The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Death Rates and Food Prices

Posted by Stuart Staniford on January 14, 2008 - 11:32am
Topic: Alternative energy
Tags: peak oil [list all tags]

Ratio of crude food/feed producer price index to all US consumer prices, Jan 1969-Dec 2007. Source: St Louis Fed.

This post is a follow-on from my post last week Fermenting the Food Supply. I've been investigating biofuel and food issues further, in an effort to clarify the issues raised there. I'll begin by briefly summarizing the argument of last week's piece:

- The total biofuel equivalent of the entire world food supply is a small fraction of the world liquid fuel supply,
- Biofuel production is taking a rapidly expanding share of the (potential) food supply. The share in the US is higher than globally, but in both cases production is growing at around 25%/year.
- In the US, biofuel production has become highly profitable at times in the last few years, and would have been profitable even without subsidies part of the time; the profits are what have fueled the growth.
- If biofuel growth continues at the present rate for even a few more years, it will sharply affect the food supply (it already has had material effects).

- Demand for fuel in developed countries appears to be much less elastic than demand for food in poor counties, raising the specter of a significant fraction of the world's population being unable to afford a minimal diet in the face of competition from the world's drivers.

Nate emails to point out that corn prices went up about 10% last week. So I guess it was good trading advice this time, at least.

However, I found my conclusions of last week very depressing and so I have been doing my best to falsify them. I have found at least some good news ("good" by the abysmal standards of last week's post, at any rate). The portion of that post that I was most uncertain of was the connection between food prices and the impact on the global poor. I made a very simple argument based on the global income distribution, and the elasticity of demand for both food (in poor countries) versus fuel (in rich countries).

However, there are several complicating factors here - many people in poor countries are subsistence farmers, and some poor economies are not really connected to the global commodity markets. So this raises the question - how do death rates in poor countries really respond to global commodity markets? One way to explore this is to look at the global food crisis of the early 1970s. This was a major crisis, triggered by high commodity prices, where there were fears of mass starvation. As Time Magazine put it in a 1974 article:

> Nearly half a billion people are suffering from some form of hunger; 10,000 of them die of starvation each week in Africa, Asia and Latin America. There are all too familiar severe shortages of food in the sub-Saharan Sahelian countries of Chad, Gambia, Mali, Mauritania, Senegal, Upper Volta and Niger; also in Ethiopia, northeastern Brazil, India and Bangladesh. India alone needs 8 to 10 million tons of food this year from outside sources, or else as many as 30 million people might starve.
>
> Only slightly less serious are the situations in Honduras, Burma, Burundi, Rwanda, the Sudan and Yemen. Additionally, poor harvests threaten food supplies in Nepal, Somalia, Tanzania, Zambia and even the Philippines and Mexico. In Haiti, because of disregard for soil conservation, hundreds of thousands of subsistence farmers face starvation. Whole families are often so hungry that they do not wait for mangoes to ripen; they boil the green fruit and eat it.
>
> Some of the broader dangers were cited recently by Norman Borlaug, winner of the 1970 Nobel Peace Prize for his development of wheat strains essential for the famed Green Revolution. "You cannot have political stability based on empty stomachs and poverty," he warned. "When I see food lines in developing countries, I know that those governments are under pressure and are in danger of falling." Shortages or high prices of food have already contributed to the toppling of governments in Ethiopia, Niger and Thailand.
>
> Food riots have become commonplace in vast sections of Bangladesh and India. "In the worst-affected areas, gruel kitchens have been opened that provide a watery mess of broken wheat, fragments of pumpkin and lentils," reports TIME New Delhi Correspondent James Shepherd. "Queues of several hundred emaciated people at each kitchen get what is often no more than a quarter-pound of the gruel, and sometimes that is shared among six people. In one village, a shame faced elder confessed that Hindus were violating the ban on eating cows and were consuming dead cattle and buffaloes. 'What else can we do?' he implored pathetically."

Even the beggars of Calcutta are better off than the estimated 15 million people now starving in West Bengal. "In the Kutch district of drought-stricken Gujarat," adds Shepherd, "peasants patiently wait for dogs and vultures to finish picking at the carcasses of dead cattle. The hungry gather up the bones and sell them to mills where they are made into bone dust, a kind of fertilizer."

In Bangladesh, there are barely rations to provide even gruel for the starving in Dacca's crowded refugee camps. Children are so emaciated—their flesh clinging to their brittle bones—that they almost look like deformed infants. Shortages of vitamin A, iron and iodine in India and Bangladesh are increasing the incidence—especially among the young —of goiter, blindness and cretinism.

The causes of the food crisis are discussed in [The Word Food Crisis, Periodic or Perpetual](http://www.theoildrum.com/node/3495), by Dale Hathaway of the International Food Policy Research Institute.

In general, the world did not do badly in keeping up with the increase in demand from 1950 to 1970. World food output increased 0.75 percent per capita per year, and in the developed countries about 1.5 percent. But, this was not enough. The FAO estimated that in 1974 at least 400 million persons were suffering from malnutrition, if not starvation.

But, though not good enough to prevent widespread malnutrition in some developing countries, world production growth kept pace with world consumption increases until 1970. The first trouble started with the corn blight in the United States in 1970, but the United States had huge stocks of grain to meet the deficit between production and consumption.

In 1972, the weather was adverse simultaneously in the Soviet Union, Asia, and Africa, and world grain production dropped nearly 40 million metric tons, compared to an increase of 85 million tons the previous year and an average increase of 28 million tons per year over the previous decade. As a result of this decline, and the Russian decision to purchase from U.S. markets-a decision abetted by our unsound export subsidies and lack of export monitoring, world stocks, which had largely been held by the United States, plummeted. By the beginning of 1973, grain stocks were down to 10 percent of annual consumption, and prices began to rise, sharply in the United States and wildly in some of the food-deficit developing countries.

In 1973, world production recovered, with over half the increase in the United States and the USSR; but still output did not exceed consumption, and stocks were not rebuilt. Then, in 1974, world output declined again, by over 50 million tons, with the decline largely in the United States and the USSR. By the time of the World Food Conference, grain prices were at record levels. The United States had de facto export controls, and there were no significant reserve stocks in the non-Communist world.

The developing countries, buffeted by high fuel prices, fertilizer shortages, and inadequate grain supplies, were frightened and rightfully so. Some, like India and Bangladesh, faced severe shortages, if not starvation. India and several other countries used precious foreign exchange to buy high-priced food grains, thereby setting back their development plans for years. Concessionary food aid, which had been ample when food was available and low-priced, was sharply reduced, and the largest source of such

aid -the United States-refused to commit itself to increasing its food aid in late 1974 when it appeared most needed.

Ok - enough words. How much did food prices go up, and how many people died as a result?

I had some trouble finding long-term price series for agricultural commodities (the USDA numbers online don't seem to go back before 1975). However, I did find at the St Louis Fed, the producer price index for crude food/feed quantities, which ought to give us some kind of reasonable cross section of agricultural commodities. I took the ratio of it to the CPI-U (consumer price index for all items consumed by urban consumers) to look at how food prices were changing relative to just general price inflation. That graph looks like this:

Ratio of crude food/feed producer price index to all US consumer prices, Jan 1969-Dec 2007. Source: St Louis Fed.

As you can see, in 1973 food commodity prices increased by over 60% in a very short time. The initial spike only lasted a month or two, before prices began coming down, remaining at 10-20% above the level of 1972 prices for nine years. (Clearly duration of the spike matters a lot, since the longer someone goes with inadequate food, the more perilous their condition is going to become). Since that time, food commodity prices have been generally getting cheaper, bottoming out in the early 2000s at only 50% of the 1972 levels. This presumably explains much of why the global population has been getting better fed, as well as why farmers have been suffering in recent decades.

In the last few years, this average has started to rise again, but has not risen anywhere near as much as cereal prices (at least, not yet).

For another viewpoint, I found this graph of long-term corn prices.

## Corn Price and Petroleum Price Index
Adjusted to 1994 C.P.I.
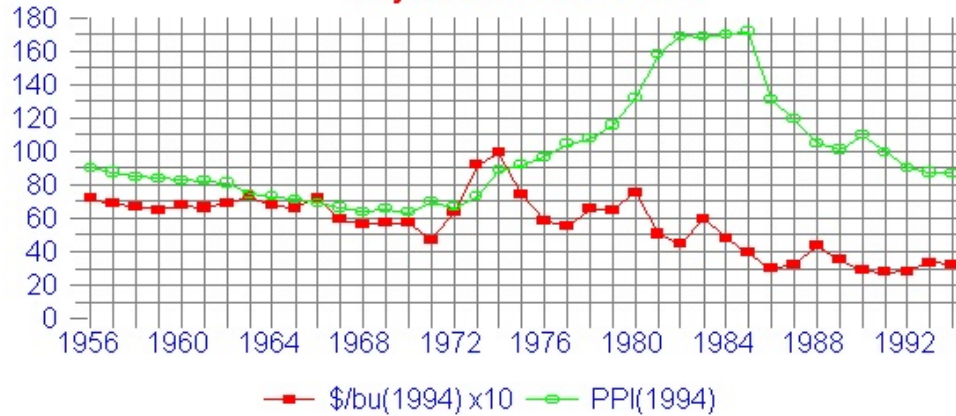
Annual price of corn in 1994 dollars, 1956-1994 (red). Source: Ontario Corn Producers Association.

This suggests a somewhat longer shock in corn prices than average food/feed prices - again about a 60% increase, but lasting through 1973 and 1974.

So, now that we understand the order of magnitude of the food price shock, what impact did this have on global death rates? I'm going to use UN population statistics to assess that. The UN divides countries into "More Developed", "Less Developed", and then "Least Developed". The "Least Developed" are a subset of the "Less Developed". This next graph shows the population in each category.
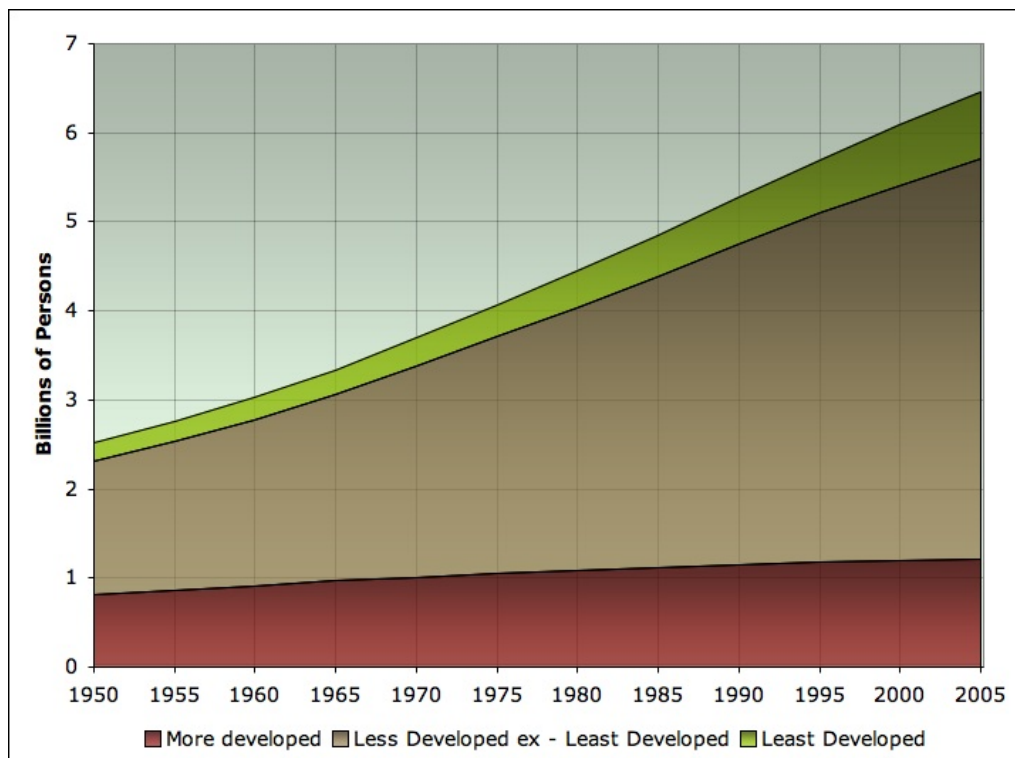
United Nations population split between more developed, less developed, and least developed regions 1950-2005. Source: United Nations: World Population Prospects, the 2004 Revision.

Next, I've plotted the death rates in the least developed countries, and all the less developed countries, as well as the infant mortality rates.
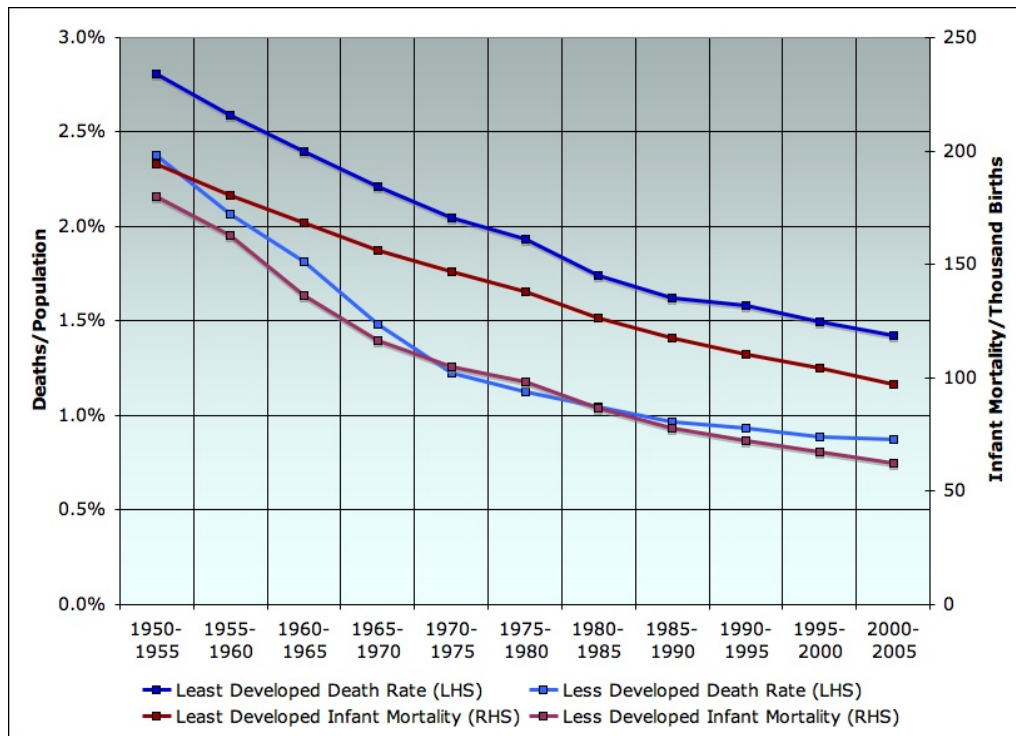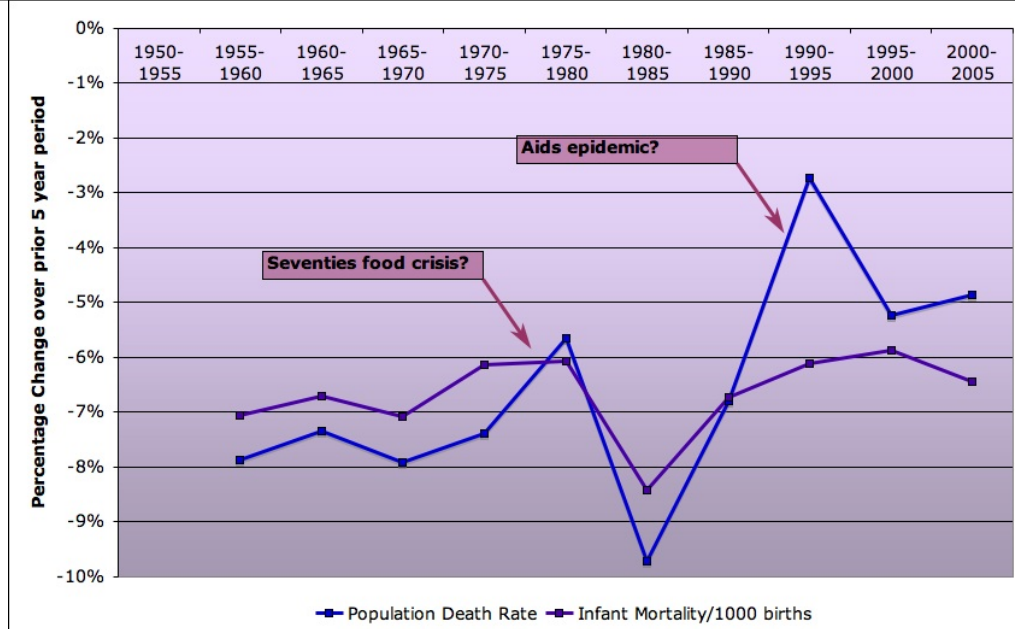
United Nations estimates of death rates per population (left scale), and infant mortality per thousand births (right scale) for less developed, and least developed regions 1950-2005. Less developed includes least developed. Source: United Nations: World Population Prospects, the 2004 Revision.

The big picture is that death rates have been dropping steadily for the last fifty years, and do not correlate closely with commodity food prices. They have dropped by half or more. The main effect is presumably the advent of western medicine gradually reaching the poorest countries (vaccination, antibiotics etc). Clearly, lack of food has not been the main control on the human population over this 55 year period.

However, a more careful inspection reveals a little bump in the seventies when the death rate stops dropping as quickly, as well as another in the 1990s. It's clearer if we look at the change from each five year period to the next in the death rate. Here is is for the least developed countries (it's roughly similar for the less developed, but the graph is too busy with all of them on):

Change in United Nations estimates of death rates and infant mortality rate for least developed regions over prior five year period 1950-2005. Source: United Nations: World Population Prospects, the 2004 Revision.

There are two obvious spikes where the death rate dropped more slowly. My assignments of the likely causes are shown - the one in the 1970s being presumably due to the food crisis, and the one in the 1990s being due to the AIDS crisis (note how the latter affects the infant mortality less than the overall death rate).

This gives us a basis to estimate the order of magnitude of the deaths due to the food crisis and price spikes. If we attribute about 2% of the death rate in forestalled changes, for about five years, and noting that the death rate for less developed is 1 1/4% of around 4 billion people at the time, then the excess deaths are of the order of 5 million people. (Just to stress, I only consider this to be an order of magnitude estimate - it could easily have been 2 million or 10 million, but there was not much chance it was only 500,000 or 50 million).

While I don't wish to trivialize the deaths of 5 million people - it's the same order of magnitude in deaths as the Holocaust - it's a lot less than the elasticity argument from last week suggested. Recall that the USDA estimates the price elasticity of food in poor countries as about -0.7. So a 60% increase in food prices might be expected to result in a 40% reduction in calorie intake, which with much of the developing world either at or under minimal calorific requirements, might have been expected to result in a lot more starvation than it did (hundreds of millions rather than single millions).

I've identified two effects that seem likely to be important. One is the briefness of the worst of the spike (only a few months in the PPI food/feed series). Assuming the series really captures a reasonable cross-section of food prices, this may explain much of the effect, since a few months is not too long to hold on with reduced rations. This is not an encouraging reason, since the causes of the 1970s crises (primarily weather and disease) were inherently transitory, while biofuel induced food price increases might be expected to be long-lasting.

However, the other cause is the fact that a lot of the world's poorest people are (or at least were) relatively divorced from the money economy, being subsistence farmers who grow all or most of their own food on smallholdings, and thus are relatively insulated from commodity price shocks in global markets. Let's explore the trends in that.

*Subsistence farmed landscape in Kenya. Source: Michican State University.*

We might expect that the urban poor, who must buy food somehow, are more likely affected. Folks living in houses like these, which surround and invade most third world cities, are not in a position to grow much food:

Shantytown in Capetown, South Africa. Source: Capetown.dj.

So, what fraction of the developing world is urban versus rural? Another UN population report has this data:
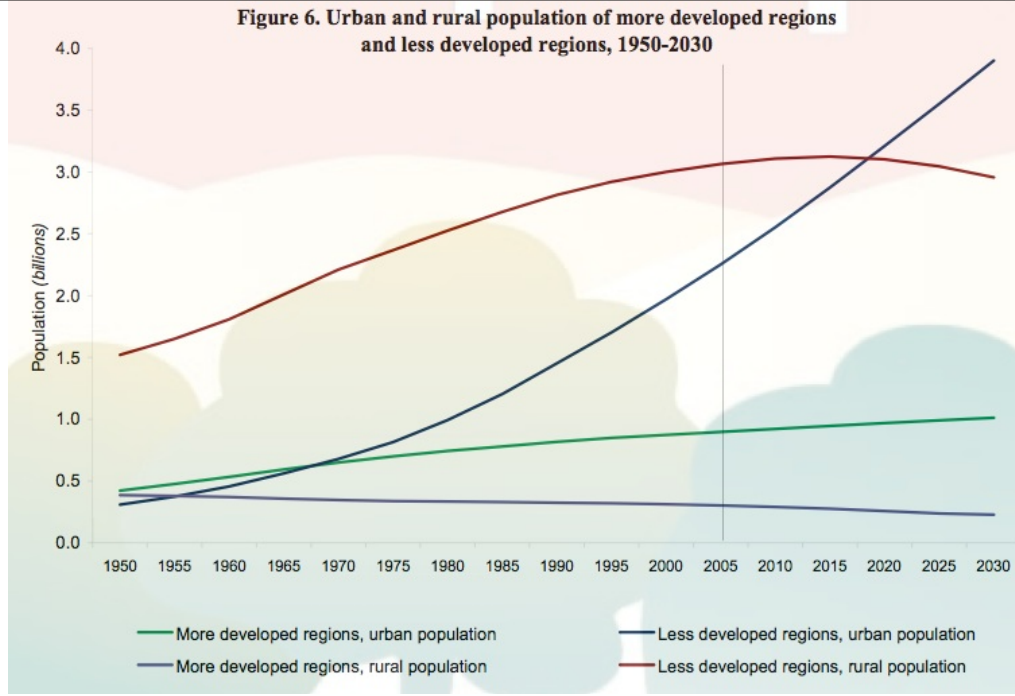
United Nations estimates of urban and rural populations for more and less developed regions 1950-2030.
Source: United Nations: World Urbanization Prospects, the 2005 Revision.

The urban population of less developed countries has roughly tripled since 1970, while the population of rural regions in those countries has increased about 50%. In 1970, it used to be that the developing countries were about 75% rural, but now they are on average a little under 60% rural. Clearly the vulnerable urban population is much larger than it was. However, it's still the case that more than half the population of developing countries is rural. Are they mostly net food producers who are insulated from global commodity price increases?

This question, as well as a number of other relevant ones, is addressed in a very useful World Bank report, World Development Report 2008: Agriculture for Development. In chapter 1, we find:

> An estimated 2.5 billion of the 3 billion rural inhabitants are involved in agriculture: 1.5 billion of them living in smallholder households and 800 million of them working in smallholder households.

So the vast majority of the developing rural population is living or working on small farms, and thus is somewhat insulated from global commodity prices:

> Even with globalization, the staple crop sector remains largely nontradable in substantial parts of the agriculture-based countries for two reasons. First, locally grown staples such as cassava, yams, sorghum, millet, and teff, which are not internationally traded (although sometimes regionally traded), often predominate in the local diets. Second, the domestic food economy remains insulated from global markets by high transport and marketing costs, especially in the rural hinterlands and in land-locked countries. In Ethiopia the price of maize can fluctuate from around $75 per ton (the export parity price) to $225 per ton (the import parity price) without triggering international trade. This nontradable staple crop sector represents 60 percent of agricultural production in Malawi and 70 percent in Zambia and Kenya.

In many developing countries, most of the poor are in the rural areas:

> More than 2 billion people, about three- quarters of the rural population in developing countries, reside in the rural areas of transforming economies, encompassing most of South and East Asia, North Africa and the Middle East, and some of Europe and Central Asia. Although agriculture contributed only 7 percent to growth during 1993–2005, it still makes up about 13 percent of the economy and employs 57 percent of the labor force. Despite rapid growth and declining poverty rates in many of these countries, poverty remains widespread and largely rural—more than 80 percent of the poor live in rural areas.
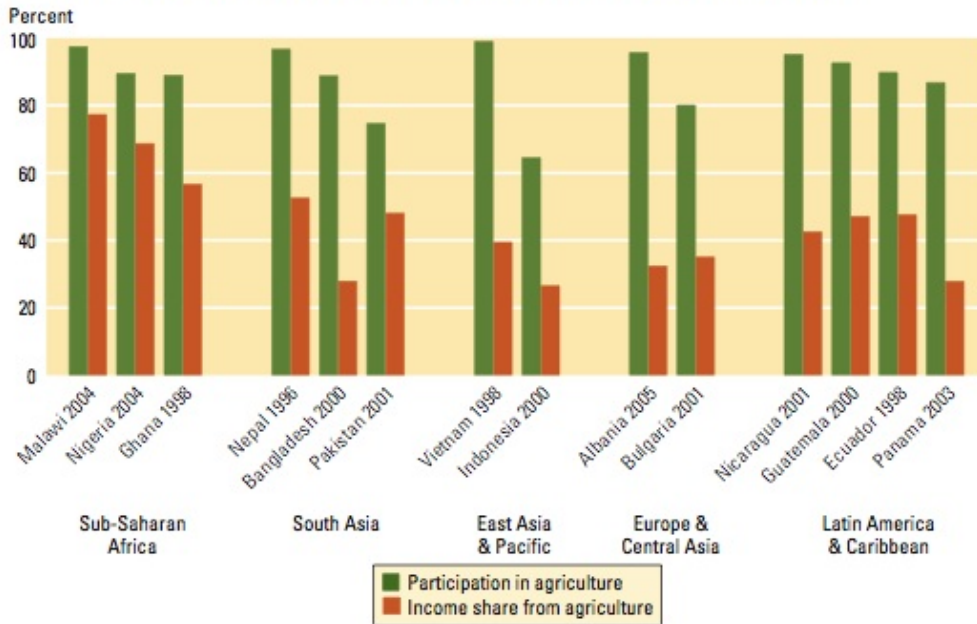
In rural sections, food price increases may help some households, by improving their incomes, even while other households suffer because they still have to buy a fraction of their food:

> From 1981–2003, 1 percent GDP growth originating in agriculture increased the expenditures of the three poorest deciles at least 2.5 times as much as growth originating in the rest of the economy.
>
> Similarly, Bravo-Ortega and Lederman (2005) find that an increase in overall GDP coming from agricultural labor productivity is on average 2.9 times more effective in raising the incomes of the poorest quintile in developing countries and 2.5 times more effective for countries in Latin America than an equivalent increase in GDP coming from nonagricultural labor productivity. Focusing on absolute poverty instead, and based on observations from 80 countries during 1980–2001, Christiaensen and Demery (2007) report that the comparative advantage of agriculture declined from being 2.7 times more effective in reducing $1-a-day poverty incidence in the poorest quarter of countries in their sample to 2 times more effective in the richest quarter of countries.

Unfortunately, although most rural households participate in agriculture to some degree, over half are net food buyers, since only a portion of their income comes from agriculture:
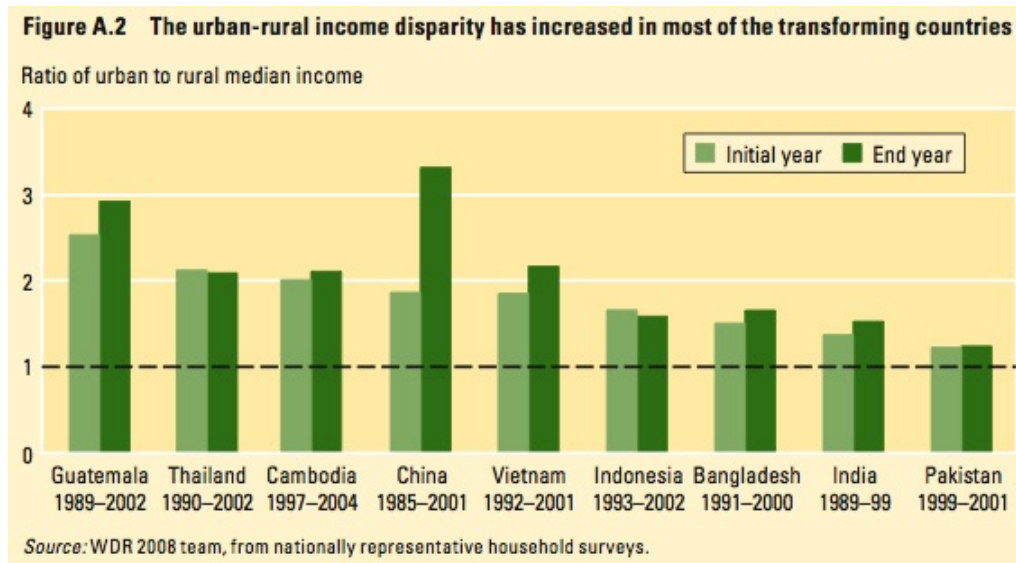
Figure 3.2   In most countries, the vast majority of rural households participate in agriculture

Percent

Sub-Saharan Africa   South Asia   East Asia & Pacific   Europe & Central Asia   Latin America & Caribbean

■ Participation in agriculture
■ Income share from agriculture

Source: Davis and others 2007.

World Bank estimates of participation and income shares for rural households in various developing countries. Source: World Development Report 2008: Agriculture for Development.

Moreover, it's not the case that urban incomes are in general massively larger than rural incomes - in most cases, the median urban income is less than twice as much as the median rural income:

Figure A.2   The urban-rural income disparity has increased in most of the transforming countries

Ratio of urban to rural median income

Guatemala 1989–2002   Thailand 1990–2002   Cambodia 1997–2004   China 1985–2001   Vietnam 1992–2001   Indonesia 1993–2002   Bangladesh 1991–2000   India 1989–99   Pakistan 1999–2001

■ Initial year   ■ End year

Source: WDR 2008 team, from nationally representative household surveys.

World Bank estimates of urban and rural income ratios for various developing countries. Source: World Development Report 2008: Agriculture for Development.

And if we look at the share of income going on food in poor countries, that too suggests vulnerability. This next graph shows the share of food expenditures going on grain products, versus the share of all expenditures going on food for a sample of countries. Bubble area is population. Note that some important countries are missing, including India and China.
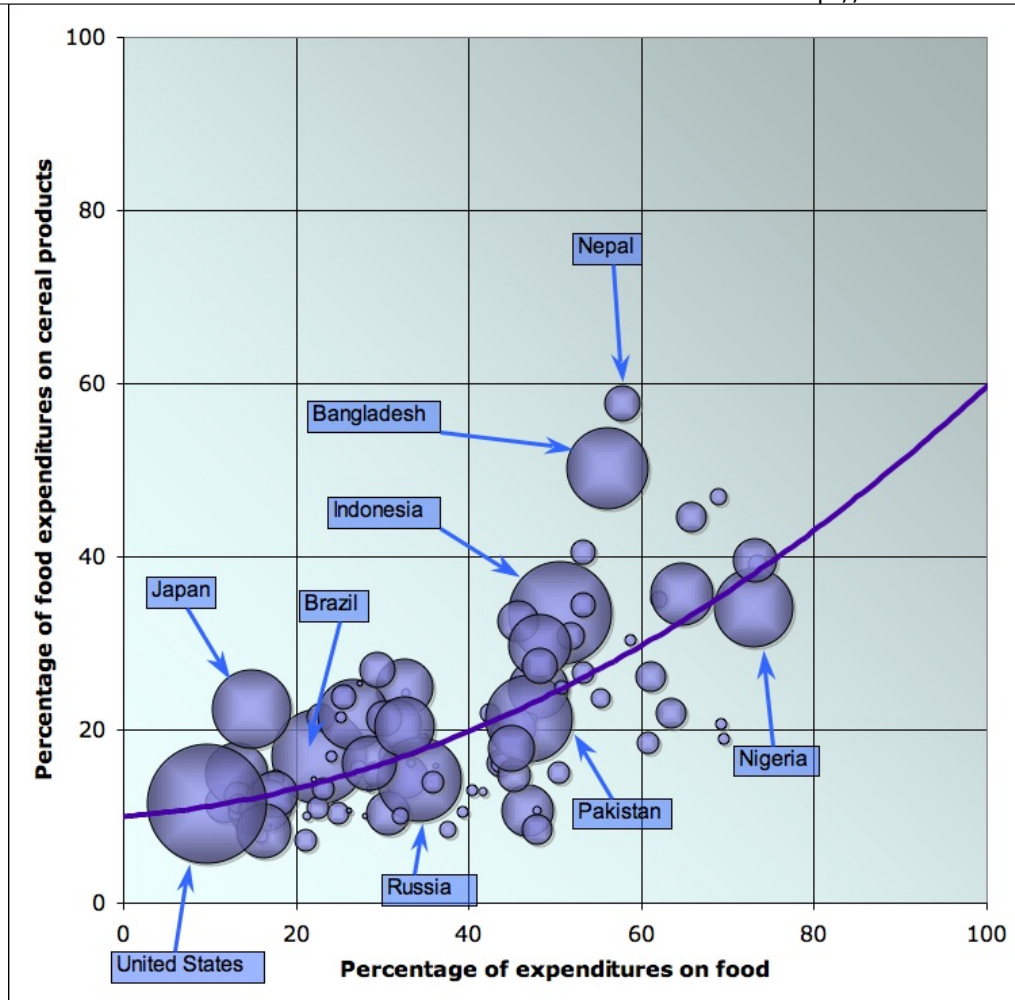
Share of food expenditures going on bread/cereal products, versus share of all expenditures going on food for a sample of 114 countries. Bubble area is proportional to country population. Trendline is a quadratic fit.
Source: USDA Economic Research Service: International Food Consumption Patterns.

It's worth noting that much of the developing world spends half or more of its income on food. Also, given that cereal products are generally the cheapest food, and this graph shows expenditure fractions, the dependency on cereal products for calories is very high at the poorer end of the scale.

In summary, it still seems to me that a sustained increase in food prices by factors of several fold, and that lasts for years, has the potential to deprive a material fraction of the global poor of enough food to live. This would be a much worse food crisis than the 1970s food crisis. Whether biofuels have the potential to bring that on depends on the future trajectory of oil prices, a subject that will have to await a future post. I'm keen to understand this issue as quickly as possible, as we do seem to be entering another food crisis of **some** scale. Here's an excerpt from a recent warning by the UN Food and Agriculture Organization.

17 December 2007, Rome – FAO is urging governments and the international community to implement immediate measures in support of poor countries hit hard by dramatic food price increases.

Currently 37 countries worldwide are facing food crises due to conflict and disasters. In addition, food security is being adversely affected by unprecedented price hikes for basic food, driven by historically low food stocks, droughts and floods linked to climate change,

high oil prices and growing demand for bio-fuels. High international cereal prices have already sparked food riots in several countries.

In its November issue of Food Outlook, FAO estimated that the total cost of imported foodstuffs for Low Income Food Deficit Countries (LIFDCs) in 2007 would be some 25 percent higher than the previous year, surpassing US$ 107 billion.

If we weren't converting over 5% of the global food supply to biofuels already, would this be happening?