By Derek Headey & Shenggen Fan

Reflections on the

Global Food Crisis

How did it happen?

How has it hurt?

And how can we prevent the next one?

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How Did It Happen? How Has It Hurt? And How Can We Prevent the Next One?

Derek Headey and Shenggen Fan

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Preface

Cheap food has been taken for granted for almost 30 years. From their peak in the 1970s crisis, real food prices steadily declined in the 1980s and 1990s and eventually reached an all-time low in the early 2000s. Rich and poor governments alike therefore saw little need to invest in agricultural production, and reliance on food imports appeared to be a relatively safe and efficient means of achieving national food security. However, as the international prices of major food cereals surged upward from 2006 to 2008 these perceptions quickly collapsed. Furthermore, although food prices are now lower than their 2008 peak, real prices have remained significantly higher in 2009 and 2010 than they were prior to the crisis, and various simulation models predict that real food prices will remain high until at least the end of the next decade.

Needless to say, the stability and effectiveness of the world food system are no longer taken for granted. For researchers and policymakers alike, the food price crisis presented nothing but puzzles. Many possible causes have been identified, but their relative importance is uncertain. A number of studies estimated the impacts of rising food prices, but these simulations often generated unconvincing results, and most were limited by the absence of general equilibrium effects, country-specific price changes, and other relevant shocks, such as rising fuel prices. Moreover, while the recent crisis closely resembled the 1974 crisis, international policymakers still failed to prevent history from repeating itself. In this research monograph the authors explore these puzzles through a review of the existing literature and fresh analysis. While hardly the last word on the subject, this timely and unusually comprehensive assessment of the crisis will be a valuable resource both for researchers trying to make sense of current problems and for policymakers deciding how to prevent future crises.

Acronyms and Abbreviations

CARD	Center for Agricultural Research and Development
CBOT	Chicago Board of Trade
CPI	consumer price index
E.U.	European Union
FAO	Food and Agriculture Organization of the United Nations
FAPRI	Food and Agricultural Policy Research Institute
FEWSNET	Famine Early Warning Systems Network
GDP	gross domestic product
GIEWS	Global Information and Early Warning System
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
LDC	least-developed country
MENA	Middle Eastern and North African
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
R&D	research and development
TFP	total factor productivity
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
WFP	World Food Programme
WTO	World Trade Organization

Summary

From 2005 to May 2008, the international prices of major food cereals surged upward, in many cases more than doubling in the space of a few years, and in some cases—such as rice—more than doubling in the space of just a few months.[1] Although food commodities are not unique in undergoing such rapid price rises (energy and mineral prices have also surged), a sharp escalation in the price of basic foods is of special concern to the world's poor. All poor people spend large portions of their household budgets on food, and most impoverished people depend on food production for their livelihoods but have very limited capacity to adjust quickly to sharp changes in relative prices. Consequently, surging food prices have caused panic and protest in developing countries and have presented the policymaking community with a challenge at least as severe as the 1972–74 global food crisis.

This review of the 2007–08 food crisis attempts to provide a balanced and comprehensive assessment of the causes and consequences of the crisis for researchers and policymakers alike. This study was finalized in early 2010, about 18 months after international cereal prices peaked and then plummeted, before rising again in 2009. It is therefore an appropriate point in time to reflect on the events of 2008 and the preceding years, reassess our understanding of the crisis (especially in light of the sharp drop in prices), and update the evidence on the impacts of the crisis with new data and fresh analysis. It is also an opportunity to emphasize to policymakers that food prices remain high by historical standards in both international and local markets, and that if higher prices in 2007 and 2008 were at least partly the result of fundamental pressures on international cereal markets, then it is reasonable to expect prices to remain high in the years to come (especially as economies recover from the financial crisis). Indeed, without actions to repair some significant flaws in the global food system, the food crises of 1972–74 and 2008 could be repeated, perhaps sooner rather than later.

Regarding the causes of the 2007–08 crisis, this report aims to review the latest evidence in the literature, given that we have the luxury of more time

[1] Much of this document builds on Headey and Fan (2008), although several sections are derived from additional work for the U.S. Agency for International Development (USAID), including Headey and Raszap Skorbiansky (2008) and Headey (2010). Moreover, the analysis presented in Headey and Fan (2008) is updated and extended in several important dimensions.

(two years since the peak of food prices in April–May 2008). Many academic reviews link problems that existed before the food crisis to the rise in prices, without providing compelling evidence of causal linkages. Many are also generally based on preliminary evidence only or often use piecemeal approaches rather than comprehensive ones. Indeed, the more one assesses this crisis, the more one concludes that it is the result of a complex set of interacting factors rather than any single factor.

Despite this complexity, the assessment presented here suggests that some explanations still hold up much better than others. This set of interconnected factors includes rising energy prices, the depreciation of the U.S. dollar, low interest rates, and investment portfolio adjustments in favor of commodities. All these factors are related to a range of underlying global macroeconomic phenomena that affected both food and nonfood commodities. As for agriculture, specifically, energy prices are a significant supply cost in cereal production, but rising energy revenues also fueled increased cereal demand from energy-exporting nations. However, a major effect of rising energy prices was the consequent surge in demand for biofuels. Demand for biofuels had a stronger effect on maize than on other biofuel crops (such as oilseeds), although knock-on effects for other food items may have been substantial (especially for soybeans). Interestingly, we also find that the surge in U.S. maize production for biofuels was of an order-of-magnitude equivalent to the primary explanation of the 1972–74 crisis—the surge in U.S. wheat exports to the Soviet bloc.

The surge in rice prices stands apart as being almost entirely a bubble phenomenon. The late and rapid rise in rice prices, almost all of which took place in the first few months of 2008, was closely related to the export restrictions of several major international producers and to large precautionary imports from major international consumers. These shocks compounded the existing volatility in rice prices that arises from the relatively thin international trade in rice. Export restrictions were also important for wheat markets, although these were partly triggered by weather shocks to wheat production, especially in the case of Ukraine. The Australian drought was also a significant short-term factor, especially as southern hemisphere exporters like Australia and Argentina (who restricted wheat exports) provide counterseasonal wheat supplies to northern hemisphere countries.

In contrast to other assessments, we do not attribute much of a role to other factors cited in the literature, by politicians, or by the popular press. Many people cite surging demand from China and India, including the shift in their diets toward more meat consumption, and hence greater demand for feed cereals. This research theme was prominent prior to, and independent of, the 2008 food crisis, and it was brought up again as the crisis unfolded, albeit as an untested hypothesis. However, surging demand from China and India turns out not to present any compelling linkages to the crisis. At the national level both countries are largely food secure, so they rarely rely on substantial food imports, except some oilseeds. It is true that both countries, especially China, have experienced greatly increased demand for energy and other minerals, but their demand is by no means the only cause of rising oil prices and is perhaps not even the main cause. Chinese demand for soybeans has also grown dramatically, but since 1995 rather than very recently. Moreover, this longer term increase in demand was accommodated mostly by area expansion in Brazil and Argentina, so the effects on other commodities would appear to be quite limited. China and India might also have influenced international food prices by depleting their stocks of major cereals, but there is no direct evidence that declines in their stock influenced expectations elsewhere. In China's case, estimated stock levels in the 1990s were excessively high, and still are, so China shows little or no sign of being unable to feed itself in the foreseeable future. India's stocks also declined from excessive levels and were briefly too low during the crisis, which may have led to the hasty decision by India to ban rice exports in November 2007—an action that undoubtedly had a large adverse effect on international rice prices. But these are all quite indirect linkages to the crisis, and in fact we find that growth in cereal imports was much stronger among other sets of countries, including Mexico, the European Union (E.U.), and a range of Middle Eastern and North African (MENA) countries.

Another perennial research literature that was prominent before the food crisis was declining yield growth in cereal production and related trends, such as low levels of agricultural research and development (R&D) and land degradation. These problems are certainly significant in some parts of the world, but the real linkage to international prices must come from global supply and demand, which is best examined by looking at global cereal production per capita and trade statistics. It turns out that production per capita has indeed declined, but about three-quarters of that decline is explained by falling production in the former USSR and Eastern Europe. However, that trend did not affect international trade, because the former Soviet bloc countries actually increased cereal exports to the rest of the world over this period. Hence much of the decline in global grain production simply relates to structural change in transition countries, which does not appear to have adversely affected international prices. The remainder of the decline comes from Sub-Saharan Africa, where cereal production has struggled to keep up with rapid population growth. Here the factors cited above probably are pertinent—low R&D, soil degradation, climate change—but Africa is a very small player in international cereal trade, so the linkage is tenuous at best.

Stock declines in other countries, especially the United States and other major cereal importers, are also a compelling explanation for the price crisis. However, there are two problems with this explanation. First, global stock declines are much less impressive once policy-driven reductions of the excessive stocks in China and the former USSR are excluded. Second, because stocks are a residual, stock declines in other countries primarily reflect deeper causes, such as rising demand or insufficient supply. Indeed, in the case of wheat markets we find that trade shocks reduced U.S. wheat stocks, so that low stocks can hardly be a cause of the crisis. Similar results are true of biofuels demand and U.S. maize stocks. Hence we do not believe low stocks were an important cause of the crisis.

Another contentious factor relates to speculation in futures markets. Futures markets are normally thought of as an instrument for price discovery, but the entry of noncommercial participants has raised fears that speculators may be artificially driving up prices. Our view is ultimately agnostic, because we believe it is impossible to discern causality in the context of futures markets, even from time series econometrics, as futures-market variables represent expectations of the future. Thus the usual Granger-causality tests are potentially irrelevant, because expectations of price rises at time t might be noncausally associated with higher prices at time $t + 1$. However, whether or not futures market activities were a cause of the crisis, we find it unlikely that they were a driving force, if only because we have substantial confidence in several of the more tangible explanations of the crisis discussed above: oil prices, biofuels demand, a depreciating U.S. dollar, and various trade shocks, in particular.

The remainder of this monograph assesses the consequences of the crisis. Here, too, considerable academic work has been done, much of it impressively quickly. However, the broader weakness of this research is a large disconnect between macro- and microeconomic assessments of the consequences of rising food prices. For example, macroeconomic studies look at the effects on import bills, foreign exchange reserves, and fiscal deficits, but there are generally no linkages down to the household level. Other macroeconomic studies look at price transmission, but that is certainly not the same as impact. A country might have low rates of transmission but only because it has decreased food taxes or increased subsidies, actions that place the burden of rising international prices on the fiscal deficit (or back on to international prices, in the case of export bans), rather than on to consumer prices. Moreover, what is typically called "transmission" sometimes also reflects country-specific factors, such as agricultural output shocks or loose monetary policies.

Microeconomic studies, in contrast, often lack good data on actual price changes at the country level; they must therefore assume that international price changes are partially transmitted to domestic markets, or they must simulate the effects of arbitrary price changes, such as 10 percent food inflation. And of course, most microanalyses have the usual limitations of simulation techniques, especially somewhat simple assumptions regarding consumer and producer responses. A further weakness of much of the microeconomic work is that it solely focuses on food prices, even though it is quite possible that rising oil prices could have similarly large effects on poverty and national welfare. It is true that poor people generally spend much more of their income on food than on fuel. However, least-developed country (LDC) oil imports are 2.5 times larger than LDC food imports, and rising oil prices raise the prices and restrict the output of other goods. These facts indicate that the overall effects of rising oil prices could certainly be on par with the impacts of rising food prices in many cases and could thus further worsen the food crisis.

Despite these qualifiers, our review of local price trends in developing countries does show that real prices in 2008 were substantially higher than prices in 2007, often double, especially around the middle of 2008. The good news is that prices generally did start to decline in late 2008 as international prices fell. Had higher prices persisted, the crisis could have turned especially severe. The bad news is that price rises were surprisingly high in a large number of countries. In Africa, prices rose especially high, particularly for imported products principally consumed by urban populations, but also for some local commodities that are not widely traded (indeed, commodities for which international prices are not even reported). In this monograph we can only speculate on why African prices rose so substantially, and ultimately the answer remains a matter for future research.

With the worst of the food crisis over, this monograph provides a timely discussion of how the 2008 food crisis compares to the previous food crisis of 1972–74. In many ways the two crises had similar causes, including rising energy prices, similarly sized shocks to U.S. cereal demand (from the Soviet bloc in the 1970s and from the biofuels industry today), low interests rates, and the devaluation of the dollar, as well as declining stocks and some adverse weather shocks. The most daunting aspect of the existing global food system is not only the strong possibility that food crises are an inherent aspect of the global food system—which is pervaded by various distortions of production, trade, and agricultural investment and suffers from a huge regional imbalance in cereal production—but also that this system may well be hit hard by several shocks in the future. These include adverse weather shocks and declining productivity related to climate change, and a recurrence of oil price shocks and surging biofuels demand. The real concern is that the precipitous fall in food prices over the second half of 2008 will once again lead to the wide-spread apathy toward the agricultural sector that has prevailed among policy-makers in both developed and developing countries. Indeed, a long history of neglecting agricultural investments has made it difficult for many developing countries and their donors to quickly scale up agricultural investments in the wake of the crisis. Despite these obstacles, sustained and smart investments in developing-country agriculture will be essential if the world food system is to finally deliver what it ought to: greater food security and real income gains for the world's poorest people.

CHAPTER 1

Introduction

Beginning in 2003, international prices of a wide range of commodities surged upward in dramatic fashion, in many cases more than doubling in a few years and, in some cases, in a few months. Yet unlike other commodities, surging food prices are of special concern to the world's poor. Many impoverished people depend on food production for their livelihoods, and all poor people spend large portions of their household budgets on food. Sharply rising prices offer few means of substitution and adjustment, especially for the urban poor, so there are justifiable concerns that millions of people may be plunged into poverty by this crisis, and that those who are already poor may suffer further through increased hunger and malnutrition. Equally grave concerns have been felt with respect to the impacts that rising food and fuel prices may have had on macroeconomic stability and economic growth. And although the food and fuel crises have largely abated since mid-2008 and have taken a back seat to the ongoing global financial crisis, food prices have remained high by historical standards and are predicted to stay high in the years to come.

Prior to the financial crisis, high food prices certainly received a great deal of attention from policymakers, the media, and the academic community. Active and often heated debate has arisen regarding what may have caused the food crisis, what impact it will have on the poor, and—on the basis of the debate—what needs to be done to resolve the crisis. Much of the nonacademic commentary on these issues was not based on evidence backed by research. Much of the academic research was also necessarily "quick and dirty," in response to the pressing needs of policymakers. However, some of this research was insightful, resourceful, and impressively rigorous, given the sudden demand for such work. For the most part, this monograph constitutes a review of existing research on the food crisis, synthesizing the best results and pointing out the knowledge gaps we still have. In doing so we follow in the footsteps of several capable and rigorous assessments of the crisis. These include the work of Abbott, Hurt, and Tyner (2008, 2009) and Mitchell (2008) on the causes of the crisis, and Abbott (2009) on its consequences. We draw on these works quite extensively, and sometimes revisit and revise them empirically. However, in addition to reviewing and revising this evidence, we regularly augment it where necessary (and feasible) with fresh research. Indeed, the present research provides several important new pieces of evidence on both the causes and consequences of the crisis.

A second group of papers inadequately addresses some specific questions on the consequences of the crisis. Although often technically adept, this body of research is of limited use for a robust assessment of the likely impacts of the crisis. Several papers follow Ivanic and Martin (2008) in using microeconomic data to simulate the impacts of rising food prices on household poverty. Other papers in this group look at macroeconomic effects, such as the strength of transmission from international to domestic prices (Dawe 2008) or the impact of rising food prices on import bills (IMF 2008a). Ideally, a full assessment of the short-term impacts of the crisis on poverty requires consideration of both macroeconomic impacts and transmissions, as well as household and intrahousehold effects, for both food and fuel price increases. Some country studies admirably adopt a more comprehensive line (Arndt et al. 2008; Cudjoe, Breisinger, and Diao 2008), but cross-country analyses of this kind are notably absent. To partially bridge this gap, we collect and analyze a new and impressively large Global Information and Early Warning System (GIEWS 2009) dataset on food prices in developing countries. Such data can be used to broadly infer where consumers have been severely effected, although the impacts on farmers remain unclear.

A final objective of this monograph is to look beyond the events of the past few years. We show that the current crisis bears some remarkable similarities to—as well as some equally important differences from—the first food crisis of 1974 (Headey and Raszap Skorbiansky 2008). The similarities between the two crises lend credence to the hypothesis that the causes of these crises relate to some deeper failings of the global food system. In Chapter 4 we compare the two crises and consider this hypothesis.

As we discuss in the concluding chapter (Chapter 5), some of these failings were addressed after the 1972–74 crisis, but with only limited success, and some were not addressed at all. Particularly important is the large regional imbalance in cereal production. Africa's poor track record in agricultural production may not have been a significant cause of the crisis, but it undoubtedly makes the region highly vulnerable to the vagaries of international markets. Reversing a long-term decline in agricultural investment in Africa and other lagging regions is an immense and difficult step but almost certainly a necessary one. The good news is that donor commitments to agricultural development were indeed scaled up drastically in 2008. The concern is that the global financial crisis will mean that many of those commitments will not be honored or sustained into the future.

A system of global reserves was also never set up in the wake of the 1972–74 crisis despite much research and a number of international meetings. Suggested solutions to the current crisis once again include an international system of grain reserves, as well as a system of virtual reserves to address speculation in futures markets. However, our assessment concludes that low stocks and speculation were, at best, indirect causes of the crisis. Furthermore, international grain reserves also have their problems, and a great deal of further research would be required before effective real or virtual reserve systems could be put in place. Freer trade may also be a more viable means of stabilizing cereal prices, although the political barriers are undoubtedly daunting.

Whatever the solutions, they must be sought and sought collectively, because the global food system does indeed face global challenges in the years ahead. Factors that were not important causes of the crisis—such as changing diets, climate change, and a greater incidence of natural disasters—may yet impose significant pressure on international food markets in the near future, as may many factors that were important in this crisis, such as higher energy prices and biofuel production. We hope the evidence presented in this monograph will encourage researchers and policymakers to take the food crisis of 2008 seriously. Some of the price rise was indeed a passing bubble, but much of it was also related to real supply and demand pressures on international food markets. Worse still, the price changes and consumption losses witnessed in developing countries were all too real and all too costly.

CHAPTER 2

Causes of the Crisis

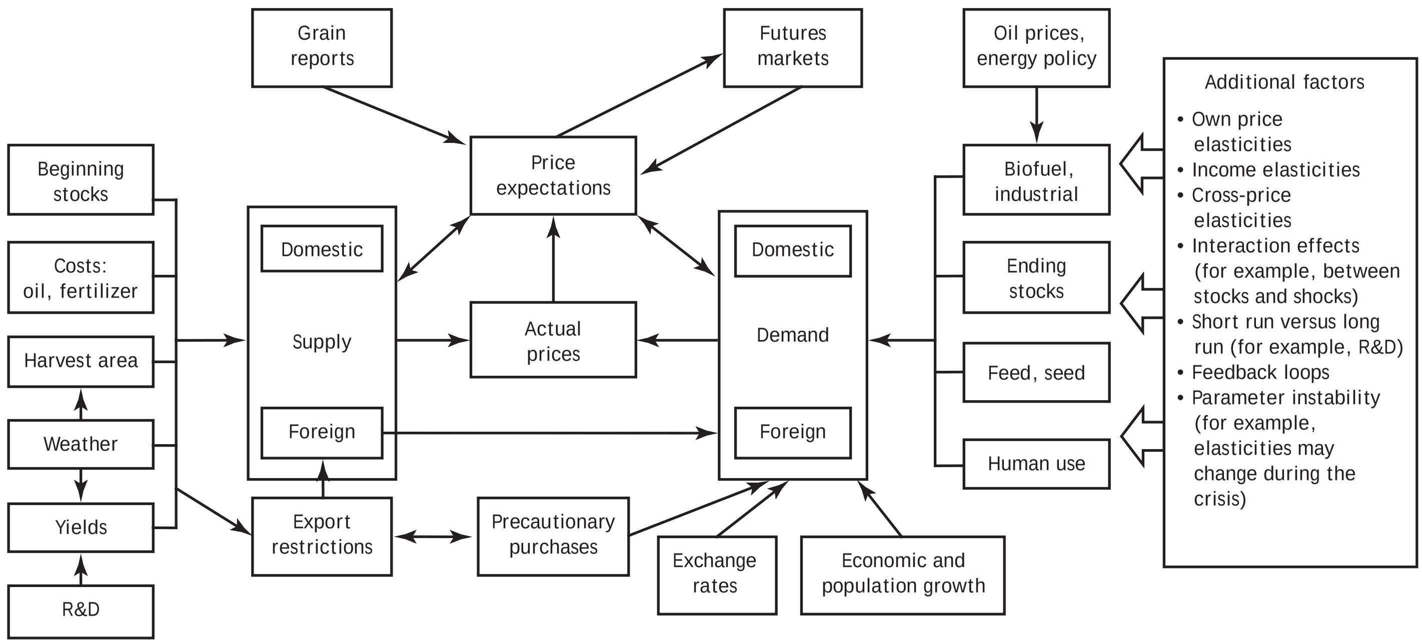
Broad-based research studies have attempted to identify the factors that might have caused the recent surge in food prices, but only a few have attempted to add explicit (albeit approximate) orders of magnitude to each factor. In this chapter we review, reassess, and extend the evidence on this issue. A significant constraint on all assessments of the crisis, including ours, comes about because it is a global phenomenon and one regarded by many as a distinct event. Thus some of the usual tools favored by economists for uncovering causality, such as regression analysis or simulation models, have quite limited application in this context. Instead, some less formal "detective work" is needed, involving a mix of economic theory, economic history, and more rudimentary statistical analysis. The review begins with a reassessment of the basic facts of the crisis. Bearing these facts in mind, each individual explanation of the crisis is assessed in terms of how well it holds up against both the general facts and the more specific evidence.

Commodity Price Formation: A Conceptual Framework

Implicit in all discussions of the causes of rising food prices is some model of commodity price formation. That said, there seems to be little agreement as to how international commodity prices are formed. As we discuss below, some writers emphasize traditional agronomic determinants of commodity prices (such as the role of stocks and the interactions between stocks and various supply and demand movements), some see macroeconomic phenomenon as critical, and still others emphasize the role of futures markets in influencing spot prices. Less frequently discussed is whether international price increases are predominantly driven by price changes in U.S. markets—because the United States is the largest exporter of maize and wheat, and the third largest exporter of soybeans—or whether other markets are also price makers.

To address the price-formation question more explicitly, Figure 2.1 sets out a comprehensive model of price formation in major international (exporter) grain markets. The model is centered around the complex interactions among supply, demand, actual prices, and price expectations. Buyers and sellers of

Figure 2.1 The complicated nature of commodity price formation



Source: Constructed by the authors.
Note: R&D, research and development.

grain reach price arrangements based on a host of supply and demand conditions but also on expectations of future prices, especially as grains are storable commodities. Price expectations themselves are influenced by current prices and supply conditions (such as area planted, levels of stocks, and weather forecasts) but also by grain reports (which transmit explicit information on supply and demand conditions) and futures markets (which transmit more implicit information about where market actors think prices may be heading over various time horizons). The remainder of the model sets out some of the hypothesized determinants of price movements in the current crises—such as the interplay among weather, export restrictions, and precautionary (or panic) purchases —and such factors as exchange rate movements, economic and population growth, R&D, and the nexus between oil prices and biofuels.

The model's transmission mechanisms and outcomes are conditioned by a range of parameters and relationships (listed as "additional factors" in the box on the right side of Figure 2.1), including supply and demand elasticities, interaction effects among factors, feedback loops, and various dynamic nuances relating long- versus short-term price adjustments. These complexities have some important implications for how well any analysis can identify the causes of the crisis, particularly more formal analytical techniques, such as simulation models or time series econometrics. To give just one example, Headey (2010) argues that two of the most important causes of the food crisis were government interventions on both the supply side (for example, export restrictions) and the demand side (such as government-to-government import deals). In effect, these policies meant that supply and demand elasticities changed during the crisis in quite perverse ways; that is, high prices led to supply restrictions and demand surges. Hence simulation models or time series regressions that use or derive pre-crisis parameters could well be incorrectly specified. So instead of adopting these more formal but more restrictive techniques, we opt to treat the crisis as a distinct event—albeit one with similarities to previous crises—best investigated with what we can only describe as economic detective work. To push that analogy further, we acknowledge upfront that most of the evidence that we and others bring to bear on this case is circumstantial at best.

Some Basic Facts of International Grain Markets

In addition to the general model in Figure 2.1, it is also important to consider how the four major international markets for staple foods—maize, rice, soybeans, and wheat—vary with respect to price formation.[1] Some of the major facts of these grain markets are as follows:

[1] The following paragraphs draw heavily from Schepf (2006).

1. *Dominance of the U.S. grain markets.* The United States heavily dominates global exports of maize (60 percent) and wheat (25 percent), and although U.S. soybean exports have been overtaken by those of Argentina and Brazil in recent decades, the United States is still the world's third largest soybean exporter. Only in rice markets is the United States not a leading exporter. Hence U.S. grain prices are typically quoted as international prices for all grains except rice, where Thai prices are typically quoted.
2. *Importance of U.S.-specific factors.* Given Fact 1, events in the U.S. economy or in U.S.-dominated grain markets can be thought of as possible suspects in the recent food crisis. Such events include the advent of biofuels, the depreciation of the U.S. dollar and the build-up of dollar reserves in other countries, and movements in commodity futures markets. That said, trade shocks in the U.S. market are also important. Schepf states that "Since the market events of 1972 [in which the Soviet Union made unexpected purchases of large amounts of U.S. grain] most market observers consider exports to be the great uncertainty underlying commodity supply, demand, and price forecasts" (2006, 17).
3. *Degree of competition and market efficiency in the United States.* These three U.S. grain markets are highly commercialized and, despite the importance of some large players (for example, Cargill), these markets are highly competitive. They have a sophisticated market infrastructure, including the information services of the U.S. Department of Agriculture (USDA) and the price-discovery functions afforded by futures markets.
4. *Seasonality and inelastic supply and demand functions.* Because most grains are limited to a single annual harvest, new supply flows to market in response to a postharvest price change must come from either domestic stocks or international sources. Hence, supply elasticities tend to be highly inelastic in grain markets, making them very vulnerable to relatively small shocks, especially when stocks are low. Similarly, demand elasticities tend to be low, because the farm cost of basic grains generally amounts to a small share of the retail cost of consumer food products in developed countries.[2] In poor countries demand can be inelastic for the opposite reason: poor people are so close to subsistence that higher prices of their staple grain force them to concentrate their consumption on this essential item.[3]

[2] In other words, changes in grain prices generally have little impact on retail food prices and therefore little impact on farm-level demand. For example, a 20 percent rise in wheat prices would translate into only about a 1 percent rise in the price of a loaf of bread.

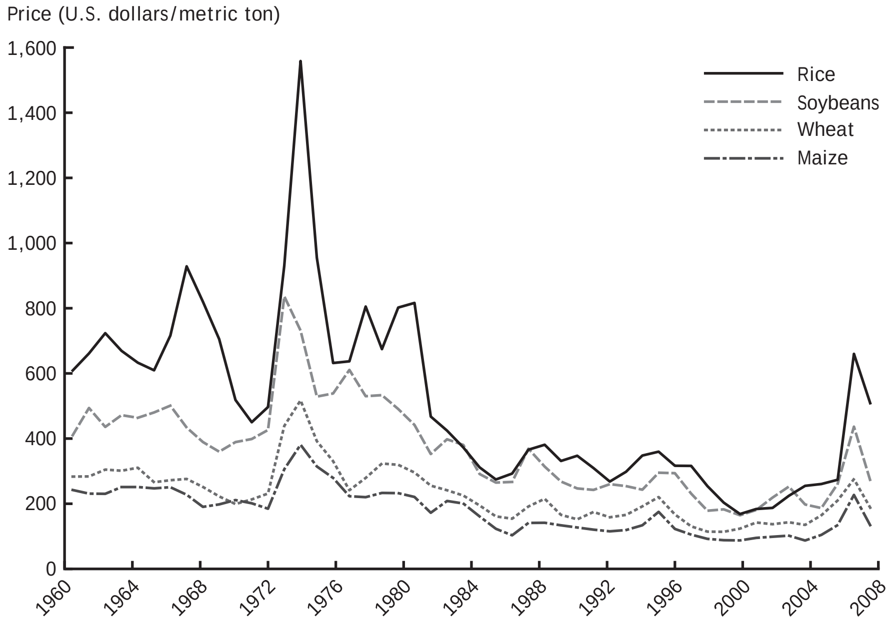
[3] Indeed, higher prices could even induce the very poor to consume more of the grain (Jensen and Miller 2008).

5. *Variations among wheat, maize, and soybean markets.* Despite being generally inelastic goods, Schepf (2006) notes important variations among these grain markets. He argues that U.S. wheat prices are generally more stable than maize prices because (i) there are two crops annually for U.S. wheat; (ii) there are two counterseasonal southern hemisphere grain exporters (Australia and Argentina); (iii) there are price-stabilizing U.S. government policies for wheat; and (iv) feed demand can act as a price buffer for wheat. Soybean prices might also be less volatile because of more elastic demand (soybeans are mostly used as feed, for which there are substitutes), the rarity of trade restrictions on soybeans, and the existence of important counter-seasonal southern hemisphere producers (Brazil and Argentina). But soybean prices could be sensitive to demand shocks, because China and the European Union (E.U.) account for almost two-thirds of global imports. In contrast to wheat and soybeans, maize exports are heavily dominated by the United States (two-thirds of the global share), making the maize market very sensitive to events in the United States.
6. *Peculiarities of the rice market.* As Timmer (2009) discusses, rice markets are very distinctive in that (i) only about 6 percent of global rice production is exported; (ii) exports are dominated by Asian countries, such as Thailand, India, and Vietnam; (iii) most exporters and many importers of rice impose substantial barriers to trade; (iv) rice is extensively produced and traded by smallholders and small traders; and (v) demand for rice is highly inelastic, as it is the major food staple for millions of people in Asia in particular. Hence, international rice prices are generally more volatile than those of other grains, although domestic prices in Asia are much more stable.

Facts of the Crisis Itself

The basic price-formation framework illustrated in Figure 2.1 and the facts listed in the previous section provide us with a useful platform for investigating the causes of the crisis, although they make no specific mention of the events leading up to it. Hence in this section we focus on the facts pertaining to the crisis itself. Figure 2.2 presents long-term data on export prices from 1960 to mid-2008 for four major staples—maize, rice, soybeans, and wheat—as measured in key markets in the United States and, in the case of rice, key markets in Thailand. All measures are deflated using the U.S. Bureau of Economic Analysis gross domestic product (GDP) deflator. Some of the same data are also used to more narrowly examine the growth rates of real prices over particular periods of interest (Table 2.1). In addition, price changes are included for a wider range of commodities categorized into

Figure 2.2 Trends in real international prices of key cereals, 1960 to mid-2008



Source: IMF (2009a).
Notes: Data are deflated using the U.S. Bureau of Economic Analysis gross domestic product deflator. The 2008 data are for July.

various groups of interest (Table 2.1). Figure 2.3 focuses more on nominal short-term price data to more clearly delve into the timing of price changes in the current crisis. These three sets of data give rise to the basic facts outlined below.

Consistent with the above arguments, the first observation is that long-term trends may be relevant to an understanding of the current crisis. The price levels in mid-2008—when food prices peaked—are about as high as they were in the late 1970s or early 1980s in real terms (Figure 2.2). However, the nature of this crisis is not how expensive prices are relative to their historical trend, but how quickly they have risen, together with the related problem of behavioral adjustments by consumers and producers. Thus the first, and rather trivial, fact is that *food export prices have risen very quickly.* The rise in prices in the recent crisis is similarly sharp in percentage terms to the price shocks of 1972–74 crisis (Figure 2.2 and Table 2.1). In both crises, rice prices shot up the most (about 220 percent), but wheat prices rose steeply in 1974 (180 percent), and maize and soybeans both exhibited rapid price increases on the

Table 2.1 Changes in international prices across commodity groups, the 1972-74 crisis and today (percentage change of prices measured in real 2000 U.S. dollars)

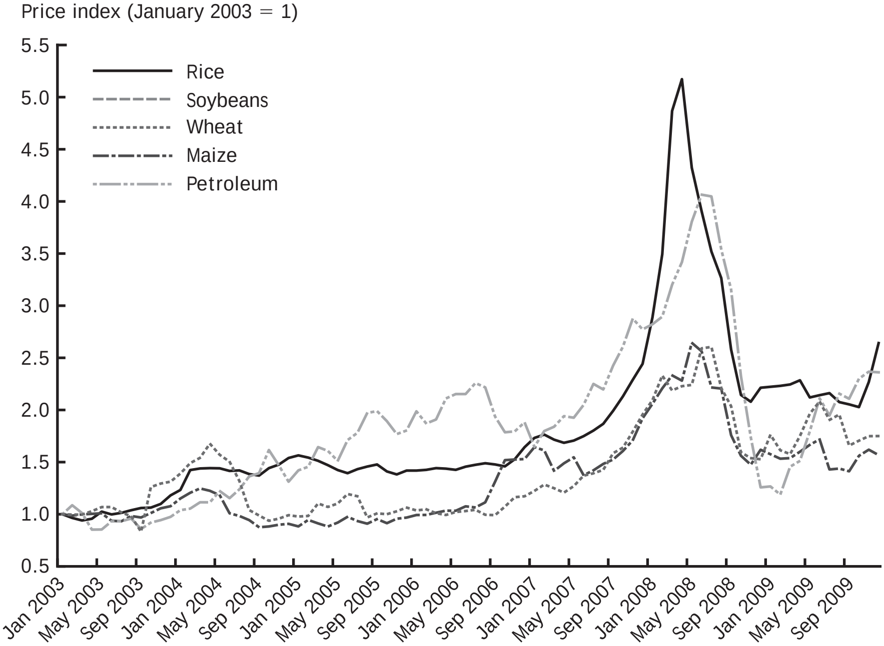
Commodity	1970–74	1974–78	January 2004–May 2008	May 2008–March 2009	Notable features
Food					
Staples	136.6	–41.2	124.8	–34.7	Subject to declining stocks; inelastic demand; competition for biofuels
Wheat	182.0	–53.8	107.9	–27.6	Subject to production shocks and diversion to biofuel crops in Europe
Maize	80.4	–42.2	88.5	–30.4	Of 2007 U.S. production, 30 percent diverted to biofuels
Soybeans	88.0	–27.6	52.9	–29.6	Subject to large demand from developing Asia
Rice	225.3	–48.1	223.6	–36.2	Subject to export bans by major producers; very distinctive market
Nonstaples	159.3	–40.4	62.4	–30.9	
Meat	24.5	10.1	50.7	–21.8	
Beef (Brazil)	n.a.	n.a.	40.2	21.7	
Seafood	42.8	7.2	41.7	–15.7	
Other agricultural commodities					
Textiles	115.3	–14.3	18.1	–25.0	

Wood	40.4	–7.3	7.1	–8.3	
Cash crops	49.4	35.0	61.2	–9.6	
Fertilizers	299.4	–44.6	369.8	–36.5	Market relatively concentrated and closely linked to energy prices
DAP	280.8	–58.3	676.1	–55.9	
Potash	475.3	–75.8	381.8	–70.7	
Metals	82.1	–5.9	121.1	–32.6	
Energy					
All energy	327.8	–3.0	136.4	–50.7	
Petroleum	410.2	–15.7	181.4	65.6	In both crises, petrol prices have risen more than other energy prices
Coal	360.1	–16.2	139.8	–41.9	
Natural gas	n.a.	n.a.	162.7	–56.7	
General prices					
U.S. Inflation	26.0	31.7	15.5	–2.9	
Pound	1.9	15.4	–1.7	39.3	
Yen	–15.9	–35.3	0.0	–5.7	
Euro	n.a.	n.a.	–12.4	19.3	Significant depreciation against a number of currencies

Source: IMF (2009b).

Notes: All commodity prices are deflated using the U.S. Bureau of Economic Analysis gross domestic product deflator so as to be expressed in terms of constant 2000 U.S. dollars. DAP, di-ammonium phosphate; n.a., data not available.

Figure 2.3 Trends in nominal prices of cereals and oil, January 2003-November 2009



Source: Calculations by the authors using data from IMF (2009a).

order of 50–90 percent. Although seemingly trivial, this speed component of the crisis is important, because it might focus suspicion on explanations that involve short-term factors rather than long-term changes.[4]

A second fact that may hold some significance is that *prior to the current price rise the real prices of staple foods were at an all-time low after declining for the best part of 30 years.* Whether these long-run trends and the similarities to the 1972–74 crisis are truly integral components of the current crisis remains to be seen, but—as is explored below—there are good grounds for the argument that they are.

A third fact that has yet to receive much attention is that *the prices of a wide range of commodities increased sharply.* The surge in the price of oil is well known, of course, as is its being a leading factor in the 1974 food crisis, but all energy prices have risen by 80–120 percent (so have the prices

[4] Of course, as will be shown, this is not necessarily the case. Long-term factors could have depleted stocks, which ultimately would have contributed to price increases.

of metals and minerals), and fertilizer prices roughly quadrupled during both crises. Other agricultural commodities (for example, cash crops) have not risen anywhere near as quickly, however (Table 2.1). This observation begs the question of whether food-specific factors are driving the surge in food prices or whether other factors that have common effects across these commodity groups—such as the importance of energy costs in production, global macroeconomic factors (including growing commodity demand from China and India), or low interest rates and their effects on investment decisions—are the dominant cause of recent price trends.

A fourth fact is that *the timing of price rises is somewhat different across commodities, and even across staple foods.* The fourth column of Table 2.1 shows percentage price changes from 2004 to the first five months of 2008 only, and Figure 2.3 shows graphically which commodity prices rose first. Figure 2.3 shows that maize prices rose first, then wheat, and then rice. Table 2.1 confirms that most of the price rise in wheat and maize occurred prior to 2008, but that three-quarters of the increase in the price of rice occurred in 2008—almost certainly because of adverse policy responses, such as export bans from some major exporters. Nevertheless, increases in rice prices from 2004 to 2007, which were on the order of 60 percent, were actually higher than the contemporaneous price increases of the other three staple crops considered (57 percent for wheat, 44 percent for maize, and 28 percent for soybeans). This fact has mostly been overlooked, although it is worth noting that rice is a thinly traded commodity (90 percent of all rice output is consumed domestically), and rice prices are generally more volatile than the prices of other staple crops. Hence rice is distinctive both in terms of the timing of the price rises and the nature of its international trade.

A fifth fact is that *the U.S. dollar has depreciated against a wide range of currencies.* Against the other special drawing-rights currencies (the U.K. pound, euro, and Japanese yen), the U.S. dollar has depreciated some 30 percent since the beginning of 2002. All commodities listed in Table 2.1 are expressed in U.S. dollars; thus the price increases would be much less sharp if measured, for example, in euros. The increase in nominal prices of key staples is about 25 percent less when measured in euros, somewhat less than that when measured against the USDA's trade-weighted agricultural exchange index, and roughly the same when measured in pounds or yen. Some authors also consider U.S. dollar depreciation to be a causal factor in the crisis, an issue that is revisited below.

A sixth fact is that in both the 1974 and 2008 crises, *commodity prices quickly plummeted from their peaks.* From 1974 to 1978 the prices of staple grains (and several other commodities) fell by about 50 percent (Table 2.1), with most of this decline occurring in 1975 and 1976. In the recent crisis, prices peaked in May 2008, but by March 2009 prices of staple grains had fallen by 30 percent from that peak, while energy prices fell by about 50 percent. Figure 2.3 shows that nominal prices have rebounded somewhat since the second half of 2008, with 2009 price still significantly higher than they were in 2005 or 2006. Nevertheless, the rapid rise and fall of commodity prices suggests a commodity bubble, with peak prices reflecting some kind of overshooting effect. Whether this effect is related to oil prices, dollar movements, export restrictions, or demand surges is ultimately an empirical question we shed light on in the next section.

Assessing Existing Explanations of the Crisis

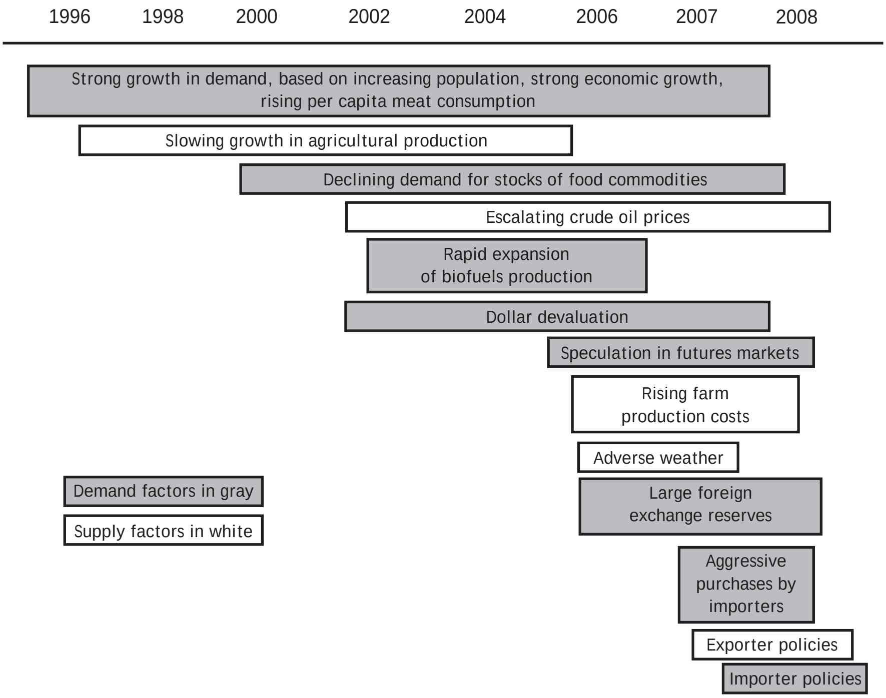
As for the factors that are hypothesized to have caused the crisis, Trostle (2008) provides a very useful timeline of events, which we present in Figure 2.4. The timeline distinguishes between supply- and demand-side factors, and also distinguishes between long-term factors (such as strong growth in demand and slowing agricultural production), medium-term factors (for example, dollar devaluation, rising oil prices, biofuels production, and the build-up of foreign exchange reserves); and short-term factors (such as adverse weather and various trade shocks). Following the taxonomy in Figure 2.4, the following discussion is structured around this chronology of events.

Strong Growth in Demand, Especially from China and India

Many studies, policy briefs, and media publications have attributed rising food prices to strong economic growth, especially the rapid growth in China and India. It is an explanation that has some intuitive appeal in that two countries with a combined population well in excess of 2 billion people, many of whom are indeed experiencing rapid income growth, have enormous potential to augment global demand for food and other resources. Such popular books as *Who Will Feed China?* have documented this possibility (Brown 1995). Many observers writing on the crisis have referred to changing consumption patterns in China and India, particularly the rapid growth in meat and vegetable consumption.

In our reckoning the Asian-diet hypothesis is not corroborated by available data. Although it is true that diets in countries like China and India are changing, it is not at all obvious that these countries are becoming more dependent on cereal imports (except in the case of Chinese soybean imports, discussed separately below). For example, cereal import trends around the world indicate that Spain and Mexico stand out as the two countries that have most increased their cereal imports in the 2000s. No Asian country figures in the top 10 of that list, and China actually imported fewer cereals in the 2000s than in the 1990s (although the composition of imports changed). Indonesia

Figure 2.4 Timeline of events contributing to the food crisis



Source: Adapted from Trostle (2008).

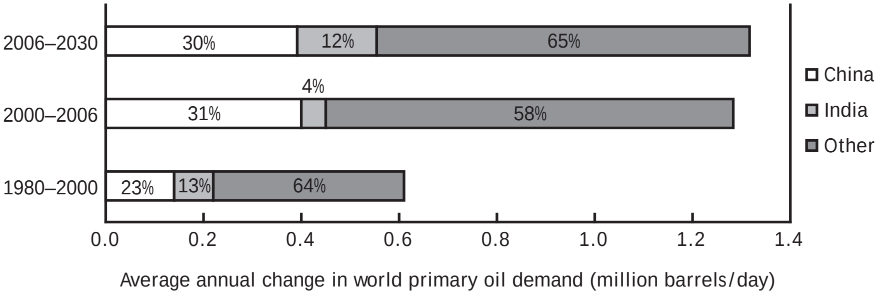
Notes: The authors added "Speculation in futures markets" to the original figure because this factor was excluded from Trostle's (2008) analysis on the grounds that there was insufficient evidence at that time (R. Trostle, pers. comm., February 2010). In addition, the authors interpret all these factors as hypotheses only, whereas Trostle's original figure referred to factors he considered likely causes of the crisis.

has also been a larger importer of cereals, but has actually decreased its cereal imports in recent years (Headey 2010). So even though it is true that Asian countries have indeed experienced various increases in their consumption of fruits and some meats, this has not translated into larger cereal bills.

If there is a China–India story, it is more indirect. First, China, and to a lesser degree India, are demanding more oil and more commodities. China has contributed about 30 percent of the increased demand for oil from 2000 to 2006 and will continue to do so from 2007 to 2030 (Figure 2.5). Monthly import data in Figure 2.6 also suggest that rising oil imports in China could have contributed to rising oil prices, although the surge in oil prices is far more dramatic than the upward trend in Chinese imports.

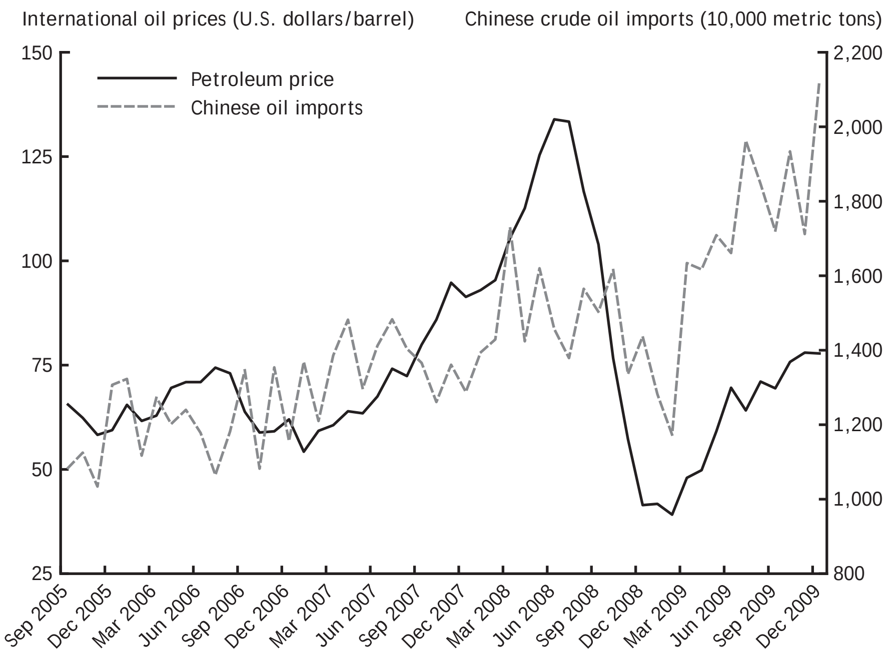
Of course, readers might be skeptical that Chinese demand for oil and metals could cause such a sudden upsurge in prices, given that China's demand

Figure 2.5 Contributions to changes in primary oil demand, 1980–2000, 2000–06, and 2006–30



Source: IEA (2007, table 1.2).
Note: 2006–30 data are based on the IEA (2007) projections.

Figure 2.6 Chinese crude oil imports and international oil prices, September 2005–December 2009



Sources: IMF (2009a) for price data, and General Administration of Customs of the People's Republic of China (2008).

for these commodities has been rising since the 1970s (Figure 2.5). However, oil market experts argue that supply response is sufficiently slow that, even when rising demand is foreseen, the industry still struggles to respond. Moreover, China's economy was so flush with foreign exchange that it could afford to keep importing large volumes of oil even as prices rose, thus crowding other economies out of the market. In 2009—after the crisis—it also looks like the rebound in oil prices is intimately connected to strong growth in Chinese oil imports, as media reports have suggested.

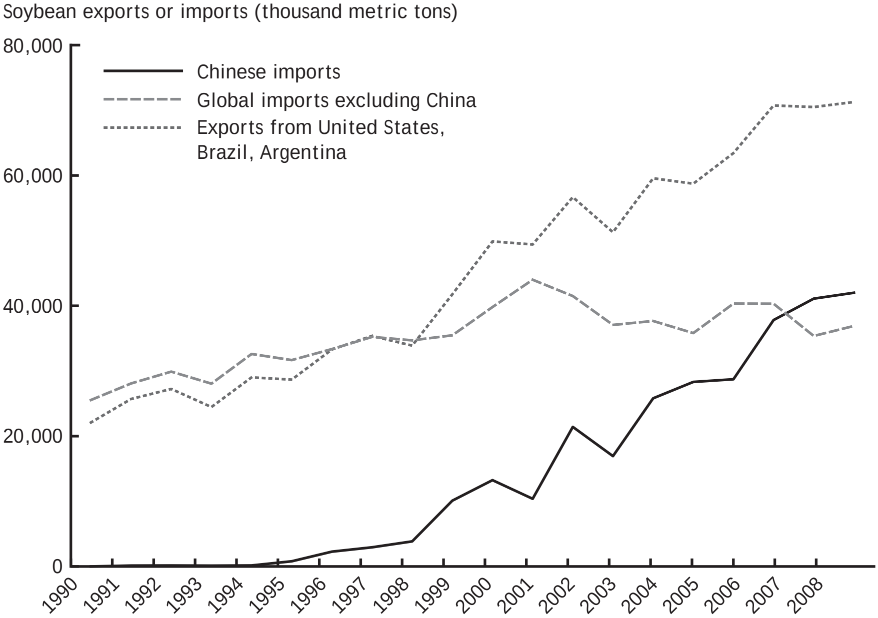
In summary, Chinese demand looks like an important component in the surge in oil prices, although previous analyses have also shown that rises in oil prices are also closely linked to political instability in the Middle East, Nigeria, and Venezuela and to supply decisions made by the Organization of Petroleum Exporting Countries (OPEC) (WRTG Economics 2008). As for India, its contribution to rising oil prices has thus far been fairly negligible, but its contribution will rise to 12 percent over the next 20 years or so (Figure 2.5).

A second narrative about China is also quite indirect. Although China's participation in oil and food markets has generally been steady, one agricultural commodity for which China's demand is characterized by a strong import surge is soybeans. In the mid-1990s China appears to have made a conscious decision to move away from domestic soybean production, which was relatively uncompetitive, and to instead rely on exports from North and South America. From a position of self-sufficiency in the early 1990s and before, Chinese imports of raw soybeans steadily rose to more than 50 percent of global imports (Figure 2.7), while soybean oil imports have generally risen but fluctuated between 10 to 30 percent of global imports. However, Figure 2.7 also shows that this increase in demand has been accommodated by increased soybean production (almost entirely through area expansion) by Argentina, Brazil, and the United States.

This trend has contributed to U.S. farmers' shifting large amounts of land out of wheat, maize, and other coarse grains into soybeans. In fact, USDA data suggest that soybean production area increased by more than 11 million hectares during this period. By using average yields for other crops, simple back-of-the-envelope calculations suggest that non-soybean grain production in the United States might be 3 percent higher today than would have been the case had this switch not occurred. In Brazil, soybean exports were largely fueled by expansion of total agricultural area, such that the impact on production of other crops was not strong.

It certainly seems possible that China has had some modest effect on tightening coarse-grain production in the United States, but this increased demand was spread out over many years and seems to have been sufficiently accommodated by extensive production growth among the three major

Figure 2.7 Chinese imports of soybeans and soybean oil, 1990–2008



Source: Constructed by the authors using data from USDA (2008c).
Note: Global imports also equal global exports.

exporters. However, one factor we have to consider is interaction effects. A plausible hypothesis is that increasing soybean demand from China from 1995 onward reduced a great deal of the slack in U.S. soybean and maize markets (the two crops compete for land) such that when the biofuels surge occurred, the competition for land between maize and soybeans became much tighter. Consistent with this hypothesis, Figure 2.3 suggests that U.S. maize and soybean prices have tracked each other closely during 2005–09.

China and India may have had a third indirect effect on food prices by means of depletion of stocks. Largely because of increased demand for meat, grain consumption has risen rapidly in China from 1991 to the present, and it has often outpaced production growth. For example, maize consumption in China increased by 88 percent, but production increased by only 55 percent. Because China hardly imports any maize (it is generally one of the larger net exporters of maize), most of this excess demand was satisfied through the depletion of stocks.

Of course, China may have contributed in some small way to the crisis through the depletion of stocks, but this seems fairly unlikely. For one thing, China is not a major exporter of maize, and China's stock levels were excessively high prior to the recent surge and—at 22 percent of consumption—are still robustly above so-called optimal levels of 17–18 percent. And as for other cereals, China has long held excessively large stocks of wheat and rice. These stocks have declined somewhat in recent years, but relative to current consumption they are still extremely high. Indeed, Slayton and Timmer (2008) have suggested that China could largely solve the rice-price problem simply by releasing these stocks. So if China's declining levels of stocks have had an effect on prices, it may be through some indirect effects on market psychology. But because China is not a major exporter of these commodities and looks unlikely to become a major importer any time soon, such a strong sensitivity to Chinese stock estimates among non-Chinese markets would seem somewhat irrational.

As for Indian stocks of major cereals, these have been quite low in recent years (see below), and agricultural output growth in India has been volatile, but sluggish on average. However, India is not a major importer of cereals. In fact, it is typically the world's second largest rice exporter and is also a moderately large exporter of wheat. However, a poor wheat harvest in 2006/07 led to pressure on India's wheat stocks and India's Public Distribution Scheme, which keeps stocks of both wheat and rice (Gulati and Dutta 2009). In 2006/07, government stocks of wheat fell short of buffer-stock norms, and about 6 million metric tons[5] of wheat were imported. And although rice was in surplus and India exported more than 4.5 million tons of rice that year, the fear of a food shortage influenced policymakers, who faced impending national elections. Hence India's decision to ban exports was not the result of rising economic growth or the end of India's self-sufficiency in grain production but rather the interplay of bad weather, government policies, and national politics.

All in all, then, we believe that the China–India hypothesis can largely be dismissed as a direct explanation for the price surge. However, this is not to say that economic growth in general was not a factor contributing to the crisis. As we argue below, monthly trade data suggest that several demand surges in recent years seem to be closely linked with international price movements. But these demand surges came from a diverse array of countries that do not include China or India. In addition, China's contribution to the rising prices of oil and other nonfood commodities was indeed a significant, albeit not the sole, factor involved.

[5] Throughout this monograph the term "tons" refers to metric tons.

Productivity Decline and Falling R&D

Several press articles and policy briefs have cited declining productivity growth and declining stocks as the principal causes of the supply–demand imbalance (for a review, see Abbott, Hurt, and Tyner 2008). In many of these documents, slowing productivity growth is chiefly attributed to lower rates of investment in agricultural research. Declining yields are used as evidence for reduced growth, including a widely cited figure from the World Bank's (2008c) *World Development Report* that shows declining growth rates in yields of rice, maize, and wheat (especially in the 1990s). Other studies also cite land degradation as a cause of the productivity slowdown (see Pender 2009). However, Fuglie (2008) argues that total factor productivity (TFP) measures are preferable and finds that TFP growth did not decline on average, but actually increased. Nevertheless, Fuglie did find that agricultural investment had slowed down, which potentially accounts for why TFP accelerated even as partial productivity growth measures decelerated.

In our view, however, several arguments suggest that the productivity-based explanation of the food crisis should be seriously questioned. Most importantly, it is highly questionable whether yield growth or TFP growth is directly relevant in this context. Logically, a global supply–demand imbalance relates to total production per capita and its impacts (if any) on global trade; yields and other productivity measures are only determinants of production. For a broader perspective, Figure 2.8 shows trends in yields, production, irrigation, and input use across regions and from the 1960s to today. The most pertinent measure is production per capita, and it is indeed true that global cereal production per capita was about 6 percent lower in the 2000s than it was in the 1980s. In other words, cereal production did not keep up with population growth.

The most important question is "What caused this decline?" The answer is complicated, but one simple means of addressing the question is to calculate global cereal production per capita after excluding individual regions, to supply at least superficial regional explanations of the decline in cereal production (Table 2.2). It turns out the oft-cited decline in Asian yield growth looks irrelevant (production growth would have been much lower if Asia were excluded from global production), confirming our earlier assessment of the China–India hypothesis. And although it is true that yield growth slowed in Asia, the slowdown came on the back of unsustainably high rates in the 1980s that resulted from the Green Revolution (a revolution cannot be sustained indefinitely). As shown below, poor performance in Australia is also not much of a long-term explanation, even though one could argue that climate change and unsustainable farming methods are affecting long-term growth.

Africa's experience is more relevant, because its population grew rapidly during this period, so Africa's sluggish growth remains a reasonably strong explanation of the global decline in per capita agricultural production. But if one excludes Africa's population and cereal production from the global calculations, the –6 percent reduction in global cereal production per capita increases to just –4.75 percent. So Africa's poor performance only explains around one-quarter of the global decline. And for that one could certainly cite low R&D in Africa as an explanation, but only one of many. Other factors could include land degradation, the increasing exploitation of marginal lands, and some adverse outcomes of economic liberalization, which had negative impacts on both input and output markets (Kherallah et al. 2002).

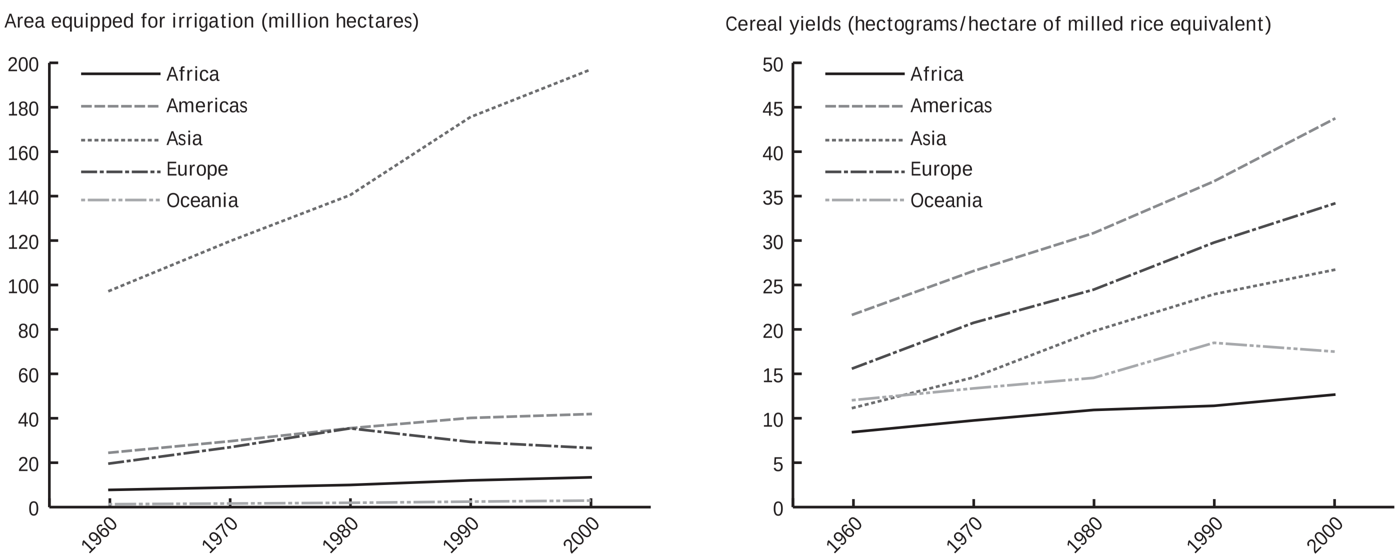
In any event, the remaining three-quarters of the decline in global food production is explained by poor performance in Europe (Figure 2.8), especially the former USSR and several Eastern European countries, which together account for virtually all the decline in European cereal production during 1985–2006 (Figure 2.9). The explanation of this decline does not concern yields, which grew fairly quickly.

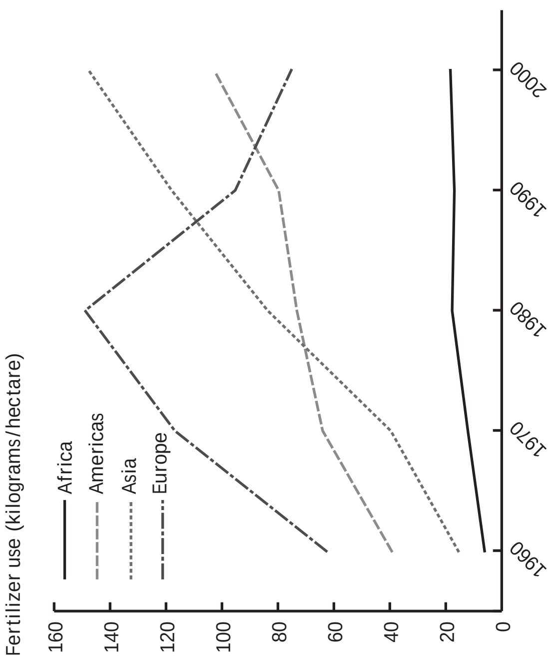
The real story is instead about inputs: land allocated to cereals in Europe declined by 30 percent during 1985–2006, the population working in agriculture fell by 50 percent, farming land equipped for irrigation declined by 26 percent, and fertilizer use declined by 62 percent. In other words, one novel explanation of the food crisis is the fall of the Berlin Wall and the ensuing policy and institutional failures (Liefert and Swinnen 2002; Rozelle and Swinnen 2004). But international prices are primarily determined by trade, so for the decline in cereal production from East European and former Soviet regions to result in a rise in international prices, we need net exports from these countries to have also declined. However, USDA trade estimates suggest that net exports from this region actually increased. Indeed, it is other regions that experienced a decline in net cereal exports over the 1990s and 2000s: North America, South America, Sub-Saharan Africa, and the MENA region. The data also confirm that South Asia and East Asia (including India and China, respectively) are basically self-sufficient in cereals. Thus we find no substantial evidence that links a productivity decline to increased pressure in international cereal markets, except perhaps in Sub-Saharan Africa.

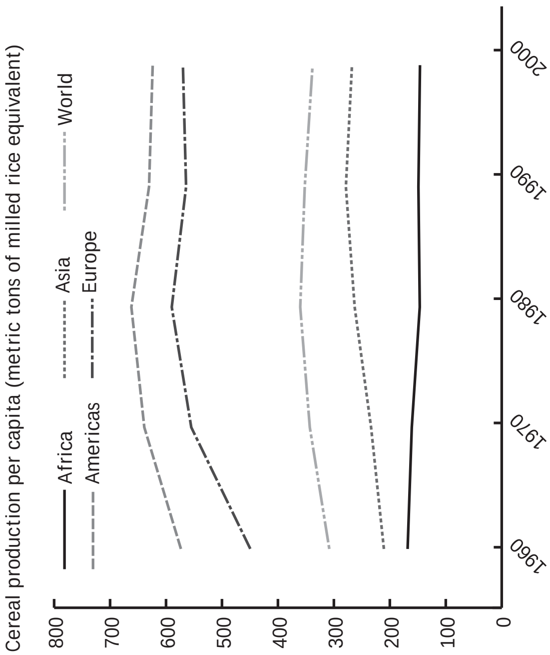
Rising Oil Prices

International fuel and food prices are closely linked historically. Rising oil prices were closely associated with the 1972–74 crisis and indeed were arguably the dominant factor, so there is clearly some precedent here (see Table 2.1 and Figure 2.1). More systematic econometric evidence also con-

Figure 2.8 Trends in yields, production, and input use across regions and decades







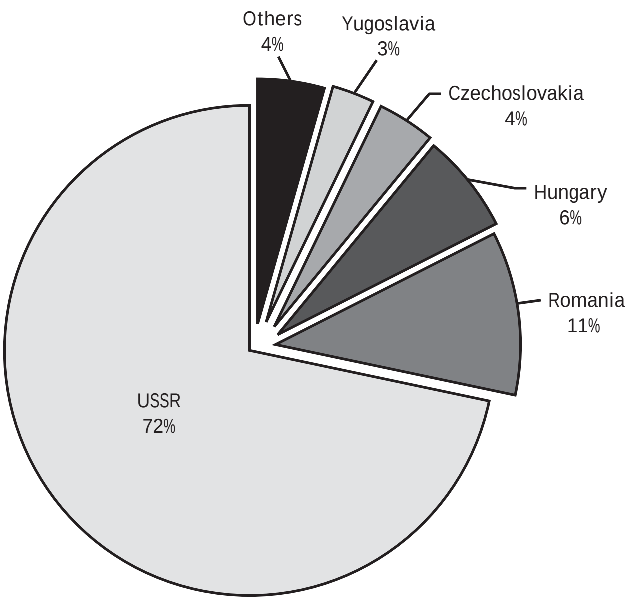
Source: Calculations by the authors using data from FAO (2009).

Table 2.2 Growth rates in cereal production per capita, 1980s–2000s

Region	Growth rate (percent)	Implication
World (total)	–6.1	
World minus Africa	–4.8	Africa accounts for almost one-quarter of global shortfall
World minus Americas	–5.8	
World minus Asia	–9.6	Asian growth was much stronger than global growth
World minus Europe	–2.8	Eastern Europe accounts for almost half of global shortfall
World minus Oceania/Australia	–6.3	

Source: Calculations by the authors using data from FAO (2009).
Notes: Growth rates are calculated as the percentage difference between average annual cereal production per capita during 2000–06 and average annual production in the 1980s. Cereal production is measured as milled rice equivalent.

Figure 2.9 Explaining Europe's declining cereal production, 1985–2006



Source: Calculations by the authors using data from FAO (2009).

firms this link. Using data from 35 internationally traded primary commodities for 1960–2005, Baffes (2007) finds that the pass-through of crude oil price changes to the overall non-energy commodity index is 0.16, whereas the fertilizer index had the highest pass-through (0.33), followed by agriculture (0.17) and metals (0.11).

What explains this strong link? Oil can affect food prices through various channels, including both the supply and demand sides. Here we focus on two: supply-side costs of agricultural production and biofuels (which are discussed separately below).[6]

On the supply side, oil and oil-related costs constitute a substantial component of the production of most commodities, so rising oil prices provide a strong explanation of commodity-price escalation across a wide range of food and nonfood commodities. Moreover, unlike noncommodity sectors, agriculture is more reliant on fuel-related inputs than on other types of energy. Figure 2.10 compares International Energy Agency (IEA) data, which disaggregate energy usage by economic sector and by energy source. Total energy usage at the national level is then compared with total output measured in current U.S. dollars. Figure 2.10a shows that, relative to its output, agriculture does not use a large amount of energy in production. Clearly these calculations depend on the prices of different types of energy, however. For that reason Figure 2.10b shows the proportion of all energy usage in a sector that is accounted for by oil-related energy.

Agriculture is second only to transport in the oil intensity of its energy usage, suggesting marginal costs in agricultural production could be quite sensitive to oil prices, although cross-country evidence listed in Appendix Table A.1 suggests that substantial variations exist across countries. U.S. agricultural production in particular, though, is almost solely dependent on oil for its energy use. And to rising fuel costs we also need to add the enormous surge in fertilizer prices, most of which are made from energy products, such as natural gas. Indeed, energy costs can constitute up to 90 percent of the costs of fertilizer production (for example, nitrogen fertilizers), which helps explain why fertilizer prices rose by double the amount of cereal prices from 2005 to 2008. Moreover, the bulky nature of grains means that agricultural prices are strongly influenced by transport costs.

But just how substantial are energy costs in food production and trade? Mitchell (2008) provides the best appraisal of the effect of energy costs on

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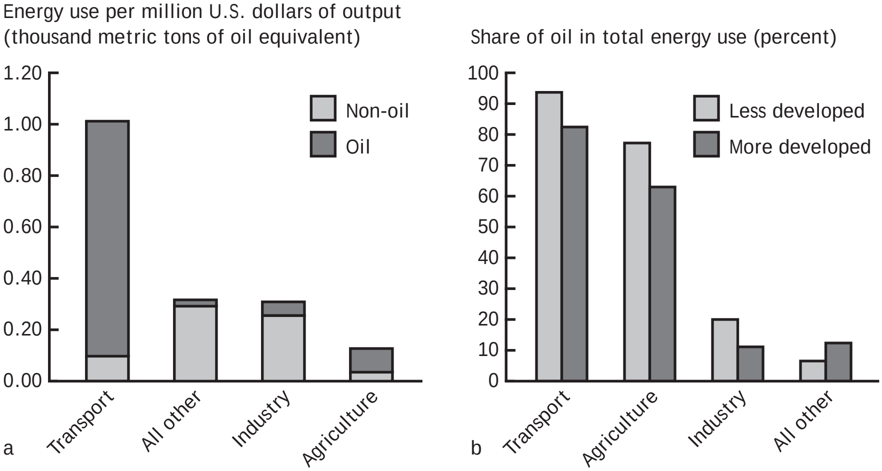
[6] One might add some kind of general inflationary effect, but our focus is on changes in food prices relative to other prices. Rising oil prices also positively affected the economic growth of energy-exporting economies, many of which are major importers of food staples. This effect is discussed separately below.

Figure 2.10 Intensity of energy and oil use in production: Some macroeconomic measures



Sources: Calculations by the authors using data from IEA energy balance sheets on energy use by source of energy and sector (IEA 2008), and United Nations (2008) national accounts data on value-added in U.S. dollars by sector.

Note: Sample includes a set of more-developed countries (excluding one significant outlier, Australia) and less-developed countries.

rising export prices, although some of his calculations are rather sensitive to the methodology he adopts. First, Mitchell (2008) finds that the contribution of the energy-intensive components of total production costs (fertilizer, chemicals, fuel, lubricants, and electricity) in U.S. production were 13.4 percent for maize, 6.7 percent for soybeans, and 9.4 percent for wheat. Mitchell uses these data to calculate that the production-weighted average increase in the cost of production due to these energy-intensive inputs for these crops was 11.5 percent between 2002 and 2007. Transport costs also increased because of higher fuel costs, and the margin between domestic and export prices reflects this increase. Mitchell (2008) calculates that the margin for maize between central Illinois and the Gulf ports increased from US$0.36 to US$0.72 per bushel, whereas the margin for wheat between Kansas City and the Gulf ports registered hardly any increase at all. An export-weighted average of these prices suggests that transport costs could have added as much as 10.2 percent to the export prices of maize and wheat (comparable data were not available for soybeans). Hence Mitchell (2008) estimates that the combined increase in production and transport costs for the major U.S. food commodities—maize, soybeans, and wheat—was at most 21.7 percent during 2002–07.

However, in recalculating production costs ourselves, we found that Mitchell's (2008) estimates are somewhat sensitive to his assumptions, and that energy-related production costs were probably higher than the 11.5 percent increase that Mitchell derived. For one thing, total production costs include several nonexplicit (imputed) costs associated with the management side of farm production that are more-or-less fixed costs. In terms of more variable operating costs (which exclude management-related items), we calculate that fuel-related costs are about 80 percent of the total. Second, Mitchell deflates his cost measures by yield differences between 2007 and 2002 (to calculate per bushel energy costs), but yields were unusually low in 2002 for wheat and maize. Using 2001 data actually makes some difference. Third, the energy component of rising production costs is probably best calculated by asking what production costs would be in 2007 if fuel-related costs had only increased by the same margin as prices in the broader economy (that is, by the GDP deflator), which was about 20 percent during 2002–07. In that case it would appear that production costs were 30–40 percent higher in 2007 than they would have been without oil-related cost increases during 2001–07 (Table 2.3). Hence, at least for U.S. production costs, we find that rising energy costs are a strong factor. We also note that the rise in energy

Table 2.3 Estimated impact of fuel-related costs on U.S. farming costs, 2001–07

Row number	Indicator	Maize	Soybeans	Wheat
1	Yield gap (ratio of 2001 to 2007 yields)	0.9	0.9	1
2	Total costs in 2007 with 2001 cost levels[a] (U.S. dollars)	325.1	225.6	180.1
3	Actual total costs in 2007 (U.S. dollars)	453.5	295.4	235.7
4	Difference (row 3 – row 2) (U.S. dollars)	39.5	30.9	30.9
5	Difference deflated by yield growth (row 4 x row 1) (U.S. dollars)	35.5	27.8	27.8
6	Change in prices received by farmers (percent)	132.6	99	101.7
7	Oil-related cost increase as a percentage of the total price increase paid to farmers (row 5 ÷ row 6)	8	11	20.3

Source: Calculations by the authors using data from USDA (2008b).

Notes: The percentage change in prices uses actual prices received by farmers for 2000/2001 and actual prices received by farmers in 2006 multiplied by the percentage change in U.S. export prices, because actual prices received by farmers in 2007 were not available at the time of writing. If farmers received less than the full U.S. export price change from 2006 to 2007, then the last indicator (oil-related cost increase as a percentage of the total price increase paid to farmers) is underestimated.

[a]Extrapolated to 2007 using the U.S. Bureau of Economic Analysis gross domestic product deflator.

prices predates that in food prices, which at least suggests the possibility that rising energy prices caused food prices to increase, rather than the reverse.

However, we also attribute a large role to demand-side factors that would have interacted with supply-side factors affecting production costs. If the supply curve alone had shifted upward because of rising fuel prices, the profits of farmers and food wholesalers would not normally be expected to rise much unless demand was very inelastic. Because U.S. farmers (and major firms, such as Cargill) experienced sharply rising profits in 2006, 2007, and 2008 (see Appendix Table A.2), it can safely be inferred that demand factors are also important contributors to rising food prices. Indeed, we argue below that biofuels and import surges are two highly significant sources of demand growth.

Biofuels

The third and newest link between oil prices and food prices is biofuels. Once oil prices exceed US$60 a barrel, biofuels become more competitive, and grains may be diverted to biofuel production (Schmidhuber 2006), especially if high oil prices are expected to persist. Most of the more rigorous analyses to date conclude that the diversion of the U.S. maize crop from food to biofuel uses constitutes the largest source of international biofuel demand and the largest source of demand-induced price pressure (Abbott, Hurt, and Tyner 2008; Mitchell 2008; Schepf 2008; von Braun 2008a). The reasons are as follows:

1. The use of maize for ethanol grew especially rapidly from 2004 to 2007, and ethanol production used 70 percent of the increase in global maize production.
2. The United States is the largest producer of ethanol from maize and is expected to use about 81 million tons for ethanol in the 2007/08 crop year (USDA 2008a).
3. The United States accounts for about one-third of global maize production and two-thirds of global exports, so impacts on U.S. production easily affect international prices (Mitchell 2008).
4. European biofuel production is concentrated on biodiesels and uses about 7 percent of global vegetable oil supplies (amounting to about one-third of the increase in vegetable oil consumption from 2004 to 2007).
5. Biofuel production in other parts of the world is either relatively small or uses different crops (for example, sugarcane in Brazil), which have not experienced price surges.

Biofuels constitute a major new source of demand in maize and vegetable oil markets, so biofuels are an especially strong candidate to explain price rises in these markets. But the knock-on effects for other foods are also significant. In the United States, rapid expansion of maize area by 23 percent in 2007 resulted in a 16 percent decline in soybean area, which reduced soybean production and contributed to the 75 percent rise in soybean prices from April 2007 to April 2008 (Mitchell 2008). In Europe other oilseeds displaced wheat for the same reason.

Another knock-on effect of significant concern is that biofuels have added substantially to the depletion of grain stocks. Several studies try to estimate these effects. Mitchell (2008) estimates that had areas planted in vegetable-oil crops for biodiesel been used for wheat production, European wheat stocks would almost have been as large in 2007 as they were in 2001 rather than lower by almost half (although it is not clear that in the absence of biofuel production farmers would have increased areas devoted to wheat). The U.S. maize story is also different, because even though some "new" land was diverted to maize production, most of the maize provided for biofuel production came from existing land and from production that would otherwise have been used to feed people or livestock.[7]

Several formal studies have simulated the effects of various biofuel scenarios on food prices. Generally, these simulations are difficult to compare, because they can vary substantially in terms of time periods considered, prices used (export, import, wholesale, and retail), coverage of food products, the currency in which prices are expressed, and whether prices are real or nominal (Schepf 2008). Different methodologies will typically give different outcomes. General equilibrium models generate long-term price impacts resulting from specific shocks by factoring in interactions among markets, but their ability to capture short-term price dynamics is highly constrained. Conversely, detailed studies of specific crops may include the short-term dynamics, but they often exclude the impact on other markets. There are also issues of whether shocks are considered to be independent (Schepf 2008).

In spite of these methodological variations, most studies find biofuel production to be a significant driver of food price trends, as Schepf's (2008) review of these studies concludes. In terms of short-run studies, the International Monetary Fund (IMF) estimates that biofuel demand has accounted for 70 percent of the increase in maize prices and 40 percent of the increase in soybean prices so far (Lipsky 2008). Collins (2008) used a mathematical simulation to estimate that about 60 percent of the increase in maize prices from 2006 to 2008 may have been due to the increase in maize used for ethanol. The Council of Economic Advisors (Lazear 2008) estimates that retail food

[7] Even the USDA suggests that biofuel diversion in the United States is a much larger source of demand than increased demand from China (see Helbling, Mercer-Blackman, and Cheng 2008, figure 4).

prices increased only about 3 percent during 2008 due to biofuel production, but this low value is largely because they only considered the impact of maize prices on retail food prices, for which raw maize only constitutes a small portion of the total value-added.

Rosegrant et al. (2008) use a partial equilibrium model to calculate the long-term impact on weighted cereal prices of the acceleration of biofuel production from 2000 to 2007 to be 30 percent in real terms. Maize, wheat, and rice prices were simulated to increase 47, 26, and 25 percent, respectively (applying Schepf's conversion to the real-price estimates of the model), which is similar in order of magnitude to values calculated using the World Bank's linkages model (World Bank 2008a).

In terms of the effects of U.S. biofuel policies, a study by the Food and Agricultural Policy Research Institute (FAPRI) attempts to measure the pure and joint price effects of the U.S. biofuel subsidies and tax credits. FAPRI's study (Meyers and Meyer 2008) suggests that implementation of subsidies (in the absence of the tax credit) will raise maize prices by about 19 percent once the new long-run equilibrium has been established. The FAPRI study also estimates that the ethanol tax credit of US$0.51 per gallon supports maize prices by a slightly smaller amount—11 percent. Because of interactions between the two subsidies, it is estimated that joint implementation of both the Renewable Fuels Standard and tax credit supports maize prices by about 20 percent. Strong effects were also observed by FAPRI for other commodities because of competition for land: the wholesale price of soybean oil is projected to increase 73 percent under the joint subsidy + tax-credit scenario. A similar study by the Center for Agricultural Research and Development (CARD) found that the subsidy + tax-credit program supported the price of maize by 16 percent (McPhail and Babcock 2008). Both studies found the results to be highly dependent on the price of petroleum (or gasoline), which substitutes for government incentives and diminishes the relative impact of such incentives on maize prices. Schepf (2008) notes that neither study evaluates the effect of the U.S. import tariff of US$0.54 per gallon on imported ethanol from Brazil, although the CARD study points out that the maize price impacts would be greater if the tariff on Brazilian ethanol were eliminated. In addition, neither study includes the effects of the various grants and subsidized loans that have been made available to the U.S. biofuel sector for research and infrastructure development. Abbott, Hurt, and Tyner (2008) are also critical of some of the studies discussed above, insofar as they incorporate substitution effects that are stronger than those observed in the real world. Biofuel lobby groups have also pointed out that ethanol only uses the starch in maize, preserving the maize oil and protein, so that about one-third of the maize made into ethanol goes back into the animal-feed system. Hence the diversion from food uses is generally overestimated.

Despite these qualifications, there is little doubt that biofuel demand in the United States is having a major impact on maize prices and probably on soybeans as well, while E.U. and European agricultural trends toward increased oilseed production have increasingly affected wheat markets. Moreover, the unwillingness of these governments to move away from biofuel subsidies will probably keep agricultural markets significant tighter for years to come. Helbling, Mercer-Blackman, and Cheng (2008) also note an asymmetry: biofuel industries have large effects on agricultural prices and very small effects on oil prices. So for the moment at least, biofuels are not substantially lessening the impact that rising oil prices are having on agricultural production and trade.

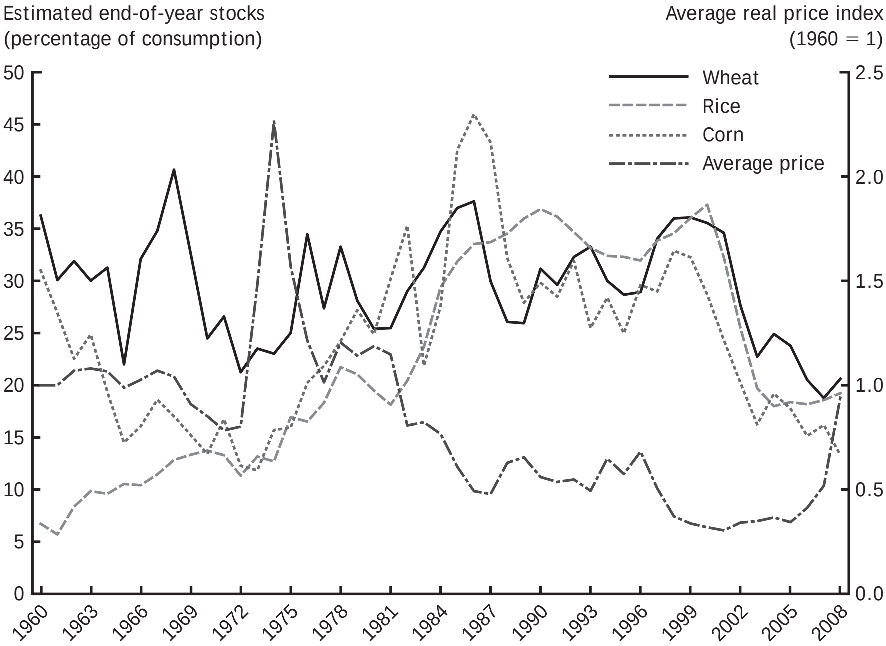
Declining Stocks and Reserves

The total supply of agricultural goods depends not only on current production but also on available stocks. Moreover, stocks are probably the most direct indicator of security for both food self-sufficient countries and major food importers who monitor the stocks of their largest suppliers. For such commodities as rice, which is dominated by consumers who depend on rice as their staple food, demand is highly inelastic. It is only when demand for stocks is added to demand for current consumption that total demand becomes more elastic (because a decrease in production can be compensated for by release of stocks). Conversely, relatively small changes in supply at low levels of stocks can result in rapid price changes (Wright 2009). Food scientists and economists have generally argued that countries need to keep stocks of around 17–18 percent of total consumption or use levels (FAO 1983), although a clear distinction should be made between countries that predominantly consume staples and those that predominantly export them. Exporters of staples usually have little interest in keeping any reserves in excess of those needed to ensure a steady supply of staples to their export destinations, although hoarding is possible if suppliers are confident that a price rise is on the horizon.

Stocks certainly seem to be highly relevant to the current crisis, if only because there has been much more action in the trends of stocks for major staples than in production tends. Indeed, stocks have declined markedly in recent years. Figure 2.11 presents a highly aggregated picture of trends in the global stocks of wheat, maize, and rice relative to the global consumption of each staple, along with the average real international dollar price of all three staples.

Agricultural economists rightly emphasize that when stocks are high, prices are generally low and stable. This high-stock/stable-price regime char-

Figure 2.11 Global trends in stocks relative to consumption, 1960–2008



Source: Calculations by the authors using data from USDA (2008c).

acterized the 1950–60s, and the 1980–90s, but not the 1970s or the current decade. Indeed, declining stocks preceded the 1974 food crisis, when wheat stocks declined from 30–35 percent of consumption in the 1960s to just more than 20 percent in the early 1970s, and maize stocks declined from more than 20 percent in the 1960s to just 12 percent during the 1972–74 crisis (Rojko 1975). Rice stocks—which are primarily produced and consumed in developing Asia—were just being built up in the 1960s as the Green Revolution began, so they are less relevant in explaining the 1972–74 crisis. Likewise, in the recent crisis the stocks of all three staples declined at about the same time, 2000–2003, before the price surge. Maize stocks in particular have shrunk to well below the 17–18 percent benchmark, and rice and wheat stocks are now roughly at that benchmark. The facts support the conclusion that stock declines present a potentially powerful explanation for the price increases, because stocks declined across all three major staples, and these declines occurred well before the current crisis (and well before the 1972–74 crisis).

Our view, however, is that stock declines only offer a superficial explanation for the price surge, and that the relevant factors determine what is behind the decline in stocks. We suggest three possible explanations of why stocks have declined. First, declining stocks might simply reflect increased demand or reduced production levels, which would then push the burden of explanation back to other factors, such as weather shocks or biofuels. Second, stock levels could have declined because of exogenous policy decisions, such as the view that stocks were too high or involved too much wastage. This observation seems particularly pertinent to China as well as some of the former Soviet bloc countries. And third, prices could affect stock decisions, so that very low food prices up until 2003 may have decreased the apparent need to hold stock, especially given the advent of just-in-time inventory systems.

All these explanations have some merit, but they are very difficult to observe empirically. The most important means of delving further into the stocks story is to set aside China. China is estimated to have had immensely high stock-to-use ratios for all major cereals in the 1990s—on the order of 70–90 percent—and markedly reducing these stocks was a justified policy action for China. Table 2.4 presents stocks of major consuming and exporting countries and recalculates global trends with and without China for 1990–2000 and 2005–08. Netting out China turns out to be very important.[8] World stocks for maize, for example, declined from 26 percent of consumption during 1990–2000 to just 14 percent during 2005–08, but excluding China from the global figures suggests that world stocks remained the same over the two periods, at just 12 percent. However, because the United States heavily dominates maize exports, U.S. stock trends—which declined from 16 to 12 percent over the two periods—still offer a promising explanation of maize price trends. The USDA has argued that biofuel production has already contributed to the depletion of U.S. maize stocks and will continue to do so in the next decade (USDA 2008a), and maize prices, biofuel demand, and maize stocks all appear to have changed at about the same time (Figure 2.12).[9] It is also possible that surges in foreign demand in 2006 and 2007 also contributed somewhat to these stock declines, as we show below.

The story for wheat is complicated. Without China, world wheat stocks declined from above the recommend 17–18 percent threshold in the 1990s (19 percent) to several points below the threshold in 2005–08 (14 percent). Stocks declined in Canada, Europe, India, Kazakhstan, Pakistan, Russia (to just 7 percent of use), Ukraine, and the United States (bizarrely, stocks increased significantly in drought-affected Australia). What explains this almost pervasive decline in stocks? There appear to be two factors: one is long term and the other short. The long-term story is that, globally, per capita production

[8] One caveat here is that the USDA only projects stock levels in China, so we cannot claim that data errors do not significantly alter our inferences from these data.
[9] See Dawe (2009) for similar arguments.

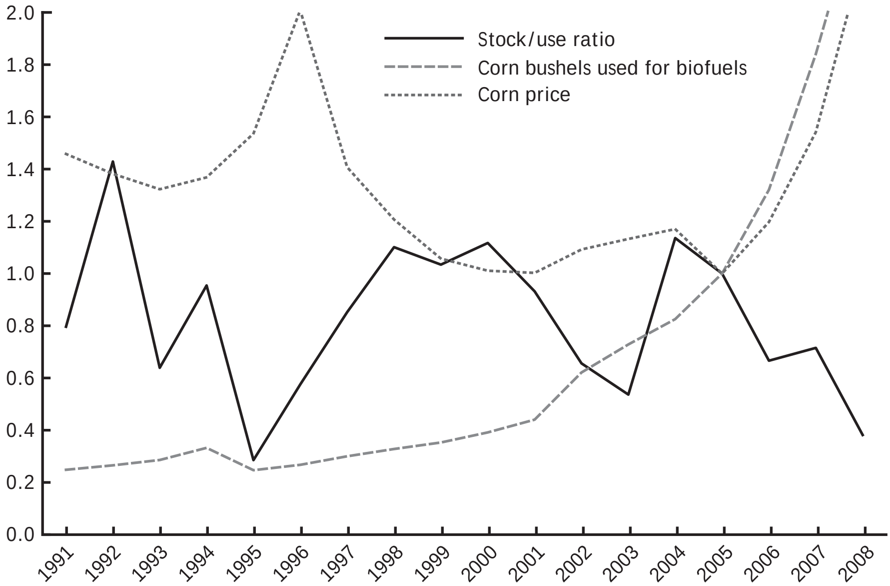
Table 2.4 Trends in stocks relative to domestic consumption plus exports among major exporters and consumers, 1990-2000 and 2005-08

Commodity	Country or region	Level of exports	Stocks / (consumption + exports) 1990-2000	Stocks / (consumption + exports) 2005-08	Stock outcome
Maize	Argentina	Major	6	7	Up but low
	China	Minor	93	24	Well down but still high
	India	Major	3	7	Up but low
	EU-15	Minor	8	14	Up
	United States	Major	16	12	Well down
	World	—	26	14	Well down
	World (excluding China)		12	12	Unchanged
Rice	China	Moderate	70	29	Well down
	EU-15	Minor	22	37	Up
	India	Major	18	13	Down
	Pakistan	Major	19	8	Well down
	Thailand	Major	7	13	Up
	United States	Major	15	14	Unchanged
	Vietnam	Major	2	7	Up but low
	World	—	33	17	Well down
	World (excluding China)	—	14	13	Largely unchanged but low
Wheat	Argentina	Major	4	3	Always low
	Australia	Major	20	35	Up
	Canada	Major	32	24	Down but still high
	EU-15	Major	16	11	Down and below optimum
	India	Major	13	6	Down and below optimum
	Kazakhstan	Major	23	14	Down
	Pakistan	Minor	17	11	Down and below optimum
	Russia	Major	16	7	Down and below optimum
	Ukraine	Major	23	11	Down
	United States	Major	27	21	Down but still high
	China	Minor	71	38	Well down but still very high
	World	—	27	18	Down but still adequate
	World (excluding China)		19	14	Down and below optimum

Source: Calculations by the authors using data from USDA (2008c).

Notes: EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom; —, not applicable.

Figure 2.12 Trends in stocks, prices, and biofuel production: U.S. maize



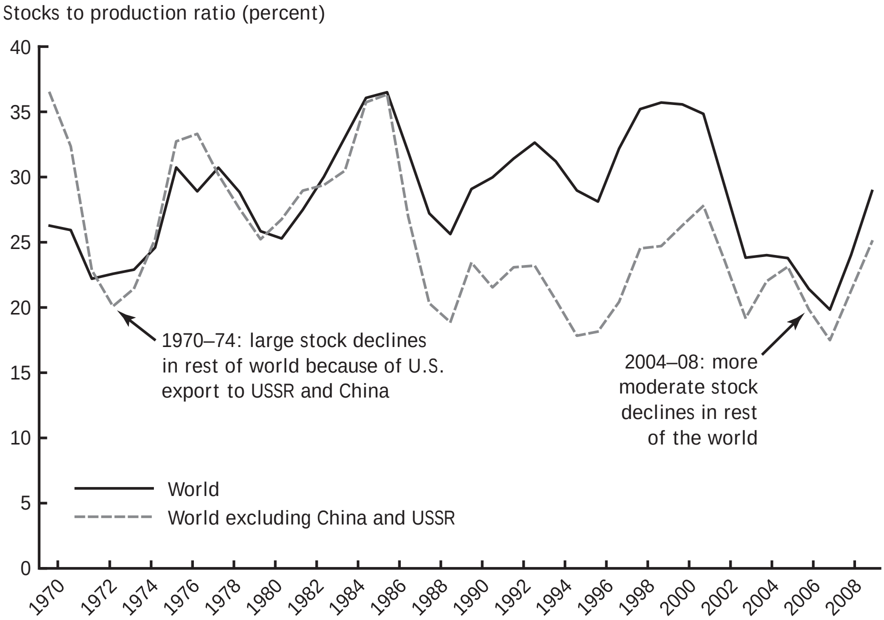
Sources: Data on stocks, usage, and biofuels were calculated by the authors using data from USDA (2008c); data on maize prices were calculated by the authors using data from IMF (2008b).

Note: 2005 = 1 for all series.

of wheat grew rapidly in the 1960s and 1970s but stagnated in the 1980s and declined in the 1990s. The long-term decline in production is, again, almost entirely due to the structural changes taking place in the former USSR countries. Hence, when the former USSR and China are excluded from the global estimates of wheat stocks/use ratios (Figure 2.13), the recent crisis is marked by fairly moderate declines in wheat stocks, in contrast to the 1970–74 crisis, when stocks in the United States were severely depleted by exports to the USSR and China (that is, the Communist countries kept their stock-to-use ratios constant at the expense of stocks-to-use ratios in the Western countries). The short-term wheat story appears to be a combination of some poor harvests (2002, 2003, and 2006) and increasing international demand: average annual production growth was 1.7 percent during 2000–08, whereas average annual export growth was 2.3 percent despite rising prices. In the case of wheat we show below that surges in foreign demand entirely explain the sharp decline in U.S. stocks in 2007.

For rice, the exclusion of China suggests that there has been virtually no change in the global stock-to-use ratio. China is estimated to have had

Figure 2.13 Global trends in wheat stocks-to-use ratios



Source: Calculations by the authors using data from USDA (2008c).

extremely high stock levels (70 percent of use in the 1990s) and has quite rationally reduced them. Indian and Pakistani stocks have also decreased to what may seem like perilously low levels, although there are caveats in these cases as well. Pakistan (unlike India) tends to export a large proportion of its rice production (chiefly the Basmati variety), whereas in India stocks came down from inefficiently high levels and were still well above the long-term norm during the recent food crisis (Gulati and Dutta 2009). Wheat stock declines in India reflect poor harvests that resulted in that country engaging in unusually large imports in 2006 (6 million tons). Indeed, it was actually its recent experience with wheat shortages that prompted the Indian government to restrict non-Basmati rice exports in November 2007, as well as a surge in demand for Indian rice exports, possibly because of substitution effects from the ensuing crisis in international wheat markets (Headey 2010).

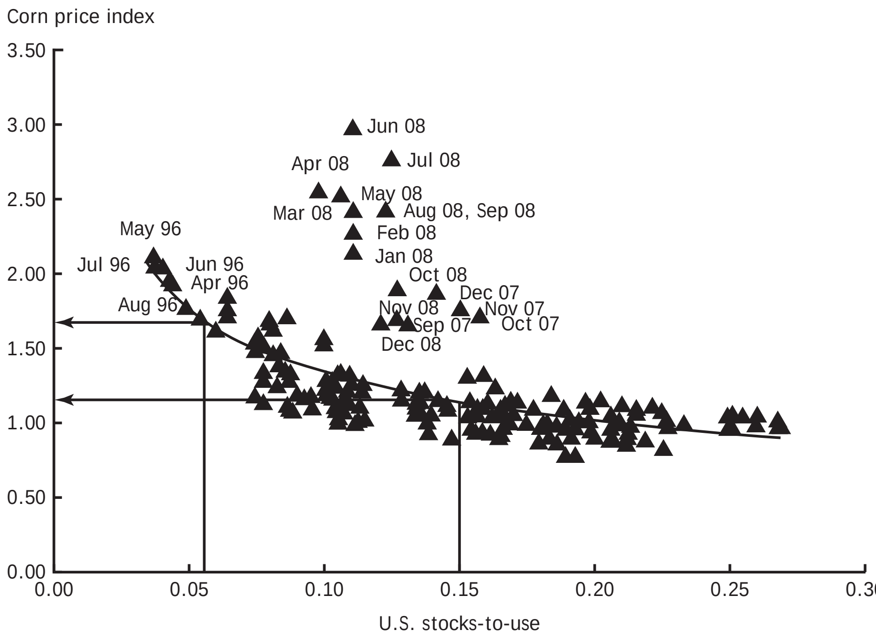
In other major exporting countries the stocks story is even less compelling. Stocks have actually almost doubled in the world's largest rice-exporting country (Thailand) and have been rising quickly in another leading exporting country (Vietnam). Thus stocks do not look like an important factor in determining rice prices, except insofar as they contributed to India's rice export ban, which did have a big impact on surging prices beginning in late 2007.

Instead, export bans, panic buying, and a justifiable fear that more such actions would follow seem to be the principal causes of the rice crisis. In this regard our assessment partly contradicts that of Wright (2009).

Are stock declines, then, a powerful story when it comes to explaining the price surge? Stock declines played only an indirect role for rice, biofuel demand seems to account quite well for maize stock declines, and trade and production shocks seem to explain some of the decline in wheat stocks. These factors suggest that declining stocks were largely caused by other factors rather than acting as a primary cause, although low stocks probably did exacerbate the price rise after the initial impetus, especially as market actors closely monitor stocks. Recent evidence collated by Abbott, Hurt, and Tyner (2009) also suggests that U.S. maize stocks in 2007 and 2008 were much higher than would have been predicted by the prices prevailing at the time (Figure 2.14). In conjunction with the evidence shown in Figure 2.13, it would appear that this crisis was not precipitated by stock declines.

So in some contrast to Wiggins (2008) and other observers, our doubts regarding causation and the efficacy of stocks in managing the global food sys-

Figure 2.14 Monthly maize prices relative to U.S. maize stocks, April 1996-December 2008



Source: Calculations by Abbott, Hurt, and Tyner (2009).

tem make us skeptical that declining stocks are a principal cause of the crisis. There are also legitimate reasons to think that larger stocks are not an important part of the solution. Maintaining high levels of stocks is costly, multilateral grain reserves suffer from weak incentives for participation, and trade liberalization is potentially a viable alternative to large international reserve systems. However, we leave this complex issue for future research.[10]

Decline of the U.S. Dollar

Some analyses have at least made passing mention of the weakening of the U.S. dollar over the past 6 years and have even analyzed the simple arithmetical implications of depreciation for transmission of international prices into domestic prices. However, only one or two papers have also assessed the extent to which the depreciation of the dollar has had a causal impact on food prices, and, as noted above, the rise in commodity prices is much less when converted to euros.

Why the U.S. dollar has depreciated as it has does not particularly concern us here, although the most obvious cause of the general decline is the large U.S. trade deficit and low real interest rates in the United States. Of more interest is how the depreciating dollar might have caused changes in food prices and in a broader range of commodity prices. Abbott, Hurt, and Tyner (2008) make note of three crucial facts regarding these relationships.

First, the patterns of commodity price changes and nominal exchange-rate movements have been similar since 1970: when the dollar is weak, commodity prices are generally high, and when the dollar is strong, commodity prices decline (this pattern is also shown by the decline in food prices and the strengthening of the dollar since mid-2008). In the case of oil, the relationship has often been quite direct. A weakening U.S. dollar was one of the primary motivations for OPEC's decision in 1974 to raise oil prices. In the current crisis the divergence between the dollar and many (but not all) other currencies is quite stark compared to previous increases in nominal dollar-denominated food prices (such as during 1995–96). Second, the variations in commodity prices have always been greater than changes in exchange rates, which is especially true for the recent dollar depreciation. This phenomenon is perhaps due to the dampening effects of capital flows. And third, changes in agricultural commodity prices also appear to have lagged other commodity price changes, especially since 2002, so that recent high agricultural commodity prices are just now catching up with price increases for oil and metals

[10] See Headey and Raszap Skorbianksy (2008) for a review, as well as Williams and Wright (1991) and <http://www.bufferstock.org/biblio.htm#trade>.

that began earlier. This lag may be because the initial surge in demand for cereals was partly met through depletion of stocks, thus delaying the price change but perhaps making it sharper than would otherwise have been the case. In addition, there is the more important role of Chinese demand in price formation for nonfood commodities.

As for the effects of the depreciation of the U.S. dollar, conversion to euros, for example, would cut off 20–30 percent of the nominal increase in U.S. dollar–denominated food prices (inflation rates in Europe and the United States have not diverged much, so conversion to real prices matters little). But is there also a causal effect? As Abbott, Hurt, and Tyner (2008) discuss, when the dollar weakens, agricultural exports—and particularly grain and oilseed exports—grow. Using USDA's agricultural trade-weighted index of real foreign currency per unit of deflated dollars, they find that from 2002 to 2007 the U.S. dollar depreciated 22 percent, and the value of agricultural exports increased 54 percent. Assuming that the United States is a large country in international agricultural markets—which it certainly is for maize, soybeans, and wheat—depreciation of the exchange rate should lead to higher prices in the United States but lower prices in the rest of the world, all else being equal. Previous research has indicated that a depreciation of the U.S. dollar increases dollar commodity prices with an elasticity between 0.5 and 1.0 (Gilbert 1989), and Mitchell (2008) calculates that the depreciation of the dollar has increased food prices by about 20 percent, assuming an elasticity of 0.75.

Low Real Interest Rates

Another theory that has been advanced in some quarters is that low real interest rates (Frankel, 2008a, 2008b, 2008c), especially in the United States, have caused a general price increase in a wide range of commodities (for a discussion of the theory, see Lustig 2008). The decision on whether to hold a commodity for the next period (in stocks or in the ground) or to sell it at the current price, invest the proceeds, and earn interest will depend on the interest rate and expectations about prices in the future. When interest rates are low, money flows out of interest-bearing instruments and into foreign currencies, emerging market stocks, other securities, and commodities, including food commodities. This portfolio shift drives the prices of these assets higher and higher until they reach a level where people perceive that they lie above their future long-term equilibrium level. Monetary policy therefore causes real commodity prices to rise more than other prices, because other prices are "sticky" (in other words, they rise at a lower rate). Because of the different rates of price adjustments and arbitrage conditions regarding price expectations and interest rates, commodity prices and other asset prices overshoot in real (and often in monetary) terms. Frankel (2006) provides econometric evidence in support of the inverse relationship between commodity prices and real interest rates in the United States dating back to the 1950s, and Frankel argues that more recent data points—before and after the commodity price peak in mid-2008—are consistent with historical evidence and the overshooting hypothesis.

How consistent this theory is with the evidence is still questionable, however. Some commentators claim that a major inconsistency is that inventories are not high, but low. How true this observation is for metals and minerals is debatable, because part of the "inventory" of these commodities is in the ground, so that stocks for some of these commodities are not especially low (for example, oil). But agricultural stocks are low by historical standards. Of course, the data on stocks could be wrong or biased, because it is difficult to measure private stocks and because public reserves are influenced by policy decisions that may not be consistent with profit motives. Another caveat is that the diversion of assets from treasury bills and the like to commodities may have influenced agricultural futures prices, but as noted above, the jury is still out on the issue of whether futures prices affect spot prices. It is also difficult to distinguish between this channel of impact resulting from low interest rates and the effects of interest rates on exchange rates.

Speculation in Financial Markets

Various commentaries have suggested that commodity futures markets may have triggered the oil and food crises, and speculators have been denounced in the popular media and in high-level political circles. In fact, many of these discussions are themselves speculative, based on little theoretical reasoning or robust empirical evidence. The background to the speculation debate is that futures markets are relatively new to agriculture. For nearly a century, food markets have been organized around forward contracts between producers and buyers that reduce producers' risks by providing a guaranteed future price. Over time, the forward contract market developed into a futures contract market consisting of forward contracts that can be traded as separate financial products on exchanges, the most important of which is the Chicago Board of Trade (CBOT) Futures Exchange. The reputed benefit of food securitization is that it facilitates hedging against risk and price discovery, because it allows buyers and sellers of agricultural commodities to indicate their expectations of price movements. Futures prices therefore provide a benchmark for spot prices.

Despite these benefits, there may be risks (CBC 2008). One area of concern is that, unlike forward contracts, futures contracts allow a variety of noncommercial participants to partake in trade (that is, those who are not directly engaged in agricultural production, distribution, and delivery to markets).

Because the U.S. Commodity Futures Trading Commission gradually loosened the rules over who may trade in agricultural futures markets such that by 2008, index funds' participation in futures markets has grown by leaps and bounds: they accounted for about 40 percent of the futures contract trading in wheat, with smaller shares in maize (27.4 percent) and soybeans (20.8 percent). The potential significance of this trend is that nontraditional participants can now speculate on food price trends, because the value of a futures contract varies in relationship to the commodity prices in the current spot market, much as bond prices vary in response to changing interest rates. This variation affords speculators an opportunity to bet on futures contracts as a separate asset class quite apart from the spot prices of agricultural commodities in today's market. So a short futures position (involving contracts that function up to 6 months) protects against price decreases, whereas a long futures position (involving contracts of longer than 6 months) enables the holder to benefit from price increases in the longer term. Most commercial agricultural traders play in the short futures market, because it is critical to the fundamentals of agriculture and decisions on agricultural production and delivery. Most noncommercial players (that is, financial intermediaries) play in the long-term market of contract price expectations. Hence, measures of speculative activity typically focus on long positions, or the share of long positions taken by index funds.

Proponents of the speculation hypothesis must establish theoretical and empirical linkages between speculation and futures prices, and between futures prices and spot prices. This is no easy task. Sanders and Irwin (2010) review theory and evidence. They suggest three logical inconsistencies in the arguments made by bubble proponents as well as five instances where the bubble story is not consistent with observed facts. The first problem is that money flows are not the same as demand. With equally informed market participants, there is no limit to the number of futures contracts that can be created at a given price level. These contracts are essentially just bets on future prices, so why should a bet affect an actual price outcome? Second, although theoretical models show that uninformed/noise traders can drive a wedge between market prices and fundamental values, index fund buying is very transparent, so it seems highly unlikely that other large rational traders would hesitate to trade against an index fund if they were driving prices away from fundamental values. Third, speculation is not excessive when correctly compared to hedging demands.

Fourth, index investors do not participate in the futures delivery process or in the cash market; nor do they engage in the purchase or hoarding of the cash commodity (Headey and Fan 2008). However, Gilbert (2010) argues that increased long futures positions could be viewed as a positive shock to inventory demand, because long positions would suggest to cash-market participants that prices will rise. This last linkage is perhaps the most important, but it is also contentious, because stocks have been declining during 2005–08. Gilbert (2010) suggests that in the short term stocks are largely a postharvest residual rather than a conscious decision. If stocks are therefore fixed in the short term, suppliers may raise prices rather than hoard. Although this assumption may be somewhat extreme (stocks may be neither fixed nor fully adjustable), it makes the question largely an empirical one. However, in the next subsection we show that U.S. wheat stocks were depleted by foreign demand, which would seem to constitute a real shock rather than one related to futures market activities.

Fifth, if index fund buying drove commodity prices higher, then markets without index funds should not have seen prices advance. Headey and Fan (2008) caution against directly comparing commodity markets selected for futures contracts—because they may have characteristics that exacerbate volatility, such as relatively inelastic supply and demand—to those commodities without futures markets. But with that caveat in mind, Headey and Fan (2008) cite the rapid increases in the prices for nonsecuritized commodities (such as rubber, onions, and iron ore) as evidence that rapid inflation occurred in commodities without futures markets. Similarly, Sanders and Irwin (2010) show that the size of index fund investments in different markets does not predict market returns. For example, futures markets with the highest concentration of index fund positions (livestock markets) showed little or no increase, whereas those markets with the smallest index fund participation (grains and oilseeds) saw the largest price increases.

More generic tests, however, do find an econometric linkage between futures market activities and spot market prices. Robles and Cooke (2009) use monthly CBOT data to test whether lagged proxies for speculative activity in the CBOT (for example, various ratios of noncommercial activities relative to total activities) predict changes in spot prices. They conduct 23 tests based on four commodities and six proxies for speculative activity. They find evidence of Granger causality in 6 of the 23 tests. Gilbert (2010) also tests the impacts of futures market activity on spot prices, although he uses different dependent and independent variables. His dependent variable is the IMF's index of agricultural food prices, whereas the independent variables measured with monthly data from March 2006 to June 2009 are oil prices, an exchange rate index, and an index of futures positions on 12 major U.S. agricultural futures markets constructed from the data in the U.S. Commodity Futures Trading Commission's *Supplementary Commitments of Traders Reports.* Gilbert (2010) tests both contemporaneous and lagged variables and treats oil prices and futures positions as endogenous, chiefly being determined by deeper factors, such as Chinese growth rates and exchange rates (because investors could use commodity prices to expose themselves to Chinese growth and to hedge against exchange rate movements). He finds that futures positions have a large effect on food prices.

Although this descriptive and econometric evidence seems superficially compelling, it is quite difficult to construe causality from it. Part of the recent comovement between rising spot prices and rising futures prices comes about because financial speculation through securitization is most profitable when there is substantial volatility in the underlying markets. When markets are flat, futures contracts tend merely to reflect the discounted future value at today's prices. But when markets are in turmoil, expectations of future prices may vary considerably (CBC 2008). Thus speculation may be more a symptom than a cause of underlying volatility. And because expectations play a role in futures markets (by definition), Granger-causality tests based on time lags (as in Robles and Cooke 2009) may not be indicative of causation, especially in the absence of a full set of other control variables. Indeed, this "Christmas cards Granger-cause Christmas" problem is a well-known fallacy in time series econometric work (Atukeren 2008). Gilbert's (2010) results, however, are only as good as his instruments. Of particular concern is that such instruments as Chinese economic growth and stock market performance may not be validly excluded from the equation explaining agricultural prices. Of course, by the same token these caveats on the evidence do not mean that the evidence is wrong, only that the jury is still out.

Trade Shocks: Export Restrictions, Import Surges, and Droughts

Export restrictions and import surges are widely regarded as an especially potent explanation for the sharp increase in rice prices, although Headey (2010) finds evidence of important trade shocks in wheat and maize markets as well. Even so, there are several reasons why rice markets are vulnerable to shocks. Rice itself is unusual in having relatively weak substitution effects with other cereals, being mostly produced by smallholders, constituting a large proportion of the diets of millions of people, and being very thinly traded (IRRI 2008; Timmer 2009). Hence, for political reasons, very few Asian governments are willing to tolerate significant increases in rice prices, and many countries have permanent trade distortions applying to rice. Indeed, the notoriously thin trade in rice, with global imports constituting less than 10 percent of all rice consumption, partly explains why international rice prices have always been more volatile than other prices and much more volatile than domestic rice prices.

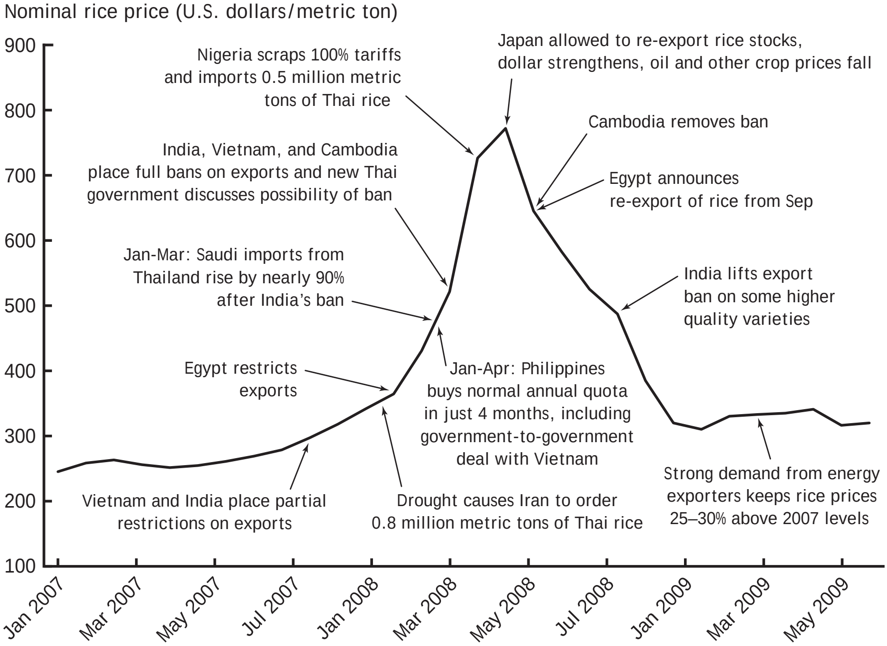
Rice is therefore quite clearly a special case relative to other grains. Indeed, from August 2005 until November 2007 rice prices increased steadily by about 50 percent above an all-time trough, so that it was widely felt that rice markets were avoiding the price surge being witnessed in other cereal markets. But from November 2007 to May 2008 they increased by a further 140 percent (Figure 2.15). This rise was despite production reaching an all-time high in 2007 and fairly stable rice stocks (with the exception of China, which held excessive stocks prior to their reduction and is not a major trader of rice).

What appeared to prompt this remarkable surge in international prices is the export restrictions imposed on the Indian and Vietnamese rice markets in October and November 2007. According to USDA,[11] Vietnam placed a partial ban on new sales because it had oversold in the global market and the government was concerned about rising domestic food prices. Headey (2010) shows that there was also increasing demand for Indian rice exports, which he ties to the run-up in wheat prices, because many major rice importers are also major wheat importers. To make matters worse, a poor wheat harvest put pressure on India's Public Distribution Scheme, which relies on both wheat and rice stocks. Although the action prompted protest by rice producers and the academic community (Gulati and Gupta 2007), the Indian government initially argued that its responsibility was to its own poor rather than to its neighbors. However, the worst direct impacts of this decision—rice shortages in India's largest export market, Bangladesh—were eventually averted in April 2008, when India decided to make concessions to Bangladesh by selling their smaller neighbor 500,000 tons of rice at prices less than half of those prevailing in international markets at the time.

The concessionary act probably averted a humanitarian disaster in Bangladesh, but it did not undo the panic that ensued in international markets, especially as India is often the world's second largest rice exporter. In early 2008 further export restrictions were imposed by Vietnam, Cambodia, and Egypt. Panic buying, or precautionary demand, was also important. The Philippines, one of the largest net importers of rice, engaged in panic buying, importing 1.3 million tons of rice in just the first 4 months of 2008—an amount that exceeded its entire import bill for 2007. These actions exacerbated the crisis, and the price surge continued until May. In May Slayton and Timmer (2008) proposed that China, Japan, and Thailand could solve the crisis by releasing excess rice stocks. In Japan most of this excess rice has accumulated because of World Trade Organization (WTO) rules requiring Japan to import rice from overseas. But most of this imported rice is used as feed grain. In late May 2008 Japan promised to release 300,000 tons of rice

[11] See <http://www.ers.usda.gov/news/ricecoverage.htm>.

Figure 2.15 Effects of export restrictions on rice prices



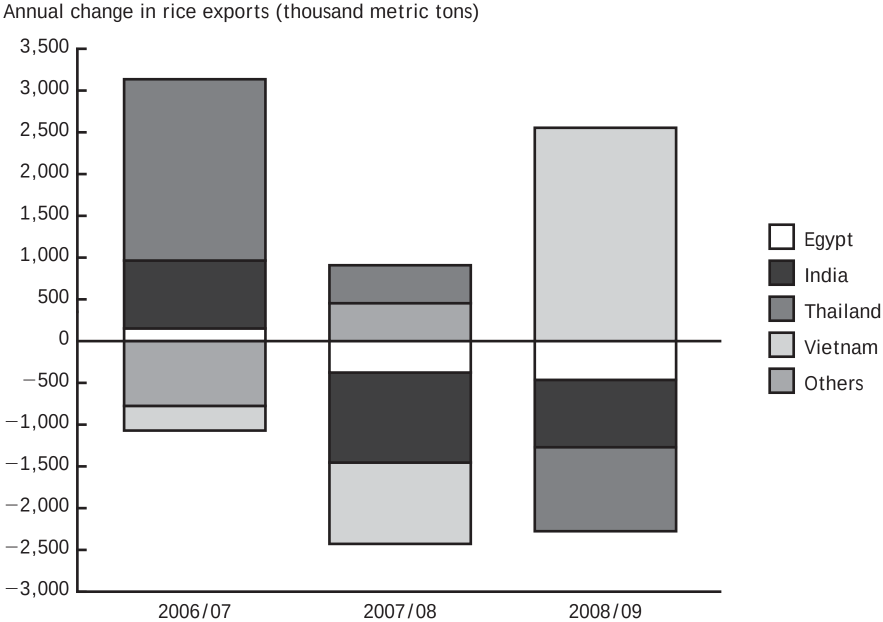
Source: Headey (2010), based on the collation of various media articles and USDA Foreign Agricultural Service reports.
Note: Price is for Thailand A1 variety.

to the Philippines, although it was later reported that Japanese rice stocks were never actually released to developing Asian markets (Nakamoto and Landingin 2008).[12] Whether this information had an effect is difficult to tell —at the same time oil prices also plummeted, as did other commodity prices, while the U.S. dollar also strengthened. In any event the rice bubble burst in June 2008, and rice prices fell precipitously.

The size of these trade shocks can be discerned by comparing annual changes in exports and imports from leading market actors in the rice market. Figures 2.16 and 2.17 show that 2007/08 saw major reductions in Indian and Vietnamese exports and surges in imports from Bangladesh, Philippines, and energy-exporting countries flush with foreign reserves. Incorporating these shocks into some back-of-the-envelope calculations based on short-run supply and demand elasticities, Headey (2010) calculates that export restric-

[12] This information is anecdotal, but certainly USDA data do not indicate any increase in Japanese rice exports.

Figure 2.16 Decomposing annual changes in rice exports before and after the crisis



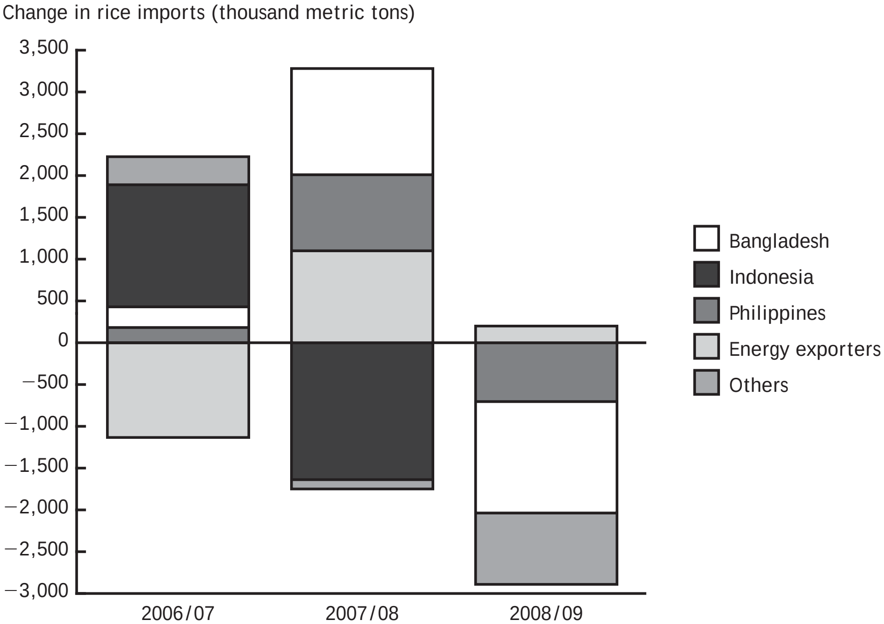
Source: Headey (2010).

tions and demand surges accounted for virtually all of the increase in rice prices; Mitra and Josling (2009) reach fairly similar conclusions regarding the effect of India's export restrictions.

Export restrictions and panic buying were probably less important for other major staples because the export markets of most of these staples are heavily dominated by countries that have not imposed restrictions (Australia, Canada, the E.U., and the United States). Nevertheless, Headey (2010) shows that there were major demand surges and supply-side shocks in wheat markets, and even in maize markets, for which the biofuel explanation tends to dominate.

The case of wheat is striking because of the important interplay between weather shocks and trade restrictions. Most spectacularly, Australian wheat production was 50–60 percent below trend growth rates in two successive years (2005–06). As a counterseasonal southern hemisphere exporter, it is quite possible that the Australian drought had a particularly sharp effect on prices, especially given that the United States also experienced a poor harvest (some 14 percent lower than the previous year), and more modest declines

Figure 2.17 Decomposing annual changes in rice imports before and after the crisis



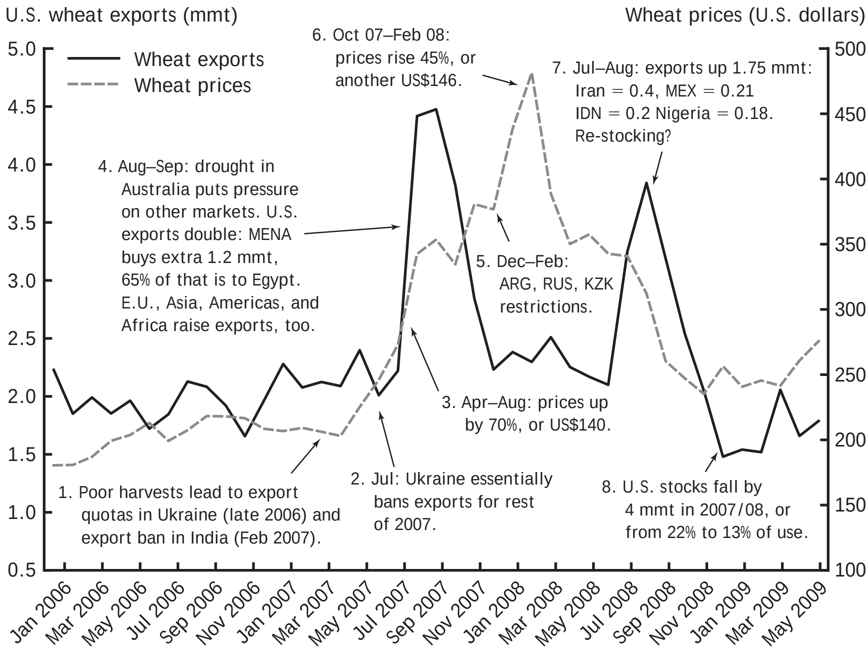
Source: Headey (2010).

also characterized Russian and Ukrainian production. Dollive (2008) regards Ukraine's export ban (later modified to an export restriction) as the most critical of these bans. He shows that Ukrainian grain exports in 2007 were 77 percent lower than in 2006. Dollive (2008) also reports that many of Ukraine's largest grain clients switched entirely to other grain markets, such as those of Argentina, Australia, France, North America, Kazakhstan, and Russia. The last two countries are particularly relevant, because Ukraine's export ban increased demand for Russian and Kazakh grain exports, which resulted in greater price pressure in these markets, including the halving of stocks-to-use ratios. By early 2008, Russia and Kazakhstan had both implemented export restraints to protect prices in their domestic markets. Hence, as with rice, there was a clear contagion effect. Argentina also began to indirectly restrict exports by closing its exports registry in March 2007, although this action only slowed exports later in the year as existing registrations began to expire (Dollive 2008). However, in November 2007, the Argentine government raised its export taxes on wheat (to 28 percent), before reopening and then reclosing the exports registry in January and February.

The effects of these export restrictions in India, Ukraine, Argentina, Russia, and Kazakhstan also seem to be apparent in descriptive data (1, 2, and 4 in Figure 2.18). Ukraine imposed fairly tight export quotas as early as the second half of 2006 when monthly exports dropped by two-thirds. India imposed an export ban in February 2007, and then in late June Ukraine announced new export quotas that virtually imposed a complete export ban, so that from July 2007 to March 2008 Ukraine scarcely exported any wheat. Drought in Australia significantly reduced the wheat crop there, and Europe's combination of too much rain in France and Germany and too little rain in Eastern Europe resulted in reduced exports in the second half of 2007.

These events coincided with U.S. wheat prices rising by 70 percent from April to August 2007 and a surge in demand for U.S. wheat exports. In August U.S. wheat exports doubled from their July level of 2.2 million tons to reach 4.4 million tons in August and September 2007 (4 in Figure 2.18). The August–

Figure 2.18 Wheat exports: Droughts, export restrictions, price increases, and import surges



Source: Headey (2010).

Notes: The wheat price relates to U.S. Wheat No. 2, Hard Red Winter, but trends for the soft red are very similar. ARG, Argentina; IDN, Indonesia; KZK, Kazakhstan; MENA, Middle East and North Africa; MEX, Mexico; mmt, millions of metric tons; RUS, Russia.

September surge was principally fueled by an increase of 1.2 million tons of exports to the MENA region (55 percent of the total surge); two-thirds of this 1.2 million tons went to Egypt alone. Other regions (South Asia, East Asia, South America, Africa, the E.U.) each increased their demand for U.S. wheat exports by about 0.15–0.22 million tons each. Overall, wheat prices increased by 72 percent from trough to peak, and Headey (2010) suggests a ballpark estimate that trade shocks increased prices by about 44 percent. He suggests that about half (48 percent) of this increase was due to the Australian drought, roughly one-third was due to Ukraine's export restrictions, and 19 percent to the E.U.'s poor harvests and subsequent drop in wheat exports.

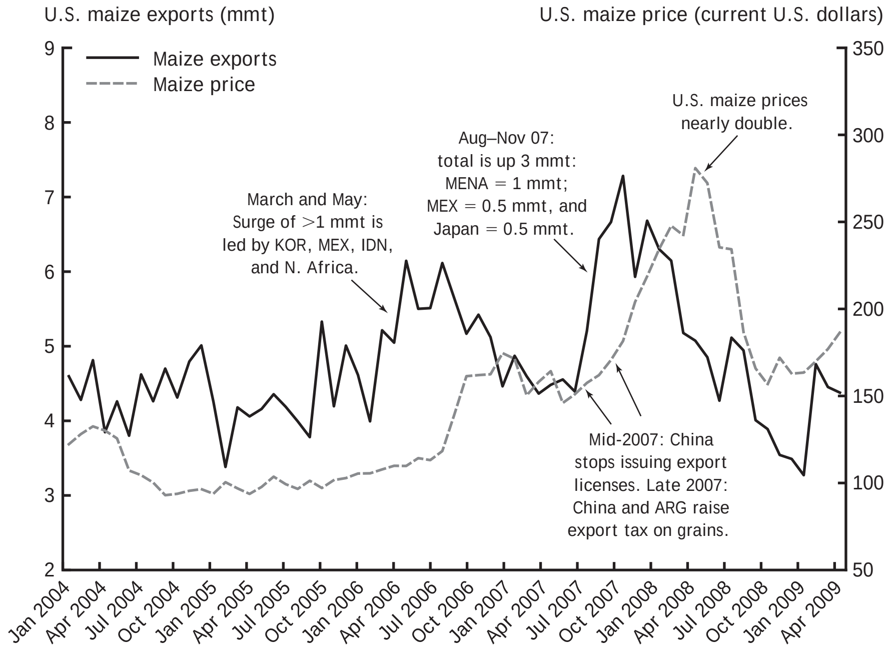
Trade shocks have scarcely been discussed in the context of maize markets, where biofuel-based explanations dominate. Nevertheless, Dollive (2008) documents how China—typically the world's third largest maize exporter—began to indirectly restrict exports in the second half of 2007.[13] As a result, Chinese maize exports declined significantly, and China stopped exporting grain to its largest client, South Korea, as well as to other important customers (such as Japan, Malaysia, and Indonesia). These countries had to turn to other international markets for maize, principally the United States. The shift to U.S. maize was not inconsequential. South Korea alone accounted for 6.9 percent of U.S. maize exports in the first five months of 2007, but this number rose to 15.5 percent in 2008. Although the effect of China's restriction on maize exports is still low compared to the surge in demand for biofuels from within the United States, China's actions certainly exacerbated an already tight market.

However, Headey (2010) shows that there were demand pressures on U.S. maize markets even in 2006 and 2007. Figure 2.19 reports monthly maize export and price data for the U.S. market. The figure shows that not only did U.S. maize exports surge twice in recent years—from March to May 2006 and from August to November 2007—but that these two import surges preceded two large price surges. The first export surge involved a 2 million ton (or 54 percent) increase, which was followed by a 59 percent price increase. The second (3 million ton or 65 percent) export surge from August to November 2007 preceded a 75 percent increase in prices that took place from September 2007 to May 2008. So as with rice and wheat markets, Headey (2010) again finds large export surges preceding price surges.

However, it remains puzzling as to why these surges took place, especially as trade-diversion effects are not so obvious. Even though South Korea

[13] Specifically, China stopped issuing new export quotas for maize in the second half of 2007. In December 2007 China also removed the rebate on value-added taxes for major grain exports and imposed export taxes on grains and grain powders (typically 10 percent).

Figure 2.19 Surges in demand for U.S. maize exports precede maize price surges



Source: Headey (2010).
Notes: The maize price relates to U.S. Maize No. 2, Yellow. ARG, Argentina; IDN, Indonesia; KOR, South Korea; MENA, Middle East and North Africa; MEX, Mexico; mmt, millions of metric tons; SSA, Sub-Saharan Africa.

and Japan played some role in these surges, Mexico and the MENA countries played much larger roles. Hence China's export restrictions, and their impact on Japanese and South Korean trade, seem to be only a small part of the story. The other countries involved are something of a puzzle. Mexico basically imports U.S. maize for feed use, but given the important of domestic maize in the Mexican diet, future research should look at substitution effects more closely. As for the MENA region, there is no particular evidence of panic, although poor weather seems to have characterized some of the region. Another factor to consider is the large foreign exchange reserves of many importing countries, which would suggest that imports were simply unconstrained.

In summary, the evidence reported in Headey (2010) and Dollive (2008) suggests that various trade shocks—export restrictions, demand surges, and bad weather—were more important short-term factors than previous analyses had suggested. Trade shocks seem to account almost entirely for the surge in rice prices (along with deeper spillovers from other commodities, such as wheat and oil markets) and could perhaps account for as much as half of the increase in wheat prices. They may even have played an important role in maize markets.

Summary of the Causes and a Model of a "Near-Perfect Storm"

Only two studies to date have considered all factors with sufficient rigor: the studies by Abbott, Hurt, and Tyner (2008) and by Mitchell (2008). Mitchell alone was bold enough to give some rough estimates of the contribution of each cause to the overall rise in food prices. An encouraging feature of both these analyses is that they are in broad agreement, although Abbott, Hurt, and Tyner (2008) stress the importance of the weakened dollar somewhat more than does Mitchell (2008). Although we extend the evidence in several regards, our own appraisal also offers similar conclusions and supporting evidence. These points of consensus are as follows.

First, all three studies emphasize growing demand, but they attribute it mostly to demand from the biofuels industry for maize and, to a lesser extent, for oilseeds. None of the three studies could find any substantial increase in demand from China and India, except in the case of soybeans (although this trend started many years ago), and in the case of demand for fuel (although China's and India's increasing demands are not necessarily the dominant explanation for rising oil prices). However, unlike the other two studies, we emphasize short-term demand surges from an array of countries as a significant determinant of tighter international cereal markets.

Second, all three studies emphasize higher energy prices, but Abbott, Hurt, and Tyner (2008) emphasize that the main effect of rising energy prices was to make biofuels more profitable, rather than agricultural production more expensive (that is, it was a demand-side effect). Mitchell (2008) estimates that oil prices had a supply-side effect that accounts for about 15–20 percent of the food price increase, but we find that (1) agriculture is much more oil-intensive than is production in other sectors, which generally rely on other forms of energy, and (2) oil-related production costs on U.S. farms have risen by almost 40 percent of revenues. How much of these increased production costs are passed on to prices is difficult to say, but we suggest that Mitchell's (2008) estimate is probably too low. We also emphasize that rising oil prices, the weaker dollar, and the influx of foreign exchange reserves for energy-exporting countries significantly strengthened their demand for U.S. cereals.

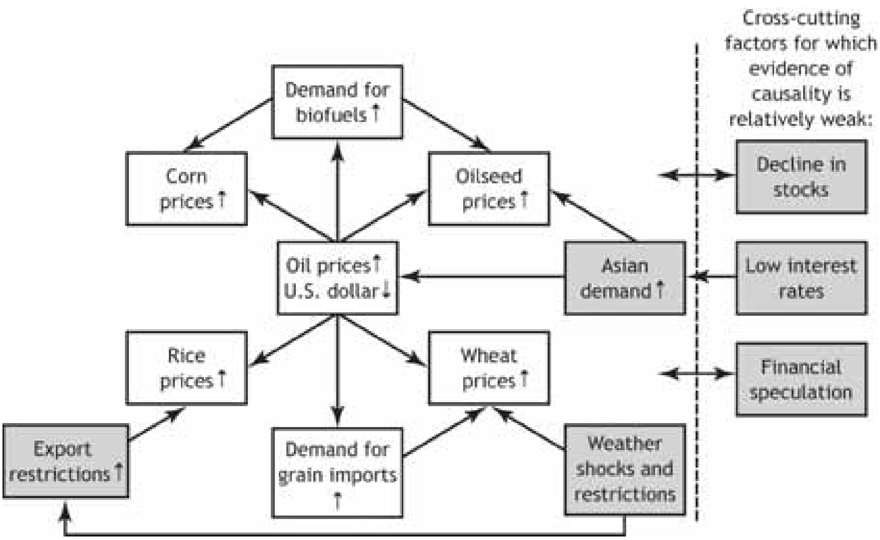
Third, the studies by Mitchell (2008) and Abbott, Hurt, and Tyner (2008) go further than other analysts in emphasizing the effects of dollar depreciation. Mitchell (2008) suggests this effect accounts for another 20 percent of the rise in food prices by sustaining international demand even as nominal prices continued to increase. Abbott, Hurt, and Tyner (2008) show that the main difference between the current price surge and the 1995–96 price surge —which did not constitute a crisis—is the marked depreciation of the dollar this time around. The strengthening of the dollar since mid-2008 and the commensurate fall in food prices seem to support this association.

Finally, all three analyses emphasize that rice is almost certainly a special case, given the sensitivity of rice prices to export restrictions, and all emphasize that a series of poor wheat harvests at least made matters worse.

One area of ongoing contention is the role of stocks: some authors cite lower stocks as a potentially driving factor, while others view low stocks as a symptom of the crisis more than a cause. Causality undoubtedly runs both ways with stocks. We have shown that excluding China and the former USSR countries leads to much more modest declines in grain stocks that occur fairly late in the game, which suggests that stocks were driven down by surging demand and some poor harvests. However, low stocks can certainly make matters worse, as market actors use stocks ratios to form their price expectations.

Our own basic model of the food crisis is summarized in Figure 2.20. In this figure we also note those factors that we regard as key drivers of surging

Figure 2.20 Summary model of the principal causes of the crisis: A near-perfect storm



Source: Constructed by the authors.
Notes: Boxes in gray denote less significant, crop-specific causes. The decline of the U.S. dollar and the rise in oil prices are shown together because they are universal factors that may be causally related.

food prices. First, there is no consistent evidence to date that speculation has contributed to the crisis, and what evidence there is does not show that it was a primary cause of the crisis. Second, we have omitted stocks from the main model. As with speculation, we find it very difficult to view stock declines as a primary cause of the crisis rather than merely a symptom of rising demand (for maize and soybeans) and weak production (of wheat). Instead the dominant factors consist of a set of interlinked cross-commodity factors—a weakening U.S. dollar, rising oil prices, and the consequent surge in biofuel demand—as well as two or three commodity-specific explanations. In general the complexity of this model supports the description advanced by the director of the World Food Programme (WFP) that the current crisis constitutes a perfect storm.

Finally, it is worth emphasizing the dynamic processes that have led to this crisis. In general, economists point to the efficacy of markets in smoothing out price volatility. Increasing demand should lead to increasing prices, which should result in a supply response, which should then lead to lower prices. Conversely, decreasing supply should lead to higher prices, which should prompt consumers to switch to substitutes. The remarkable surge in prices in 2007 and 2008 begs the question of why markets were not self-correcting, or more specifically, why they did not self-correct until mid-2008. Our review points to some interesting explanations of why prices kept rising before eventually being checked by external events (the global financial crisis) and the inherently unsustainable nature of the price bubble. We particularly emphasize why the markets did not self-correct. That is, why did not demand decrease more and supply increase more as prices started to rise?

Several factors explain this anomaly. On the supply side, production is seasonal and may only respond to price rises with some lag. Bad luck was also an issue, with 2006–07 witnessing some weather shocks, which in turn contributed to export restrictions, which rippled across other markets as consuming nations switched to less restricted markets. On the demand side, the biofuels sector sustained maize demand because of ongoing high oil prices. Strong economic growth and large foreign reserves also made importing nations less sensitive to the initial price rises. In addition, in some instances importing countries seemed to panic. The peculiar nature of the rice market made precautionary purchases and hoarding a high priority for households, producers, and traders. For these reasons high prices were not immediately countered by reduced demand or increased supply, with both market and government failures contributing to these outcomes.

CHAPTER 3

Consequences of the Crisis

Several factors suggest that the recent surge in food prices had—and may still be having—a severe impact on the poorer populations of the world. The large number of food riots in diverse locations around the developing world, beggar-thy-neighbor policies that not only increase prices but also restrict physical access to food, increased dependence of many poor countries on food imports, and expectations that both food and oil prices will stay high for many years to come are all factors that seem to justify the utmost concern for the food security and broader well-being of the poor. Moreover, the evidence of large household surveys since the 1970s generally indicates that food prices will have a negative impact on the welfare of not just urban areas, because many rural poor in developing countries are also net food consumers (World Bank 2008b). These facts have prompted some development agencies to suggest that rising food prices plunge millions more into poverty and deepen poverty still further for those already struggling (World Bank 2008a).

However, all these assumptions and predictions require much closer examination and often significant qualification. The group most vulnerable to rising food prices is still the urban poor, but this group is also the most vociferous (Bezemer and Headey 2008). Thus protests may be evidence of suffering, but not of "net suffering": price changes always create winners and losers. Moreover, judging who is negatively affected requires accurate data and careful analysis of food dependency, poverty/vulnerability, and price changes at both the micro and macro levels. A great deal of progress has already been made in these endeavors, especially in microsimulation work, but a large gap still exists between micro- and macroassessments of the consequences of the crisis. A further distinction must also be made between the short and long terms. In the short term the adjustment costs of responding to rapid price changes may be prohibitively high and painfully slow. But even in the long term the ability of the poor to make adjustments depends on their access to productive assets and on national and international policies aimed at raising agricultural output or successfully pursuing other strategies to increase food security. This chapter does not remotely attempt to fill in all the gaps, but it does provide some conceptual analysis and a review of existing findings and key data.

From International Markets to Household Welfare: An Analytical Framework

The effect of rising international food prices on the welfare of individuals is complex and highly heterogeneous across both household types and countries. Figure 3.1 depicts eight steps through which international prices influence household welfare. Pertinent policy questions are listed outside each box. Although surprisingly complex, Figure 3.1 is still a simplification of the process by which rising international prices affect individual welfare. Our aim is to flesh out some of the additional complications in the discussion below. In the figure boxes 1–4 largely refer to macroeconomic effects, whereas boxes 5–8 mostly refer to microeconomic responses that depend on the endowments and behavior of individual producers and consumers. Most macroeconomic studies focus on the areas listed in boxes 1–4 (a few focus on the substitution effects of box 5), and most microeconomic studies focus on boxes 6–8. This dichotomy is unfortunate, because it is by no means clear that countries that are vulnerable in a microeconomic sense (that is, those with high rates of poverty and hunger) are automatically vulnerable in a macroeconomic sense (having high import bills, low reserves, and high rates of transmission) and vice versa. Identifying the most vulnerable countries, which we do later in this chapter, necessitates an examination of both the micro and macro sides of the food-security equation.

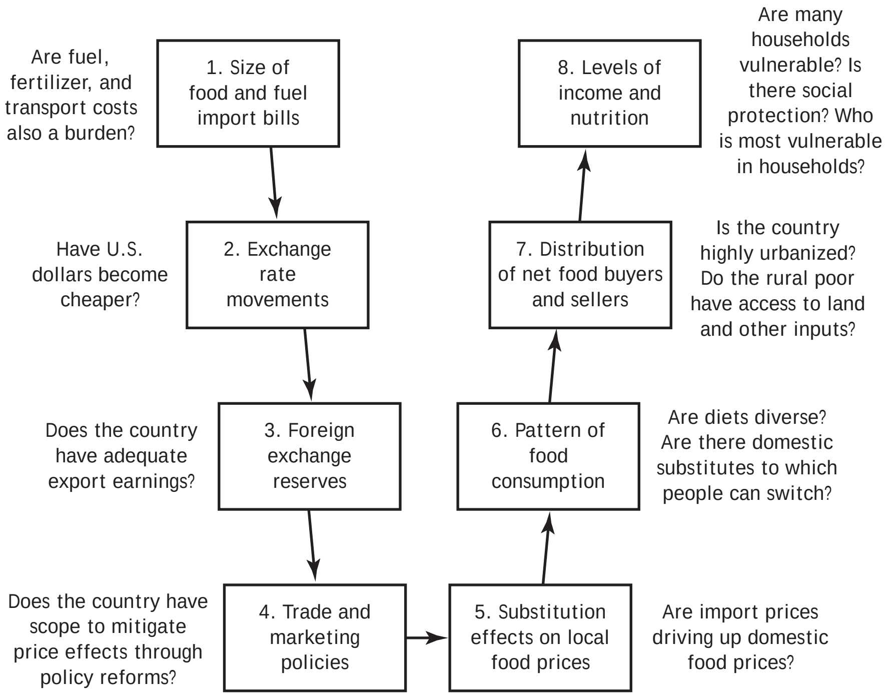
Macroeconomic Impacts

Many recent impact studies refer solely to food prices, but any comprehensive assessment of current poverty trends needs to incorporate changes in a range of prices, including fuel costs and fertilizers. Oil prices in particular will have a pervasive effect on a country's vulnerability to the current crisis through their effect on exchange rates, foreign reserves, transport costs, and domestic inflation. For these reasons the most relevant macroeconomic assessments of the crisis incorporate the effects of rising oil prices. Particularly useful in this regard is a recent IMF (2008a) assessment of oil and food price increases.

Import Bills

The first question to ask is how changes in all commodity prices will affect a country's macroeconomy. We therefore need to distinguish each country's position vis-à-vis their net import position with respect to food, oil, and other

Figure 3.1 Transmission from international markets to households and individual welfare



Source: Constructed by the authors.

commodities. The Food and Agriculture Organization of the United Nations (FAO) classifies 82 developing countries as low-income, food-deficit countries based on four criteria. The two main criteria are (1) the country must be a low- or middle-income country according to the World Bank's classification and (2) the country must have an aggregate calorie-based food deficit in the sense that national food demand exceeds its production. It would appear that many developing countries are dependent on food imports and that the impacts of rising food prices will indeed be almost pervasively severe. Moreover it has been widely noted that dependency on imports appears to have increased in recent decades.

Yet the conclusion that poor countries have become heavily dependent on food imports needs significant qualification. For example, Gürkan, Balcombe, and Prakash (2003) calculate food-import bills from 1970 to 2001 for net food-importing developing countries and for LDCs. On average, they find that developing countries have become more dependent on food imports for consumption (although prior to 2001, at least, the ability to pay for these imports had increased among the net food-importing developing countries but declined among the LDCs).

However, Aksoy and Ng (2008) give a more nuanced picture. They recalculate both food and general agricultural net import bills for low-, middle-, and high-income countries, but they disaggregate within each category by oil exporters, conflict states, small islanders, and "normal" countries. The key findings of their study are as follows. First, once the three special groups are omitted, the average low- or middle-income country has gone from being a net food importer in 1980/81 to being a net food exporter in 2004/05. However, Africa still contains a large number of oil exporters and conflict states, as well as other exceptions, meaning that most African countries (35 of 47) are still net importers of food, even though most are also net exporters of all agricultural goods (32 of 47). Third, only six low-income countries have food deficits that are more than 10 percent of their imports, so most net food-importing developing countries are marginal net food importers. Finally, Aksoy and Ng (2008) also identify countries with considerable potential to switch from being net exporters of nonfood agricultural products to net exporters of food. Of course, this switch is much less relevant to the short-term impacts of the crisis, because switching from cash crops to food production takes a considerable amount of time and may be prohibitively costly.

So the basic message from Aksoy and Ng (2008) is that the severity of food dependence is often overstated. For these reasons one might regard the rise in oil prices as a more serious threat to macroeconomic stability in developing countries. Indeed, oil import costs are 2.5 times larger than food imports for low-income countries and twice as large for middle-income countries. Consistent with this observation, IMF (2008a) simulations confirm that in the absence of policy responses, the impacts of oil prices are considerably larger than those of increases in food prices. The study estimates that for 33 net food-importing countries with available data, the adverse balance-of-payments impact of the increase in food prices from January 2007 to April 2008 is 0.5 percent of 2007 annual GDP (US$2.3 billion, or 0.2 months of 2008 imports of goods and services). During the same period, the impact of the increase in oil prices in 59 net oil-importing countries is estimated to be 2.2 percent of GDP (US$35.8 billion, or 0.7 months of 2008 imports of goods and services). Moreover, IMF (2008a) also finds that further oil price increases in 2008 and 2009 would have had much larger adverse effects on foreign reserves than would equal rises in food prices (see Table 3.1). As it turns out, both oil and food prices have declined since mid-2008.

Finally, although we have no data on overall terms-of-trade movements that factor into other commodities, we know that many net exporters of

Table 3.1 Number of countries severely affected by food and oil price increases, 2007-08

Type of shock[a]	Number of low-income countries severely affected	Number of middle-income countries severely affected
Severe negative shocks		
Oil price shock	48	33
Food price shock	13	3
Combined shocks	42	30
Positive shocks		
Oil price shock	11	23
Food price shock	30	28
Combined shocks	23	23
Less-than-adequate reserves		
Before the combined shocks	30	18
After the oil price increase	37	26
After the food price increase	27	19
After the combined shocks	37	25
Total countries	74	71

Source: IMF (2008a).
[a]Severe negative shocks are defined as those that induce drops in reserves of more than 0.5 months of imports. Positive shocks are those that result in increased reserves.

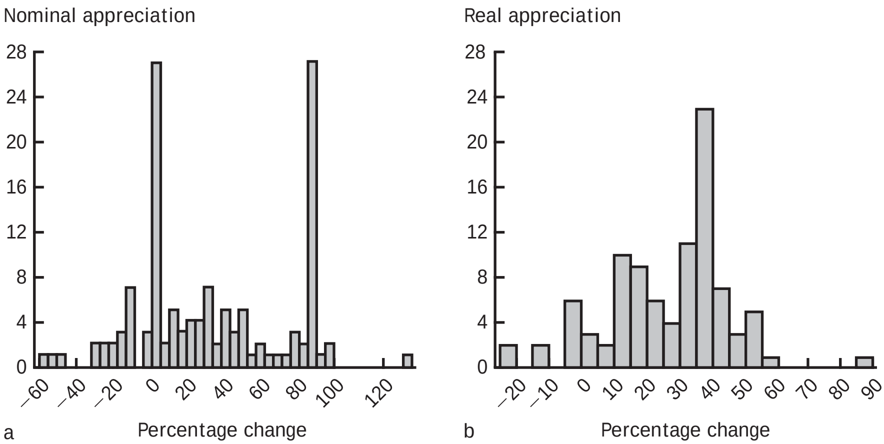
other minerals have also benefited from rising commodity prices to some extent (for example, Zambia), as have countries that are net exporters of labor to oil-producing countries (South Asian countries and Philippines; see Rosen and Shapouri 2008). Indeed, the estimates of terms-of-trade trends from the IMF (2009a) show that African economies have done well overall as a result of the commodities boom, so much so that the end of the commodities boom (that is, the 2009 financial crisis) will likely hurt their balance of payments more than the food crisis did. From this perspective it appears that the food crisis was not a macroeconomic crisis in the majority of countries. Of course, the story at the household level is likely to be quite different.

Exchange Rate Movements

As noted in Chapter 2, several currencies have appreciated against the U.S. dollar, the currency in which food and oil exports prices are usually denominated. The distribution of both nominal and real measures are presented in Figure 3.2 for the percentage change in exchange rates from the first quarter of 2002 to the second quarter of 2008, a period that covers the major movements of the U.S. dollar as well as the rise in oil and food prices. The distribution of nominal movements is centered around a median of a little more than 20 percent, but the distribution is also highly bimodal because of three currency unions. The euro area and the West African franc zone (which is pegged to the euro) have appreciated against the U.S. dollar by some 80 percent during this period. Thus the adverse effects of rising commodity imports for many West African countries should, all else being equal, be limited from a macroeconomic perspective. In contrast, the Central American and Caribbean area, which consists of currencies largely pegged to the U.S. dollar, and quite a large number of other countries around the world have experienced a stable rate of exchange with the dollar, while a few countries have experienced depreciation. Real exchange rate movements are still centered around a positive mean, but the distribution is slightly less bimodal, with only the euro area still standing out as a clear group, as variation in inflation rates across euro countries is quite limited. In either case it is clear that although most countries have appreciated against the dollar, considerable variation remains in terms of countries' vulnerability to rising dollar-denominated food and oil prices.

Of course, countries do not need to buy food imports in U.S. dollars. A country can buy food imports from other regions or, in principle, convert to euros, for example. One way to judge how much cheaper it would be to import from non–U.S. suppliers of food staples is to examine trends in the USDA commodity-specific, trade-weighted U.S.–dollar exchange rate, which shows movements of the U.S. dollar against U.S. agricultural competitors.

Figure 3.2 Histograms of exchange rate appreciations against the U.S. dollar, Q1 2002–Q2 2008



Sources: Calculations by the authors using data from IMF (2008b) for Figure 3.2a (covering 124 countries) and from USDA (2008c) for Figure 3.2b (covering 95 countries).

Note: Q1 and Q2 are the first and second quarters of the year, respectively.

This index indicates that export prices denominated in the currencies of other exporters of maize, wheat, and rice have declined by about 15–17 percent (relative to dollar-denominated prices) from 2002 to 2008.

In many instances, however, there is relatively little opportunity for countries to switch suppliers. First, countries that peg their currency to the U.S. dollar will generally have experienced the same depreciation that the dollar experienced. Second, variations in transport costs are still a significant cost of trade. Third, variations in trade patterns determine the composition of foreign exchange reserves for countries, so limited trade with other countries also limits foreign exchange capacity. A country might earn foreign reserves in euros, for example, but might want to purchase cereals from the United States in dollars. This limited room for maneuver vis-à-vis food supplies suggests that we should investigate the relationship between dependency on U.S. food imports and exchange rate movements, because countries that are both dependent on the United States and have not benefited from appreciation against the dollar may be particularly vulnerable in a macroeconomic sense.

Table 3.2 reports data for the two largest U.S. cereal exports, wheat and maize, as well as real exchange rate movements and foreign reserves, for regions and selected countries. Unsurprisingly, the regions that are most dependent on the United States as a source of food imports are Central America, the Caribbean, and some of the more northern countries of South America. A few other countries and regions are fairly dependent on the United States for food imports, but there are strong mitigating circumstances in most cases. First, many of these countries are either wealthy or only major consumers of U.S. wheat, whereas Central America, the Caribbean, and some South American countries consume both U.S. wheat and U.S. maize. The second mitigating factor is currency appreciation. In Africa the only country seriously dependent on U.S. food imports is Nigeria, but its currency appreciated by 42 percent in real terms against the U.S. dollar, and of course it is benefiting substantially from increased oil revenues.

As for foreign exchange reserves, the IMF has calculated months of imports as of the first quarter of 2008. Disconcertingly, the Caribbean and Central American countries appear to be highly vulnerable in this dimension as well. (In Africa some discrepancy exists between oil and non-oil exporters, but there is variation in both groups, suggesting that mineral exporting capacity alone does not wholly explain the status of reserves—policies matter more.) This evidence therefore suggests that, so far, it is the Central American and Caribbean countries that have been most vulnerable to rising U.S. dollar–denominated export prices because of their dependence on U.S. exports and their lack of any major compensating currency movements.

Table 3.2 Dependence on U.S. imports, appreciation against the U.S. dollar, and reserve status

Country or region	U.S. wheat imports (percent consumption)	U.S. maize imports (percent consumption)	Real appreciation against U.S. dollar, 2002–08 (percent change)	Foreign reserves, 2008 (months of imports)
Middle East and North Africa	2	15	20	15.0
Caribbean	28	36	15	3.5
Dominican Republic	46	49	12	2.6
Haiti	26	n.a.	5[a]	3.0
Trinidad and Tobago	48	95	18	n.a.
Jamaica	26	100	15	4.1
Central America	45	24	10	3.5
Costa Rica	55	47	10	n.a.
El Salvador	31	21	8	3.2
Guatemala	46	20	26	4.1
Honduras	45	21	12	3.5
Mexico	20	13	–2	3.7
Nicaragua	46	9	4	1.7
Panama	44	80	0	4.1
South America	4	1	25	8.7
Colombia	23	31	41	6.3
Ecuador	9	23	8	2.5
Peru	9	6	20	15.5
Venezuela	27	22	–12	n.a.
Sub-Saharan Africa	10	0	40	7.0
Non–oil-producing countries				5.0
Ghana	10	0	35	2.2
Nigeria	42	0	42	20.6
East Asia	2	7	1	n.a.
Hong Kong	1	49	–21	n.a.
Japan	26	90	2	n.a.
Republic of Korea	16	28	15	n.a.
South Asia	0.3	0.4	22	5.6 (4.0)[b]
Southeast Asia	12	1	25	6.0
Thailand	19	0	30	7.1
Philippines	32	0	29	6.3

Sources: Calculations by the authors using data from USDA (2008c) for imports and from IMF (2008b) for exchange rates.

Note: n.a., data not available.

[a] Only the nominal exchange rate is reported for Haiti because of a lack of inflation data.

[b] Average excludes India.

Another admittedly indirect indicator that countries are suffering as a result of rising prices is the change in cereal imports in 2007 and 2008. USDA data suggest that most developing regions experienced declines of 10–20 percent in 2007 or 2008 (Appendix Figure A.1). The main exceptions are wheat imports in the MENA region, as discussed above.

Food Price Trends in Developing Countries (Transmission)

The transmission of rising international prices into domestic markets is quite complex. Analytically speaking, "transmission" refers to several steps. The first step is the conversion of dollar-denominated international prices into local currency prices, as discussed above. The second refers to domestic policies that alter the local price of foods through tariffs, subsidies, export bans, reserve systems, price controls, and so on. However, the effects of these factors are generally bundled together as a residual. This residual also reflects a range of other factors, including substitutability between imported and domestic foods; supply and demand responses to price changes; and, more problematically, domestic factors that may have nothing to do with rising international food prices, such as exogenous supply shocks related to weather, the rising cost of oil, or nonfood inflationary factors (for example, monetary policies). Thus it may be possible that the change in domestic prices is very high, even though, strictly speaking, there is little transmission of international prices.

Bearing these important caveats in mind, how strongly might international prices be transmitted to domestic markets? Both commodity-specific prices and consumer price indexes can be used to assess this issue. Each approach has different strengths. Commodity-specific approaches are useful for assessing transmission proper, including the impacts of exchange rate movements. In principle, the food consumer price index (CPI) is more comprehensive and should be a better indicator of welfare costs, especially when it is deflated by the nonfood CPI to look at the terms of trade for food, or real food-price trends. A potential weakness of this type of measure is that if oil prices or domestic policies are also driving up nonfood inflation, then the terms of trade for food may change very little, but domestic consumers might still suffer, because even general inflation appears to have a strong adverse effect on poverty (Easterly and Fischer 2001). Another potential weakness is that the CPI may not reflect the consumption bundle of the poor, or of certain groups of the poor.[1] An additional problem for the present analysis is that CPI

[1] Conversely, in some countries (for example, Mali) governments use the price of one commodity (such as rice) as a proxy for a broader food basket.

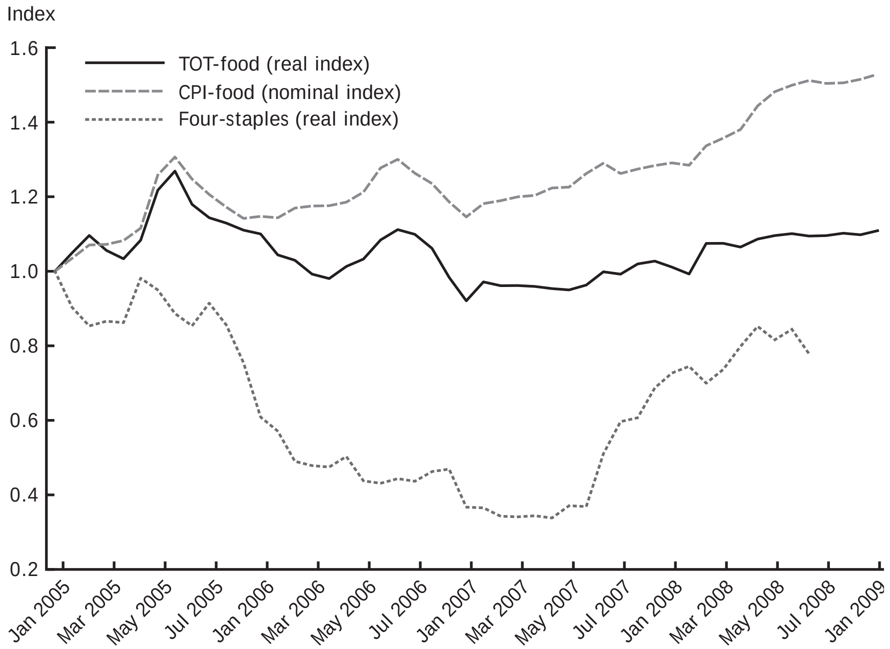
data have not been updated to a large set of countries and mostly pertain to 2007. Hence we do not report it here (see Headey and Fan 2008).

Nevertheless, to demonstrate the importance of the distinction between nominal and real prices, and between food CPI trends and individual commodity trends, we look at the very instructive case of Nigeria. In that country the nominal food CPI increased by 50 percent from January 2005 to the end of 2008. However, inflation in the rest of the economy (the nonfood CPI) was sufficiently high to minimize real price changes. Indeed, the real food-price index was lower in 2008 than it was in mid-2005. When we compare this index to the average of four staples, also in real prices, we see only a broadly similar story with one critical difference. The broad similarity is that real prices for the four-staple average in 2008 were indeed lower than they were in 2005. The critical difference is that staple prices doubled between September 2007 and late 2008, which the food CPI barely registered. The Nigerian example is pertinent because it shows that price changes may be rapid, but not large relative to historical norms or to inflation in the broader economy.

Figure 3.3 demonstrates three things: (1) it is vital to look at real prices; (2) it may be important to focus on the key staples that make up a large portion of a poor person's consumption rather considering the broader CPI; and (3) it may be important to look at food price changes in 2008 because of the speed of price changes. An assessment of individual commodity trends across countries was initially quite difficult in the current crisis because of the paucity of data on both wholesale and retail prices in developing countries (Headey and Fan 2008). However, the crisis prompted a significant scaling up of local food-price collection and dissemination by such bodies as USAID/Famine Early Warning Systems Network (FEWSNET), the WFP, and the GIEWS, among others. For the commodity-level analysis below we use the new GIEWS (2009) dataset, which reports real food price trends for more than 50 countries and a wide range of commodities. Although impressive in scope, the GIEWS dataset is unbalanced in that different commodities are reported across countries, sometimes in wholesale prices and sometimes retail, and variously as processed (for example, bread) or semi-processed (for example, flour).

So Table 3.3 reports some broad price trends by commodity, whereas Table 3.4 explores the heterogeneity in price movements by making use of cross-country and cross-commodity regressions. The descriptive statistics in Table 3.3 relate to the average real price change for each commodity between a given month in 2008 and the corresponding month in 2007, thereby taking account of seasonality. The statistics show that the real monthly prices of commodities were significantly higher in 2008 than they were in the corresponding months of 2007. Prices were highest for potatoes (only five

Figure 3.3 Comparing real and nominal CPI trends to real staples prices in Nigeria



Sources: CPI data are from the Nigerian Bureau of Statistics. Staple prices are from GIEWS (2009).

Notes: Staple prices include those for cowpeas, maize, millet, and sorghum, which were used to calculate an average price index with each commodity weighted by the staple's share in dietary energy. CPI, Consumer Price Index; TOT, terms of trade.

observations, mostly from Latin America), followed by sorghum (27 percent, only nine observations), maize and rice (about 25 percent), and millet (20 percent, but only nine observations). Wheat prices rose by about 10 percent, perhaps because wheat prices rose earlier than those of some other commodities. An important feature of Table 3.3 is that in all cases there was wide variation in price changes.

Table 3.4 explores this variation with a cross-country regression. The dependent variable is the change in the price of any given month over the corresponding month in 2007, so we again control for seasonality effects. Moreover, we can look at when prices were highest in 2008 relative to 2007. Unsurprisingly, price peaks occurred when international prices were significantly higher, albeit with some lag. Specifically, the seasonal price difference was highest in May, June, and July 2008. Prices continued to be significantly higher in August and September.

Table 3.3 Descriptive statistics for average monthly price changes by major commodity, 2008

Commodity	Number of observations	Mean (percent change)	Standard deviation (percent change)	Minimum (percent change)	Maximum (percent change)
Beans	21	9.4	15.6	–29.2	36.8
Bread	11	9.8	10.4	–10.0	22.3
Maize	42	35.9	81.8	–26.9	500.0
Cassava	6	1.7	8.0	–13.1	10.0
Millet	9	19.7	21.3	–6.3	68.5
Potatoes	5	51.2	68.8	2.2	159.1
Rice	44	24.3	23.6	–8.8	89.4
Sorghum	9	27.0	17.4	3.5	62.7
Wheat	14	7.8	18.8	–20.2	52.9
Wheat (flour)	12	12.2	17.7	–9.4	52.9

Source: Calculations by the authors using data from GIEWS (2009).

Table 3.4 Patterns of price changes across time, commodities, and regions

Dependent variable	Annual change in prices by corresponding month (percent)
Number of countries	48
Number of observations	1,967
R-squared	0.08

Variable	Coefficient	Variable	Coefficient
Monthly dummies (January = base)		Regional dummies (South America = base)	
February	5.4	Central America	17.5*
March	10.4	Middle East and North Africa	20.6
April	16.1*	Sub-Saharan Africa	20.2*
May	20.2*	East Asia	1.6
June	21.8*	South Asia	15.1*
July	20.4*	Landlocked versus coastal	33.5*
August	17.1*		
September	16.2*	Commodity dummies (all others = base)	
October	8.6	Wheat	20.7*
November	4.4	Maize	33.6*
December	2.6	Rice	19.6*
Constant	–15.2	Rice (high quality)	15.9
		Potatoes	31.0*
Product characteristic dummies		Cassava	–14.7**
Retail versus wholesale	–4.1	Millet	8.9
Semi-processed	–9.5**	Beans	7.4
Processed	–6.4	Bananas	–22.9

Source: Calculations by the authors using data from GIEWS (2009).

Notes: Prices are in real local currency units, except in a few cases (see Appendix Table A.3). Monthly prices in 2008 are compared to 2007 to address seasonality issues. Coefficients are significant at the 1 percent (*) and 10 percent (**) levels, respectively.

We now look at the characteristics of each commodity. We would expect retail price changes to be lower than wholesale price changes, which is what we find on average, although the effect is not significant. Only marginally lower price changes occurred for processed and semi-processed goods. Each of these dummies predicts price changes that are 5–10 percentage points lower than the base (wholesale or unprocessed).

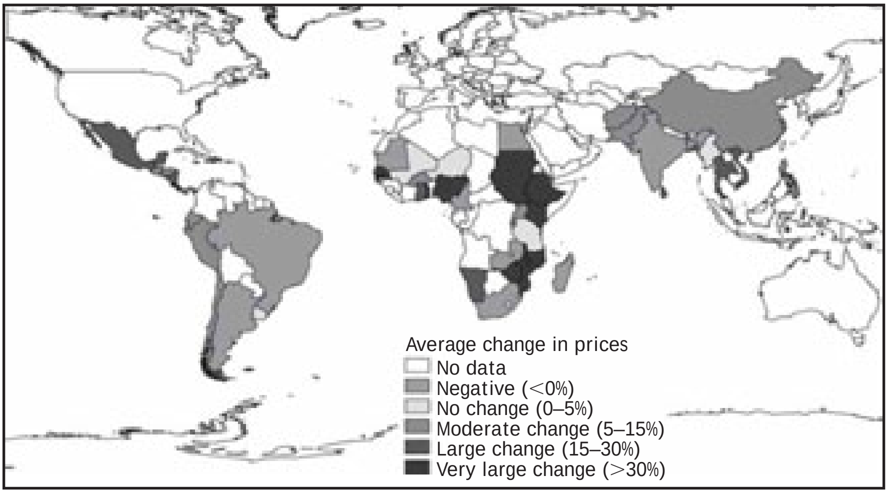
Turning next to regional effects, we find that relative to the base continent, South America, price changes were low in East Asia but high in Central America, South Asia (except India) and Sub-Saharan Africa. The large price rise in Africa is somewhat surprising, as is the 33.5 percentage points extra rise in prices in landlocked countries relative to coastal countries. With the exception of Afghanistan, all landlocked countries in our sample are in Africa, so we also ran a regression excluding the landlocked dummy variable. This regression shows that the average difference between price changes in Africa and South America is 33 percent. Thus there is something of an African price puzzle, which future research would do well to explore further.

Finally, we look at individual commodities. Unlike that in Table 3.3, the regression model used in Table 3.4 nets out the effects of retail versus wholesale, processed versus unprocessed, and regional effects. Relative to a base consisting of such goods as barley, lentils, meats and seafoods, sorghum, teff, and other less common food types, price changes were highest in maize, potatoes, rice, and wheat; lower in beans and millet; and much lower in bananas and cassava. Price increases that are highest in those commodities characterizing the global food crisis again suggest high rates of transmission. However, future work could use other variables to explain cross-country patterns in price changes, such as monetary policies or trade and exchange rate policies.

Finally, we look at food-price impacts at the country level using GIEWS (2009). This is challenging, given the incomplete and unbalanced coverage of the data, but essentially we try to construct a food price index using several steps designed to make the data more comparable. First, a cross-country and cross-commodity regression (similar to the one used in Table 3.4) was used to determine price change differences between wholesale and retail commodities and between unprocessed, semi-processed, and fully processed products. Wholesale, semi-processed, and fully processed items were then adjusted to give an unprocessed retail price equivalent. Next we again netted out seasonality effects by taking the average of differences between prices in each month of 2008 over corresponding months of 2007. Finally, we aggregated multiple commodities into a single price index using dietary energy shares as weights. Note, however, that in a few cases total energy shares of all commodities for a country were quite low (in some cases a little less than 30 percent; this result may be because of diverse diets, such as in Uganda [Benson 2008]), whereas in other cases only one food item was reported, but this item constituted 50–60 percent of dietary energy (for example, rice in Asia). Also, some countries did not report data for all of 2008, although we ensured that at least nine months of data were available, or we used the rise in prices over the first half of 2008 to proxy to garner an estimate. Countries with these caveats attached to them are listed in the notes to Figure 3.4. The figure groups countries by their level of real price change.

Figure 3.4 demonstrates some basic spatial patterns. Most Asian countries for which we have data witnessed moderate price changes, although Vietnam and Thailand—two large rice exporters—witnessed big price changes in rice. India and Bangladesh actually witnessed lower prices in 2008, partly because prices in 2007 were quite high. Price changes were significant in Afghanistan and Pakistan, and very high in Sri Lanka. In Latin America, price changes were modest and sometimes even negative in South America, but several Central American countries experienced large changes in food prices, consistent with

Figure 3.4 Some cautious estimates of price changes in staple foods during 2008



Source: Calculations by the authors using data from GIEWS (2009).

Notes: Prices are in real local currency units, except in a few cases (see Appendix Table A.3). The price series is an estimate of retail prices for unprocessed staple foods. Countries with limited data include Cameroon, Chile, China, Costa Rica, Ecuador, Honduras, Namibia, Nigeria, Pakistan, Rwanda, Uganda, and Zambia. In these cases, either monthly data for 2008 were incomplete or the commodities in question made up less than 30 percent of dietary energy share.

our above analysis, which emphasized the lack of any counteracting effect from favorable exchange rate movements with the U.S. dollar.

In Africa the story is complex. A few countries witnessed declining real prices, such as Cameroon, Madagascar, South Africa, and Zambia (whose strong currency might have affected the cost of imports). However, many countries experienced steep price changes in 2008, including some of the most populous countries, such as Ethiopia, Ghana, Kenya, Mozambique, Nigeria, Senegal, and Sudan. In some cases, domestic factors were undoubtedly important (for example, monetary factors in Ethiopia or conflict in Kenya and Sudan). In some instances these factors spilled over into tighter food markets in neighboring countries, such as Uganda.

The results in Figure 3.4 should be treated with caution, but they do seem to be broadly consistent with other evidence.[2] In a study of seven Asian economies, Dawe (2008) found that transmission rates of rice and wheat prices were generally low in Asia. In India, Philippines, and Vietnam the pass-through was just 6–11 percent, but in the remaining countries it was 41–65 percent. However, as our data suggest, several South Asian countries seem to have been more affected than were East Asian countries and India. Dawe (2008) finds that Bangladeshi international wheat prices were fully transmitted into Bangladesh (albeit mostly in 2007). Ul Haq, Nazli, and Meilke (2008) find that Pakistan's food CPI increased by 14.4 percent from 2006/07 to 2007/08, which is more than twice that of the nonfood CPI.

For Latin America there is not much data updated beyond early or mid-2008. The International Development Bank (see Cuesta and Jaramillo 2009) reports food price inflation for Latin America countries from January 2006 to March 2008. These data suggest large nominal increases (greater than 25 percent) in Bolivia, Costa Rica, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Paraguay, Trinidad and Tobago, Uruguay, and Venezuela. For Mexico during a similar period, Valero-Gil and Valero (2008) find larger nominal food-price changes than would be suggested by Mexico's food price index (which rose by 13 percent of 2006 to March 2008): most food prices increased by about 15–30 percent, such as those for beans (26 percent), chicken (32 percent), and tortillas (20 percent), but larger increases were observed for eggs (63 percent) and vegetables (80 percent), and much lower increases (less than 10 percent) for beef, milk, sugar, and tomatoes.

For Africa, other evidence is mixed. Data for Uganda (Benson et al. 2008), Ghana (Cudjoe et al. 2008), and Mozambique (Arndt et al. 2008) are quite consistent in finding moderate, large, and very large changes, respectively.

[2] Demeke, Pangrazio, and Maetz (2009) provide an overview of price increases across developing regions based on the same GIEWS data.

But FEWSNET data report price changes that appear to be lower than those reported in Appendix Table A.3, although the raw data were not made available for cross-checking.[3] However, Abbott (2009) reviews evidence from FAO and WFP researchers that identifies similarly large increases in prices, despite the initial delay in transmission. This delay is not surprising. Our earlier appraisals of World Bank (2008a) food and nonfood CPI data for 2007 and early 2008 showed a low degree of food inflation in most African countries (see Headey and Fan 2008). But it would appear that at that stage international prices had not yet peaked and had not worked their way into African markets. Moreover, the spread of the financial crisis outside of the United States to Europe led to a strengthening U.S. dollar, so that although international prices were declining in U.S. dollars, they were declining much less in euros. Indeed, in our earlier appraisal we had cautioned against putting too much weight on data from early 2008 for this very reason: exchange rates can reverse quickly. Evidence cited in Abbott (2009), for example, confirms that West African cereal prices, especially in the euro-pegged West African franc zone, remained relatively high in the second half of 2008 and in early 2009.

In light of the updated facts, we put forth several factors that could explain why African countries appear to have experienced surprisingly rapid inflation:

1. Greater dependence on cereal imports in large parts of Africa (Ng and Aksoy 2008)
2. Relative to Asia, much weaker policy mechanisms for stabilizing food prices (Dawe 2008)
3. Increasing transport costs stemming from the rise in fuel prices
4. An increased prevalence of climatic shocks (as in Niger or Uganda), political instability (as in Kenya, Somalia, or Sudan), strong regional spillovers into neighboring markets (such as Kenya's impact on Uganda; Benson et al. 2008), and relatively loose monetary or fiscal policies (as in Ethiopia or Malawi)[4]
5. High rates of substitution between international cereals and domestic staples (such as for beans, cassava, millet, and sorghum)

On this final point, however, we can offer relatively little evidence. In addition, historical evidence on elasticities of substitution may provide limited guidance because of rapid urbanization and because demand elasticities during crises may differ from those that prevail in normal times.

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[3] FEWSNET data are available at <http://www.fews.net/Pages/markettrade.aspx>.

[4] These factors contribute to price rises independently of international transmission but could also reinforce transmission.

Future research would do well to explore this question further, especially what appears to be the somewhat puzzling rise in food prices in Africa, even in several landlocked countries typically thought to be shielded from international price movements.

Microeconomic Simulations of the Effects of Rising Food Prices on Poverty

This section reviews three papers that provide cross-country simulations of the impacts of rising prices on household poverty: Ivanic and Martin's (2008) study of 9 countries across several continents; the study by Wodon et al. (2008) of 12 West African countries; and the study by Dessus, Herrera, and Hoyos (2008) of the urban sector of 73 developing countries.[5] These papers have been selected because they cover a range of countries and use quite similar methodologies despite their different sample sizes and scopes.

The basic approach in these papers follows Deaton (1989) in estimating the change in food welfare (ΔW_{Food}) as the product of the food net-benefit ratio (NBR_{Food}) and the change in food prices (ΔP_{Food}):

$$\Delta W_{Food} = \Delta P_{Food} \times NBR_{Food} = \Delta P_{Food} \times (Y_{Food}/Y_{Total} - C_{Food}/C_{Total}),$$

where Y_{Food}/Y_{Total} is the ratio of food sales and own-production to total household monetary income, and C_{Food}/C_{Total} is the ratio of food expenditure and own-consumption to total household expenditure. Notice that, by definition, own-production equals own-consumption, and because each enters into Y_{Food}/Y_{Total} and C_{Food}/C_{Total}, respectively, the consumption of food produced by the household is netted out of NBR_{Food}. Hence the main issues with microeconomic assessments of the poverty impacts concern the size of price changes, the numbers of net buyers and sellers, and the choice of poverty line. The most important point to note about these papers is that none of them assesses the most likely impact on poverty for the following reasons:

1. *Data sources.* All three studies simulate results from admittedly quite recent macroeconomic surveys, although this problem is not serious, as the key parameters derived from these surveys will not have changed significantly in recent years.

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[5] See also the study by Zezza et al. (2008) of the welfare impacts of 13 LDCs. That study is omitted from the present discussion because it does not calculate the effects of rising prices on poverty headcounts. ADB (2008) also makes estimates, but for only two countries. The Economic Commission for Latin America and the Inter-American Development Bank are also reported to have made estimates, but these were not publicly available, and they appeared to have used different and rather simplistic methods (see Lustig 2008).

2. *Price changes.* All three studies assume domestic food price changes for lack of actual data. Thus the results of these studies should be treated as experimental answers to the research question "What *would* happen to poverty rates if prices increased by *x* percent?" In one simulation by Ivanic and Martin (2008), the authors do use real international prices, but they assume a common 60 percent transmission rate to domestic prices. In general, however, the three studies simulate real price changes ranging from 10 to 30 percent. Whether these guesses are too high or too low is still not clear. So far we have very limited data on how much overall food prices are changing. Also, what data we do have tend to be urban prices (often wholesale prices). Food prices in rural areas will often be very different, and price rises will probably be smaller in rural areas because of higher transaction costs. Recent studies show that African markets in the same country may not be equally well integrated with international markets (Cudjoe, Breisinger, and Diao 2008; Ulimwengu, Workne, and Paulos 2009), which has strong implications for the spatial impacts of the crisis.
3. *Behavioral responses.* The three studies assume a limited range of behavioral responses by consumers and producers. All acknowledge this, and Martin and Ivanic's (2008) study provides a slightly more sophisticated model that also incorporates wage effects based on the Stolper–Samuelson matrix relating net factor incomes to changes in the domestic prices of trade goods. But there could be other responses, even in the short term. Many households have diversified income sources that are also flexible, and in Africa most rural people have access to land. When food prices are low, households may chiefly allocate their labor to the nonfarm sector and only farm their own land to supplement their disposable income. Rising food prices, however, could result in fairly quick and reasonably sizable shifts back into on-farm production (much of which would not show up in national production data). Likewise, many countries have diversified diets and may be able to switch to locally produced alternatives. This behavior would, of course, induce prices rises in locally produced goods, but overall food inflation may be contained.
4. *Net buyers and net sellers.* Many of the countries in the study samples of Ivanic and Martin (2008) and Wodon et al. (2008) experience significant increases in poverty. Similar methods applied to individual country studies find equally strong results, including poverty increases in Ghana (Cudjoe, Breisinger, and Diao 2008), Mexico (Valero-Gil and Valero 2008), and Pakistan (ul Haq, Nazli, and Meilke 2008). Even a net rice exporter like Thailand appears to experience an increase in national poverty because of

higher food prices (Warr 2008). Moreover, changes in rural poverty are sometimes larger than those in urban poverty, especially in Africa. In Zambia, for example, Ivanic and Martin (2008) estimate that the incidence of rural poverty increases three times as much as urban poverty, which is surprising. Is it possible that these surveys overestimate net food consumers? Aksoy and Isik-Dikmelik (2008) also analyze household surveys (including some of the surveys analyzed by Ivanic and Martin [2008]) and conclude that (i) although most poor households are net food buyers, almost 50 percent are marginal net buyers and (ii) net buyers typically have higher average incomes than net food sellers in eight of the nine countries surveyed, so that a rise in food prices would generally have progressive effects on income distribution. Another explanation for the high impacts on rural poverty found in Ivanic and Martin (2008) may be related to measurement error. Household surveys may generally underestimate the degree to which rural households are net sellers of food, because the consumption side of household accounts is generally better measured than the production side (Cudjoe, Breisinger, and Diao 2008).[6] For similar reasons, household income in rural regions may not be as well measured as it is in urban regions. Hence, the Ivanic and Martin (2008) and Wodon et al. (2008) studies may overestimate the impact of price rises on rural poverty.

5. *Excluding oil prices.* None of these papers considers rising oil prices (or fertilizer prices) as a simultaneous shock to income and revenue streams. This omission is significant, because oil prices have increased more than food prices, oil prices have larger and more pervasive impacts on exports, and oil prices affect prices of a number of other goods. The study of Mozambique by Arndt et al. (2008), for example, finds that rising fuel prices induce much larger increases in poverty than do rising food prices. Passa Orio and Wodon (2008) estimate the longer term impact of specific commodity price spikes on the price of other commodities by using a social accounting matrix multiplier. They find that indirect effects are significantly larger for oil than they are for food in three of eight countries sampled.
6. *Excluding broader economic growth.* None of these studies factor in strong economic growth, which characterizes several developing countries that have been benefiting from strong commodity prices.
7. *Poverty lines.* Finally, there is the choice of poverty lines; specifically, whether to use a national or an international measure (for example, US$1

[6] We thank Xinshen Diao for this astute comment. The specific argument is that microsurveys are more regularly updated on the consumption side; production—being largely seasonal—is only measured at distant intervals. It is sometimes argued that household income is also underestimated in these surveys.

a day). The international measure is quite imperfect, although the International Comparison Program will soon be releasing internationally comparable poverty-specific cost-of-living indexes. In the absence of better measures, all these studies use international poverty lines, but this choice can potentially make a considerable difference to the results.[7]

In addition to these general limitations, the individual studies have some specific limitations (Table 3.5). Wodon et al. (2008) consider different food items for different countries, which generally constitute dissimilar shares of total consumption, casting some doubt on whether their results are highly comparable. Dessus, Herrera, and Hoyos (2008) only examine the effects of aggregate food consumption on urban poverty, assuming constant shares of food expenditures and fixed food/nonfood elasticities across countries. Moreover, their estimates often contradict findings from the other two studies (Appendix Table A.4), suggesting measurement error may be a problem in their results. Appendix Table A.4 compares urban poverty estimates in the handful of countries analyzed in at least two of the three studies. The comparisons indicate that in at least five of the countries listed the results differ greatly across two of the three studies. In Cambodia, Nigeria, and Ghana, the Dessus, Herrera, and Hoyos (2008) estimates of urban poverty changes are several percentage points higher than those of Ivanic and Martin (2008) and Wodon et al. (2008) for total poverty changes. For Senegal and Guinea, the Dessus, Herrera, and Hoyos estimates are considerably smaller than those from Wodon et al. In most other cases the differences are negligible.

On this basis—and with significant doubts about the magnitude of price transmission within countries—we conclude that these cross-country microeconomic studies point to the possibility of marked increases in hunger, but they do not provide reliable indications of the actual effects of rising food prices on poor and vulnerable people.

Global Estimates of the Impacts of Rising Food Prices on Poverty and Malnutrition

When a global crisis emerges there is an understandable demand for global estimates of just how serious the crisis is. From the average impacts of their

[7] Ivanic and Martin (2008) provide some robustness tests, indicating that the sign of their effects are indeed quite robust. ADB (2008) gauges poverty effects in Pakistan and Philippines using national poverty lines, but in Pakistan's case this line is much higher than the US$1 per day line, hence the Asian Development Bank's estimates of the impact on poverty are many times larger than those estimated by Ivanic and Martin (2008). Ivanic and Martin also find that the results for Pakistan are sensitive to changes in the price shock being simulated, with rural poverty declining slightly for a 10 percent shock but increasing slightly for a 20 percent shock.

Table 3.5 Summary of three cross-country studies on the effects of rising food prices

			Price shock scenario			
Study	Sample size	Scope	Scenario number	Price shock (percentage increase)	Impacts of 20–25 percent price shocks	Limitations
Ivanic and Martin (2008)	Nine LDCs in several regions	Rural and urban areas	1 2 3	10 20 (robustness check) Real world price shocks, 2005–07	Poverty declines in two LDCs and increases in seven, including all three African countries	Study does not model demand elasticities, substitution effects, or supply responses (although second-order wage effects are estimated as a robustness test)
Wodon et al. (2008)	Twelve West African LDCs	Consumers and producers	1 2	25 50	Poverty increases in all cases, but varies considerably	As above, but a more limited number of food items are considered
Dessus, Herrera, and Hoyos (2008)	Seventy-three LDCs	Urban areas	1 2 3	10 20 30	20 countries are found to be vulnerable, with an average increase in poverty of 4.5 percent	As above, but this study only examines aggregate food prices rather than specific food items; it only examines urban poverty, and it assumes that food expenditure shares and food/nonfood price elasticities are the same in all countries

Note: LDC, least-developed country.

nine-country study, Ivanic and Martin (2008) estimate that 105 million people could be thrown into dollar-a-day poverty. Clearly this estimate is extremely tenuous, given the diversity of country circumstances (for example, net buyers/net sellers and degrees of transmission) and that many of the largest poor countries (China, India, and Indonesia) were scarcely affected at all.

In its 2008 state of food insecurity publication, FAO (2008) estimates that the number of chronically hungry people in 2007 increased by 75 million over its estimate of 848 million undernourished in 2003–05, with much of the increase attributed to high food prices. These estimates are also very provisional but are at least more comprehensive. The estimation technique is as follows. First, trends in dietary energy supply are derived from detailed "supply utilization accounts" and more recent data covering cereals, oils, and meats available for human consumption (accounting for about 80 percent of dietary energy supply). Next, the more recent data were used to extrapolate the core database to 2007. Finally, the 2007 estimates were used to capture the impact of food prices on hunger at the global and regional levels only. These estimates suggest that Asia accounts for 41 million of the extra 75 million undernourished, Africa for 24 million, and Latin America and the MENA region for the remaining 10 million. FAO (2008) argues that its figures may underestimate the increase in hunger because it is assumed that the distribution of dietary energy intake stays the same when prices rise, whereas microeconomic work suggests otherwise (Zezza et al. 2008). Rosen and Shapouri (2008) of the USDA estimate an increase of 133 million extra malnourished people in some 70 countries. Their estimate is significantly higher, because they choose a required caloric intake of 2,200 calories that is not adjusted for age and gender, factors which can reduce the required intake to as low as 1,600 calories. Despite the usual caveats, estimates of malnutrition incidence have the benefit of not having to rely on assumptions about price transmission. The downside is that not all of the increase in malnutrition can be attributed to rising food prices, although rising prices are justifiably a prime suspect.

Distribution of Poverty Impacts across Socioeconomic Groups and Individuals

The diversity of microeconomic vulnerability across socioeconomic groups within countries is also a major issue. Clearly there are a range of factors that influence the vulnerability of households to rising food prices within and across countries. Zezza et al. (2008) go further than the three simulation studies examined at the start of this section by disaggregating vulnerability across groups and explaining vulnerability measures with ordinary least squares regressions. Across 13 developing countries from different parts of the developing world, they find that the most vulnerable households are urban or rural nonfarm, larger, less educated, more dependent on female labor, less well served by infrastructure, and in the rural sector, those with limited access to land and modern agricultural inputs. All these findings are fairly intuitive, but it is still useful to see microeconomic evidence confirming these intuitions and offering orders of magnitude as to which household attributes matter most.

An omission from all these studies is the intrahousehold allocation of food. Anecdotal evidence during the crisis pointed to the greatest consumption losses falling on women and girls (for example, Sullivan 2008). Food allocation is widely studied, and yet an earlier review of the intrahousehold literature by Haddad et al. (1996) found that, outside of northern India and Bangladesh, evidence of pro-male biases in food consumption is scarce. Of course, in times of scarcity or in food insecure regions (for example, the Sahel), this behavior may change. It has been noted that women often act as shock absorbers of household food security by reducing their own consumption to leave more food for other household members, notably children (Dercon and Krishnan 2000; Quisumbing, Meinzen-Dick, and Bassett 2008). FAO (2008) summarizes a range of recent historical evidence in support of this observation, including drought-induced stunting in Zambia in 2001 and increased maternal undernutrition and anemia in Indonesia following the 1997 financial crisis. So far, however, we have not seen any recent studies of this issue in the context of the world food crisis, but it is sure to be a fruitful research area in the future.

Impacts on Producers: Supply Response and Welfare Implications

Early in the crisis it was widely assumed that prices would remain high because of production constraints, and that higher prices would hurt the rural poor for the same reason. With the benefit of new estimates of production in 2008/09, it is now possible to at least assess supply response at the national, regional, and global levels.

Excluding such outliers as Argentina (troubled by a series of poor policy decisions and farmer protests), Australia (still troubled by drought), and Kenya (troubled by conflict), most major cereal producers—including both major consumer nations and major exporter nations—responded very positively. Table 3.6 reports USDA (2009) production data on the percentage change between 2007/08 and 2008/09. The table separates producers into those primarily producing for domestic consumption (especially consumer countries with large populations) and those in which a significant portion of production (more than 10 percent) is for export. The major consuming nations increased production during this period by 16.8 percent for maize, 12.4 percent for rice, and 8.5 percent for wheat. Particularly strong was the supply response in China and India, both of which increased their public agricultural spending by about 20–30 percent in 2008. As might be expected, the response from major exporting nations was even stronger, especially for maize and wheat production, which increased by 25–30 percent. Production increases in rice were more limited, which is consistent with the hypothesis that smallholders (who dominate rice production) have less scope to respond.

However, other factors could account for the sometimes sluggish response of rice. First, the increase in rice prices arrived late in the crisis and the bubble burst quickly. Rice producers may have rationally identified the rice spike as a short-term bubble that would soon collapse. Second, as discussed above, export restrictions were highly prevalent in rice-producing countries, and most Asian countries insulate domestic markets from international price movements. Thus in most rice-producing countries the incentives to increase production were limited by government policies and not necessarily by lack of responsiveness from smallholders. Third, Asian rice producers are much more dependent on fertilizers than smallholders from other regions. In countries where fertilizers are highly subsidized and/or their export is restricted so that fertilizer prices do not rise much (such as in China and India), supply response in rice production was quite high (about 10 percent for both countries) despite the modest increase in the price of rice. In other countries with fertilizer subsidies, supply response was also significant. In Malawi, maize production increased by 50 percent. In Nigeria maize and rice production increased by 17.9 percent and 30.7 percent, respectively. Ethiopia, where food inflation has been high for several years, is also estimated to have experienced rapid growth in maize production in 2008/09 (52.7 percent).

Of course, with rising fertilizer prices on international markets, domestic subsidies have become very expensive. Gulati and Dutta (2009) report that India's fertilizer subsidies have almost doubled from 2000–01 to 2006–07 and will most likely double again in 2008–09. In Malawi direct program costs to government and donors were just less than US$91 million before the food crisis, total government expenditure was 25 percent over budget, and subsidies comprised 40 percent of the Ministry of Agriculture budget and more than 5 percent of the national budget (Dorward et al. 2009). With the rise in fertilizer prices, fertilizer subsidies constitute a significant threat to the fiscal balances of the government. In Nigeria fertilizer subsidies made up 50–70 percent of federal government expenditure during 2000–05, so rising costs were once again a significant drain on the public coffers (Mogues et al. 2008), although Nigeria is of course much better off fiscally because of the oil boom.

Table 3.6 Positive supply response to rising world food prices in the 2008/09 season

Maize	Output (percent change)	Rice	Output (percent change)	Wheat	Output (percent change)
		Major consumers			
Central America	12.2	East Asia	9.2	North Africa	–13.2
EU-27	7.2	Central America	0.6	East Asia	17.4
Sub-Saharan Africa	18.6	Sub-Saharan Africa	20.2	South Asia	9.7
Southeast Asia	18.5	Middle East	–13.9	Sub-Saharan Africa	25.8
North Africa	4.9	South Asia	10.4	Middle East	–22.1
East Asia	22.9	Indonesia	3.5	Bangladesh	–7.1
Mexico	16.7	China	10.0	Ethiopia	41.6
Peru	16.0	Brazil	2.2	Egypt	4.8
Tanzania	17.8	India	10.9	China	17.6
Democratic Republic of Congo	–1.1	Bangladesh	8.5	Pakistan	5.4
Malawi	47.9	Democratic Republic of Congo	0.0	India	14.2
South Asia	12.7	Ghana	–3.7	Uzbekistan	7.6
Nigeria	17.9	Madagascar	12.7		
Ethiopia	52.7	Malawi	69.8		

Ghana	1.9	Nigeria	30.7		
China	23.3	Philippines	10.9		
Kenya	–20.2	Tanzania	29.2		
Average (excluding Kenya)	16.8	Average	12.4	Average	8.5
Major exporters					
Thailand	4.3	South America	4.1	Brazil	27.6
Brazil	19.0	Southeast Asia	5.4	EU-27	16.8
South Africa	34.6	Vietnam	5.1	South Africa	10.9
Former Soviet Union	60.4	Egypt	6.1	Former Soviet Union	43.8
North America	11.7	Australia	–81.3	Ukraine	92.6
United States	11.2	Thailand	8.0	Kazakhstan	10.0
Ukraine	56.2	United States	–4.4	North America	18.7
Argentina	–26.8	Pakistan	20.7	Argentina	–44.9
				Australia	2.3
Average (excluding Argentina)	25.3	Average (excluding Australia)	5.1	Average (excluding Argentina and Australia)	31.5

Source: USDA (2009).
Notes: Major consuming (exporting) nations are those with export–consumption ratios of less than (greater than) 10 percent.

Despite positive signs at the national, regional, and global levels, it is still difficult to say that small farmers in developing countries are significantly better off than they were before the crisis. In addition to rising input costs, transport costs have increased because of rising fuel prices, and these too may eat into farmers' profits. Moreover, there is so far no systematic data on farmgate prices, so it is unclear to what extent higher retail prices in developing countries are being translated into higher farmgate prices. We strongly suggest that this issue is both an important policy question and a longer term research question.

CHAPTER 4

Learning from the Past: Comparisons to the 1972–74 Food Crisis

The recent surge in food prices has been commonly termed a crisis, and not without justification. But such a crisis is not new. The world experienced a remarkably similar event in the early to mid-1970s. In this chapter we ask whether there are common causes of these crises. In the next chapter we ask whether these events point to systemic problems in the global food system.

Food Crises Past and Present

As discussed in Chapter 2, the 1972–74 crisis was of a similar scale and scope to the current food crisis (see Table 2.1 and Figure 2.1). In constant dollar terms, wheat and soybean price increases have been slightly smaller in the current crisis (in the case of wheat, increasing 180 percent during 1970–74 versus 110 percent from 2005 to May 2008), but the maize price increase has been slightly larger (80 percent in 1972–74 versus 90 percent during the current crisis). The increase in rice prices has been roughly the same (a little more than 225 percent in both cases). Changes in fertilizer prices have been about the same, although percentage changes in oil prices were much larger in the 1970s. Finally, the sudden decline in international food prices from June 2008 to March 2009—contrary to the predictions of leading organizations and prominent experts—also closely follows the decline in food prices after mid-1974.[1] By our calculations, real prices of staple grains dropped by a little more than 40 percent from 1974 to 1978, and from June 2008 to March 2009 staples have dropped by 35 percent on average. Hence the intertemporal and intercommodity profiles of price changes across the two crises are remarkably similar.

[1] Gulati and Dutta (2009) nicely summarize the inflated predictions regarding food prices by such eminent writers as Jagdish Bhagwati, Jeffrey Sachs, and Paul Krugman, as well as high-level officials in prominent agricultural and development institutions, such as IFPRI, the FAO, and the World Bank.

Causes of the 1972–74 Crisis

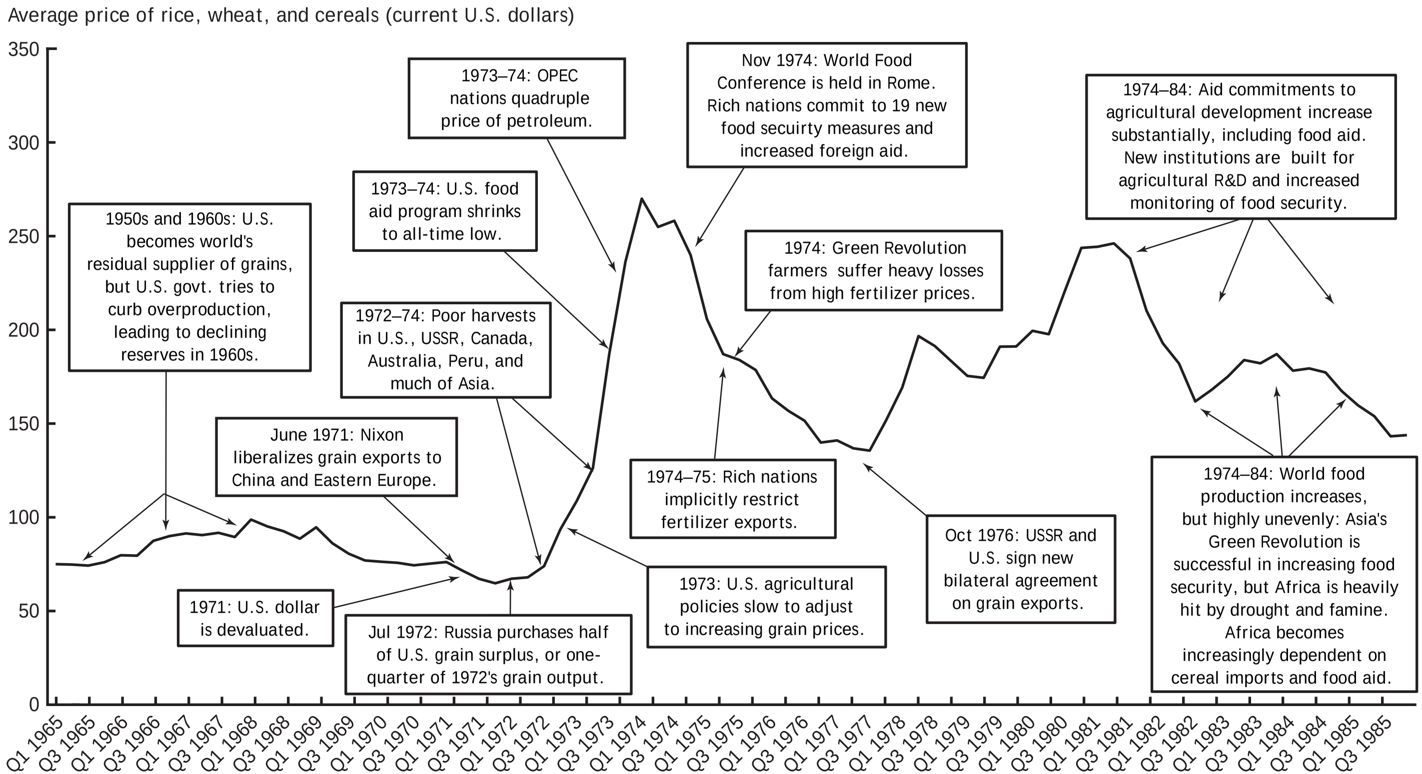
If the profiles of the two crises are similar, is it also possible that the crises had common causes? To answer this question we need to revisit the 1972–74 food crisis. Figure 4.1 depicts a timeline of events leading up to and following this event, and the following discussion explores these factors in more detail.

As with the current crisis, the causes seem to fall into three categories: rising oil prices, a variety of market shocks on both the supply and demand sides, and longer term pressures on international food commodity markets. Like today, many of the causes of the 1972–74 crisis relate to U.S. production and trade conditions, especially with respect to wheat and other coarse grains. In the 1930s North America exported a mere 5 million tons of grain, and of all the other regions of the world, only Europe was a net importer (Figure 4.2). By 1966, however, North American grain exports had increased twelvefold to reach nearly 60 million tons, the Communist countries went from a 5 million ton surplus to a 4 million ton deficit, and Asia moved from a 2 million ton surplus to a deficit of 34 million tons. North America had become the global epicenter of the grains trade, meaning that changes in North American trade and production had the potential to significantly impact international prices and global food security. This is still true today.

In this regard, the earliest contributing factor to the crisis was probably U.S. policies regarding wheat production (Johnson 1975; Destler 1978). The market condition saw chronic surpluses and depressed prices, and the "farm problem" was seen to be overproduction. By the 1960s the U.S. Commodity Credit Corporation had already accumulated large amounts of grain stocks as a result of policies that supported prices well above market-clearing levels. In effect the United States was the world's residual supplier of grains, through both cheap exports and food aid. Domestically, however, these large grain stocks raised political concerns over the high costs of storing the grain, which could not be disposed of at the prevailing support levels. Therefore, the U.S. government—as well as the Australian and Canadian governments, who also stored large stocks of wheat—took steps to drastically reduce the production of wheat by one-third from mid-1970 to mid-1972, reducing their global share of world grain production from 15 percent to about 10 percent (Johnson 1975). Even after this huge decrease in wheat production the three major grain exporters continued to further reduce their stocks (Johnson 1975).

These policies contributed to a radically different international wheat market in the 1970s (Johnson 1975; Destler 1978). The existence of large grain reserves during the 1950s and 1960s had meant that major fluctuations in production only prompted minor changes in prices, because the United States, Canada, and Australia could use their large reserves to buffer price

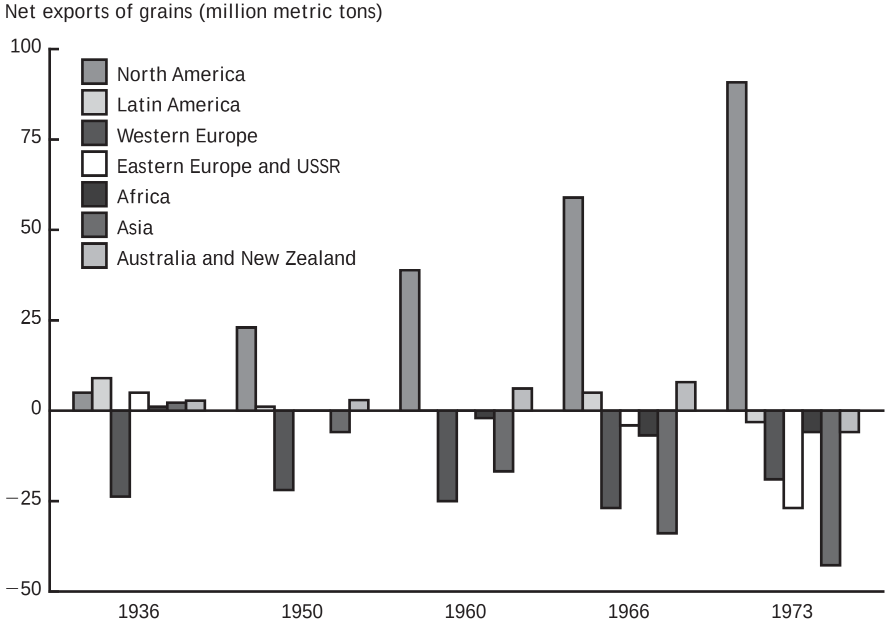
Figure 4.1 Timeline of events for the 1972-74 food crisis



Source: Constructed by the authors.

Notes: Q*n* indicates the *n*th quarter for the year. OPEC, Organization of Petroleum Exporting Countries; R&D, research and development.

Figure 4.2 Changing patterns in the grain trade, 1930s–1970s



Source: USDA as cited in Ward (1974).

shifts. For the crop years 1960–71 wheat prices were held within a range of US$59–65 per ton in 11 of the 12 years, and maize prices were similarly stable. But by the 1970s these reserves had been depleted, largely as a deliberate policy, so that even relatively mild shocks to demand and supply could cause extreme fluctuations in prices (Hopkins and Puchala 1978). In fact, a high degree of price stability was achieved during the 1960s even though the absolute shortfall of world grain production below trend during 1961/62–1965/66 was greater than during 1971/72–1974/75 (72 million tons compared to 36 million tons). Despite this significant change in grain markets, only India responded to the shift by increasing its own stocks as an offset to the declines of North American and Australian stocks.

During this increasingly fragile grains trade regime, several reasonably significant shocks ensued in the early 1970s. The most important of these, however, was effectively a demand rather than a supply shock.[2] In June 1971 the Nixon administration liberalized exports to the China, Eastern Europe,

[2]Although Communist countries' demand for U.S. wheat was itself precipitated by production shocks (especially in the USSR) and poor agricultural policies, the sudden entry of the Communist bloc into world grains trade amounted to a demand shock.

and the USSR after receiving predictions of normal demands for grains for the rest of the world (Johnson 1975; Schuh 1983).[3] The amount purchased by the USSR was about half of U.S. carryover stocks of July 1, 1972, and more than one-quarter of 1972 production. It would be shipped before the 1973 crop was in. The USSR also made significant wheat purchases from Canada, further depleting North American wheat stocks. By August 1972, the wheat export price jumped from US$1.68 per bushel in July to US$2.40 in early August. U.S. policies were slow to adjust. Stagnant wheat markets for many years had convinced the United States that high prices were not sustainable, so the government held the net export price target at about US$1.63, even though this target drove up U.S. prices and increased the costs of U.S. farm subsidies from an estimated US$67 million up to an actual cost of US$300 million for 1973 (Destler 1978). Pricing policies that had worked reasonably well for more than a decade became simply inappropriate. Without the export subsidy, market prices would have much more promptly reflected the impact of the enormous grain exports contracted to the Communist countries in 1972, and a more gradual price rise would probably have ensued, allowing for more timely supply responses.

In addition to the demand shock from the Communist countries, several supply shocks affected global grains production (Destler 1978). Harsh winters, droughts, or tropical cyclones affected some major producers, including Argentina, Australia, India, Peru (a major producer of animal feed), Philippines, and the USSR, leading to a 3 percent decline in world grain production in 1972, and 1974 also produced poor grain harvests, especially in Canada and the United States. This conflagration of output shocks in a relatively short time certainly exacerbated some of the deeper troubles in global food markets, but it is unlikely that they were a driving factor, if only because similar shocks have occurred in other years (for instance in the early 1960s) with relatively little repercussion on international prices.

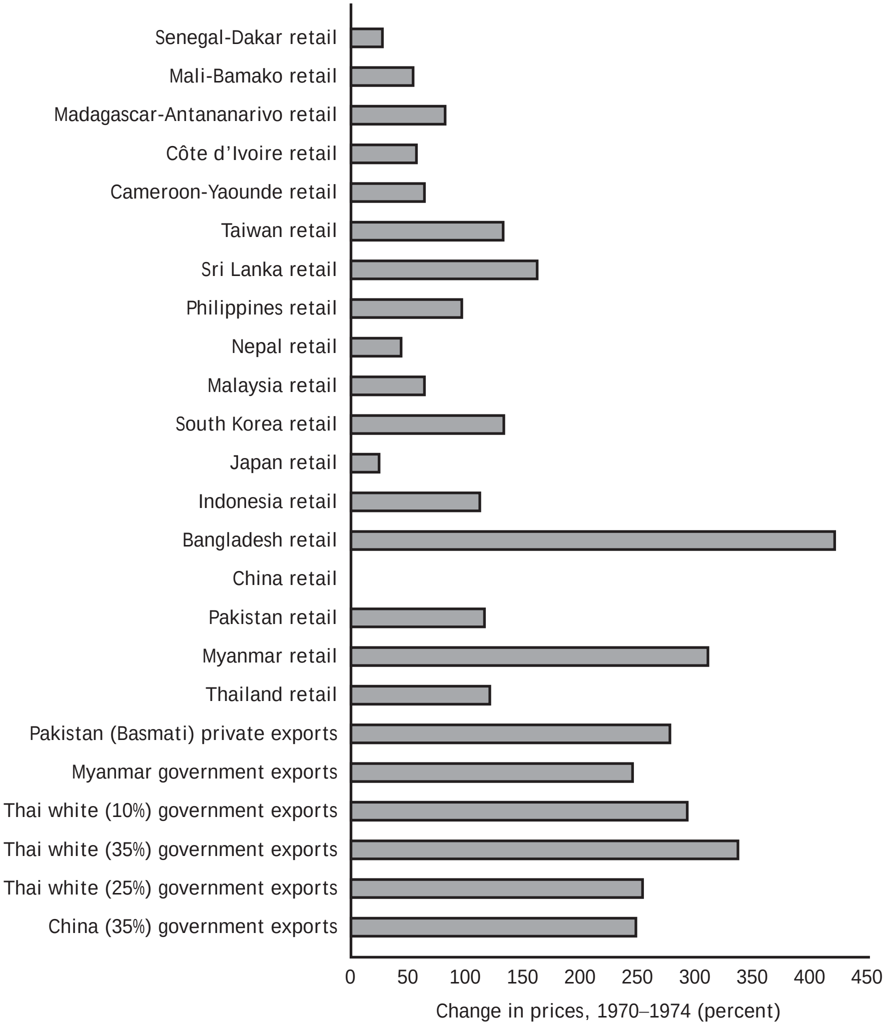
The rapid rise in rice prices is more puzzling, however, as most of the aforementioned shocks related to wheat production in more developed countries (even the 1974 weather shocks in India mostly affected wheat production). The volatility in rice export prices came about precisely because of the thinness of the international rice trade and the special characteristics of the rice market (Timmer 2009; Chapter 2). But as in the current crisis (Dawe 2008), the percentage change in nominal retail prices for rice during 1970–74 were generally a fraction of the international price change, with Bangladesh

[3] On June 10, 1971, Nixon terminated the need for companies to obtain clearance from the U.S. Department of Commerce to export wheat, flour, and other grains to China, Eastern Europe, and the USSR, and the requirement that 50 percent of grain sold must be carried in U.S. ships was suspended.

again being the exception (Figure 4.3; see Chapter 3), although in the early 1970s the food crisis in Bangladesh had significant domestic causes.

Other factors contributing to rising cereal prices were not shocks, but rather long-term factors that fostered tighter international food markets. At the time, a great deal was made of rapid population growth, but the fortunate emergence of a Green Revolution in Asia just prior to the 1972–74 crisis

Figure 4.3 Comparing changes in rice export prices versus changes in retail prices, 1970-74



Source: Calculations by the authors using data collected by the International Rice Research Institute.

mitigated the worst impacts in Asia. Rapid population growth was a bigger problem in both Sub-Saharan Africa and North Africa (Egypt, Algeria, and Morocco), where cereal imports were becoming an increasing portion of total food demand. However, from the 1930s to the 1970s it was estimated that about one-third of total growth in cereal demand was from more affluent diets, mostly from wealthier countries (Ward 1974). Indeed, as with the 2008 crisis, the 1972–74 crisis was preceded by more than a decade of strong global economic growth. And discussed in Chapter 2, a surge in cereal exports to oil-exporting countries accounted for more than one-third of cereal export growth in 1974.

Indeed, the OPEC oil crisis was the other critical factor in raising cereal prices. The deeper causes of the crisis were both political and economic. On August 15, 1971, the United States pulled out of the Bretton Woods Accord, taking the United States off the Gold Exchange Standard (whereby only the value of the U.S. dollar had been pegged to the price of gold and all other currencies were pegged to the U.S. dollar), allowing the dollar to float. The result was a depreciation of the value of the U.S. dollar, which had two effects. First, such devaluations may have increased the dollar price of grain by as much as 15 percent (Johnson 1975). The second and more important effect was that the devaluation triggered a chain of events in oil markets. Because oil was priced in dollars, oil producers were receiving less real income for the same price after the devaluation. The OPEC cartel responded to this problem by issuing a joint communiqué stating that OPEC would forthwith price a barrel of oil against gold. However, in the years after 1971, OPEC was slow to readjust prices to reflect this depreciation.[4] Then on October 17, 1973, OPEC announced, as a result of the ongoing Yom Kippur War, that they would no longer ship oil to nations that had supported Israel in its conflict with Syria and Egypt (namely, the United States, its allies in Western Europe, and Japan). Although the embargo did not persist for long, the resultant price shock was enough to push both developed and developing countries into an inflation contagion. The direct effects on agricultural production were severe, because the major food production systems in the world were by that time already highly energy intensive. Rising oil prices were therefore directly transmitted to rising food prices in the United States and other major producers, and these elevated prices were then transmitted to other markets because of North America's vital role in the grains trade.

[4]From 1947 to 1967 the price of oil in U.S. dollars had risen by less than 2 percent per year. Until the oil shock, the price remained fairly stable against other currencies and commodities, but suddenly became extremely volatile thereafter. OPEC ministers therefore had had no reason to develop the institutional mechanisms required for updating prices rapidly enough to keep up with changing market conditions, so their real incomes lagged for several years.

For non-oil exporting developing countries, the effects were especially severe. Foreign reserves were increasingly eaten up by oil, food, and fertilizer imports, with the depreciation of the U.S. dollar providing only a limited buffer. Rising imports costs were also exacerbated by Organization for Economic Cooperation and Development (OECD) policies. Real volumes of food aid—especially U.S. aid—had declined markedly, because rising grain prices meant that the cost of procuring a given volume of food aid had essentially doubled. In 1974 U.S. food aid was less than 40 percent of the average volume provided in the late 1960s and early 1970s (Grant 1975). Rising fertilizer prices were also exacerbated by implicit export bans in OECD countries (Ward 1974; Grant 1975) and by large nonfarm usage of fertilizers. Even well after the 1975 World Food Conference—which tried to convince wealthy countries to divert fertilizer exports to developing countries—fertilizer sellers still discriminated toward selling to American buyers, and the U.S. and other OECD governments did not attempt to reduce nonessential uses of food and fertilizers. Small farmers in developing countries that had adopted Green Revolution strategies suffered especially severely, because their strategies centered on the production of fertilizer-intensive wheat and rice varieties and they were dependent on small retail outlets at the very end of the fertilizer supply-distribution chain. Shortages of fertilizer and oil were arguably the primary cause of the poor 1974 winter wheat harvest in India, which only totaled 23 million tons in contrast to a projected yield of 30 million tons (Grant 1975).

Similarities between the 1972–74 and 2008 Crises

Table 4.1 compares the principal causes of each crisis. The three most important factors in both cases were rising oil prices, the associated decline of the U.S. dollar, and large demand shocks. As noted above, the oil shock was actually larger in the early 1970s, although oil prices were increasing from a low base. Abbott, Hurt, and Tyner (2008) find that real rest-of-the-world prices changed about three-quarters as much as nominal U.S. dollar prices in 1972–74, which is less than in the current crisis but still significant. As for demand shocks, which fall more in the purview of agricultural policies than of price movements of oil and U.S. dollars, these were from different sources in each crisis, but the shocks in question were of remarkably similar magnitudes. In 1972–74 the demand shock came from the USSR, which, following its own crop failure that year, purchased more than one-quarter of U.S. wheat production in 1972. In 2005–08 the primary demand shock came from the U.S. biofuels industry, which also absorbed one-quarter of U.S. production in 2007, this time in maize. Consistent with this story is that the 1972–74 crisis was characterized by large price increases in wheat rather than in maize, whereas the reverse was true of the 2008 crisis.

Table 4.1 Comparing causes of the current crisis with the 1972-74 crisis

Factor	Importance in 1972-74 crisis	Importance in current crisis	Lessons to be learned
Rising oil prices	The oil crisis was a significant catalyst through direct and indirect effects on the costs of production (for example, fertilizers) and also on cereals demand.	Although the recent oil price surge was not as sudden as the 1974 surge, rising oil prices again raised production costs and fueled demand from oil exporters. Biofuels are a new linkage.	Oil price trends need to be carefully assessed when monitoring food security.
Demand shocks	Soviet imports accounted for 80 percent of the variation in world exports and were a major demand shock.	Biofuel demand is a similarly sized demand shock in maize.	U.S. policymakers need to be much more aware of how the effects of U.S. agriculture, trade, and energy policies affect global food security.
Decline of the U.S. dollar	The dollar declined significantly against many currencies, bolstering U.S. cereal exports but also triggering the revaluation of oil prices by OPEC.	The dollar again declined heavily against many other currencies, especially those of the euro region, again bolstering U.S. cereal exports.	Movements in the U.S. dollar need to be assessed when monitoring food security.
Weather shocks and other output shocks	Major shocks included poor harvests in the USSR and poor harvests in India.	During 2004–06, wheat production fell in Australia (–52 percent), the E.U. (–14 percent), and the United States (–16 percent), as did coarse grains.	It is not clear that output shocks were a significant direct cause of either crisis; output among major producers is already adequately monitored.

(*continued*)

Table 4.1 Continued

Factor	Importance in 1972-74 crisis	Importance in current crisis	Lessons to be learned
Long-term demand pressures in commodity markets	The crisis was preceded by two decades of rapid economic and population growth.	The crisis has been preceded by rapid economic growth in China, India, and other large developing economies.	Improved international monitoring of international demand is needed, but more importantly, preemptive investments in agricultural production are vital.
Longer term supply pressures	U.S. grain reserves declined markedly in the decade preceding the crisis, although investment in food production increased throughout most of South and Southeast Asia, but not in Africa.	Before the crisis, U.S. and other major grain reserves declined and investments in agriculture declined in most of the developing world, but production growth slowed slightly, suggesting that these declines were not principal factors in the crisis.	Increased public investments in and foreign aid to agriculture, especially agricultural R&D in Africa, are needed. Increased investments for agricultural development, such as transport infrastructure in Africa, are needed.
Speculation, hoarding, and export bans	Fears of a wheat export embargo were widely cited as a cause of rising wheat and soybean prices. Several countries imposed export restrictions, and Western countries were reputed to have implicitly restricted fertilizer exports.	Financial market speculation is a new risk, but there is not much evidence yet that it made matters worse. Likewise, there has been some discussion of interest rates and the housing market bubble driving loose money into commodities.	It is difficult to say because of lack of conclusive evidence that speculation is an important factor, but commodity markets certainly warrant closer monitoring.

Source: Headey and Raszap Skorbiansky (2008).
Notes: OPEC, Organization of the Petroleum Exporting Countries; R&D, research and development.

Other factors are also common across both crises—long-run supply constraints, growing demand stemming from sustained economic growth, weather shocks, export bans, and hoarding—but these residual factors played relatively minor roles, although such factors either triggered additional problems (for instance, the U.S.-Soviet grain deal) or exacerbated each crisis once the wheels were set in motion. These similarities between the two crises suggest that there is scope for contemporary policymakers to learn from the successes and failures of the 1972–74 crisis.

CHAPTER 5

Lessons for the Future: Does the Global Food System Need Fixing?

Although adverse by definition, food crises do present opportunities for positive change. Not only does a higher price regime provide incentives for farmers to scale up production, but it can also render the weaknesses of existing policies transparent to a broader policymaking audience. Indeed, the 1972–74 food crisis produced and bolstered a number of new institutions to fill the perceived failures of the global food system: for food aid (WFP), financing (International Fund for Agricultural Development), research (IFPRI and the Consultative Group on International Agricultural Research), and early warning systems (GIEWS). But at the same time international policymakers failed to address many of the most fundamental deficiencies of the global food system, a fact that was acknowledged at the time. In 1981, for example, Valdes and Siamwalla came to the following conclusion:

> International prices of cereals have fallen in real terms, grain stocks have been rebuilt, and the crisis atmosphere has abated. World food security has ceased to be a major concern for the press and for the general public. Yet, the underlying causes of food crises such as the one in 1972–74 have not disappeared . . . on the international scene only limited progress has been made to help them in these efforts. (1981, 1)

The deficiency of previous efforts to improve global food security is borne out not only by the recurrence of a global food crisis, but also by the persistence of year-to-year food insecurity in a range of developing countries, persistently high rates of rural poverty, and stagnating agricultural productivity growth. These are all complex problems requiring different sorts of solutions. Some problems are international in nature (for example, trade barriers, aid modalities, and the reserve systems of major exporters), whereas others are more national in nature (for example, agricultural policies, social protection, infrastructure investment, and political stability).[1] However, rather than trying to comprehensively review the policy responses of developed and developing countries, or even of the UN-coordinated response to the crisis,[2] this concluding chapter focuses specifically on the lessons derived from our own analyses of the 2008 food crisis and our reflections on the 1972–74 food crisis.

As for what constitutes food security, the basic notion used in most of the literature is that food-deficit countries, regions, or households should be able to meet target consumption levels on a year-to-year basis (Valdes and Siamwalla 1981). "Target levels" generally refer to normal consumption levels, although a more stringent definition would refer to adequate levels in a nutritional sense. A second, more instrumental, aspect of this definition is that attaining food security involves several different dimensions:

1. Producing enough food at the global level, at a minimum
2. Ensuring country-level access to food imports at affordable and relatively stable international prices
3. Ensuring household-level access to food purchases at affordable and relatively stable domestic prices

Several points are of note regarding these characteristics. First, some definitions of food security restrict themselves to affordability. However, predictability is also important. The nature of a food crisis, after all, is not so much absolute prices changes but the speed of price changes and the degree to which they take consumers, producers, and governments by surprise. Second, the degree to which these various aspects of food security pertain to national and international food systems is somewhat fuzzy. Clearly global production (1) and international trade (2) are largely dimensions of the international food system, although access to imports also depends on domestic factors (such as sufficient export earnings to meet import requirements), whereas dependence on food imports is largely the result of low levels of domestic food production. Likewise, access to food within countries (3) is more a national-level dimension of food security, except insofar as foreign assistance influences these outcomes through food aid, agricultural aid, infrastructure aid, the influence of technical assistance and conditional loans on food and input subsidies, and so on.

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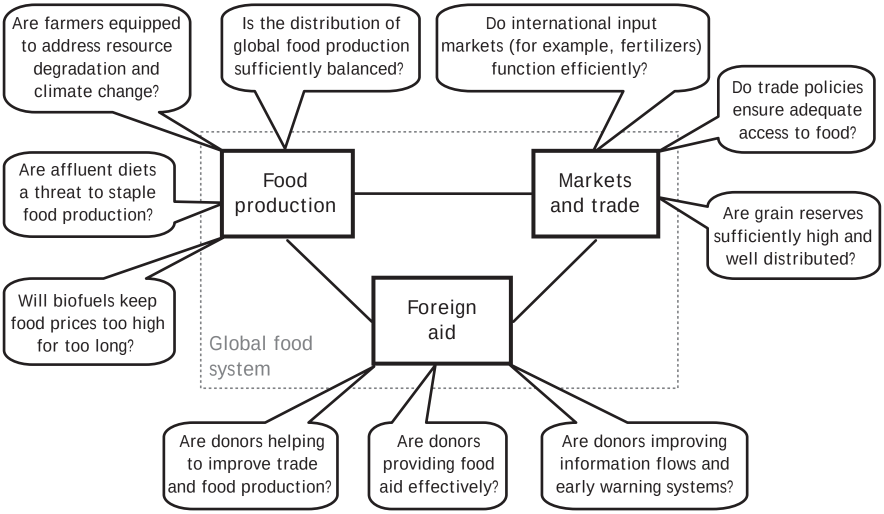
[1] In this section we largely restrict our analysis to the markets, policies, and regulations that constitute the global food system. However, the interdependencies between international and national food systems require the discussion to be quite flexible in this regard.

[2] These responses are ably summarized by Abbott and de Battisti (2009), among others.

Figure 5.1 Does the global food system need fixing?



Source: Constructed by the authors.

Figure 5.1 breaks down the global food system into three components: food production, food markets and trade, and the foreign aid system as it relates to food policies. It is important to point out that these three components are intimately interlinked. At a global level food production and trade are primarily private-sector activities, but they are heavily influenced by national and international policies. Foreign aid is just one component of the broader policy environment, but it merits being treated as a separate component of the global food system, because food aid is a large component of food imports in many developing countries and donor efforts to improve food production in developing countries constitute an international flow of resources rather than a purely national policy.

Near each component of the global food system, Figure 5.1 lists the most significant questions facing the global food system. Figure 5.1 illustrates a long-term perspective rather than the narrower view of those problems that directly relate to the world food crisis. That said, both the 2008 and 1972–74 food crises have revealed weaknesses in the global food system, so the remaining discussion focuses more narrowly on these issues.

Predicting the Next Crisis

Whether either food crisis could easily have been predicted is debatable, given that it took most observers by surprise, even most experts (although there were concerns about declining stocks among some agricultural experts).[3] Nevertheless, the fact that the 1972–74 crisis prompted policy interest in predicting and preventing future crises suggests that the failure to give early warning signals for the current crisis is rooted in methodological or institutional failings, or both. Essentially our conclusion is that food security organizations and agricultural researchers were caught between two extremes: tracking recent price developments on the one hand and predicting long-term swings on the other.

GIEWS, for example, was set up in response to the lack of any forewarning to the 1972–74 crisis, so it might have been expected to have offered some early warning of the current crisis. However, Headey and Raszap Skorbiansky (2008) review GIEWS's *Food Outlook*—a quarterly publication that deals with global food security issues—during 2005–07, yet find no evidence that GIEWS gave any early warning of an impending food crisis. This is partly because GIEWS has a strong mandate to focus on year-to-year food crises in individual countries and partly because publications like *Food Outlook* are not monitoring all necessary variables, such as oil prices, cereal futures prices, and U.S. dollar movements (the good news on this front is that such organizations as GIEWS, WFP, and FEWSNET have scaled up their efforts to collect and disseminate data on food prices). Interestingly, FAO (2008, 21) seems aware of this deficiency, and GIEWS has beefed up its monitoring of domestic food prices in the wake of the crisis. The other extreme is represented by sophisticated modeling exercises carried out by other sections of the FAO, IFPRI, and various other research institutions (see the review by McCalla and Revoredo 2001). What is needed is an intermediate approach that combines some of the rigor of a formal model with shorter term predictors of international prices, such as oil prices, exchange rates, futures market indexes, harvest information, and demand shocks (imports or biofuels).

Improving the Functioning of Markets and Trade

The international price increases can partly be explained by factors outside the food system (such as oil prices and U.S. dollar movements), but it is also likely that several key features of the global food system made the impacts of these exogenous factors all the more severe. First, the world currently relies on the grain reserves of just a few exporting countries to stabilize prices and ensure stable food supply. However, this arrangement has been informal since the failure of negotiations on food reserves after the 1972–74

[3] Von Braun et al. (2005) raised concerns about rising food prices because of supply constraints, and other experts voiced concerns about declining stocks, but for the most part nobody expected the sharp surge in prices that ensued.

crisis, and it has largely broken down due to rising prices and new just-in-time inventory methods. Nevertheless it is not clear that pushing for more formal reserve arrangements among major producers is the right way to proceed. Reserves are costly—especially in mostly humid developing countries—and generally incompatible with the incentives of private agricultural producers in developed countries.

Another option might be to use virtual reserves to smooth out futures prices (Robles, Torero, and von Braun 2009; von Braun and Torero 2009). Although innovative, more research is needed to prove causal linkages between futures prices and spot prices. Other policies might also help to ensure short-run access to international food imports. These include the World Bank's US$1.2 billion rapid financing facility, the Global Food Response Program, or a proposed international grain reserve managed by the WFP (von Braun and Torero 2009).[4] In the wake of the 1972–74 crisis, a wave of research tried to assess all of these ideas, but so far such research has not been triggered by the recent crisis.

An alternative instrument for reducing price volatility in international markets is to promote freer trade in agricultural commodities. This idea is consistent with our assessment: export restrictions played a dominant role in turning a critical situation into a full-blown crisis, especially in the case of rice. Moreover, analyses conducted after the 1972–74 crisis also demonstrated that free-trade regimes were a potentially viable alternative to large international grain reserves (see Walker and Sharples 1976; Johnson 1981; Reutlinger and Bigman 1981),[5] although more recent research has not yet revisited this question. Another practical issue is how to obtain a more liberal but also more secure international trade regime for agriculture. In the current crisis international markets failed because WTO statutes did not prevent countries from imposing export restrictions that induced so much unnecessary volatility. It has also been recognized that reforms proposed in the July 2008 Framework Agreement did not include provisions to discipline export taxes or bans, nor would special safeguard mechanisms in the agreement have approximated a free-trade arrangement (Abbott 2009). New arrangements need to take into

[4] The international grain-reserve proposal in question involves a modest emergency reserve of about 300,000–500,000 tons of basic grains—about 5 percent of the current food aid of 6.7 million wheat-equivalent tons—that would be supplied by the main grain-producing countries and funded by a group of countries participating in the scheme (the G8+5 plus some other major grain-exporting countries). This decentralized reserve would be located at strategic points near or in major developing-country regions, using existing national storage facilities. A range of measures would ensure financial sustainability of the reserve. See von Braun and Torero (2009) for details.

[5] Much of the debate on trade liberalization has focused on its growth and poverty impacts, although the size of these costs is disputed (see the comprehensive review by Bouët 2008). Here we point out that trade liberalization also has an impact on food security.

account the clear preference of developing countries for domestic market stabilization. Another potentially important implication of our research on both the 1972–74 and 2008 crises is that it is the actions of major grain traders (exporters and importers) that has the greatest impact on international markets. As a result, binding agreements between a smaller set of large producers and importers may be sufficient to stabilize international markets.

Addressing Long-Term Threats to Global Food Production

The global system largely satisfies the objective of producing sufficient food to feed the world's population. Moreover, as noted above, the short-term supply response to the most recent crisis was surprisingly strong. But despite these encouraging signs that the production side of the global food system did address the food crisis adequately, several prevailing trends threaten the long-term security of global food production. The challenge most relevant to the food crisis is clearly the diversion of crops from food or feed to biofuels. As noted in Chapter 2, a growing number of studies are finding that biofuels production has a large positive impact on food prices, but virtually no negative impact on energy prices. In the foreseeable future, biofuels production does not look good for global food security, unless ways can be found to minimize the diversion from food production or involve poor farmers in biofuels production. But technologies and investments that would achieve these outcomes seem a long way off.

A second major challenge to longer term food production is climate change and resource degradation. We found that there is no real evidence that environmental factors were a major cause of the crisis—the only potential link is Australia's unusually severe drought—but some studies find that climate change and resource degradation could severely impact food production in much of the developing world (Lobell et al. 2008; Slater et al. 2008).

We also found no link between the food crisis and the "affluent diets" hypothesis. Moreover, in the past increasingly affluent diets seem to be associated with a decline in real prices (after all, U.S. cereal prices have declined with only a few interruptions since the 19th century). Nevertheless, policymakers and researchers should not ignore the potential impacts—positive or negative—that increasingly affluent diets and climate change may have on food security in the future.

Improving Social Protection

In response to rising international prices governments and aid agencies have used a wide range of tools to directly or indirectly protect consumers from rising food prices (World Bank 2008a; Demeke, Pangrazio, and Maetz 2009). These include:

- Restricting exports
- Liberalizing imports
- Removing sales taxes
- Releasing stocks
- Inducing supply response by scaling up fertilizer subsidies and other quick impact agricultural programs
- Scaling up existing safety net programs

Only the last of these items is conventionally thought of as social protection, although in the absence of existing social protection programs and the high costs and long delay in setting up new ones, it is understandable that developing country governments resort to the more indirect means of protecting consumers. However, some of these alternative means of protecting consumers are less desirable than others. Export restrictions were a major cause of the rice price crisis, and a fairly significant cause of the rise in wheat prices.

In light of this problem some authors have proposed that social safety net programs should be scaled up. The rationale here may be threefold. First, if social protection programs are in place, then governments need not resort to costly export restrictions. This argument is feasible, but the first country to impose significant export restrictions on rice was India, and India has many large social safety net programs, such as the National Rural Employment Guarantee Scheme, the Food for Work Scheme, and the Public Distribution Scheme for food grains. None of these schemes stopped the Indian government from imposing an export ban, and the Public Distribution Scheme perhaps contributed to sluggish growth in the production of wheat and rice in India.

A second rationale for such programs is that they contribute to productive capacity by building up human capital and assets. Productive safety nets therefore seem to hit two targets with one instrument (Alderman and Hoddinott 2006). Over the long run there is good evidence that productive safety nets could indeed achieve some growth in productivity, but the productivity impacts are likely to be small relative to strictly agricultural investments. And as a means of responding to the current crisis they are largely irrelevant. Instead their main benefit is in making poor people less vulnerable to future crises.

Finally, social safety nets are argued to be more poverty efficient than the indirect alternatives suggested above. Wodon et al. (2008) note that the targeting efficiency of social protection policies in Sub-Saharan Africa is much better than that of other economywide policies (such as tax cuts, tariff reductions, and subsidies). Bhaskar, Ahmed, and Shariff (2009) also review social protection programs in response to the food crisis and compare programs in four Asian countries.

Addressing the Regional Imbalance in Food Production

In contrast to those who list declining agricultural productivity of major cereals as a significant threat to global food production, we argue that it is the longer term regional imbalance in cereal production that is the most significant problem facing global food security. Essentially, large parts of the developing world, especially Sub-Saharan Africa and the Middle East, are heavily dependent on cereal imports from the rest of the world, especially Argentina, Australia, Brazil, Europe, North America, and a few Asian rice exporters. This imbalance emerged before the 1972–74 crisis, but Africa's rapid population growth combined with its weak growth in food production have made the imbalance starker. Of course, insufficient production growth may not be a problem if net cereal importers have adequate access to foreign exchange, but with the exception of mineral exporters, net cereal importers often rely heavily on foreign aid for bolstering their exchange reserves or directly accessing food aid. And although this problem existed before and after the two world food crises, both events were exacerbated by this excessive reliance on cereal imports.

Yet addressing this issue is arguably more important than ever, especially in the face of longer term threats to food production (such as climate change and resource degradation) and changes in international trade in cereals (for example, the growth in biofuels). However, it is also clear that the solutions to this imbalance need to be country specific and that not every country in the world need be, or could be, totally self-sufficient in food production. Thus the question is essentially how to properly balance domestic food production and reliance on imports. In many food-deficit countries the binding constraint is that food production is currently vastly lower than its potential because of a history of distortionary policies and inadequate or inappropriate investments in agricultural R&D, extension, and rural infrastructure (Bezemer and Headey 2008). In some of these countries, agriculture has traditionally been underemphasized in national development strategies because of ambitious industrialization goals or easy access to mineral earnings.

However, even in countries with considerable nonfarm growth potential (such as Cameroon, Democratic Republic of Congo, Ghana, and Nigeria), the equally impressive potential of agriculture means that such countries can play a vital role in improving food security both domestically and regionally. In contrast, many landlocked African countries lack nonagricultural prospects but also suffer from severe and worsening agroclimatic constraints (particularly the Sahelian countries). Thus, unfortunately, they will never be regional breadbaskets. So although raising food production might still be important in these more agriculturally challenged and food-insecure countries, supporting agricultural production growth in areas of real biophysical potential is probably the more critical step. Indeed, Asia's own Green Revolution was not pervasive but generally restricted to the region's traditional breadbaskets, such as the Punjab in India and Pakistan.

What Can Donors and Major Grain Producers Do to Improve Global Food Security?

Bilateral donors and the international institutions they support play a critical role in several aspects of the world food system, including public investments in developing countries; funding of agricultural R&D; and provision of early warning systems, food aid, and humanitarian assistance. Many Western countries and other emerging donors (such as Brazil and China) are also major grain producers. Together these countries have enormous potential to improve the global food system through international resource flows, including knowledge dissemination. Given the evidence cited in this monograph on the causes and consequences of the crisis, what major actions should these countries take to improve the global food system?

Perhaps the least controversial goal should be to refocus foreign aid on agriculture. This shift back to agriculture was already taking place before the recent crisis, as donors became increasingly cognizant of the neglect of agriculture in developing countries and in aid institutions themselves (Bezemer and Headey 2008; World Bank 2008b). Although many donors were already in the process of ramping up agricultural aid, the food crisis undoubtedly reemphasized the critical and multidimensional role that food production and food prices play in human development, especially in organizations that were debating a withdrawal from agricultural investments (for example, the Asian Development Bank). So the good news is that there is now a wider consensus on the importance of agriculture, backed up by an impressive list of donor commitments to agricultural development (see von Braun 2008b; Abbott and Borot de Battisti 2009; Demeke, Pangrazio, and Maetz 2009). The potentially bad news is that with the financial crisis looming as the next big threat to both donor countries and their recipients, there is a very real concern that the more than US$12 billion in aid commitments to food security and agriculture that were made in 2008 will not be kept.

Moreover, donors cannot solve the global imbalance by throwing money at the problem. Aid effectiveness is undoubtedly conditional on the proactive policy efforts of aid recipients. But developing countries vary substantially in how much they emphasize agricultural development and how well they can implement agricultural projects. Even where the political will is strong, weak technical capacity is a real issue because of a history of underinvestment and the hasty adoption of structural adjustment programs in the 1980s and 1990s that often left an institutional vacuum in the agricultural sector.

Figuring out how to rapidly scale up public investment—or crowd in private investment—in this institutional vacuum is going to be a key policy challenge in the years to come. It is perhaps understandable that many developing countries have opted for the quick fix of subsidizing fertilizers, but there are understandable doubts about how financially sustainable these programs are (Poulton, Kydd, and Dorward 2006; Dorward et al. 2009) and what the implicit costs are of neglecting other R&D and infrastructure. Indeed, those with a longer perspective recall that the 1972–74 crisis produced some extremely costly subsidy programs that are politically difficult to dismantle. Scaling up agricultural development projects in an efficient and sustainable way is the critical policy challenge in the years to come.

Concluding Remarks

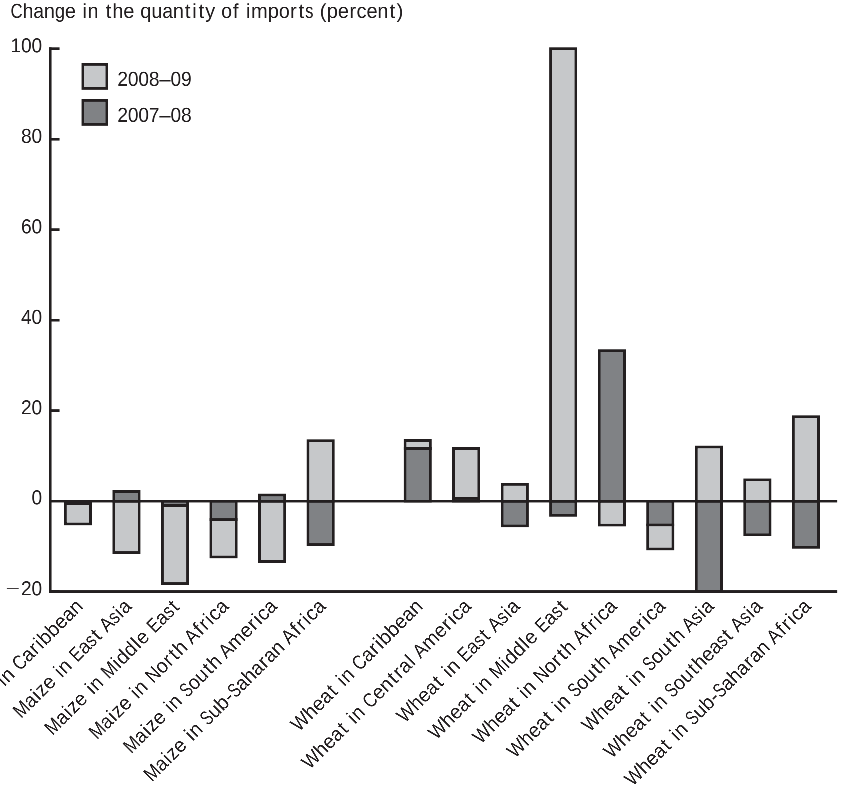
With the benefit of hindsight, the causes of the current food crisis are increasingly clear, even if there are still some doubts about the precise magnitude of each factor and certain misperceptions still persist in the public arena. It is also clear that many poor countries have been hard hit by the sharp rise in food prices over recent years. Taking action to limit the vulnerability of poor populations to increasing food prices is essential in the short run, but it is also vital in the longer run. After all, millions of poor people face their own food crises on year-to-year, season-to-season, and day-to-day bases. Their problems are enduring and indicative of deeper deficiencies in both national and international food systems that are hardly new. Reflecting on these issues in the wake of the 1972–74 crisis, Gale Johnson wrote:

> The primary reason we have failed to achieve the degree of international food security that is now possible is not nature but man. And the aspect of man that is responsible for our failure is not man as a farmer or scientist or extension worker or grain marketer or food retailer but man as a politician. (1981, 257)

These remarks are just as pertinent today as they were three decades ago. Given the right incentives and the right opportunities, farmers, traders, scientists, and others can engage in activities that improve both their own welfare and also lift millions of others permanently out of poverty and hunger. Yet the catalyst for these activities will be farsighted and deeply committed policy actions that address the most fundamental problems facing both international and national food systems.

Additional Data

Figure A.1 Response of import quantity to rising international food prices



Source: Calculations by the authors using data from USDA (2008c).

Table A.1 Energy and oil intensity by sector for selected countries, 2005

Less-developed countries				More-developed countries			
Country/sector	Energy intensity[a]	Oil intensity	Oil share (percent)	Country/sector	Energy intensity	Oil intensity	Oil share (percent)
Argentina				Australia			
GDP	0.28	0.11	40	GDP	3.98	0.30	8
Industry	0.23	0.02	7	Industry	2.73	0.19	7
Transport	0.95	0.71	75	Transport	3.31	1.96	59
Agriculture	0.22	0.21	97	Agriculture	1.31	0.13	10
All other	0.16	0.01	9	All other	5.36	0.06	1
Brazil				Canada			
GDP	0.24	0.11	46	GDP	0.19	0.09	46
Industry	0.30	0.05	16	Industry	0.20	0.02	12
Transport	1.51	1.27	84	Transport	0.76	0.69	91
Agriculture	0.14	0.08	58	Agriculture	0.16	0.10	64
All other	0.07	0.02	22	All other	0.09	0.02	18
China				France			
GDP	0.50	0.12	25	GDP	0.09	0.05	50
Industry	0.51	0.04	8	Industry	0.12	0.02	19
Transport	0.94	0.90	95	Transport	0.42	0.41	97
Agriculture	0.15	0.08	52	Agriculture	0.08	0.07	81
All other	0.44	0.05	10	All other	0.05	0.01	21

(*continued*)

Table A.1 Continued

Less-developed countries				More-developed countries			
Country/sector	Energy intensity[a]	Oil intensity	Oil share (percent)	Country/sector	Energy intensity	Oil intensity	Oil share (percent)
Ghana				Germany			
GDP	0.79	0.23	29	GDP	0.10	0.04	43
Industry	0.72	0.18	24	Industry	0.09	0.01	7
Transport	2.77	2.77	100	Transport	0.43	0.41	95
Agriculture	0.06	0.06	100	Agriculture	0.10	0.07	63
All other	1.25	0.04	4	All other	0.07	0.01	21
India				Russia			
GDP	0.48	0.14	30	GDP	0.63	0.14	23
Industry	0.65	0.12	19	Industry	0.58	0.05	8
Transport	0.57	0.55	96	Transport	1.41	0.80	57
Agriculture	0.11	0.04	42	Agriculture	0.29	0.13	46
All other	0.45	0.06	12	All other	0.45	0.05	10
Kenya				United Kingdom			
GDP	0.65	0.14	22	GDP	0.08	0.04	48
Industry	0.27	0.13	49	Industry	0.09	0.02	21
Transport	0.80	0.80	100	Transport	0.38	0.37	99
Agriculture	0.02	0.02	96	Agriculture	0.05	0.02	37
All other	1.07	0.04	4	All other	0.04	0.00	7
Thailand				United States			
GDP	0.38	0.21	55	GDP	0.13	0.07	54
Industry	0.31	0.06	18	Industry	0.14	0.02	12
Transport	1.70	1.69	100	Transport	0.87	0.84	96
Agriculture	0.18	0.18	99	Agriculture	0.14	0.13	96
All other	0.18	0.03	15	All other	0.05	0.00	9

Sources: Calculations by the authors using IEA energy balance sheets (IEA 2008) and UN national accounts data (United Nations 2008).
Note: GDP, gross domestic product.
[a]Energy intensity is defined as energy/oil use per million U.S. dollars of output (thousand metric tons of oil equivalent).

Table A.2 U.S. maize, soybean, and wheat production profits per planted acre, excluding government payments, 2004–09 (U.S. dollars)

Crop	2004	2005	2006	2007	2008	2009
Value of production less all costs						
Maize	n.a.	–126.5	–57.9	25.0	100.0	14.6
Soybeans	n.a.	n.a.	–23.3	58.3	110.3	79.1
Wheat	–48.1	–74.8	–72.8	–27.9	56.4	–62.6
Value of production less operating costs						
Maize	n.a.	74.1	145.9	240.0	333.7	264.2
Soybeans	n.a.	n.a.	161.4	252.1	318.7	308.3
Wheat	71.7	53.2	59.0	111.1	208.1	n.a.

Source: Data are from USDA (2008d).
Notes: Values for the two most recent months are revised or preliminary. Values are U.S. averages; n.a., data not available.

Table A.3 Price changes in leading staples by country, 2008

			Change in prices (percent)		
Country	Commodity	Market	Average increase M-07 to M-08[a]	January–June 2008	July–December 2008
Exporting countries					
United States	Maize	Export	35.4	24.5	–36.9
Thailand	Rice	Export	111.1	80.3	–27.3
United States	Sorghum	Export	20.1	4.5	–34.5
United States	Wheat	Export	32.9	–21.9	–25.2
Central America					
Costa Rica[b]	Rice (second quality)	Retail	26.6	–10.2	43.0
Dominican Republic	Rice	Wholesale	7.7	10.8	16.0
El Salvador[b]	Maize	Retail	4.7	13.6	–12.0
Guatemala	Maize (white)	Wholesale	–4.4	14.6	3.4
Haiti	Rice (imported)	Retail	27.4	–5.6	–30.9
Honduras	Maize (white)	Wholesale	–6.6	39.0	4.6
Mexico	Maize (white)	Wholesale	3.5	13.1	–4.0
Nicaragua	Rice	Retail	37.8	23.3	3.3
Panama	Rice	Retail	7.2	20.6	0.0
South America					
Argentina	Maize (yellow)	Wholesale	6.0	–1.2	–14.4
Bolivia	Wheat	Wholesale	40.5	33.1	–7.1
Brazil	Rice (first quality)	Wholesale	37.7	34.2	–15.4
Chile	Rice	Retail	46.3	67.6	n.a.
Colombia	Rice	Wholesale	39.2	52.0	12.1
Peru	Rice	Retail	7.6	–4.3	–5.8
Uruguay	Wheat (flour)	Wholesale	33.2	30.9	–16.2

(*continued*)

Table A.3 Continued

Country	Commodity	Market	Change in prices (percent)		
			Average increase M-07 to M-08[a]	January–June 2008	July–December 2008
East Asia					
China	Rice (*Indica*)	Wholesale	6.3	8.1	0.3
Philippines	Regular milled rice	Wholesale	20.5	38.6	–9.4
Thailand	Rice	Wholesale	75.3	44.5	–6.8
Vietnam	Rice	Retail	25.7	44.0	–17.2
South Asia					
Afghanistan	Wheat	Retail	71.4	24.2	n.a.
Bangladesh	Rice (coarse)	Wholesale	31.1	2.4	–24.1
India	Rice	Wholesale	15.7	2.2	4.6
Pakistan	Wheat	Retail	36.4	–0.3	4.1
Sri Lanka	Rice	Retail	39.2	–8.8	n.a.
Eastern Africa					
Djibouti	Rice (*belem*)	Retail	63.7	9.5	n.a.
Egypt	Rice	Retail	25.9	11.8	n.a.
Ethiopia	Maize	Wholesale	114.7	119.2	–45.0
Kenya[b]	Maize	Wholesale	60.1	41.7	0.6
Uganda[b]	Maize	Wholesale	108.6	27.6	–1.2
Sudan	Millet	Wholesale	59.7	68.5	n.a.
Southern Africa					
Burundi	Maize	Retail	21.8	154.8	–28.0
Democratic Republic of Congo[b,c]	Cassava	Retail	56.7	59.3	n.a.
Madagascar	Rice (local)	Retail	–8.1	–6.2	–0.6
Malawi	Maize	Retail	116.3	52.9	3.3
Mozambique	Maize (white)	Retail	42.3	5.7	10.4
Namibia	Millet	Retail	10.9	31.2	1.7
Rwanda[b]	Beans	Wholesale	18.1	–9.1	–31.9
South Africa	Maize (white)	Wholesale	–4.8	5.5	–3.1
Tanzania[b]	Maize	Wholesale	73.1	–26.9	32.6
Zambia	Maize (white)	Retail	25.6	–9.9	40.7
West Africa					
Burkina Faso	Millet (local)	Wholesale	14.2	25.9	–12.8
Cameroon	Maize	Retail	8.4	5.5	23.6
Ghana	Maize (white)	Retail	39.1	84.6	0.0
Mali	Millet (local)	Wholesale	8.4	14.3	–17.4
Mauritania	Wheat (flour)	Retail	12.8	–0.4	–4.6
Niger	Sorghum	Wholesale	26.4	16.0	3.3
Nigeria	Millet	Wholesale	113.9	11.0	–21.3[d]
Senegal	Millet	Retail	7.0	8.3	–5.1
Senegal	Rice (imported)	Retail	51.5	58.9	–3.3
Togo	Maize	Retail	38.9	62.3	–14.6

Source: Calculations by the authors using data from GIEWS (2009).
Notes: n.a., data not available.
[a]Average percentage difference between the change in price from a given month in 2007 to the corresponding month in 2008. In this way seasonal fluctuations can be accounted for.
[b]Data for these countries are available in U.S. dollars only. They should be regarded with caution, as they may not be appropriately deflated.
[c]Data for these countries are sparse and should be regarded with caution.
[d]This figure applies from June to October rather than from June to December.

Table A.4 Comparing urban poverty impacts across three microsimulation studies

	Change in poverty headcount (percentage points)			
Country	**IM: Total poverty**	**DHH: Urban poverty**	**WEA: Total poverty**	**Suggested explanation of discrepancy**
Nigeria	—	6.1	0.56	WEA results may be too low because urban poverty is high in Nigeria and foods covered in their report represent just 11.5 percent of consumption.
Cambodia	1	5.8	—	DHH results are probably too high, given that IM employ more sophisticated methodology and most Cambodians are rural.
Senegal	—	0.4	4	DHH results may be too low, given Senegal's dependence on imports.
Ghana	—	3.1	0.6	DHH results may be too high, given low urban poverty and the diversified Ghanaian diet. WEA results are also similar to Cudjoe, Breisinger, and Diao (2008).
Guinea	—	1.3	2.5	
Pakistan	2.56	1.8	—	
Nicaragua	4.3	3.7	—	
Madagascar	3.6	4	—	
Malawi	—	1	0.6	
Gabon	—	1.1	1.4	
Bolivia	1	1.2	—	
Zambia	1	1.2	—	
Vietnam	0.2	0.1	—	
Mali	—	2.3	2.3	

Sources: Constructed by the authors from Dessus, Herrera, and Hoyos (2008), Ivanic and Martin (2008), and Wodon et al. (2008).

Notes: The table reports specific results from the three studies that maximize the basis for comparison: poverty is measured as changes in US$1 per day poverty headcount levels; price shocks are 20 percent; and only urban poverty results are reported, because the DHH results are the only ones common to other studies. In the case of WEA results, data have been adjusted in a linear fashion from their 25 percent price increase (that is, their results have been multiplied by 20 and then divided by 25). Variations in results reflect differences in surveys and simulation methods. —, the study did not include the country in question; DHH, Dessus, Herrera, and Hoyos (2008); IM, Ivanic and Martin (2008); WEA, Wodon et al. (2008).

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The dramatic surge in food prices from 2005 to 2008 seriously threatened the world's poor, who struggle to buy food even under normal circumstances, and led to protests and riots in the developing world. The crisis eventually receded, but such surges could recur unless steps are taken to prevent them. Using up-to-date information, the authors of ***Reflections on the Global Food Crisis*** identify the key causes of the food price surge, its consequences for global poverty, and the challenges involved in preventing another crisis.

Breaking from many earlier interpretations, the authors conclude that the crisis was not primarily fostered by increased demand for meat products in rising economies such as China and India, or by declines in agricultural yields or food stocks, or by futures market speculation. Instead, they attribute the rising food prices to a combination of rising energy prices; growing demand for biofuels; the U.S. dollar depreciation; and various trade shocks related to export restrictions, panic purchases, and unfavorable weather. As part of their analysis, the authors also provide the first comprehensive review of both the macroeconomic and microeconomic consequences of the crisis, as well as a detailed comparison of the current crisis with the food price crisis of 1974.

To prevent another crisis, the authors conclude that the global food system should be reformed through several key steps: make trade in agricultural commodities more free yet more secure; address long-term threats to agricultural productivity, such as climate change and resource degradation; scale up social protection in potentially food-insecure countries; and encourage agricultural production in at least some of the countries now heavily dependent on food imports. ***Reflections on the Global Food Crisis*** will be a valuable resource for policymakers, development specialists, and others concerned with the world's poorest people.

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