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Spatial Equilibrium and Agriculture

Session Moderator: Robert R. Piper, Naval Postgraduate School, Monterey, California

Summary by Session Moderator

All three papers treated the impact of transportation rates on sales of agricultural products to different markets or allocation among transportation modes.

1. Cathy Halbrendt: Corn (as feed for hogs) in China, corn being cultivated in regions different from where hogs are grown.

2. Won Koo: Hard red spring wheat, grown predominantly in the Dakota's, Minnesota, and other northwestern states, transported to population centers and export ports by rail, truck, or barge, depending on relative transportation rates.

3. Mary Marchant: California produce markets, some competitive with producers elsewhere (e.g., Arizona and Florida) and some not competitive, as influenced by truck fuel prices.

The Halbrendt paper on intra-China corn movements excluded exports, a topic for follow-on research. Corn is exported from northern provinces to Japan. The point was made that the desire for hard currency may outweigh other economic considerations in determining corn flows. The nature of the Chinese railroad network was the topic of much discussion. Despite being over 70% steam powered, the system is remarkably efficient by many conventional measures, according to one knowledgeable audience participant. The principal problem is bottlenecks on some high density eastern lines where a need exists both to expand physical capacity and to automate train control and dispatching so as to make better use of existing capacity. Highways are not yet significant in bulk transportation.

There were some questions of Professor Koo regarding wheat transportation. One, from a Canadian teaching in Manitoba, dealt with the influence of Great Lakes bulk carrier rates, as opposed to ocean rates alone, on exports through the Port of Duluth. Professor Koo suggested that the distinction might be more significant for Canadian exports (through Thunder Bay) than for American wheat through Duluth. Another questioner asked if transit time had been explored as well as price. The reply was that time had entered the analysis primarily as a seasonal distinction. Barge transportation is not viable when ice blocks the waterways. In any case, the principal exports are to Asia through the Pacific Northwest ports.

In her analysis of competitive markets for California produce, Marchant concluded that Arizona and Florida were the low cost producers of certain products. She was asked why, in such circumstances, the Arizona and Florida producers did not take advantage of their low cost to expand production. She replied that USDA data implied the existence of capacity constraints. After some sniping at USDA data, the discussion shifted to capacity being a function of increasing marginal cost. She concurred that a quadratic allocation model would, accordingly, be preferable to the linear program that she had used and a logical topic for further research.

- *Transport Improvements in China's Corn Sector: A Hybrid Spatial Equilibrium Approach*
by David H. Hearn, Catherine Halbrendt, and Conrado M. Gempesaw II, University of Delaware, and Shwa-Eng H. Webb, U.S. Department of Agriculture

This paper develops a hybrid spatial equilibrium model which includes the effects of wheat and rice cross-prices. Published supply and demand elasticities are used to derive the supply and demand function parameters for the twenty regions. The model is then validated with 1986 as the base year, and the sensitivity of the model to a range of elasticities is tested. The model exhibits the ability to adequately replicate 1986 production, consumption and prices under the alternative elasticities. The model assumes that the Chinese corn market is in equilibrium and that the existing prices reflect current transfer costs between regions. An alternative scenario is simulated which assumes that capacity and other constraints are relaxed such that actual rail freight costs are now the true constraints upon corn trade within China. The results indicate that the quality of corn traded between regions increases under the alternative scenario. Although not all regions benefits from the lower transfer costs, national welfare is

increased, primarily through consumers' gains from lower prices in most of the country.

- *Spatial Equilibrium Prices of Hard Red Spring Wheat*
  by Won W. Koo,
  North Dakota State University

A quadratic programming model is used to evaluate spatial equilibrium conditions for the U.S. hard red spring (HRS) wheat industry. Criterion of the model is to maximize net social pay-off, which is the sum of social benefits.

This study reveals that modal shares of HRS wheat by rail, truck, and barge are 45, 15, and 40 percent, respectively, in the base model. Modal shares are more sensitive to changes in rail rates than to changes in other transportation rates for both export and domestic shipments.

Changes in ocean freight rates do not alter modal share and flow direction in shipping wheat from producing regions to domestic consuming regions and export ports. However, changes in ocean freight rates influence wheat prices and quantities traded at U.S. ports and prices in importing regions. The Pacific Northwestern ports are the largest for spring wheat exports; they handle about 49 percent of the total spring wheat exported in the base model. The Gulf port and Duluth handle 27 percent and 24 percent of spring wheat exported, respectively. Accordingly spring wheat price in the base model is highest at the PNW, second highest at the Gulf, and lowest at Duluth. The changes in prices at U.S. ports are much greater than those in importing regions. This suggests that unstable ocean freight rates contribute greater uncertainty in wheat prices to U.S. wheat farmers than to consumers in importing regions.

- *Impact of Rising Transportation Costs on California's Market Share of Fresh Fruits and Vegetables*
  by Mary A. Marchant,
  University of Kentucky

The purpose of this study is to determine the impact of rising transportation costs stemming from increased fuel costs on California's fresh fruit and vegetable production. Crops were divided into two categories, competitive and monopoly crops. In this study, monopoly crops include five crops which are either exclusively produced in California (90 percent or greater of the production share) or crops in which California has a seasonal advantage. Competitive crops include 13 crops whose markets are competitive in the sense that California must compete for market share with other producing regions.

Regarding competitive crops, rising transportation costs may place California at a disadvantage relative to other producing regions with shorter distances to market, thereby lower transportation costs. Both transportation and production costs must be analyzed for each producing region to determine whether rising transportation costs will alter California's market share. A linear programming transportation model was developed for analysis of competitive crops. The model allocates crops between producing regions and markets in order to minimize total costs subject to various production and consumption constraints. Results specify how much of each crop should optimally be grown in each producing region and the amount each producing region should distribute to individual markets in order to minimize total costs.

Regarding monopoly crops, production in other regions does not enter into the analysis. The key question concerning monopoly crops is whether consumers are willing to continue purchasing these commodities when their price rises as a result of increased transportation costs. In order to analyze the impact of rising transportation costs on monopoly crops, consumer demand (price forecasting) equations were used. The analysis for monopoly crops calculates the reduction in consumer demand as a result of increased transportation costs. This analysis was performed separately for transportation costs incurred by truck and rail transportation modes.

Results indicate a relatively minor effect on the demand for crops which California exclusively produces, while 58 out of 123 seasonal distribution patterns may change for nonexclusively produced California crops. This analysis was performed using data from the early 1980s. Currently, the author is updating this data set and will rerun this analysis, comparing updated results to those presented above.