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Casting Bread Upon the Water: Comments on Technology, Globalization, and Agriculture

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The issues raised in this paper session—concerning technical change, globalization, and chronic low returns in agriculture—are of long-standing importance in our profession. The papers, like many policy discussions in our discipline, have focussed largely on the U.S. agricultural sector. In this comment I will make some remarks relative to the domestic situation, but would also like to branch out a bit to address the worldwide impact of changing technology and increasingly open markets.

The "Farm Problem" in the United States

From the 1930s through the 1960s, the "farm problem" was recognized as being that of constant excess capacity caused by technical change, a situation known to agricultural economists as Willard Cochrane's famous "treadmill." In the 1970s, swings in international demand introduced a new problem, increased price risk caused by a shifting demand curve. Many people attending this conference or reading this paper may be too young to have a clear recollection of the agricultural situation in the early 1970s. From the summer of 1972 to the fall of 1974, the average price of corn tripled and the price of wheat increased fourfold (Destler). Net farm income soared and acreage expanded, to the apocryphal "fence row to fence row" level. U.S. consumers, of course, were upset by the rising food prices, which along with soaring fuel prices threw household budgets into chaos.

In hindsight we can see the decade of the 1970s as an aberration, a blip in the long-term condition of low returns. But as Emery Castle noted in 1979, the new, unstable agricultural arena of the 1970s caused economists and policy analysts to have difficulty in distinguishing between permanent and transitory phenomenon. The high agricultural earnings, coupled with inflation in the general economy, led to farm expansion, often financed by debt. In the 1980s, when inflation ended and agricultural commodity and land prices dropped dramatically the decisions of the 1970s led to a severe farm crisis. The low returns could not cover the debt payments incurred and drops in asset values moved some formerly solvent farms into bankruptcy.

Uncertainty about the long-run future of agriculture not only causes errors in resource allocation at the farm-level, but also increases the likelihood that any proposed policy remedy to a current problem could do more harm than good over the long run. While Agriculture in 2001 appears firmly resettled into the familiar territory of excess capacity and chronic low returns, Dr. Castle's caveat still applies, albeit in reversed form. While it is true, as Steve Blank points out in his paper, that agricultural profit margins over the last 20–30 years have been chronically low and fairly static, it is also possible, given the fluctuations in world markets, that the U.S. might once again experience the type of production shortfalls we saw in the 1970s. Policy makers are

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always well advised to keep in mind, as Joseph warned Pharoah, lean years can follow fat.

In his paper Dr. Blank explores the link between globalization, technology, and farm-level choices. What I found most interesting about his application of portfolio theory is the result that external shocks that reduce agricultural profitability cause even risk-averse producers to shift into the production of riskier crops. Thus a sustained period of low returns, such as the one seen in the 1950s and 60s and the one we're currently seeing, can set the stage for serious instability problems should the global market change. Because several of the counter-cyclical features of the old farm programs were eliminated in the 1990s, future price instability could lead to even greater problems of farm income instability than we saw in the 1970s.

I do have some doubts about the risk aversion of farmers as a group. While some probably are trying to minimize risks, subject to income-level constraints, others may be risk lovers. Farming is riskier than many other occupations, and those who are deeply risk averse may choose not to farm. Perceptions also matter. Because yields and prices are not known in advance, a person with an optimistic view of agriculture could continue to believe that this year or next year things will improve substantially. Such a person's behavior could not be predicted easily by someone using a less optimistic set of expectations. It is also difficult, psychologically, for most people to admit that they've made a mistake—that the career or production choices they made in the past were not, in fact, good decisions after all. This tendency can also affect decisions. A relatively new line of research, which involves psychology as well as economics, could shed more light on how producers form their expectations and make their subsequent decisions. For agricultural economists this knowledge could lead to better predictions of the long-term effects of policy changes or market shocks.

The question of who benefits from new technology discussed in detail in David Debertin's paper is also a significant issue for the agricultural economics profession. As Dr. Debertin points out, the literature on this issue does not provide a consistent answer. An astute undergraduate in a Principles class knows that the effect of technological gains on aggregate farm revenue depends crucially on the elasticity of demand. Nevertheless, despite our constant deployment of increasingly sophisticated quantitative tools, agricultural economists apparently still cannot say conclusively whether the long-run demand for agricultural products is elastic or inelastic. I agree with David Debertin that the bulk of the evidence supports an inelastic long-run demand for aggregates such as "grain" or "oil seeds." Some of the conflicting evidence may trace back to the problem pointed out some 20 years ago by Bredahl, Meyers, and Collins, concerning price transmission elasticities that are less than 1, or the differences in estimates could involve the level of aggregation or the definition of "long run."

The points raised in Dr. Debertin's paper, about gains from technology, the shifting nature of the rural community, and the likely effects on our research agendas are well worth contemplating. As rural communities become less dependent on farm income, it becomes harder to justify public-financed agricultural production research as a means of rural development. Similarly, the public at large cannot be faulted for not wishing to provide tax-breaks or other forms of subsidies to people who are, essentially, pursuing a hobby. Indeed, Lester Thurow, discussing tax subsidies for agriculture, once commented, "If anybody thought about having a more equitable tax code, they would be talking about doing major things to raise the taxes on farmers, because agriculture pays no taxes; agriculture is a tax shelter, a tax scam—just like real estate." As for the commercial operators, Willard Cochrane wrote, "I see no reason why I or other urban income earners should be called upon to pay taxes and higher-than-equilibrium prices on farm food products to provide an income subsidy to these large farmers."

If continued support for agricultural programs is desirable, policy makers may need solid justification of the benefits of the pro-

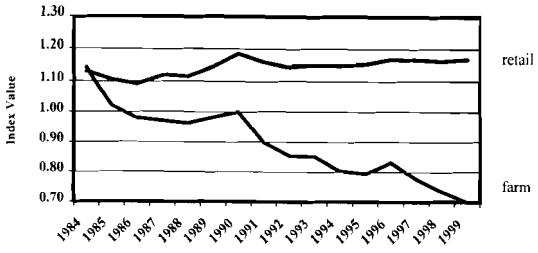

Figure 1. Retail cost versus farm value for a market basket of food (indexed)

grams to the public at large. Given the importance of safe and stable food supplies to every citizen, a program designed to ensure against possible future food shortages could receive widespread support. The United States certainly knows how to implement a reserve program. The political difficulty, as we've learned in the past, is setting entry and exit prices that do not cause excessive stock build-ups.

Dr. Debertin also raises the issue of agribusiness consolidation. In testimony to Congress, Robert Taylor provided additional information on this topic (Taylor, 1999, 2000). One factor discussed in this testimony was the increasing vertical integration of the supply chain, as exemplified by DuPont's "dirt to dinner" program for a particular type of soybeans. In this system DuPont controls all stages of supply. Technology, chemicals, and seed are provided to farmers, who produce under contract. DuPont then processes and sells the resulting products. Another issue raised in this testimony was that horizontal, as well as vertical, integration is increasing. According to Taylor, the four-firm concentration ratio exceeds 70 percent in many food and food-related industries. Figure 1 is a graph, taken from Taylor's testimony, of the relationship of retail to farm prices over the last 25 years (Taylor, 2000). The retail cost index has remained relatively flat while the farm value index has fallen markedly. Part of the reason for this phenomenon could be the result of an increased consumer reliance on processed food. However, according to Taylor, this explanation cannot fully explain the rapid increase in the farm-retail price gap that has occurred since 1990. Also, since 1984 real marketing costs for agribusiness firms have been falling (Taylor, 1999). In a competitive system, decreasing marketing costs would normally result in farm-retail price spread getting narrower, not wider. Taylor also shows that the rate of return to equity for food manufacturers and retail chains has been moving upward, at the same time that farm returns have remained low and stagnant. In the 1990s, the rate of return to equity averaged 18 percent for retail food chains, 17.2 percent for food manufacturers, and 4.5 percent for farmers (Taylor, 1999). The figure for farmers includes return from capital gains for assets. When those gains are subtracted, the rate of return from current income averaged 2.39 percent (Taylor, 1999). In the light of these figures it does appear that in the United States the primary beneficiary of future technological change would quite likely be agribusiness firms. Justification for public support of technological improvement thus seems somewhat weak if we look solely at the domestic arena.

Although the focus of this session is on public-financed research, a related and important issue is the impact of innovations protected by intellectual property rights. In recent years private sector research has become increasingly important in agriculture. The private sector, for example, currently employs about twice as many plant breeders as the public sector (Frey). A paper by Falck-Zepeda, Traxler, and Nelson examined the welfare distribution from the introduction of a specific private-sector innovation, Bt cotton in the United States. They found that 59 percent of the generated surplus from this innovation accrued to producers, 21 percent to the innovating firm (Monsanto), 9 percent to U.S. consumers, 6 percent to international consumers, and 5 percent to the germplasm supplier (Delta and Pine Land Company). I don't know of any comparable studies examining the effects of one specific private-sector innovation; thus, it is hard to say if these results are typical. They do, however, provide some empirical evidence that U.S. farmers may benefit, at least in the short run, from technical innovations. Because Bt cotton was introduced in 1996, the long-run distribution of its benefits is unknown.

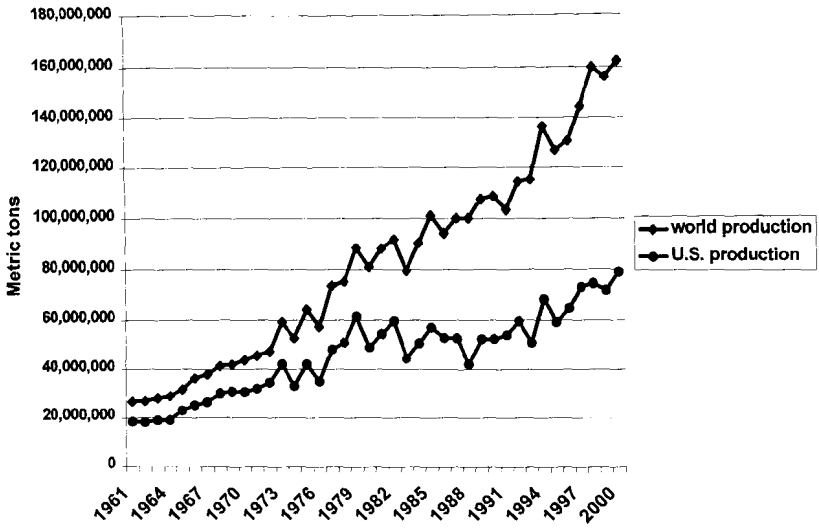

Figure 2. U.S. and world soybean production source: FAO statistics. http://apps.fao.org

The International Situation

Globalization of agriculture means that U.S. farm policies and research programs can't be effectively evaluated without awareness of the agricultural situation in the rest of the word. To put the United States in perspective as a world supplier of commodities, I've graphed 30 years of production of three major food products: soybeans, wheat, and coarse grains. Figures 2 to 4 show that while total U.S. production has increased sharply over that period, our percentage contribution to the world market has fallen. Even if technological productivity gains were to cease in the United States, technological innovations elsewhere in the world would likely still continue to exert downward pressure on prices.

Figure 5 shows the relative productivity gains in the U.S., the developed world, and the developing nations. While the U.S. has out-paced the average of other industrialized

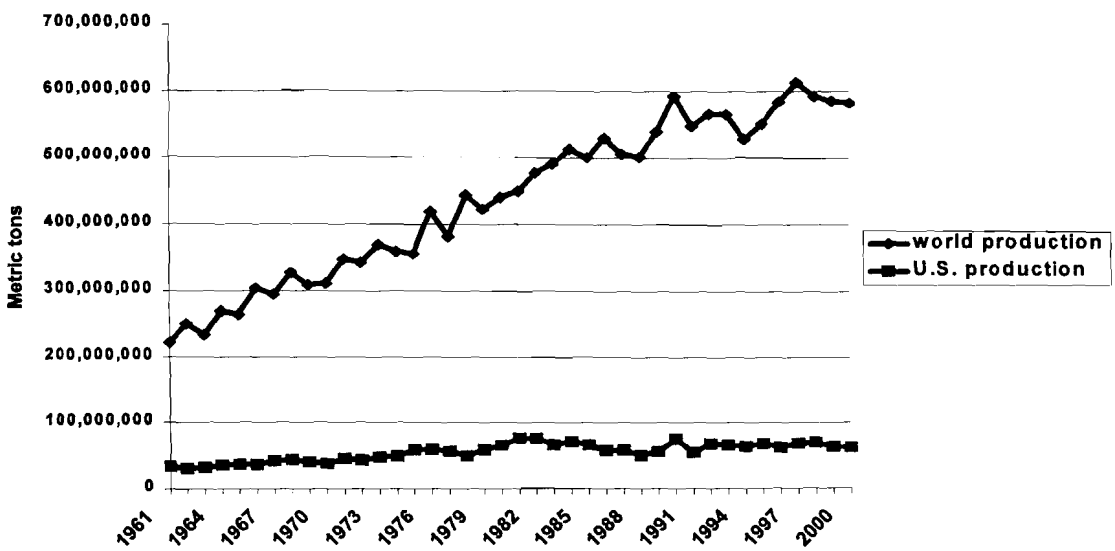

Figure 3. U.S. and world wheat production source: FAO statistics. http://apps.fao.org

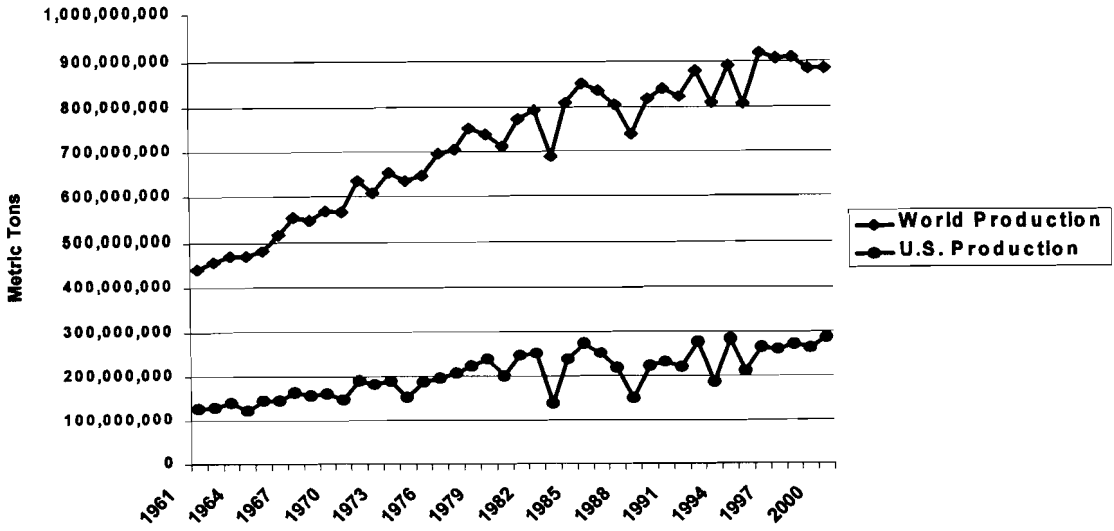

Figure 4. Coarse grain production source: FAO statistics. http://www.fao.org

countries in increasing its production, the greatest gains have occurred in the developing nations. Some may lament the declining U.S. position in the world markets, tying it to the low profits in our agricultural sector. There's another side to the story, however. One needs to look at consumers around the world to see the full impact of technology gains. We hear often that there are "more people starving today than at any time in human history" (see, for example, Cornerhouse). Depending on how one defines "starving" the statement may or may not be correct (although FAO data doesn't support it very well). Whether or not the statement is technically correct, it is highly misleading. Population has increased substantially since the 1960s. Thus, examining absolute numbers masks the dramatic decreases in the percentage of malnourished people in almost every area of the developing world.

Table 1 shows the decrease in undernourishment, as a percentage of population, in all developing nations. In 20 years, undernourishment, for the developing world as a whole, has been halved. This increase in nutritional intake around the world may be the most wonderful news of the 20th century. It stands in stark contrast to the warnings of impending catastrophe that I and many others remember from the 1960s. The improved nutrition came large-

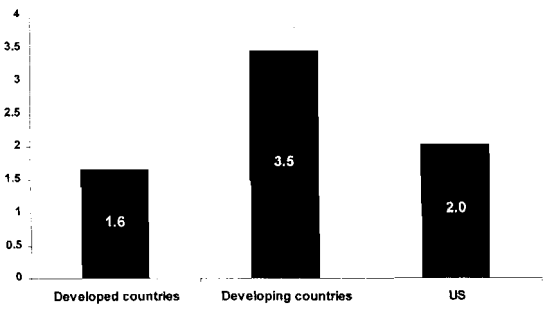

Figure 5. All agriculture production: ratio of year 2000 to year 1961 laspeyers indices source: FAO Agriculture, towards 2015/30, interim report, April 2000. http://www.fao.org

Table 1. Changes in Incidences of Undernourishment, Developing Countries

Region	1969/71	1995/97
All developing countries	37%	18%
Sub-Saharan Africa	34%	33%
Sub-Saharan Africa, excluding Nigeria	36%	39%
Latin America and Caribbean	19%	11%
South Asia	37%	23%
East Asia	43%	13%

Undernourishment is defined by the FAO as taking in fewer calories than required to meet basic energy requirements. Source of figures: FAO, Agriculture, Towards 2015/30, Interim Report, April, 2000. On-line at: http://www.fao.org.

ly through a series of technological improvements in world agriculture known collectively as the "Green Revolution." The Green Revolution brought improved varieties of grains to the developing world, along with the use of fertilizer and other technological changes. In many areas of the world food production increased quickly and dramatically.

The contribution of U.S. scientists to the first round of the Green Revolution is well known (see, for example, Dalrymple). In 1946, a USDA employee named S.C. Salmon brought 16 varieties of short Japanese wheat to the United States. Another USDA scientist stationed at Washington State University recognized the value of the Japanese wheat for breeding purposes. In 1955, Norman Borlaug, working at CIMMYT in Mexico, successfully bred the Washington State cross into Mexican wheat varieties. International diffusion of these Mexican varieties followed rapidly. By 1974, India was self-sufficient in the production of cereals, a goal described as "fantasy" only a decade before (Easterbrook). Improved wheat, maize, and rice varieties dramatically increased food production in much of the rest of the developing world as well.

The good news is not universal, however. If we break the developing world into regions, we can see that while Asia and Latin America have substantially reduced undernourishment, in sub-Saharan Africa, excluding Nigeria, the percentage of undernourished people has increased. The reasons for lack of progress in Africa are varied and complex, involving politics, disease epidemics, wars, and droughts. In the decades ahead we can hope that technological progress will reduce malnutrition in this region of the world as well. Resources from our public universities should be used to make this hope a reality. Certainly we should attempt to counter the mistaken arguments put forth by some environmentalists that the Green Revolution is harmful to nature and thus should not be extended to Africa. In reality, what is harmful to ecology is a population living near starvation levels, with low productivity agricultural techniques. Increased production allows fewer acres to be used to produce food, sparing the more fragile lands. Studies have also shown that (somewhat counter-intuitively) greater wealth and higher food productivity probably restrains population growth, rather than increasing it. Studies from our universities also need to address the fears raised by biotechnology. As educators and scientists it is our responsibility to bring correct information to the public on this controversial issue.

Thus while it is true that U.S. citizens may see little benefit from increased agricultural productivity—raw commodity costs are currently a tiny fraction of our food bills—the gains for consumers in developing nations have been substantial. Given the life-or-death importance of agricultural productivity gains in the developed world, I would argue that the United States, by any standards a wealthy nation, has a moral obligation to pursue public research that contributes to agricultural productivity gains whether or not U.S. producers or consumers directly benefit from it.

Raising living standards in the third world can also be justified from a utilitarian standpoint. The prophet who wrote Ecclasiastes told us, "Cast thy bread upon the water: for thou shalt find it after many days." This statement can be read in both a spiritual and a practical sense. In an economy that is increasingly global, all nations stand to benefit from raising prosperity and stability in the third world. The developing world provides an increasingly large share of our export markets and also provides products for U.S. consumers. As Nobel Laureate Lord John Boyd Orr, first director general of the Food and Agricultural Organization put it, "You can't build peace on empty stomachs." Wars disrupt trade and waste resources that could be used for either investment or current consumption. Poverty also spurs the spread of disease. In a world of global travel no one is truly safe from an epidemic abroad. The U.S. thus faces a clear choice: rise to the challenge of assisting in technology transfer to the world's more impoverished nations, or ignore the need and wonder why, in the future, the optimistic promise of the new millennium went unfulfilled.

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