Model Documentation

Introduction

The model-based analyses in this report use computable general equilibrium (CGE) models and partial equilibrium models. Descriptions of each model follow, including discussion of sectoral structure, factor markets, macro closure, data sources, and any innovative features of the model, such as dynamic behavior.

Dynamic Global CGE Model (Xinshen Diao, Agapi Somwaru, Terry Roe)

The model is based on neoclassical growth theory. It is a global intertemporal (dynamic) GE model with 10 countries/regions and 7 production sectors. The data used for calibrating the base-run are GTAP database, version 5.2. The dynamic model is different from a static CGE model in which firms only make a production decision for one period at a given level of factor endowments. In the intertemporal dynamic model, firms of each region have intertemporal optimization behavior (i.e., besides employing labor, capital and land, as well as intermediates to conduct production, firms also make investment decisions to maximize firm's intertemporal profits). Thus, capital accumulates over time endogenously. On the other hand, the representative consumer of each region maximizes an intertemporal utility function by making consumption and savings decisions. Thus, another difference from a static CGE model is that a country's savings are endogenously determined. This implies that the model captures not only bilateral commodity trade flows, but also financial capital flows among countries/regions over time. The intertemporal budget constraint for each country/region is equivalent to the so-called macro-closure in the static model, but along transition, international borrowing/lending, trade deficits/surplus, and hence the accumulation of foreign debt/assets in each region are endogenously determined. Thus, economic adjustments due to policy reform take time and the entire transitional path to the steady state can be solved from the model.

The model also captures the linkage between trade and total factor productivity (TFP) growth by introducing *technological spillovers*. That is, if a country becomes more open in trade to other countries, it is more likely to learn and adopt advanced technologies embodied in international trade, which will improve its factor productivity, so that more outputs can be produced using the same amount of productive resources. The technological spillover elasticity is borrowed from econometric studies (Coe and Helpman, 1995; Coe, Helpman and Hoffmaister, 1997; and Wang and Xu, 1997). The detailed description of the model can be found in Diao and Somwaru (1997).

Global CGE Model (C. Edwin Young et al.)

This analysis uses the GTAP model. GTAP is a global trade applied general equilibrium framework documented in Hertel (1997). Our model is calibrated to 1997 macro and trade data. We aggregated global data into a model with OECD countries and the rest of the world, and 16 traded commodities. The GTAP version 5.2 data have tariffs and export subsidies from the AMAD database and domestic support data from the USDA/ERS's database on the AMS (see appendix 2 in this report).

GTAP is a comparative static model with price-taking behavior for all economic agents and full employment of resources. Land is employed in agriculture only, and it is imperfectly mobile across sectors. All sectors employ labor and capital, which are perfectly mobile across sectors in a region. Households maximize utility derived from consumption and savings subject to regional income, which consists of primary factor payments and net tax collections. International trade clears commodity markets, with each commodity being differentiated by its place of origin. Regional investment is financed by domestic savings and net capital inflow from all other regions. A price index for global savings is the numeraire.

ESIM Model (Susan Leetmaa)

The European Simulation models (ESIM) are linear, time-dependent, constant elasticity, partial equilibrium models. ERS currently has five individual country/region ESIM models (EU15, the Czech Republic, Hungary, Poland, and Slovakia) and the EU-

18 model used for this analysis (EU15 plus the Czech Republic, Hungary, and Poland). ESIM covers 18 major commodities in the agricultural sector: wheat, corn, barley, other coarse grains, soybeans, rapeseed, sunflowerseed, soymeal, rapemeal, sunmeal, soyoil, rapeoil, sunoil, other oils, fluid milk, beef and veal, pork, and poultry. ESIM also includes 12 feeds and a detailed feeding scheme (developed by Jan Blom of LEI/DLO in the Netherlands).

Food Aid Needs Assessment Model (Shahla Shapouri and Michael Trueblood)

The Food Security Assessment model used in this report was developed at the USDA/ERS for use in projecting food consumption and access, and food gaps in 67 low-income countries through 2010. The model database is an average of 1997-99. The reference to food includes grains, root crops, and a category "other," which includes all other commodities consumed, thus covering 100 percent of food consumption. All of these commodities are expressed in grain equivalent.

Food gaps are projected using two consumption criteria: (1) status quo target, where the objective is to maintain average per capita consumption of the recent past; and (2) nutrition-based target, where the objective is to maintain the minimum daily caloric intake recommended by the UN's Food and Agriculture Organization (FAO).

Projection of Food Availability. The simulation framework used for projecting aggregate food availability is based on partial equilibrium recursive models of 67 lower-income countries. The country models are synthetic, meaning that the parameters that are used are either cross-country estimates or estimates from other studies. Each country model includes three commodity groups: grains, root crops, and other. The production side of the grain and root crops are divided into yield and area response. Crop area is a function of 1-year lag return (real price times yield), while yield responds to input use. Commercial imports are assumed to be a function of domestic price, world commodity price, and foreign exchange availability. Foreign exchange availability is a key determinant of commercial food imports and is the sum of the value of export earnings and net flow of credit. Foreign exchange availability is assumed to be equal to foreign exchange use, meaning that foreign exchange reserves are assumed to be constant during the projection period. Countries are assumed to be price takers in the international market, meaning that world prices are exogenous in the model. However, producer prices are linked to the international market. The projections of consumption for the "other" commodities are simply based on a trend that follows the projected growth in supply of the food crops (grains plus root crops). Although this is a very simplistic approach, it represents an improvement from the previous assessments where the contribution to the diet of commodities such as meat and dairy products was overlooked.