Planning an Expansion of Blueberry Production by Southern Growers

W. J. Florkowski and A. Bilgic[1]

Abstract

JEL: Q12, Q13

Selected Paper prepared for presentation at the
Southern Agricultural Economics Association Annual Meetings
Orlando, Florida, February 5-8, 2006

---

[1] Authors are Professor, Department of Agricultural and Applied Economics, University of Georgia, Griffin Campus, Griffin, Georgia and Assistant Professor, Harran University, Turkey, respectively. Contact author: W.J. Florkowski, Department of Agricultural and Applied Economics, University of Georgia, Griffin Campus, 1109 Experiment Street, Griffin, Georgia 30223-1797, Telephone 770-228-7231, ext. 112, Fax 770-228-7208, E-mail wflorko@griffin.uga.edu

Planning an Expansion of Blueberry Production by Southern Growers

Introduction

This paper examines factors responsible for the decision to change the existing blueberry orchard size. The decision to change orchard size is preceded by the intentions to undertake orchard expansion. Intentions reflect a change in grower preferences and are shaped by a number of factors. We model growers' expected choice with regard to orchard expansion using the random utility model (RUM). Factors influencing the blueberry production growth resulting from orchard expansion help to plan activities of different groups interacting with growers.

The Model

The discrete choice analysis based on a random utility model (RUM) has been applied to investigate the farmer decision making (McFadden, 1974; Cooper and Keim, 1996).

The decision choice set includes two possible alternatives: (1) the expansion of the orchard in the future; or (2) the retention of the current orchard size. An orchard reduction is unlikely when demand remains strong and blueberry prices have been high in recent years. Growers have perfect knowledge about the net gains occurring to them and thus maximize the net gains subject to all possible input costs. The farmer will expand his orchard if the expected gain is at least as great as at the current and past states. Similarly to the indirect random utility framework developed for quantifying preferences, let

$$U_i^1 = bx_i^1 + e_i^1 \qquad (1)$$

where U^1 is the conditional utility (i.e., a gain) derived from alternative 1, a future orchard expansion by a farmer i (i =1, 2, ..., N), $x is the deterministic component, and g is the error component not

controlled by investigators. The specific utility or gain includes, measured in monetary terms, a net gain $U^0(y; x)$ and $U^1(y+C; x)$, where 0 indicates the current orchard size, 1 marks the future state of the orchard, y is the farmer *i*'s income, and C is the net gain that will occur from an orchard expansion, *ceteris paribus* (Cooper and Keim, 1996; Qaim and Janvry, 2003). The variable C can be written as $R^* - *$, where R^* is the revenue in state 1, and * is input costs in state 1, including the pecuniary costs of expansion. Each farmer *i* is assumed to be rational and will choose the decision which generates the largest gain. For example, if $U^1 > U^0$, where U^o is the gain derived from not expanding the orchard owned by farmer *i*, then the farmer *i* will expand the orchard. A farmer derives utility from an expansion of a blueberry orchard because such an expansion improves his revenue potential and affects the livelihood. Assuming the lack of knowledge of future returns, the net gain can be explained by farm and farmer characteristics. The net gain, αB, is implicitly included in vector **x**. If Y_i is the associated latent variable indicating farmer *i*'s choice of whether or not to expand the orchard (1 or 0), then the probability of an orchard expansion is:

$$\begin{aligned} \Pr ob\left(Y_i = 1\right) &= \Pr ob\left(U_i^1 > U_i^0\right) \\ &= \Pr ob\left(\beta x_i^1 + e_i^1 > \beta x_i^0 + e_i^0\right) \\ &= \Pr ob\left[\beta\left(x_i^1 - x_i^0\right) + e_i^1 - e_i^0 > 0\right] \end{aligned} \quad , \qquad (2)$$

where U^1 and U^0 represent the gains associated with the decisions about the future orchard expansion and retaining the current orchard size, respectively. Vectors x^1 and x^0 include the future and current orchard and farmer characteristics that are relevant to the decision to expand, and β is the parameter vector to be estimated. A common practice in empirical investigations is to assume that error terms

follow a type I extreme values yielding a logit model (McFadden, 1974). The probability that the farmer chooses the expansion alternative is Prob ($U^1>U^0$) and the associated probability is:

$$\Pr ob\left(Y_i = 1|x_i, b\right) = \frac{\exp\left(b x_i\right)}{1+ \exp\left(b x_i\right)} = \Lambda\left(b x_i\right), \tag{3}$$

where x is, in general, specified as the unit of x^1 and x^0 and Λ is the logistic cumulative distribution function. The value $e^{\$}$ is the multiplicative effect of a unit increase in some attribute of a potential factor on its probability of being a factor in the orchard expansion decision.

The corresponding log-likelihood function is:

$$Ln\,L = \sum_{i=1}^{N} d_i \ln\left[\Lambda\left(b x_i\right)\right] + \left(1 - d_i\right)\ln\left[1 - \Lambda\left(b x_i\right)\right], \tag{4}$$

where d_i is a dummy indicator that equals one if a farmer decides to expand the orchard, zero otherwise. The consistent parameter estimates are obtained by maximizing (4).

Data

Data used in this study were obtained from a survey of Georgia commercial blueberry farmers. The mailing list was based on the information obtained from the Cooperative Extension Service offices in all counties and supplemented by a list of attendees of blueberry extension meetings and field days. By verifying the address list, duplicate addresses were eliminated. The initial mailing included 364 growers. During the survey implementation, a number of addresses were further eliminated for several reasons. Addresses deemed insufficient for delivery by the postal service was a cause of not reaching 10 growers; 31 growers were no longer growing blueberries; 82 addresses were of residents misidentified as growers, often these individuals provided services to growers or sold agricultural inputs and were listed as attendees of extension meetings or field days; 21 were duplicates, 1 grower refused to participate, and 23 did not respond to the survey. The final list of commercial blueberry growers

included 220 addresses. Although 196 growers (or 89.1 percent) provided information about the number of blueberry plants grown, 72 growers (or 36.7 percent) provided answers to the extended questionnaire probing for information about production, marketing and management issues.

A questionnaire was mailed in the first quarter of 2002. Subsequently, a reminder was sent about a week later. Approximately two weeks later another mailing of the questionnaire took place directed at non-respondents. However, despite these efforts, a number of growers did not respond and had to be reached by telephone. The telephone survey lasted through the latter part of 2002.

Table 1 shows variables used in the model. The variable selection was based on the practical knowledge of the blueberry industry and its resource requirements, characteristics of an entrepreneur viewed as relevant to the expansion decision, and the knowledge of spatial distribution of blueberry production in Georgia. The explanatory variables are grouped into four categories: (1) farmer characteristics, (2) factors affecting the decision to change blueberry production acreage, (3) farm characteristics, and (4) location. Farmer characteristics are income, age, education, experience growing blueberries, and the membership in a blueberry marketing organization. Income was defined as a categorical variable, due to a large number of categories offered as a choice to respondents. Categories were used to encourage responses because farmers were reluctant to share information about income in general. A question probing for a specific amount could lead to omission of this information or a termination of the questionnaire completion. Binary variables measured the degree of importance attached to production-related issues affecting the planned orchard expansion. The variables assumed the value of one if a farmer indicated that each factor was ‘important’ or ‘very important’ in his decision to change the future production plan. Binary variables were the blueberry

price, plant yields, production costs, land, water and credit availability, family labor, weather and disease problems, and prices of other crops. Because the variable measured the perceived importance of each factor, the expected direction of the effect of the price, yield, land, water and credit availability was positive, while weather, diseases and prices of other crops would likely had a negative effect on the decision to expand. The membership in an organization may bring benefits such as the latest information about research results, attention from outreach services responding to growers with specific needs, and even the ability to negotiate input purchases, but the specific direction of the membership in an organization will be empirically determined.

Farm characteristic variables included prices received by farmers selling the blueberry for the fresh and processing markets, input costs per acre, yield per acre, the use of irrigation in the orchard, the presence of two important varieties, 'Tifblue,' and 'Climax' in a grower's orchard, and two indices created to capture the significance of production problems and production practices. 'Tifblue' was a leading variety in Georgia orchards in the 1980s and most of the 1990s, but was planted less often in recent years. 'Climax' was an early-maturing variety, but its earl blooming exposed it to freeze damage. New early-maturing varieties bloom at a later date and outperformed 'Climax' in terms of quality and yield.. Given the variety characteristics, the expected signs of the coefficients were difficult to discern a priori: on one hand, the presence of any of them would encourage an expansion using different varieties; on the other hand, growers might be discouraged from any expansion given the lackluster performance of these varieties in their orchards and the perennial nature of the crop.

We regressed the observed prices , i.e., those reported by other respondents, on farmer and farm characteristics and used the expected values of the regressed variable in the questionnaires where

respondents did not to report the price. This approach allowed us to include in the sample those respondents who otherwise would have been dropped, while retaining them augmented the sample size.

The production practice index accounted for the use of insecticides, herbicides, fungicides, mowing between rows, the cultivation under the plants and between rows, the application of herbicides between rows, and the fertilizer application. The production practice index reflected the intensity of management of existing operations. However, the directional effect of this variable on the decision to expand an orchard is not clear. A good manager could be expected to face fewer obstacles in managing a larger operation, but intense management might result in limiting available resources and discourage acreage additions.

Appling, Bacon, Clinch and Ware counties were included to capture the effects of location. These counties have been leading blueberry growing areas. Appling and Bacon counties led in the production already in the 1980s and 1990s (Hubbard et al., 1992) and differed from other counties with respect to the blueberry marketing infrastructure.

Results

Table 2 shows estimation results. The likelihood ratio test (LR) confirmed the explanatory power of the empirical model. Among farmer characteristic variables, the percentage of gross income received from blueberry production was statistically significant and had a negative affect on the likelihood of expanding a blueberry orchard. It appears that growers who already specialized in blueberry production and generated a high percentage of their gross income from blueberry sales were experiencing barriers, possibly managerial in nature, preventing further expansion. The variable measuring the affect of a grower's gross income was marginally insignificant, but the sign was positive.

This direction of the income's influence is plausible because farmers with already high income may search for even higher returns by expanding blueberry orchards, especially when blueberry prices have remained relatively high in recent years. The plausible direction of the grower's age suggested that as it increased, he was less likely to expand the production of blueberries although the variable was not significant. Age-squared variable was used to capture the non-linear relationship with the probability of expanding the orchard. Farmers 43 years old or older (i.e., 0.260/(2*0.003)) would be more reluctant to increase the production of blueberries. By the mid-40s, a farmer had developed skills and experience needed to sustain a profitable operation and venturing into a new enterprise may have a limited appeal. Blueberries are a perennial plant and evidence shows that plants can remain highly productive for several decades, i.e., for a longer period than time of reaching the retirement age.

Water and credit availability variables were statistically significant among factors viewed important in the decision to change the production acreage. Water is an essential agricultural input. The prolonged drought in Georgia (1999-2003) demonstrated that access to water sources was essential for the economic viability of number of enterprises including blueberries. Although blueberry plants tolerate some drought and do not like waterlogged soil, water availability affects the yield and the size of berries. Furthermore, fluctuations in water supply may cause quality deterioration because of ruptured skin, which is unlikely to heal prior to harvest. Berries with broken skins lower the grade and the price paid to farmers. Therefore, the statistically confirmed influence of water availability on orchard expansion decision was consistent with expectations. Credit availability was also positively related to the likelihood of orchard expansion. Expenses associated with an enlargement of a blueberry orchard include the cost of plants and the purchase and installation of an irrigation system, among others. These

expenses could be substantial and critically affect the future profitability of the venture. The statistical significance of both water and credit availability coefficients was consistent with expectations. Importance attached to the price, yields, land availability, family labor, weather problems and prices of other crops had a negative relation to the probability of expanding the production of blueberries, but the coefficients were statistically insignificant.

The larger the number of 'Tifblue' plants reported by a grower, the less likely was he willing to expand the operation, but the result was not statistically confirmed. However, the directional affect deserves a discussion. 'Tifblue' blueberries were a mainstay of Georgia industry a couple of decades ago, but their popularity has waned as new varieties have become available. To take advantage of market demand for fresh, early-maturing berries, growers have been planting varieties maturing earlier than the mid-season maturing 'Tifblue,' harvested mostly for processing. Its maturity date in Georgia puts this variety in a direct competition with blueberries harvested in North Carolina and New Jersey, supply sources located closer to the major urban markets of the eastern United States. As a result, growers with a large share of 'Tifblue' in their production tend to receive lower prices than growers with the early-maturing varieties. Both 'Tifblue' and 'Climax' varieties suggest growers using dated technology and, as expected, less likened to expansion.

Both prices received for the fresh and processing markets had the expected positive signs, but were statistically insignificant. Demand for processing blueberries has been relatively strong, but prices for blueberries for processing were more volatile than the prices in the fresh market. The fluctuations were caused by the size of wild (lowbush) blueberry crop, quality, the crop size of cultivated berries in competing growing areas, and the unloading of frozen low bush blueberry inventories in 1999. The

opposite effect of prices for fresh and frozen (processed) blueberries on the expansion decision was consistent with the price differences suggesting the expansion of blueberry production aimed at a fresh market.

Knowledge of the significance and directional effects of variables on the decision to expand an orchard were augmented by detailed measures of changes in the probability decision associated with each specific variable. The signs of marginal effect estimates were consistent with the signs obtained for the initial estimates. However, the marginal effects of the originally significant variables had a relatively small impact in magnitude and larger t-values as compared to the initial estimates.

From a practical standpoint, we are interested in the probability decision of several variables. The effect of a grower total income, the percentage of income generated by the blueberry operation, experience in growing blueberries, education, and age are important. The three latter variables can be relatively easy to establish during a person-to-person contact with the outreach staff. Extension service workers can use such information to prioritize their outreach efforts, while those sourcing blueberries may be able to focus their search among growers with specific characteristics. The calculation of probability decision with regard to each of the five selected variables assumes that all other variables are constant, *ceteris paribus*.

The effects on the decision to expand a blueberry orchard of income, the percentage of gross income received from blueberry production, experience in growing blueberries, education and age were simulated. The increase in total income reported by a respondent contributed to relatively quick gains in the probability of choosing to expand a blueberry orchard. However, after the probability reached 0.8 additional changes in total income had a very limited effect. The relationship between the total

income and the orchard expansion decision seems to support earlier identified importance of credit availability. Growers with more income were more likely to choose orchard expansion. The available data do not allow to discern the possible varied motives behind the expansion decision, but the coincidence of the decision and total income level is clear.

A grower is reluctant to increase the production of blueberries as the percentage of gross income received from the blueberry production increases. Plotted values suggest that once the percentage of income generated by the blueberry production reaches 50 percent, the probability of orchard expansion drops below 0.5. Only few growers can be expected to continue with expansion if the share of their total income generated by blueberry sales already exceeds 50 percent. Farmers may continue the production of other crops and maintain some diversity because they are risk averse. However, it is plausible that an expansion would eventually involve planting new bushes on marginal land for the blueberry culture.

Gaining experience in blueberry production led initially to small gains in the probability of orchard expansion. The probability increased at a faster rate if a grower reported six years to 14 years of experience. Growers with about 14 years or more of experience in growing berries were becoming increasingly likely to enlarge production. This is a good indicator who among growers can be expected to be interested in expansion. Experience can be relatively easily verified by extension service and, therefore, expansion agents and specialists find growers who may require advice on the latest developments in production. Given the importance of credit availability confirmed earlier, growers with 14 years to 20 years of experience seem to be potential borrowers. Because of the location of blueberry operations, rural banks are the primary credit suppliers that can be approached by growers.

The inverse relationship between the decision to expand and the educational attainment level was not expected and had to be confirmed empirically. The overall and the marginal effects of education on the probability of orchard expansion were very small (Table 2). The probability of enlarging blueberry production rapidly declines with the increasing level of growers education. For college-educated growers (i.e., those who received approximately 16 years of schooling) the probability is about a third lower than for a high school graduate (i.e., respondent reporting about 12 years of schooling).

There is a dramatic decline in the probability of deciding to enlarge an orchard for growers 50 years to 60 years old. Clearly, the perennial nature of the crop may be an important factor in the observed rapid change. Some growers may be reluctant to expand as they age because they intend to leave the decision to their heirs. An expansion could be financed through credit, forcing the possible repayments of loans on future operators of a family farm. Physical demands to manage a growing production may also force farmers to reconsider the possible expansion as they age. A calculation based on the estimation results indicates that the decline in probability of orchard expansion noticeably decreases after a grower reaches mid-40s.

Implications

Factors identified as relevant to the orchard expansion decision can be viewed as both general and location-specific. The availability of credit in the decision-making process seems a fairly universal factor. The lack of access to credit or the cost of credit is often cited as a major obstacle to entrepreneurial undertakings. A grower may have adequate production knowledge, land, and equipment to perform cultural practices, but may lack adequate funds to invest in plants. The high

density of plants and the increasing use of patented varieties increases the costs of establishing an orchard. A specific factor influencing the expansion decision was water availability. Blueberry plants tolerate short periods of low moisture and if irrigated, do not require large amounts of water. However, the year in which data were collected was the fourth year of prolonged dry weather in Georgia. The persistence of drought affected all agricultural production, even the production of blueberries. Although many growers install a supplemental irrigation systems in blueberry orchards, a substantial portion of them lacked any irrigation system. Furthermore, the multi-year period of less-than-normal precipitation increased competition for water resources among agricultural enterprises and between agricultural and non-agricultural users. Therefore, access to water made it an important factor in the expansion decision among Georgia growers, but it may be less important for growers in other regions.

The profile of a grower who considered a blueberry orchard expansion emerged from the study. Most often, it was a person in his 30s or early 40s, who already produced some blueberries. Their gross annual income was below $40,000 and they wanted to increase the portion of income generated by blueberry production. He likely carried a high school diploma and had about 10 years of experience growing blueberries. Firms servicing farmers and the extension service may find this information useful in developing their commercial offers or instructional programs, respectively.

Knowledge of factors influencing an expansion decision is limited because an empirical analysis requires detailed information about the farm and the farmer. Such information is fragmented and seldom provides all the necessary details. Future studies tackling this empirically important topic may be possible only when the data are collected from as large number of growers as possible. However, growers often do not perceive the sharing information about their operation beneficial even though they

learn about the industry behavior. Perhaps, the continuation of growth in blueberry production and strong prices resulting from a demand increase will assure growers that the benefits outweigh risks in responding to surveys seeking information in the future.

References

Cooper, J. C. 1997. Combining Actual and Contingent Behavior Data to Model Farmer Adoption of Water Quality Protection Practices. *Journal of Agricultural and Resource Economics* 22:30-43.

Cooper J. C., and Keim, W. 1996. Incentive Payments to Encourage Farmer Adoption of Water Quality Protection Practices. *American Journal of Agricultural Economics* 78:54-64.

Florkowski, W. J. 2004. Commercial Blueberry Inventory and Prospectus, Georgia, 2002. The Georgia Agricultural Experiment Stations, Research Report #693, May.

Greene, W. H. 2003. *Econometric Analysis*, 5th Edition. Prentice Hall, Upper Saddle River, New Jersey.

Greene, W. H. 2002. LIMDEP Version 8.0. Econometric Software Inc. Plainview, New York.

Hall, M. R. and A. D. Draper. 1997. 'Austin' Rabbiteye Blueberry. *HortScience* 32:1295-1296.

Hubbard, E. E., W. J. Florkowski, G. W. Krewer, and H. J. Witt. 1992. Commercial Blueberry Inventory and Prospectus, Georgia, 1991. The Georgia Agricultural Experiment Stations, Research Report #608, July.

Krewer, G. and D. S. NeSmith. 2002. The Georgia Blueberry Industry: Its History, Present State, and Potential for Development in the Next Decade. *Acta Horticulturae* 574:101-106.

Mainland, C. M. and J. W. Tucker. 2002. Blueberry Health Information - Some New Mostly Review. *Acta Horticulturae* 574:39-43.

McFadden, D. 1974. The Measurement of Urban Travel Demand. *Journal of Public Economics* 3:303-328.

NeSmith, D. S., A. D. Draper and J. M. Spiers. 2002. 'Alapaha' Rabbiteye Blueberry. *HortScience* 37(4):714-715.

Qaim, M., and Janvry, A. D. 2003. Genetically Modified Crops, Corporate Pricing Strategies, and Farmers' Adoption: The Case of Bt Cotton in Argentina. *American Journal of Agricultural Economics* 85:814-828.

Sjulin, T. M. 2003. The North American Small Fruit Industry 1903-2003. II. Contributions of Public and Private Research in the Past 25 Years and a View to the Future. *HortScience* 38(5):960-967.

USDA. 2004. Food Consumption (per capita) Data System. Available online http://www.ers.usda.gov/data/foodconsum...&ReportType=2&btnFoodConsumption=Submi. Accessed October 25, 2004.

Table 1. Descriptive Statistics of Variables

Variables	Unit	Mean	Std. dev.	Min	Max
Farmer characteristics					
Income	$	81,197.917	201,872.554	5,000.000	1,000,000.000
Percentage of gross income received from blueberry production	%	57.9	43.4	0.00	100.0
Age	Years	56.931	14.200	23.00	87.00
Experience	Years	11.875	7.462	0.00	30.00
Education	Years	14.806	3.133	8.00	20.00
Membership in blueberry marketing organization	1=important or very important, 0 otherwise	0.375	0.487	0.00	1.00
Factors influencing changes in production acreage					
Blueberry price	1=important or very important, 0 otherwise	0.625	0.488	0.00	1.00
Blueberry yields	1=important or very important, 0 otherwise	0.625	0.488	0.00	1.00
Costs of production	1=important or very important, 0 otherwise	0.556	0.500	0.00	1.00
Land availability	1=important or very important, 0 otherwise	0.403	0.494	0.00	1.00
Family labor	1=important or very important, 0 otherwise	0.306	0.464	0.00	1.00
Weather problems	1=important or very important, 0 otherwise	0.500	0.504	0.00	1.00
Water availability	1=important or very important, 0 otherwise	0.611	0.491	0.00	1.00
Disease problem	1=important or very important, 0 otherwise	0.458	0.502	0.00	1.00
Prices of other crops	1=important or very important, 0 otherwise	0.208	0.409	0.00	1.00
Credit availability	1=important or very important, 0 otherwise	0.208	0.409	0.00	1.00

Table 1. Continued.

Variables	Unit	Mean	Std. dev.	Min	Max
Farm Factors					
Fresh market blueberry price	$/lb	0.864	1.632	0.00	9.00
Processing market blueberry price	$/lb	0.247	0.490	0.00	3.250
Input expenditure per acre	$/lb	105.342	363.762	0.00	2980.00
Pounds per acre	Lbs	583.479	726.745	0.00	5000.00
Irrigation	1=Irrigation	0.681	0.470	0.00	1.00
'Tifblue'	1=Tifblue	0.347	0.480	0.00	1.00
'Climax'	1=Climax	0.083	0.278	0.00	1.00
Production practices index	Index	4.333	2.021	1.00	8.00
Location					
Appling county	1=Appling	0.083	0.278	0.00	1.00
Bacon county	1=Bacon	0.181	0.387	0.00	1.00
Ware county	1=Ware	0.056	0.231	0.00	1.00
N			72		

Table 2. Initial Parameter and Marginal Effects Estimates of Logit Model

	Initial estimates		Marginal effects	
Variables	Parameter	t-value	Parameter	t-value
Constant	-5.4905	-.57	-1.3671	-.58
Farmer characteristics				
Income	.1920	.96	.0478	.96
Percentage of gross income received from blueberry production	-1.9878	-1.73	-.4949	-1.72
Age	-.0256	-.09	-.0064	-.09
Age-squared	.0006	.23	.0001	.23
Experience	.1951	1.61	.0486	1.64
Education	-.0272	-.13	-.0068	-.13
Membership in blueberry marketing organization	-.8213	-.54	-.2025	-.55
Factors influencing production acreage				
Blueberry price	-.7205	-.33	-.1762	-.34
Blueberry yields	.5610	.22	.1392	.22
Land availability	.2293	.22	.0569	.22
Family labor	-.9698	-.79	-.2376	-.83
Weather problems	-.9738	-.81	-.2378	-.84
Water availability	3.0817	1.80	.6428	2.67
Prices of other crops	-.5237	-.39	-.1302	-.39
Credit availability	3.7865	2.25	.6175	3.80

Table 2. Continued.

	Initial estimates		Marginal effects	
Variables	Parameter	t-value	Parameter	t-value
Farm factors				
Prices received for the fresh market	.5350	1.07	.1332	1.11
Prices received for the processing market	-.4433	-.57	-.1104	-.57
Input costs per acre	.0009	.47	.0002	.47
Pounds per acre	.0004	.27	.0000	.27
Irrigation	1.9688	1.37	.4513	1.62
Variety 'Tifblue'	-1.5605	-1.43	-3705	-1.61
Variety 'Climax'	-.9864	-.47	-.2372	-.52
Production practices index	-.1581	-.40	-.0394	-.40
Location				
Appling county	-.0705	-.03	-.0176	-.03
Bacon county	3.0576	1.41	.5375	2.77
Ware county	-1.0389	-.52	-.2475	-.59
Unconstrained log-likelihood		-26.4427		
Constraint log-likelihood		-49.6563		
Chi-squared (with 29 ")				

[a] Significant at "=.10.
[b] Significant at "=.05.