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Managing High and Volatile Food Prices

Will Martin

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by

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Will Martin is an economist at the World Bank, Washington, DC. However, the views expressed in this paper are those of the author alone and should not be attributed to the World Bank.

Author email: wmartin1@worldbank.org
tel: 202-473-3853
fax: 202-477-0569

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Will Martin

World Bank

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Abstract

The recent period of high and volatile food prices has cast doubt on many longstanding assumptions such as the inevitability of declining real food prices, and brought to an end a long period of food price stability. Some of the key driving forces appear to have been declines in yield growth for major commodities and the rapid growth of biofuels. Both high and volatile food prices are justly causes for concern. Key elements of the cure for high food prices include a strong focus on agricultural research and development, as well as rural development more generally, and a reconsideration of the role of biofuels. The best cures for food price volatility aim to reduce it by improving market information and reducing output volatility. Social safety nets are the best policy for coping with its effects, while the widely-used trade and storage policy measures have many complex and uncertain effects.

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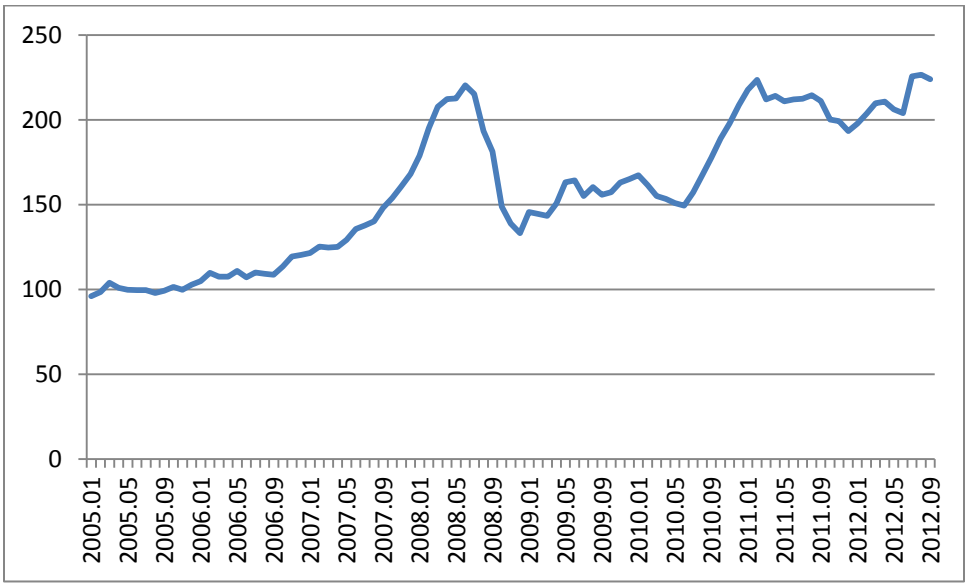
Managing High and Volatile Food Prices

Since 2007, the world prices of key staple foods have been volatile around relatively high levels. This pattern is very different from that prevailing over the past century, during which real food prices trended downwards. It has given rise to very considerable concern, especially about impacts on the poor, but also about macro-economic impacts on poor food-importing countries. While price spikes are frequently intense, these price spikes tend to be infrequent, as noted by Deaton and Laroque (1992) in their characterization of price data for storable commodities as involving long periods in the doldrums punctuated by rare but intense price spikes. By contrast, the four years since 2008 have seen three peaks in food prices—in early 2008, early 2011 and the third quarter of 2012.

Figure 1. The World Bank Food Price Index, 2005=100



Much valuable work is available on the issues considered in this paper, including policy contributions by World Bank (2005, 2007, 2012) and a recent survey by Gouel (2012) focused on food price stabilization. This survey attempts to update our understanding of some key issues, and to introduce new insights from recent research.

As always in economics (or in life more generally) it is important to be clear about the nature of the problem before identifying a solution. In the context of this paper, it is particularly

important to be clear whether the problem is one of high prices or of price volatility. Another question is whether we are concerned about the impact of food prices on individuals directly, or through impacts on macroeconomic performance. Although the focus of this paper is primarily on the direct impacts of food prices on individuals, it is important to keep in mind that the macroeconomic context can affect both policy responses and the impacts of food prices on individuals.

One aspect that this paper does not examine is whether or not there is a "shortage" of food. If prices adjust reasonably freely, as world markets generally appear to do, more rapid growth in the demand for food than in its supply will manifest itself through an increase in price. Price increases can have extremely serious consequences, since the poor tend to be the most vulnerable in terms of securing their access to the food they need. Focusing on the price of food, and on whether vulnerable households can secure access to it, is likely to be a much more fruitful lens than asking whether there are shortages, except in situations where, for some reason, prices are unable to adjust.

Another important question is what is driving the high and volatile prices that the world has experienced in recent years. Are these prices a result of some fundamental factors such as slow growth of productivity and increasing demand growth for food, feed and fuel, or are they the result of speculation in commodity markets? The distribution of prices, including their level, volatility and inter-temporal patterns may be heavily influenced by these fundamental factors.

In the next section of the paper we examine why the prices of storable commodities might have become so high and volatile in recent years. Then, in the third section, we examine why policy makers might be concerned about this development. In the fourth section we turn to potential policy responses.

Why have food prices become so high and variable?

While the main purpose of this paper is to consider managing food price volatility, it is important to briefly review some of the causes, which have important implications for the best policy

approaches to this problem. At least four broad reasons have been offered for the recent episode of high and variable food prices:

(i) Adverse supply developments,
(ii) Strengthening of linkages between grain and energy markets,
(iii) Speculation, and
(iv) Macroeconomic factors.

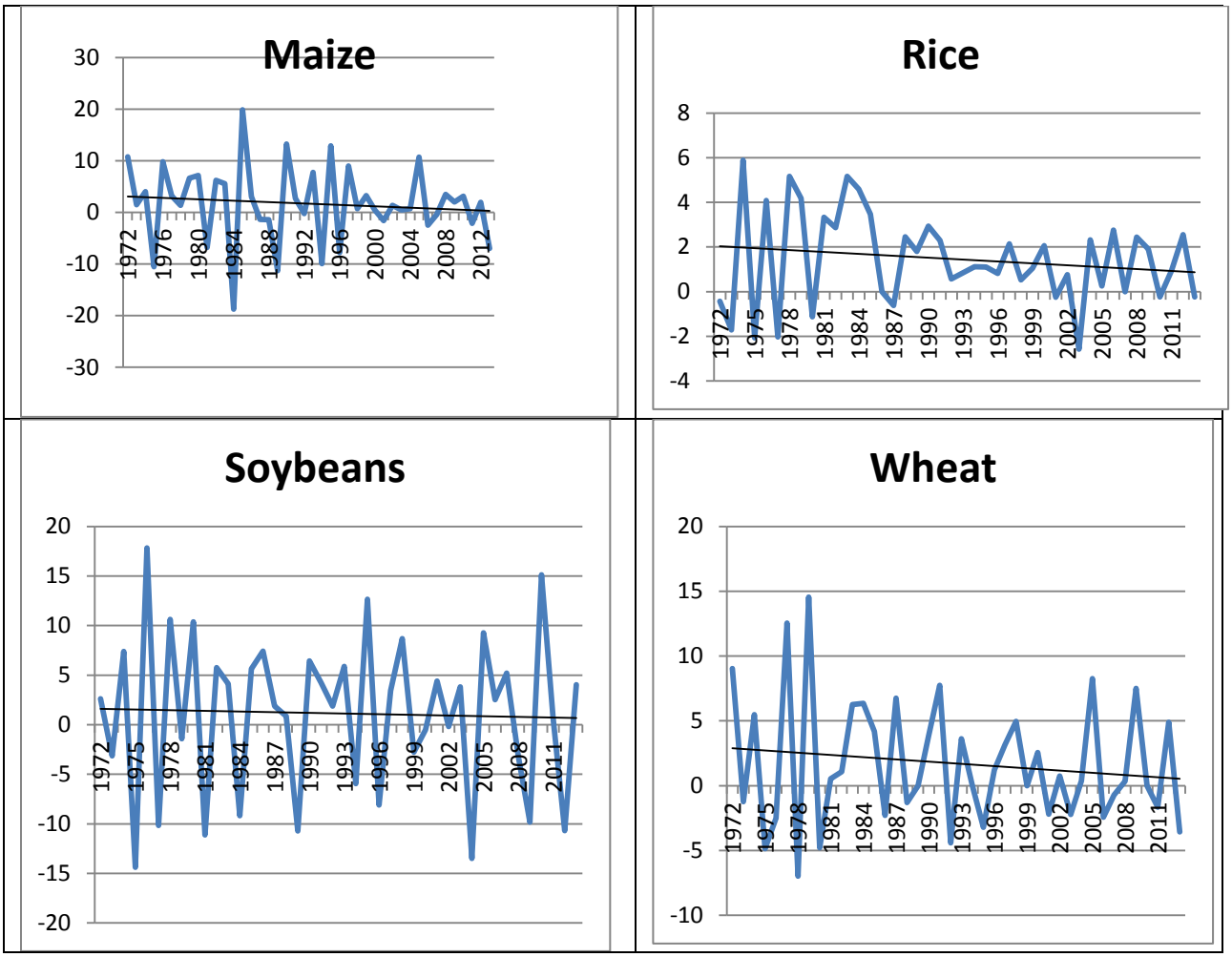
Supply-side developments

The first explanation depends almost solely on developments within the markets for key food staples. Figure 1 reports the annual proportional change in global yields for the four important staples: maize, rice, soybeans and wheat. The average growth rate over the period since 1970 was 1.7 percent per year for wheat and maize, 1.5 percent for rice and 1.1 percent for soybeans. Importantly, however, the growth rate appears to have been declining for the three grains, with the trend growth rate now appearing close to zero for wheat and maize, and half its 1970 level for rice. For soybeans, there is only a slight suggestion of a decline in the trend rate of yield growth. Another important insight from these figures is that there is no indication of any recent increase in the volatility of these growth rates—something that is important since weather shocks that influence yields have frequently been identified as the source of particular price surges. For wheat and rice, the volatility of yield growth appears to have been much lower than in the 1970s, while for maize the period of greatest volatility appears to have been in the 1980s. For soybeans, there has been no obvious change in year to year volatility.

Slowing yield growth is clearly a concern for markets that are coming under pressure, particularly with the emergence of a completely new type of demand in the form of biofuels. While the decline in yield growth is clearly not a shock of the same type as a drought that cuts yields, it is a factor that may have contributed to a gradual decline in stock levels, and hence to an increase in the vulnerability of grain markets to shocks. Fuglie (2008) finds no evidence of a slowdown in the growth of total factor productivity in world agriculture after 1990, and concludes that a major factor limiting output growth has been a reduction the growth rate of inputs, and particularly agricultural capital. Whether the decline in yields is a consequence of

falling productivity growth or falling input use, it appears likely to have been an important contributor to the increases in real food prices in recent years.

Figure 2. Annual yield growth in key staple foods



Note: Calculated using differences in natural logs of world yields from the USDA PSD database

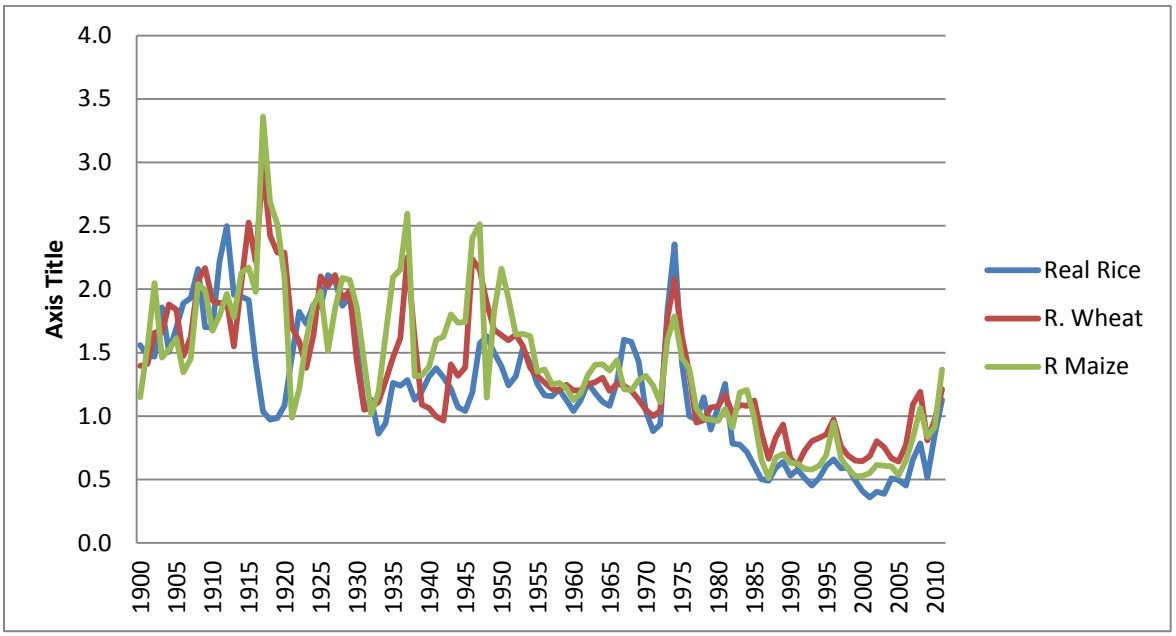
The long-run level of food prices depends fundamentally on the balance between the demand and the supply for food. On the demand side, key factors include population growth; the effects of increasing income on food demand; and rising nonfood demand for industrial uses such as biofuels. As noted by Mitchell (2008), the demand for food grains such as wheat and rice has been growing very slowly, and hence is an unlikely cause of increased prices. Global food and feed demand for maize and soybeans has been somewhat higher, with maize demand

excluding US ethanol demand growing at 2.1 percent per year over the period from 2001 to 2007, and China emerging as a major importer of soybeans.

On the supply side, the limited availability of additional agricultural land in many regions has contributed to relatively slow output growth by ruling out rapid expansion in global arable land. Another potentially important influence on agricultural output has been increases in the overall capital stock associated with high rates of economic growth and investment in many developing countries. Paradoxically, increases in the capital-labor ratio can contribute strongly, through Rybczynski effects, to reducing agricultural output in countries where agriculture is highly labor intensive (Martin and Warr 1993; Gehlhar, Hertel and Martin 1994; Martin and Warr 1994). While this question has not been investigated in recent work of which I am aware, there is every reason to expect that the recent upsurge in growth in developing countries would have drawn resources out of their agriculture, and may be contributing to the downward pressure on output arising from other sources.

The combined effect of supply-side pressures and continuing demand growth is to put upward pressure on real prices of staple foods. While there is clear visual evidence of a downward trend in the real prices of these key staples over most of the 20th century, it is less than clear that such a trend continued after 1985. While it is too early to tell, the period since that time would even potentially be consistent with an increasing trend.

Figure 3. Real prices of rice, wheat and maize.



Data source: Grilli-Yang database of Pfaffenzeller, Newbold and Rayner (2007) to 2003 updated to 2011 using World Bank Pink Sheet data. Deflated by the World Bank Manufactures Unit Value series for the price of exports of manufactures from the industrial countries.

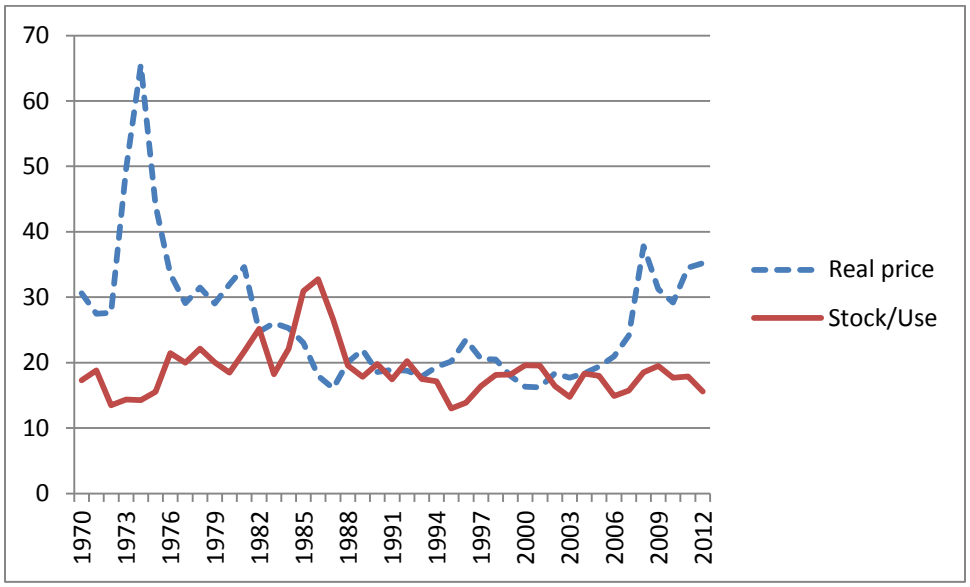
As can be seen from Figure 1, shocks to yields can be quite substantial, especially for commodities such as maize, wheat and soybeans that are typically grown under rainfed conditions. Given the relatively stable nature of demand for basic food commodities, supply shocks are much more likely to be important influences on prices than are shocks to demand. However, the relationship between output or demand shocks and prices is quite complex because of the importance of storage. In the absence of storage, prices would be extremely volatile in the short term because neither supply nor consumption demand is very price responsive in the short run. A key factor that greatly reduces price volatility in most periods is the ability to hold stocks. When stocks are adequate, an unexpected increase in production can be accommodated without a large price reduction by increasing stocks, while an adverse shock to production can be diminished by running down stocks. Given the rational storage model developed by Deaton and Laroque (1992), recently extended by Cafiero et al (2011) and placed in context by Wright (2011a), the relationship between output shocks and price responses is relatively straightforward, with adverse shocks to output having a large impact on prices only when initial stocks are at low levels and relatively small impacts at other times. This results in the type of price behavior

identified by Deaton and Laroque (1992) where prices spend most of the time in the doldrums, punctuated by intense but short-lived spikes. Consistent with this, the distributions of real prices depicted Figure 2 are positively skewed, with Excel Skew statistics of 0.27 for rice, 0.63 for rice and 0.51 for maize.

A very rough representation of the relationship between real prices of grain and ending stock levels is presented in Figure 3. This graph illustrates three key points about the relationship between real grain prices and ending stocks in that marketing year: (i) that prices and stock levels outside China are typically strongly inversely correlated, with low stock levels associated with high prices; (ii) that this relationship involves much sharper price peaks than price depressions; and (iii) that other influences can have an important impact on actual price outcomes. The reason why high stocks have less of a depressing effect on prices is simply explained in Wright (2011a). When availability of grain is high, positive shocks can be absorbed by an increase in stocks with a relatively small decline in price because the elasticity of demand for stocks is high. When stocks are low—say around 15 percent of consumption—it is difficult to push stocks lower and the overall demand elasticity is determined by the very low elasticity of consumption demand. As a consequence, adverse shocks require large increases in prices.

A number of special features need to be taken into consideration in interpreting the graph. Wright (2011a) points out that low global stock levels in 2003 were not associated with high prices because China was undertaking policy reforms and reducing its high stock levels in that period. The price surge in 2008 is not associated with low ending stocks because some countries, including major markets such as India, increased their stock levels despite the very high market prices that year. The graph also suggests a possibility that the level of grain prices may have increased secularly after the early 2000s, perhaps in response to longer-term factors such as the apparent slowdown in yield growth rates, and the rise in demand for biofuels feedstock.

Figure 4. Ending Stocks and Real Prices for Grains



Note: Includes data on consumption and ending stocks of corn, wheat and rice for all countries except China, converted to calorie equivalents using the coefficients in Wright (2011a). Prices for US corn; Thai Rice 5% broken; and Canadian wheat from the World Bank Pink Sheet historical data combined as a simple average using the same calorie conversion weights, deflated by the Manufactures Unit Value.

Linkages between Food and Energy Markets

Historically, the prices of food and of energy have not been strongly linked. The real price spike of 1974 evident in Figures 2 and 3 was, for instance, followed rather than led by an increase in energy prices. The previous period of high and volatile prices—between 1947 and 1950—was not associated with a rise in energy prices at all. However, in recent decades, both upstream and downstream linkages appear to have strengthened considerably. Petroleum-based fertilizers have become more important as inputs into production, and the use of agricultural commodities for biofuel has increased dramatically. Both of these linkages are potentially important as sources of instability given the volatile nature of energy prices, and the particular features of some policies on biofuels.

Given the apparently high intensity of petroleum in agricultural production and marketing (Baffes and Haniotis 2009), there are likely to be occasions when shocks from energy markets affect food markets. On the input side, increases in petroleum prices lower farm profitability as

prices of fertilizer and other inputs rise and the costs of transporting inputs to farms and outputs to markets rise. This decline in profitability will reduce supply but the impact of this supply decline on prices will not be immediate simply because of the time lag between changes in input prices and harvest outcomes.

On the output side, demand for commodities for use in biofuels may have been important both because of its importance in three major categories of agricultural output, and because of its very rapid growth since 2000. By 2008-10, biofuel demand accounted for 11 percent of global feed grain and vegetable oil production, and 21 percent of sugar cane production in 2008-10, with these shares expected to increase to 14, 16 and 34 percent by 2021 (OECD and FAO 2011, p86, 2012, p95). The rapid increase in the shares of these products devoted to biofuels is widely seen as contributing to the increases in food prices since 2005 (Abbott, Hurt and Tyner 2011), both by increasing demand and, during this transition period of rapid growth, reducing stocks and making the world market vulnerable to adverse supply shocks (Wright 2011a). The fact that growth in biofuel demand is increasing demand for coarse grains, oilseeds and sugar at the same time makes adjustment much more difficult than it would be if growth were concentrated in just of these since it is much easier to shift resources between different crops than it is to increase overall agricultural output.

The widespread use of quantitative mandates for biofuel consumption tends to make the commodity demand for biofuel use very inelastic with respect to food prices. This is a disadvantage when shocks arise in markets for food and biofuel demand cannot adjust to help deal with these shocks. When these mandates are below the maximum feasible share of biofuel in the fuel mix, this policy may also transmit volatility to food markets when fuel prices rise by allowing the share of biofuel in total fuel consumption to rise above the mandate. As noted by Wright (2011b), the presence of first generation biofuels could help to stabilize food markets if there were an option allowing food markets to use some of the food originally intended for biofuel use when food markets are in short supply.

Speculation

Speculation has been widely blamed for the increase in the levels and volatility of food prices during the 2000s. This is surprising to many agricultural economists, familiar with the findings

of Working (1960) that closing futures markets—and particularly the market for onion futures—can increase price volatility. A key difference between this and earlier periods is that the focus of attention has been on index fund investors, rather than conventional spectators, as the possible cause of the problem. Masters (2008) argued that the rapid entry of index investors into the market for commodities, in an attempt to diversify risk, had increased both the level of commodity prices and their volatility. Some empirical support for this proposition was provided by Singleton (2011) and by Tang and Xiong (2011). However, careful studies by Irwin and Sanders (2011) and by Fattouh, Kilian and Mahadeva (2012) conclude that there is no evidence that the dramatic increase in investment in index-fund investment caused the roughly contemporaneous large increase in the prices of food commodities or oil between 2003 and 2008. There is even less evidence that they contributed to the subsequent surges in commodity prices in 2010-11 and 2012.

To the extent that index investors might have contributed to the rise in commodity prices up to 2008, they could only have done so by encouraging stockholding, for which there is no evidence. Had they done so, the problem of low stocks and price volatility since that time would likely have been less serious. Tang and Xiong (2011) point to an apparent increase in correlations between investments in commodities and equities. They believe that this is likely to slow down the growth of investment in commodity index investment given that perceptions of low or negative correlations between these asset classes were a key driving force for the growth of commodity index investment.

Macroeconomic Impacts

Changes in macroeconomic conditions can affect the price of storable commodities. Frankel (2006) highlights one potential channel of effect, through real interest rates. If interest rates are decline, the costs of holding stocks decline, increasing the demand for stocks and raising the price of the commodity. If low interest rates are a consequence of monetary stimulus in a single country, the resulting real devaluation further raises the price of the commodity expressed in that country's currency. As in the famous Dornbusch (1976) model, the resulting increase in real commodity prices is transient as stocks reach a new equilibrium level and the prices of goods whose prices are slow to adjust catch up with flex-price commodities.

Caballero, Farhi and Gourinchas (2008) propose an extension of this model premised on the global savings surplus highlighted by Bernanke (2005). Under this model, high savings rates in Japan, emerging Asia, Europe and the oil exporters resulted in substantial surpluses in these countries, matched by deficits in the United States and a group of other deficit countries. Under this model, the strong global demand for high-quality financial assets from surplus countries resulted in a series of booms in equities, housing and finally in commodities. Following the decline in housing prices from 2006, these authors argue that funds flowed into commodities. They argue that this contributed both to the rapid increase in the prices of oil and food in the 2006-2008 period, and the subsequent decline in these prices as economic activity decelerated during the sharp recession of 2009.

Where high and sustained rates of inflation occur, or are expected to occur, Feldstein (1980) points to another potentially important macroeconomic influence on commodity prices. The key to this model is that the interaction of inflation and income taxes lowers returns on bonds (because the inflation component of the real interest rate is typically taxed as income); on equities because depreciation allowances are typically not taxed. By contrast, gains on assets are frequently taxed only on realization, and frequently on a deferred basis. These relative benefits result in an increase in the demand for land and storable commodities that might explain increases (decreases) in their real prices as the expected inflation rate rises (falls). The impact on the real price of assets such as land or gold seems likely to be greater than for assets such as food, for which storage costs are likely much larger. This channel of effect is not likely to have been important in recent years, where inflation rates have been quite low in the industrial countries, but may be important in the future if their emergence from recession involves an upsurge in inflation.

A key feature of these macroeconomic explanations is that they operate largely through increasing incentives to hold stocks. While this could explain increases in prices in some periods, the resulting increases in stocks would help both to mitigate increases in prices and to diminish price volatility in subsequent periods.

Overview of Price Behavior

From this survey of price behavior, a few tentative conclusions emerge on the likely future volatility of food prices and their level. The first is that, given the continuing prevalence of shocks to supply and demand, it seems likely that food price volatility will exhibit a similar pattern going forward. Second is that this price volatility is likely to include price spikes—associated with low stock levels—that are much more intense than the downward price movements associated with high stock levels. A third is that there do not seem to have been substantial increases in the volatility of output. If it is correct—as many have argued—that weather volatility has been increasing, this observation may reflect improvements in the resilience of crop output to weather shocks.

There are alarming signs that the century-long downward trend in real prices of key agricultural outputs may have ended around 1990, and that we may even have entered a period of trend increases in real agricultural prices. This emerges from the apparent reversal of the century-long downward trend in real food prices, a result perhaps consistent with the apparent decline in the rate of crop yield growth, the substantial increase in demand for three major crop types—coarse grains, oilseeds, and sugar—for biofuels in an environment of continuing strong growth in demand for food.

All of these conclusions are *extremely* tentative. Key conclusions could—and I hope will—be reversed by policy changes such as increasing investments in research and development designed to generate sustainable increases in output and the provision of limits or safety valves on the growth of demand from biofuels.

Why Might Policy Makers be Concerned?

At the individual level, high food prices are a concern for poor people because the poor tend to spend a large share of their incomes on food. When food prices rise, the cost of living for the poor tends to rise much more than for those on higher incomes. However, the impact of high food prices on the poor is not unambiguously bad, since three quarters of the world's poor live in rural areas, and the majority of them earn their incomes from farming (World Bank 2008). If

enough of these poor farmers produce more food than they consume, they are likely to gain from higher food prices. It turns out, however, that many of the poor farmers of the world are quite different from farmers in industrial countries in being net buyers of staple foods. When we consider the impact of higher food prices on the poor, there is a strong tendency for higher food prices to result in increases in poverty rates (Ivanic and Martin 2008). There are, however, exceptions to this rule, where poor net-selling farmers benefit from higher prices, or where higher food prices raise the wage rates for unskilled workers enough to lift them out of poverty (Ravallion 1990).

The only comprehensive analysis of the impacts of higher food prices on the poor in the short and in the long run of which we are aware is a new paper by Ivanic and Martin (2012), based on data for households in 29 countries. In this paper, the long run elasticities of supply response used are relatively high, and higher food prices result in substantial supply responses. As a consequence, higher prices cause more farm households to increase their output, with some of these households becoming net sellers, and other relatively poor farming households reducing their reliance on purchased food.

Table 1, based on their analysis, examines the impact of increases of 10 and 50 percent of food prices in the short, the medium and the long run. In the short run, they consider only the direct impacts of higher food prices on incomes, with net food sellers gaining from higher food prices, while net food buyers lose. In the medium run, they consider in addition the impact of potential impacts of higher food prices on the wage rates obtained by unskilled workers on the incomes of poor people. In the long run they take into account the ability of producers to respond by increasing their output, as well as the impact of higher food prices at their initial output levels. A clear conclusion from Table 1 is that higher food prices increase poverty sharply in the short term, but that this impact is smaller in the medium run, when wage impacts are considered, and even smaller in the long run, when producers have had the opportunity to respond by increasing output. However, even in the long run, it appears that the impact of an exogenous increase of 10 percent in prices is to increase poverty in most of the sample countries, except a few such as Albania, Cambodia and Vietnam, where higher food prices lower poverty because there is a substantial group of small net sellers, who benefit from higher food prices.

The effect of a price increase on poverty is not always, however, unimodal. While a 10 percent increase in food prices lowers poverty in Vietnam and Albania, an increase of 50 percent causes poverty to increase in both of these countries, even in the short run. While there is a group of poor farmers who are net sellers, this group is apparently not large. Once many in this group is lifted out of poverty, the critical determinant of the poverty impact is the effect of the price increase on the real incomes of net food buyers. Given the large share of food in the expenditures of people earning near the poverty line, the impact of higher food prices on poverty again comes to depend on whether higher prices reduce the impact of higher food prices on the poor. Clearly, this suggests that higher food prices raise poverty—even in the longer run—across most of the developing world.

Table 1. Impacts of higher food prices on poverty at $1.25/ day, % points

	10 percent price food price increase			50 percent price food price increase		
	Short run—simultaneous impacts	Medium run—simultaneous impacts	Long run—simultaneous impacts	Short run—simultaneous impacts	Medium run—simultaneous impacts	Long run—simultaneous impacts
Albania	-0.14	-0.14	-0.14	0.69	0.62	0.52
Armenia	0.40	0.11	0.11	3.60	2.24	1.74
Bangladesh	1.89	1.72	1.59	9.04	8.34	4.76
Belize	0.88	0.34	0.29	5.59	2.10	1.91
Cambodia	-2.90	-3.11	-3.45	-11.80	-12.69	-19.02
Cote d'Ivoire	1.27	0.64	0.51	7.76	3.92	0.99
Ecuador	0.76	0.33	0.30	5.62	2.69	1.13
Guatemala	1.42	0.90	0.78	9.12	5.96	3.22
India	4.40	4.06	4.04	20.83	19.20	19.11
Indonesia	0.68	0.63	0.60	6.18	5.60	4.45
Malawi	0.70	0.36	0.13	3.07	1.18	-5.75
Moldova	1.86	1.73	1.60	10.83	10.02	6.99
Mongolia	1.47	1.32	1.24	8.88	8.66	6.86
Nepal	0.24	0.13	-0.14	1.17	0.70	-3.37
Nicaragua	1.99	1.25	1.09	9.98	6.96	4.27
Niger	0.62	0.63	0.48	4.68	4.31	1.80
Nigeria	0.81	0.74	0.60	5.77	5.47	4.10
Pakistan	2.66	2.24	2.17	14.33	11.98	9.57
Panama	0.58	0.42	0.38	3.51	2.79	1.63
Peru	0.39	0.25	0.19	2.62	1.76	0.41
Rwanda	0.70	0.53	0.49	2.96	3.11	1.76
Sri Lanka	2.36	2.19	2.19	14.88	13.64	12.59
Tajikistan	3.29	2.94	2.63	17.23	15.05	8.57
Tanzania	1.86	1.45	1.39	8.44	6.12	2.96
Timor-Leste	1.25	1.03	1.01	10.17	9.16	7.88
Uganda	0.96	0.50	0.39	3.78	2.15	-0.72
Vietnam	-0.46	-0.57	-0.67	2.28	1.27	-1.04
Yemen	1.95	1.60	1.36	13.21	10.60	8.11
Zambia	1.25	0.69	0.47	6.55	3.22	-1.04
Average	1.14	0.86	0.75	6.93	5.38	2.91
Source: Ivanic and Martin (2012)						

When is Price Stability Desirable?

Standard economic theory provides some surprising insights into the question of whether price stability is desirable. For the producer, a case can be made that fully-anticipated price volatility is advantageous. The gains to producers from high price periods are greater than the losses from low-price periods. Formally, this result can be seen from the convexity of producers' profit functions in prices. Intuitively, it is due to the welfare gain from higher output during high priced periods outweighing the losses during low-priced periods. A similar result applies for consumers

and is associated with the concavity of the consumer's expenditure function in prices. Massell (1969) however, showed that these two sources of potential gain are not compatible, but that there could potentially be gains from stabilization through a buffer-stock arrangement that took advantage of the high-productivity in high output years and transferred some of the resulting output into low-output years. He noted, however, the serious difficulties involved in knowing the level around which to stabilize.

None of these results requires that consumers or producers be risk averse and a key development in the literature on price stabilization was to incorporate risk aversion by producers and consumers. Sandmo (1971) showed that producer welfare is likely to be reduced by unanticipated price volatility, and that producers are likely, in response to price instability, to reduce the volume of their output. Turnovsky, Shalit and Schmitz (1980, p143) showed that the situation for consumers is more complex. The preference for volatility inherent in the concavity of the expenditure function can be overcome, but only where:

$$(s_1(\eta_1 - \rho) - e_1) < 0$$

where s_1 is the share of the good in total expenditure; η_1 is the income elasticity of demand for the good; ρ is the Arrow-Pratt coefficient of relative risk aversion; and e_1 is the compensated elasticity of demand. From this expression, it is clear that this expression is more likely to be positive (and stabilization less desirable to consumers) if e_1 is large in absolute value. In this case, consumers benefit more from their ability to be able to switch away from consumption of the good in high-price periods and towards it when prices are low. The expenditure share is important because it determines the impact of a price change on real incomes. The risk aversion coefficient, ρ, and the income elasticity for the good have opposite effects for risk-averse consumers and normal goods. For consumers to prefer price stability, the consumer's coefficient of risk aversion must be larger than the income elasticity of the good and the income share times their difference must be greater than the compensated demand elasticity. This is much more likely to be the case for staple foods with high budget shares and low income and price elasticities than for luxury goods. Turnovsky, Shalit and Schmitz (1980, p143) make the point, however, that for a parameter set like e=-0.2, η= 0.6, ρ=1 and s=0.3, this criterion is comfortably

satisfied. For individual, low-income households, where the expenditure share on food is likely considerably higher, the value placed on stability might be even greater.

The nature of the distribution of food prices—with much more intense price spikes than price downturns—implies that price spikes are likely of greater concern than the less acute price downturns. The typically short duration of such price spikes might be seen as providing more opportunities to manage them through strategies such as consumption smoothing. While this is true, many low-income households may have limited access to credit markets and be forced to adopt responses that are likely much more costly in the longer term, such as taking children out of school. The short duration of price spikes also makes it much more difficult to respond by increasing output, and hence reducing the size of the adverse impact on poor net-food-buying households.

What about high prices?

A large number of studies using household survey data (see, for example, Ivanic and Martin 2008, Ivanic, Martin and Zaman 2012) have confirmed that high prices for staple foods tend to increase poverty in poor countries. Most of these studies have focused on the short-run period during which producers are unable to respond to the higher prices by increasing output. Ivanic and Martin (2012) address this issue by allowing producers to respond to higher prices. They find that allowing for this effect reduces the adverse impact of higher food prices on poverty rates, and reverses it in some countries. However, they find that higher food prices result in higher poverty, even in the long run case where the food output of farm households increases in a highly-elastic manner consistent with the high agricultural supply responses in most global computable general equilibrium models.

If higher prices are addressed through improvements in agricultural productivity—and especially if these increases in productivity occur in developing countries—the gains in terms of poverty reduction are even greater than those resulting from a reduction in food prices for a reason external to agricultural productivity, such as a reduction in demand for grains for use in first-generation biofuels (Ivanic and Martin 2012b).

What Policy Responses Might be Used?

It is probably useful to distinguish between policies directed towards addressing high food prices, and those focused primarily on managing food price instability.

Addressing high food prices

Policies addressing high levels of food prices include:

(i) raising agricultural productivity,
(ii) strengthening markets for agricultural land, labor, credit and intermediate goods,
(iii) improving rural infrastructure and connections to markets, and
(iv) reconsidering biofuel policies.

Each of these options is considered in turn in the remainder of this section.

Raising agricultural productivity

Raising agricultural productivity has been critical to income growth and poverty reduction worldwide, both by lowering real food prices to consumers, and by raising farm incomes at any price level. It appears that, historically, governments have substantially under-invested in agricultural research and development, with the result that the rate of return on these investments has been extremely high, averaging perhaps 100 percent per year on funds invested (Alston et al 2000).

It is important that the improvements in agricultural productivity be disseminated widely, partly because it results in greater aggregate expansion in output and lower real prices to consumers. Wide dissemination is also important because producers who do not benefit from a new technology may face declines in incomes when its price falls after other groups gain access to the new technology. A particular example of the latter problem arises when producers in some regions are unable to adopt technologies such as the use of BT cotton because of public regulations.

The international community invests in improving agricultural technology in developing countries in part through the Consultative Group on International Agricultural Research (CGIAR). However, the CGIAR would ideally complement strong national institutes for research, development and extension and these institutes have frequently been underdeveloped in many countries. An important recent development is the rapid increase in investment in national research institutes in many middle income countries—and particularly Brazil, China and India--highlighted by Pardey, Alston and Chan-Kang (2012). However, this is occurring in a situation where the growth rate of investment in agricultural research and development has declined sharply in the industrial countries.

Strengthening markets for agricultural inputs

Many markets for agricultural inputs are missing or perform poorly in many developing countries. Markets for land are frequently deficient, with strongly adverse impacts for agricultural output as well as for equity and avoidance of conflict (Deininger 2003). Markets for rural credit frequently perform poorly, with adverse impacts both on agricultural output and on the ability of households to adjust to shocks. Markets for critically-important inputs such as seeds or modern agricultural inputs are frequently also absent or poorly developed (de Janvry, Fafchamps and Sadoulet 1991).

Policies to improve the operation of these markets can have substantial impacts on output and farm incomes. However, the range of improvements that governments can make is limited and choices need to be made. An important recent development is the use of rigorous impact-evaluation techniques to allow choices to be made based on information about the impacts of particular interventions on key target variables (Khandker, Koolwal and Samad 2010; Bannerjee and Duflo 2011).

Improving rural infrastructure

Improvements in rural transport infrastructure can have critically-important impacts on farm outputs by raising the prices received for outputs, while reducing the costs of intermediate inputs. They also improve the standard of living of rural households by lowering the cost of living.

Other infrastructure improvements, such as improvements in irrigation and rural electrification can also be transformational. Again an example or two can strengthen your argument here.

As in the case of market improvements, the ability of governments to make improvements is limited and it is extremely important to make these investments in the areas with the highest rates of return. As long as evaluation approaches are designed in to the roll out of such investments, developments in impact evaluation make it much easier to obtain reliable estimates of the value of such projects both in terms of overall economic benefits, and in terms of impact on the poor (Khandker, Koolwal and Samad 2010).

Reconsidering biofuel policies

The current projected growth path of biofuel use of grains, oilseeds and sugar threatens to put considerable upward pressure on their prices, particularly during the transition period during which it puts downward pressure on stock levels. Clearly, some experimentation with biofuels is desirable in hopes of generating breakthroughs such as the long-sought emergence of second-generation biofuels with attributes such as low cost, small environmental impact and limited competition with food crops. However, expansion of conventional approaches such as production of ethanol from corn or sugar cane seems unlikely to be justified as a path to improvements in technology.

It seems important to assess the cost-effectiveness of biofuels in achieving greenhouse gas abatement when deciding about any expansion (or contraction) in requirements to use biofuels. The studies reported by DEFRA (2008) suggest that ethanol from sugarcane is the lowest cost of the currently-available technologies for greenhouse gas emission reduction from first-generation biofuels and that the cost per ton of CO_2 emissions avoided is likely much higher for alternative biofuels such as ethanol from maize and wheat, and biodiesel from oilseeds. Extension of biofuel mandates in general appears to be a relatively high cost approach to mitigation of CO_2 emissions. From a global welfare point of view, biofuel use should be concentrated on the alternatives with the lowest cost per ton of CO_2 emissions avoided.

An optimal global biofuel policy would focus on research and development of a range of alternatives, in hopes of identifying an approach more promising than current first-generation

biofuels. Resources spent subsidizing costly first generation biofuels such as biodiesel from oilseeds are not available to support costly research and development into new types of biofuels.

Addressing Agricultural Price Volatility

Policies addressed towards agricultural price volatility might include:

(i) improving market information
(ii) increasing resilience of farm output to shocks, such as weather shocks,
(iii) social safety nets
(iv) commodity risk management
(v) trade and other tax policies
(vi) improving storage policy
(vii) restrictions on futures markets, and
(viii) macroeconomic policy adjustments.

Improving market information

An important contributing factor to volatility is frequently uncertainty about the true level of key variables such as production and stock levels. In this situation, improving market information is likely to be one of the most cost-effective approaches to reducing price volatility. The new Agricultural Market Information Service (AMIS) seeks to do this by providing market information and analysis (see http://www.amis-outlook.org/home/en/). A key to the success of international initiatives of this type is the availability of key data from countries.

Increasing resilience of farm output

Increasing resilience, or lowering vulnerability of farm output, to season shocks is important both as a means of increasing average output, and as a means of reducing the volatility associated with shocks to output. In some cases, such as shifting from traditional, taller varieties of wheat and rice to the semi-dwarf varieties associated with the green revolution, can contribute to both goals. In other cases, there may be a trade-off between increasing resilience and the value

of output. Certainly, wherever these two goals are complementary, it is important to seize the opportunities to meet both objectives.

In recent years, the evidence presented in the first section of this paper suggests that the resilience of output to shocks may have increased for the major commodities—particularly if the baseline has involved increasing weather volatility associated with climate change. To some extent this may be the result of improved varieties whether introduced simply to increase yields, or as part of an adaptation strategy. A continuing strong focus on resilience in plant breeding programs could help to further reduce the volatility of output that contributes to price volatility.

Social safety nets

Social safety nets are, in principle, the best instrument for dealing with concerns about ensuring access of vulnerable people to the food they need. These instruments can be targeted to problems associated with high food prices and, possibly, to other problems that may restrict access to food. In most cases, it would be preferable for them to provide the resources needed to obtain food, rather than specific types of food. This allows households to adjust what they buy along many margins of adjustment, which may allow households to meet their needs at considerably lower cost. It also minimizes the impact of the intervention on world market prices arising from differences in the income elasticity of demand between those benefited and those paying for the intervention emphasized by Do, Levchenko and Ravallion (2012). Such a measure also eliminates the substitution effects in both demand and supply that result from measures such as export restrictions. By focusing the income effect only on the vulnerable, rather than on all net-buying households, the total income effect on food demand is also likely to be much smaller than in the case of less-targeted measures such as trade interventions.

There are clearly many difficulties associated with developing social safety nets that are adequate to deal with major shocks such as the 2008 food price crisis. If they are to be effective and affordable, such interventions need to be carefully designed and implemented, which is difficult to do in the heat of a crisis. In the recent episodes of high food prices, it appears that the countries that had implemented policies in advance were much better placed to deal with the worst aspects of the crisis than countries that had not done so This area of policy is changing rapidly because of the surprisingly fast improvements in adoption of cell phones, even amongst

poor people. The options for low-cost transfers of funds are increasing rapidly and this may reduce the hurdles for establishment of schemes in new countries.

Commodity Risk Management

Market-based commodity risk management tools such as the purchase of options to buy food can, in principle, play an important role in managing high and volatile food prices. Like safety nets, they can be targeted directly to the problem of ensuring access to food. They are also much less likely to have adverse impacts on markets because they need not create the substitution effects associated with trade interventions—substitution effects that raise domestic demand and reduce supply in countries where prices are held down by border interventions. A person or institution that has hedged its future purchases or sales of a good is protected from the adverse income effects of a price change against it, but still faces the incentive to economize on it use if its price has risen.

While these tools are widely used by individual farmers in industrial countries, it seems unlikely that many small farmers in developing countries will be able to use directly to a substantial degree. This is partly because of transaction costs, partly because of differences between the prices used for hedging and those faced by farmers (basis risk) and partly because of uncertainty about the amount to be produced and delivered. However, careful use of these risk management tools can play a very important role (Anderson 2012) for governments or larger firms in managing risk exposure associated with trade or, potentially, the provision of safety nets.

Trade and Other Tax Policies

Trade policy interventions are widely used to reduce the volatility of domestic prices for key staple foods. *Ad valorem* tariffs or export taxes cannot be expected to contribute to stabilization as, in the presence of trade, the domestic price is likely to change in proportion with changes in world prices. Specific tariffs or export taxes have some stabilizing impact since a higher border price translates into a lower *ad valorem* rate. When the prices of staple food prices change sharply, many countries appear to be willing to make explicit changes in the rates of their trade measures affecting food trade. In the aftermath of the 2007-8 food crisis, Demeke, Pangrazio and Maetz (2009) surveyed 81 developing countries in Asia, Africa and Latin America and found

that over half (43) had reduced import levies, 25 had restricted exports, and 23 had reduced domestic prices of staple foods. Historically, these policies have been widely used in today's high-income economies. The European Economic Community, for instance, used variable levies prior to recent reforms in order to stabilize domestic prices from both upward and downward changes in world prices.

The attractiveness of insulating trade policies of this type is clear. They can typically be implemented at the stroke of a pen, unlike social safety-net type policies. They are likely to be much less costly than domestic storage policies and they avoid the complexities associated with decisions to accumulate and to release stocks. Gouel (2012) highlights the apparent political effectiveness of such policies both in avoiding extreme political crises and in contributing to re-election prospects. For exporters, they can be very effective in reducing price increases in the domestic market since the food needed is likely to be available domestically. For importers, the policy is potentially of more limited effectiveness unless tariffs are initially very high, or policy makers are willing to pay import subsidies and use export restrictions to prevent low-priced domestic goods being re-exported.

For a small country such policies can look particularly attractive since it is unlikely to affect the international prices of food . A small country seeking to lower the domestic price of a key imported food by, say, 10 percent would not expect the price of its imports to rise when it lowers its tariff in order to bring this about. When large countries—or groups of countries that are collectively large—take such an action, the situation may be quite different. In the limit, if all countries intervene to the same degree, the policy is completely ineffective. If, for example, all exporting countries raise export duties by $10 and all importing countries lower their import duties by $10, the effect is to raise the world price by $10 and to leave domestic prices exactly where they would have been in the absence of intervention (Martin and Anderson 2012). With 68 out of 81 countries in the Demeke, Pangrazio and Maetz (2009) sample either reducing tariffs or raising export barriers, it seems likely that this collective action problem would be serious. Martin and Anderson (2012) concluded that 45 percent of the increase in the world price of rice between 2005 and 2008 (and 29 percent of the increase in the price of wheat) was due to the changes in protection that countries made in seeking to reduce the effect of changes in world prices on their domestic prices.

The fact that the beggar-thy-neighbor nature of price-insulating policies reduces their effectiveness need not render them completely ineffective as it does in the example where all countries intervene. If some countries insulate more than others, and if those that insulate the most are those where poor people are most vulnerable to poverty, then insulation may rearrange the price increases in such a way that the adverse impacts on poverty are favorable. Anderson, Ivanic and Martin (2012) examine this case for the 2006-2008 increases in world prices. Their tentative conclusion was that the combined impact of the interventions taken in this period was to reduce the adverse impact on the global poverty headcount by around 58 million. This result was much less favorable than the impact of the policy would have appeared to individual policy makers comparing the changes in world prices with those in their internal markets. Using this approach the impact on poverty would have appeared to be considerably greater. Some countries using active insulating policies to mitigate the impact of the increases in world prices would have experienced considerably smaller price increases if they—and others—had refrained from insulating policies.

Improving on the current, largely non-cooperative, outcome is challenging. A small country that refrains from insulating experiences much larger shocks than it would have done in the absence of price insulation by other countries. It can reduce this impact but only by exacerbating the shock to world prices. Some advocate a goal of limiting price insulation to developing countries, with the industrial countries acting as a buffer. While the industrial countries have greatly reduced the extent of their price insulation, they are simply too small to effectively absorb shocks in some key markets, and particularly the market for rice where they account for only 3 percent of total consumption. Potential approaches to dealing with the collective action problem seem to arise both nationally and internationally.

At the national level, Timmer (2011) points to some encouraging signs of potential willingness by a number of important countries to move to more transparent approaches towards price insulation than those currently used. Another important step forward would be for exporting countries to take a longer term view of the implications of using export barriers on the perception by importers of their reliability as suppliers. In the repeated game that is world trade in staple foods, importers who fear that their suppliers are likely to use export restrictions are likely to move either towards increased self-sufficiency or greater diversification of import suppliers, or both. Establishing themselves as reliable export suppliers is likely to be important

for major exporters who are relatively new since traditional exporters such as Canada, Australia and the United States have learned from past experience the importance of being seen as reliable suppliers and the costs of threats to use export restrictions.

In 2007-8, some of the countries that appeared most ready to use export restrictions were large traders, whose policy makers seemed not to take fully into account their ability to change world market prices, particularly in the short run. It seemed to many observers that these countries had not fully internalized their impact on world prices, and the always-adverse nature of world price impacts when a country seeks to stabilize its domestic prices. In this respect, a large country seeking to stabilize its domestic market prices is in a completely different situation from one seeking to improve its terms of trade. Size helps a country seeking to improve its terms of trade by restricting imports, as in Broda, Limao and Weinstein (2010), and allowing it more easily to depress the price of its imports or raise the price of its exports. By contrast, a large country seeking to stabilize its domestic prices is at serious disadvantage—any attempt to hold down domestic prices causes the world price to increase further, and any attempt to raise prices when they have fallen causes external prices to fall further.

Given the nature of the collective action problem involved in the use of price-insulating policies, international agreement seems the most promising long-term approach. A key asymmetry in current trade rules is that between import and export policies. Import tariffs on agricultural products are all bound—albeit frequently at high rates--while there are effectively no disciplines on export restrictions. Further, the risk of export restrictions frequently encourages importing countries to move towards policies focused on self-sufficiency, despite the fact that this policy is likely to have seriously adverse implications for the poor in these countries. Proposals designed to help assure the reliability of export supplies, such as those offered by Japan (2001), Jordan (2001) and DRC Congo (2001) in the context of the WTO's Doha Round agenda, seem a good place to start.

Recent research by Gouel and Jean (2012), like earlier World Bank research by Bigman and Reutlinger (1979), considers both trade policies and storage. An important insight from both of these studies is that combinations of trade and storage can yield better outcomes for a single country than either trade or storage policy alone. This is particularly clear for storage policy alone. In a small, open economy that is consistently an importer or an exporter, public storage alone makes little sense. In this situation, a policy of reducing stocks in periods of high prices

will help contribute to moderation of volatility at the international level, but will have no impact on the stability of domestic prices. Storage policy has, by contrast, an advantage when domestic output is large and increased storage can help raise domestic prices. Gouel and Jean (2012) estimate that the gains from a combination of trade and storage policies are nearly twice as large as those for trade policies alone, and more than three times as large as those from use of storage policies alone.

Storage Policies

As noted by Massell (1969), storage can potentially increase welfare for both producers and consumers. However, doing so can be very difficult in practice, largely because of difficulties in managing the stocks needed to stabilize prices. As noted above, storage by an individual country makes little sense unless it is coordinated with some form of insulating trade policy. A great deal of attention has been focused on the potential use of storage at the international level, with the objective of stabilizing world prices for commodities (Gouel 2012).

Storage policies designed to stabilize world prices have had an extremely chequered history. A large number of commodity programs were introduced under the auspices of UNCTAD, and some of these survived for a considerable period. However, as noted by Gouel (2012), virtually none of these was successful in stabilizing world prices for any extended period. Those that did survive for a long time frequently did so by setting such wide price bands that they were almost ineffective in stabilizing prices. The ultimate failure of all of International Commodity Agreement schemes, along with schemes such as the Australian Reserve Price Scheme for wool suggest a major need for caution in considering proposals to reintroduce international stocks designed to stabilize world prices. Critical issues have included difficulties in setting price bands at levels that do not lead to unlimited accumulation of stocks.

Use of combinations of trade and storage policy at the national level appears to have been much more sustainable for individual countries than at the international level. Countries like China and India have combined these policy instruments in ways that have resulted in domestic prices being much less volatile than world prices. However, the operation of these schemes has involved substantial challenges, with accumulation even at critical times such as during 2008 and a strong reluctance to reducing stocks even in periods of shortage (Basu 2010).

Restrictions on Futures Markets

Much of the policy discussion about the potential role of index-only investors in creating the 2006-8 commodity price boom has focused on proposals to introduce position limits on index-only investors. Even if the problem of high prices during that period had been created by such index-only investments, it is far from clear whether this was the fundamental cause and, if it were, whether such limits would have the desired effect (Irwin and Sanders 2011). The experience of regulation in such agricultural futures market is not encouraging, with the strong evidence that the closure of the onion futures market in the United States actually increased the volatility of onion prices (Working 1960). If the problem is not due to the presence of index-only investors, then regulations of this type are likely to be at best ineffective and at worst to compromise the ability of the futures market to perform its role of price discovery.

Macroeconomic Policy Adjustments

To the extent that the behavior of commodity prices is influenced by macroeconomic shocks, improving the stability and predictability of macroeconomic policy would seem to help reduce volatility in commodity markets. Long periods of low real interest rates may, as suggested by Frankel (2006) tend to increase commodity prices, although they would do this by increasing stock demand, hence likely ushering in a subsequent period of relatively low and stable commodity prices.

There are potentially important linkages between food price changes and inflation. When inflation is rising because of problems such as excessively expansionary fiscal or monetary policies, countries appear to be more inclined to use costly trade distorting policies in an attempt to reduce food prices. This is not likely to solve the inflation problem and may well cause serious problems for domestic food producers. Frankel (2012) highlights an important macroeconomic management concern for countries with a floating exchange rate and for whom food imports or exports are important. If food importers seek to stabilize a price index of consumption, the adverse impact on national income of a food price increase will be compounded by the contractionary monetary policy response designed to reduce its inflationary impact. A consumer price target will also fail to adequately counter the stimulatory effect of increases in food export

prices on the economy. To deal with problem, he suggests using a producer price index, rather than a consumer price index, as an inflation target.

Conclusions

Important contributors to the high and volatile food prices experienced in recent years appear to have included a sustained decline in the growth of crop yields for the key crops of rice, wheat and maize. Another cause has been the substantial increase in the growth of demand for coarse grains, oilseeds and sugar for use in biofuels. These primary shocks to international prices were magnified to a substantial degree by changes in countries' trade policies, as they sought to insulate themselves from changes in world prices—either by restricting exports or by reducing the barriers to imports.

A key issue is whether the problem is high food prices, or volatility of these prices. The effects of high prices cannot be determined from theory alone, since the vast majority of poor people live in rural areas, and most of them earn their incomes from farming. Given this, it might seem reasonable to welcome high food prices as providing a benefit to poor farmers. Careful empirical analysis, however, suggests that high food prices actually increase the number of poor people on net, although with substantial gross flows in each direction. Volatile prices exacerbate these problems because of the severity of the price spikes when stocks are low.

Three broad approaches show promise for dealing with high agricultural prices. Perhaps the most important is a renewed focus on raising agricultural productivity. This requires investments in agricultural research and development which have high economic returns and are a powerful force for poverty reduction both by lowering food prices and raising farm incomes at any price level. A second broad approach focuses on rural development in poor countries, through a wide range of policies such as improving the performance of agricultural factor, input and product markets; and improving rural infrastructure. A third broad approach involves reconsideration of biofuel policies, with a view to focusing on generating new knowledge and on using only the most cost-effective approaches to reducing greenhouse gas emissions.

Many approaches to reducing the adverse impacts of food price volatility need to be considered. Improving market information is a high priority given its potentially great benefits and modest costs. Reducing the sensitivity of crops to weather fluctuations is also potentially

important, and the available data suggest that substantial progress may already have been made. Given any level of market price volatility, social safety net policies have the desirable feature of being able to be targeted precisely to the problem, rather than—as with non-targeted policies such as export taxes and import barrier reductions—creating unpredictable impacts on different groups.

Many countries use varying trade barriers, such as export restrictions and import tariff reductions during periods of high prices, to help stabilize their domestic prices relative to world prices. While this can be effective for an individual country, it will be completely ineffective if all countries use it in the same way. In reality, it appears that countries insulate to differing degrees, and there is some evidence that countries where the poor are most vulnerable used it to a greater extent than others during the 2006-8 food price surge, leading to a modest reduction in the impact of high food prices on the poor. However, the use of similar interventions by many countries made it much less effective than comparisons of domestic and world prices would suggest.

Storage policies are obviously potentially important in managing food price volatility. Both economic theory and the experience of numerous attempts to stabilize international prices make clear that this approach is extremely difficult and liable to costly failures. Stockholding at the national level is unlikely to be helpful unless it is combined with a trade policy that involves a (likely modest) degree of price insulation. Implemented in this way, a combination of policies can be more cost-effective than either trade or storage policies alone. Designing such a combination of policies is challenging, with it being particularly important for storage to focus on increasing stocks when supplies are large and releasing them when prices are high—essentially mimicking the approach of profit-maximizing storers. This appears to be challenging for many public stockholding agencies, many of which increased their stocks in the 2008 food price crisis.

There have been many proposals to restrict investment in futures markets, and particularly the role of index investors. Given the limited evidence that these investors contributed to the problems experienced in recent years, there is a need for considerable caution in adopting such policies, and little expectation that they are likely to achieve a great deal. Food prices are importantly linked to macroeconomic policies and outcomes, and particularly with inflation and interest rates. High and rising inflation appears to encourage use of trade

restrictions on food that are unlikely to be successful in dealing with the underlying problems. Food price changes also have important macroeconomic impacts in many countries and careful thought needs to be given to ways to respond to these challenges.

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