Summary

Development of the Equilibrium Displacement Mathematical Programming Model (EDMP) started in response to the passage of the Federal Agricultural Improvement and Reform Act of 1996. The 1996 Farm Act fundamentally changed the traditional economic incentives in commodity policy by decoupling most Government commodity payments from the levels of individual farmers' production of the commodities, by eliminating acreage reduction programs, and by no longer limiting production eligible for support to a producer's historic production base. The effects of these changes in economic incentives were to render temporarily obsolete all econometric simulators estimated under the previous policy regime. The first published article using EDMP assessed the likely effects of the 1996 Farm Act on production, prices, net farm incomes, and farm asset values in the Great Plains. Subsequent applications of the EDMP framework evaluated the effects of market resistance to genetically modified grains and the implications of demand and supply elasticities for the distribution of rents in supply chain industries.

This bulletin documents the theory, structure, and operating characteristics of a U.S. aggregate agricultural sector EDMP model that is flexible and user friendly. This bulletin includes all activities and parameter values in tabular summary form, the actual quadratic programming tableau, the SAS code for solving the model, and a user's manual. The authors have cast the discussion in simple, conceptual terms rather than detailed, technical terms, in order to demystify the methodology for researchers not specifically trained in mathematical programming.

What Are the Issues?

Government policies, both agricultural and general economic, have pervasive influences on the structure and performance of the agricultural sector. Furthermore, policies and programs frequently interact to potentiate or mitigate their separate effects on sector structure and performance. The model documented in this bulletin focuses on the effects of agricultural policies and programs on the performance of the U.S. agricultural sector. The agricultural sector is treated as operating in perfect competition, subject to the provisions of agricultural and economic policies. Scenario analyses—"what if" questions—concerning alterations in policy, technology, demand, and/or supply are addressed by comparing the new equilibrium under the scenario with the base period equilibrium. Economic changes frequently occur in cascades of changes involving several policies, commodities, or technologies. The effects of such cascades of changes can be very different from the sum of the effects of the individual changes. This model specifically addresses such interactions. In addition to portraying a sector or industry in perfect competition, the EDMP model can be formulated to allow monopolistic/monopsonistic behavior in one or more sectors, while the remainder of the model operates in perfect competition.

What Does the Model Do?

The U.S. agricultural sector EDMP model is a price-endogenous quadratic programming model providing sectorwide comparative static analyses of production and disposition of the 16 top crop commodities and 8 top live-stock commodities, including disposition among farm sector use, domestic demands, exports and competing imports, and storage and dis-storage. The model is constructed from data compiled by U.S. Department of Agriculture's Economic Research Service: cost-of-production estimates, farm income and production accounts, and Agricultural Resource Management Survey (ARMS). The sector performance effects of major agricultural poli-cies—such as direct payments, counter-cyclical payments, loan deficiency payments, the Conservation Reserve Program, and crop insurance—are endogenously calculated in the model.

How Does the Model Work?

In solving the model, the quadratic programming solution algorithm enforces the optimality conditions of perfectly competitive equilibrium across all products and factors. That is, marginal revenues from a one-standard-unit increase in production are equalized across all products while simultaneously equalizing the marginal values (shadow prices) of each limiting factor across all products using that factor. This procedure is conceptually equivalent to maximizing the combined producer plus consumer surplus. The base period model is calibrated to reproduce all base period prices and quantities to the desired degree of accuracy without the use of artificial constraints or limita-tions. Scenario analyses are performed by comparing the equilibrium solution under the scenario assumptions with the base period equilibrium. Change parameters allow the user to customize both the base period solution and the scenario solution by specifying acreages, yields, cost levels, and demand parameters for any combination of products in the model. A post-optimal calculations spreadsheet calculates the following performance indicators:

- Net farm income, short and long run

- Net cash flow, short and long run

- Crop acreages, by commodity

- Livestock production levels, by commodity

- Domestic nonfarm demands, by commodity

- Market demand prices, by commodity

- Storage and dis-storage levels, by commodity

- Exports and competing import levels, by commodity

- Direct payments, by base commodity

- Counter-cyclical payments, by base commodity

- Loan deficiency payments and marketing loan gains, by commodity

- Crop insurance subsidies, by commodity

- Domestic consumer surplus, by commodity

- Export consumer surplus, by commodity

- Producer cash market income, by commodity

- Producer cash expenses, by commodity

- Producer net cash margin, by commodity

Other user-defined performance activities, constraints, and performance measures can be added to fit the model to the problem.