Proc. Fla. State Hort. Soc. 90:359-361. 1977.

PREDICTING SEASON PRICE FOR HASTINGS AREA POTATOES

G. BRYAN WALL
IFAS Food and Resource Economics Department, 1157 McCarty Hall, University of Florida, Gainesville, Florida 32611

Additional index words. Economic model.

Abstract. **This study develops a single equation price predicting model to forecast the season average price of Florida potatoes grown in the Hasting's area. It is designed for use by extension personnel and interested growers. The model includes production in the major competing areas of Texas and California in addition to U.S. storage stocks on hand as of January 1 as additional explanatory variables.**

Florida is a producer of potatoes whose importance lies not so much in total volume produced as the temporal pattern of its production. In 1975, Florida produced less than 2% of the total potato production of the United States in terms of weight and only 1.6% of the total crop value. In seasonal production, Florida produced 63% of total winter production and 18% of the total spring production. Florida's only competition in winter season from January through March is from California while both California and Texas offer competition in the early spring market between April 1 and May 15 (1, 4, 6).

The purpose of this paper is to develop a statistical method of predicting seasonal prices for Florida produced potatoes. Florida has limited competition for the "new" or fresh potato market as mentioned above but must also compete with fall potatoes held in storage. As the owners of these storage potatoes are able to release them when market prices are favorable, they exert a profound influence on the prices received by Florida growers. The ability to predict a Florida price based in part on fall production will increase the growers ability to make appropriate planting decisions. What is presented is an ordinary least squares regression model based on the market factors faced by Florida producers. Given the complexity of the national potato market, the author does not feel that a single equation system is the most accurate means of reflecting grower decisions. It is, however, a useful first step in analyzing the components of the system and thus the model presented here is intended as a foundation for a more complex simultaneous system.

Production Decisions

Economic theory suggests that the supply response of a producer is in general determined by several factors including such items as the price of the product, the price of competing products, and the relative cost of production. In agricultural markets, since the decision to plant is made without complete certainty of the price to be received, this years' production is likely to be in part a function of last year's price. A production year characterized by above average returns is generally expected to induce growers to increase supplies the next year which has the effect of putting a downward pressure on prices. The planting date for Florida potatoes is between September 15 and March 1, which is well after the major late summer and fall harvest. Because a larger portion of the late summer and fall harvest is held in storage and released from December to April, Florida growers have at the time of planting a good estimate of the total quantity of storage potatoes with which their product will be competing and ideally they should incorporate this into their production planning.

Model Formulation

The previous section has detailed how the prices received by the Florida grower are in part a function of acreage planted. While this is true, the role played by the demand for potatoes is also a dominant factor in the determination of F.O.B. price. It is the interaction of the supply schedule, touched on briefly above, and the demand schedule which determine price. The concern in this paper is to simply predict that price and not to identify the underlying components of that price. Thus the model used here will be based on justifiable assumptions but will not attempt to incorporate the simultaneous reaction between supply and demand. What is developed first is an acreage response model. This model will generate a measure of the degree of change in acreage planted as current prices change. Secondly, the price predicting model will be presented and its findings discussed. Following this, a discussion of the usefulness will be presented.

Acreage Response Model

The acreage response model presented here is taken from Levins (6) and is in fact a standard partial adjustment model. Kmenta (5) has a very straightforward presentation of the partial adjustment model and its properties and Griliches (3) has provided a somewhat broader survey. The interested reader is recommended to these authors for a thorough study of the statistical properties of the partial adjustment model.

The model used is presented in equation 1

$$(1)\quad A_t^* = \beta_0 + \beta_1 P_{t-1} + \epsilon_{t1}$$

where A_t^* is the optimum desired acreage in year t and is a function of the previous years price, P_{t-1}, and a random disturbance term, ϵ_{t1}. As the optimum acreage is never reached in a single season and therefore unmeasurable, the relationship between actual and desired acreage may be specified as follows

$$(2)\quad A_t - A_{t-1} = \rho\,[A_t^* - A_{t-1}] + \epsilon_{t2} \quad \text{where } 0 < \rho < 1.$$

The measure of the speed of the adjustment process is ρ and A represents actual acreage planted in year t. This equation, (2), states that the difference in this and last years acreage is a function of the degree to which last years acreage, A_{t-1}, differs from the optimum desired acreage, A_t^*. The random disturbance term is represented by ϵ_{t2}.

The combination of these two equations yields the form shown in equation (3)

$$(3)\quad A_t = \rho\beta_0 + \rho\beta_1 P_{t-1} + A_{t-1}(1-\rho) + \xi_t \quad \text{where } \xi_t = \rho\epsilon_{t1} + \epsilon_{t2}$$

Equation 3 states that this year's acreage, A_t, is a function of last year's price, P_{t-1}, and last year's acreage, A_{t-1}, and the speed with which growers attempt to react toward the optimum desired acreage. Again, the speed of adjustment is measured by ρ.

Florida Agricultural Experiment Station Journal Series Number 790.

Table 1. Acreage, quantity produced, and prices received by Florida potato growers and major competing areas.

	Plantings[z]		Prices[z]		Quantity produced[z]			Quantity
	Fla. Winter	Hast.[x]	Fla. Winter	Hast.	Cal. Winter	Texas Spring	Fla. Hast.	stored Jan. 1[y]
Year	1000 acres		Dollars		1000 cwt			
76	9.4	19.5	10.37	4.95				
75	9.5	16.2	5.22	4.32	1054	825	3159	152,920
74	9.5	19.0	10.20	6.10	1166	962	3290	162,900
73	9.1	19.0	6.35	5.05	1078	838	3420	133,585
72	10.4	21.3	3.95	3.25	969	294	2996	134,320
71	10.9	21.3	4.60	3.70	1562	399	3036	151,400
70	11.0	24.7	5.02	3.40	1955	448	4043	150,030
69	12.2	26.5	3.80	2.80	1848	403	4866	138,140
68	11.7	28.3	3.90	3.16	1890	247	4384	130,350
67	12.0	30.0	3.90	3.15	2752	304	2376	139,170
66	11.3	30.5	4.39	3.74	3504	210	4350	128,050
65	10.1	27.8	5.50	4.30	2209	308	4309	124,170
64	7.5	24.0	4.33	3.43	2507	190	3808	115,000
63	8.4	24.6	2.92	2.38	2580	152	4674	115,770
62	7.3	20.7	2.90	3.19	2828	132	3002	122,215
61	10.2	21.0	2.85	2.09	3657	140	3990	103,595
60	10.0	23.0	4.65	3.80	2164	54	2850	99,400
59	12.5	21.5	2.33	3.08	2145	60	2688	107,900
58	17.5	25.5	4.75	1.96	3675	22	3952	92,700
57	25.0	26.0	2.14	1.85	3570	18	3770	100,600
56	16.3	21.0	3.76	3.49	2492	24	3528	86,000
55	12.8	21.0	4.09	3.85	2871	24	3339	88,000
54	11.6	17.0	2.32	2.66	1600	113	3162	91,800

[z]Vegetable Summary, Florida Crop and Livestock Reporting Service.
[y]Potatoes and Sweetpotatoes, ERS, USDA.
[x]Hastings area.

This model presents a measure of the growers' response to last year's price in determining acres to be planted this year. This response is referred to as an acreage response elasticity and specifically measures the percentage change in acreage planted for a one percent change in the price per unit. Levins calculated both a short run and a long run elasticity and these estimates are presented in Table 2. These elasticities are for both the Florida winter and Hastings area production.

If one chooses to work with expected yields, one can derive output price elasticities and then move to the formulation of regional supply equations. The interested reader is again referred to Levins [p. 23] since that is not the main point of this study.

This acreage response will be combined with the price predicting model which follows, to be used in forecasting growers' prices.

Price Predicting Model

An intuitive measure of a predicting model's accuracy is the degree to which the model relies on realistic assumptions. The model presented below attempts to account for the major forces which contributed to the determination of Florida f.o.b. price for fresh market potatoes. Hee (4) in his detailed demand analysis of potatoes investigated the competitive relationship between winter and early spring potato production and storage of potatoes during January through April.

In the early spring and winter market, Florida produced potatoes compete with other fresh supplies as well as storage potatoes. The high perishability of winter and early spring potatoes requires that they be marketed soon after harvest. Although such "new" potatoes have a demand schedule separate from that of storage potatoes, the quantity consumed of the early new potatoes depends on the price of these potatoes versus the price of those coming from storage. Historically, prices received for the early potatoes have been higher than those of storage potatoes.

The following model includes the major competing areas as identified by Hee in addition to parameters for Florida production:

$$(4) \quad P_H = \beta_0 + \beta_1 QFS + \beta_2 QCW + \beta_3 QTS + \beta_4 QSTO + \beta_5 FHA + \epsilon_t.$$

The variables are defined as:

P_H = Hastings price
QFS = quantity of Hastings area potatoes
QCW = quantity of California winter production
QTS = quantity of Texas spring production
QSTO = quantity of fall potatoes in storage on January 1
FHA = acreage planted in Hastings area
$\beta_{1 \ldots 5}$ = variable coefficients

Table 2. Estimates of supply parameters for Florida potatoes by region.[z]

Area of Production	Constant	Coeff. P_{t-1}	Coeff. A_{t-1}	R^2	Short Run Elast.	Long Run Elast.
Florida winter	745.8	10.314 (3.113)	.52898 (.1683)	.7082	.3911	.8304
Florida early spring	6179.0	19.942 (12.93)	.55822 (.2285)	.5815	.2244	.5079

[z]Source: Levins (6), pp. 24, 25.

Ordinary least squares regression techniques were used to estimate the coefficients of the model. The results are presented in equation 5 with the standard errors shown in parentheses below the coefficients.

$$
(5)\quad P_H = \underset{(1.303)}{5.18} - \underset{(.00030)}{.00078QFS} - \underset{(.00023)}{.00028QCW} + \underset{(.0012)}{.0049QTS} - \underset{(.000013)}{.000031QSTO} + \underset{(.0074)}{.018FHA}
$$

$R^2 = .725$ Durbin-Watson Statistic 1.83

The coefficient of determination, R^2, is simply the proportion of the variation in endogeneous, dependent, variable, Hastings' price, that can be attributed to the model's exogenous, explanatory, variables. In other words, the model presented explains approximately 73% of the historical variation in Hastings area's prices. Of the coefficients, all are of the expected sign except for Hastings acreage, FHA, and the quantity of Texas potatoes, QTS and both are significant at the 5% level. The quantity produced by the Hastings area has a negative effect on prices received and is significant at the aforementioned level of acceptance. One interpretation of this is that the acreage planted in the Hastings area is fairly stable but fluctuations in actual output results in expected fluctuations in prices.

The Durbin-Watson statistic, used here because of the reliance on time series data, indicates that the least squares estimates of the coefficients have not suffered a loss of efficiency nor is there a bias in the estimated standard errors. The significance level used is 2.5% and is simply another indication that the model has performed adequately.

Price Flexibility

A useful measure that can be derived from this model is called a price flexibility elasticity. This value shows the percentage change in price which results from a 1% change in quantity produced. The flexibility is defined as percentage change in price divided by the percentage change in quantity. The price flexibility taken from this model is –.757 which means that a 1% increase in quantity will force a .757 percent decrease in price per unit. There is a differerence of opinion as to the appropriate value to be used for the unknowns P and Q in calculating the percent changes. The simple averages of both price and quantity has been used here, although some would argue that the geometric mean is more appropriate.

Usefulness of the Models

The combination of the 2 models presented makes it possible to predict with reasonable accuracy the season average price of Hastings potatoes. It is granted that the season average price clouds any within season price variations but nonetheless is useful as a planning tool.

The first step in using such a model is to determine the effect that the past season's average price will have on this year's acreage through equation 3. With this forecasted acreage and additional information concerning California and Texas quantities and the size of storage stock on hand January 1 of the new year, one can predict the Hastings price. It will be necessary to transform the Florida acreage estimate, from equation 2, into total quantity produced by applying a yield estimate for the variable QFS in equation 5.

Summary and Conclusion

What has been developed in this study is a means of predicting season prices for Hastings area production. The models involved include a standard partial adjustment model and a simple price predicting model.

The time factor of the Florida potato market is such that Florida's major competition is from fall potatoes held in storage and new production from Texas and California. The development of acreage response elasticities from the Levins' study and the use of the predicting model presented in this study enables an investigator to predict future season price using last year's prices, acreage, quantity estimates of California and Texas production, and the size of storage stocks on January 1.

Such a model as presented here, while useful as a planning tool, should not be used as the final word. The determination of price is due to the simultaneous adjustment of supply and demand forces. Any single equation model, such as the one which is presented here, cannot be expected to accurately reflect the many factors important to the determination of Hastings area F.O.B. prices. The nature of the national potato market requires a model that reflects the simultaneous balancing of fresh production with flows from storage stocks. Hastings area growers operate in both the fresh and process market and each market has a separate demand and supply schedule. The lack of appropriate data prohibits the separation of these 2 markets at the farm level. The models used here combine these 2 markets in the sense that the data used refers to both fresh market and process market sales. The need at this point is to develop a model that deals with each separate market, including storage potatoes, and the simultaneous action of these markets in the determination of relative prices, both at the farm and at the retail level.

Literature Cited

1. Edman, Victor G. and Alfred J. Burns. 1970. Prices and spreads for potatoes, sweetpotatoes, and other selected vegetables sold in fresh markets, 1962/63-1966/67. *U.S. Dept. of Agr., Economic Research Service. Research Report No. 901.*
2. Florida Crop and Livestock Reporting Service. *Vegetable Summary.*
3. Griliches, Z. 1967. Distributed lags: A survey. *Econometrica.* 35: 16-49.
4. Hee, Olman. 1967. Demand and price analysis for potatoes. *U.S. Dept. of Agr., Economic Research Service. Technical Bulletin No. 1380.*
5. Kmenta, Jan. 1971. *Elements of Econometrica.* 473-495. Macmillan, N.Y.
6. Levins, Richard Allen. 1973. The Competitive Position of Potato Producers in the Hastings Area of Florida. Unpublished Masters Thesis. Food and Resource Economics Department. University of Florida.
7. Statistical Reporting Service. 1977. Potatoes and Sweetpotatoes. Crop Reporting Board. U.S. Dept. Agr.