Terminal Market Windows for Mississippi Small-Farm Vegetable Producers

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This study investigated various marketing strategies involving market windows at wholesale fruit and vegetable terminal markets. Data used in the analysis included weekly prices for okra, sweet corn, strawberries, and green cabbage at terminal markets located in Dallas, St. Louis, Atlanta, Chicago, Cincinnati, and Detroit. Strawberries showed relatively high profit margins for small farmers operating in southwest Mississippi. Sweet corn and okra showed more narrow profit margins, while green cabbage appeared to yield negative net returns (generally) for these farmers. Furthermore, stochastic dominance analysis of various combinations of crop/market/window revealed the following as the preferred marketing strategies: (1) strawberries in all markets in the last third of the calendar year; (2) sweet corn in all six markets in the first third of the calendar year; and (3) okra in St. Louis and Cincinnati in the first third of the calendar year.

Trends in U.S. agriculture continue to show a steady decline in the number of small farms and an increase in average farm size. The bulk of U.S. agricultural production comes from large farming operations, even though small farms still represent a large percentage of the total number of farms in the United States. According to the 1997 Census of Agriculture, 75 percent of all farms were classified as small farms in the United States, whereas more than 83 percent of all farm sales originated from large-scale operations with annual sales of $1 million or more.

Small farms are defined as those farming operations that generate a gross income of $50,000 or less annually. Small farmers usually have limited resources (land, labor, and especially capital) to devote to the farming operation. Small farms represented approximately 82 percent of the total number of farms in the State of Mississippi, according to the 1997 Census of Agriculture (USDA-NASS, 1997). In Mississippi, as in many other southern states, small producers with limited resources are encouraged to produce vegetables and small fruits to maximize their returns, since most of these crops fall into the category of high-value enterprises. Furthermore, small farmers have been advised to emphasize vegetables and small fruit production because of the growth in the demand of these products during the past three decades. U.S. retail sales of fresh fruits and vegetables increased to more than $54.5 billion dollars by the middle of the *1990s (Supermarket Business,* 1995).

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Vegetable and small fruit farming, however, encompasses production and marketing decisions made by growers independently with less than perfect knowledge about expected costs and risks involved in production, market opportunities, marketing risks, anticipated prices, and profit margins. The uncertainty about future market prospects is even more acute for small producers with limited resources, especially when these farmers are operating in a state outside of the traditional regions where the bulk of vegetables and small fruits are produced. Limited resource farmers often report tremendous barriers in attempting to penetrate the traditional commercial channels for marketing fresh produce between the farm gate and the final consumer. More specifically, one of the most significant hindrances related to small farm vegetable production is the lack of knowledge about the profitable wholesale target markets located at large terminal markets in the major metropolitan areas in the United States.

Objectives

The overall objective of the study was to assess the feasibility of various marketing strategies involving delineated market windows at terminal markets. The specific objectives were: (1) to examine fluctuations of weekly prices for green cabbage, sweet corn, okra, and strawberries; (2) to identify profitable market windows for small farmers shipping produce from southwest Mississippi; and (3) to examine the relative risk involved for farmers targeting specified market windows at the terminal markets.

Methods and Procedures

The Market Window Technique

The market window technique was used to identify the periods (weeks) of the year for which farmers shipping produce from southwest Mississippi would be able to make a profit above production and handling costs. In past studies, the market window technique has been applied to assess the potential of alternative vegetable crops raised by small farmers in Florida (Colette and Wall, 1978), Louisiana, Kentucky, and Washington (Hinson and Lanclos, 1988; Jermolowicz, Pendulum, and Love, 1984; O'Rourke, 1983). The market window approach is based on the premise that economic feasibility of a crop depends both on the costs of production, transportation, and handling, and on the market price of the product at terminal markets accessible to the producer. Since most markets will already have a number of suppliers, there will be opportunities for new suppliers only if the market price is above the costs of production and marketing to the market. Furthermore, feasibility would be dependent on the ability of the new supplier to schedule production activities so as to supply the commodity at the time periods identified. Supply of the commodity has to be in useable volumes with quality attributes required by the market. In this study, sweet corn, green cabbage, okra, and strawberries were selected for analysis. The terminal markets considered for new entry were Dallas, Detroit, St. Louis, Chicago, Cincinnati, and Atlanta.

Weekly price data collected at the terminal markets for a period of 10 years (1985–94) were used in the analysis. These price data were collected and reported by the U.S. Department of Agriculture-Agricultural Marketing Service. Price means and standard deviations were generated for each week of the year.

Production Costs and Transportation Costs to Destination Markets

Costs of production were derived from enterprise budgets developed for sweet corn, green cabbage, okra, and strawberries. The regular production budget for an acre parcel of land was translated into costs of production per marketing unit traded at the terminal markets. These marketing units are: 50-pound box for sweet corn; 50-pound bag for green cabbage; 12-pint crate for strawberries; and 30-pound crate for okra. Costs of production per marketing unit are shown in Table 1 below. These costs include direct (variable) costs as well as indirect (fixed) costs of production.

Table 1. Total Costs of Production.

Commodity	Production Costs Per Acre	Quantity Per Acre	Production Cost Per Marketing Unit
Sweet Corn	$ 822.98	160	$ 5.14/50-lb.box
Green Cabbage	$ 1,053.87	200	$ 5.27/50-lb. bag
Strawberry	$1,531.49	800	$1.91/12-pint bskts.
Okra	$ 1,619.54	200	$8.10/30-lb. crate (1/2 bu. crate)

Costs of transporting fresh produce in refrigerated trucks were assumed at $1.20 per mile (USDA-AMS, 1989). Transportation costs to the terminal markets were estimated assuming a standard 40-foot trailer. Furthermore, it was assumed that all fresh produce will be assembled in a central location near Jackson, Mississippi prior to shipment to the destination terminal markets.

Generalized Stochastic Dominance

Stochastic dominance is an analytical technique for determining whether any strategy dominates another completely or in part with respect to the expected utility from uncertain outcomes. The strategies were defined as specific market windows. The calendar year was divided into three market windows as follows: Window # 1 covers weeks 1 through 18; window # 2 extends from week 19 to week 35; and window # 3 extends from week 36 to week 52 of the year. Obviously, preferred windows are those weeks when suppliers from southwest Mississippi will have the fresh produce (newly harvested) in adequate quantity and quality, ready to be shipped to the terminal market for a (positive) profit margin. Stochastic dominance (Meyer, 1977) guarantees dominance under the assumption that the decision-maker's risk aversion coefficient (RAC) falls between a lower bound $[r_l(y)]$ and an upper bound $r_u(y)]$. Stochastic dominance, with respect to a function, establishes both necessary and sufficient conditions for the price cumulative density function

(CDF) of F(y) to be preferred to the CDF of G(y) by all individuals whose risk aversion coefficients are between the specified lower and upper bounds. F(y) and G(y) are the distributions of any two marketing strategies that are being compared. The application of stochastic dominance requires that the utility function U(y) be identified and used to minimize the following:

$$(1) \qquad [F(y) - G(y)]\, U'(y)\, d\, y,$$

with (y) being between positive and negative infinity, subject to:

$$(2) \qquad r_l\,(y) < U''(y)/U'(y) < r_u\,(y).$$

Distributions of weekly prices at the terminal markets were compared with the objective of identifying preferred market/week/commodity combinations that could be targeted by farmers operating in southwest Mississippi.

Results

Three scenarios depicting various assumptions regarding costs of production and marketing were considered in the break-even analysis at the terminal markets. Scenario 1 assumes yields and production costs as shown in Table 1. Scenario 2 encompasses a 15 percent markup by the first handler and a 25-cent brokerage fee per marketing unit of commodity traded. The third scenario assumes a 20 percent reduction in yield, in addition to the brokerage fees and markup specified in the second scenario. Such reduction in yield reflects the lower level of productivity usually experienced by small producers. The profit margin (net return per marketing unit) was estimated as the difference between the mean of weekly prices and the costs of production and handling to the designated market. The weekly profit margin for a commodity at a given terminal market is expected to vary according to the equation below:

$$(3) \qquad \Pi = f(D, A, P, I, HC, FPC),$$

where:

Π = the weekly profit margin for a small-farmer or small farm group shipping fresh produce from southwest Mississippi;

D = demand for the product in a given metropolitan area for the specified week of the year;

A = weekly product availability (supply) at the terminal market originating from domestic as well as international sources;

P = observed weekly prices;

I = information available to wholesale buyers, resellers, and potential suppliers about market conditions in the metropolitan area;

HC = handling costs (including transportation, storage and refrigeration costs, brokerage fees, repackaging, transfer costs, etc.); and

FPC = farm production costs per marketing unit in southwest Mississippi.

Stochastic dominance allowed for pair-wise comparisons of various marketing strategies. The adjusted weekly terminal market price distributions and the alternative moving average distributions provided additional input in the evaluation of the risk-efficient sets for the marketing strategies. The certainty-equivalent formula was used and defined below:

$$(4) \qquad CE = mu - s[r(y)],$$

where CE is the certainty equivalent coefficient and mu, s, and r(y) are the mean, the standard deviation (of the different price distributions), and the risk aversion coefficient, respectively.

The certainty equivalent was set equal to zero in order to obtain an initial value for the upper limit of the risk aversion coefficient. A generalized stochastic dominance (GSD) computer program (Goh et al., 1989) was used to compare the profit margins of okra, sweet corn, and strawberries at the terminal markets. The approach takes into account the decision-maker's utility function as related to the relative risk involved. The market windows, where some products showed a consistently negative profit margin (for example, green cabbage in all markets), were omitted in this part of the analysis. The markets were compared in each of the three windows, that is, first third, second third, and last third of the calendar year. In addition, an efficient set of marketing strategies was identified to rank the percentage of the most dominant and least dominant crops from all possi-

ble crop/market/window combinations. Distributions by crops were compared with the objective of determining preferred crop/market/window combinations for small farm groups operating from southwest Mississippi.

Some of the pair-wise GSD results pertaining to a single commodity in a given market window are shown in Tables 2, 3, 4 and 5. Table 6 shows the GSD results for the pair-wise comparisons of all products at the six terminal markets. The marketing strategy in Table 6 is a combination of commodity, market, and time period. In these GSD tables, "1" indicates that the distribution in the row dominates the distribution in the column. This means that in a pair-wise comparison, the item in the row would be preferred to the item in the column. "0" indicates that the item in the row is dominated by the item in the column, and "?" means that no dominance can be demonstrated by either distribution in the table.

Table 2. GSD Matrix of Profit Margin for Okra in the First Window.

Weeks 1–18	Chicago	St. Louis	Cincinnati	Atlanta
Chicago		0	0	1
St. Louis	1		1	1
Cincinnati	1	0		1
Atlanta	0	0	0	

Table 3. GSD Matrix of Profit Margin for Sweet Corn in the First Window.

Weeks 1–18	St. Louis	Detroit	Chicago	Dallas	Atlanta	Cincinnati
St. Louis		?	0	0	0	0
Detroit	?		?	?	?	0
Chicago	1	?		?	?	?
Dallas	1	?	?		?	0
Atlanta	1	?	?	?		0
Cincinnati	1	1	?	1	1	

Table 4. GSD Matrix of Profit Margin for Strawberries in the Second Window.

Weeks 19–35	Cincinnati	Atlanta	Dallas	Chicago	St. Louis	Detroit
Cincinnati		?	1	1	1	1
Atlanta	?		1	1	1	1
Dallas	?	0		1	1	1
Chicago	0	0	0		0	?
St. Louis	0	0	0	1		1
Detroit	0	0	0	?	0	

Table 5. GSD Matrix of Profit Margin for Strawberries in the Third Window.

Weeks 36–52	Atlanta	Cincinnati	Chicago	Detroit	St. Louis	Dallas
Atlanta		1	?	1	?	1
Cincinnati	0		0	1	0	?
Chicago	?	1		1	0	1
Detroit	0	0	0		0	0
St. Louis	?	1	1	1		1
Dallas	0	?	0	1	0	

Table 6. Percentage of All Market/Crop/Window Combinations Dominated by Selected Strategies.

Strategy: Market/Crop/Window	Combinations Dominated (Percent of Total)
St. Louis/Strawberries/ Weeks 36–52	95
Atlanta/Strawberries/Weeks 36–52	93
Chicago/Strawberries/Weeks 36–52	93
Dallas/Strawberries/Weeks 36–52	90
Cincinnati/Strawberries/Weeks 36–52	88
Cincinnati/Sweet Corn/Weeks 1–18	52
Chicago/Sweet Corn/Weeks 1–18	45
Dallas/Sweet Corn/Weeks 1–18	45
Atlanta/Sweet Corn/Weeks 1–18	45
St. Louis/Sweet Corn/Weeks 1–18	43
St. Louis/Okra/Weeks 1–18	36
Cincinnati/Okra/Weeks 1–18	36

As shown in Tables 2 through 5, the St. Louis Market dominates all other markets in the first window as far as okra is concerned. On the other hand, Cincinnati would be the preferred market (for Okra) in the third window. Also, Cincinnati would be preferred to all other destinations in marketing sweet corn between weeks 1 and 18 of the calendar year (Table 3). For strawberries, Atlanta dominates Dallas, St. Louis, Detroit, and Cincinnati for the first and second thirds of the calendar year. In the last third of the year, St. Louis would become the preferred destination market for strawberries produced in southwest Mississippi. Some results pertaining to pair-wise comparisons of all possible combinations of market/crop/window are shown in Table 6. Strawberries appear to be a strong alternative in all markets, except Detroit.

Technical Feasibility: Optimal Planting Dates

Climatic conditions in Mississippi are conducive to late fall harvesting. The median date for the first freeze in southwest Mississippi is between November 3 and December 2. This allows farmers to harvest corn and okra crops until October 20 or October 30 (MSU, 1990). For okra, the greatest net returns in most of the terminal markets (examined in this study) occur in the second half of the third window. Since the cycle for the okra crop is approximately nine weeks, the optimal planting date would be between August 7 and August 14. For sweet corn, late varieties planted between August 7 and August 14 would allow farm groups to target the profit windows at the terminal markets. As for strawberries, the optimal planting dates are earlier than usually recommended. In order to capture the greatest profit margins, farmers should plant at least four weeks earlier than the usual recommended date. However, planting that takes place later would still allow producers to realize sizeable profit margins in marketing strawberries to the major metropolitan areas.

Conclusions

Problems facing small farmers in the South are diverse. These problems span from production to credit, resource availability, marketing, and technical know-how. Marketing opportunities exist at the wholesale terminal markets for farm groups or organizations targeting large metropolitan areas. How-

ever, complete feasibility of the market windows identified will depend on the farmers' ability to pull small lots of produce into large enough volumes for shipment to the destination markets. Furthermore, production, harvesting, storage, and handling activities have to be optimal in order to ensure the highest quality of product. An examination of the shipping points indicated that, for strawberries, most of the shipments came from Florida, California, and Mexico during the 10-year period covered by the study. This is further evidence that farmers from the region could enter these markets and hold a competitive position as far as distance and transportation costs are concerned.

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