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Southeastern Peanut-Production Cost Efficiency Under the Quota System: Implications for the Farm-Level Impacts of the 2002 Farm Act

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In the article, stochastic frontier analysis of peanut-production efficiency in the Southeastern region of the United States is conducted with a view of assessing the likely farm-level impacts of the 2002 Farm Act. Results indicate that, although quota ownership did not significantly impact inefficiency, it is likely that limitations on the quota's transferability to areas with better growing conditions were a significant cause of inefficiency. The acreage shifts and improved yields following the passage of the 2002 Farm Act support this conclusion. Certain farm characteristics, such as farm size and operator's education and age, were also important for efficiency.

Key Words: 2002 Farm Act; peanut production; stochastic cost frontier analysis; supply management policies

JEL Classifications: Q18, D61, Q15, Q12.

Peanuts are one of the crops whose production was, until recently, regulated by a supply-management system, which was a price-quantity (quota) control. The 2002 Farm Act replaced this system with the Marketing Loan Program that dealt away with the quantity controls/quota and significantly lowered price support. As a result, quota holders lost the quota privileges, whereas quota renters were relieved of them, and producers were no longer constrained in production quantities or output destination.

These changes have produced significant redistributive and income effects. Although the decrease in output price drives less efficient growers out of peanut production, the elimination of quantity controls benefits efficient producers by providing them with additional production and marketing options (Dohlman et al.). Since 2002, about a quarter of peanut acreage has been reallocated from the historic peanut-growing counties to counties with higher yields. This shift shows that the program changes caused growers to consider expected returns among competing crops and other factors, such as crop rotations and yield potential, when making planting decisions (Dohlman et al.).

The change in the farm support policies is

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being accompanied by gradual agricultural trade liberalization. Although peanut imports have been declining since 2002, they are likely to grow as the North America Free Trade Agreement (NAFTA) and the Central America-Dominican Republic-United States Free Trade Agreement (CAFTA-DR) are fully implemented. The declining exports are partly due to the increasing competition from low-cost producers (e.g., Argentina, Brazil, Nicaragua, China, and India). These trends put increasing competitive pressure on domestic producers, particularly in the Southeast, where peanut production is of vital importance to the rural communities. Based on the U.S. Department of Agriculture (USDA) Census of Agriculture, many counties in the South derive 50–70% of their agriculture income from peanuts; therefore, farm-support policies have played a major role in maintaining rural income in these regions (Fletcher and Revoredo).

The impact of the 2002 Farm Act on individual producers has not been well understood, however. Research on agricultural support policies indicates that farm supports usually affect production efficiency of the targeted producers, although not always positively (Battese; Kalaitzandonakes; Rezitis, Tsiboukas, and Tsoukalas).[1] To the best of our knowledge, no empirical research has been conducted on the relationship between quota ownership and production efficiency. This article evaluates peanut production cost efficiency under the quota system explicitly incorporating quota ownership in the analysis to assess potential farm-level impacts of the recent changes in the industry. The hypothesis of lower efficiency of quota owners is rejected in favor of the conclusion that peanut quota ownership did not have any significant impact on cost efficiency.

The empirical analysis uses data from the 2002 Southeast Peanut Farm Costs and Returns Survey that was conducted in the spring of 2002 by the Georgia, Alabama, and Florida National Agricultural Statistics Service (NASS) state offices and sponsored by the National Center for Peanut Competitiveness, the National Peanut Board, the Southern Peanut Farmers Federation, the University of Georgia, Auburn University, and the University of Florida. This survey is the latest comprehensive source of data on Southeastern peanut production because the last similar survey of this region was conducted on a much smaller scale by the Economic Research Service (ERS) of the USDA in 1996.

The choice of analytical approach is motivated by the relative advantages of the available methodologies and by data availability. The nature of peanut production under the quota regime satisfies the assumptions of cost minimization required for cost efficiency estimation better than those of profit maximization required for production efficiency analysis. In addition, the survey contains only data on variables required for cost function but not for production-function estimation.

Although the 2002 survey did not capture the effects of the 2002 Farm Bill, efficiency analysis permits construction of a cost frontier. The construction of a cost frontier makes it possible to analyze the effects of quota ownership and other farm and producer characteristics on efficiency. The results of this analysis can help explain the shifts in peanut production observed since 2002 and, possibly, identify the producers that are likely to benefit or lose from the policy change.[2] However, this article does not assess in detail the new program's impacts on efficiency of individual growers because the new policy environment

[1] Battese provides a good overview of the literature (although a little dated). Kalaitzandonakes finds that price protection in the New Zealand beef/sheep industry produced negative productivity growth. Rezitis, Tsiboukas, and Tsoukalas find that the 1994 EU farm credit program actually reduced efficiency of Greek farms.

[2] In a seminal article on frontier analysis in agricultural economics, Battese wrote: "Philosophical issues concerning the existence of technical efficiency for individual farm operators and the measurement of managerial ability are likely to involve considerable debate among economists in the future. However, it is clear that frontier production functions are quite significant for the investigation of causes of inefficiency in production and indicating means by which efficiency may be reduced and production increased, given the level of technology involved" (p. 205).

has introduced uncertainty and numerous adjustment pressures.

The rest of the article is structured as follows. Section 1 provides a brief overview of peanut farm-support policies and discusses how they affect production and cost efficiency. Section 2 describes different efficiency estimation methodologies and the motivation of the choice of analytical techniques. Section 3 describes the data and presents estimation results, together with discussion of policy implications. Section 4 concludes.

Changes in Peanut-Production Support Policies

The 2002 Farm Act dealt away with the supply management system that, being preceded by a similar system of acreage allotments, existed since 1981. Under the supply management system, both price and quantity controls were imposed on peanut production. The quantity/volume of peanuts grown for domestic consumption for "edible purposes" was limited by an annual quota, which was fixed and belonged to some peanut farmers and not to others.

The advantage of growing quota peanuts was that they could be sold at a price not less than the mandated support price that ranged from \$600 to \$680 per ton during the 1990s and early 2000s. Any additional quantities produced but not covered by the quota (the so-called "additionals") had to be exported at world prices that typically ranged between \$300 and \$375 per ton. If these "additionals" were not exported, they had to be crushed at a value of approximately \$200–\$250 per ton. As a result, some producers rented quota quantities (in lbs.) from quota owners, which was equivalent to buying the right to sell domestic "edible" peanuts. This support regime created distortions in peanut markets, affecting not only production patterns and efficiency but also the land prices that were often inflated because of the quota allocated to the land.[3]

The 2002 Farm Act replaced the quota system with a Marketing-Assistance Loan Program (MLP) that lifted the quantity restrictions on peanut production and introduced a per-unit revenue floor in the form of marketing loan rate. Under the MLP, producers can move the crop into the marketing loan (government storage) as a pledge for a (current) loan rate of \$355 per ton (the producer per-unit revenue floor). At the end of the postharvest period of 9 months, farmers can either forfeit the loan (give up the "collaterized" peanuts and keep the loan rate) or repay it at the lower of the loan rate or the loan repayment rate, which is set equal to the "weekly posted prices" and is announced by the USDA (Westcott, Young, and Price).

Although the mechanics of the interaction among the producers, crop processors, and the government within the framework of the MLP are quite complicated, it is clear that lifting the quantity restrictions and substituting the fixed support price with a significantly smaller per-unit revenue floor is going to affect producers differently. The effects of this transfer are particularly interesting with regard to those quota owners who were peanut growers because subsidies and other producer supports have been found to have an adverse effect on efficiency.

With a half-century history of production support, one could expect the quota owners to be less efficient than quota renters. Dohlman et al. report that, in 2001, quota owners' production costs were about one-quarter (\$83) smaller than those of quota renters because the owners did not have to rent the quota rights. This cost advantage might have allowed some inefficient quota owners to stay in business, whereas nonowners with the same characteristics would not be able to keep up. Thus, we can hypothesize that, on average, quota own-

[3] To the best of our knowledge, there has been no recent research on the impact of peanut quota on land prices, mainly because of the complexity of both the old and the new support regimes. However, under a poundage quota regime, peanut quota was a farm asset, which had a significant impact on land's sale and rental values. At the same time, the quota poundage could be separated (sold) from the farm (Fletcher et al.), and its value was approximated by the quota rental rate, which suggests that the land could also be sold with or without the quota.

ership might have been associated with lower cost efficiency and that the removal of the quota system put at least some of the owners at a disadvantage and may force them out of business.

In addition, quota ownership may have induced inefficiency by encouraging reduced effort. This argument is similar to the utilitarian, as opposed to profit-maximizing, approach to modeling production decisions, which can be illustrated with a simple utility-maximization model where effort is a costly but necessary production input. Assuming a Cobb-Douglas production function $Q = x^{\alpha}e^{\beta}$, which requires a single physical input x sold at price w and producer effort e subjectively valued at v implies that $\partial(e/x)/\partial(w/v) = \beta/\alpha$, i.e., a drop in the price of x causes substitution away from effort or, in the case of a fixed x, lower effort.

Without introducing additional complications, by the same logic, lower quota costs per pound (i.e., higher percentage of quota ownership) could result in lower producer effort that, in turn, might have led to lower efficiency. As production and cost functions used in the stochastic frontier analysis normally account only for physical inputs but not for the (unobservable) effort and other intangible inputs, individually optimal lower effort under a subsidy regime has a negative impact on production or cost efficiency. Similarly, differences in producer age, education, and other demographic characteristics may also affect efficiency. For example, Muller states that "little is known about the role of nonphysical inputs, especially information and knowledge, which influence the firm's ability to use its available technology set fully" (p. 731). Considering possible rigidities associated with adjustment to the new regime and changing farming practices, the allocative inefficiencies associated with quota ownership may even persist for a while after elimination of the quota.

On the other hand, transferability of the quota (ability to rent it out) implies that peanut farmers owning the quota could have chosen producing versus renting out because they believed they could make better use of their asset by growing peanuts themselves. Assuming that the opportunity costs of quota owners were the same as those of the other peanut farmers, this suggests that quota owners may have been just as efficient as nonowners.

Although farm-level data on who has left the industry are not available, the methodology employed in this article allows us to test the relative efficiency of quota owners. Given that the Southeast is an important peanut growing region and that the competition from foreign producers is growing (Dohlman et al.; Diop, Beghin, and Sewadeh), understanding the impact of agricultural policies on the peanut production efficiency in this region is particularly timely and important.

Methodology

This article uses stochastic frontier analysis to study peanut production efficiency. The stochastic frontier approach is an econometric technique based on assuming a specific functional form for the cost or production frontier. In its simplest form, the approach posits a stochastic model for a cross-sectional frontier with a two-component disturbance specification: one error term is the usual two-sided noise component, whereas the other is a one-sided disturbance component associated with inefficiency (Fare, Grosskopf, and Lovell). The main advantage of this approach is that it accommodates statistical noise by allowing deviations from the frontier to be associated with both inefficiency and random factors, thus avoiding possible overestimation of inefficiency.[4]

Instead of a production-frontier model, a cost-frontier model is estimated for several reasons. First, the survey data contain detailed information on input prices, cost shares, and output value but do not contain data on phys-

[4] An alternative method for the stochastic frontier analysis is data-envelopment analysis (DEA), which requires data on input quantities that are not available. In addition, DEA is a nonparametric analysis, which is an extreme point technique, meaning that noisy data can cause significant problems (Charnes, Cooper, and Rhodes). Finally, most statistical hypothesis tests based on DEA results are difficult to implement and unreliable (Coelli, Rao, and Battese, Ch. 6).

ical input quantities and output prices, which makes cost efficiency analysis a more suitable methodology. Second, unlike the production frontier analysis, which is concerned with technical efficiency only and does not impose any behavioral assumptions, cost frontier analysis implies cost minimization (Khumbakar and Lovell).

The cost-minimization assumption is appropriate when input prices, rather than input quantities, are strictly exogenous. This condition is usually satisfied in competitive and in some regulated industries. Peanut production is competitive, which implies that input and output prices are indeed exogenous. In addition to that, Kumbhakar and Lovell argue that, when not all inputs are variable due to either contractual arrangements or short-run fixity, variable costs minimization frontier is appropriate. From a theoretical perspective, Chambers shows that, under some regularity conditions, duality principles ensure consistency between variable cost function and production function and, therefore, either describes farming activity equally well and both can be used in empirical analysis (as in Hazarika and Alwang).

Based on these considerations, the stochastic variable cost frontier analysis is used for estimating peanut production cost function and for testing for a possible impact of quota ownership on inefficiency. In this analysis, the cost function is of the form $C_i \geq c(y_i, w_i, \beta)$, where C_i is the actual (variable) cost of producer i, and $c(\cdot)$ is the efficient cost function of output y_i, input prices w_i, and a vector of coefficients β. The difference between the actual and the efficient cost is captured in the error term e_i that consists of two parts: the truly random shock v_i and the cost-inefficiency term u_i, which is random but nonnegative. Although several distributional assumptions about u and v are possible, they are always assumed to be independently distributed:

$$(1) \qquad v_i \sim \text{iid } N(0, \sigma_v^2); \qquad u_i \sim \text{iid } N^+(0, \sigma_u^2).$$

With these specifications, it is possible to derive marginal density, mean, and variance of $e_i = u_i + v_i$. Given these values, an expression for conditional distribution of u, given e, can be obtained: $f(u \mid e)$. Thus, estimating the cost function that incorporates e_i using either maximum likelihood estimation (MLE) or method of moments provides estimates of the cost inefficiency term, u_i. The producer specific measure of cost inefficiency, CE_i, can be expressed as

$$(2) \qquad CE_i = \frac{c(y_i, w_i; \beta)}{E_i} = E[\exp(-u_i) \mid e_i],$$

where E_i defines individual expenditure.

The impact of various factors on the inefficiency u_i is estimated using equation (3):

$$(3) \qquad \hat{u}_i = \sum_i \gamma_i z_i + \varepsilon_i,$$

where z_i are the variables that explain the inefficiency (Kalirajan; Pitt, and Lee).

This approach, however, has been criticized because the model of predicted inefficiency effects contradicts the assumption of identically distributed u_i from the first stage. Battese and Coelli proposed a method that combines the estimation into a single step by assuming that u_i is distributed independently but not identically as truncations of the normal distribution, $N^+(Z_i\gamma, \sigma_u)$. Thus, the mean of the cost inefficiency effect is modeled as a function of Z_i's. This specification permits the coefficients in γ to be estimated together with the coefficients of the cost frontier.

The functional forms most commonly used for cost-frontier estimation are Cobb- Douglas and translog (Kumbhakar and Lovell).[5] The Cobb-Douglas specification is simple and allows the focus to be on the error term:

$$(4) \qquad \ln E_i = \beta_0 + \beta_y \ln y_i + \sum_n \beta_n \ln w_{ni} + v_i + u_i.$$

[5] The translog functional form is less restrictive but requires more observations because of the cross-price terms it contains. Thus, the empirical analysis in this article focuses on estimation of the Cobb-Douglas functional form (Equation [5]).

Table 1. Data Description and Summary Statistics

	Mean	SD
Output (value of peanuts in $ per acre)	666	174
Variable cost (value in $ per acre)	329	78
Price of paid labor (per hour wage)	11	6
Price of fertilizer ($ per acre)	45	28
Price of seed ($ per acre)	67	2
Price of pesticide ($ per acre)	115	48
Price of materials ($ per acre)	63	33
Dummy renters only	0.13	0.34
Dummy owners only	0.28	0.45
QUOTA (% of quota owned)	43	38
SIZE (total acres planted)	202	190
OAGE (operator age in years)	50	13
OEDU (index of education)	2.54	0.88

Since cost frontier must be linearly homogeneous in input prices, the parameter restriction $\beta_k = \Sigma_{n \neq k} \beta_n$ must be imposed before estimation or incorporated in the equation above as:

$$\text{(5)} \quad \ln\left(\frac{E_i}{w_{ki}}\right) = \beta_0 + \beta_y \ln y_i + \sum_n \beta_n \ln\left(\frac{w_{ni}}{w_{ki}}\right) + v_i + u_i.$$

Data Description

The survey questionnaire contains a wide array of questions grouped by several topics into the following cost components: land operated and commodities produced, peanut acreage and seeding, farm production costs and returns (seeds, fertilizer, chemicals and pesticides, labor, vehicles and tractors, irrigation, peanut quota ownership and renting, peanut marketing and miscellaneous expenses, and other crop costs), as well as producer demographic characteristics.

Of the 740 questionnaires distributed across the Southeast peanut production area, only 232 growers responded. The returned questionnaires resulted in 189 questionnaires with some input quantity and expense data. However, the returned questionnaires contained many missing data for one or several variables and only 69 of these questionnaires contained all the necessary data for variable cost stochastic frontier analysis. The final sample consists of 61 observations as some extreme outliers were eliminated.[6] The largest part of the respondents (87%) are peanut growers from Georgia, which is the largest peanut-producing state in the country, whereas respondents of Alabama and Florida represent a much smaller part of the sample (10 and 3%, respectively).

The variables used in the stochastic frontier analysis are summarized in Table 1. The *cost* variable represents variable costs and includes the value of paid labor and the costs per acre of seed, fertilizer, pesticides, fuel, electricity, farm supplies, and marketing. Output is measured as the per-acre value of the total farm peanut production. The input prices are per-hour wages to paid labor, and per-acre costs of seed, fertilizer, pesticides, and materials. The last category groups together fuel, electricity, farm supplies, and marketing costs. To impose the homogeneity restriction, the *cost* variable and all input prices were divided by the cost of materials.

The main variable hypothesized to affect inefficiency is *QUOTA,* measured as the percentage of peanut quota owned relative to the total peanut quota grown (both own and rent-

[6] The main reason for the low (or rather incomplete) response rate is perhaps the sheer length of the questionnaire (more than 2000 entries), which was difficult to complete.

ed). In addition, two other variables were used in estimation—a dummy variable *Dummy owners only,* which takes the value of 1, if the producer owned 100% of the quota produced, and 0, otherwise; and a dummy variable *Dummy renters only,* which takes the value of 1, if the producer rented 100% of the quota produced.

Empirical work indicates that farm size and operator demographic characteristics affect efficiency (Battese). Peanut operation size may also be an important determinant of cost efficiency in the Southeast because Dohlman et al. find that these peanut producers have relatively smaller farm size (averaging 816 acres compared with 1,583 acres in the Southwest) but also lower production costs. The potential impact of peanut operation size is captured by the variable *SIZE* (measured as a log of peanut acres harvested).

Dohlman et al. point out that peanut farmers in the region were found to be, on average, 10 years older than those in the Southwest (average age, 42 years), suggesting a role for operator age as a variable that may affect efficiency. Operator age (*OAGE*) captures the impact of farming experience. As an operator's age advances, however, it is likely that the relationship between efficiency and age reverses because, as operators grow older, they may be less willing to maintain efficient levels of production or be less able to take care of it. To capture this possible nonlinear effect, operator' age squared (OAGE2) is also included.

The level of education as another proxy for operator's management skills is measured by *OEDU,* which is an index of education varying from 1 to 5, where 1 stands for incomplete high school, 2 for completed high school, 3 for some college education, 4 for completed Bachelor degree, and 5 for graduate school. Inclusion of educational level is also important because the 1998–2002 Agricultural Resource Management Survey (ARMS) data indicate that, despite higher yields, Southeastern farm operators have the lowest educational attainment in terms of both high school and college completion compared with the rest of the country.

Table 2. Comparison of the Means of the Census/ARMS and Sample Data

	Census	Sample
Average peanut acreage harvested	142	202
Peanut acreage percent irrigated	36	18
Yield (pounds per acre)	2,510	2,934
	ARMS[a]	
Farm land owned	385	347
Operator age	52	50
Age class		
Less than 50 years of age (%)	45	51
50 years or more (%)	55	49
Education		
Completed high school (%)	85	89
Completed college (%)	13	16

Source: 2003 Census of Agriculture for the 2002 crop year; data on Georgia.
[a] Source: 2002 Agricultural Resource Management Survey (ARMS) of cotton farms; data on the Southeastern region.

Table 2 presents a comparison of summary statistics of the sample data used in the analysis and the 2003 Census of Agriculture data for Georgia complemented with demographic characteristics from the 2002 ARMS data. Two data sources are used because only the ARMS survey furnished the demographic data. However, peanut-specific data was taken from the Census because the 2002 ARMS was a survey of cotton farms that were not representative of peanut farms. The comparison reveals that the producers in the sample are similar to those in the ARMS data set. The largest difference seems to be in our sample's smaller proportion of irrigated land (18 versus 36%), which can be attributed to a difference in definition. Although the Census has a very broad definition of irrigated land, our survey left the definition largely to the discretion of the respondent. The larger harvested peanut acreage in the sample could be attributed to the difference between the Census definition of a farm and that of an operator used in the survey. The higher yields in the sample are most likely a result of self-selection bias. This is confirmed by a less-significant difference between the Census data and the sample aver-

Table 3. Cobb-Douglas Stochastic Frontier: Normal/Truncated-Normal Model

		Model 1[a]	Model 2[b]
Log VC	*Log output value*	0.010	0.006
		(0.138)	(0.139)
	Log price of labor	0.355***	0.354***
		(0.056)	(0.055)
	Log price of seeds	0.303***	0.303***
		(0.042)	(0.042)
	Log price of fertilizer	0.043	0.044
		(0.044)	(0.044)
	Log price of pesticide	0.125***	0.125***
		(0.044)	(0.044)
	Constant	−3.467***	−3.442***
		(0.912)	(0.922)
Inefficiency	*QUOTA*	0.003	
		(0.002)	
	Dummy own only		0.142
			(0.223)
	Dummy rented only		−0.178
			(0.184)
	SIZE	−0.553***	−0.564***
		(0.129)	(0.137)
	OAGE	−0.056	−0.058
		(0.035)	(0.040)
	OAGE2	0.0005	0.0005
		(0.0003)	(0.0004)
	OEDU	−0.352*	−0.347*
		(0.118)	(0.212)
	Constant	4.341***	4.488***
		(1.145)	(1.127)
	σ_u^2	0.004	0.004
		(0.008)	(0.007)
	σ_v^2	0.048	0.048
		(0.008)	(0.008)
	χ^2	263	268
	Log-likelihood	6.092	6.40
	Observations	61	61

[a] Model 1: quota ownership is measured as a percentage of the owned quota.
[b] Model 2: quota ownership is measured by *dummies for only owned* and *only rented* quota use.
* Indicates significance at the 10% level.
** Indicates significance at the 5% level.
*** Indicates significance at the 1% level.

ages that include returned incomplete observations (not included for the sake of space).

Empirical Results

The results from the stochastic frontier regression estimation are presented in Table 3. In Model 1, quota ownership is measured as percentage of owned quota. Model 2 shows results of a specification where the impact of quota ownership is captured by the dummies for owners only and renters only. In both models, the data fit the Cobb-Douglas specification reasonably well.[7]

[7] The translog functional form was also estimated. A generalized likelihood ratio test of the form $\lambda = -2[LLH_0 - LLH_A]$, where LLH_0 and LLH_A are the val-

Because the coefficients on input prices and output value and variables explaining the inefficiency do not change significantly in Model 1 and Model 2, the underlining relationship seems fairly robust to alternative specifications. As expected, all input prices have positive coefficients, except for the coefficients on the price of fertilizer and of output, which have the correct sign but are not statistically significant. The reason behind these results may be the relatively small number of observations and some peculiarities of the industry discussed below.[8]

The coefficient of the input variable is less than 1, which suggests increasing returns to scale, indicating that peanut farmers were engaged in production on nonoptimal scale.[9]

In the one-stage estimation, the variance of the inefficiency term, σ_u^2, is 0.004 or almost 10 times smaller than the random cost disturbance σ_v^2, which is 0.048. For comparison, the variances in the two-stage estimation show that the deviation from the frontier due to inefficiency was much higher ($\sigma_u^2 = 0.375$ and $\sigma_v^2 = 0.195$). However, the hypothesis that all producers are fully efficient ($\sigma_u^2 = 0$) is rejected in the one-stage estimation at the 5% level.

Table 3 also shows the impact of the variables used to explain the mean of the inefficiency term described in the methodology section. These are quota ownership, operation size, and operator demographic characteristics. The main variable of interest—percentage of quota owned—does not affect efficiency as indicated by the lack of statistical significance on the coefficient on *QUOTA* (quota ownership) in Model 1, as well as the statistically insignificant coefficients on the *Dummy owners only* and the *Dummy renters only.*

These results seem consistent with recent data on the regional shifts in peanut production. Since 2002, six of the eight largest peanut-growing states have seen either a dramatic increase or decrease in peanut acreage, which can be explained by the differences in soil and climate conditions. Production in the Southeastern states of Georgia, Florida, and South Carolina, where highly irrigated land provides ideal conditions, increased dramatically during the past two years. At the same time, less-traditional and dryer peanut-growing regions, such as Oklahoma, Texas, and Virginia, reported big declines. There was also a modest reduction in Alabama and North Carolina, although the trend indicates that these states could soon catch up with their pre-2002 production.

Although microdata on the identities of the growers who exited peanut production as a consequence of the legislative changes are unavailable, evidence suggests that the farmers who are either exiting or shrinking peanut production are not exclusively the former quota owners. The only uniform result has been that production expanded in areas geographically better suited for peanuts, indicating an increase in production and cost efficiency.

These findings might explain the objections to peanut policy change voiced by some peanut-growing regions before 2002. These objections came from the Southwestern Peanut Growers Association, the GFA Peanut Association, and the Peanut Growers Cooperative Marketing Association (representing peanut farmers in North Carolina and Virginia), who

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ues of the log-likelihood function under the null (Cobb-Douglas), and the alternative (translog) hypotheses was also performed. The statistics for λ has a chi-squared distribution, with degrees of freedom equal to the number of restrictions imposed under the null hypothesis, that is, the number of coefficients that appear in the translog but not in the Cobb-Douglas specification (Coelli). Given these restrictions, the critical value was 12.59 at the 5% level, which is higher than the estimated 6.202 given the results of the two specifications. Thus, the test failed to reject the null hypothesis that the Cobb-Douglass functional form is an appropriate representation of the cost function. Experimenting with the total cost function produced inferior results, and some models failed to converge after homogeneity restrictions were imposed, which could be caused by poor data quality and imperfect proxies of the quasi-fixed inputs.

[8] Peanut extension specialists confirm that applying fertilizers to peanuts is of little use. However, growers often continue using fertilizers.

[9] Recent applied research done at the National Center for Peanut Competitiveness using stochastic dynamic programming analysis of a sample of representative peanut farms in the Southeast found that, currently, variable peanut-production costs decrease with acreage (Flanders et al.).

supported continuation of a modified quota system. At the same time, Georgia, Florida, and some other states were in favor of the marketing loan (Smith). Perhaps it is not surprising that a decline in peanut planted acres attributed to higher and more variable production costs (often above market prices) has been observed in the Southwest, whereas the less-financially vulnerable and more peanut-dependent Southeastern farmers have expanded or at least retained their acreage (Dohlman et al.).

However, using post-2002 data on the inter- and intraregional shifts to draw conclusions about the future of peanut production may be misleading because the past two years have been characterized by unusually high yields in the United States, due to favorable weather conditions, and by significant foreign supply shocks affecting world prices, particularly the poor quality of the China's peanut harvest in 2003. Although this put the U.S. growers in an advantageous position, the data from these two years are not enough to make any realistic long-term predictions.

The finding that peanut cost inefficiency decreases with the size of operations may be indicative of the relatively high management intensity of peanut production in comparison to other crops. Peanut practitioners have long observed that, although the average production costs for such staple crops as corn, soybeans, and wheat are usually decreasing and convex, the average peanut production costs for a fixed farm size are U-shaped. In the light of our findings, this suggests that the relatively small Southeastern peanut farms may be on the declining portion of the variable production cost curve.

The impact of experience on inefficiency seems to confirm the hypothesis that efficiency increases with operator's age up to about 56 years of age (according to Model 1), and then starts to decrease. However, this result is not statistically significant although it is close to the 10% level of significance, possibly because of the small sample. Operator's educational level, which is another proxy for managerial skills, has a positive and significant effect on efficiency.

The lack of significance of some of the input prices and the output value is not unusual in this type of analysis. Chambers states that, in empirical work, limited data availability and quality affect the results of cost-function estimation. The small sample size of the survey, which necessitates aggregation of inputs, regulated nature of peanut production before 2002, and input market rigidities may all contribute to the weaknesses of some of the results.

Without knowing the background of peanut-production support policies, the finding that the output coefficient (yield per acre) in the cost function is statistically insignificant seems unusual. However, it can be explained by a peculiarity of the quota system. Under this quota support program, the quota, i.e., the volume of peanuts to be produced for edible purposes, was tied to specific land tracts because of the original peanut quota allocation (allotments).[10] Switching production to more fertile land would invalidate the quota. The quota tracts had vastly different qualities and peanut production potential—although some land was productive enough to bring high yields even without applying high volumes of agricultural inputs, other areas required more inputs, which still did not result in proportional yield increases. The inability of producers to allocate appropriate land to peanuts because of the quota constraints may be behind the observed lack of positive dependence between the yields and per-acre costs in the estimation results. Evidence of massive reallocation of peanut acreage that took place after 2002 of nearly one-quarter of the peanut base acres confirms this argument.

Conclusions

The article studies the impact of quota ownership on the efficiency of peanut production in 2001 in order to draw conclusions about the likely farm-level impacts of the 2002 Farm Act. Data from the 2002 Southeast Peanut

[10] Quota quantity restrictions were introduced later to curb the increase in harvested quota peanuts, which resulted from the applications of technological innovations in agriculture.

Farm Costs and Returns Survey are used in a stochastic cost-frontier analysis using Cobb-Douglas functional forms. The stochastic frontier approach was chosen because the nature of competitive but regulated peanut production satisfies the assumptions required for cost-efficiency estimation better than those of profit maximization and because the survey data contained variables appropriate only for this type of analysis.

This article contributes to the discussion of the likely farm-level effects of the 2002 Farm Act, which replaced the quota system with the marketing assistance loan program. Results show that quota ownership did not affect cost efficiency. This means that the advent of the 2002 Farm Act put the quota owners engaged in peanut farming in no worse position than other peanut growers, which implies that they should not be expected to be the first to go out of business. The results also suggest that other producer characteristics, such as operation size and operator's educational level, impact cost efficiency.

These results are helpful in understanding how vulnerable the Southeastern producers are to agricultural trade liberalization and shed some light on the competitive potential of the industry for improving cost efficiency. A finding that former quota owners are less efficient than quota renters would suggest that eliminating the quota restrictions should lead to replacement of the old producers with the new more efficient ones. This would hurt the former quota owners but increase the overall competitiveness of the peanut sector. Our finding that quota ownership did not inhibit efficiency, therefore, suggests that there is little reason to expect significant improvement in productivity from replacing the old peanut producers with the new ones. Instead, recent evidence suggests that the efficiency and productivity improvements come mainly from reallocation of peanut acreage to areas and regions better-suited for peanut production.

An interesting extension of this analysis would be to use cost-function estimates in deriving aggregate or regional peanut supply function. Domestic peanut supply estimation was virtually impossible before 2002, when production and prices were fixed by the quota. Besides, there was little practical sense in such estimations because the quota was always filled and the purchasing price maintained, whereas the share of the "additionals" was too small. The derived supply, calibrated with current or hypothetical price and production data, can be used in simulations of various trade scenarios showing production responses and their distributional and welfare effects.

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