The Economics of Food Price Volatility

by

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1. Introduction

Historically, food markets have been subject to much instability, and the last few years have seen very large swing in food prices. This price volatility has had large effects on farmers, market participants and consumers. Higher commodity prices benefit sellers (including grain farmers), but they hurt buyers (including consumers, and dairy/livestock farmers who face higher feed cost). Lower prices have the opposite effects. Market instability makes anticipating future price patterns difficult and creates significant price risk/uncertainty for market participants. It can also lead to hasty and injudicious policy responses that might be difficult to reverse. This puts a premium on understanding the factors that contribute to large price swings as a prelude to designing policy schemes that can help reduce this uncertainty or to ameliorate its effects.

The recent increase in food price volatility raises three important sets of questions.

- What are the main causes of food price instability? Does instability arise primarily from technological or weather related supply shocks or from demand shocks such as those induced by biofuels? Does financial speculation and globalization lead to increased or decreased volatility? And is the current market instability just a short-term phenomenon or is it the beginning of a longer term trend?
- What are the welfare effects of increased food price volatility for farmers, traders and consumers? How does it affect the welfare of poor households in developed as well as developing countries?

- What are the management and policy implications of increased volatility in agricultural markets? What is the role of private stockholding in reducing price instability? How can financial markets help improve the allocation of food price risk? Do existing agricultural, energy, climate and trade policies mitigate or exacerbate volatility and can reforms of those policies lead to better management of food price volatility and the reduction of food insecurity around the world?

Providing better answers to these questions is the main motivation for this book. This book presents and assesses the latest research on central issues related to recent food price volatility. This research evaluates current knowledge on the causes and effects of food price volatility, examines the extent to which particular current economic conditions contribute to this volatility, and identifies issues that are in need of further investigation. By disseminating new research on food price volatility, it intends to help both private and public decision makers to develop improved management strategies and policies that can address current and future market instability.

2. Food Price Volatility: Historical Evidence

The evolution of food prices over the last decade is shown in Figure 1 for three agricultural commodities: corn, wheat and rice. This figure, drawn from FAO (2010), shows very large changes in food prices in 2008. In a period of few months, grain prices basically doubled, followed by a very sharp decline. The changes were most dramatic for rice. These rapid price fluctuations are quite unsettling for any market participant.

Figure 1: Nominal prices of food, 2000-2010, US $/ton.

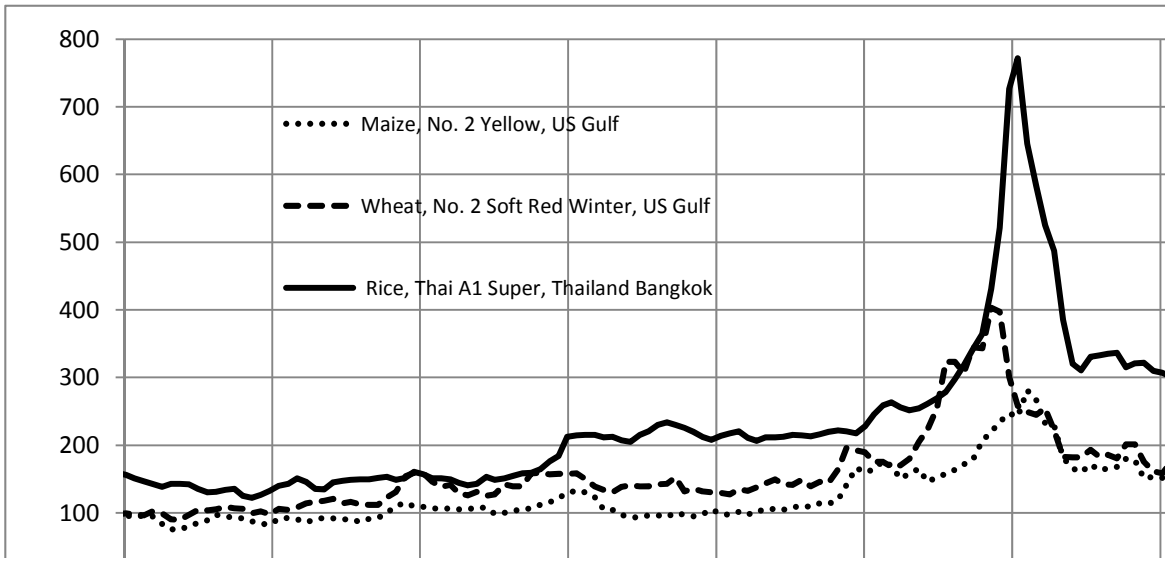


Figure 2, which presents data from ERS (2010) and USDA (2010), shows longer-term annual data on agricultural prices. It shows the real price of food (nominal dollar prices divided by the US CPI) over the last century for three farm commodities: corn, milk and wheat. There is a long term declining trend in real prices. Over the last 90 years, the average annual rate of change in real price was -1.8 per cent for corn, -1.9 per cent for wheat, and -0.8 per cent for milk. This is a remarkable fact: agriculture has been able to feed the growing world population at a lower price for consumers.

Figure 2: Real prices of food, 1913-2011, U.S. 1983 $.

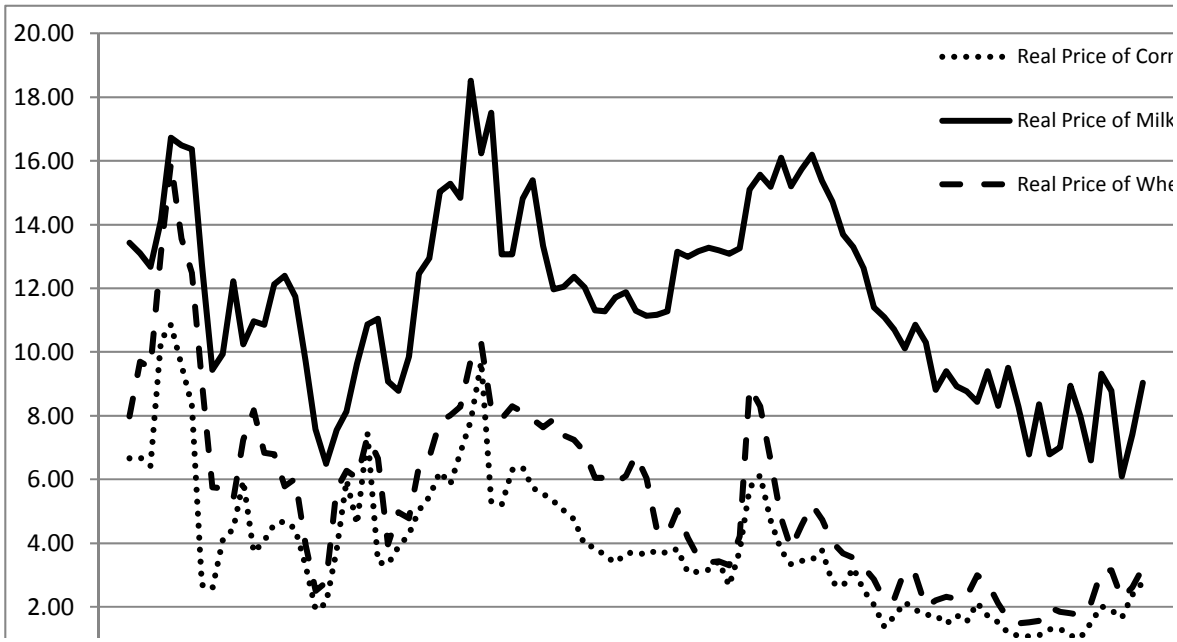
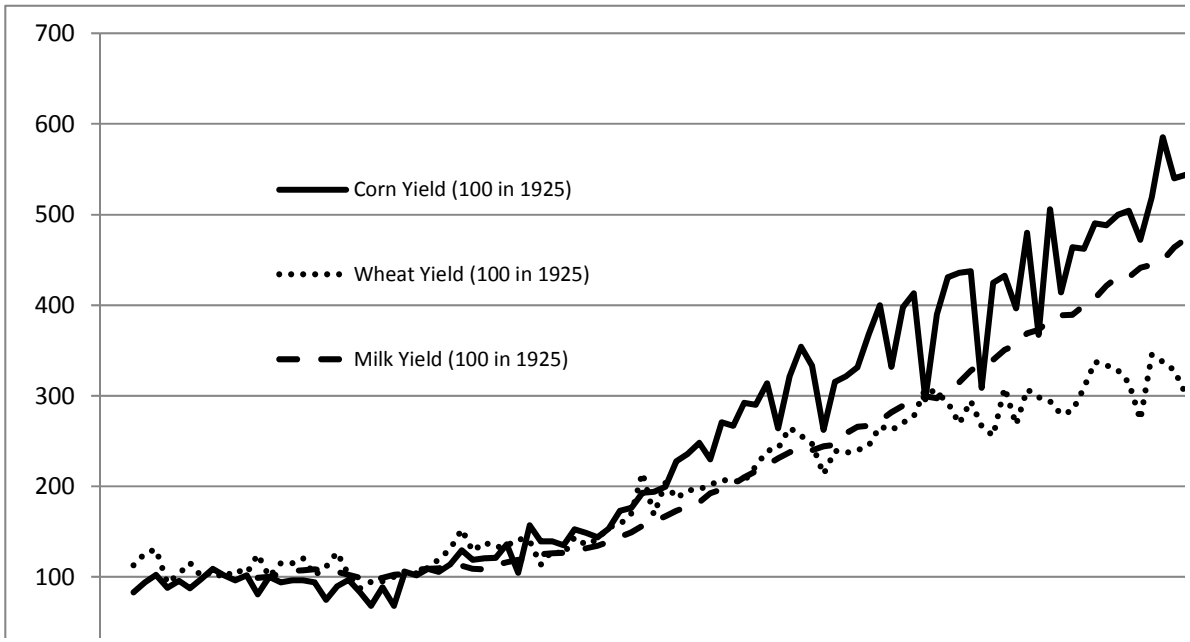


Figure 2 also shows that prices exhibit substantial variability. Two periods are particularly noteworthy: the 1930's (during the Great Depression) when food prices were very low; and the early 1970's when food prices were very high. The 1970's was a period exhibiting high population growth and increased resource scarcity. But it was followed by three decades of fairly steady decline in real prices for food, which has been good news for consumers. However the last few years have seen a large increase in price variability. For example, the real price of milk in the US has declined by 34 percent from 2007 to 2009, followed by a 48 percent increase from 2009 to 2011. Similarly, the real price of corn in the US has doubled from 2005 to 2007, followed by a 19 percent decline from 2007 to 2009 and then by a 70 percent rise from 2009 to 2011. These large fluctuations create significant challenges to market participants. They also raise questions about what is coming next.

Figure 3: Evolution of agricultural yields, US, 1913-2012.

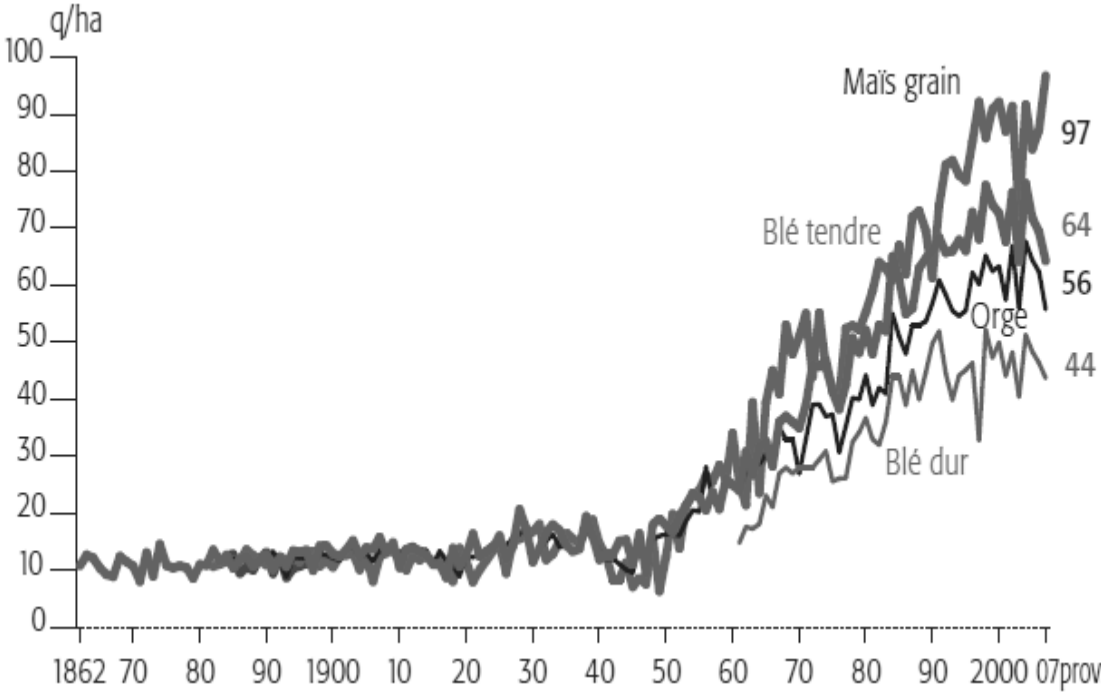


Source: ERS, USDA (2012).

Since the Great Depression, the main source of the long-term decline in real food prices has been improvements in agricultural productivity. Figures 4 and 5 illustrate the evolution of agricultural yields over the last few decades. Figure 3 shows how US yields have changed for three commodities: corn, wheat and milk. Over the last 80 years, the average annual growth rate in yield was 2.0 per cent per year for corn and 1.4 per cent per year for wheat, reflecting very large increases in land productivity. Similarly, the last 80 years have seen an average annual growth rate in milk production per cow of 1.9 per cent per year. Recently, we have seen several unusual shortfalls in grain yields. For example, the US Corn Belt suffered a widespread drought in 2012: US corn yield in 2012 was 16 percent lower than in 2011 and 25 percent lower than in 2009. To the extent that such supply shocks are associated with climate change, they may become more frequent and contribute to greater instability in agricultural markets. Figure 4

shows the evolution of yield for selected farm commodities in France. Like Figure 3, it shows a large and steady increase in land productivity over the last 50 years. Since 1930, the average annual growth rate in yield was 2.3 per cent per year for corn and 1.9 per cent per year for soft wheat. These are very large increases that were crucial in increasing food production.

Figure 4: Evolution of agricultural yields, France, 1862-2007.



Note: The Figure is from Agreste Primeur (2008). The yields are in quintals (100 kg) per hectare. “Maïs grain” is corn/maize, “Orge” is barley, “Blé tendre” is bread wheat, and “Blé dur” is durum wheat.

How much of these increases come from technological change? Part of the historical increases in food production came from increased input use (e.g., fertilizer, pesticides, capital). But the evidence shows that most of these increases came from technological improvements (Ball et al., 1997; Gardner, 2002; Fuglie, 2008). For example, Ball et al. (1997) documented that US agricultural production grew at an average rate of 2 per cent annual rate over the last few

decades, most of it (1.94 per cent) coming from productivity growth (as measured by a total factor productivity TFP index). Remarkably, such changes took place while US agricultural labor input was declining at an average rate of 2.7 per cent a year (reflecting both rural-urban migration and increased mechanization). In addition, Fuglie (2008) found that, over the last four decades, agricultural productivity has been growing at fairly high rates in most regions of the world. This reflects the important role played by innovations in farming systems, fertilizer use, pest control methods, mechanization, and genetic improvements. It means that technological change has been the principal factor responsible for increased food production around the world. Although the rates of growth in yields of rice and wheat appear to have declined recently, at this point there is no definitive evidence of a general slowdown in agricultural productivity growth. What is less clear is what is coming next. Is the recent increase in food price volatility a short-term issue? Or is it a sign of significant and longer-term changes in agricultural markets? To the extent that climate change is contributing to increasing both the frequency and severity of adverse weather shocks on crop yields and food supply, increased price volatility may become a permanent feature of food markets. In addition, other factors (besides supply shocks) may also play a role. Could financial speculation and globalization also be contributing factors? What can be done to improve the functioning of food markets? How does food price volatility affect welfare and income distribution? What are the policy implications? The objective of this book is to present the latest research and inquiries addressing these questions.

3. Overview of the Book

The book includes ten papers that investigate the economics of food price volatility along five directions of inquiry. First, they document the recent and historical patterns in food price

volatility, including the evolving food supply and demand conditions. Second, they study how food price volatility relates to linkages between food markets and energy markets, with special attention given to the role of biofuel policy. Third, they assess the impact of storage and speculation on food price volatility. Fourth, they examine the role of international markets, with a focus on the role of trade policy. Finally, they evaluate the distributional and welfare effects of food price volatility and their effects on the poor around the world.

The role of innovation and technological progress in agriculture has been significant. As noted above, large productivity gains in the food sector have been major drivers of the long run decline in food price. The paper by Alston, Martin and Pardey evaluates the role of agricultural technology and its effects on food price volatility. Technological change affects the variability of food prices by changing the sensitivity of aggregate farm supply to external shocks. After reviewing patterns of production, yields, and prices for the major cereal grains—wheat, maize, and corn—over the last fifty years, the Alston et al. paper studies how technological change can help reduce food price variability. It also shows how technical change has contributed to reducing the importance of food price variability for the poor, especially by reducing the number of poor.

The paper by Berry, Roberts and Schlenker presents estimates of the elasticity of aggregate supply and demand for food and the implications for agricultural price volatility. These estimates are important because price volatility depends not just on the magnitude of shocks but the elasticity of response to them. The paper also provides important insights on two sets of issues: 1/ the effects of ethanol and biofuel policy on the food sector; and 2/ the effects of weather shocks on food supply. The first issue is timely given current biofuel policy. The United States is now diverting about 30% of the food or feed value of corn to bioethanol production.

And Europe and the United States are using a substantial amount of oilseeds to generate biodiesel. This new demand contributes to diverting agricultural land away from food production, thus reducing food supply and increasing food prices. Finally, the issue of evaluating weather shocks is particularly relevant as agriculture is a sector most vulnerable to climate change. The paper examines how adverse weather conditions in 2012 have contributed to a 14 percent decline in US maize production. It predicts that such effects may become the new normal under anticipated climate change.

The paper by Abbott provides a refined analysis of the effects of recent biofuel policy and its implications for linkages with the food and energy markets. The paper argues that current biofuel policy has created incentives to increase ethanol plant capacity, thus creating a new and persistent demand for corn and upward pressure on corn and food prices. It also provides evidence that these effects vary over time, depending in part on whether the capacity of ethanol plants is binding or not. The paper argues that apparent corn price volatility is due in part to switching between alternative policy regimes.

In a period of globalization, market linkages across sectors are important. The dynamic linkages between agricultural, energy and other markets are studied in the paper by Enders and Holt. Relying on refined multivariate time series models, the paper examines the factors that contributed to recent changes in the grain markets. It documents how energy prices, exchange rates, and interest rates have affected grain prices. It also examines how the introduction of ethanol as an important fuel source has contributed to the run-up in grain prices. Finally, economic growth in emerging economies such as China, India, and Brazil are identified as contributing factors.

The recent increase in food price volatility has raised questions about its relationship with the functioning of markets. One question is about the role of storage as a means of reducing price volatility. The paper by Bobenrieth and Wright examines what the theory of stock holding offers on this issue. The paper studies the implications of storage behavior for the time series properties of market prices. In this context, the analysis rules out "bubbles" as defined in financial economics. Yet, it shows the presence of price runs that could be characterized as "explosive" and might seem to be bubble-like. This warns us not to interpret observations of large price increase as evidence of excessive speculation.

With the rapid development of financial markets over the last decade, there have been some concerns about the "financialization" of commodity futures markets (Domanski and Heath, 2007). This has generated a debate on the role of financial markets in the recent increase in market volatility. The paper by Irwin, Garcia and Aulerich examines this issue in the context the food markets. It provides a refined analysis of the market impact of financial index investment on agricultural futures markets. The analysis is applied to twelve agricultural markets. It shows that buying pressure from financial index investment in recent years did not cause massive bubbles in agricultural futures prices.

In a period of globalized exchange, the role of trade and its effects of food price volatility have been the subject of much interest. If domestic shocks are large and uncorrelated with foreign shocks, trade can reduce domestic volatility. But trade can also transmit volatility from foreign shocks into an otherwise tranquil domestic market. And when food price spikes in countries with large numbers of poor people, public interventions involving both domestic and trade policies can help alleviate hunger and malnutrition. This has raised many questions. How effective can domestic economic policy be in reducing price instability? How does trade

liberalization relate to price volatility? What has been the quantitative impact of ad hoc export restrictions in transferring volatility from domestic to foreign markets? Are certain trade instruments especially problematic in transmitting or helpful in diminishing volatility? Are temporary trade restrictions beneficial to individual nations even as they distort and destabilize global markets?

The paper by Gouel evaluates the relationships between food price volatility and domestic stabilization policies in developing countries. The paper analyzes the tradeoff existing between government interventions in the domestic markets to stabilize food prices (e.g., storage and restrictive trade policies) and greater reliance on international trade. It evaluates the economic and policy challenges to balance the benefits of greater integration in world markets and the domestic welfare effects of economic and trade policy. It stresses the need to better integration between public and private agents involved in food markets.

The paper by Anderson, Ivanic and Martin investigates the effects of the 2008 world food price crisis, with implications for welfare distribution. Many governments pursued policies intended to insulate domestic prices from changes in world prices. But such policies also substantially increased world prices for key food crops such as rice, wheat, maize and edible oilseeds. High food prices benefit food sellers but hurt food buyers and consumers. In the absence of domestic policy interventions, the consequences are particularly severe for low-income households who spend a large share of their income on food. The Anderson et al. paper presents evidence showing that the actual poverty-reducing impact of insulation has been much less than originally anticipated. This raises the challenge of designing effective policies that can reduce the impact of higher food prices on the poor.

The paper by Do, Ravallion and Levchenko provides a theoretical analysis of this issue. It evaluates conditions under which trade insulation can provide social protection against food price volatility. It shows that in the presence of consumer preference heterogeneity, implementing an optimal social protection policy can potentially induce higher food price volatility. The paper urges caution against policy positions that would condemn trade insulation practices. And it calls for a reassessment of food stabilization policies.

Finally, the paper by Cafiero and Schmidhuber provides a broad worldwide view of the economics of food security, as seen from the FAO. It reviews the data currently available and their use in the assessment of the 2008 food crisis. It evaluates the quality and coverage of available data and the methods used to assess the state of food security around the world. It stresses the importance of good data (on agricultural prices, production, trade, and food consumption) to support economic analyses that can help inform market participants and policy makers about the evolution of the food sector around the world. And it identifies the current challenge of improving the assessment of food security around the world.

4. Challenges Ahead

The recent increase in food price volatility has stimulated much academic research. The chapters presented in this book provide a broad overview of the current state of academic inquiries on the economics of food price volatility. They document the progress made in identifying the factors that have contributed to the 2008 food crisis, along with their economic and policy implications. Yet more research is needed to refine our understanding of evolving food markets. Below, we briefly discuss a few directions for future inquiries.

It is important to distinguish between price volatility and high prices. Under price instability, prices are at times high (benefiting producers and hurting consumers) and at times low (benefiting consumers and hurting producers). It is possible to have an increase in the price level without changes in price volatility. And it is also possible to have both simultaneously (which may have been the case in the food crisis of 2008). The distinction appears to be important for at least two reasons.

First, price changes might or might not be anticipated by market participants. If price changes are anticipated, economic and econometric analyses can focus on analyzing structural change issues. But the situation becomes more complex when (at least part of the) price changes are not anticipated by producers, consumers or traders. In this case, the econometrician needs to distinguish between what is known versus what is not known to market participants. The changes in what is not known can be captured by changes in the distribution of price volatility. In econometrics, this means examining changes in variance (or higher moments) of the price distribution, as seen from the viewpoint of market participants. This raises the issue of empirically evaluating both changes in market conditions and changes in the information available to market participants. For example, how much of the 2008 food crisis was due to poor information available to market participants about food stocks? To the extent that there was no obvious food shortage in 2008, could better information about food stocks have prevented the large increase in food prices observed in 2008? These questions stress the need to have good information about the causes and nature of evolving market conditions. Unfortunately, access to such information by economists and policy makers is often limited. This reduces our ability to provide an in-depth analysis and evaluation of price volatility issues. This argument emphasizes

that future progress on understanding the economics of food price volatility must rely on access to good data.

Second, the distinction between anticipated versus non-anticipated price changes is important for an economic and policy viewpoint. Anticipated changes are easier to manage by both private agents and policy makers. For example, if a supply shock is anticipated, then production, consumption and storage behavior can adjust ahead of time and reduce the economic and welfare effects of the shocks on market participants. But if the shock is not anticipated, the economic implications are quite different. First, the welfare and distributional effects can be stronger. Second, the adjustments must be contingent on the particular shock, implying state-contingent decisions that are in the realm of insurance and risk markets. But insurance and risk markets are known to be incomplete. For populations for whom food constitutes a minor share of the budget, this is not important. For people so poor that food has a major expenditure share, why such markets tend to be incomplete remains an interesting question. Recent experience indicates that insurance markets in agriculture do not develop easily (in the absence of heavy government subsidies). This suggests that the welfare costs of volatility are not large enough to justify paying the full cost of insurance, including administrative expenses. If this is so there is no problem of under-provision of insurance. Is it possible to improve on the welfare outcome associated current food price volatility? What is the role of markets? What is the role of government policies (including both domestic policy and trade policy)? As discussed above, free trade can help reduce the welfare effects of location-specific shocks in food supply (e.g., the case of a drought, flood, heat wave or cold spell in a given region). But it would be less effective in addressing the effects of worldwide shocks to the food sector.

Two sources of shocks are of particular interest. First, globalization has strengthened the linkages between food markets, energy markets and financial markets. It means that shocks to the energy or financial markets now have stronger effects on the food sector. How are the food markets adjusting to these shocks? Second, climate change is increasing the prospects of seeing significant weather shocks in agriculture. The implications for food markets and agricultural and trade policies remain unclear. While we know that markets and free trade can help improve aggregate efficiency, the issue of private and public risk management schemes associated with unanticipated shocks to the food sector needs further investigations. This is particularly crucial when considering that large food price increases can have devastating effects on the welfare of poor households around the world.

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