Forecasting Pecan Prices During Harvest

by

W. J. Florkowski

FORECASTING PECAN PRICES DURING HARVEST

W. J. Florkowski*

The USA pecan production area extends from the Carolinas to California and from Florida to Kentucky. The harvest begins in October and ends in January, and was valued at $196 million in 1986. Although the pecan tree is not native to the state, Georgia is the leading state in pecan production. Despite Georgia's dominance in pecan production, growers recently revealed the lack of pecan market and price information (Hubbard et al. 1987a). Similar opinions were voiced by pecan accumulators[1] and shellers (Hubbard et al. 1987b).

Pecan market studies have primarily focused on estimating demand relationships for pecans and the effect of prices of other nuts (Lerner 1959; Dhaliwal 1972; Wells et al. 1986; Florkowski and Fletcher 1988). Other studies provided a rather descriptive treatment of price trends (Williams et al. 1972; Shafer and Bailey 1977). Pecan price forecasting has received limited treatment in agricultural economic studies (Epperson and Allison 1980; Florkowski and Fletcher 1988). Yet, forecasting pecan prices is of interest to growers and some have developed their own price forecasting methods (Wilson 1988). The objective of this paper is to present applications of price forecasting techniques to predict the prices during harvest for two pecan varieties produced in two southern states. The results could provide growers with information about possible prices at the beginning of harvest and the direction in which prices may change.

Characteristics of Pecan Industry

For decades the pecan industry was plagued by trees bearing pecans in alternate years. Pecan prices are highly variable compared to prices of other major nuts (Figure 1). However, the general relationship between pecan quantities and prices varied among regions. Also, regional production patterns have been attributed to the heterogeneity of planted pecan varieties and differences in applied technology.

Pecan trees are divided into two large groups of native or seedling and improved varieties. Pecan trees propagated through seeds since 1772 (Crocker 1982) are called seedlings or natives. These trees are commonly grown in Texas, Oklahoma, Louisiana, Arkansas, and Mississippi. From among native or seedling trees, growers selected the best bearing trees for grafting to produce improved pecan varieties. Among old, improved varieties, Stuarts dominate pecan production in the Southeast. Some newer hybrids developed by USDA breeders are grown in the West and are becoming more popular in newly planted orchards. New pecan cultivars have less tendency towards alternate-year bearing. Recently, breeders attempted the application of tissue culture techniques to develop new pecan cultivars (Merkle et al. 1987).

*Assistant professor, Department of Agricultural Economics, Georgia Experiment Station, University of Georgia.

[1]Accumulators assemble, grade, store, and distribute in-shell pecans.

The use of fertilizers, pesticides, and irrigation extends the period during which trees retain leaves in the fall. This longer growing period enhances flower bud setting in the fall and helps reduce the alternate-year bearing pattern. Currently, most new commercial pecan orchards are irrigated, and many producing orchards are equipped with irrigation systems. In 1987, 55.1 percent of the trees in Georgia were irrigated (Hubbard et al. 1988) with 75.3 percent of non-bearing age trees irrigated. As a result of technological progress, improved management, and the weather pattern, the tendency toward alternate bearing is becoming less pronounced.

Pecan price variability is attributed largely to variable supply rather than quality of the crop. Furthermore, forecasts of the new crop influence pecan prices. New crop forecasts, issued in September, October, and December, have not always been sufficiently accurate, in the opinion of growers, and may adversely impact prices that are not justified by the actual supply. Inaccurate early forecasts of crop size may have caused some growers to rely less on the USDA Crop Reporting Service as a source of information. But, the Crop Reporting Service contends that greater resources are needed to increase the accuracy of forecasts. Pecans are only one of several crops for which forecasts are made and, although important to some areas, annual pecan value is less than that of major agricultural commodities.

Pecan price fluctuations, according to industry experts, may be influenced by shellers' marketing practices. Some pecan shellers enter contracts with wholesale pecan buyers, brokers, confectionery producers, and other handlers before harvest. At the beginning of harvest, shellers are prone to offer a higher price because of their commitment to deliver pecans before the holiday season. There is also a prevailing opinion among pecan producers that early pecans are of better quality than pecans harvested later in the season. Pecans do not mature uniformly and kernels of nuts staying longer on the tree tend to be darker and less filled. They are also exposed to weather and pests for a longer period of time. This increases the probability of damage; however the incidence of molds inside the shell does not increase (Beuchat 1975). The color of kernels changes through the harvest with seed coats becoming progressively darker. The shade of a kernel varies widely among varieties but some research indicates consumers prefer bright seed coats (Heaton et al. 1975).

Pecan Price Data at Harvest

Prices for pecans are reported by the Federal-State Market News Service located in Thomasville, Georgia. During the harvest, prices are quoted twice a week for several major improved pecan varieties (Stuarts, Schley, Desirable, Moneymaker), other improved cultivars, and seedlings. The quotations are reported for selected states (e.g. Florida) and regions (e.g. Southeast) by two lot sizes of good and fair quality. Small lots weigh under 1,500 lbs. Prices for large lots tend to be higher. Occasionally, only one weekly price is reported because of holidays or because no significant trade in a given variety occurred. The latter is true towards the end of the season. Gaps in price reports tend to be more common for prices of large lots. After the season, prices are published in the annual Pecan Marketing Summary.

Tables 1, 2, and 3 provide examples of the starting and ending dates of harvest, its duration, and price differences for the Stuart variety in Georgia, and native varieties in Oklahoma and Georgia. Despite the prevailing opinion that the pecan harvest starts earlier in the Southeast than the Southwest, price quotations for Georgia often occur later than in Texas. But, the later harvest starting dates hold true for Oklahoma.

The Crop Reporting Service overestimated pecan crop production in 1980. This is alleged to have caused improved varieties to initially be sold at lower prices, but adjustment quickly occurred. With a short harvest, the price of native pecans increased substantially following adjustments of improved pecan price. According to data in tables 2 and 3, the native pecan price in 1980 increased by 10¢/lb and 12.5¢/lb in Oklahoma and Georgia, respectively. That was the largest price increase within the season for Georgia pecans in the illustrated period. Another substantial upward price adjustment for native pecans took place in 1985 after a disappointing crop of improved varieties. The price increase was larger in Oklahoma (12.5¢/lb) than in Georgia (10¢/lb). In years when native pecan prices increased after the first price quotation, the average price adjustment in Oklahoma was 9.3¢/lb and 7¢/lb in Georgia. But price adjustments in Georgia took place earlier in the season. In Oklahoma, price increases frequently occurred towards the end or at the end of the season, sometimes after the Georgia harvest ended. Oklahoma growers took advantage of the short supply and sold some of their crop at higher prices, although for only a brief period.

Pecan Price Forecasting

The annual price pattern for native (or seedling) pecans differs from prices for improved pecans. In recent years, native pecans represented from 23 percent to 38 percent of the total U.S. pecan production. Their share fluctuated according to the alternate-year bearing pattern and the crop of improved pecans. The pattern of alternate-year bearing resulted in the cobweb movement of prices and quantities (Figure 2). The pattern was well known centuries ago to American Indians who planned stops in their nomadic journeys every other year to native pecan groves in Southern Texas. The biological factor and the weather also prevent the convergence or divergence of a cycle because of the relatively random shifts in supply. Probably because of the genetic nature of the alternate-year bearing, the cobweb pattern on the native pecan market was fairly stable.

The presence of the annual cobweb pattern is primarily important for producers of native pecans in Louisiana, Oklahoma, and Texas. However, fluctuations of supply in improved pecans do not follow a clear pattern. In the average year, the change in supply of pecans in Georgia and New Mexico does not exceed 20 percent. Annual variations in Oklahoma are larger.

Annual price change patterns provide little information about price changes during the harvest. Various factors such as cash flow needs, earlier contracts, lack of on-farm cold storage, and quality deterioration of kernels or in-shell pecans stored at room temperature influence many pecan growers to market largely during harvest. Thus, there is no year-round cash market for pecans at the farm level. The tendency toward early crop high prices has been an additional incentive to sell pecans earlier in the season. The higher price includes a premium for better quality according to some growers and shellers. The quality characteristics included, among others, color and filling of kernels.

The emphasis on early marketing of pecans because of higher prices offered by accumulators and shellers caused a seasonal price pattern. The seasonal price pattern, contrary to annual price patterns, is more clearly defined for improved varieties (Figure 3) than for native pecans.

Several approaches were used to provide meaningful price forecast information to pecan growers. Good quality native pecans in Georgia and Oklahoma and Stuart pecans in Georgia sold during the second half of November and December of the 1985 harvest were selected for ex-post forecasting. The harvest of 1985 was relatively short with more price variability than during the average harvest season.

The first specified model had an autoregressive structure. The model was different for each state and pecan variety but similar for small and large lots of pecans. The final form of each model was selected from several alternative specifications. The model for Georgia native pecans included as the explanatory variables prices of small and large lots. Prices of Oklahoma natives were a function of the dependent variable lagged one and two periods. The price of small lots, lagged one period was included in the model of large lot prices. A symmetric addition was made to the model of small lot prices. Two sets of binary variables were included in specified Georgia and Oklahoma pecan price relationships. First, a binary variable was generated to represent all but one year of the used time-series (1980 through the first half of November 1985). Second, a binary variable assumed a value of one for years with less-than-average crop, zero otherwise. It was expected that in years of less-than-average crop the coefficient of the binary variable would be positive. The final form of the model for native (or seedling) pecans in Georgia and Oklahoma included the first set of binary variables.

The next set of models was specified under the assumption that some growers may take into account their past forecast errors. The model used for testing the adaptive expectation hypothesis was similar for all pecan varieties and all states:

$$P_{it} = a + b_1 P_{it-1} + b_2 (P_{it-1} - P_{it-2})$$

where i=small lot, large lot. The autoregressive and adaptive expectations models for Georgia were estimated using seemingly unrelated regression (SUR) and three stage least squares (3sls) for Oklahoma native pecans. Finally, an ARMA model was specified for each state. The model lag structure included two autoregressive components and one moving average.

Results of forecasting pecan prices are presented in Tables 7-12. The ex-post forecasts followed historical forecasts based on the econometric model (autoregressive), and comparison (Table 5 and 6) with actual prices during the second half of November and December of 1985. The comparison revealed substantial differences between the actual and forecasted prices. The ex-post forecasting results were compared with the naive forecast currently used by some growers. In almost all cases, the naive forecast was better than forecasts obtained using any of the specified models. Apparently none of the selected models reflected accurately the real structure of the data-generating process. Judging by the value of u-Theil coefficient, none of the models could outperform the naive forecast. Also, all models frequently failed to predict turning points.

The Future of Pecan Price Forecasting

Several alternative approaches to pecan price forecasting can still be explored. Future studies may focus on processing raw data into more consistent time-series, for example using one observation per week obtained by averaging the existing statistics or forecasting for regions (Southeast or Southwest) rather than individual states. The use of other estimation techniques for new model specifications may improve the forecast quality. For example, the use of vector autoregressive procedure.

The pecan industry is subject to dynamic changes. Changes result primarily from the development and adoption of new technology and expansion of orchards. For example, the dominance of seedlings in Georgia pecan orchards has been replaced by Stuarts. Recently the cultivar Desirable has become more popular than Stuarts. Desirables account for 43 percent of trees ten years of age and younger (Hubbard et al. 1988). Stuarts continue to be planted on a smaller scale and still compete for orchard space with newer cultivars such as Cape Fear, Sumner, and Cheyenne. A change in cultivar selection is important because of the 75 year span over which pecan trees can be economically managed. The time span can be extended if appropriate thinning and trimming methods become available for the control of the tree height without negative effects on yield.

The application of irrigation in almost all new commercial orchards is expected to change the alternate-year bearing pattern, which should improve price forecasting. Price forecasting for abnormal years will remain difficult. But the forecasting process may benefit from an expansion experienced by the pecan industry in the past decade. New orchards have come into production in Arizona and California. There are reports of new pecan orchards being planted in Kansas and Nebraska. Increasing plantings and production will increase the amount of information and can contribute to the efficiency of the price discovery process. A larger industry may also be interested in more analytical work in price and market forecasting.

New cultivars will enter production on a large scale in the next few years. Marketing of pecans from new cultivars will require more attention from Crop Reporting Service. The list of cultivars for which separate prices have been reported in the past would have to include names of new cultivars and their price quotations. This information will be necessary for additional studies of pecan prices.

REFERENCES

Beuchat, L. R. 1975. Incidence of Molds on Pecan Nuts at Different Points During Harvest. Applied Microbiology 29(6):852-854.

Crocker, T. F. 1982. Commercial Pecan Production in Georgia. Cooperative Extension Service. The University of Georgia College of Agriculture Bulletin 609.

Dhaliwal, H. 1972. An Econometric Investigation of Demand Interrelationships Among Tree Nuts and Peanuts. Unpublished Ph.D. Thesis. Oregon State University, 185 p.

Epperson, J. E., J. R. Allison. 1980. Price Futures for the United States Pecan Industry. HortScience 15(4):475-478.

Florkowski, W. J., S. M. Fletcher. 1988. Generating Information for Pecan Producers in a Thin Market Environment. Pecan South and Pecan Quarterly 22(1):17-19.

Heaton, E. K., R. E. Worthington, A. L. Shewfelt. 1975. J. Food Science 40:15-17.

Hubbard, E. E., J. C. Purcell, S. L. Ott. 1987. Identification of Major Problems and Marketing Practices of Pecan Growers in Georgia's Twenty Leading Pecan Counties, 1985. Georgia Agricultural Experiment Station, The University of Georgia College of Agriculture. Research Report 523 (in press).

Hubbard, E. E., J. C. Purcell, S. L. Ott. 1987. Purchasing and Marketing Practices - Georgia Pecan Accumulators and Shellers. Georgia Agricultural Experiment Station, The University of Georgia College of Agriculture. Research Report 544 (in press).

Hubbard, E. E., J. C. Purcell, T. F. Crocker. 1988. Commercial Pecan Tree Inventory and Prospectus, Georgia, 1987. Georgia Agricultural Experiment Station, The University of Georgia College of Agriculture. Research Report 554 (in press).

Lerner, E. B. 1959. An Econometric Analysis of the Demand for Pecans With Special Reference to the Demand Interrelationships Among Domestic Tree Nuts. Unpublished M.S. Thesis. Oklahoma State University, 112 p.

Merkle, S. A., H. Y. Wetzstein, H. E. Sommer. 1987. Somatic Embryogenesis in Tissue Culture of Pecan. HortScience 22(1):128-130.

Pecan Marketing Summary, 1980-1985 Crops. Federal-State Market News Service. USDA-AMS and Cooperating State Department of Agriculture.

Shafer, C. E., B. Bailey, Jr. 1977. Trends in Pecan Production Use and Prices, 1956-1976. Department of Agricultural Economics, Texas Agricultural Experiment Station, DIR 77-3, April 1977.

Wells, G. J., S. E. Miller, C. S. Thompson. 1986. Farm Level Demand for Pecans Reconsidered. S. J. Agri. Econ. 16(1):157-160.

Williams, F. W., M. G. LaPlante, E. K. Heaton. 1972. The Consumer Market for Pecans and Competing Nuts. Georgia Agricultural Research 14(1):8-10.

Wilson, H. 1988. Personal communication.

Table 1. Pecan Prices for Georgia Stuarts, Small Lots, 1980 - 1985

Year	First report	Last report	Number of reports	Highest price report number	Difference between the first and the highest report
1980	Oct. 23	Jan. 13	22	2	2.5¢/lb
1981	Oct. 20	Jan. 26	28	1	X
1982	Oct. 12	Jan. 27	26	3	2.5¢/lb
1983	Nov. 2	Jan. 27	24	3	5¢/lb
1984	Oct. 18	Dec. 20	25	1	X
1985	Oct. 17	Nov. 21	11	1	X

Note: The highest paid price could have been maintained in the following reports.
Source: Based on Pecan Marketing Summary, 1980-1985 Crop.

Table 2. Pecan Prices for Texas Natives, Small Lots, 1980 - 1985

Year	First report	Last report	Number of reports	Highest price report number	Difference between the first and the highest report
1980	Nov. 13	Jan. 8	13	3	10¢/lb
1981	Oct. 27	Jan. 26	21	1	X
1982	Nov. 16	Dec. 28	7	2	2.5¢/lb
1983	Nov. 29	Jan. 31	10	9	6.5¢/lb
1984	Nov. 6	Jan. 29	21	14	15¢/lb
1985	Nov. 7	Jan. 21	18	12	12.5¢/lb

Note: The highest paid price could have been maintained in the following reports.
Source: Based on Pecan Marketing Summary, 1980-1985 Crop.

Table 3. Pecan Prices for Georgia Natives, Small Lots, 1980 - 1985

Year	First report	Last report	Number of reports	Highest price report number	Difference between the first and the highest report
1980	Nov. 4	Jan. 13	20	2	12.5¢/lb
1981	Oct. 20	Jan. 26	28	1	X
1982	Oct. 12	Jan. 27	30	3	5¢/lb
1983	Nov. 2	Jan. 27	24	4	5¢/lb
1984	Oct. 18	Jan. 17	22	18	2.5¢/lb
1985	Oct. 17	Jan. 9	23	17	10¢/lb

Note: The highest paid price could have been maintained in the following reports.
Source: Based on Pecan Marketing Summary, 1980-1985 Crop.

Table 4. Examples of Seasonal Price Variability for Small and Large Lots

	Stuarts, Georgia		Native, Georgia		Native, Oklahoma	
Year	Small lot Variance	Large lot Variance	Small lot Variance	Large lot Variance	Small lot Variance	Large lot Variance
1980	.00898	.01573	.00101	.00059	.00058	.00000
1981	.00686	.00863	.00195	.00345	.00240	.00292
1982	.00898	.00449	.00236	.00045	.00015	.00101
1983	.01477	.01293	.00130	.00147	.00061	.00042
1984	.03897	.00986	.00023	.00109	.00281	.00355
1985	.00964	.00274	.00201	.00185	.00220	.00314

Source: Based on Pecan Marketing Summary, 1980-1985 Crop.

Table 5. Historic Forecast[a] of Small and Large Lot Prices of Georgia and Oklahoma Seedlings, 1985 Harvest

	Georgia, natives				Oklahoma, natives			
	Small lot		Large lot		Small lot		Large lot	
Date	Actual	Forecast	Actual	Forecast	Actual	Forecast	Actual	Forecast
11/21	.475	.489	.560	.564	.475	.495	.525	.548
11/26	.475	.489	.570	.564	.475	.491	.525	.542
12/03	.525	.489	.595	.569	.525	.491	.575	.542
12/05	.525	.523	.595	.590	.530	.524	.580	.577
12/10	.525	.523	.595	.590	.535	.522	.610	.574
12/12	.525	.523	.595	.590	.545	.521	.610	.577
12/17	.575	.523	.605	.590	.575	.528	.625	.580
12/19	.575	.555	.600	.604	.585	.551	.660	.601
12/24	.575	.555	.650	.600	.585	.549	.660	.606

a. $/lb.

Table 6. Historic Forecast[a] of Small and Large Lot Prices of Georgia Stuarts, 1985 Harvest

	Small lot		Large lot	
Date	Actual	Forecast	Actual	Forecast
12/10	.535	.516	.610	.561
12/12	.545	.520	.610	.582
12/17	.575	.528	.625	.586
12/19	.585	.554	.660	.596
12/24	.585	.561	.660	.621
12/31	.525	.560	.565	.625
01/02	.525	.507	.565	.562
01/07	.525	.511	.575	.550
01/14	.525	.511	.575	.557
01/21	.475	.511	.525	.558

a. $/lb.

Table 7. Price Forecasts[a] of Seedling Pecans in Georgia, 1985 Harvest, Small Lots

		Model			
Date	Actual	Naive	Econometric	Adaptive	ARMA
11/19	.475	.425	.446	--	.420
11/21	.475	.475	.478	.472	.451
11/26	.475	.475	.478	.478	.446
12/03	.525	.475	.482	.481	.464
12/05	.525	.525	.514	.508	.525
12/10	.525	.525	.515	.515	.518
12/12	.525	.525	.516	.515	.501
12/17	.575	.525	.520	.519	.507
12/19	.575	.575	.553	.548	.577
12/24	.575	.575	.555	.555	.571

a. $/lb.

Table 8. Price Forecasts[a] of Seedling Pecans in Georgia, 1985 Harvest, Large Lots

		Model			
Date	Actual	Naive	Econometric	Adaptive	ARMA
11/19	.560	.485	.509	--	.467
11/21	.560	.560	.554	.554	.486
11/26	.570	.560	.555	.557	.558
12/03	.595	.570	.563	.565	.555
12/05	.595	.595	.583	.581	.572
12/10	.595	.595	.584	.583	.594
12/12	.595	.595	.585	.584	.593
12/17	.605	.595	.586	.585	.593
12/19	.600	.605	.598	.591	.593
12/24	.650	.600	.600	.592	.609

a. $/lb.

Table 9. Price Forecasts[a] for Native Pecans in Oklahoma, 1985 Harvest, Small Lots

		Model			
Date	Actual	Naive	Econometric	Adaptive	ARMA
11/21	.475	.475	.438	.464	.463
11/26	.475	.475	.465	.465	.454
12/03	.525	.475	.465	.466	.489
12/05	.530	.525	.466	.499	.444
12/10	.535	.530	.500	.505	.523
12/12	.545	.535	.506	.509	.516
12/17	.575	.545	.509	.518	.531
12/19	.585	.575	.518	.540	.537
12/24	.585	.585	.541	.549	.596
12/31	.525	.585	.550	.548	.564

a. $/lb.

Table 10. Price Forecasts[a] for Native Pecans in Oklahoma, 1985 Harvest, Large Lots

Date	Actual	Model: Naive	Econometric	Adaptive	ARMA
11/21	.525	.520	.479	.506	.453
11/26	.525	.525	.507	.511	.495
12/03	.575	.525	.511	.512	.591
12/05	.580	.575	.512	.543	.481
12/10	.610	.580	.544	.549	.586
12/12	.610	.610	.549	.569	.557
12/17	.625	.610	.557	.572	.597
12/19	.660	.625	.570	.584	.604
12/24	.660	.660	.585	.610	.647
12/31	.565	.660	.611	.609	.631

a. $/lb.

Table 11. Price Forecasts[a] of Stuart Pecans in Georgia, 1985 Harvest, Small Lots

Date	Actual	Model: Naive	Econometric	Adaptive	ARMA
10/22	.925	.975	.884	.885	1.009
10/24	.925	.925	.853	.853	.885
10/29	.900	.925	.854	.854	.876
10/31	.900	.900	.834	.834	.863
11/05	.875	.900	.838	.838	.857
11/07	.875	.875	.822	.822	.854
11/12	.750	.875	.820	.820	.863
11/14	.700	.750	.730	.730	.820
11/19	.725	.700	.694	.694	.722
11/21	.725	.725	.712	.712	1.176

a. $/lb.

Table 12. Price Forecasts[a] of Stuart Pecans in Georgia, 1985 Harvest, Small Lots

Date	Actual	Model: Naive	Econometric	Adaptive	ARMA
11/19	.925	1.025	.914	.914	1.078
11/21	.925	.925	.884	.884	.824
11/26	.925	.925	.876	.876	.914
12/03	.925	.925	.877	.877	.908
12/05	.900	.925	.878	.878	.918
12/10	.875	.900	.862	.862	.909
12/12	.800	.875	.842	.842	.869
12/17	.885	.800	.792	.792	.793
12/19	.875	.885	.842	.842	.822
2/24	.875	.875	.843	.843	.836

a. $/lb.

Figure 1. Real prices for selected tree nuts, 1960–1983 (1967 = 100).

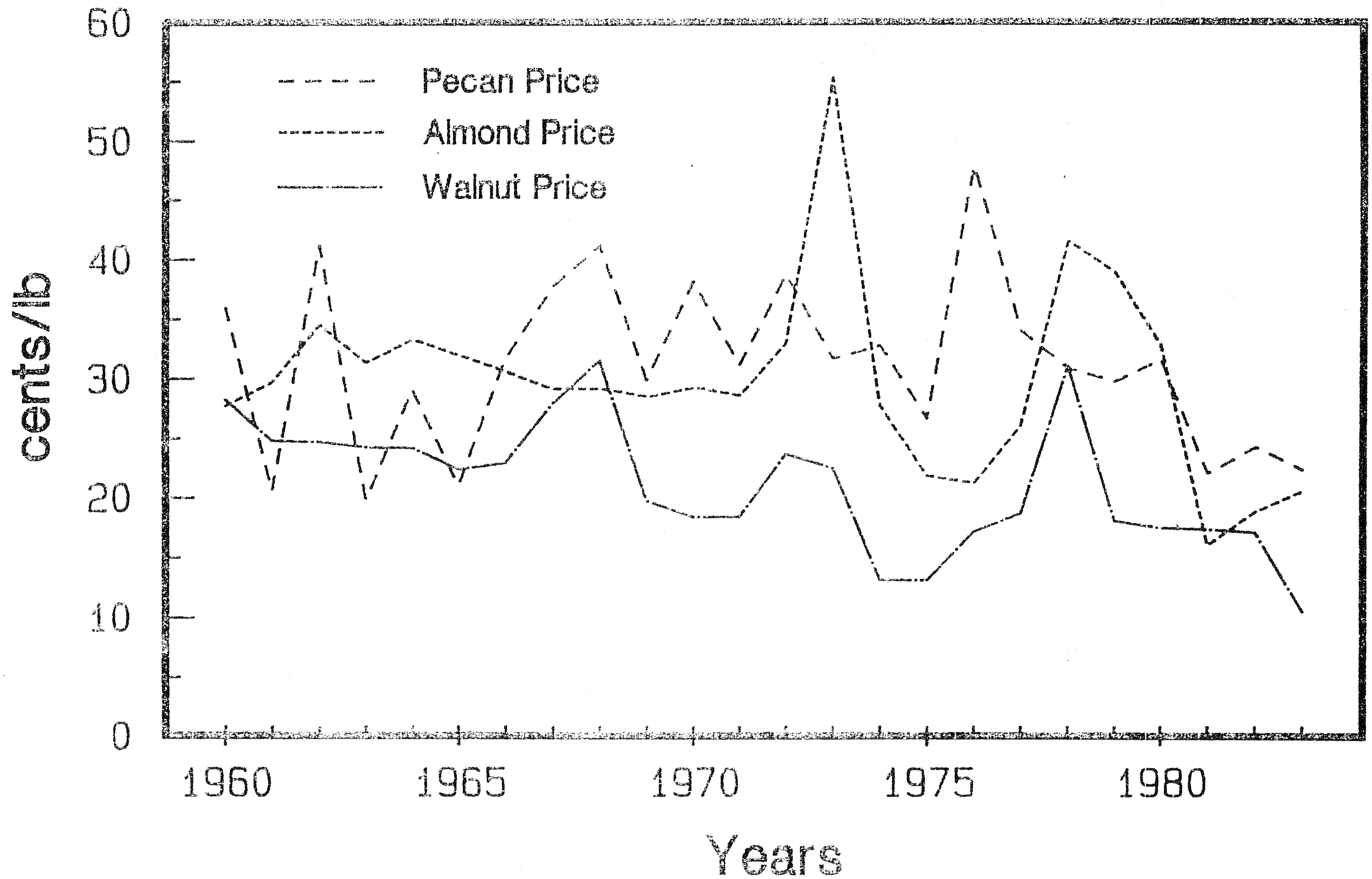

Fig.2: Price and quantity relationship for native pecans in the United States, 1973-1985.

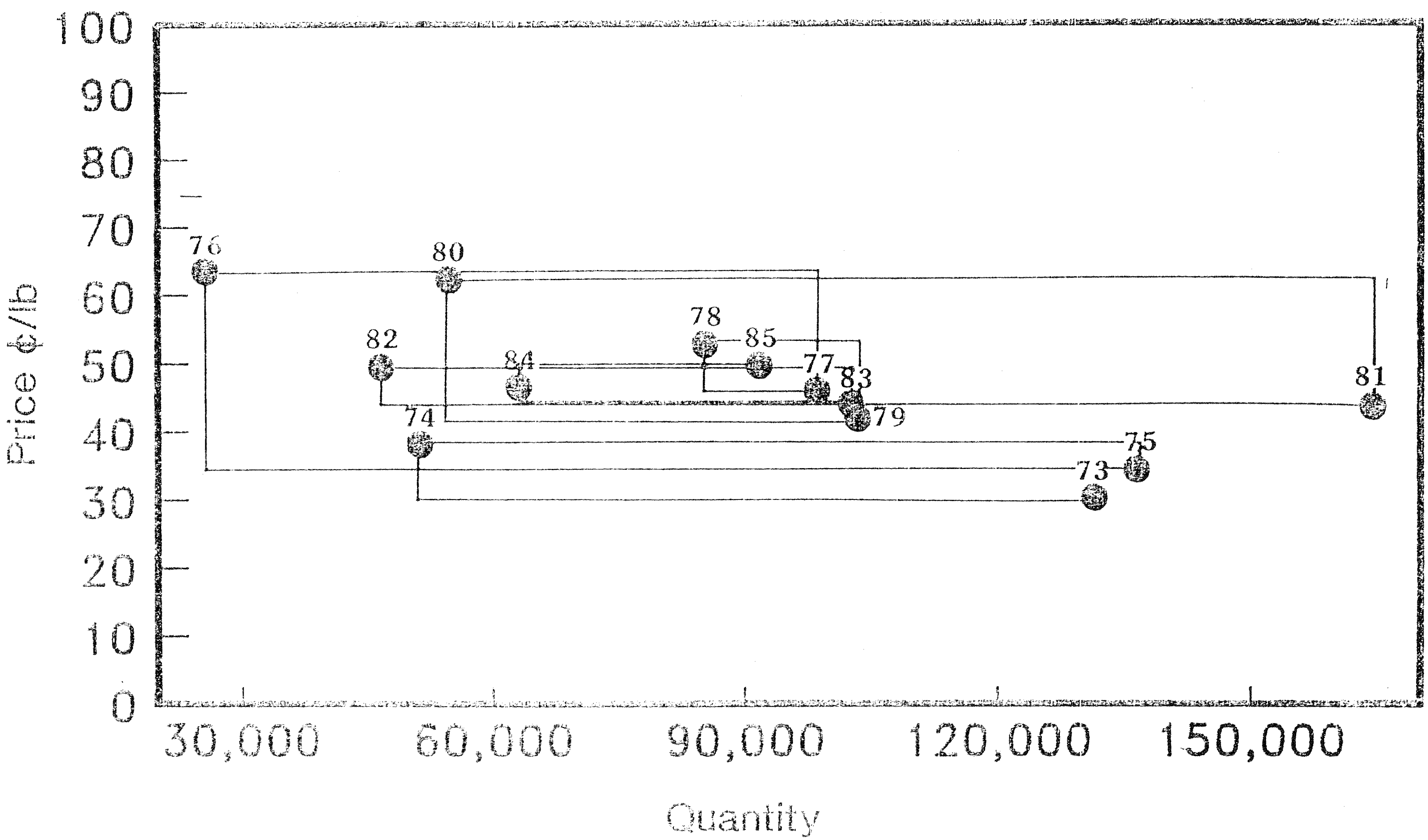

Fig.3: Price fluctuations of peacan prices during harvest in Georgia, variety Stuart, small lots, 1980–1985.