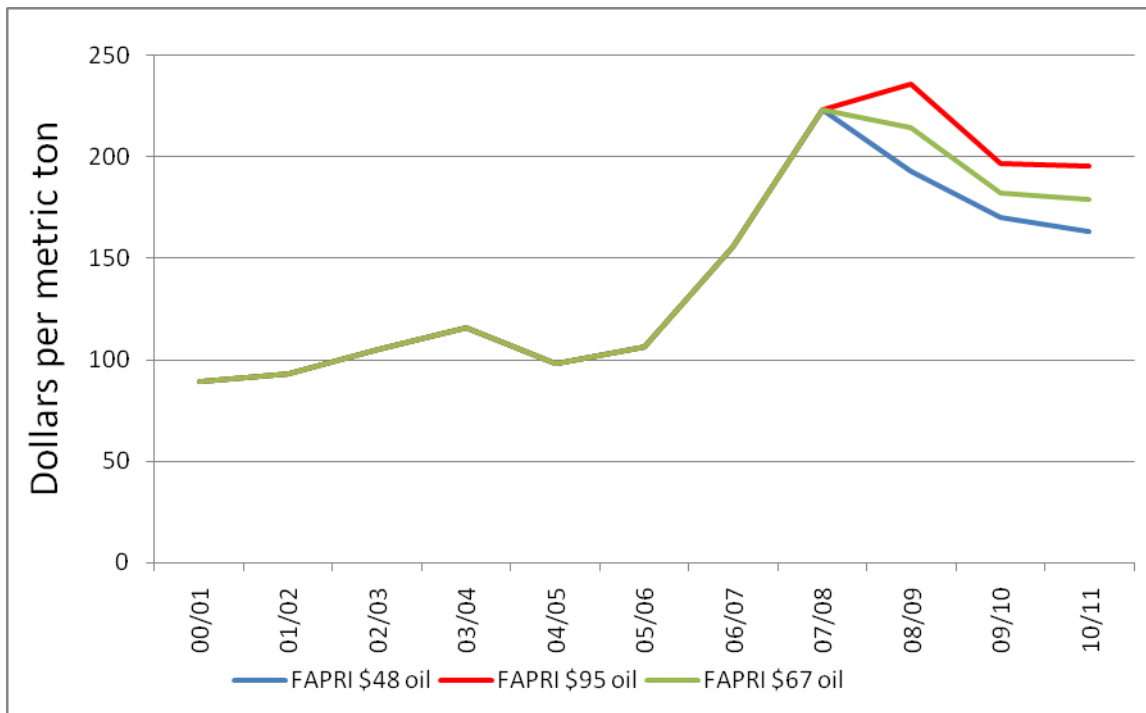
The 2007/08 prices are the last USDA estimates, and the 2008/09 are the top, bottom and average of the range reported by USDA in the last estimate on November 10. All prices are in nominal terms. The remaining prices come from the model as generated by the stochastic simulations (figures 31-36). Wheat and maize prices fall almost back to 06/07 levels in the low oil price scenario, which would be a decline of 37 and 28 percent, respectively, from 07/08 levels. In the high oil price scenario, the drop is 11 and 21 percent, respectively. Rice price projections fall at most 12 percent, and in the high oil price scenario hardly fall at all. Soybean price drops by 18 percent in the low oil price scenario to less than five percent in the high oil price scenario. Of course, soybean price is driven by oil and meal prices. As in the recent past, vegetable oil is the strong demand component and only declines slightly in the low oil price scenario. Since the stronger demand growth is on the oils side, meal declines in all scenarios and by 25 percent in the lowest oil price case.

Figure 31. Short term projection of US Export Prices of Wheat



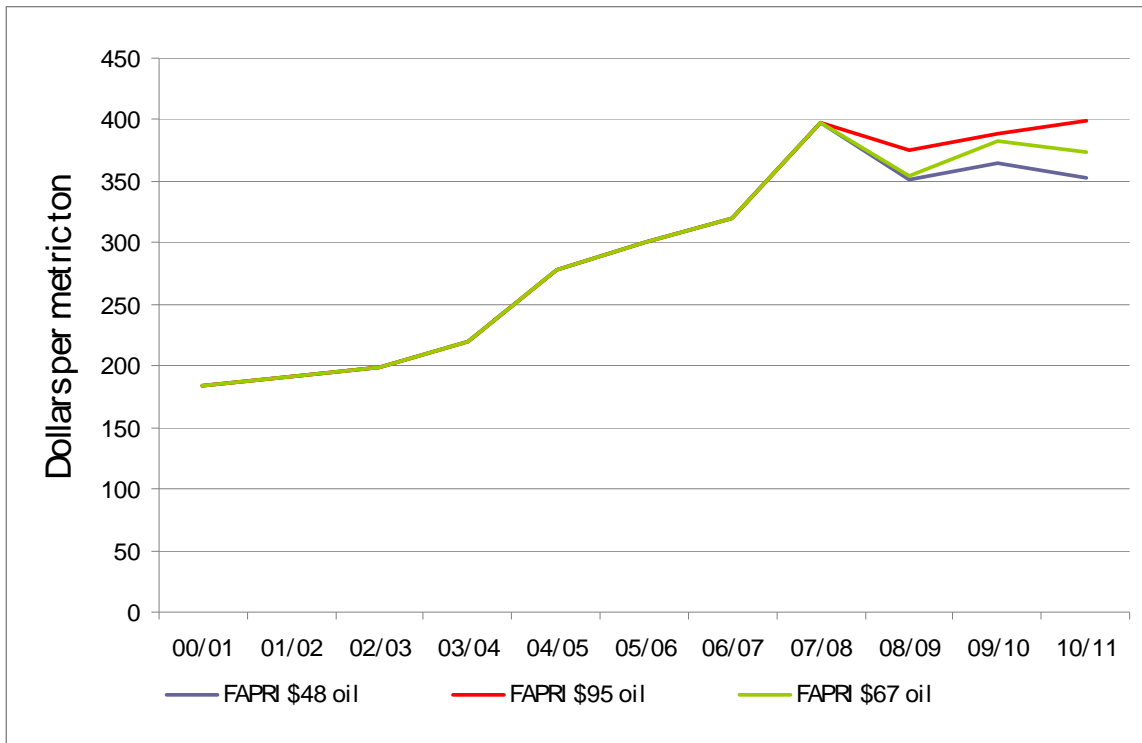
Source: Derived from FAPRI 2008a.

Figure 32. Short term projection of US Export Prices of Maize



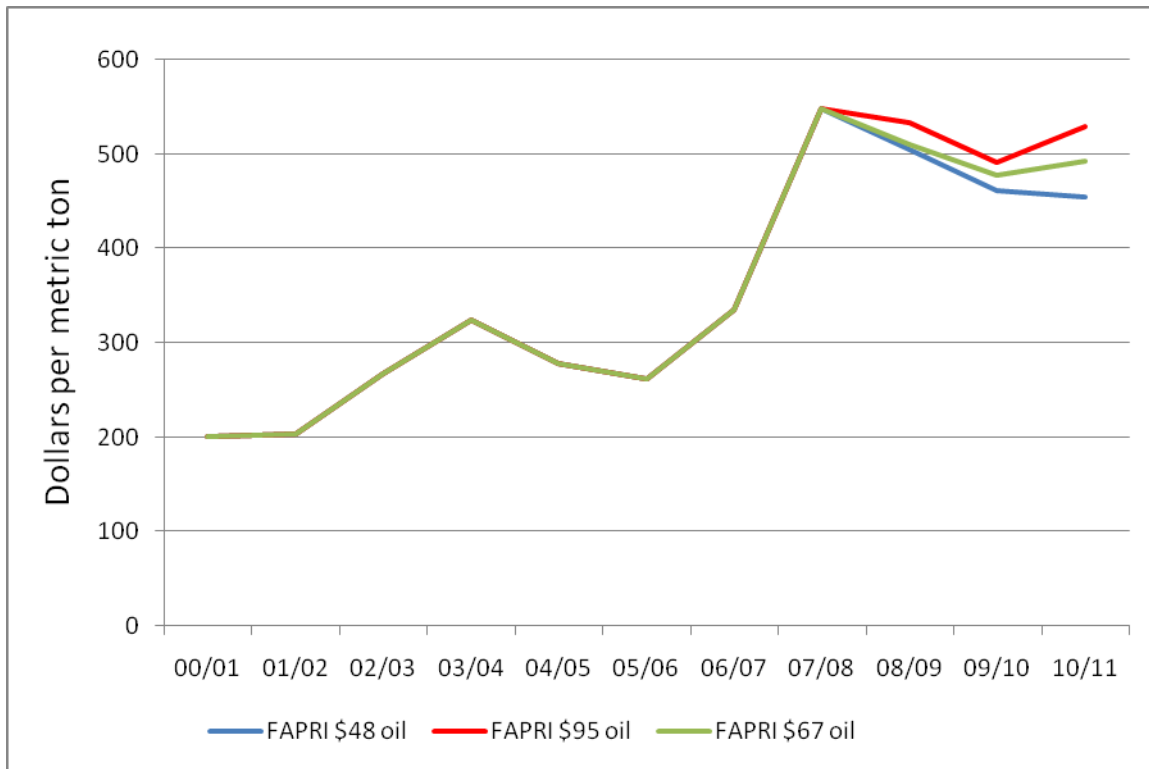
Source: Derived from FAPRI 2008a.

Figure 33. Short-term projection of US Export Prices of Rice



Source: Derived from FAPRI 2008a.

Figure 34. Short-term projection of US Export Prices of Soybeans



Source: Derived from FAPRI 2008a.

Figure 35. Short-term projection of US Export Prices of Soybean Oil



Source: Derived from FAPRI 2008a.

Figure 36. Short term projection of US Export Prices of Soybean Meal



Source: Derived from FAPRI 2008a.

Given the way prices have already fallen recently, these all seem quite realistic and could even be lower than these results suggest. The reason is that the macroeconomic outlook is surely less optimistic in the near term than those shown in figure 30, where world GDP growth is more than 3.5 percent in 2010. This implies that the lower end of the commodity price distributions may be more likely than the upper one, given the less favorable macroeconomic outlook. The caveat on the opposite side is that high input prices may discourage plantings in 2009 and thereby slow the production response that has been underway. In any case, the two most important drivers of this near-term outlook are the level of petroleum price and supply response that has been generated by high prices and favorable weather so far this year.

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Annex Tables

Table 1. Regional Grain Consumption and Production Changes, 2005/06 to 2007/08

	05/06	07/08	Change	%Change		05/06	07/08	Change	%Change
5 Grain Consumption	(million metric tons)				5 Grain Production	(million metric tons)			
Australia	12.5	12.5	0.0	-0.4%	Australia	37.7	22.1	-15.6	-41.5%
Brazil	60.9	63.4	2.5	4.1%	Brazil	56.4	72.7	16.4	29.0%
Canada	29.0	27.9	-1.1	-3.9%	Canada	46.8	42.7	-4.1	-8.7%
China, Peoples Republic of	374.6	386.3	11.8	3.1%	China, Peoples Republic of	369.2	396.6	27.4	7.4%
EU-27	246.4	242.6	-3.8	-1.5%	EU-27	250.0	226.6	-23.4	-9.4%
India	178.0	192.4	14.4	8.1%	India	184.0	200.7	16.7	9.1%
Japan	34.0	33.4	-0.6	-1.9%	Japan	9.3	9.0	-0.3	-3.1%
Mexico	44.3	47.3	2.9	6.6%	Mexico	29.0	33.4	4.5	15.5%
Ukraine	22.6	24.0	1.4	6.2%	Ukraine	34.9	27.4	-7.5	-21.6%
United States	276.7	306.7	30.1	10.9%	United States	361.3	412.1	50.8	14.1%
Rest of World	653.6	676.7	23.1	3.5%	Rest of World	554.3	583.8	29.5	5.3%
World	1932.7	2013.3	80.7	4.2%	World	1932.8	2027.1	94.3	4.9%
5 Grain Feed Use									
China, Peoples Republic of	106.3	111.7	5.4	5.1%					
ROW	615.4	625.2	9.7	1.6%					
World (30%)*	721.7	736.9	15.1	2.1%					
5 Grain Food, Seed, & Industrial Use									
United States	107.6	143.1	35.6	33.1%					
US Maize Ethanol (70%)*	28.5	53.3	24.8	87.1%					

Source: PSD database for maize, wheat, sorghum, barley and rice, USDA.

*30 percent of the maize for ethanol volume is the byproduct distiller's dried grains (DDGs), which is used for feed. Thus in order to correctly reflect feed and other uses, we count 70 percent of the volume as used for ethanol (industrial use of maize) and 30 percent for feed.

Table 2. Regional Rice Consumption and Production Changes, 2005/06 to 2007/08

	05/06	07/08	Change	%Change		05/06	07/08	Change	%Change
Rice Consumption	(million metric tons)				Rice Production	(million metric tons)			
Australia	0.4	0.4	-0.1	-12.5%	Australia	0.7	0.0	-0.7	-97.3%
Brazil	8.5	8.4	0.0	-0.3%	Brazil	7.9	8.4	0.5	6.1%
China, Peoples Republic of	128.0	127.3	-0.7	-0.5%	China, Peoples Republic of	126.4	129.8	3.4	2.7%
EU-27	2.7	2.8	0.1	3.7%	EU-27	1.7	1.7	-0.1	-2.9%
India	85.1	90.8	5.7	6.7%	India	91.8	96.4	4.6	5.1%
Japan	8.3	8.2	-0.1	-1.2%	Japan	8.3	7.9	-0.3	-4.0%
Mexico	0.8	0.8	0.0	-2.1%	Mexico	0.2	0.2	0.0	7.7%
United States	3.8	3.9	0.1	2.8%	United States	7.1	6.3	-0.8	-11.2%
Rest of World	174.2	179.8	5.6	3.2%	Rest of World	174.2	178.7	4.5	2.6%
World	411.6	422.3	10.6	2.6%	World	418.3	429.5	11.2	2.7%

Source: PSD database for rice, USDA.

Table 3. Regional Wheat Consumption and Production Changes, 2005/06 to 2007/08

	05/06	07/08	Change	%Change		05/06	07/08	Change	%Change
Wheat Consumption	(million metric tons)				Wheat Production	(million metric tons)			
Australia	6.4	6.2	-0.2	-3.1%	Australia	25.2	13.0	-12.1	-48.2%
Brazil	10.8	10.5	-0.3	-2.8%	Brazil	4.9	3.8	-1.0	-21.5%
China, Peoples Republic of	101.5	104.0	2.5	2.5%	China, Peoples Republic of	97.5	109.9	12.4	12.7%
EU-27	127.5	118.1	-9.4	-7.4%	EU-27	132.4	119.4	-13.0	-9.8%
India	70.0	75.9	5.9	8.4%	India	68.6	75.8	7.2	10.4%
Japan	6.0	6.0	0.0	-0.3%	Japan	0.9	0.9	0.0	4.0%
Mexico	6.1	6.4	0.3	4.1%	Mexico	3.0	3.6	0.6	19.2%
United States	31.4	29.0	-2.4	-7.5%	United States	57.3	56.2	-1.0	-1.8%
Rest of World	258.7	261.2	2.4	0.9%	Rest of World	231.2	228.2	-3.0	-1.3%
World	618.4	617.2	-1.2	-0.2%	World	620.9	610.9	-10.0	-1.6%

Source: PSD database for wheat, USDA.

Table 4. Regional Maize Consumption and Production Changes, 2005/06 to 2007/08

	05/06	07/08	Change	%Change		05/06	07/08	Change	%Change
Maize Consumption	(million metric tons)				Maize Production	(million metric tons)			
Australia	0.4	0.4	0.0	1.4%	Australia	0.4	0.4	0.0	1.8%
Brazil	39.5	42.5	3.0	7.6%	Brazil	41.7	58.6	16.9	40.5%
China, Peoples Republic of	137.0	149.0	12.0	8.8%	China, Peoples Republic of	139.4	151.8	12.5	8.9%
EU-27	61.5	61.5	0.0	0.0%	EU-27	60.7	47.3	-13.4	-22.0%
India	14.2	16.9	2.7	19.0%	India	14.7	19.3	4.6	31.3%
Japan	16.7	16.5	-0.2	-1.2%	Japan	0.0	0.0	0.0	0.0%
Mexico	27.9	32.0	4.1	14.7%	Mexico	19.5	22.7	3.2	16.2%
United States	232.1	264.0	32.0	13.8%	United States	282.3	332.1	49.8	17.6%
Rest of World	175.2	191.3	16.1	9.2%	Rest of World	139.9	158.1	18.2	13.0%
World	704.4	774.1	69.6	9.9%	World	698.5	790.2	91.7	13.1%

Source: PSD database for maize, USDA.

Table 5. Regional Barley Consumption and Production Changes, 2005/06 to 2007/08

	05/06	07/08	Change	%Change		05/06	07/08	Change	%Change
Barley Consumption	(million metric tons)				Barley Production	(million metric tons)			
Australia	3.5	3.2	-0.3	-8.7%	Australia	9.5	5.9	-3.6	-0.4
Brazil	0.6	0.5	-0.1	-11.1%	Brazil	0.4	0.3	-0.1	-0.3
China, Peoples Republic of	5.6	4.3	-1.3	-22.8%	China, Peoples Republic of	3.4	3.2	-0.2	-0.1
EU-27	54.1	54.4	0.3	0.6%	EU-27	54.8	57.7	3.0	0.1
India	1.2	1.1	-0.1	-5.8%	India	1.2	1.3	0.1	0.1
Japan	1.7	1.6	-0.1	-4.2%	Japan	0.2	0.2	0.0	0.0
Mexico	1.0	1.1	0.1	10.5%	Mexico	0.8	0.9	0.1	0.2
United States	4.6	4.4	-0.2	-3.4%	United States	4.6	4.6	0.0	0.0
Rest of World	68.2	66.1	-2.1	-3.0%	Rest of World	62.0	59.0	-2.9	0.0
World	140.2	136.6	-3.6	-2.5%	World	136.8	133.2	-3.6	0.0

Source: PSD database for barley, USDA.

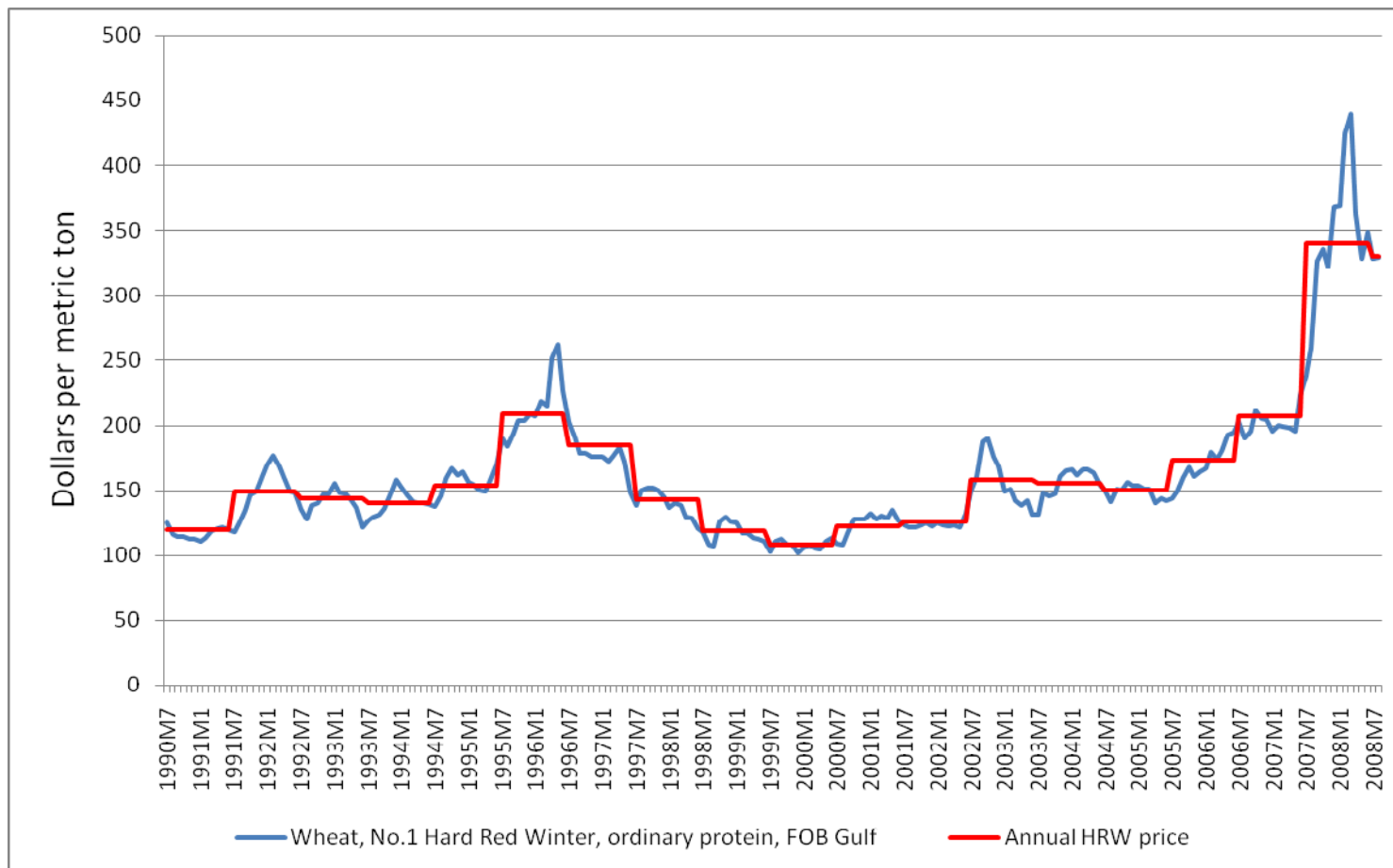
Table 6. Regional Vegetable oil Consumption and Production Changes, 2005/06 to 2007/08

	05/06	07/08	Change	%Change		<u>05/06</u>	<u>07/08</u>	<u>Change</u>	<u>%Change</u>
4 Vegetable Oils									
Consumption	(million metric tons)				Production of 4 Oils	(million metric tons)			
Argentina	0.8	1.3	0.6	72.0%	Argentina	<u>7.5</u>	<u>8.6</u>	<u>1.1</u>	<u>14.3%</u>
Brazil	3.4	4.1	0.7	22.0%	Brazil	<u>5.6</u>	<u>6.3</u>	<u>0.8</u>	<u>13.5%</u>
China, Peoples Republic of	17.5	19.2	1.7	9.9%	China, Peoples Republic of	<u>11.2</u>	<u>10.9</u>	<u>-0.3</u>	<u>-2.6%</u>
EU-27	16.6	17.5	0.9	5.3%	EU-27	<u>10.7</u>	<u>12.0</u>	<u>1.3</u>	<u>12.4%</u>
India	9.0	9.0	0.1	0.7%	India	<u>3.9</u>	<u>3.8</u>	<u>-0.1</u>	<u>-1.9%</u>
Indonesia	4.4	4.8	0.4	10.1%	Indonesia	<u>15.6</u>	<u>18.3</u>	<u>2.7</u>	<u>17.6%</u>
Malaysia	3.0	3.4	0.5	15.1%	Malaysia	<u>15.6</u>	<u>17.8</u>	<u>2.2</u>	<u>14.1%</u>
United States	9.7	10.7	1.0	10.7%	United States	<u>9.9</u>	<u>10.2</u>	<u>0.3</u>	<u>3.0%</u>
Rest of World	31.4	34.6	3.3	10.4%	Rest of World	<u>18.5</u>	<u>19.5</u>	<u>1.0</u>	<u>5.5%</u>
World	95.6	104.8	9.2	9.6%	World	<u>98.4</u>	<u>107.4</u>	<u>9.0</u>	<u>9.2%</u>
Industrial Use of 4 Oils									
United States	0.7	1.4	0.7	93.1%					
EU-27	6.3	7.3	1.0	15.4%					
World	14.8	18.2	3.4	23.2%					
Food and Other Use of 4 Oils									
World	80.8	86.6	5.7	7.1%					

Source: PSD database for soybean oil, sunflower oil, rapeseed oil and palm oil, USDA.

Annex Figure

Wheat annual and monthly prices, July 1991 to August 2008.



Source: IMF commodity price database (monthly) and USDA (annual).