CONCEPTUAL MODEL FOR ALLOCATING THE GULF OF MEXICO RED GROUPER RESOURCE TO THE COMMERCIAL SECTOR

1. INTRODUCTION

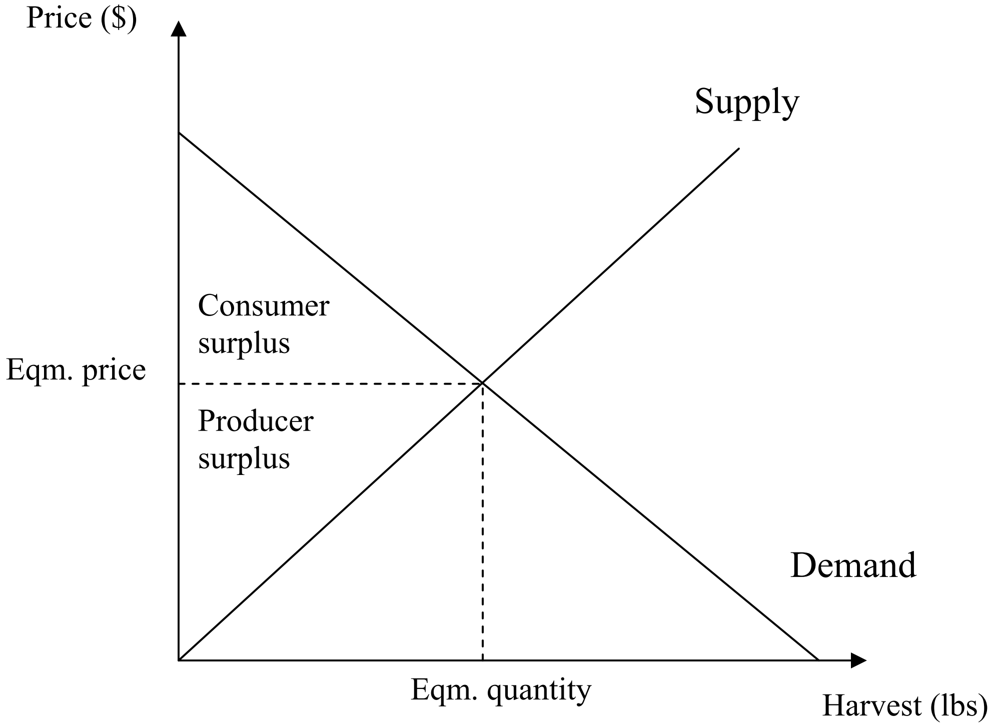
The growing demand for seafood and recreational opportunities has encouraged the Gulf of Mexico Fishery Management Council to investigate ways to best allocate the red grouper resource between the commercial and recreational sectors as to maximize net benefits to the Nation. To assist in this effort, the Southeast Fisheries Science Center is developing a conceptual framework and an empirical application to assess the economic benefits to society from a potential redistribution of the resource between these two sectors. In developing this economic framework, we draw on the *equimarginal principle*, which states that in order to maximize benefits from a resource the incremental value gained by one sector receiving a larger allocation is just equal to the incremental value lost by other sector due to a corresponding smaller allocation.

This interim report offers a brief update on the progress to date. All results should be considered preliminary and subject to change based on the recommendations of the Gulf of Mexico Fishery Management Council Socioeconomic Panel (SEP) and Scientific and Statistical Committee (SCC) members. The report continues as follows. Section II discusses the conceptual framework for assessing the economic benefits provided by the commercial sector. Section III introduces the empirical model and describes the data available for the analysis. Section IV discusses the econometric results and hypothesis tests on the structure of the underlying technology and Section V discusses the simulation framework. The last section touches on the strengths and weakness of the proposed framework.

2. CONCEPTUAL FRAMEWORK FOR ESTIMATING BENEFITS FROM THE COMMERCIAL SECTOR

The conceptual framework for the commercial sector requires that we assess the diverse values placed on catch. For analytical convenience, we restrict ourselves to the use values derived from harvesting and consumer sub-sectors.[1] Both producers and consumers receive increased surpluses (or benefits) from a larger allocation. Larger allocations will likely favor fishermen by yielding higher rents (producer surplus) and will also likely favor consumers by generating lower seafood prices (consumer surplus). Figure 1 offers a graphical representation of the aggregate producer and consumer surpluses for a single species fishery. The triangular area above the supply curve but below the equilibrium price is known as the producer surplus, whereas the triangular area under the demand curve but above the equilibrium price (eqm. price) is known as the consumer surplus.

Figure 1: Graphical depiction of producer and consumer surplus for a single species fishery.



Now that we have introduced these key concepts, let us relax the single species fishery assumption and investigate how these benefits vary when redistribute the total allowable catch (TAC).

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[1] We recognize the presence of other values such as lifestyle benefits that we cannot accurately estimate with the information available.

Harvesting sub-sector

To set the scene, we assume a profit maximizing multioutput (multispecies) industry, whose indirect short-run profit function is given by

$$(1) \qquad \pi(p,w;K)=\sum_{i=1}^{n}p_i y_i(p,w;K)-\sum_{j=1}^{m}w_j x_j(p,w;K)$$

where π is the restricted (short-run) profit function, p_i is the price of species i, y_i is harvest of species i, w_j is the price of input j, and x_j in the amount of input j used. K is the quasi-fixed capital stock. As is customary in production analysis, we assume that the profit function is non-decreasing in output prices and fixed factors, non-increasing in input prices, linear homogenous and convex in prices, concave in fixed quantities, and continuous and twice differentiable.

The restricted profit function measures quasi-rent. Quasi-rent is the payment to factors of production which are temporarily in fixed supply. The short-run nature of the model is not only conditional of the quasi-fixed capital stock but is also conditional on the available fish biomass. Thus, changes in the capital stock and resource biomass will influence the profitability of the industry.

Applying Hotelling's lemma, we obtain the output supply and factor demand functions, respectively.

$$(2) \quad \frac{d\pi(p,w;K)}{dp_i}=y_i(p,w;K)$$

$$(3) \quad \frac{d\pi(p,w;K)}{dw_j}=-x_j(p,w;K)$$

These supply and demand functions describe the optimal adjustment of outputs and inputs in response to changes in output and input prices.

Because the focus of this analysis revolves around the redistribution of the red grouper resource among competing interests, we assume that the total allowable catch (TAC) is composed of the a total allowable commercial catch (TACC) and a total allowable recreational catch (TARC). To investigate the welfare impact of imposing a quota we need to incorporate this additional constrain in the profit function.

Following Vestergaard (1999), suppose that fishery managers impose a commercial harvesting quota on red grouper, TACC, such that $TACC \leq y_1$. Fulginiti and Perrin (1993) describe the relationship between a quota-constrained quasi-rent function and an unconstrained quasi-rent function using the concept of virtual price. Virtual price, p_v, is the price that would induce an industry (or firm) to freely produce at the desired quota level.

Mathematically, the virtual price is given.

$$(4)\quad p_v = (p_1 - \lambda_1)$$

where p_1 is the output price and λ_1 is the unit quota rent for red grouper (output 1). Lambda expresses the marginal valuation of output 1.

Formally,

$$(5)\quad \frac{\partial \pi}{\partial p_v} = TACC$$

At the virtual price for quota 1, the quota quasi-rent function must equal to the quota-free quasi-rent function

$$(6)\quad \pi(p_1, p_h; TACC, K)^{TACC} = \pi(p_v, p_h, w; K)$$

P_h is the *n-1* vector of other output prices.

Alternatively, the quota quasi-rent function can be expressed as

$$(7)\quad \begin{aligned} \pi(p_1, p_h; TACC, K)^{TACC} &= \pi(p_v, p_h, w; K) + (p_1 - p_v)\ TACC \\ &= \pi(p_1 - \lambda_1, p_h, w; K) + \lambda_1\ TACC \end{aligned}$$

Rewriting (7) we get

$$(8)\quad \begin{aligned} \pi(p, w; TACC, K)^{TACC} &= \sum_{i=2}^{n} p_i y(p_1 - \lambda_1, p_h, w; K) + \lambda_1\ TACC \\ &\quad - \sum_{j=1}^{m} w_j x_j (p_1 - \lambda_1, p_h, w; K) \end{aligned}$$

Applying Hotelling's lemma, we get the output and input functions

$$(9)\quad \frac{\partial \pi^{TACC}}{\partial p_i} = y_i (p_1 - \lambda_1, p_h, w; K)\ \forall\ \mathrm{i} \geq 2$$

$$(10)\quad \frac{\partial \pi^{TACC}}{\partial w_j} = -x_j(p_1 - \lambda_1, p_h, w; K)$$

Differentiating with respect to the quota levels, we obtain the inverse derived demand for quota. The difference between market output price and the virtual price is the quota rent.

$$(11)\quad \frac{\partial \pi^{TACC}}{\partial TACC} = \lambda_1(p, w; TACC, K)$$

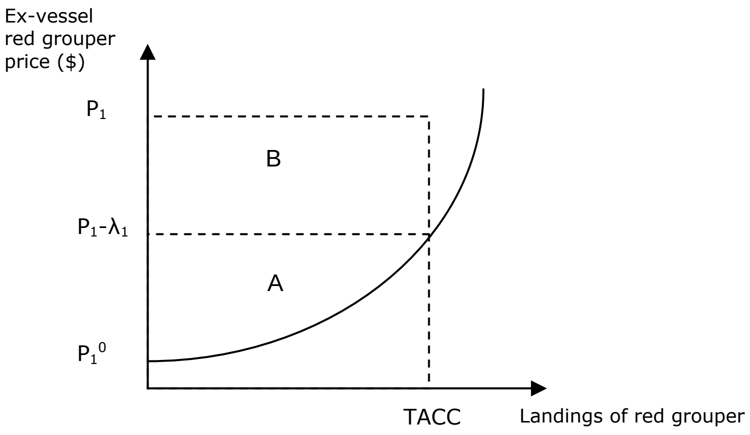
The industry's (or firm's) inverse derived demand for quota captures the optimal adjustment in inputs used and other outputs as the quota changes. It indicates by how much the industry's implicit marginal valuation of quota must change for vessels to want to hold an additional quota unit (Squires and Kirkley, 1996).

Now let us turn our attention to estimating welfare impacts. Using the inverse derived demand for quota relationship, we can obtain the quasi-rent from either the output or input market when a quota is imposed. Drawing on equation 9, we can estimate the producer surplus (and quasi-rent) from the output market

$$\begin{aligned} PS^{TACC} &= \int_{p_1^0}^{p_1-\lambda_1} \frac{\partial \pi}{\partial p_1}(p, w; K, S)dp_1 + \int_{p_1-\lambda_1}^{p_1} TACCdp_1 = \int_{p_1^0}^{p_1-\lambda_1} y_1(p, w; K, S)dp_1 + \int_{p_1-\lambda_1}^{p_1} TACCdp_1 \\ (12) \qquad &= \pi(p_1 - \lambda_1, p_h, w; K, S) + \lambda_1 TACC = \pi^{TACC}(p, w; TACC, K, S) \end{aligned}$$

Figure 2 shows that producer surplus in the output market. The producer surplus is the sum of the harvest surplus (area A) and quota surplus (area B). Mathematically, the harvest surplus and quota surplus is can be estimated by solving the first and second integral of equation (12), respectively.

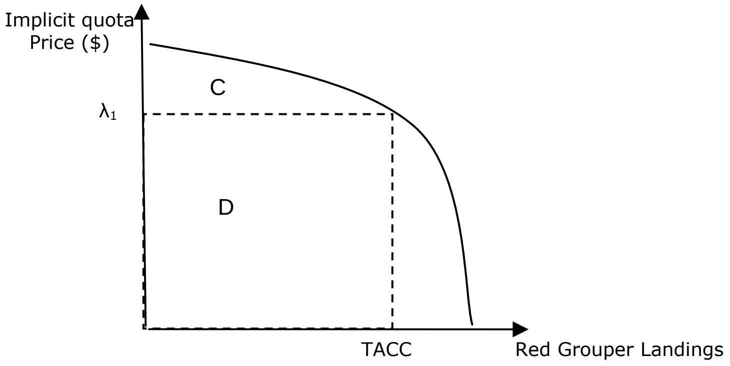
Figure 2: Producer surplus in output market.



Alternatively, we can also calculate changes in quasi-rent in input space. The area under the implicit derived quota demand up to the quota level can also be used to measure estimate quasi-rent (Figure 3). This is true, because the inverse derived demand for quota reflects the industry's valuation of quota as the quota level varies. Mathematically,

$$(13)\ PS^{TACC} = \int_0^{TACC_1} \lambda_1(p,w;TACC,K)dy_1 = \int_0^{TACC_1} \frac{\partial \pi}{\partial TACC} dy_1 = \pi^{TACC}(p,w;TACC,K)$$

Figure 3: Producer surplus in input market.



Using the above framework, we can estimate producer surplus or quasi-rent gains (or losses) under different TACC levels (or commercial-recreational allocation scenarios). Next, we consider consumer benefits.

Consumer sub-sector

Catch restrictions not only impact the profitability of harvesters, but also impact consumers who have to pay higher seafood prices. Thus, changes in consumer surplus must be considered when allocating thinning harvest levels between the commercial and recreational sector. To examine the changes in consumer surplus, we propose estimating a retail demand relationship for red grouper. Mathematically,

$$(14)\quad P_{redgrouper} = f(P_{complements}, P_{substitutes}, Income, Population\ size, Own\ landings \mid TACC)$$

Potential substitutes for red grouper would include both other domestic species such as other shallow water groupers, snappers and mahi-mahi and fresh and frozen grouper imports.

To estimate changes in consumer surplus, we take as the base the most recent year available (i.e., 2005) and set average values for the price of complement and substitutes, income, and population size. Then, we would estimate consumer surplus by changing the value of own landings to reflect different TACC levels. A similar approach is proposed for the harvesting sub-sector, however, instead of using demand curves we would be using the red grouper output supply function.

Finally, we would combine both quasi-rent and consumer surplus at each TACC level and compare how these net benefits change as we reduce the TACC. The optimal static allocation should be were the MB to the commercial sector equal the MC (marginal net benefits forgone) to the recreational sector.

3. EMPIRICAL MODEL

Commercial sub-sector

In developing the empirical model, we assume that fishermen seek to maximize profits in two stages (Squires and Kirkley, 1991). In the short-run, fishermen advance their welfare by choosing the revenue maximizing catch bundle conditional on existing fixed factor levels, weather, habitat and resource abundance constraints and relative output prices. In other words, we assume that revenue maximization is an appropriate behavioral hypothesis since fishing vessels cannot readily change input levels during the harvesting process. In the long-run, fishermen maximize profits by selecting the optimal capital endowment.

In this study, we assume that hook and line and longline vessels maximize short-run profits (revenue) by selecting the optimal catch mix conditional upon quasi-fixed factors (Kirkley and Strand, 1988, Squires and Kirkley, 1991). The hook and line gear encompasses both handline and bandit gear vessels. Following Kirkley and Strand (1988), we adopt the non-homothetic generalized Leontief quasi-rent function. Mathematically,

$$(15)\ \pi(p;K)=\sum_{i=1}^{n}\alpha_i p_i K^2+\sum_{i=1}^{n}\beta_{ij}(p_i p_j)^{1/2}K$$

where π is the quasi-rent function, K is the quasi-fixed input, and p_i is output prices of species i. Symmetry is imposed by setting $\beta_{ij}=\beta_{ji}$ for $i\neq j$. Although there are several flexible functional forms available to approximate fishermen's unknown profit function, we selected the non-homothetic generalized Leontief functional form because it places few restrictions on the underlying structure of the technology which permits the examination of important properties such as separability and non-jointness.[2] Another consideration was that this functional form permits the estimation of output levels rather than output shares like in the case of the translog functional form (Kirkley and Strand, 1988). Modeling output levels rather than shares is appealing because is not only more intuitive to decision-makers but also it readily lends itself to the estimation marginal benefit schedules.

Applying Hotelling's lemma, we obtain the associated input-compensated supply equations,

$$(16)\ \frac{\partial\pi}{\partial p_i}=y_i=\alpha_i K^2+\beta_{ii}K+\sum_{j\neq i}\beta_{ij}\left(\frac{p_j}{p_i}\right)^{1/2}K$$

The supply equations are input-compensated because they are conditional on the fixed input.

To investigate the welfare changes of introducing TACC for red grouper, we replace the red grouper ex-vessel price by its virtual price. After rearranging the terms, we obtain the fleets' derived demand for quota

$$(17)\ \lambda_1=p_1-\left[\frac{\sum_{j\neq 1}\beta_{1j}p_j^{1/2}K}{TACC-\alpha_1K^2-\beta_{11}K}\right]^2$$

where the first tem is the red grouper dockside price and the second term is its virtual price. To estimate the quasi-rent we first integrate equation (17) from zero to quota level. Because fisheries

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[2] However, this functional form imposes linear homogeneity in prices (Kirkley and Strand, 1988).

agencies set the quota, lambda adjusts at the margin rather than the quota (Squires and Kirkley, 1996).

Estimation:

We specified the non-homothetic generalized Leontief revenue function as

$$\begin{aligned}\pi(p;K) = {} & \sum_i \alpha_i p_i K^2 + \sum_i \sum_j \beta_{ij} (p_i p_j)^{1/2} K + \sum_i \sum_k \delta_{ik} d_k p_i K + \sum_i \sum_l \varepsilon_{il} e_l p_i K + \\ & \sum_i \sum_m \phi_{im} f_m p_i K + \sum_i \sum_n \varphi_{in} g_n p_i K + \sum_i \sum_o \gamma_{io} h_o p_i K + \sum_i \sum_r \eta_{ir} l_r p_i K + \\ & \sum_i \sum_s \kappa_{is} t_s p_i K + \sum_i \sum_u \varpi_{iu} v_u p_i K \end{aligned} \tag{18}$$

where $\pi(p;K)$ is the quasi-rent function, K is the quasi-fixed input, and p_i is output prices of species i. d_k is the k^{th} of eleven monthly dummies (February -December), and e_l is the l^{th} of three year dummies (2002-2004). The number of days away from port is set as the quasi-fixed input since during the fishing trip capital and labor are effectively fixed. Symmetry was imposed by setting $\beta_{ij}=\beta_{ji}$ for $i \neq j$.

Monthly and yearly dummies control for changes in the availability and abundance of the targeted stocks. f_m is the m^{th} landing county dummy (akin to a port dummy). For the hook and line fleet, Bay, Citrus, Franklin, Lee, Monroe, Pinellas, Okaloosa and Wakulla counties were selected whereas for the longline fleet, Bay, Manatee and Pinellas counties were chosen.

G_n, h_o, and l_r are a dichotomous dummies that capture the presence of three closures. The g_n captures the closed season from red, gag, and black grouper, which has been in effect from February 15 and March 15 since 2000. The second closure dummy, h_o, captures the closure of shallow water grouper and red grouper fishery on November 15, 2004 and on 10 October, 2005. The third closure dummy captures the closure of the deep-water grouper fishery on July 15, 2004 and on June 23, 2005. These closures take a value of 1 when active.

T_s is the monthly accumulated cyclonic energy (ACE) index, which captures intensity and duration of Atlantic named storms and hurricanes occurring during a given season, and v_u is a dichotomous dummy for the hook and line fleet only; it takes the value of 1 if bandit gear is used and zero otherwise (i.e., handline gear is used).[3]

Applying Hotelling's lemma, we obtain the associated input-compensated supply equations

$$(19)\quad \frac{\partial \pi(p;K)}{\partial p_i} = q_i = \alpha_i K^2 + \beta_{ii} K + \sum_{j\neq i} \beta_{ij} (\frac{p_j}{p_i})^{1/2} K + \rho\, K$$

$$\rho = \sum_k \delta_{ik} d_k + \sum_l \varepsilon_{il} e_l + \sum_m \phi_{im} f_m + \sum_n \varphi_{in} g_n + \sum_o \gamma_{io} h_o + \sum_r \eta_{ir} l_r + \sum_s \kappa_{is} t_s + \sum_u \omega_{iu} v_u$$

Data

Dual specifications rely on output and factor prices and output and input quantities. To model fishermen's revenue maximizing behavior we used the Florida's *Marine Fisheries Trip Ticket* database, which collects trip-level landings, prices, crew size, area fished, county landed, and gear-specific fishing effort. Although we could have used the Fishery Logbook System (FLS) database contains trip-level landings and effort information in conjunction with the Accumulated Landings System (ALS), which collects seafood dockside prices, we decided against for several reasons. First, the Florida trip ticket program is the only program that collects trip-level prices, which 'should' help capture any price signals (if present). Although, combining FLS and ALS databases can also provide dockside prices, these prices would be at a monthly level rather than at a trip level. Aggregating prices at a monthly level may dampen (or conceal) fishermen's behavioral response to price signals. A second consideration was the wider coverage and finer spatial resolution of the Florida trip ticket relative to the logbook program. Specifically, the Florida trip ticket program distinguishes between inland waters, inshore state waters, offshore state waters, and federal waters whereas the logbook program uses broader Gulf of Mexico statistical grid areas. Furthermore, the logbook only requires fishermen to report catches in federal waters.

Despite the above, the Florida trip ticket database has a major shortcoming. It does not collect cost information. The FLS has an economic add on which covers about 20 % of the commercial

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[3] Formally, the ACE index is defined as the sum of the squares of the maximum sustained surface wind speed (knots) measured every six hours for all named systems while they are at least tropical storm strength.

fleet operating in the Gulf of Mexico. This economic add on collects trip-level input prices (or imputed prices) for selected expenditures (e.g., gas, bait, ice, crew payments, food and miscellaneous supplies). Unfortunately, because the bait units are not consistent in the FLS (they are reported as either counts or weight) we cannot develop derived demands for this input. Bait costs account for 10-15% of the revenue. Another consideration is that the crew size variable in the Florida trip ticket database is consistently under-reported. For example, for the handline about 80% of the observation had no information on crew size. Therefore, we cannot link both databases and hope to obtain reliable labor expenses.

In light of the abovementioned, we restricted our analysis to the Florida trip ticket database. We modeled the industry behavior using data from 2002 to 2005. For the hook and line fleet, we specified four species groups: red grouper, shallow-water groupers, shallow and mid-water snappers and a residual or miscellaneous group, which captured all species not included in the earlier groupings. For the longline fleet, we specified three species groupings, which included red grouper, shallow water groupers, and a miscellaneous group. We adjusted all output prices to December 2005 prices using the producer price index. To account for the possibility of differing targeting behavior due changes in relative prices, our sample consisted of all hook and line and longline boats that harvested red grouper at least once during the last four years. Descriptive statistics of the hook and line and longline fleets are presented in tables 1 and 2.

Table 1: Descriptive statistics of the hook and line fleet.

Variable	Mean	Std. Dev.	Min	Max	N
Red grouper landings per trip (lbs)	217.59	434.35	0.10	9,489.00	25,749
Shallow-water grouper landings per trip (lbs)	238.87	528.52	0.10	11,736.00	25,749
Shallow and mid-water snapper landings per trip (lbs)	348.05	730.74	0.10	10,097.00	25,749
Residual species landings per trip (lbs)	218.68	517.47	0.10	12,787.00	25,749
Price of red grouper ($/lbs)	1.66	0.43	0.46	4.09	25,749
Price of shallow water grouper ($/lbs)	2.06	0.51	0.57	4.32	25,749
Price of deep-water grouper ($/lbs)	1.60	0.48	0.23	4.56	25,749
Price of residual species group ($/lbs)	0.88	0.38	0.10	4.56	25,749
Quasi-fixed input (days)	3.33	2.51	1.00	30.00	25,749

Table 2: Descriptive statistics of the longline fleet.

Variable	Mean	Std. Dev.	Min	Max	N
Red grouper landings per trip (lbs)	2,438.33	2,421.72	0.10	18,836.00	5,601
Shallow-water grouper landings per trip (lbs)	859.02	1,405.55	0.10	13,577.00	5,601
Residual species landings per trip (lbs)	1,111.08	2,170.08	0.10	20,688.00	5,601
Price of red grouper ($/lbs)	1.65	0.44	0.69	3.42	5,601
Price of shallow-water grouper ($/lbs)	2.03	0.52	0.57	4.29	5,601
Price of residual species group ($/lbs)	1.19	0.46	0.12	9.15	5,601
Quasi-fixed input (days)	7.89	4.08	1.00	25.00	5,601

Consumer sub-sector

We continue to work on this section. However, we attempted to estimate a simple annual demand curve for the retail prices as a function of disposable income, Gulf of Mexico landings and fresh grouper imports. Table 3 shows descriptive statistics of these variables adjusted by the 2005 consumer price index. Mathematically, the demand function is given by

$$(20) \quad P_{redgrouper} = f\,(P_{substitutes}, Disposible\ Income, Fleet\ own\, landings)$$

Table 3: Descriptive statistics of the retail demand.

Variable	Mean	Std. Dev.	Min	Max	N
Retail price of red grouper ($/lbs)	3.51	0.18	3.22	3.93	15
Import price of fresh grouper ($/lbs)	1.32	0.15	1.10	1.57	15
Disposable income ($)	27.67	1.90	25.25	30.53	15
Gulf of Mexico landings (million lbs)	6.18	0.85	4.68	7.52	15

<u>Data:</u>

Disposable income, population size, and consumer price index data was obtained from the Bureau of Labor Statistics (BLS) and Bureau of Economic Analysis (BEA). Retail prices (Fulton Market), dockside prices and landings of substitutes and complements were obtained from NOAA Fisheries website. Information on fresh and frozen imports originally came from the Foreign Trade Division of the U.S. Census Bureau.

4. ESTIMATION RESULTS

Harvesting sector:

We started estimating individual equations separately using ordinary least squares (OLS) and tested for heteroscesdaticity using White's test. Based on earlier production work with this specification, we anticipated that the heteroscedasticity would be introduced by the square of the quasi-fixed input variable (Squires and Kirkley, 1991; Campbell and Nicholl, 1994) so we weighted the sample by the quasi-fixed input. This addressed the heteroscedasticity present in the red grouper and shallow water grouper equations in the longline model; but it failed to remove any of the heteroscedasticity present in the hook and line model. Given the above and the utility of standardizing both models, we estimated input-scaled output supply functions for both the longline and hook and line fleets using Zellner's seemingly unrelated regression method (Greene, 2000). [4]

The generalized R^2 for the system of equation prior to the correction for heteroscedascity was 47% for the hook and line and 55% for the longline fleet. Space limitation precludes us from discussing parameter estimates in detail; however, we briefly discuss key explanatory variables. Appendix 1 shows the parameter estimates and their standard errors for both models.

Table 4 shows that for the hook and line fleet all dummies as a group, were statistically significant. Perusal of the Appendix 1, shows that most red grouper parameters of the hook and line fleet conformed to our expectations. For example, the seasonal closure and shallow-water grouper closure were negative and statistically significant suggesting that these closures constrained the production of red grouper. On the other hand, the deep-water grouper closure was positive and statistically significant. The ACE parameter was negative and statistically significant suggesting that increased cyclonic activity adversely affects this fleet's ability to catch red groper.

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[4] The functional form was presumed to be exact rather than an approximation. We also assumed that the errors are from optimization rather than approximation and applied only to the input-scaled supply equations (Squires and Kirkley, 1991). The issue of zero outputs came up in some instances, creating a limited-dependent variable problem, which can introduce bias and non-normality of the residuals. The procedure of Lee and Pitt (1987) addresses this issue using virtual prices, but it is not computationally feasible with the number of variables in this study (Squires and Kirkley, 1991). A Box-Cox transformation could be used, but we decided against it because a particular form of non-normal disturbances is assumed prior to transformation (Squires and Kirkley, 1991). Thus, we substituted a value of 0.1 for zero when necessary.

The bandit gear dummy was positive and statistically significant suggesting that bandit boats are more productive catching red grouper.

Table 5 shows that all dummies as group were statistically significant for the longline fleet. Examination of the parameters of the longline red grouper supply function shows that most variables agreed with our expectations. The seasonal closure and shallow-water grouper closure were negative and statistically significant suggesting that these closures restrain the harvesting of red grouper. However, the deep-water grouper closure was positive and statistically significant. The ACE parameter was positive but statistically insignificant (at the 5% significance level) suggesting that increased cyclonic activity does not affect the harvesting of red grouper, presumably because, on average, longline vessels are larger than hook and line vessels.

Table 4: Statistical significance of group dummies.

Fleet	Hypothesis	χ^2	Prob> χ^2	Outcome (α=0.05)
Hook and line	Yearly dummies	325.02	<.0001	Reject null
	Monthly dummies	1,978.3	<.0001	Reject null
	Fishing ground dummies	4,564.7	<.0001	Reject null
	County landed dummies	4952.3	<.0001	Reject null
	Seasonal closure dummies	476.47	<.0001	Reject null
	Shallow-water grouper closure dummies	538.48	<.0001	Reject null
	Deep-water grouper closure dummies	124.87	<.0001	Reject null
	ACE dummies	120.89	<.0001	Reject null
	Bandit gear dummies	207.86	<.0001	Reject null

Table 5: Statistical significance of group dummies.

Fleet	Hypothesis	χ^2	Prob> χ^2	Outcome (α=0.05)
Longline	Yearly dummies	87.80	<.0001	Reject null
	Monthly dummies	116.60	<.0001	Reject null
	Fishing ground dummies	604.28	<.0001	Reject null
	County landed dummies	150.76	<.0001	Reject null
	Seasonal closure dummies	184.60	<.0001	Reject null
	Shallow-water grouper closure dummies	127.22	<.0001	Reject null
	Deep-water grouper closure dummies	16.98	0.0007	Reject null
	ACE dummies	13.41	0.0038	Reject null

Table 6 presents hypothesis tests on the underlying technology. The hypothesis of input and output separability and overall non-jointness-in-inputs were rejected for both the longline and hook and line fleets. The rejection of input-output separability implies that there are specific interactions between input and output combinations. Therefore, changes in relative prices can influence the optimal combinations of capital and labor devoted in the harvesting process. The rejection of input-output separability also implies that the technology does not allow for the creation of a single composite input and single composite output. Thus, fishery managers should consider management measures that require lower levels of species aggregation such as species group or species-specific quotas.

The rejection of overall non-jointness-in-inputs indicates that all inputs are required to produce all outputs. It also indicates that the harvesting process is interrelated. Hence, each species' production process cannot be regulated independently because of the presence of spillover effects on other species. For instance, establishing a quota for any of these individual species may lead to the overexploitation of an unregulated substitute species. If the harvesting process was not joint-in-inputs then single species would be appropriate since the regulations would not have impact the production process of the other species. Species-specific non-jointness-in-inputs was rejected for all species, except for the shallow-water grouper longline aggregate. The rejection of species-specific non-jointness-in-inputs indicates that the production of any given species is affected by the relative prices and quotas of the other jointly-caught species.

This study also examined own-price and cross price elasticities of supply. The diagonal elements represent the own-price elasticities, and the off-diagonal elements represent the cross-price elasticities (Tables 7 and 8). The mixed pattern of complementarity and substitutability suggests that limits single species management may have unintended consequences on the rest of the fishery. All own-price elasticities for the hook and line and longline fleets were positive; however, they were only statistically significant for shallow-water grouper, shallow and mid-water snapper, and miscellaneous species groupings in the hook and line fleet. The residual species group was only statistical significant own-price elasticity in the longline fleet. In both the hook and line and longline fleets, the residual group was found to be a statistically significant substitute of red grouper. Thus, if managers imposed a quota on the residual species group, fishermen would be able to adjust their catch mix landing more red grouper. All scale elasticities were positive and statistically significant.

Table 6: Hypothesis tests of the technological structure of the longline and handline fleets.

Fleet	Hypothesis	χ^2	Prob> χ^2	Outcome (α=0.05)
Hook and line	Input-output separability	974.72	<.0001	Reject null
	Non-jointnes in inputs			
	Overall	467.54	<.0001	Reject null
	Red grouper	139.19	<.0001	Reject null
	Shallow-water grouper	182.34	<.0001	Reject null
	Shallow and mid-water snappers	215.06	<.0001	Reject null
	Miscellaneous species	271.98	<.0001	Reject null
Longline	Input-output separability	198.19	<.0001	Reject null
	Non-jointnes in inputs			
	Overall	13.32	0.0040	Reject null
	Red grouper	11.09	0.0039	Reject null
	Shallow-water grouper	0.36	0.8371	Accept null
	Miscellaneous species	12.81	0.0017	Reject null

Table 7: Input-compensated own and cross price and scale elasticities for the hook and line fleet (standard errors in parenthesis; N=56,251)

Prices and effort	Elasticity			
	Red grouper	Shallow-water grouper	Shallow and mid-water snappers	Miscellaneous species
Red grouper	0.09	0.12	0.05	-0.26*
	(0.09)	(0.08)	(0.04)	(0.02)
Shallow-water groupers	0.09	0.60*	-0.68*	0.01
	(0.06)	(0.08)	(0.05)	(0.02)
Shallow and mid-water snappers	0.03	-0.61*	0.67*	-0.10*
	(0.03)	(0.04)	(0.05)	(0.02)
Miscellaneous species	-0.48*	0.01	-0.29*	0.76*
	(0.04)	(0.06)	(0.08)	(0.06)
Effort	0.31*	0.65*	1.91*	0.36*
	(0.04)	(0.06)	(0.06)	(0.12)

Significance levels: 0.01,0.05** and 0.1****

Table 8: Input-compensated own and cross price and scale elasticities for the longline fleet (standard errors in parenthesis).

Prices and effort	Elasticity		
	Red grouper	Shallow-water grouper	Miscellaneous species
Red grouper	0.16	-0.07	-0.09*
	(0.13)	(0.13)	(0.03)
Shallow-water groupers	-0.17	0.16	0.01
	(0.30)	(0.30)	(0.05)
Miscellaneous species	-0.27*	0.01	0.26*
	(0.08)	(0.07)	(0.08)
Effort	0.70*	1.05*	3.20*
	(0.10)	(0.15)	(0.23)

Significance levels: 0.01,0.05** and 0.1****

Consumer sector:

As noted above, we continue to work on this section. However, we attempted to estimate a simple annual demand curve for the retail prices as a function of disposable income, Gulf of Mexico landings and fresh grouper imports. We attempted an annual model rather than monthly model to make it easier to examine welfare changes due to quotas. A monthly model would force us to make assumptions about monthly mini-quotas if you will. Unfortunately, because we don't have long time series of seafood imports, this severely limited our ability to incorporate more explanatory variables as we had hoped (i.e., lack of degrees of freedom).

The estimation was conducted in two steps. First, we regressed monthly red grouper retail prices (using NOAA prices from Fulton Market) against Gulf of Mexico red grouper ex-vessel prices and found that without intercept, the slope was 1.61 suggesting 61% mark-up for whole fish. Second, because we wanted to estimate an annual welfare loss from reducing the red grouper commercial quota, we regressed imputed annual retail prices (i.e., ex-vessel prices times 1.61) over disposable income, prices imported fresh imports and Gulf of Mexico red grouper landings using OLS. All prices were adjusted by the consumer price index (2005=100). Parameter estimates are shown in Table 9. The equation was statistically significant at the 0.05 level (F-value was 5.26). The adjusted R^2 for this regression was 48%. Examination of the parameter estimates shows that none of them were statistically significant suggesting that red grouper flexibilities are inelastic.

Table 9: Parameter estimates for red grouper annual retail demand function (N=15).

Parameter	Estimate	Std. Error	t Stat	P-value
Constant	1.79	3.23	0.55	0.59
Import Price	1.08	0.94	1.15	0.28
Disposable income	0.02	0.07	0.29	0.78
GOM red grouper landings	-0.05	0.04	-1.08	0.30

5. SIMULATION RESULTS

Harvesting sector:

To investigate the incremental benefit of changing the commercial share of the TAC (thus, revealing the marginal benefit schedule) we anticipate undertaking the following steps. First, we will estimate the predicted red grouper landings for each complete trip record in 2005 drawing on the red grouper parameter estimates and the 2005 Florida trip ticket data. In other words, we intend to trace the marginal benefit curve for 2005. Then, we will substitute the recorded ex-vessel red grouper price by its virtual price ($p_v = (p_1 - \lambda_1)$), and simulated harvest levels increasing the lambda from \$0 to \$5; thus, numerically obtaining an individual marginal benefit schedule for each trip taken. Because the monotonicity requirement of the regulatory conditions will likely not always be satisfied (i.e., meaning that the predicted harvest levels were not always positive in the relevant range) we will set those negative and/or non-real observations equal to zero. We will conduct this procedure for the longline and hook and line vessels separately. Later, we will aggregate all well-behaved observations from both fleets to obtain a unique marginal benefit schedule. Finally, due to the presence of kinks in this marginal benefit schedule we conducted a numerical interpolation to obtain a relationship between marginal benefit and quota levels. Using the interpolation function, we will integrate the derived demand for quota for various quotas (assuming 2005 landing levels) to obtain welfare estimates. Similarly, we integrated the retail demand curve to estimate consumer surpluses at various quota levels (assuming 2005 values for disposable income, fresh grouper imports, Gulf of Mexico red grouper landings).

6. CONCLUDING REMARKS

In concluding this update, we wanted to highlight again this continues to be work in progress and briefly touch on the strengths and weaknesses of this model.

Strengths:

- This multiproduct model, which permits the estimation of marginal benefits on a species or species group level.

- This specification allows us to test for the underlying structure of the technology rather than arbitrarily impose a fixed proportions technology.

Weaknesses and other considerations:

- This is a static model, which prevent us from examining how (marginal) benefits change as a function of stock size, technology, and consumer preferences.

- The present framework only considers the longline and hook and line fleets, which constrains the commercial sector marginal benefit schedule since the do not account for the potential contribution of a number of gears.

- This model only considers a first stage production (i.e., fishing trip). It ignores long-term adjustments to the industry capital stock via refitting the vessel and/or entry-exit into the fishery. This important to consider because of the uncertainty regarding the participation of former red grouper trap fishery (phase out in Feb 2007). It is unclear what will happen to the trap share and more importantly whether these displaced participants will seek to continue harvesting red grouper with other gears.

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Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Appendix A: Hook and line and longline fleet parameter estimates.

Model Summary	
Model Variables	4
Parameters	162
Equations	4
Number of Statements	284

Note: The parameter beta12 is shared by 2 of the equations to be estimated.

Note: The parameter beta13 is shared by 2 of the equations to be estimated.

Note: The parameter beta14 is shared by 2 of the equations to be estimated.

Note: The parameter beta23 is shared by 2 of the equations to be estimated.

Note: The parameter beta24 is shared by 2 of the equations to be estimated.

Note: The parameter beta34 is shared by 2 of the equations to be estimated.

The 4 Equations to Estimate	
redgrplbs =	F(alpha1(esf_a2), beta11(esf_a1), beta12, beta13, beta14, a1, a2, a3, a4, a5, a6, a7, a8, a9, m2a, m3a, m4a, c1, d1, e1, z1, ban1, j1, m5a, m6a, m7a, m8a, m9a, m10a, m11a, m12a, g1, g2, g3, g4, y1, y2, y3, gg1, gg2, gg3, gg4)
swgrplbs =	F(beta12, alpha2(esf_a2), beta22(esf_a1), beta23, beta24, a10, a11, a12, a13, a14, a15, a16, a17, a18, m2b, m3b, m4b, c2, d2, e2, z2, ban2, j2, m5b, m6b, m7b, m8b, m9b, m10b, g5, m11b, m12b, g6, g7, g8, y4, y5, y6, gg5, gg6, gg7, gg8)
swsnaplbs =	F(beta13, beta23, alpha3(esf_a2), beta33(esf_a1), beta34, a19, a20, a21, a22, a23, a24, a25, a26, a27, m2c, m3c, m4c, c3, d3, e3, z3, ban3, j3, m5c, m6c, m7c, m8c, m9c, m10c, m11c, m12c, g9, g10, g11, g12, y7, y8, y9, gg9, gg10, gg11, gg12)
l_misclbs =	F(beta14, beta24, beta34, alpha4(esf_a2), beta44(esf_a1), a28, a29, a30, a31, a32, a33, a34, a35, a36, m2d, m3d, m4d, c4, d4, e4, z4, ban4, j4, m5d, m6d, m7d, m8d, m9d, m10d, m11d, m12d, g13, g14, g15, g16, y10, y11, y12, gg13, gg14, gg15, gg16)

Observations will be weighted by	inv

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure
ITSUR Estimation

```
NOTE: At ITSUR Iteration 3 CONVERGE=0.001 Criteria
Met.
```

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure
ITSUR Estimation Summary

Data Set Options	
DATA=	NEW9
OUT=	REST
OUTEST=	FIN

Minimization Summary	
Parameters Estimated	162
Method	Gauss
Iterations	3

Final Convergence Criteria	
R	2.759E-6
PPC(beta24)	0.003202
RPC(beta24)	0.003202
Object	1.11E-16
Trace(S)	102814.4
Objective Value	3.993708
S	0

Observations Processed	
Read	25749
Solved	25749

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Summary of Residual Errors							
Equation	**DF Model**	**DF Error**	**SSE**	**MSE**	**Root MSE**	**R-Square**	**Adj R-Sq**
redgrplbs	40.5	25709	1.6624E8	6466.2	80.4125	0.4023	0.4014
swgrplbs	40.5	25709	4.0324E8	15685.1	125.2	0.3084	0.3074
swsnaplbs	40.5	25709	8.7612E8	34079.2	184.6	0.3743	0.3734
l_misclbs	40.5	25709	1.1976E9	46584.0	215.8	0.1159	0.1146

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
alpha1	0.146672	0.2269	0.65	0.5179
beta11	30.67862	11.7570	2.61	0.0091
beta12	13.60061	9.6277	1.41	0.1578
beta13	7.056668	5.9840	1.18	0.2383
beta14	-46.0292	3.9153	-11.76	<.0001
a1	-1.39544	2.0563	-0.68	0.4974
a2	9.541236	3.0410	3.14	0.0017
a3	90.45645	5.6817	15.92	<.0001
a4	92.3595	3.8075	24.26	<.0001
a5	75.62838	2.7198	27.81	<.0001
a6	93.70827	2.3563	39.77	<.0001
a7	73.70434	3.1316	23.54	<.0001
a8	47.9946	3.5266	13.61	<.0001
a9	16.02563	4.3160	3.71	0.0002
m2a	-4.02809	2.4601	-1.64	0.1016
m3a	-9.56421	2.5205	-3.79	0.0001
m4a	-3.0416	2.2619	-1.34	0.1787
c1	-9.56786	2.4892	-3.84	0.0001
d1	-60.7049	3.7685	-16.11	<.0001
e1	15.78955	2.2896	6.90	<.0001
z1	-0.01162	0.00342	-3.40	0.0007

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
ban1	6.427973	1.2845	5.00	<.0001
j1	-0.75031	0.1812	-4.14	<.0001
m5a	4.418862	2.2859	1.93	0.0532
m6a	7.587462	2.3214	3.27	0.0011
m7a	13.70332	2.4439	5.61	<.0001
m8a	13.45533	2.6911	5.00	<.0001
m9a	16.31813	3.3876	4.82	<.0001
m10a	10.76185	2.6720	4.03	<.0001
m11a	-3.75289	2.7687	-1.36	0.1753
m12a	-0.43342	2.9533	-0.15	0.8833
g1	1.286955	2.2565	0.57	0.5685
g2	27.96188	4.1580	6.72	<.0001
g3	9.965956	2.1712	4.59	<.0001
g4	4.189086	3.2156	1.30	0.1927
y1	-9.11965	1.7880	-5.10	<.0001
y2	-27.0074	1.8071	-14.95	<.0001
y3	-15.6187	1.7567	-8.89	<.0001
gg1	-5.97203	3.4865	-1.71	0.0867
gg2	17.93324	3.4974	5.13	<.0001
gg3	9.234651	3.2339	2.86	0.0043
gg4	23.62822	4.4620	5.30	<.0001
alpha2	1.104643	0.3533	3.13	0.0018
beta22	124.7976	11.6357	10.73	<.0001
beta23	-111.324	8.2489	-13.50	<.0001
beta24	0.887172	5.3737	0.17	0.8689
a10	0.398924	3.2006	0.12	0.9008
a11	5.647495	4.7356	1.19	0.2330
a12	63.9168	8.8483	7.22	<.0001
a13	65.49479	5.9274	11.05	<.0001
a14	93.15134	4.2341	22.00	<.0001
a15	64.8388	3.6645	17.69	<.0001
a16	106.5328	4.8733	21.86	<.0001

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
a17	58.10419	5.4911	10.58	<.0001
a18	7.123664	6.7212	1.06	0.2892
m2b	-18.9571	3.8282	-4.95	<.0001
m3b	-13.1498	3.9243	-3.35	0.0008
m4b	-35.8654	3.5216	-10.18	<.0001
c2	-41.6105	3.8743	-10.74	<.0001
d2	-103.666	5.8668	-17.67	<.0001
e2	34.85209	3.5642	9.78	<.0001
z2	0.015173	0.00532	2.85	0.0044
ban2	2.107	1.9996	1.05	0.2920
j2	2.520805	0.2821	8.94	<.0001
m5b	-37.3523	3.5433	-10.54	<.0001
m6b	-56.5965	3.5974	-15.73	<.0001
m7b	-66.6485	3.7903	-17.58	<.0001
m8b	-93.9752	4.1810	-22.48	<.0001
m9b	-91.1179	5.2728	-17.28	<.0001
m10b	-35.1337	4.1606	-8.44	<.0001
g5	0.217392	1.7536	0.12	0.9013
m11b	-41.6545	4.3118	-9.66	<.0001
m12b	-18.4797	4.5972	-4.02	<.0001
g6	23.52942	6.4757	3.63	0.0003
g7	14.36078	3.3787	4.25	<.0001
g8	41.45167	5.0065	8.28	<.0001
y4	-1.76724	2.7841	-0.63	0.5256
y5	-14.1284	2.8129	-5.02	<.0001
y6	-2.36966	2.7360	-0.87	0.3864
gg5	92.04028	5.4222	16.97	<.0001
gg6	-11.4949	5.4438	-2.11	0.0347
gg7	39.07256	5.0316	7.77	<.0001
gg8	-8.64057	6.9477	-1.24	0.2136
alpha3	1.071308	0.5208	2.06	0.0397
beta33	331.7994	12.8304	25.86	<.0001

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
beta34	-28.0973	6.5265	-4.31	<.0001
a19	-18.6244	4.7188	-3.95	<.0001
a20	-33.1342	6.9795	-4.75	<.0001
a21	-160.904	13.0427	-12.34	<.0001
a22	-160.523	8.7380	-18.37	<.0001
a23	-128.175	6.2411	-20.54	<.0001
a24	-152.031	5.4020	-28.14	<.0001
a25	-183.397	7.1836	-25.53	<.0001
a26	-133.833	8.0944	-16.53	<.0001
a27	-208.321	9.9048	-21.03	<.0001
m2c	13.01072	5.6367	2.31	0.0210
m3c	28.47899	5.7841	4.92	<.0001
m4c	70.1242	5.1899	13.51	<.0001
c3	3.523947	5.7118	0.62	0.5373
d3	48.58923	8.6463	5.62	<.0001
e3	-12.7634	5.2544	-2.43	0.0151
z3	-0.02293	0.00785	-2.92	0.0035
ban3	29.75725	2.9471	10.10	<.0001
j3	-0.08073	0.4159	-0.19	0.8461
m5c	70.51297	5.2151	13.52	<.0001
m6c	86.35948	5.2975	16.30	<.0001
m7c	74.25638	5.5829	13.30	<.0001
m8c	65.44092	6.1593	10.62	<.0001
m9c	52.87615	7.7711	6.80	<.0001
m10c	62.30457	6.1324	10.16	<.0001
m11c	65.31952	6.3556	10.28	<.0001
m12c	64.87344	6.7752	9.58	<.0001
g9	-112.282	5.1675	-21.73	<.0001
g10	-49.0236	9.5448	-5.14	<.0001
g11	-123.187	4.9794	-24.74	<.0001
g12	353.558	7.3792	47.91	<.0001
y7	-9.04674	4.1030	-2.20	0.0275

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
y8	1.020507	4.1454	0.25	0.8055
y9	-0.31713	4.0328	-0.08	0.9373
gg9	52.47773	7.9892	6.57	<.0001
gg10	-114.365	8.0257	-14.25	<.0001
gg11	-42.567	7.4154	-5.74	<.0001
gg12	-99.0274	10.2407	-9.67	<.0001
alpha4	-18.9391	0.6089	-31.11	<.0001
beta44	249.8567	10.5726	23.63	<.0001
a28	-109.526	5.5182	-19.85	<.0001
a29	10.73422	8.1610	1.32	0.1884
a30	63.43046	15.2485	4.16	<.0001
a31	67.08596	10.2148	6.57	<.0001
a32	18.07718	7.3022	2.48	0.0133
a33	-22.2842	6.3212	-3.53	0.0004
a34	-16.1864	8.4035	-1.93	0.0541
a35	-25.2311	9.4647	-2.67	0.0077
a36	-46.4212	11.5791	-4.01	<.0001
m2d	13.39457	6.5829	2.03	0.0419
m3d	-54.656	6.7647	-8.08	<.0001
m4d	-85.2433	6.0666	-14.05	<.0001
c4	131.9988	6.6724	19.78	<.0001
d4	86.97231	10.1082	8.60	<.0001
e4	-11.096	6.1392	-1.81	0.0707
z4	0.153045	0.00918	16.66	<.0001
ban4	25.56086	3.4482	7.41	<.0001
j4	-1.09005	0.4862	-2.24	0.0250
m5d	-89.778	6.1031	-14.71	<.0001
m6d	-80.3336	6.1951	-12.97	<.0001
m7d	-69.119	6.5237	-10.60	<.0001
m8d	-48.6226	7.2003	-6.75	<.0001
m9d	-47.2264	9.0821	-5.20	<.0001
m10d	-55.1232	7.1697	-7.69	<.0001

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
m11d	-64.0138	7.4306	-8.61	<.0001
m12d	-64.3939	7.9210	-8.13	<.0001
g13	119.6056	6.0816	19.67	<.0001
g14	0.254913	11.1595	0.02	0.9818
g15	26.96854	5.8221	4.63	<.0001
g16	83.86132	8.6265	9.72	<.0001
y10	8.593999	4.7994	1.79	0.0734
y11	8.494055	4.8429	1.75	0.0795
y12	-1.45079	4.7150	-0.31	0.7583
gg13	54.68371	9.3405	5.85	<.0001
gg14	30.57969	9.3823	3.26	0.0011
gg15	-4.623	8.6708	-0.53	0.5939
gg16	-110.455	11.9737	-9.22	<.0001

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own supply elasticity of red gro	0.08756	0.0885	0.99	0.3225	(-0.5)*(beta12*sqrt(xpswgrp/xpredgrp)+beta13*sqrt(xpswsnap/xpredgrp) +beta14*sqrt(xl_pmisc/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own supply elasticity of sw grou	0.595261	0.0753	7.90	<.0001	(-0.5)*(beta12*sqrt(xpredgrp /xpswgrp)+beta23*sqrt(xpswsnap/xpswgrp) +beta24* sqrt(xl_pmisc/xpswgrp))*(xesf_a1/xswgrplbs)

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own supply elasticity of sw snap	0.670644	0.0529	12.67	<.0001	(-0.5)*(beta13*sqrt(xpredgrp/xpswsnap)+beta23*sqrt(xpswgrp/xpswsnap) +beta34 *sqrt(xl_pmisc/xpswsnap))*(xesf_a1/xswsnaplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own supply elasticity of l_miscl	0.761163	0.0561	13.56	<.0001	(-0.5)*(beta14*sqrt(xpredgrp/xl_pmisc)+beta24*sqrt(xpswgrp/xl_pmisc) +beta34*sqrt(xpswsnap/xl_pmisc))*(xesf_a1/xl_misclbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price red grouper with sw	0.115874	0.0820	1.41	0.1578	(0.5)*(beta12*sqrt(xpswgrp/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price red grouper with sna	0.052974	0.0449	1.18	0.2383	(0.5)*(beta13*sqrt(xpswsnap/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price red grouper with oth	-0.25641	0.0218	-11.76	<.0001	(0.5)*(beta14*sqrt(xl_pmisc/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price sw grouper with red	0.085392	0.0604	1.41	0.1578	(0.5)*(beta12*sqrt(xpredgrp/xpswgrp))*(xesf_a1/xswgrplbs)

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Estimates

Term	Estimate	Approx Std Err	t Value	Approx Pr > |t|	Label
Cross-price sw grouper with snap	-0.6847	0.0507	-13.50	<.0001	(0.5)*(beta23*sqrt(xpswsnap/xpswgrp))*(xesf_a1/xswgrplbs)

Nonlinear ITSUR Estimates

Term	Estimate	Approx Std Err	t Value	Approx Pr > |t|	Label
Cross-price sw grouper with othe	0.004049	0.0245	0.17	0.8689	(0.5)*(beta24*sqrt(xl_pmisc/xpswgrp))*(xesf_a1/xswgrplbs)

Nonlinear ITSUR Estimates

Term	Estimate	Approx Std Err	t Value	Approx Pr > |t|	Label
Cross-price snappers with red gr	0.03451	0.0293	1.18	0.2383	(0.5)*(beta13*sqrt(xpredgrp/xpswsnap))*(xesf_a1/xswsnaplbs)

Nonlinear ITSUR Estimates

Term	Estimate	Approx Std Err	t Value	Approx Pr > |t|	Label
Cross-price snapper with sw grou	-0.60527	0.0448	-13.50	<.0001	(0.5)*(beta23*sqrt(xpswgrp/xpswsnap))*(xesf_a1/xswsnaplbs)

Nonlinear ITSUR Estimates

Term	Estimate	Approx Std Err	t Value	Approx Pr > |t|	Label
Cross-price snapper with other s	-0.09988	0.0232	-4.31	<.0001	(0.5)*(beta34*sqrt(xl_pmisc/xpswsnap))*(xesf_a1/xswsnaplbs)

Nonlinear ITSUR Estimates

Term	Estimate	Approx Std Err	t Value	Approx Pr > |t|	Label
Cross-price other species with	-0.4828	0.0411	-11.76	<.0001	(0.5)*(beta14*sqrt(xpredgrp/xl_pmisc))*(xesf_a1/xl_misclbs)

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price other species with	0.010346	0.0627	0.17	0.8689	(0.5)*(beta24*sqrt(xpswgrp/xl_pmisc))*(xesf_a1/xl_misclbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price other species with	-0.28871	0.0671	-4.31	<.0001	(0.5)*(beta34*sqrt(xpswsnap/xl_pmisc))*(xesf_a1/xl_misclbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Red Grouper Scale Elasticity	0.310064	0.0438	7.08	<.0001	(2*alpha1*xesf_a1+beta11+beta12*sqrt(xpswgrp/xpredgrp)+beta13*sqrt(xpswsnap/xpredgrp) +beta14*sqrt(xl_pmisc/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Shallow water grouper Scale Elas	0.654598	0.0621	10.54	<.0001	(2*alpha2*xesf_a1+beta22+beta12*sqrt(xpredgrp/xpswgrp)+beta23*sqrt(xpswsnap/xpswgrp) +beta24*sqrt(xl_pmisc /xpswgrp))*(xesf_a1/xswgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Snappers Scale Elasticity	1.90627	0.0628	30.33	<.0001	(2*alpha3*xesf_a1+beta33+beta13*sqrt(xpredgrp/xpswsnap)+beta23*sqrt(xpswgrp/xpswsnap) +beta34*sqrt(xl_pmisc /xpswsnap))*(xesf_a1/xswsnaplbs)

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Other species Scale Elasticity	0.361598	0.1170	3.09	0.0020	(2*alpha4*xesf_a1+beta44+beta14*sqrt(xpredgrp/xl_pmisc)+beta24*sqrt(xpswgrp/xl_pmisc) +beta34*sqrt(xpswsnap/xl_pmisc))*(xesf_a1/xl_misclbs)

Test Results				
Test	**Type**	**Statistic**	**Pr > ChiSq**	**Label**
Test0	Wald	974.72	<.0001	alpha1, alpha2, alpha3, alpha4
Test1	Wald	467.54	<.0001	beta12, beta13, beta14, beta23, beta24,
Test2	Wald	139.19	<.0001	beta12, beta13, beta14
Test3	Wald	182.34	<.0001	beta12, beta23, beta24
Test4	Wald	215.06	<.0001	beta13, beta23, beta34
Test5	Wald	271.98	<.0001	beta14, beta24, beta34
Test6	Wald	207.86	<.0001	ban1,ban2,ban3,ban4
Test7	Wald	476.47	<.0001	c1,c2,c3,c4
Test8	Wald	538.48	<.0001	d1,d2,d3,d4
Test9	Wald	124.87	<.0001	e1,e2,e3,e4
Test10	Wald	305.47	<.0001	z1,z2,z3,z4
Test11	Wald	4952.3	<.0001	g1,g2,g3,g4,g5,g6,g7,g8,g9,g10,g11,g12,
Test12	Wald	979.54	<.0001	gg1,gg2,gg4,gg5,gg6,gg7,gg8,gg9,gg10,gg
Test13	Wald	5540.3	<.0001	g1,g2,g3,g5,g6,g7,g8,g9,g10,g11,g12,g13
Test14	Wald	120.89	<.0001	j1,j2,j3,j4
Test15	Wald	305.47	<.0001	z1,z2,z3,z4
Test16	Wald	1978.3	<.0001	m2a, m3a, m4a, m5a, m6a, m7a, m8a, m9a,
Test17	Wald	4564.7	<.0001	a1,a2,a3,a4,a5,a6,a7,a8,a9,a10,a11,a12,
Test18	Wald	325.02	<.0001	y1,y2,y3,y4,y5,y6,y7,y8,y9,y10,y11,y12

Weighted ITSUR Model for the Handline and Bandit Fleet

The MODEL Procedure

Number of Observations		**Statistics for System**	
Used	25749	**Objective**	3.9937
Missing	0	**Objective*N**	102834
Sum of Weights	9627		

Heteroscedasticity Test					
Equation	**Test**	**Statistic**	**DF**	**Pr > ChiSq**	**Variables**
redgrplbs	White's Test	1859	698	<.0001	Cross of all vars
	Breusch-Pagan	11.12	2	0.0038	1, esf_a1, esf_a2
swgrplbs	White's Test	2719	698	<.0001	Cross of all vars
	Breusch-Pagan	95.21	2	<.0001	1, esf_a1, esf_a2
swsnaplbs	White's Test	2821	698	<.0001	Cross of all vars
	Breusch-Pagan	121.2	2	<.0001	1, esf_a1, esf_a2
l_misclbs	White's Test	1435	698	<.0001	Cross of all vars
	Breusch-Pagan	108.0	2	<.0001	1, esf_a1, esf_a2

Normality Test			
Equation	**Test Statistic**	**Value**	**Prob**
redgrplbs	Kolmogorov-Smirnov	0.19	0.0010
swgrplbs	Kolmogorov-Smirnov	0.20	0.0010
swsnaplbs	Kolmogorov-Smirnov	0.18	0.0010
l_misclbs	Kolmogorov-Smirnov	0.22	0.0010
System	Mardia Skewness	-1E5	.
	Mardia Kurtosis	2291	<.0001
	Henze-Zirkler T	151.2	<.0001

Leontieff Normal(ITSUR):3 species Longline (DAs, 0 qualify, w depth)

The MODEL Procedure

Model Summary	
Model Variables	3
Parameters	104
Equations	3
Number of Statements	155

Note: The parameter beta12 is shared by 2 of the equations to be estimated.

Note: The parameter beta13 is shared by 2 of the equations to be estimated.

Note: The parameter beta23 is shared by 2 of the equations to be estimated.

The 3 Equations to Estimate	
redgrplbs =	F(alpha1(esf_a2), beta11(esf_a1), beta12, beta13, a1, a2, a3, a4, a5, a6, a7, a8, a9, m2a, m3a, m4a, c1, d1, e1, z1, j1, m5a, m6a, m7a, m8a, m9a, m10a, m11a, m12a, g1, g2, g3, y1, y2, y3)
swgrplbs =	F(beta12, alpha2(esf_a2), beta22(esf_a1), beta23, a10, a11, a12, a13, a14, a15, a16, a17, a18, m2b, m3b, m4b, c2, d2, e2, z2, j2, m5b, m6b, m7b, m8b, m9b, m10b, m11b, m12b, g5, g6, g7, y4, y5, y6)
l_misclbs =	F(beta13, beta23, alpha3(esf_a2), beta33(esf_a1), a19, a20, a21, a22, a23, a24, a25, a26, a27, m2c, m3c, m4c, c3, d3, e3, z3, j3, m5c, m6c, m7c, m8c, m9c, m10c, m11c, m12c, g9, g10, g11, y7, y8, y9)

Observations will be weighted by	inv

NOTE: At ITSUR Iteration 3 CONVERGE=0.001 Criteria Met.

The MODEL Procedure

ITSUR Estimation Summary

Data Set Options	
DATA=	NEW9
OUT=	REST
OUTEST=	FIN

Minimization Summary	
Parameters Estimated	102
Method	Gauss
Iterations	3

Final Convergence Criteria	
R	0.000011
PPC(beta12)	0.002448
RPC(beta12)	0.002448
Object	2.98E-16
Trace(S)	244650.7
Objective Value	2.981789
S	0

Observations Processed	
Read	5601
Solved	5601

Nonlinear ITSUR Summary of Residual Errors							
Equation	**DF Model**	**DF Error**	**SSE**	**MSE**	**Root MSE**	**R-Square**	**Adj R-Sq**
redgrplbs	34	5567	6.0851E8	109307	330.6	0.3811	0.3775
swgrplbs	34	5567	1.5181E8	27269.3	165.1	0.2190	0.2143
l_misclbs	34	5567	6.0165E8	108074	328.7	0.2013	0.1965

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
alpha1	-11.7513	1.1657	-10.08	<.0001
beta11	503.6381	84.7564	5.94	<.0001
beta12	-40.9832	71.8341	-0.57	0.5683
beta13	-65.4572	20.0685	-3.26	0.0011
a1	58.74269	67.1171	0.88	0.3815
a2	69.14226	27.9841	2.47	0.0135
a3	183.1552	28.0394	6.53	<.0001
a4	180.5534	24.9648	7.23	<.0001
a5	250.4253	23.7888	10.53	<.0001
a6	245.4604	24.6420	9.96	<.0001
a7	128.4917	27.2453	4.72	<.0001
a8	53.39686	26.9959	1.98	0.0480
a9	-30.7679	34.8182	-0.88	0.3769
m2a	-29.6816	21.7995	-1.36	0.1734
m3a	-71.603	23.0529	-3.11	0.0019
m4a	-50.5335	20.3312	-2.49	0.0130
c1	-232.481	24.4960	-9.49	<.0001
d1	-340.618	46.7296	-7.29	<.0001
e1	61.91307	19.6058	3.16	0.0016
z1	-0.26058	0.0291	-8.96	<.0001
j1	2.512413	1.5009	1.67	0.0942

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
m5a	-94.7625	20.8794	-4.54	<.0001
m6a	-79.9393	20.8874	-3.83	0.0001
m7a	-91.2241	22.0836	-4.13	<.0001
m8a	-81.3713	24.1857	-3.36	0.0008
m9a	-124.179	28.7181	-4.32	<.0001
m10a	-37.1268	23.6318	-1.57	0.1162
m11a	-5.21685	24.2721	-0.21	0.8298
m12a	-30.9352	25.9710	-1.19	0.2336
g1	24.29813	19.6364	1.24	0.2160
g2	27.78094	24.0569	1.15	0.2482
g3	11.63874	17.3516	0.67	0.5024
y1	-107.95	15.1822	-7.11	<.0001
y2	-97.9574	15.2445	-6.43	<.0001
y3	-64.2131	14.5040	-4.43	<.0001
alpha2	-0.12249	0.5826	-0.21	0.8335
beta22	151.4441	67.9045	2.23	0.0258
beta23	2.556463	14.1403	0.18	0.8565
a10	77.55972	33.5247	2.31	0.0207
a11	33.13414	13.9782	2.37	0.0178
a12	42.27884	14.0068	3.02	0.0026
a13	65.63499	12.4739	5.26	<.0001
a14	67.52628	11.8854	5.68	<.0001
a15	98.17378	12.3309	7.96	<.0001
a16	64.99869	13.6629	4.76	<.0001
a17	28.13978	13.4896	2.09	0.0370
a18	-27.7206	17.3933	-1.59	0.1110
m2b	-26.4589	10.8952	-2.43	0.0152
m3b	-19.3151	11.5233	-1.68	0.0938
m4b	-15.6907	10.1710	-1.54	0.1230
c2	-89.19	12.2352	-7.29	<.0001

Nonlinear ITSUR Parameter Estimates

Parameter	Estimate	Approx Std Err	t Value	Approx Pr > |t|
d2	-113.698	23.3887	-4.86	<.0001
e2	13.57761	9.7976	1.39	0.1659
z2	-0.08993	0.0145	-6.19	<.0001
j2	1.914308	0.7500	2.55	0.0107
m5b	-32.9749	10.4955	-3.14	0.0017
m6b	-23.3641	10.5200	-2.22	0.0264
m7b	-42.1905	11.1140	-3.80	0.0001
m8b	-59.8472	12.1357	-4.93	<.0001
m9b	-74.7393	14.3890	-5.19	<.0001
m10b	-38.9859	11.8122	-3.30	0.0010
m11b	-20.2806	12.1346	-1.67	0.0947
m12b	-15.411	12.9948	-1.19	0.2357
g5	29.75307	9.8474	3.02	0.0025
g6	-85.8166	12.0172	-7.14	<.0001
g7	-18.586	8.6741	-2.14	0.0322
y4	-22.4501	7.5858	-2.96	0.0031
y5	-4.95801	7.6167	-0.65	0.5151
y6	5.485534	7.2448	0.76	0.4490
alpha3	-8.23718	1.1622	-7.09	<.0001
beta33	654.8367	38.9661	16.81	<.0001
a19	58.65473	66.7359	0.88	0.3795
a20	-242.612	27.8355	-8.72	<.0001
a21	-376.583	27.8902	-13.50	<.0001
a22	-333.742	24.8218	-13.45	<.0001
a23	-406.807	23.6500	-17.20	<.0001
a24	-398.153	24.4742	-16.27	<.0001
a25	-330.612	27.0290	-12.23	<.0001
a26	-217.031	26.8583	-8.08	<.0001
a27	-164.576	34.6369	-4.75	<.0001
m2c	-41.9227	21.6822	-1.93	0.0532

Nonlinear ITSUR Parameter Estimates				
Parameter	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**
m3c	38.91651	22.9396	1.70	0.0899
m4c	-3.55726	20.2630	-0.18	0.8607
c3	250.8257	24.3606	10.30	<.0001
d3	435.5041	46.4404	9.38	<.0001
e3	-60.9895	19.4914	-3.13	0.0018
z3	0.197345	0.0289	6.82	<.0001
j3	-4.08175	1.4943	-2.73	0.0063
m5c	13.27562	20.7886	0.64	0.5231
m6c	9.680702	20.8020	0.47	0.6417
m7c	78.16657	21.8854	3.57	0.0004
m8c	23.00848	24.0266	0.96	0.3383
m9c	87.41485	28.5324	3.06	0.0022
m10c	2.179452	23.5164	0.09	0.9262
m11c	-24.4584	24.1223	-1.01	0.3107
m12c	-29.4444	25.8047	-1.14	0.2539
g9	-121.09	19.4830	-6.22	<.0001
g10	-84.1559	23.9224	-3.52	0.0004
g11	-72.0154	17.2478	-4.18	<.0001
y7	48.88748	15.0986	3.24	0.0012
y8	0.349609	15.1606	0.02	0.9816
y9	-4.21031	14.4232	-0.29	0.7704

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own-price supply elasticity of r	0.163291	0.1310	1.25	0.2126	(-0.5)*(beta12*sqrt(xpswgrp/xpredgrp)+beta13*sqrt(xl_pmisc/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own-price supply elasticity of s	0.160626	0.3007	0.53	0.5933	(-0.5)*(beta12*sqrt(xpredgrp /xpswgrp)+beta23*sqrt(xl_pmisc/xpswgrp))*(xesf_a1/xswgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Own-price supply elasticity of o	0.262306	0.0796	3.29	0.0010	(-0.5)*(beta13*sqrt(xpredgrp /xl_pmisc)+beta23*sqrt(xpswgrp/xl_pmisc))*(xesf_a1/xl_misclbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price red grouper wrt sw g	-0.07356	0.1289	-0.57	0.5683	(0.5)*(beta12*sqrt(xpswgrp/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price red grouper wrt misc	-0.08973	0.0275	-3.26	0.0011	(0.5)*(beta13*sqrt(xl_pmisc/xpredgrp))*(xesf_a1/xredgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price sw grouper wrt red g	-0.16959	0.2973	-0.57	0.5683	(0.5)*(beta12*sqrt(xpredgrp/xpswgrp))*(xesf_a1/xswgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price sw grouper wrt misc	0.008965	0.0496	0.18	0.8565	(0.5)*(beta23*sqrt(xl_pmisc/xpswgrp))*(xesf_a1/xswgrplbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price misc wrt red	-0.27419	0.0841	-3.26	0.0011	(0.5)*(beta13*sqrt(xpredgrp /xl_pmisc))*(xesf_a1/xl_misclbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Cross-price misc wrt sw grouper	0.011882	0.0657	0.18	0.8565	(0.5)*(beta23*sqrt(xpswgrp/xl_pmisc))*(xesf_a1/xl_misclbs)

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Scale of red grouper	0.702978	0.1031	6.82	<.0001	(xesf_a1/xredgrplbs)*(2*alpha1*xesf_a1+ beta11+beta12*sqrt(xpswgrp/xpredgrp) +beta13*sqrt(xl_pmisc/xpredgrp))

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Scale of sw grouper	1.051715	0.1463	7.19	<.0001	(xesf_a1/xswgrplbs)*(2*alpha2*xesf_a1+beta22+beta12*sqrt(xpredgrp/xpswgrp) +beta23*sqrt(xl_pmisc /xpswgrp))

Nonlinear ITSUR Estimates					
Term	**Estimate**	**Approx Std Err**	**t Value**	**Approx Pr > |t|**	**Label**
Scale of Misc	3.201931	0.2251	14.22	<.0001	(xesf_a1/xl_misclbs)*(2*alpha3*xesf_a1+beta33+beta13*sqrt(xpredgrp/xl_pmisc) +beta23*sqrt(xpswgrp/xl_pmisc))

Test Results				
Test	**Type**	**Statistic**	**Pr > ChiSq**	**Label**
Test0	Wald	198.19	<.0001	alpha1, alpha2, alpha3
Test1	Wald	13.32	0.0040	beta12, beta13, beta23
Test2	Wald	363.06	<.0001	beta11,beta22,beta33
Test3	Wald	11.09	0.0039	beta12, beta13
Test4	Wald	0.36	0.8371	beta12, beta23
Test5	Wald	12.81	0.0017	beta13, beta23
Test6	Wald	118.56	<.0001	z1,z2,z3
Test7	Wald	184.60	<.0001	c1,c2,c3
Test8	Wald	127.22	<.0001	d1,d2,d3
Test9	Wald	16.98	0.0007	e1,e2,e3
Test10	Wald	13.41	0.0038	j1,j2,j3
Test11	Wald	116.60	<.0001	m2a, m3a, m4a, m5a, m6a, m7a, m8a, m9a,
Test12	Wald	150.76	<.0001	g1,g2,g3, g5,g6,g7 ,g9,g10,g11
Test13	Wald	604.28	<.0001	a1,a2,a3,a4,a5,a6,a7,a8,a9,a10,a11,a12,
Test14	Wald	87.80	<.0001	y1,y2,y3,y4,y5,y6,y7,y8,y9

Number of Observations		Statistics for System	
Used	5601	**Objective**	2.9818
Missing	0	**Objective*N**	16701
Sum of Weights	463.8267		

Heteroscedasticity Test

Equation	Test	Statistic	DF	Pr > ChiSq	Variables
redgrplbs	White's Test	306.9	470	1.0000	Cross of all vars
	Breusch-Pagan	84.63	2	<.0001	1, esf_a1, esf_a2
swgrplbs	White's Test	408.4	470	0.9814	Cross of all vars
	Breusch-Pagan	92.20	2	<.0001	1, esf_a1, esf_a2
l_misclbs	White's Test	1239	470	<.0001	Cross of all vars
	Breusch-Pagan	239.2	2	<.0001	1, esf_a1, esf_a2

Normality Test

Equation	Test Statistic	Value	Prob
redgrplbs	Kolmogorov-Smirnov	0.10	0.0010
swgrplbs	Kolmogorov-Smirnov	0.18	0.0010
l_misclbs	Kolmogorov-Smirnov	0.23	0.0010
System	Mardia Skewness	78696	<.0001
	Mardia Kurtosis	1475	<.0001
	Henze-Zirkler T	50.86	<.0001