The Economic Potential of the Arkansas Sweet Potato Industry: Some Evidence from Dallas

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Abstract

This paper examines the Arkansas sweet potato industry, which appears to have succeeded in moving the market for its agricultural product from the traditional perfect competition to monopolistic competition. Transport costs are found to play a major role in getting the product to market. Since Arkansas is unlikely to be able to economically compete directly with producers from much larger entities such as California and China, the fact that marketing and distribution differentiators have been used to turn around what was considered a dying industry is somewhat remarkable,. The authors hope that this industry will serve as a success story for product differentiation and niche marketing.

I. Introduction

The purpose of this paper is to explore the potential of sweet potatoes as a reliable money crop for small farmers in the Arkansas Delta region, an economically depressed area. A national trend has been toward large farm operations and away from smaller farms.   This paper will present evidence that Arkansas sweet potatoes, a product sold largely in Dallas, may provide the best opportunity for local farmers to strategically reverse the trend and benefit from marketing a previously overlooked commodity.

Widely acknowledged throughout the world as an extremely nutritious vegetable (Low, et. al., 2007; Peet, 2001; Prakash, 1994), the sweet potato has been the subject of much recent research. Some authors have suggested that sweet potatoes might be the answer to some of the world's thorniest problems: efficient feeding of the masses and sustainable agriculture (Peet, 2001; Prakash, 1994). China is the world leader in sweet potato production, as shown in Table 1, producing over 80 percent of the world's crop in 2007. However, China appears to consume most of the sweet potatoes it grows (largely for animal feed). Figure 1 depicts Chinese trade in sweet potatoes, shown in a logarithmic scale so that both imports and exports can be portrayed on the same graph even though the two measures have vastly different scales.[1] Both imports and exports of sweet potatoes have grown in China recently, indicating that China is not so large a threat to other sweet potato producing countries as its sheer volume of production might indicate.

Fairly easy to grow in well-drained, sandy loam, it is well-adapted to the southern United States. North Carolina is the leading producer of sweet potatoes in the United States, followed by California, Mississippi, Louisiana, Alabama, and Texas, in order (NCSPC, LASPC).   Figure 2 shows that the four-firm concentration ratio (by state) for sweet potatoes has been almost steadily increasing over the past thirty years, indicating that the sweet potato industry in the United States is tending to consolidate in the top four states. However, the composition of the top four producing states has changed over the

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[1] To put the numbers plotted in Figure 1 in perspective, the Chinese imports in tonnes from a low of 2 in 1987 to a high of 177 in 1998. Chinese exports of sweet potatoes in tonnes varied from a low of 310 in 1966 to a peak of 96932 in 1991.

past thirty years with California and Mississippi surpassing Louisiana in sweet potato production. This indicates a potential opportunity for a state whose sweet potato industry is willing to become more efficient and/or market its product better.

Table 1
World Production of Sweet Potatoes by Country, 2007

Rank	Country	Production (Metric Tons)	Share of Total
1	China	102,000,000	80.91%
2	Nigeria	3,490,000	2.77%
3	Uganda	2,602,000	2.06%
4	Indonesia	1,829,042	1.45%
5	Viet Nam	1,450,000	1.15%
6	Japan	1,000,000	0.79%
7	India	980,000	0.78%
8	Tanzania	960,000	0.76%
9	Rwanda	940,000	0.75%
10	Madagascar	870,000	0.69%

Sources: USDA National Agricultural Statistics Service and UN Food and Agricultural Organization

Figure 1
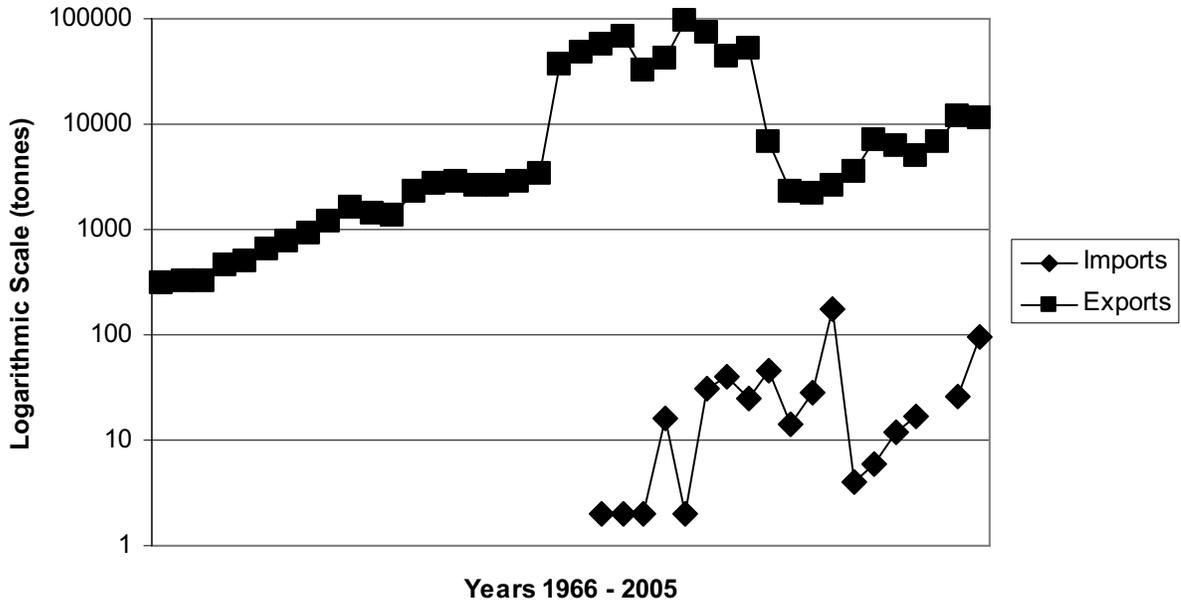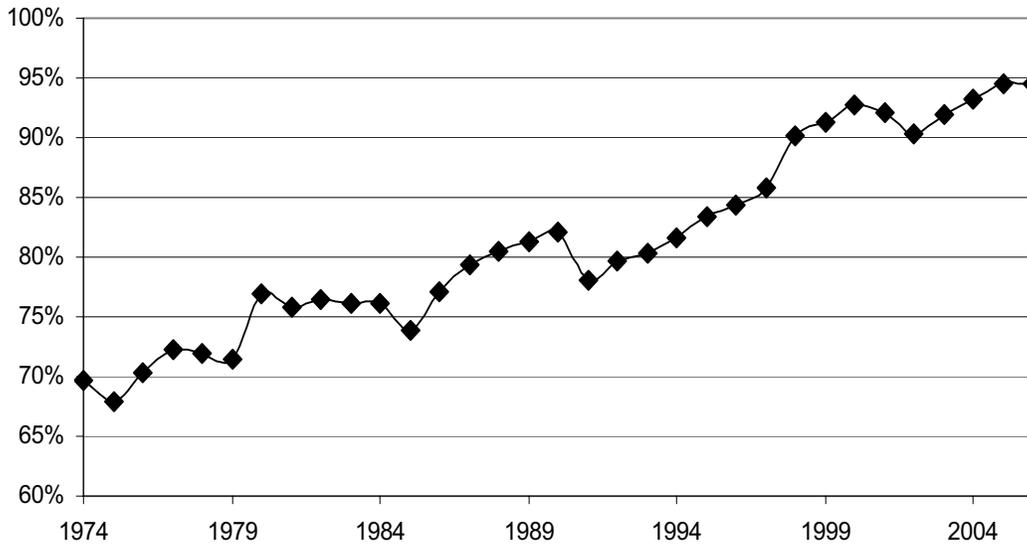
China Sweet Potato Trade, 1966 - 2005

Figure 2

**Four-firm (state) Concentration Ratio for Sweet Potato
Production in U.S., 1974-2006**

Why is the position of the top states so fluid in market share? The example of Arkansas illustrates some of the dynamics of the U.S. sweet potato industry. One of the most impoverished areas in the United States, the Arkansas Delta region that was deposited by the Mississippi River and its western tributaries is a prime sweet potato potential growing area (Gaul and Morgan, 2007). As recently as 1977, Arkansas produced about 1 percent of the United States production in sweet potatoes (the same as Arkansas' percentage of U.S. population). This share has fallen dramatically during the past thirty years as technological advantages in production, storage, and marketing have paid off for other states such as California and Mississippi. Around 2000, in dire need of a cash crop, Arkansas sweet potato farmers sought economic development efforts centered on their primary product (FSMIP Report, 2000). Hoping to use vertical relationships with users of sweet potatoes, the farmers sought one-time payments tied to particular marketing and distribution strategies rather than ongoing price supports (Gaul and Morgan, 2007). In market structure terms, the approach was to turn a short-term niche into long-term competitive advantage.

Recognizing the need for assistance in the region, the U.S. Department of Agriculture Federal-State Marketing Improvement Program awarded more than $285,000 in grants to the Arkansas State Plant Board from 2000 to 2005 to help Arkansas Delta farmers market their products (FSMIP Reports, 2000 – 2005). Some of these funds were used for technical assistance from Louisiana State University for improved growing and marketing techniques. Much of the funding was to complement the $1.9 million sweet potato storage facility in Helena-West Helena. The facility, completed in 2007, received a $500,000 grant from the U.S. Department of Commerce (News Release, 2006). The facility is designed to accommodate 120,000 bushels of sweet potatoes for up to 12 months and can be expanded to accommodate 300,000 bushels (FSMIP Report, 2005).[2]

II. The Economics of Sweet Potato Storage and Distribution

Intended for use in both curing and storing[3] sweet potatoes, the facility has been projected as a means to store the product while the selling price is low. Then, when the price is higher, the product can be brought out of storage to be sold at a premium. In this regard, the purpose of a storage facility is the same as that of a futures market[4]: to reduce price volatility. Since agriculture is a noted example of an industry in which price swings result in zero long-run economic profit, a steady price would allow sellers to at least cover fixed cost (such as the cost of a storage facility) and thereby stay in business.

For the minority farmers of the Arkansas Delta Produce Marketing Association (ADPMA) (notably Lee, Monroe, and Phillips Counties), contracts negotiated by the non-profit Winrock International provided a steady market for virtually all of their produce. The Fort Smith, Arkansas, plant of Gerber Foods, the largest baby food manufacturer in the world, and Bright Harvest, a Clarksville, Arkansas, processor of frozen food products,

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[2] The actual USDA Grant Report states that the facility opened in Fall, 2006, at a cost of $2.5 million.
[3] Curing is necessary to bring out the required flavor of sweet potatoes. After curing, sweet potatoes must be stored at temperatures from 55 to 60 ° F to minimize losses from pests and diseases. Uncured sweet potatoes are referred to as "green." The Phillips County, Arkansas, facility is designed to be adaptable to long-term storage. Thus far, because of the effectiveness of marketing efforts, the facility has functioned as a sorting, curing, packaging, and distribution site only, since contractual demand has provided a ready market for the entire crop. This means that the effectiveness of the facility for smoothing demand has not yet been needed or tested.
[4] No futures market exists for sweet potatoes.

agreed to purchase No. 2 graded, cured, sweet potatoes in bulk from January through June. In addition, Glory Foods, an Ohio-based retailer of Soul Food, agreed to purchase green sweet potatoes during the months of November and December. Furthermore, ADPMA has succeeded in selling fresh sweet potatoes to Affiliated Foods for distributed in Arkansas grocery stores and is seeking certification to bid on USDA contracts for public school lunch programs (FSMIP Report, 2005). Sweet potatoes grown in Arkansas are also sold to the public in farmer's markets, most notably the Dallas market as mentioned below.

III. Data

The primary source of price information on Arkansas sweet potatoes is The Agricultural Marketing Service (AMS, 2007) of the U.S. Department of Agriculture (USDA). These data are micro, consisting of daily prices for agricultural commodities, including sweet potatoes, grown in the U.S. and sold as fresh in fourteen major agricultural markets throughout the U.S.

The USDA data indicate that no Arkansas sweet potatoes have been sold in the following markets from 1998 to 2007: Atlanta, Boston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, or Seattle. Negligible amounts have been sold in Baltimore, Chicago, and Detroit. No Louisiana sweet potatoes have been sold in Atlanta for over a year. Since most sweet potatoes are sold from trucks, it is little wonder that the high transport cost to far-flung markets may not justify the effort. In spite of this, California, further removed from the Dallas market than Arkansas or Louisiana are located from Atlanta or St. Louis, still sells substantial numbers of sweet potatoes in Dallas.

From the USDA data, it would appear that Arkansas sweet potato farmers were selling their product primarily in St. Louis from October, 1998. The market was very thin, representing only a couple of farmers selling differing varieties, grades, and sizes. The seasonal nature of Arkansas sweet potato sales resulted in fragmented price series with substantial breaks for long periods of time.

However, in late June, 2005, Arkansas sweet potato farmers began selling their product in Dallas. Sales quickly shifted from St. Louis to Dallas, with the last St. Louis sales occurring in November, 2006. The Dallas market has proven much more reliable than the St. Louis market for Arkansas sweet potatoes, with the only significant break in sales occurring for 14 days over Christmas, 2006.

Since Dallas is the dominant Arkansas sweet potato market, we analyzed price series for the Dallas market to estimate Arkansas farmers' perceptions of solidity or softness of the market for their products and to compare and contrast Arkansas farmers' potential relative to those from other states that are represented in the Dallas market. Sweet potato prices are quoted for forty pound cartons. To construct a price series, we averaged the prices for a particular product across all sellers that day. For the popular southern Beauregard variety, ungraded, Jumbo size sweet potato, we found only six breaks in Dallas sweet potato sales from all sources. Most of these breaks were for three weeks or less. The longest break was for 100 days, during the first half of 2002.

We conjecture that high transport costs are a major factor in explaining why China's sweet potato growers are not major competitors with Arkansas farmers. Although China leads the world by far in the production of sweet potatoes, as of 2001 the U.S. exported about four times as many sweet potatoes as did China (FAO Stat, 2007).

Although we did not have access to fuel costs for China, we analyzed United States data to evaluate the proposition that transport costs work in favor of Arkansas farmers.

IV. Methodology and Results

We compared Dallas market data for Arkansas, California, Louisiana, North Carolina, South Carolina, and Texas sweet potatoes. Figure 3 shows the percentage of days that the various states sold sweet potatoes in Dallas from 1998 to 2005. California was obviously the dominant state selling sweet potatoes in Dallas during this period, selling in Dallas for the entire month of September and never showing up less than 49 percent of the time. By contrast, Arkansas producers sold no sweet potatoes in the Dallas fresh market from 1998 to 2005. South Carolina sold only in October and November, showing up 22 and 4 percent of the time, respectively.

Figure 3

Percentage of Market Days that Sweet Potatoes were Sold in Dallas, 1998-2005
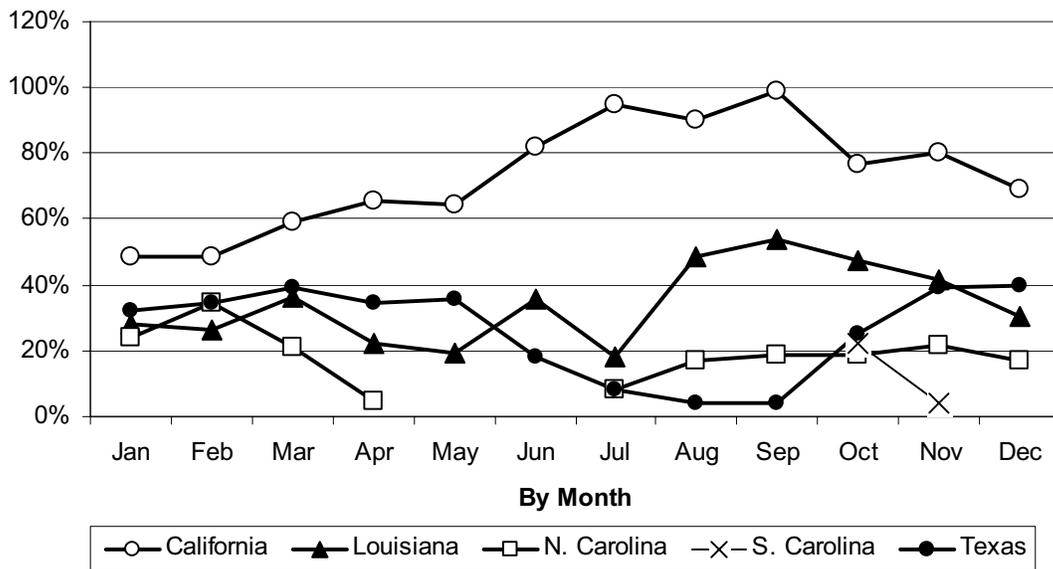
The situation changed dramatically when Arkansas entered the market in June, 2005, as shown in Figure 4. California sellers were represented in the Dallas market 100 percent of the time in October, but none of the time in January, February, and December. South Carolina dropped out completely. Sales of North Carolina and Louisiana sweet potatoes became more seasonal. Arkansas and Texas sellers showed up almost the whole time. It is probably no accident that the market change accompanied large spikes in fuel prices.

Figure 4

Percentage of Market Days that Sweet Potatoes were Sold in Dallas, 2005-2007
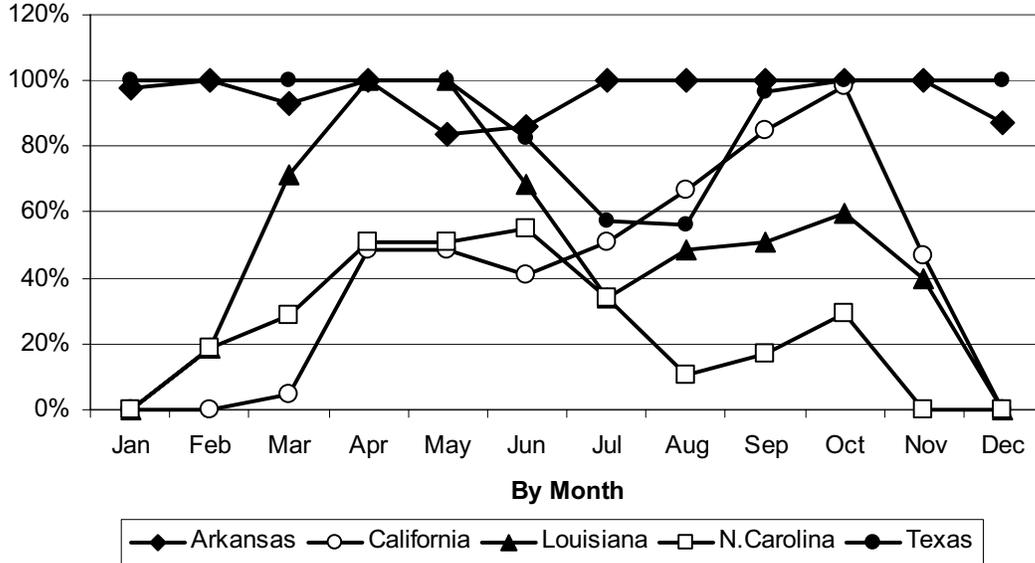
As a proxy for fuel costs, we used the Producer Price Index (PPI, 2007) for gasoline as reported monthly by the U.S. Bureau of Labor Statistics. The results of simple OLS regressions of monthly sweet potato prices against the gasoline PPI are shown in Table 2. Of Arkansas, California, and Texas, only California's sweet potato prices were significantly correlated with fuel prices.[5] Figures 5, 6, and 7 plot the prices of California, Arkansas, and Texas sweet potatoes, respectively, alongside prices estimated from the OLS model using fuel costs.   Consistent with the regression results, only California's prices closely track the prices that fuel costs explain. As might be expected, transport costs in general and fuel costs in particular remain a primary consideration for sweet potato farmers.

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[5] Since we model transportation costs, the fuel PPI is the only dependent variable we consider in   Table 2. In each case (for all three states), the Durbin-Watson statistic lies below the critical lower bound, indicating positive autocorrelation (see Gujarati, 1978, pp. 226, 235-239). This is also borne out by a plot of the residuals from the regressions. Were we to use our F or t ratios for statistical inference (relying on the p values), this would be cause for concern, since the presence of autocorrelation results in inefficient, but unbiased and consistent OLS estimates. Since we are merely showing R^2 (and plotting the fit) for the three locations, however, we see no need to correct for positive autocorrelation. A possible extension of the paper is to derive a comprehensive pricing model for sweet potatoes, for which additional variables and corrections for autocorrelation would be needed, including the use of possible co-integrating factors.

Table 2
Regression Results with Producer Price Index for Gasoline as Explanatory
Variable for Sweet Potato Prices by State of Origin

	California	Arkansas	Texas
R^2	0.4212	0.0506	0.0290
Adjusted R^2	0.4128	0.0154	0.0074
Number of Observations	71	29	47
Overall F Ratio	50.2187	1.4385	1.3450
Significance F	9.27E-10	0.2408	0.2523
Intercept (t ratio)	8.3006 (12.1125)	10.9930 (5.1133)	12.7260 (19.0880)
P value	9.63E-19	2.25E-05	3.33E-23
PPI – Gasoline (t ratio)	0.0394 (7.0865)	0.1292 (1.1994)	0.0446 (1.1597)
P value	9.27E-10	0.2408	0.2523
Durbin-Watson D	0.4006	0.2812	0.9332

Figure 5

**Average Price of California Sweet Potatoes sold in Dallas and
Results of Model Using Gasoline PPI, 1999-1007**
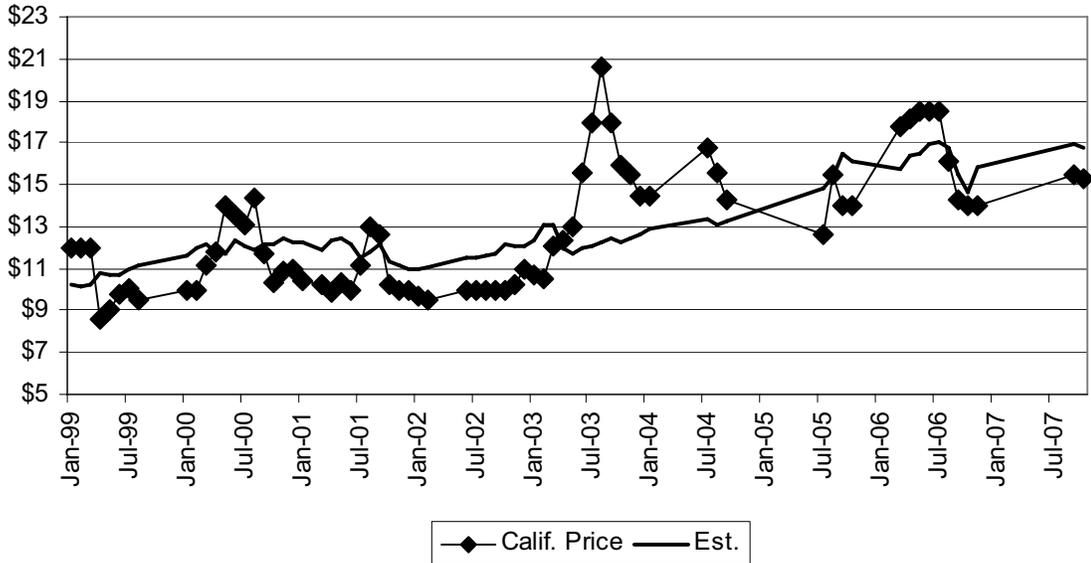
Figure 6

**Average Price of Arkansas Sweet Potatoes sold in Dallas and
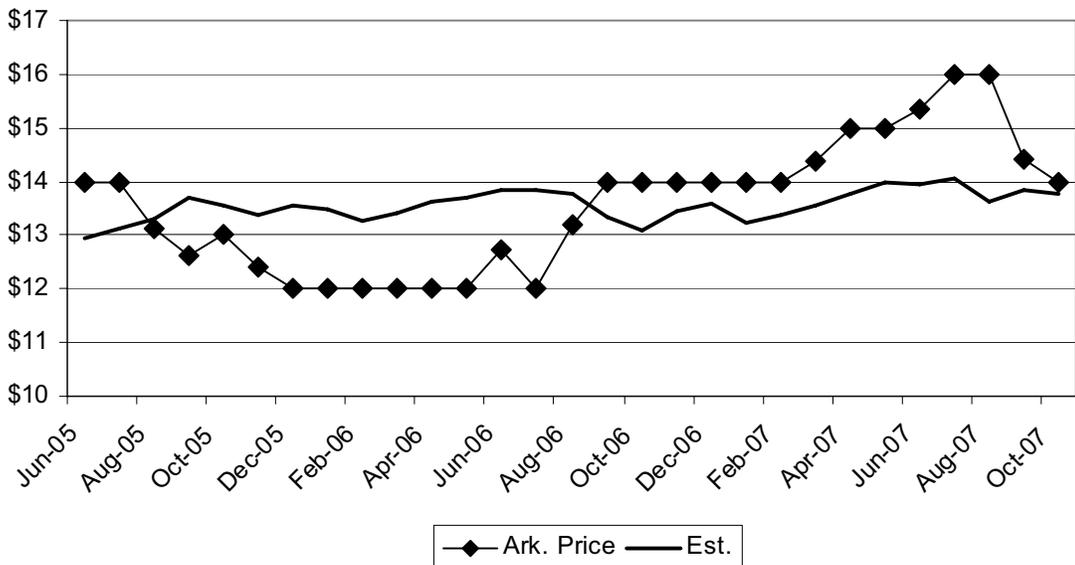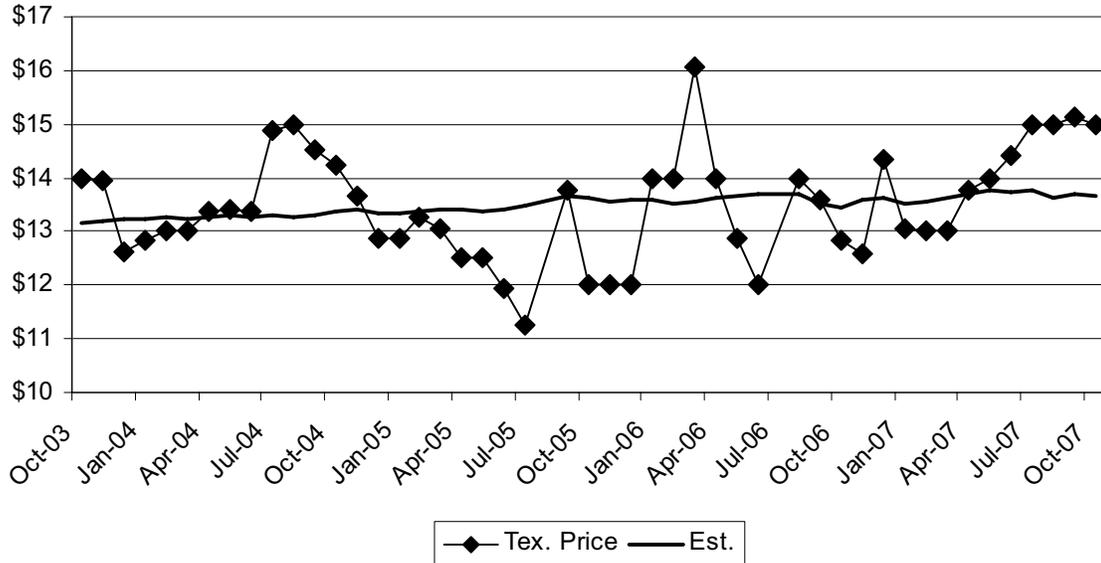Results of Model Using Gasoline PPI, 2005-2007**

Figure 7

Average Price of Texas Sweet Potatoes sold in Dallas and Results of Model Using Gasoline PPI, 2003-2007

V. Conclusion

Sweet potatoes remain primarily a regional commodity. Even though China has a significant comparative advantage in their production and remains the world's leading producer, China consumes most of the sweet potatoes it produces. On the other hand, Arkansas has carved out a small, profitable, niche in selling sweet potatoes inside Arkansas and Texas. In terms of market structure, the Arkansas sweet potato industry would appear to be closer to monopolistic competition than the traditional market structure for agricultural products: perfect competition. If as successful as it appears, the Arkansas sweet potato industry would appear to be breaking out of the dominant firm/competitive fringe situation in which it had operated for over thirty years.

The most important factor in this success is likely product differentiation.[6] For example, one of the sweet potato's beneficial ingredients is beta-carotene. Since beta-carotene is found only in orange vegetables, varieties other than Beauregard (including the purple-fleshed varieties more popular in the Orient) may not have the nutritional value of the sweet potatoes traditionally grown in the southern U.S. (van Jaarsveld, *et. al.*, 2005) Arkansas farmers appear to have been careful to grow only Beauregard sweet potatoes, unlike California. Other product aspects that Arkansas farmers seem to have successfully exploited in differentiating their product include the proximity to the world's leading producer of frozen sweet potato products and the world's leading producer of baby food. The fact that both of these users of Arkansas' product are located in Arkansas, within a few hundred miles by highway and river, means that Arkansas'

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[6] To be fair, we should not neglect the influence of the weather and acts of God. For example, Mississippi's sweet potato industry was sent reeling by an abnormal number of hurricanes drenching the fields one year and an unprecedented drought the next (LSUAgC, 2006).

advantage in transport costs is significant. Given the recent widespread concern over food products imported from China, Arkansas' reputation as a provider of a safe product is beneficial.

Unlike farmers in other states, Arkansas sweet potato farmers seem to have concentrated on the size and grade of product that their end users most request: medium size and number one grade. Another important aspect of branding Arkansas sweet potatoes is that of culture. As pointed out in Horton and Robbins (2007), Arkansas sweet potato producers have been successful in marketing their product to Glory Foods, an Ohio-based producer of Soul Food. Alternative uses of the product, such as sweet potato French fries, have also been successfully marketed.

Much additional work remains to be done. The dynamics of the Chinese sweet potato market are difficult to discern because of limited data. In addition, different sweet potato varieties make comparisons between states, regions, and countries difficult to interpret. Also, in spite of advances in growing, transportation, and storage over the past thirty years, most sweet potato markets have remained primarily local, again making comparisons between different locations subject to error.

A fully developed time series model of sweet potato prices, while beyond the scope of this paper, may be developed using the USDA databases referred to in the reference section. As mentioned in a footnote above, such a model should investigate possible co-integrating factors since commodity prices tend to be non-stationary. In addition, a production model of sweet potatoes, again using input data available from the USDA, is needed for Arkansas and surrounding states. Another possible extension of the current paper would be a case comparison of the Arkansas sweet potato industry with that of its less successful neighbor in the industry, Mississippi.

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