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Competitiveness of South Central U.S. Potato Production: An Examination of the Spring and Summer Market

by

Stephen Fuller
Professor
Department of Agricultural Economics
Texas A & M University
College Station, Texas

H. L. Goodwin
Associate Professor
Department of Agricultural Economics
Texas A & M University
College Station, Texas

John Schmitz
Graduate Research Assistant
Department of Agricultural Economics
Texas A & M University
College Station, Texas

Producer/shippers in the south central United States (lower Rio Grande Valley and South Plains) are uncertain about the ability of this region to be a competitive supplier of new-crop potatoes for the tablestock or fresh market during the spring and summer market windows. Currently, the lower Rio Grande Valley is a minor supplier of new potatoes (round reds) during the spring market window (1 percent share), whereas the South Plains' shipments (Norgold Russets) are concentrated in July and August, with smaller marketings extending into September. In contrast to the Rio Grande Valley area, the South Plains has been increasing its market share during the summer window. In recent years the South Plains has supplied 10 to 15 percent of the summer season market.

During the spring months, potato shipments from the fall producing regions (Idaho, Colorado, Oregon, Washington, Maine) dominate the tablestock market. The fall produced potatoes come from storage and make up

about three-fourths of all table consumption during the spring. The remaining demand is satisfied by the new-crop product. Important new potato suppliers during the spring window include Arizona, California, Florida, North Carolina and Virginia. It is estimated that California and Florida's combined market share in the spring is about 75 percent, with California supplying about two-thirds of the new product (USDA, *Fresh Fruit and Vegetable Shipments*).

During the summer season, virtually all table consumption is satisfied by new potatoes. Important summer producers include California, Delaware, New Jersey, Long Island (New York), North Carolina, Texas and Virginia. In addition, major fall shippers enter the tablestock market with early varieties during the summer season and often dominate. California is the largest shipper in July (40 percent) while the Pacific Northwest states are predominant in August (48 percent) and

September (41 percent) (USDA, *Fresh Fruit and Vegetable Shipments*).

This study employs a national inter-regional trade model to examine the ability of the lower Rio Grande Valley and High Plains potato producer/shippers to compete with other new-crop production regions for table-stock sales in the spring and summer seasons. About a fourth of the table consumption during the spring is satisfied with the new potatoes, while nearly all consumption during the summer is a new product. During the spring season some consumers prefer the new potato to the stored product; that is, the two products are not perfect substitutes. This is implied by the higher price often associated with new potato shipments during the spring period (Goodwin, et al.). The spatial model used in this analysis considers regional potato production costs and distribution costs that link surplus producing areas with potato-deficit consumption regions.

Framework for Analysis

Efficient resource use implies a geographical distribution of production that satisfies market requirements at the lowest possible cost of production and transfer (Bressler and King). King outlined how the transportation model in combination with production and processing cost might be used to offer insight into the cost competitiveness of producing regions. Numerous studies have successfully used transportation and transshipment models to examine the competitiveness issue. Examples of studies using this methodology are those by Bates and Schmitz, Ben-David and Forker, and O'Rourke.

The spatial model developed for this study includes each surplus region's monthly supply of table potatoes, transportation charges which link the surplus producing regions with consumption regions, and estimated regional demands for table potatoes. Based on this information, the model determines the most efficient (least-cost) flow of potatoes between production (supply) and consumption (demand) regions. Efforts to obtain reliable regional potato production costs were unsuccessful; thus, as an alternative, assumptions about regional differences in production costs were made and the associated impact on market share determined.

An effort was made to include potato production costs in the model for a comparable quality and size of potato in each pro-

duction region, but reliable data was not available. Grower level prices were investigated as a proxy for production costs but were judged inappropriate due to regional differences in marketing practices which were subsequently incorporated in price. Furthermore, the recorded prices confounded fresh and processed potato prices. As an alternative, specific assumptions about regional differences in production costs were made and analyzed with the trade model. This approach seemed appropriate in view of the focus on the lower Rio Grande Valley and the South Plains regions. In order to offer intuitive evidence on region production costs, a review of available cost budgets is included.

Economic Model

The developed trade model includes spatial and temporal dimensions and can be expressed in mathematical notation as follows:

Let:

- i = potato producing region ($i = 1 \dots n$)
- j = potato consuming region ($j = 1 \dots m$)
- Q_{ik}^s = quantity of potatoes supplied in region i in month k ($k = 1, 2, 3 \dots 12$)
- Q_{jk}^c = quantity of potatoes consumed in region j in month k
- S_{ijk} = quantity of potatoes shipped from region i to region j in month k
- TC_{ijk} = transfer cost linking region i to region j in month k
- P_{ik} = shipper's production cost differential in lower Rio Grande Valley or South Plains in month k

The objective is to determine the S_{ijk} s which minimize:

$$\sum_{i=1}^n \sum_{j=1}^m \sum_{k=1}^{12} S_{ijk} TC_{ijk} + P_{ik}$$

Subject to:

$$S_{ijk} \geq 0$$

$$Q_{ik}^S = \sum_{j=1}^m S_{ijk}$$

$$Q_{jk}^C = \sum_{i=1}^n S_{ijk}$$

$$\sum_{i=1}^n Q_{ik}^S = \sum_{j=1}^m Q_{jk}^C$$

Data Components of Model

To construct the interregional trade model, there was a need to (1) delineate production and consumption regions, (2) estimate available supplies in each producing region, (3) estimate consumption in each consumption or demand region and (4) estimate transportation charges that link production and consumption regions.

Demand and supply regions: The national model includes 57 regions. Twenty regions are consumption or demand regions (Figure 1), while the remaining 37 are supply regions made up of Canada and 36 states. Monthly table potato supplies for each region are based on an average of its 1983-85 shipments (USDA, *Fresh Fruit and Vegetable Shipment Totals by Commodity*).

The consumption of table potatoes was estimated with data from the *Nationwide Food Consumption Survey* (NFCS) and the *Census of Housing*. The Food Consumption Survey is a national survey of 15,000 households and includes comprehensive and detailed data on weekly food consumption patterns. Consumption in each demand region is estimated with the NFCS and Census data. In particular, consumption in each demand region is estimated by multiplying per household consumption (NFCS) for each region by estimated number of households per region (Census).¹

The NFCS shows per household potato consumption to be about 12 percent greater in the fall and winter than during the spring and summer. Further, per household consumption of table potatoes varies by region. Household consumption of table potatoes per week is highest in the north central United States (3.06 lbs.), followed by the South (2.83 lbs.), Northeast (2.77 lbs.) and West (2.64 lbs.)

regions--average weekly consumption of tablestock potatoes in the United States was found to be 2.82 pounds per household.

Transportation costs: For low-valued, bulky products such as potatoes, the cost of transportation can have an important bearing on the ability of a supply region to compete in a national market. Based on truck rate data obtained from the *Fruit and Vegetable Truck Rate and Cost Summary*, seven regression equations were estimated and subsequently used to estimate rates over the various transportation corridors. All equations show distance of haul (miles) to be the most important factor determining rates and, to a lesser extent, the month of shipment. Over 90 percent of the variation in rates was explained by each of the estimated rate equations. The estimated rates linking the study regions with the twenty demand regions during their market window are shown in Table 1.

Railroads are important carriers of potatoes produced in California, Idaho, Oregon and Washington. Rail carriers in these regions (Burlington Northern, Union Pacific, Southern Pacific) offer strong competition in the transcontinental transportation market and are often the low-cost carriers on movements to eastern U.S. demand regions. Estimated truck rates were compared to railroad rates for purposes of identifying the least-cost mode linking supply and demand regions.

Cost of potato production: Cost budgets for spring and summer season producers were collected to offer evidence on regional differences in potato production costs. Because fixed costs and extent of harvesting services included in the various budgets differed, the focus of the cost comparison was on operating or variable production costs.

Based on the available information, the estimated per cwt variable cost of spring season table production in California, Florida, Arizona and North Carolina ranged from \$3.30 to \$3.90/cwt (California Cooperative Extension Service: Hathorn, Harper and Wade; North Carolina Cooperative Extension Service: Smith and Taylor). Clearly, there was little evidence of significant cost advantages or disadvantages for these major spring producers. The Florida budget was most inclusive regarding harvest and marketing costs with the identification of digging, grading, hauling, selling and container costs: the estimated costs of these respective activities were \$.60, \$1.34, \$.15, \$.25 and \$.66 per cwt or a total harvest

Figure 1
Demand Regions Included in Spatial Model

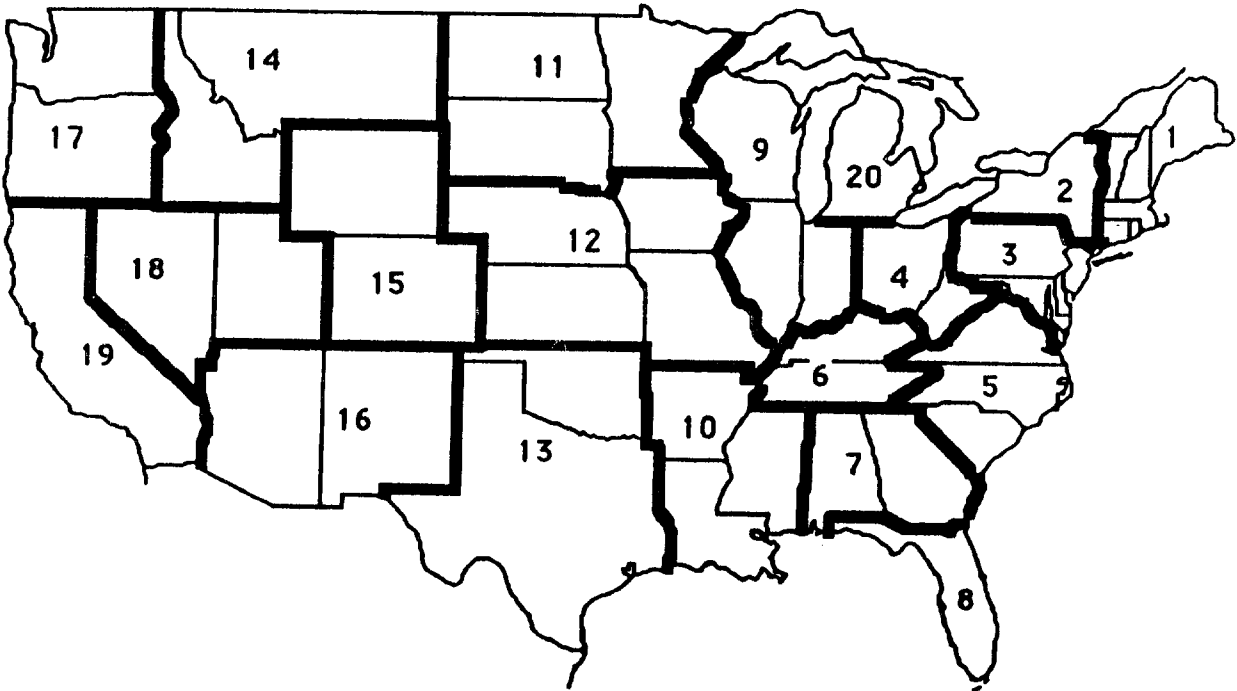


Table 1. Estimated Truck Transportation Rates Linking the Lower Rio Grande Valley and the South Plains With the Twenty Demand Regions
 (Figure 1) During their Shipping Season, 1983 $\frac{1}{2}$

Shipping Month	Demand Regions (Figure 1)																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
April	5.20	4.73	4.35	3.36	3.94	2.65	3.01	3.73	3.08	2.06	3.09	1.91	1.05	3.52	1.60	1.81	4.45	2.54	3.82	3.14
May	5.23	4.76	4.38	3.39	3.97	2.68	3.04	3.76	3.11	2.09	3.12	1.94	1.08	3.55	1.63	1.84	4.48	2.57	3.85	3.17
June	5.22	4.75	4.37	3.38	3.96	2.67	3.03	3.75	3.10	2.08	3.11	1.93	1.07	3.54	1.62	1.84	4.47	2.56	3.84	3.16
July	5.21	4.74	4.36	3.38	3.95	2.66	3.03	3.74	3.09	2.07	3.10	1.92	1.06	3.53	1.62	1.82	4.47	2.56	3.83	3.15
Aug	5.19	4.72	4.34	3.36	3.93	2.64	3.01	3.72	3.07	2.05	3.08	1.90	1.04	3.51	1.60	1.80	4.45	2.54	3.81	3.13
Sept	5.21	4.74	4.38	3.38	3.95	2.66	3.03	3.74	3.09	2.07	3.10	1.92	1.06	3.53	1.62	1.82	4.47	2.56	3.83	3.15

and marketing cost of \$3.00 per cwt (Smith and Taylor). When the variable production, harvesting and marketing costs are aggregated for the various regions, the total variable costs range from \$6.30 to \$7.00/cwt.

It was difficult to generalize regarding summer season production costs because of few comparable cost budgets for the important shipping regions. Many of the suppliers during the summer season are important fall crop producers, in which case their budgets focus on that season. Horticulturists in fall-producing states indicate their summer yields are generally lower but per acre production costs similar to the fall season production. After making these allowances, per hundredweight costs were estimated. In general, the variable production cost in combination with harvest and hauling costs ranged from \$3.00 to \$4.00/cwt. The cost of handling, grading, inspection and bagging added from \$2.50 to \$3.00/cwt to variable costs; in which case total variable costs ranged up to \$7.00/cwt for summer season table potatoes (Benson and Preston; Snyder, Sieber, White and Bills; USDA, *Economic Indicators of Farm Sector*). In 1987, variable production cost in the South Plains, in combination with harvesting and marketing cost, was estimated to be \$6.70/cwt (Texas Cooperative Extension Service).

Results

Market shares of spring and summer season study region shippers is estimated under two assumed situations: (1) lower Rio Grande Valley and South Plains production is unconstrained while competing regions' production is fixed at historical levels and (2) all regions' production is unconstrained.

Competitiveness of Lower Rio Grand Valley

The analysis shows the Rio Grande Valley to be favorably located for purposes of increasing its share of the spring potato market (Table 2). If market share were based only on transport costs--that is, if potato production costs in the Rio Grande Valley were similar to other new-crop producers in the spring window--the Valley producers would claim 49 percent of the national market. This outcome is based on the assumption that competing regions' shipments are constrained to historical averages, while Valley shipments are unconstrained. Further, if the Valley had a \$.50/cwt production cost advantage, a 63 percent market share would result; or, with a \$.50/cwt cost disadvantage, a 33 percent mar-

ket share. Even with a \$2.50/cwt cost disadvantage, a 16 percent national market share is projected for the lower Rio Grande region. Except for California and Florida, the market share of competing regions is virtually unchanged as production costs in the Rio Grande region are adjusted. The advantage of the Rio Grande region is primarily in relation to California, the leading shipper of new potatoes during the spring window. This is the result of the Valley's proximity to major consumption centers in the eastern half of the United States and the associated lower transportation costs.

The market share information in Table 3 is based on the notion that all production regions have unlimited ability to expand production; accordingly, this is a more conservative estimate of the Valley's potential market share. If all producing regions are assumed to have similar production costs, the estimated market share held by the lower Valley is 44 percent, slightly smaller than the 49 percent share estimated under the earlier scenario. Even with a cost disadvantage of \$1.50/cwt, the market share of Rio Grande Valley producers is estimated to be 14 percent--substantially greater than the area's current 1 percent market share.

The trade model shows the geographic market for spring potato production in the lower Rio Grande to be concentrated in the midwest (45%) and central (40%) United States, with smaller quantities shipped to southeast and eastern states. As the trade model is adjusted to reflect a production cost disadvantage in the Valley, both market share and dimensions of its geographic market decline. Increasingly, the market for spring potato production in the lower Rio Grande is restricted to the south central (55%) and north central (45%) regions as costs are unfavorably adjusted. This finding was expected in view of the proximity of the Valley to the central United States as compared to that of the major shippers (California and Florida).

Competitiveness of South Plains

The South Plains has become a significant shipper during the summer with a seasonal market share ranging from 10 to 15 percent. If production levels of competing regions are assumed to be constrained and production costs in the Plains were similar to those of competing regions, the national market share held by the study region is estimated to be 39 percent (Table 4). When potato

Table 2. Estimated Market Share in Spring Window for New Crop Potato Producing States as Rio Grande Valley Production Cost Advantage/Disadvantage is Adjusted with Rio Grande Valley Production Unconstrained and Competing Regions' Production Constrained to Historical Levels

Producing Regions	Valley Cost Advantage			Valley Cost Disadvantage		
	\$1.50/cwt	\$1.00/cwt	\$0.50/cwt	\$1.00/cwt	\$1.50/cwt	\$2.00/cwt
	%	%	%	%	%	%
Arizona	1	3	3	4	5	5
California	12	12	12	23	46	51
Florida	5	10	17	19	21	21
North Carolina	2	2	2	2	2	2
Rio Grande Valley	77	70	63	49	22	18
Virginia	3	3	3	3	3	3

Table 3. Estimated Market Share in Spring Window for New Crop Potato Producing States as Rio Grande Valley Cost Advantage/Disadvantage is Adjusted with all Region's Production Unconstrained

Producing Regions	Valley Cost Advantage			Valley Cost Disadvantage				
	\$1.50/cwt	\$1.00/cwt	\$0.50/cwt	\$0/cwt	\$0.50/cwt	\$1.00/cwt	\$1.50/cwt	\$2.00/cwt
Arizona	0	2	2	3	4	5	10	24
California	12	12	12	14	25	25	25	25
Florida	5	8	17	20	23	26	30	30
North Carolina	3	3	3	3	3	3	3	3
Rio Grande Valley	68	63	54	44	27	23	14	0
Virginia	12	12	12	16	18	18	18	18

Table 4. Estimated Market Share in Summer Window as South Plains Production Costs Advantage/Disadvantage is Adjusted with South Plains Production Unconstrained and Competing Regions' Production Constrained to Historical Levels

Producing Regions	Plains Cost Advantage				Plains Cost Disadvantage				
	\$1.50/cwt	\$1.00/cwt	\$0.50/cwt	\$0/cwt	\$0.50/cwt	\$1.00/cwt	\$1.50/cwt	\$2.00/cwt	\$2.50/cwt
Northeast	9	9	9	9	9	9	9	9	9
Mid-Atlantic	10	10	10	10	10	10	10	10	10
South	<1	2	2	2	3	3	3	3	3
Midwest	7	18	18	18	18	18	18	18	18
North-Central	1	2	2	3	3	3	3	3	3
South Plains	55	42	41	39	31	19	15	9	9
Southwest	<1	<1	<1	<1	1	1	1	1	1
Mountain	0	0	<1	1	2	4	5	5	5
Northwest	9	9	9	9	12	18	21	27	27
West	8	8	8	8	10	14	14	14	14
Canada	<1	<1	1	1	1	1	1	1	1

production costs in the South Plains are \$1.00/cwt higher than competition, the Plains' national market share declines to 19 percent, and at a \$2.00/cwt cost disadvantage, the share declines to 9 percent. The share of the summer market held by the South Plains is 8 percent when competing regions are assumed to have similar production costs and production in competing regions is not constrained to historic levels (Table 5).

The geographic market served by the South Plains in the summer is concentrated in the southeast and south central (60%) states with important shipments to the midwest (27%) and central (10%) U.S. regions. As costs in the South Plains are unfavorably adjusted, the geographic market is increasingly restricted to the south central (47%) and southeast (46%) regions. Principal competitors with the South Plains during the summer season are western, mid-Atlantic, midwest and northeastern states; thus, the cost advantage the Plains has in serving the south central and southeast U.S. regions.

Summary and Conclusions

A review of available cost budgets offers no evidence that the Rio Grande Valley or South Plains (south central United States) is at a production cost disadvantage during its production window. The spatial analysis shows the Rio Grande Valley to be favorably located for purposes of increasing its share of the new-potato market during the spring season. This is the result of the Valley's proximity to major consumption centers in central and midwestern regions as compared to California, the principal supplier of new potatoes in the spring season. Spring potato producers in the Rio Grande Valley could claim up to 50 percent of the market for new potatoes if production costs in that region were similar to those in California, and if they offered a product of equal quality to that of competitors. Further, Rio Grande producers could claim a 16 percent market share if their production costs were as much as \$2.50/cwt higher than those of competing regions. This is a substantial increase in market share relative to the current share which averages less than 1 percent. The geographic markets for expanded spring shipments from the Rio Grande Valley would be central and mid-western states.

If potato production costs and quality in the South Plains were similar to those in competing regions, the area could claim a 39 per-

cent market share, with a \$1.00 and \$2.00/cwt production cost disadvantage, a 19 and 9 percent share respectively. The South Plains would have the greatest advantage in serving south central and southeast states. Recently, South Plains producer/shippers took significant steps toward insuring a high quality potato by putting in place a federal marketing order.

The analyses shows the South Plains, but in particular, the Rio Grande Valley to have opportunities to expand their potato marketings; however, expansion of the region's market share would not be easily accomplished. California produces several varieties of new potatoes during the spring which are widely accepted; these include a long white (White Rose), round reds and the Centennial russet. Clearly, if the Rio Grande area is to expand its market, a uniform, high quality product would be essential. Further, storage technology is continually extending the shipping season and the quality of the stored product, thus increasing competition for the new crop potato.

Endnote

¹When this research was initiated (1986), the most recent *Nationwide Food Consumption Survey* (NFCS) was for the 1977-78 period. The Survey includes detail on household consumption by region, and metropolitan, and rural consumers, etc. Further, the NFCS and Census of Housing data are compatible and, when multiplied, it was thought that high-quality estimates of regional potato consumption resulted. Because per capita consumption of potatoes is relatively constant and demand inelastic, it was reasoned that the estimated potato demand by region would change only as a result of population. The regional demands as determined by the 1980 Census data were increased by the estimated rate of population growth to generate regional demand estimates representative of the mid-1980s. Production of potatoes by geographic region varies from year to year as a result of weather and economic factors, and, in the long run, regional production patterns may be substantially altered. It was reasoned that the most recent regional supply information should be used and several years averaged to remove effect of weather, etc. The 1983-85 potato shipment data was averaged to obtain representative supplies by region. Thus, the estimated regional potato demands and

Table 5. Estimated Market Share in Summer Window as South Plains Production Cost Advantage/Disadvantage is Adjusted with all Region's Production Unconstrained

Producing Regions	Plains Cost Advantage				Plains Cost Disadvantage		
	\$1.50/cwt	\$1.00/cwt	\$.50/cwt	\$0/cwt	\$.50/cwt	\$1.00/cwt	\$1.50/cwt
	%	%	%	%	%	%	%
Northeast	18	18	18	18	18	18	18
Mid-Atlantic	19	20	21	24	24	24	24
South	2	4	6	7	7	7	7
Midwest	17	19	19	25	25	25	31
North-Central	3	3	3	3	3	3	3
South Plains	28	23	18	8	8	8	0
Southwest	0	0	1	1	1	1	3
Mountain	<1	<1	1	1	1	1	1
Northwest	4	4	4	4	4	4	4
West	9	9	9	9	9	9	9
Canada	0	0	0	0	0	0	0

supplies were constructed to be representative of the mid-1980s.

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