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A USER'S INTRODUCTION TO THE DAIRY MARKET POLICY SIMULATOR (DAMPS)

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Preface

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A USER'S GUIDE TO THE DAIRY MARKET POLICY SIMULATOR (DAMPS)

What Kind of Model is DAMPS?

Economists work with various types of models. Economic models differ in a number of ways. They may be: spatially aggregated or disaggregated (national or regional), static or dynamic, positive or normative. They may differ in the type of methodology they employ, the market level (farm, retail, etc.) they seek to describe, the degree of product aggregation (e.g., food, dairy products, butter), the extent to which they represent the complex interrelationships evident in the real world, and so on.

The characteristics of the Dairy Market Policy Simulator or DAMPS and its predecessor, the Federal Milk Marketing Order Policy Simulator or FMMOPS, have been detailed by Babb et al. (1, 2), Banker et al. (5), Martella et al. (6) and Novakovic et al. (7, 8, 9, 10, 11).[1] The publications by Babb et al. (1, 2) and Novakovic et al. (9) contain broad descriptions of the models, as well as more technical information.

A Dairy Sector Model

As its name implies, DAMPS is a model of the dairy sector. It has been designed to be a complete and rather detailed model of the entire dairy sector. It does not attempt to describe behavior in any other economic sector.

The dairy sector is viewed at three market levels, which are referred to as farm, wholesale, and retail levels. Raw milk production at the farm level is separated into four categories depending on the grade of milk and the type of regulation under which the milk is priced. These four categories are: Grade A milk regulated under Federal Milk Marketing Orders, Grade A milk priced under state regulations, unregulated Grade A milk, and Grade B milk.

At the wholesale level, milk is assumed to be processed into six dairy product groups; these are: fluid milk products (Class I under Federal Orders), soft manufactured products (Class II under Federal Orders), cheese, butter, nonfat dry milk, and miscellaneous hard manufactured products (these latter four represent Class III products under Federal Orders). Foreign cheese, butter and nonfat dry milk may be imported. Cheese, butter and nonfat dry milk may be removed from commercial markets or resold on commercial markets under the federal price

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1 For the most part, the documentations on FMMOPS are relevant to DAMPS. The component of DAMPS that models Federal Orders is essentially identical to FMMOPS, and the overall design and method of using the two models are the same.

support program. Storable dairy products, i.e., cheese, butter, nonfat dry milk, and miscellaneous hard products, may be stored commercially or by the USDA.

All products, except nonfat dry milk, are consumed at the retail level. Although there is some retail consumption of nonfat dry milk, most nonfat dry milk is used as an ingredient for other processed foods. Hence, DAMPS assumes that there exists only a wholesale level demand for nonfat dry milk.

Transshipment and Spatial Model

DAMPS is a transshipment model of the dairy sector. A transshipment model is a special kind of transportation model that assumes that a product must pass through an intermediate point (such as a processing plant) when it flows from a supply point to a demand point.

DAMPS is a model of the entire U.S. dairy sector, but it is spatially disaggregated; it disaggregates the U.S. into a number of regions.

Basically, each Federal Order defines a market area. All milk associated with that area is represented by a point in the Order area. Similarly, each of the states that price milk at the farm is represented as a market area. Nine multi-state regions are used for unregulated Grade A and Grade B milk market areas.

Each Order area, state, or region in DAMPS represents a supply point for raw milk (of the appropriate grade and type). Each area or region also contains processing points and demand points for the various dairy products.

A Model with Positive and Normative Characteristics

Some models seek to describe or duplicate economic behavior based on historical observations; they are often referred to as positive models. Statistical or econometric models are usually identified as positive.

Other models try to describe optimal economic behavior based on a set of technical relations and a set of performance goals; these models may be called normative models. Linear (or other types of mathematical) programming models are usually identified as normative. They seek to maximize (or minimize) an objective function subject to a set of constraints.

DAMPS is an optimizing model. It minimizes the cost of purchasing, assembling, processing, and distributing milk and milk products. Considerable effort was made in designing DAMPS to incorporate real-life constraints resulting from regulation or naturally occurring market forces. Although DAMPS is in some sense a normative model, it is not

designed to say what prices ought to be or how milk ought to be produced, processed or consumed. The model is intended to describe the economic performance of the dairy sector assuming that milk is transported and processed efficiently within and across geographic areas. In that sense, it does have positive characteristics.

A Dynamic Model

DAMPS is a quarterly model that can recursively simulate economic activity in the dairy sector for up to 20 quarters (five years). DAMPS simulates activity in the dairy sector by minimizing marketing costs one quarter at a time; however, there are linkages between quarters. Quarterly production and consumption is assumed to be determined by lagged prices (as well as other exogenous factors). Stocks of dairy products accumulated in one quarter are available for use in the next quarter. Producers can convert from Grade B to Grade A milk production and can shift from one regulated market to another.

The Role of Prices

DAMPS does not estimate prices. It does not calculate equilibrium prices or attempt to specify prices based on any other norm.[2] DAMPS simulates the results of prices that are chosen by the model user. These prices can be administratively determined or based on any other criteria.

Prices that clear the market or achieve some other goal can be calculated through experimentation, i.e., trying sets of prices until the desired objective is attained. Alternatively, users can postulate any random or predetermined change in price levels and examine the consequences of the postulated price behavior.

How Does DAMPS Work?

The purpose of this section is not to explain the intricacies of DAMPS; that type of information is provided elsewhere by Novakovic et al. (7, 8, 9). Rather, the objective of this section is to describe what is required of a user of the model and what a user can expect as output from the model.

The user's guide to FMMOPS, written by Babb et al. (2), contains information on how FMMOPS can be used. A document by Novakovic et al. (10) explains input forms for and output from DAMPS.

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2 Another variation of FMMOPS developed at Purdue is an equilibrium model of Class I milk markets. This model was developed by Kerry Litzenberg and Emerson Babb.

As the paper by Novakovic et al. (9) indicates, users can change a number of the basic model assumptions regarding elasticities, various constraints, and other factors affecting the model environment. The primary user input variable, though, is price.

Users specify the price of Grade B milk, which is assumed to be identical to the Class III price in Market Orders, and Class I and II prices. These prices must be specified for every simulated quarter.[3] Wholesale and retail prices for dairy products are computed internally but are based on the appropriate class price.

Based on these prices, other user input data (10), and a set of base data (11), the model begins by calculating raw milk production and fluid milk consumption in regulated and unregulated Grade A milk markets. Based on processing costs and transportation costs the most efficient movements of milk between supply areas and processing points and between processing points and consumption areas are calculated. Based on the flow and use of milk and the assumed class prices, blend prices are calculated in regulated areas. These blend prices form the basis for production decisions in the following quarter. The Class I price in a given quarter is used to determine the retail price of fluid milk and, consequently, fluid milk consumption for the next quarter.

Grade A milk not used for fluid consumption then becomes available for manufacturing purposes. Grade B milk production is calculated from the assumed Grade B price and is summed with the Grade A milk in excess of fluid milk consumption to total all milk available for manufacturing. Consumption of the five manufactured product groups is calculated from product prices which are based on Class III or Class II prices, depending on the particular product. The demand for these products can be met by imports, available commercial or government stocks, or from products processed from the available supply of manufacturing milk. DAMPS computes the least cost movement of these various sources of dairy products to fulfill the existing demand. Any amounts of dairy products not used for current consumption are assumed to enter commercial or government storage. The model assumes a certain inventory requirement for commercial stocks, such that any remaining product is automatically assumed to enter government storage.

Once the entire model has been solved for one quarter, the model is reinitialized to begin the solution procedure for the following quarter. Blend prices and retail prices computed in the current quarter are used to calculate milk production and dairy product demand, respectively, in the following quarter. Ending dairy stocks become beginning stocks in successive quarters.

The model is capable of generating a large variety and amount of output. Basic model output includes prices, production, processing

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3 Users may specify Class I prices for every area and all class prices for every quarter; however, the model is also capable of internally generating quarterly prices based on absolute or percentage changes in base prices.

levels, and consumption in each of the areas. Movements of milk and milk products between areas is also reported, along with the associated transportation cost. Net quantities of dairy products entering government storage and government expenditures are also a part of the model output. (See Novakovic et al. [10] for further details on and examples of model output.)

How Can DAMPS Be Used?

Basically, any event or action that can be translated into a set of milk prices can be analyzed by the model. This includes any changes in Class price structures in regulated milk markets and changes in Grade B prices that would result from the price support program. The model can be used to analyze the impact of changes of any of the basic model variables, such as transportation costs, regional plant capacities, processing costs, Grade B milk conversion, supply or demand elasticities, etc. Users can also determine the price structures that are consistent with a particular goal that can be measured by the model, such as a minimum level of Class I utilization or a particular level of government purchases or expenditures.

The user can explore a variety of changes in Milk Marketing Order provisions. The model is very flexible in the range of provisions which can be analyzed, but users may need some assistance in taking advantage of this flexibility. Further, there will be a better understanding of provisions analyzed and projections of consequences when there is consultation between the user and researcher. The researcher can be of assistance in suggesting policy alternatives which would achieve user objectives.

Some uses which might be made of the model as it relates specifically to Federal Orders are as follows:

1. Provide a basis for development of economic impact statements. For almost any change that might be made in Federal Orders, the model should be able to project the impact on retail prices, production, consumption of various dairy products, government expenditures, and many other variables of interest. The smallest unit of observation is a Market Order area; so DAMPS cannot be used to estimate different impacts on smaller units within an Order area.

2. The model should be able to project the consequences described above for alternative price levels, alternative geographic price differences, methods of pooling and many other changes in Federal Order provisions. It might even be useful for such analysis as a change in pool plant requirements in a specific Order, although that impact would be greatest on a single Order and nearby Orders as opposed to the national situation.

3. The model can be used for forecasting production, consumption and the like for Orders in the aggregate and even for specific Orders. This was not the intended purpose of the model, but it does a very good job of forecasting, given an assumed set of

prices. The problem with individual Order forecasts is that plants might shift from one Order to another or go out of business and this has unexpected effects on pool statistics.

4. The impacts of factors external to the Orders could be analyzed. For example, over-Order payments are common in Federal Orders and have an impact on consumption, production, and other performance measures in the Orders.

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