Implications from Food Supply-Demand Simulation Models

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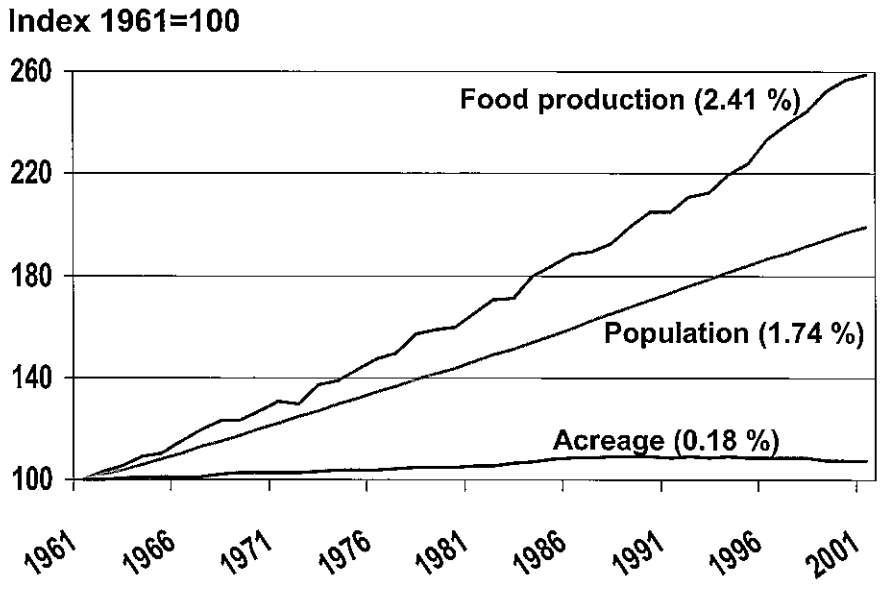
ABSTRACT

Outlook on food production and demand indicates that there will be enough food on the global scale at constant or even slightly falling real prices for the next 20 to 25 years to come. However, on the regional level many developing countries have to increase food imports in order to improve the nutritional status of their population. To make this outlook a reality, stewardship of the natural resources, especially of water and land, has to be enhanced. This requires institutional innovations, decentralisation of policy making and good governance. Technical progress in both animal and crop production also must continue. Declining yield growths could have a very strong impact on world prices for agricultural raw materials. Research on agriculture should focus more closely on the linkage between natural resources and food. It also should stress distributional issues on various spatial and time scales.

BACKGROUND

Over the last forty years, growth of food production has considerably outpaced the increase in the world's population.

According to Figure 1, food production increased at an annual rate of 2.4% between 1961 and 2001,



Source: FAO (2003)

Fig. 1. Global development of food production, population and acreage (1961-2001)

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while the population increased at an annual rate of 1.7%. Moreover, only a small part of the additional food production resulted from the use of additional acreage.

Another very important development over the last forty years has been the decline in real agricultural prices.

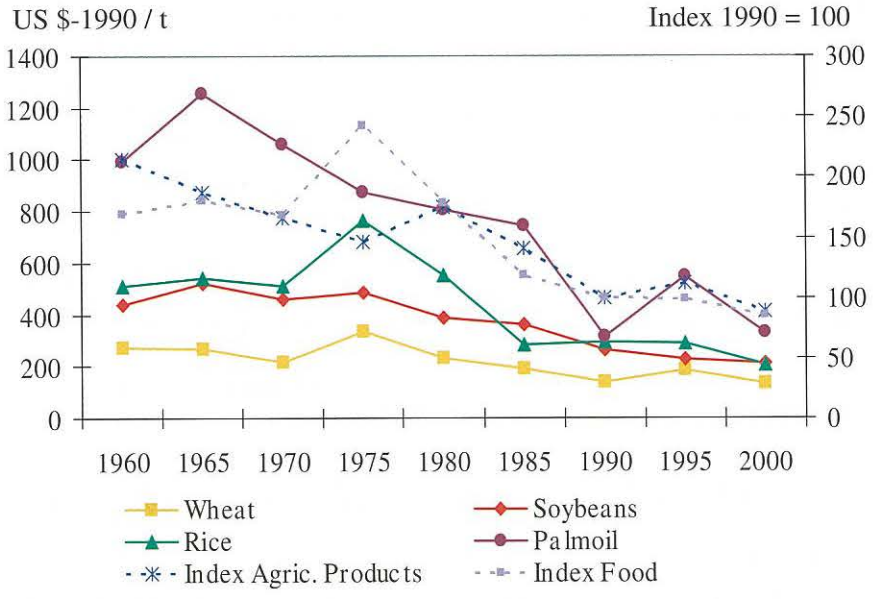
Figure 2 shows the general price trend at world market of some important commodities in real terms. The left scale is a measure of the real commodity prices in constant dollars per ton. It shows that among the commodities shown, wheat prices declined least but most smoothly while those of rice and soybeans took a slightly steeper downturn. Real prices fell furthest for palm oil. The right scale indicates the development of indexes for food and agricultural prices. The indexes moved almost in parallel, except during the mid-seventies when many feared a food crisis.

TYPES OF SIMULATION MODELS

For the sake of simplicity, simulation models can be grouped into two classes. The first group consists of dynamic simulation models that determine demand and supply in one-year time intervals and find market clearance through appropriately set prices. They commonly include quite exogenous information such as technology and production factors such as land and water on the supply side, and population and preference structures for consumption on the demand side.

The second group, the static or dynamic trade models (the static ones dominate), are basically policy analysis tools applied to investigate trade issues. The purpose of these trade models sets them apart from the supply and demand models, which are generally used to project possible market conditions in the years ahead.

Though these two groups of models are very large in number, they have begun to show some degree of convergence. As many of the models now adopt common methodologies and approaches, particularly those belonging to the supply and demand group, the results are more consistent now than they have been in the past.



Source: FAO (2002)

Fig. 2. Real world market prices of selected agricultural products and foodstuff (1960-2000)

Demand, Supply, and Trade Patterns

The results obtained with the supply and demand models depict the message that real food prices will not increase. There is some possibility of even a decline. The latter would be consistent with the past.

As mentioned, the amount of exogenous information included in these models is largely shaping their results in the long run. This refers to the increased use of land as well as the increased intensity of cropping, the expansion of irrigation, the frequent improvement of water efficiency, and the further increases in yields and resulting increases in the use of fertilizer. The models are not strong in depicting bio-physical processes and have yet to incorporate the latest biotechnological approaches.

On the demand side, the models incorporate declining population growth rates, especially in developing countries (populations in many of the industrialized countries are already shrinking). Changes in income growth and consumer preference structures lead to changes such as increased consumption of meat and declining intake of staples in developing countries, and increased attention to food safety in the developed countries.

Another important result output by these models is a growing division of labor in agriculture. The developing countries, especially those in Africa, are found to depend more on imports of cereals and meat products from the industrial countries, and their share of trade in agricultural products, in terms of total exports and imports, appears to be declining. The industrial countries, on the other hand, are found to be increasingly dependent on vegetables and fruits not grown domestically, as well as products such as vegetable oils and protein feeds.

The trade models, those that look at trade policies explicitly, arrive at the general statement that much is to be gained from liberalizing trade. This is particularly so in the developing countries, given their comparative advantage in labor and land, their ability to more quickly adapt new technologies, and their potential to implement growth strategies. The gains in the industrial countries, on the other hand, are enjoyed mostly by consumers and taxpayers, though producers actually lose in welfare roughly by the same amount that consumers and taxpayers benefit. The general outcome of these models is substantial gains from free trade.

Policy Requirements

What kind of policy requirements do these results lead to? Differentiating between developing and industrialized countries, dissimilar sets of policies emerge.

In the developing countries, the farmers have to get fair prices, and as such they should be neither taxed nor excessively protected. The models have been used for identifying the types of farms that gain from these advantages. Small holdings, in fact, have proven to be a disadvantage, and their analytical treatment in these models needs to be improved. The models also need to focus more closely on investment in rural infrastructure, a frequent impediment to improvements in agriculture and farming. Another shortcoming is the inability of the models to identify the types of innovations needed, especially in the field of biotechnology. Gene modified crops, for example, can offer substantial advantages for developing countries, but the question remains whether people will accept them. Most important are institutional innovations, a crucial aspect of agricultural growth in developing countries that has not been adequately built into these models. Still further advances in modeling are thus required.

In the industrialized countries, the basic message deals with market access (dismantling trade barriers), protecting natural resources, introducing technological innovations, and mitigating climate change. Protecting natural resources is of course very important, as a large share of the land has already been degraded. Regarding efforts to mitigate the effects of climate change, several models have forecasted potentially drastic climactic effects in industrialized countries and developing ones alike.

METHODOLOGICAL ISSUES ON FORMAL ANALYSES

Several methodological issues with regard to these formal analyses have arisen, both in terms of demand and supply.

Demand side

In the developing countries, most of these models do not explicitly handle the age structure, a rapidly changing factor with drastic effects on population compositions. In addition to this shortcoming, the models also need to reflect the changing nutritional needs of the populations, as well as micro nutrients and other impediments to eradicate poverty and hunger.

In the industrialized countries, the models need to reflect the very important issues of food quality and food safety. The consumer in the industrialized country will request complete information, from the very first stage of food production until it reaches his or her table. This requirement of complete quality information for the sake of food safety and quality poses a problem for the developing countries, given that prevailing producers, the small-scale farms, will certainly have not the technologies for providing this information.

Placing new product in the markets to industrialized countries is another very important aspect that needs to be considered as a factor determining demand. Much marketing is needed for introducing new products on sales shelves, and developing countries usually lack the necessary means to finance the product promotion.

Supply side

On the supply side, the models need to consider the progress of the developing countries in improving their stewardship of natural resources, as well as developing institutions of the type already established in the industrialized countries. Some developing countries also have transboundary (water) problems that the models need to address. The adaptation of biotechnology was mentioned already as an additional aspect worth considering in the models, as is climate change, particularly in Africa.

CONCLUSIONS

This brief overview of supply-demand simulation models has focused less on the results of the models than on the factors that need to be built into the structures of the models as analytical tools. Further research will have to be conducted to enlarge the scope of the models in several areas, for example, food safety, the chain of information on food safety, the adaptation of biotechnological innovations, and the disadvantages of the developing countries with regard to productivity.

The significant impediment of trade barriers must also be examined. The models that look at free trade may have structural problems-for example, an inappropriate focus on different categories of traded goods-that cause them to vastly overstate the gains from free trade. With the collapse of the DOHA Round, new efforts to create bilateral trade are springing up all over the world, and this is a factor that must be considered.

Lastly, one of the most important factors to consider in developing countries is the design of new institutions, both to steward natural resources such as land and water, and to decentralize the function of decision-making to ensure that the people most closely affected are the same people making the decisions.

Summarising, the agenda for deepening our knowledge is indeed very broad. New analytical tools may have to be developed, and new organizational structures would help in facilitating the analyses of food supply and demand both at the global scale and at a regional level for identifying local problems.