Assessing the Louisiana Shrimp Fishing Fleet Technical Efficiency Using A Bayesian Stochastic Cost Frontier Model.

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, February 1-5, 2003

This project was funded by the NMFS grant #NA76FK0429.

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Abstract

A Bayesian stochastic cost frontier analyzed the shrimp fleet of Louisiana. A translog cost function was estimated. 269 vessels were included and sub-grouped by length (#20 ft, 21-40 ft, 41-60 ft, and > 60ft), and net type (trawl, skimmer, and butterfly). Results indicated no influence of these factors on cost efficiency.

1. Introduction

Shrimp is very important for the economy of Louisiana and the US. Approximately 40% of all shrimp caught in the US is landed in Louisiana. At the state level, the value of shrimp landings oscillates around US$ 250 million every year, i.e., about 67% of the value of all commercial fisheries landings in the state. Some estimates of economic impacts indicate that commercial fisheries have a large multiplicative effect in the economy with a multiplier of 8.9 (Southwick, 1997). Accordingly, shrimp landings generate in Louisiana a total economic effect of about U$2.2 billion. This outcome shows the extent of the economic importance of the shrimp industry for Louisiana. Therefore, a better understanding of the operations of the shrimp fleet should be a priority for the economic agents of the state. However, up to the present, most studies conducted to analyze the shrimp industry in Louisiana have not provided a deep analysis of the relationship between seasons and technical efficiency in the industry. Declines in shrimp prices during the year 2002 have brought new pressure on shrimp fishers and cause a number of them either to shift to other fisheries or to get out of business. In addition, price declines compel producers to reduce cost, i.e., to be more cost effective in the production process. This situation raises questions about economic efficiency. This paper focuses on the economic efficiency of fishing for shrimp taking into account vessel size, gear used, fishing season and, consequently, species of shrimp. The objective of this research is to gain more knowledge about the nature of shrimp production in Louisiana in order to assess the importance of the afore mentioned factors on the cost efficiency of fishing for shrimp. This information is of relevance for shrimp fishers, management and regulatory agencies, and the general public. This paper is organized in several sections. The following section reviews the regulations affecting the shrimp industry in Louisiana. Section 3 provides a brief history of the shrimp industry in Louisiana. Section 4 examines the theoretical requirements of the cost function. Section 5 deals with the Bayesian stochastic cost frontier methodology. Section 5 details the data used in this study.

Section 6 provides a description of the data used in this study. Section 7 presents. Section 8 discusses the results from the empirical estimation. Finally, section 9 draws conclusions and recommendations based on the exercise developed in this research.

2.- Brief History of the Shrimp Industry in Louisiana

According to Landry (1990), many Louisiana fishermen come from a tradition of fishing and shrimping during the spring, summer and fall months, then oystering and trapping during the winter months. There is information indicating that shrimp fishing in Louisiana started as early as in the second half of the sixteenth century. Since that time shrimping has become a way of life and it is linked to traditional life in Louisiana. According to Landry (1990), in 1774, early travelers in Louisiana noticed that shrimp were fished in the lakes south of New Orleans using small skiffs or wading in shallow waters. Shrimp were caught with seine nets in the shallow coastal lakes and bays and along the beach. Today most shrimp fishermen still use small vessels and fish near shore. It may be argued that this fact may be related to historical development of the fishery as well as shrimp abundance near shore, and water shallowness. White shrimp (Penaeus setiferus Linnaeus) and brown shrimp (Penaeus Aztecus Ives) are the two species of the most relevant economic importance. In addition, there are three more species of minor economic importance (LDWF, 1992). Brown shrimp is mostly caught between May and July and white shrimp during the months of August through December. In 2000, 6,904 (63%) out of over 11,000 commercial shrimp gear licenses holders landed shrimp in Louisiana (LDWF,2001).

3.- Current Regulations Affecting The Louisiana Shrimp Fishery

Regulations are an important factor influencing productivity in any industry. Many regulations encourage technological changes, constraints, and development. Therefore, regulations can have a very substantial impact on economic and technical efficiency. This section provides an overview of main regulations affecting the shrimp industry in Louisiana. Like most industries in

Louisiana, the shrimp fishery in Louisiana is under heavy regulation. Shrimping areas in Louisiana are divided into inshore waters, the offshore territorial sea and the federal Exclusive Economic Zone (EEZ). The line (shrimp line) that separates inshore waters from offshore territorial waters generally follows the coastline, although there are some exceptions. The line that separates state territorial waters from the EEZ generally runs along the Louisiana coast three miles from shore. In addition, for management general purposes, state inshore and state offshore territorial waters have been divided into three shrimp management zones. Shrimp seasons are flexible and are set by the Louisiana Wildlife and Fisheries Commission based on biological and technical data on shrimp populations in Louisiana waters. Usually, the spring inshore season begins in late May or early June and extend into July. The fall inshore season usually begins in late August and extends into November or December. The shrimp season in Louisiana's offshore territorial waters is usually open year-round. However, the Commission has authority to close this area when deemed necessary. The shrimp season in the Federal waters of the Gulf outside (south) of Louisiana's territorial waters is usually open all year; these waters are controlled by the federal government. There is no size limit on any saltwater shrimp taken during the spring open season nor is there any size limit on brown shrimp or seabobs taken during any open season in Louisiana. There is, however, a possession count on saltwater white shrimp taken in either inside or outside (offshore) waters of Louisiana of 100 count (whole shrimp per pound). This size restriction applies to the taking or possession of such shrimp aboard a vessel, with the exception of the period from October 15 through the third Monday in December when there shall be no possession count on saltwater white shrimp taken or possessed. When more than 50 percent by weight of the saltwater shrimp taken or possessed is seabobs or brown shrimp, then the maximum allowable amount of undersized white shrimp taken or possessed shall not exceed 10 percent by weight of the total saltwater shrimp taken or possessed. Finally, there are many regulations regarding types of gear, bycatch reduction devices (BRD), turtle excluder devices (TED), net, and mesh size. These regulations stipulate where and when a given type of gear, net and mesh size can be used (LDWF, 1999).

4.- The Economic Model

Since the theoretical framework of this study is based on the concept of the cost function, it is important to mention its properties. Consider cost to be a function of output (*q*) and input price (*p*). This can be expressed as $c=c(q,p)$. It is important to mention the properties of the cost function. The first property, monotonicity, indicates that total cost must increase with input price, i.e., $\partial c/dp > 0$ which implies that the same applies to output, i.e., $\partial c/dq > 0$. Concavity in inputs prices, i.e., $\partial^2 c/dp^2 < 0$, indicates that the underlying conditional demand function is decreasing in input price, resulting in a downward-sloping input demand curves. The third property is homogeneity of degree one in input prices. Homogeneity of degree one requires that $c(tp)=tc(p)$ where t>0. If the cost function is homogeneous of degree one, then the first derivative of the cost function with respect to input price (which is the conditional input demand) must be homogeneous of degree zero, i.e., $x(tp)=x(p)$ where $x=\partial c/dp$. For empirical specification, a translog cost function is considered as the empirical functional form as in (1). The translog cost function imposes homogeneity of degree one

$$lnc(p,q) = \alpha_0 + \sum_{i=1}^{n} \alpha_i lnp_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \alpha_{ij} lnp_i lnp_j + \sum_{i=1}^{n} \gamma_i lnq_i + \sum_{i=1}^{n} \beta_i (lnq_i)^2 \quad (1)$$

$$Where:\ \alpha_{ij} = \alpha_{ji}$$

$$\sum_{i=1}^{n} \alpha_i = 1,\ \sum_{j=1}^{n} \alpha_{ij} = 0$$

with respect to input prices under these conditions. As a second order approximation to an arbitrary cost function, the translog also fulfills Diewert's minimum flexibility requirement for flexible forms.

There are several methods to analyze technical efficiency using a cost function. For purposes of this research, the Bayesian stochastic frontier cost model is used. Recent developments have shown that Bayesian approach may have, in some cases, several advantages over the classical econometric methods in applied research. For example, in the case of cost efficiency, in the Bayesian model prior information can be easily incorporated. In addition, when using maximum likelihood estimation, the likelihood function is difficult to estimate and often fails to converge. In the Bayesian approach, even without a prior, it is easy to calculate. Bayesian approach does provide standard errors of the inefficiency term, which cannot be estimated in the classical methods. Finally, it is easier than in classical econometrics to impose restrictions such as concavity and monotonicity of the cost function.

The stochastic cost frontier model operates as follows. Initially, the cost function of an (the most) efficient firm in an industry, which is called the cost frontier, is estimated. Deviations from that frontier are used to measure inefficiency. The stochastic frontier model allows inferences about the efficiency of each firm or the industry and the cost function of the efficient firm. Consider a production unit producing one unit of output using a single input. The line in Figure 1 shows amount it would cost an efficient firm (*D*) to produce one unit of output at each possible input price i.e., $c = f(p_i, q_i)$ is a cost function as described earlier. Not surprisingly, as the input price rises the firm's production cost also rises. The points A and B on the graph represent the reported cost and input price for two firms besides *D*. Note that production units report higher costs than would the fully efficient firm *D* to produce one unit of output. As Figure 1 shows, there are two sources of deviations from the frontier, a measurement error (u) and an inefficiency distance (v). Therefore, for both firms A and B, Figure 1 breaks the deviation into its two components. The error term v_i, which measures inefficiency, is nonnegative and always serves to increase cost. The other error, u_i, takes into account the measurement error and may be positive or negative. In the context of our statistical model, deviations from the frontier can be broken into these two components to estimate the inefficiency of each firm. For illustration purposes, the estimate of v_i can be used to measure the percentage cost reduction that could be achieved if firm *i* operated efficiently. If a firm is 10 percent inefficient (90 percent efficient), that firm's costs could be reduced by 10 percent with no change in output by improving efficiency.

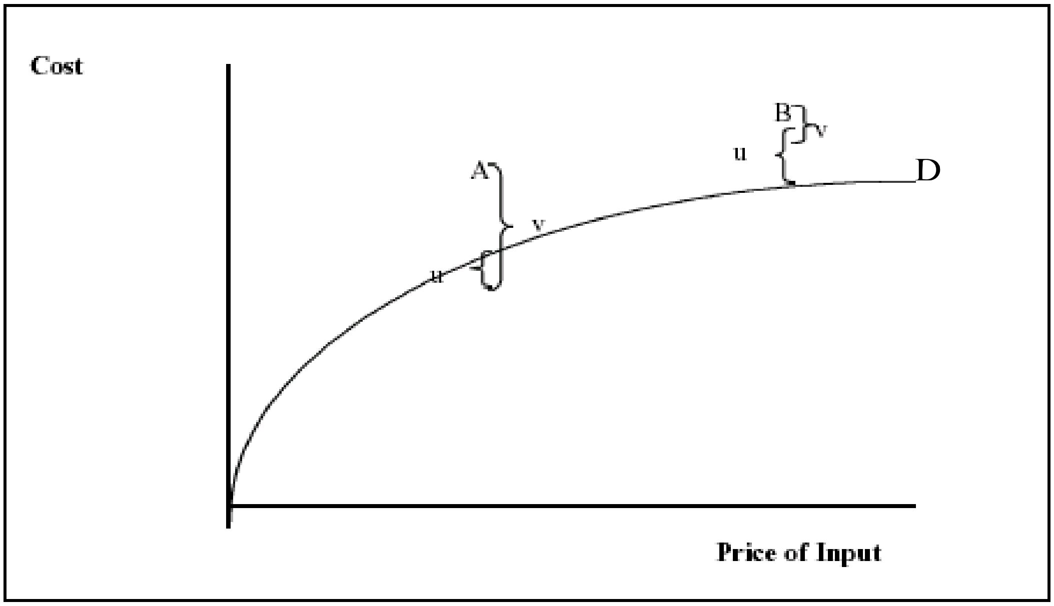

Figure 1. Deviations due to random errors (u) and to inefficiencies (v)

5.- The Statistical Model and Econometric Procedure

In this section, the empirical estimation of the Bayesian stochastic cost frontier is explained. First, consider, for the most efficient firm *i*, the indirect cost *c* to be a function of a price vector *p* and a quantity vector *q*, i.e., $c_i=f(p_i,q_i)$. This is the cost frontier. The cost for other firms can be represented as the cost frontier plus the deviations *v* and *u* mentioned earlier, i.e., the cost model for any other firm can be specified as in (2)

$$c_i = f(p_i, q_i) + u_i + v_i \tag{2}$$

where $f(p_i,q_i)$ is the cost frontier. Note that plant *i*'s cost deviates from the frontier due to inefficiency

(u_i) and measurement error (v_i). The disturbance u_i is assumed to be normally identically distributed, i.e., $u_i \sim N(0, \sigma^2)$. The non-negative term v_i is assumed to be exponentially distributed with shape parameter **λ**. The statistical model follows (2) and is estimated specifying a linear model. The translog function is linear in the parameters. Therefore, in matrix notation, the statistical model can be specified as (3)

$$\begin{aligned} y_i &= X_i\beta + u_i + v_i \\ u_i &\sim N(0,\sigma^2) \\ v_i &\sim EXP(\lambda) \end{aligned} \tag{3}$$

where y_i is the log cost for firm i, X_i is a row vector of independent variables such as logs of inputs prices and output quantities, β is a column vector of parameters of the translog cost function, u_i is a two-sided error term accounting for measurement error, and v_i is a one-sided (non-negative) error term measuring firm inefficiency.

The specification of prior distribution is one of the most important portions of the Bayesian approach used in this study. Most applications using a Bayesian approach choose an informative prior only for **λ** because this is the only requirement to obtain a proper posterior. Typically, a flat prior is chosen for **β** and **σ**, and a gamma prior is chosen for $\boldsymbol{\lambda}^{-1}$ as in (4)

$$\pi(\boldsymbol{\lambda}^{-1}) = f_G(\boldsymbol{\lambda}^{-1}|1, -ln(r^*)) \tag{4}$$

where $f_G(.|v_1,v_2)$ denotes a gamma density with mean v_1/v_2 and variance v_1/v_2^2. The complete prior is defined as in (5)

$$\pi(\boldsymbol{\beta}, \boldsymbol{\sigma}^2, \boldsymbol{\lambda}^{-1}) \ \% \ \boldsymbol{\sigma}^{-2} f_G(\boldsymbol{\lambda}^{-1}|1, -ln(r^*)) \tag{5}$$

Note that with y defined as log cost, $r_i = exp(-u_i)$ measures the efficiency of the *ith* firm and r^* is simply the prior median efficiency. The combination of the prior and the likelihood produces the posterior. Let $p(\theta)$ represent the posterior, where $\theta = (\beta, \sigma^2, \lambda, v)$. It is important to mention that elasticities, efficiency measures, and returns to scale are all functions of θ. Generally, these are functions of interest in efficiency analysis. To understand how inferences are drawn, let $g(\theta)$ be an arbitrary function of interest. It can be shown that obtaining the distribution and moments of $g(\theta)$ is easy. For example the posterior mean is $E[g(\theta)] = \int g(\theta)p(\theta)d\theta$. Since, in general, this integral cannot be computed analytically, numerical sampling procedures have to be used. In doing so, the posterior mean can be estimated as $E[g(\theta)] = \sum g(\theta)/n$ where n is the sample size. Samples are generated from the posterior by noting the conditional densities are simple. Conditional on v, the model simplifies to the normal linear regression model $y\text{-}v = x\beta + u$. If $y\text{-}v$ is treated as y^*, the conditional densities can be defined as (6)

$$\beta |\, \sigma^2, \lambda, v, y \sim N(\beta^*, (x'x)^{-1}\, \sigma_u^2) \tag{6}$$

where $\beta^* = (x'x)^{-1}x'y^*$ and $1/\sigma_u^2 | \beta, \sigma^2, \lambda, v \sim \Gamma((T\text{-}2)/2, SSE/2)$, where $SSE = (y^* \text{-} x\beta)'(y^* \text{-} x\beta)$. If v is known, β and σ^2 provide no additional information about the mean of the exponential function. The conditional distribution of λ is defined as (7)

$$\lambda^{-1} | \beta, \sigma^2, \lambda, v \sim \Gamma(n+1, [v_i\text{-}ln(r^*)]^{-1}) \tag{7}$$

Since the the mean of a gamma distribution $\Gamma(\alpha,\beta)$ is $\alpha\beta$, the the mean is as in (8)

$$E[\lambda^{-1}] = \frac{n+1}{\sum_{i=1}^{n} v_i - \ln(r^*)} \tag{8}$$

If the sample is large, the mean of λ^{-1} is roughly $1/mean(v)$, which is the inverse of the maximum likelihood estimate of λ given v. The final conditional distribution applies to the vector v, containing the inefficiency error for each firm. The distribution of v is truncated normal (TN) as in (9)

$$v | \beta, \sigma^2, \lambda, y \sim TN(e - (\frac{\sigma_u^2}{\lambda}), \sigma_u^2 I) \tag{9}$$

The numerical estimation of all the aforementioned distribution is done with the Gibbs sampler as follows:

Step 1: Choose the initial values $\lambda^{[0]}$, $v^{[0]}$

Step 2: Sample $\beta^{[1]}$ and $\sigma^{2[1]}$ conditional on $\lambda^{[0]}$, $v^{[0]}$ from step 1.

Step 3: Sample $\lambda^{[1]}$ given $v^{[0]}$, $\beta^{[1]}$, and $\sigma^{2[1]}$ based on step 2.

Step 4: Sample $v^{[1]}$ conditional on $\lambda^{[1]}$, $\beta^{[1]}$, and $\sigma^{2[1]}$

Step 5: Iterate and complete the sample used for integration

It has been shown that under mild regularity conditions, the Gibbs sampler converges to the actual joint density as the iteration number approach infinity. Following Terrell and Dashti (1997), the estimation procedure generates 11,000 parameter vectors and drop the first 1,000 to avoid sensitivity to starting values. Thus, a sample of 10,000 adequately ensures small numerical error.

6.- Data

In the present study, two inputs prices are used in the estimation of the translog cost function. Data for input prices estimation were obtained from the ***Louisiana Commercial Shrimp Fisher's Survey 2001***. Information was collected on the operations (technology and costs) of the shrimp fleet of Louisiana concerning the period between July 2000 and June 2001. From this survey, total costs, total catch, fuel and capital price are the four variables used. Annual shrimp total costs and catch were readily available in the data set. However, fuel prices were estimated based on number of trips reported, gallons of fuel spent per day, trip length in days, and annual fuel expenses. In addition, price of capital was estimated as the market value of the vessel divided by total catch.

In order to make the analysis as specific as possible some considerations were taken into account. First, fishing vessels are not homogeneous and, therefore, there are marked differences among them. Thus, vessels were grouped in four length groups. The first group included vessels up to 20 feet long, the second group included vessels from 21 to 40 feet long, the third group included vessels between 41 and 60 feet long, and the last group included vessels above 60 feet long. In addition, in Louisiana vessels use trawls, skimmer, and butterfly nets mainly, therefore, vessels were also grouped by this attribute. Table 1 presents descriptive statistics of the data used in this study. As it can be seen in Table 1, the overall number of observations is 269. In addition, the mean, median, and the maximum value of each variable is provided. Also, the p-value is included.

Table 1. Overall Descriptive Statistics

Variable	N	Mean	Median	Maximum	Pr > |t|
Fuel Price, $/Gal	269	1.29	1.17	2.70	<.0001
Capital Price, $	269	3.10	1.22	60.00	<.0001
Total Cost, $	269	24,270.40	15,640.00	277,515.00	<.0001
Total Catch, lb	269	40,674.30	17,500.00	2,325,000.00	<.0001

Although Table 1 provides a general descriptive overview of the data used in this study, the nature of firms (vessels) in this study requires a more careful data scrutiny. Therefore, Table 2 includes descriptive statistics of the variables under analysis by boat category and Table 3 presents descriptive statistics by type of net used. As data in Table 2 show, for all four vessel sizes, estimated average fuel prices per gallon oscillate between $1.24 and $1.70. In addition, average capital price, as defined earlier, oscillate around $3.00. As it can be expected, total costs increase with vessel size, and so does total catch. Data in Table 3 show that average fuel prices and capital price remained in acceptable ranges across vessels using various net types. Trawlers showed a higher average total costs while skimmers exhibit the highest average total catch.

Table 2. Descriptive Statistics by Boat Length Category						
Length	Variable	N	Mean	Median	Maximum	Pr > |t|
#20 ft	Fuel Price, $/Gal	59	1.70	1.63	2.70	<.0001
	Capital Price, $	59	3.00	2.00	17.19	<.0001
	Total Cost, $	59	8,211.00	5,875.00	37,340.00	<.0001
	Total Catch, lb	59	6,209.20	3,000.00	37,000.00	<.0001
21-40 ft	Fuel Price, $/Gal	158	1.15	0.93	2.08	<.0001
	Capital Price, $	158	3.40	1.03	60.00	<.0001
	Total Cost, $	158	20,106.60	15,999.00	147,796.00	<.0001
	Total Catch, lb	158	46,106.70	20,300.00	2,325,000.00	0.0024
41-60 ft	Fuel Price, $/Gal	46	1.24	1.23	2.20	<.0001
	Capital Price, $	46	2.18	1.07	30.00	0.0026
	Total Cost, $	46	43,812.00	38,261.70	131,665.00	<.0001
	Total Catch, lb	46	61,769.20	47,652.50	236,500.00	<.0001
>60 ft	Fuel Price, $/Gal	6	1.25	1.05	2.10	0.0012
	Capital Price, $	6	3.24	2.33	8.61	0.0305
	Total Cost, $	6	142,017.00	138,624.00	277,515.00	0.0075
	Total Catch, lb	6	74,800.00	69,050.00	118,000.00	0.0008

Table 3. Descriptive Statistics by Type of Net						
Type of Net	Variable	N	Mean	Median	Maximum	Pr > |t|
Trawl	Fuel Price, $/Gal	99	1.40	1.34	2.18	<.0001
	Capital Price, $	99	3.43	2.00	25.00	<.0001
	Total Cost, $	99	26,877.30	10,481.00	277,515.00	<.0001
	Total Catch, lb	99	29,222.10	6,000.00	236,500.00	<.0001
Skimmer	Fuel Price, $/Gal	154	1.19	0.99	2.18	<.0001
	Capital Price, $	154	2.94	1.01	60.00	<.0001
	Total Cost, $	154	23,147.70	18,180.00	147,796.00	<.0001
	Total Catch, lb	154	49,702.50	25,000.00	2,325,000.00	0.001
Butterfly	Fuel Price, $/Gal	16	1.56	1.26	2.70	<.0001
	Capital Price, $	16	2.64	1.64	13.33	0.0079
	Total Cost, $	16	18,946.70	11,358.00	56,450.00	0.0003
	Total Catch, lb	16	24,637.50	12,000.00	140,000.00	0.0168

7.- Results

Parameter estimates of the translog cost stochastic frontier were generated using the Gibbs sampler as explained earlier. The results included in Table 4 show parameter estimates and their standard deviations. Note that instead of the standard error, the standard deviation is included. This is different from the classic econometric approach. In general, confidence interval for parameter estimates are obtained.

Table 4. Translog Cost Function Parameter Estimates		
Parameter	Estimate	Standard Deviation
Intercept	0.3780	1.5128
Ln(Fuel Price)	0.6623	0.2460
Ln(Capital Price)	0.3764	0.0601
Ln(Fuel Price)^2	0.5318	0.2952
Ln(Capital Price)^2	-0.0767	0.0264
Ln(Fuel*Capital)	0.0466	0.1066
Ln(Total Catch)	0.7400	0.3332
Ln(Total Catch)^2	0.0055	0.0183

Efficiency parameter estimates is one of the most important results in this study. Estimates of efficiency parameters by vessel length and type of net are included in Table 5. The results show a very low overall efficiency level for the vessels included in this study (30%). For most vessels, regardless of length and type of net, efficiency estimates remained low with the exception of vessel between 41-60 ft. long with butterfly nets (50%). However, note that for most groups there are also maximum efficiencies above 90%. These results indicate that vessel size and type of net are not determinant factors in the level of cost efficiency a vessel can achieve. To gain another perspective of the level of cost efficiency for the sample under analysis, vessels were distributed in four efficiency groups in which vessel length and type of net used were also considered and the results were included in Table 6. The results indicate that, for small vessel length, trawlers tend to have similar level of cost efficiency when compared to skimmers and butterfly net users. For vessels length between 21-40 ft, very low levels of cost efficiency are observed for trawlers and skimmer whereas butterfly users perform much better than the former. For 41-60 ft vessel length trawlers perform better than skimmer and butterfly users. Finally, trawlers performed poorly for vessel length above 60 ft long.

Table 5. Efficiency Parameter Estimates by Vessel Length and Net Type

Boat Length	Net Type	N	Variable	Mean	Minimum	Median	Maximum
#20 ft	Trawl	41	Efficiency	0.3749	0.0613	0.2737	0.9336
			Std. Dev.	0.0443	0.0068	0.0395	0.0991
	Skimmer	13	Efficiency	0.3445	0.0927	0.2851	0.9667
			Std. Dev.	0.0360	0.0108	0.0322	0.0784
	Butterfly	5	Efficiency	0.3133	0.0380	0.1595	0.9002
			Std. Dev.	0.0374	0.0114	0.0204	0.0844
21-40 ft	Trawl	31	Efficiency	0.2251	0.0448	0.1912	0.4826
			Std. Dev.	0.0318	0.0063	0.0293	0.0807
	Skimmer	119	Efficiency	0.2989	0.0133	0.2455	0.9752
			Std. Dev.	0.0347	0.0048	0.0301	0.2089
	Butterfly	8	Efficiency	0.2934	0.0439	0.2263	0.5436
			Std. Dev.	0.0333	0.0085	0.0252	0.0564
41-60 ft	Trawl	21	Efficiency	0.2718	0.0733	0.2411	0.8929
			Std. Dev.	0.0378	0.0103	0.0309	0.1055
	Skimmer	22	Efficiency	0.2673	0.0618	0.2122	0.7505
			Std. Dev.	0.0337	0.0103	0.0274	0.0848
	Butterfly	3	Efficiency	0.5044	0.2256	0.3744	0.9133
			Std. Dev.	0.0488	0.0276	0.0466	0.0722
>60 ft	Trawl	6	Efficiency	0.1673	0.0865	0.1436	0.2867
			Std. Dev.	0.0243	0.0127	0.0223	0.0366
Overall		269	Efficiency	0.2989	0.0133	0.2427	0.9752
			Std. Dev.	0.0360	0.0048	0.0305	0.2089

Table 6. Efficiency Distribution by Vessel Length and Net Type

Vessel Length	Net Type	Trawl	Skimmer	Butterfly
	Efficiency Group	%	%	%
#20 ft	#0.25	39.02	38.46	60.00
	0.26-0.50	34.15	46.15	20.00
	0.51-0.75	12.20	7.69	0.00
	>0.75	14.63	7.69	20.00
21-40 ft	#0.25	58.06	52.10	23.81
	0.26-0.50	41.94	34.45	4.76
	0.51-0.75	0.00	8.40	9.52
	>0.75	0.00	5.04	61.90
41-60 ft	#0.25	0.00	68.18	33.33
	0.26-0.50	75.00	22.73	33.33
	0.51-0.75	12.50	4.55	0.00
	>0.75	12.50	4.55	33.33
>60 ft	#0.25	83.33	0.00	0.00
	0.26-0.50	16.67	0.00	0.00

8.- Discussion

This research analyzed cost efficiency of the shrimp fleet of Louisiana using a Bayesian cost stochastic frontier analysis. The results indicated low cost efficiency in the industry of the state. Only 9.25% had cost efficiency above 75% and, in general, only 15% had cost efficiency above 50%. However, this poor performance can be explained. First, it is important to mention data reliability. This is always an issue when using data from mail survey. For example, under the ***Louisiana Commercial Shrimp Fisher's Survey 2001***, 8,000 survey were mailed, i.e., questionnaires were sent to all commercial shrimp gear license holders in the state. However, only 1,300 subjects responded. From those 1,300 responses, only 418 viewed their operation as a commercial activity, i.e., about 33% of all respondents. In addition, a number of questionnaires had to be discarded due to incomplete answers and other problems. At the end, only 269 observations were used in this study. However, it is important to mention that, on average, respondents devoted 75% of the time to shrimp fishing. Moreover, small vessels devote only 55% of their time to shrimping operations and the largest vessels devoted 90%. This outcome indicated that there were many participants fishing for shrimp on a part-time basis in Louisiana during the analyzed period. Some fishers also devoted their effort and time to harvest other species. By the same token, survey analysis indicated that other shrimp commercial license holders are, in fact, recreational fishers who want to pull a larger net (>16 ft) than that allowed by a recreational shrimp license. These fishers have the option of landing commercially but many do not do so on a regular basis. Therefore, their cost efficiency is low. This outcome indicates that not all the output of a fishing trip was included in the analysis because the recreational benefits of a fishing trip was not measured.

Finally, it is important to mention that functional form specification can also have its share of influence in the outcome of this research. It has been indicated that a translog cost functional specification, although a flexible form, may violate regularity conditions such as concavity and monotonicity (Terrell and Dashti, 1997). In addition, the choice of inputs in the functional form can also have a considerable influence on the performance of the estimation procedure. In the present research, fuel and capital are the only two inputs considered. However, labor, salt, ice, and other inputs may also be relevant to the analysis.

9.- Conclusions and Recommendations

The present study was a first attempt to address cost efficiency issues in the Louisiana shrimp industry. For this purpose, the economic model was represented by a translog cost function with two inputs. The statistical procedure was based in the Bayesian stochastic cost frontier model initially introduced by Greene (1990), Koop, Steel and Osiewalski (1993), Sengupta (1995), and further analyzed by Terrel and Dashti (1997). The results indicated that there is a need to refine the analysis of cost efficiency of the shrimp industry in Louisiana in order to take into account the nature of the firms (vessels) in the industry and to include other relevant input prices in the cost stochastic frontier analysis. In addition, violation of regularity conditions should be addressed in order to improve the reliability of the results of the analysis. The authors caution in the use of the results presented here based on the limitations of the study. The authors recommend to further investigate the cost efficiency of the shrimp industry of Louisiana as price declines appear to be permanent phenomenon and, therefore, industry members and policy makers need information on which to base business and policy decisions regarding the shrimp industry in Louisiana.

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