January 1998 E.B. 98-01

ESTIMATION OF REGIONAL DIFFERENCES IN CLASS I MILK VALUES ACROSS U.S. MILK MARKETS

by

James E. Pratt
Andrew M. Novakovic
Phillip M. Bishop
Mark W. Stephenson
Eric M. Erba
Craig S. Alexander

A Publication of the Cornell Program on Dairy Markets and Policy

Department of Agricultural, Resource and Managerial Economics
College of Agriculture and Life Sciences
Cornell University
Ithaca, NY 14853-7801

PREFACE

The authors (James E. Pratt, Senior Research Associate; Andrew M. Novakovic, The E.V. Baker Professor of Agricultural Economics; Phillip M. Bishop, Research Support Specialist; Mark W. Stephenson, Senior Extension Associate; Eric M. Erba, Research Support Specialist; and Craig Alexander, Extension Associate) of this report are (or were at the time of the study) members of the Department of Agricultural, Resource, and Managerial Economics.

This research was supported through grants provided by the U.S. Department of Agriculture through the Agricultural Marketing Service and the Cooperative State Research, Education, and Extension Service. Any views expressed here are those of the authors and do not necessarily reflect views of either Cornell University or the U.S. Department of Agriculture.

Additional copies of this paper can be obtained by writing:

Ms. Wendy Barrett
Program Secretary, CPDMP
Cornell University
Warren Hall
Ithaca, NY 14853-7801

This publication is also available through the internet at our World Wide Web site (see address below). You will need version 3 or above of Adobe® Acrobat Reader or its equivalent.

http://cpdmp.cornell.edu/

ESTIMATION OF REGIONAL DIFFERENCES IN CLASS I MILK VALUES ACROSS U.S. MILK MARKETS

James E. Pratt, Andrew M. Novakovic, Phillip M. Bishop, Mark W. Stephenson, Eric M. Erba, and Craig S. Alexander

Introduction

In the 1996 Farm Bill, USDA was charged with undertaking the consolidation of federal milk marketing orders from 32 currently, to between 10 and 14 orders. Although nothing more than consolidation was mandated, clearly it was the expectation of Congress that the entire classified pricing structure, as well as other provisions of federal orders, would come under review. Trade liberalization through NAFTA and GATT has also raised questions about regional price differences, as well as the average level of milk prices in the U.S. Of particular relevance to marketing orders and regional prices is the prospect of freer trade with Canada and Mexico.

One might argue that the question of how class I differentials are determined and the relationship of prices between the different market orders has been the most controversial issue to date. The issue is not new. It has been raised periodically since the beginning of the federal market order system.

The concept of location value and price alignment for milk was identified and explored in a landmark USDA study in 1955 (USDA-AMS, Report 98, 1955). Milk prices actually paid by fluid handlers were compared with the hypothesis that milk prices would be lowest in surplus areas and highest in deficit areas, but would not vary between locations by more than the cost of transportation. The results were hardly a perfect fit but they showed a general relationship of price and distance from the Upper Midwest 'surplus' areas to other areas, except for the West and Northeast which didn't quite fit that pattern. The 1955 study formed the conceptual basis for the integrated class I differential pricing system that was in place and thereafter evolved.

Current class I differentials regulated under federal milk marketing orders are illustrated in the form of equal price contour lines (isovals) over a map of the U.S. in *Figure 1*. Although the current actual differential structure varies significantly from the generally perceived notion of a strict 'Eau Claire plus transportation' formula, growing dissatisfaction in the Upper Midwest, particularly as a result of congressionally-determined class I differential changes in the 1985 Farm Bill, led to questions about the appropriate relationship of class I prices between markets. This criticism came to a head in the federal order debate during passage of the Federal Agriculture Improvement and Reform Act (a.k.a. the 1996 Farm Bill).

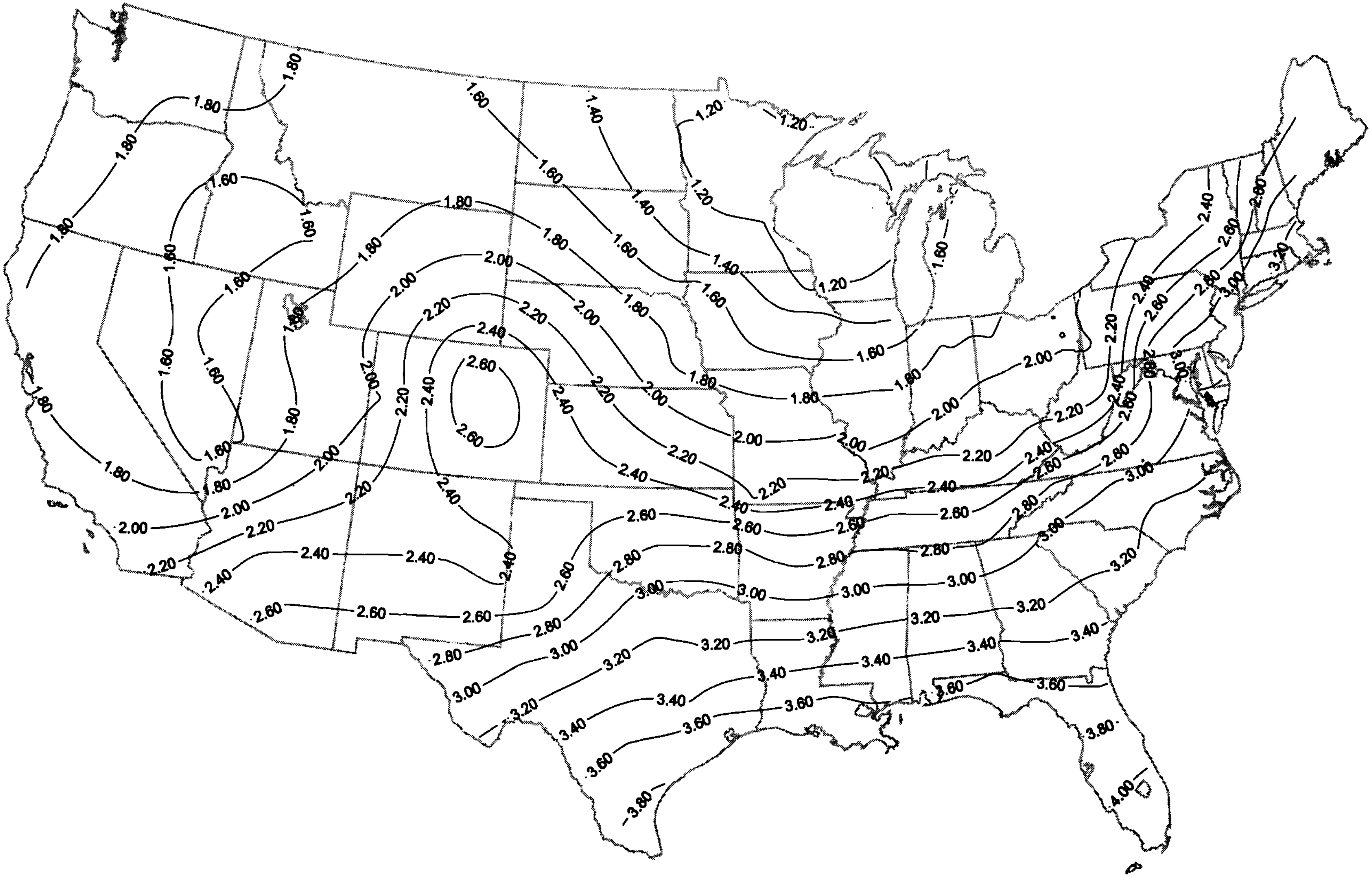

Figure 1. Current Federal Order Class I Price Differentials

As a result of the 1996 Farm Bill, USDA requested that Cornell study the issue of class I price relationships across market areas. In this study we have used a model, the U.S Dairy Sector Simulator (USDSS), which equilibrates the allocation of milk and milk products over geographic areas. This paper reports the results of the analysis to date and their implications. The research method is summarized briefly in an appendix.

The strength of the methodology used for this study is its ability to calculate regional differences in the value of milk consistent with competitive market behavior and the physical and economic characteristics of the U.S. dairy sector. Absolute levels of prices will vary over time and are not calculated here. In addition, as discussed in the appendix, the model results can be expressed in the form of class I differentials.

Analysis of the Results

The results for May 1995 are shown in contour maps labeled *Figures 2* and *3*. The model's estimated class I values are shown in terms of a derived, revenue-neutral class I price differential. This revenue-neutral differential was calculated by taking the gross value of current federal order class I differentials for all marketing areas for May, determining the level of differential that maintains our estimated regional class I price differences and results in the same gross, national revenue. The contour bands (isovals) indicate locations where differentials are equal. The contours were plotted at $.20/cwt. intervals.

Figure 2 shows that the value of class I milk was lowest in northwestern Minnesota, southern Montana, central California, and northwestern Washington with differential values between $1.40 to $1.60/cwt. A wide band of values between $1.60 and $1.80/cwt. stretches from Minnesota, through the Dakotas, Wyoming, Idaho, northern Nevada, central California, eastern Oregon, and Washington. Additional 'low' spots relative to surrounding areas were found in such states as, Arizona, New Mexico, the Lake Texoma area of Oklahoma and Texas, central Kentucky, and western New York.

The highest values were found in the Southeast, particularly Florida, where differentials reached over $5.00/cwt. in Miami. Additional high values were found in Louisiana, southern Texas, and along the east coast; with differentials generally just over $3.00. Other areas with locally high values relative to surrounding areas were Santa Fe, Las Vegas, San Francisco, and Peoria.

Comparison to Current

It can be seen from the map that estimated price relationships are not grossly different from the relationships under the current differential structure. Values still tend to be lowest in the West and Upper Midwest and highest in the Southeast. The correlation coefficient of actual class I differentials and model-generated values is .73 with 1.00 signifying a perfect

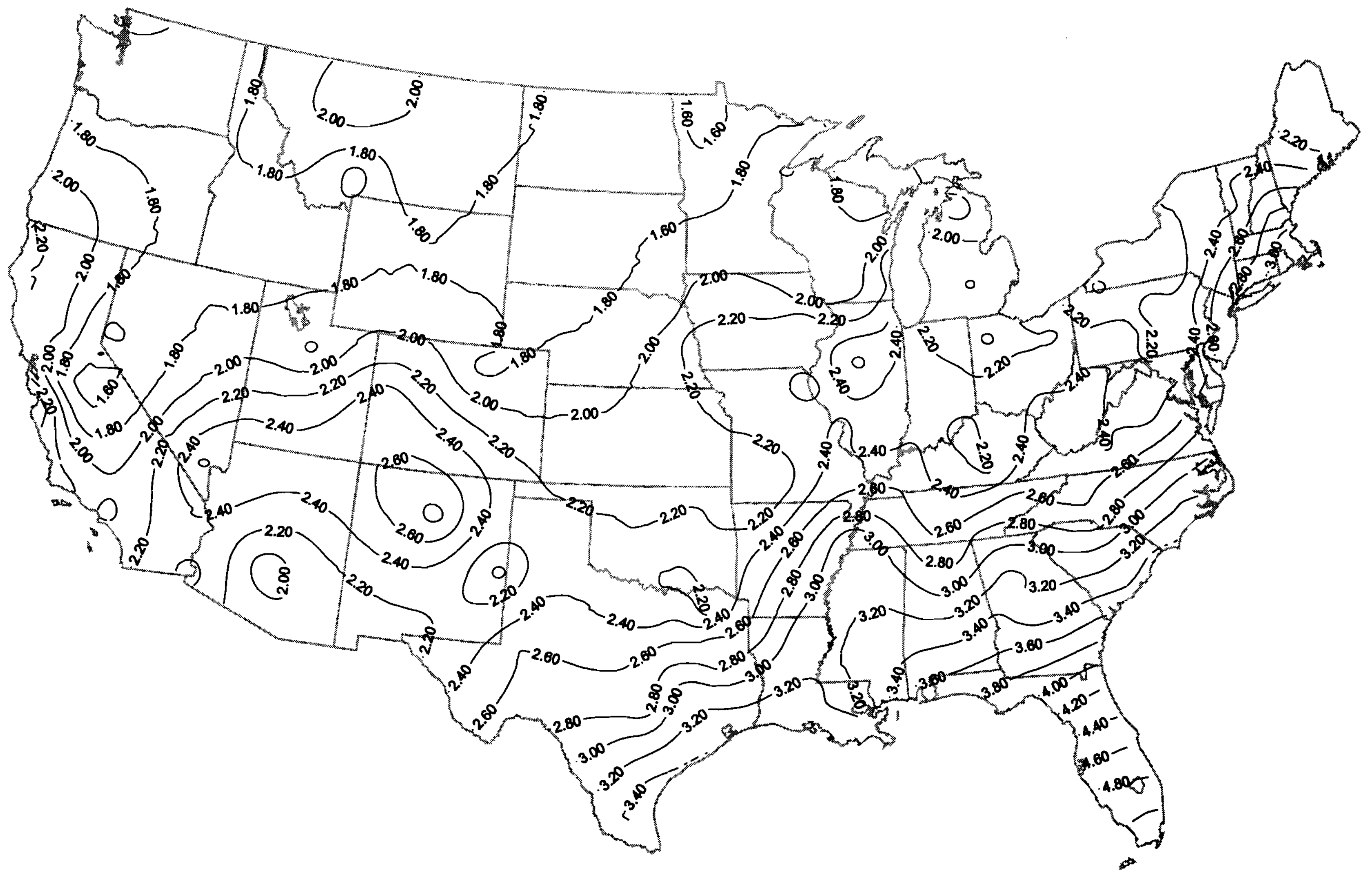

Figure 2. USDSS Model-Generated Revenue-Neutral Class I Price Differentials, May 1995

linear correlation. This suggests considerable similarity between actual and calculated differentials, but as *Table 1* (below) portrays, there are also significant differences.

Table 1. Comparison of Current and Model-Generated Class I Differentials

City	Current Class I $/cwt.	Model Revenue-Neutral	Difference $/cwt.	City	Current Class I $/cwt.	Model Revenue-Neutral	Difference $/cwt.
Chicago	$1.40	$2.46	$1.06	**Dallas**	$3.16	$2.47	-$0.69
Minneapolis	$1.20	$1.97	$0.77	**Denver**	$2.73	$1.91	-$0.82
New York	$3.14	$2.77	-$0.37	**Las Vegas**	$1.60	$2.62	$1.02
Philadelphia	$3.09	$2.52	-$0.57	**Phoenix**	$2.52	$1.88	-$0.64
Atlanta	$3.08	$3.26	$0.18	**Los Angeles**	$2.07	$1.95	-$0.12
Miami	$4.18	$5.08	$0.90	**Seattle**	$1.90	$1.88	-$0.02

Model results indicate that Eau Claire, Wisconsin, is not in the lowest band of differential values, nor do values increase uniformly from Eau Claire or any of the other low value locations. While the range from the model's lowest point to the highest point, (Thief River Falls $1.45 - Miami $5.08), is greater than under current federal order differentials, in general, there are large areas of 'flatness' that characterize the prices throughout much of the West and Midwest. A measure of this relatively 'flatter' surface can be seen by the standard deviation of the current differentials among the cities in the model being $.74/cwt. while the standard deviation across the simulated differentials is $.63. The values in general do not increase as much as transportation costs alone would indicate and with few exceptions, the price gradient only becomes very steep when one nears the population centers along the East Coast, in the Southeast, and some isolated cities in the West. Only in locations where the price contours are narrow do the differential values come close to reflecting full transportation costs. These areas, not surprisingly, are generally in deficit consumption areas which require significant inflows of milk.

The map in *Figure 3* compares the model-generated differentials and actual federal order differentials or similar state order values in the case of California, Maine, Montana, Western New York, Pennsylvania and Virginia.* The shaded areas indicate locations where differences between model-generated and current differentials were less than $.20/cwt. The areas with positive values indicate locations where model-generated values exceed

* These states establish minimum class I prices. In some cases the states do not use the federal system of a differential plus the basic formula price (bfp). Estimated differentials were calculated that, when added to the appropriate bfp, result in class I prices as specified under the state in 1995. Recent changes to class I price regulations in California and Montana are reflected instead of actual 1995 data, however. The Pennsylvania-regulated 'over-order' prices that are added to regular state and federal order class I prices, and class I prices established by the New England Compact are <u>not reflected</u>.

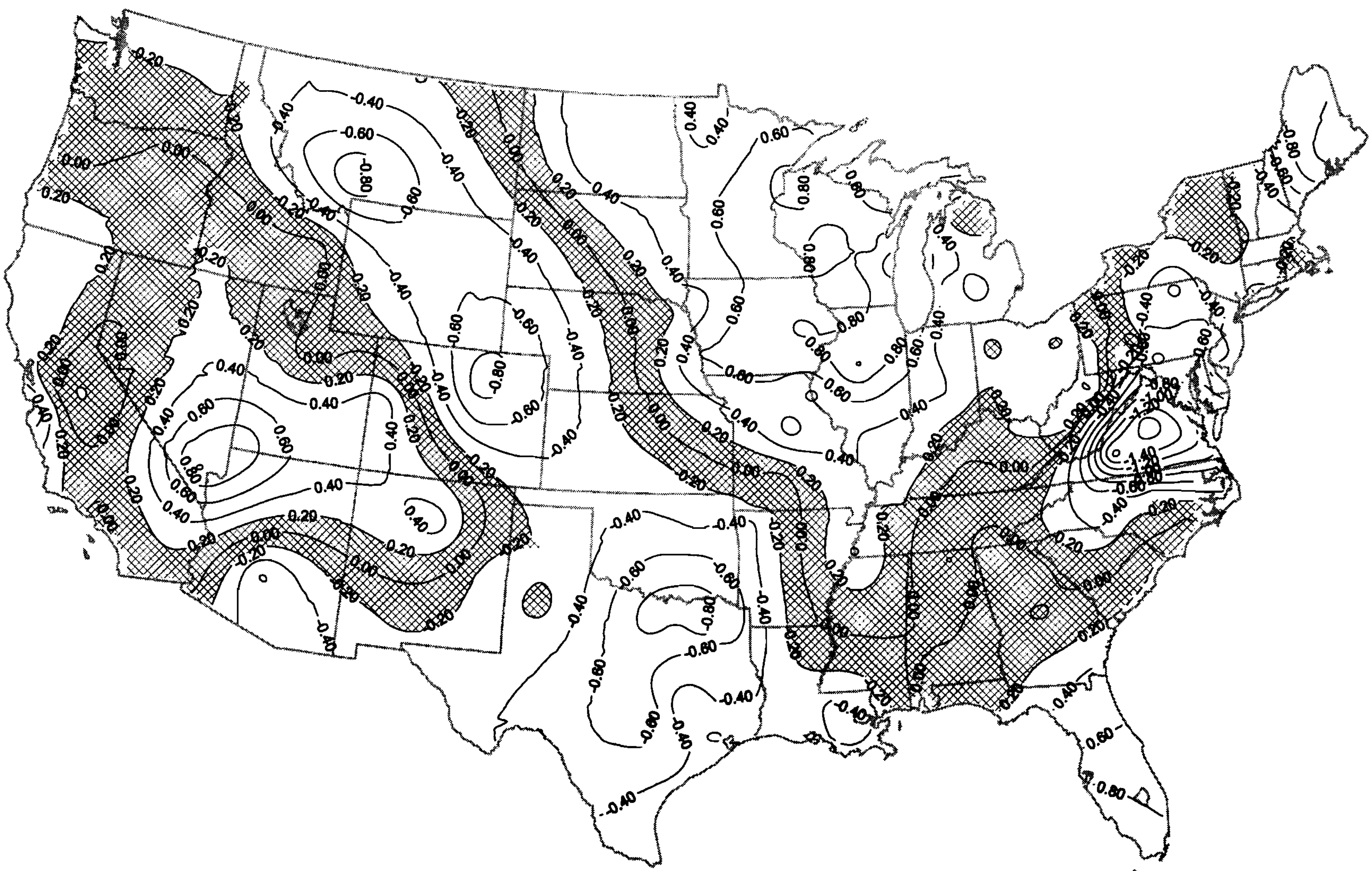

Figure 3. Revenue-Neutral Class I Differentials Minus Current Differentials

current differentials by $.20/cwt. or more. The areas with negative values indicate locations where current differentials exceed model-generated values by $.20/cwt. or more.

The highest positive regions were located in the Upper Midwest, southern Nevada/Utah, and Florida areas with model-generated values exceeding current regulated differentials of between $.80-$1.00/cwt. The area with the largest negative comparison was found in Virginia, which has a state pricing program, as well as the state order in Maine which also showed a negative comparison. Other northeastern areas where prices show negative comparisons in the range of $.40-$.60/cwt. include Maryland and Pennsylvania. A wide band of negative values also stretches from Texas and Louisiana up through Colorado and north into Montana. Southern Arizona also showed a locally negative comparison as well. Recent reductions to California's class 1 prices seem to have brought their prices relatively in line with the model's suggested values. Significant areas in the West and Southeast and spots in the Midwest and Northeast also seem to be in alignment with current differentials. Interestingly, a couple of examples of the changes in pricing relationships between regions suggested by the model and shown in *Table 1* are that Chicago, Philadelphia, Dallas, and Las Vegas should be at almost the same class I price level, and Minneapolis, Denver, and Phoenix and should be on par with Los Angeles and Seattle.

<u>Seasonal Variation</u>

In addition to May 1995, the same analysis was also conducted for October 1995 in order to consider how seasonality might impact the results. While there were some differences from the May results, they were not large. The correlation coefficient of the shadow values between May and October was .99. One might expect that high value, supply deficit areas in the spring, might have even higher values in the fall. In fact, several southeast locations did have about $.30/cwt. higher values for October as compared to May, as well as higher values relative to other locations in the fall. This may suggest that seasonal market premiums would occur in the Southeast, especially Florida; or it could justify a regulated incentive mechanism involving seasonal differentials or other performance-oriented payments to attract milk movement for class I needs.

<u>Summary and Conclusions</u>

This research uses a spatially detailed model of the U.S. dairy sector which reflects the principle marketing activities that occur between the production of milk and the consumption of dairy products. The model provides estimates of location specific milk values under the assumption that markets are organized in an efficient and marketing costs minimizing way, as theory suggests would occur in the long run under competitive conditions.

The results clearly indicate that there are distinct location values across marketing regions in the U.S. In general the model-generated values are lowest in areas of high production and low demand, as one would expect. The values increase from these low points but at generally less than full transportation costs. The overall shape and range of differences, low to high, does not strike one as remarkably different from the current set of differentials, however it is somewhat flatter. It can be argued that the general framework of location dependent values is still valid, albeit in need of some adjustment given changes in production, consumption and transportation costs over time. The results of the model can be used as an objective benchmark for reviewing current differentials keeping in mind that there may be practical milk marketing considerations and institutional factors that were not considered, of which the impact on blend prices is no small factor.

In comparing the model results with current differentials on a revenue-neutral basis, there are areas which seem to be misaligned with location values calculated by the model. The implications of misalignment could be stated in terms discussed earlier. If the administered class I price at particular fluid plant locations in a consumption area are set too high relative to other distant locations, there could be inefficient incentives to supply the area from those distant processing points to the disadvantage of local processors, while at the same time providing too much stimulus for local milk production. On the other hand, if regulated class I prices are set too low, the local fluid plant might have to pay premiums to attract milk supplies, or if not, could use the lower relative price as a competitive advantage versus other regulated handlers. In a minimum price program, premiums can provide flexibility and 'fine-tuning' to the system. However, given the imperfect characteristics of the milk market, over-dependence on market premiums could fail to appropriately represent location values to the detriment particularly of producers. Premiums may not be applied uniformly, to the detriment of certain processors and producers. Prices that are 'too low' could also lead to non-optimal production, milk movements and processing. Carried to the extreme, replacing class I differentials with over-order premiums could be at odds with the concept of pooled revenues in the federal order program.

While the model does not attempt to consider how production and consumption may be altered in response to values at various locations, it can be argued that a misalignment of regulated prices between locations could lead to the wrong milk production signals being sent, misplaced plant locations, and reduced consumption based on a higher cost, less efficient industry. If prices were changed in a manner suggested by the results, there could be intermediate and longer term implications for local production and consumption, which have not been explored by this research. Nevertheless, the direction of changes noted here makes it hard, if not impossible, to predict that surplus areas will become deficit areas and deficit areas will go to surplus; thus the basic regional pattern is likely to be stable until something other than market price movements alone comes along to shift supplies, demands and/or transportation technologies, more fundamentally. Production and consumption patterns do change over time. Therefore a system that applies location values to class I differentials will need to be periodically updated.

milk and milk components across the U.S. under assumptions of globally efficient markets. Using 240 supply locations, 334 consumption locations, 622 dairy processing plant locations, 5 product groups, 2 milk components (fat and solids-not-fat) and transportation costs between all locations, USDSS determines mathematically consistent location values for milk and milk components. The current analysis uses data from May and October 1995.

County level estimates of milk supply and dairy product consumption are aggregated to specific geographic points. These aggregated supplies and consumption levels are fixed at the various points used. Plant locations were restricted to those presently processing products but plant processing locations were not constrained with respect to the volume processed. Thus, the model permits milk to be processed with little regard to current patterns. Processing costs are assumed to be uniform between locations and across plant volumes (no economies of scale). Therefore, processing is allowed to move among available locations to find the least cost solution in terms of assembly from supply points and distribution to demand points.

Transportation costs were categorized by raw milk assembly, interplant bulk shipments, refrigerated and non-refrigerated finished products. Transportation costs among regions reflect differences in wage rates and actual highway weight limit regulations that vary by state. While assembly costs and interplant bulk shipments were calculated using a linear cost function, the refrigerated and non-refrigerated functions were non-linear. In fact, refrigerated costs (e.g. packaged milk) fell below raw milk assembly costs on an equivalent unit basis in many cases at distances over 900 miles. Previous versions of the model had assumed constantly higher fluid packaged product transportation costs versus raw milk assembly costs for all distances.*

The output from the USDSS provides information as to optimal processing locations and assembly, processing and distribution flows. It represents a least cost, or 'efficient' organization of the industry. Importantly for this research, the model provides the marginal values (i.e. the value of one more unit) of milk at each location. These values, technically known as shadow prices, are indicative of values that are consistent with the optimized solution. A shadow price on one unit of milk at processing location 'x' can be interpreted as follows: if the processor at location 'x' had one more unit of milk, the entire pattern of milk, and product transportation could be reorganized in a way that saved marketing costs by the amount

* Earlier research that has been reported elsewhere was based on an older version of the model. Present revisions have made substantial changes to the various transportation cost functions. In particular, distribution costs for refrigerated products were reduced substantially and now are on par with bulk milk assembly costs.

OTHER AGRICULTURAL, RESOURCE, AND MANAGERIAL ECONOMICS EXTENSION BULLETINS

ORDER NO.	TITLE	AUTHOR(S)
E.B. 997-22	FISA--A Complete Set of Financial Statements for Agriculture	LaDue, E.L.
E.B. 97-21	New York Economic Handbook, 1998: Agribusiness Economic Outlook Conference	A.R.M.E. Staff
E.B. 97-20	Farm Labor Regulations	Grossman, D.A.
E.B. 97-19	1997 Farm Income Tax Management and Reporting Reference Manual	Smith, S.F. and C.H. Cuykendall
E.B. 97-18	Lake Erie Grape Farm Cost Survey, 1991-1995	Shaffer, B. and G.B. White
E.B. 97-17	LEAP, Lease Analysis Program--A Computer Program for Economic Analysis of Capital Leases	LaDue, E.L.
E.B. 97-16	Analyzing Capital Leases	LaDue, E.L.
E.B. 97-15	Dairy Farm Business Summary, Eastern New York Renter Summary, 1996	Knoblauch, W.A. and L.D. Putnam
E.B. 97-14	Dairy Farm Business Summary, Intensive Grazing Farms, New York, 1996	Conneman, G., C. Crispell, J. Grace, K. Parsons and L. Putnam
E.B. 97-13	Fruit Farm Business Summary, Lake Ontario Region, New York, 1996	White, G.B., A.M. DeMarree and L.D. Putnam
E.B. 97-12	Dairy Farm Business Summary, Northern New York Region, 1996	Milligan, R.D., L.D. Putnam, P. Beyer, A. Deming, T. Teegerstrom, C. Trowbridge and G. Yarmall
E.B. 97-11	Dairy Farm Business Summary, Central Valleys Region, 1996	LaDue, E.L., S.F. Smith, L.D. Putnam, D. Bowne, Z. Kurdich, C. Mentis, T. Wengert and C.Z. Radick
E.B. 97-10	"Maximizing the Environmental Benefits per Dollar Expended:" An Economic Interpretation and Review of Agricultural Environmental Benefits and Costs	Poe, G.
E.B. 97-09	Dairy Farm Business Summary, Northern Hudson Region, 1996	Smith, S.F., L.D. Putnam, C.S. Wickswat, S. Buxton and D.R. Wood

To order single copies of ARME publications, write to: Publications, Department of Agricultural, Resource, and Managerial Economics, Warren Hall, Cornell University, Ithaca, NY 14853-7801. Visit our web site at http://www.cals.cornell.edu/dept/arme/ for a more complete list of recent publications.