Implied Discount Rates in the Gulf of Mexico Commercial Red Snapper IFQ Program

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Introduction

During the first five years of the red snapper IFQ program the percentage of the TAC that was leased increased from 57% in 2007 to 110% in 2011 (NMFS 2013). In addition, there were 16 times more quota lease than sale trades and the amount of quota pounds traded through leasing was 12 times the amount of pounds traded through sales. From 2007 to 2011 the percentage of the TAC that was held by investors, those participants that leased out their entire quota and did not fish, rose from 13% to 27%. At the same time the percentage of red snapper landings caught by lease dependent fishers, those fishers that owned no quota, increased from 9% to 26%. The large amount of quota lease trading in the red snapper fishery is not unique among IFQ programs. Newell, Sanchirico, and Kerr (2005) found that quota lease transactions increased 10-fold in New Zealand IFQ fisheries from approximately 1,500 in 1986 to about 15,000 in 2000 representing approximately 45% of the TAC, while sales of quota only accounted for about 5% of the TAC. Quota leasing in the British Columbia halibut IFQ program rose steadily from program implementation in 1993 to reach 79% of the TAC in 2006; in that same year over half of the fishers with landings had to lease in over 50% of their catch (Pinkerton and Edwards 2009). The Tasmanian rock lobster IFQ program saw similar large amounts of quota leasing with 44% of the TAC leased in 2007 the ninth full year of the program, during the same year only 3% of the TAC was sold (van Putten et al. 2010). The preponderance of quota leasing in these markets leads to the question: do potential buyers and sellers of quota have inherently different valuations of quota that preclude trading?

The implementation of a tradable rights-based management program that allows for both the sale and lease of fishing rights, such as the red snapper IFQ program, provides an opportunity to analyze discount rates in the fishery. In an IFQ fishery each fishing firm has an incentive to buy, sell, or lease quota until it attains just enough quota to cover a level of catch that maximizes its profits. The value of quota is the discounted value of all future cash flows provided by the quota or the resource rent earned from harvesting the quota (Asche 2001). The quota lease price should equal the profit from harvesting that fish (Newell, Sanchirico, and Kerr 2005). A fishing firm i can be assumed to have the generic profit function shown in equation 1 where p is the dockside price of fish, q_i is the amount of fish landed, and $c_i(q_i)$ is a function representing firm i's cost of catching q fish.

$$\pi_i = pq_i - c_i(q_i) \tag{1}$$

Maximizing profits with respect to landings, subject to the constraint that firm i holds enough quota to cover q level of catch, the firm will be willing to pay λ to lease quota amount q, as shown in equation 2.

$$\lambda_i = p - c_i{}'(q_i) \tag{2}$$

The expected present value of quota for firm i then is simply the expected future values of leasing that quota discounted back at an appropriate discount rate, r, as shown in equation 3.

$$E(V_{i,0}) = \sum_{t=0}^{\infty} \frac{\lambda_{i,t}}{(1+r_i)^t} \tag{3}$$

The objective of this research was to determine if different groups of IFQ participants value quota differently which could explain the preponderance of quota lease trading in the red snapper IFQ program noted earlier. This objective was achieved

by examining IFQ lease and sale valuations for three different types of IFQ participants: potential quota sellers, potential quota buyers, and pure fishers. The groups were determined by how they transacted in the quota lease market; those fishers that typically lease out quota were categorized as potential quota sellers, those that typically lease in quota were categorized as potential quota buyers, and those that only harvest their own quota and do not lease quota were labeled pure fishers. This analysis use IFQ participant survey data that contains information on participants' beliefs about lease prices as well as their personal, stated preference, valuations on quota. In addition, the survey gathered information on participant beliefs regarding the future of the quota lease and sale markets and the future of the fishery. This information is then applied to a dividend discount valuation model to determine each participant's personal quota discount rate.

Data

The data for this research came from both stated and revealed preference data. The stated preference data was collected from in-person interviews of IFQ participants residing in the Tampa Bay region. The second source of data was NMFS published priced data for the first six years of the Gulf of Mexico red snapper IFQ program.

Survey

The survey gathered information on quota market prices, personal quota valuations, expectations on the future of the fishery, and other general information on the IFQ program from all active IFQ account holders as of February 2014 residing in the Tampa Bay region. The geographic area stretched from Lecanto, FL at the northern end approximately 105 miles south to Sarasota, FL. The survey area is highlighted orange in

figure 1. The survey focused on the Tampa Bay region and not the entire gulf wide fishery to try to limit regional price variation in the data.

The survey population included fishers that own or lease in red snapper quota and fishers that did not own red snapper quota or fish for red snapper (but because they had a grouper-tilefish IFQ account) were eligible to trade red snapper quota. Interviews were conducted in March and April of 2014; 188 IFQ account holders were identified based on NMFS data, and an additional eight IFQ account holders were identified during the interview process. Of the 196 account holders, 25 indicated they had sold off their quota and were no longer active in the fishery. Of the 171 active IFQ participants available in the region 115 (67%) responded to the survey. Non responses included 45 (26%) who were unable to be reached and 11 (7%) who refused to participate. The survey questions are available from the author upon request.

Given the lack of quota sale trades the survey was designed in part to gather each participant's personal quota valuation. In addition, all surveys were completed in March and April of 2014 to limit temporal price dispersion due to changing market conditions.

All respondents were asked to provide their estimates of the current quota lease market price, quota sale price, and dockside price for red snapper in dollars per pound. The survey then asked about their quota leasing habits in an attempt to determine which participants were potential quota sellers and which were potential quota buyers. Those respondents that indicated they usually leased out some, or all, of their quota were asked what price they would be willing to sell their quota at given their estimate of the market lease price. Those respondents that indicated they usually leased in some,

or all, of their quota were asked what price they would be willing to purchase quota for given their estimate of the market lease price. Lastly, those respondents that indicated they only fished their own quota and did not lease in or out quota were asked for both the quota lease and sale prices at which they would lease in and purchase quota, respectively. This group was asked for the quota lease price they would transact at since they have not traded in the quota lease market indicating that their estimate of the market price was not a value they would trade at.

All respondents were asked a series of questions regarding their expectations about the future of the red snapper fishery and IFQ management. The first question asked respondents how much larger or smaller they expected the commercial red snapper quota to be five and ten years. The second question asked respondents how they expected the price per pound of red snapper leases, adjusted for inflation, to change in five and ten years. The objective of these two questions was to determine how respondents expected the value of a quota lease to change. All else equal, fishers that expect the commercial quota, and or the quota lease price per pound to increase will place a higher value on quota ownership. Although 115 (67%) fishers responded to the survey, only 56 (32%) fishers provided estimates of market lease prices, personal quota valuations, and expected changes in quota size and quota lease values going forward. Of these 56 observations, 40 were classified as potential buyers, 9 as potential sellers, and 7 as pure fishers.

Published Quota Prices

The average annual sale and lease prices were obtained from the NMFS 2012 Gulf of Mexico Red Snapper IFQ Annual Report (NMFS 2013). The data included average annual quota sale and lease prices.

Calculation of Implied Discount Rates

The first objective of this research was to determine if differences in quota valuation between quota lessors (potential quota sellers) and quota lessees (potential quota buyers) was leading to the preponderance of quota leasing in the red snapper fishery. Table 5-1 contains the personal quota valuation summary statistics by group (potential buyers, potential sellers, and pure fishers). Potential sellers had the highest average quota values ($43.00/lb), followed by pure fishers ($20.61/lb) and potential buyers ($20.31/lb). Difference in means testing indicated that the potential seller average quota value was higher than both potential buyer and pure fisher valuations at the 5% significance level. Although this data does indicate that quota lessors (potential sellers) place a higher value on quota it does not indicate whether they place a higher value on quota cash flows or if their estimates of the current market lease price and, or, expected growth in lease income are higher than the potential buyers and pure fishers. The remainder of this section outlines the technique used, and results of, analysis to net out the effects of differences in estimated market lease prices and expected growth in quota income.

Implied quota discount rates were calculated using the Gordon growth model (Gordon 1959). The Gordon growth model calculates the value of an asset based on the assets expected dividends, or cash flows, any expected changes in the size of those dividends going forward, and the investors required rate of return. The basic Gordon growth model is displayed in equation 4; P_0 is the price of the asset, D_1 is the amount of the next dividend to be paid, r is the discount rate, and g is the constant growth rate of expected dividends in perpetuity. For the purposes of this analysis, D_1 is the next lease payment to be received by the quota owner, g is any anticipated growth in the size of

the quota or increase in quota lease value going forward, r is the fisher's discount rate used to value the quota, and P_0 is the fisher's current value of quota.

$$P_0 = \frac{D_1}{r-g} \tag{4}$$

This analysis uses a slightly modified version of the Gordon growth model known as a non-constant growth model to account for some of the unique features of quota as an asset. The non-constant growth model allows for the use of multiple growth estimates to be used in calculating the present value of future dividends. Equation 5 displays the formula that was used in this analysis.

$$P_0 = \sum_{t=1}^{5} \left(\frac{D_0 (1+g_{qs1})^t (1+g_{lp1})^t}{(1+r)^t} \right) + \sum_{t=6}^{10} \left(\frac{D_0 (1+g_{qs1})^5 (1+g_{lp1})^5 (1+g_{qs2})^{t-5} (1+g_{lp2})^{t-5}}{(1+r)^t} \right) + \left(\frac{D_{11}/r}{(1+r)^{10}} \right)$$

$$\tag{5}$$

Survey responses were used to determine each respondents quota price (P_0), quota lease price (D_0), and growth estimates (g_{qs} and g_{lp}); these values were then used in equation 5 to determine each respondent's quota discount rate (r). For potential quota buyers and sellers, P_0 is the quota price, in dollars per pound, that the respondent said they would buy or sell quota at, respectively; given their estimate of the current market lease price (D_0) which is also in dollars per pound. For pure fishers, D_0 is the lease price that respondents said they would be willing to lease in quota at, and P_0 is the corresponding quota purchase price which would make them indifferent between purchasing a pound of quota or leasing it in at D_0.

Two different types of dividend growth are accounted for in equation 5: 1) growth in the quota size (g_{qs}) and 2) growth in the lease price of quota (g_{lp}). Growth in quota size (g_{qs}) measures the respondent's expectations of changes in the TAC. Any increase in the TAC will increase the pounds of red snapper that their quota entitles them to

since quota is measured as a percentage of the TAC. The survey and subsequent

analysis used pounds as the unit of measurement of quota because that is how IFQ

participants price and trade quota, in current quota pounds. During the first six years of

the red snapper IFQ program the TAC increased 62% (NMFS 2013) from 2,297,297

pounds to 3,712,613. Growth in the lease price of quota (g_{lp}) measures the respondent's

expectations of changes in the real dollar per pound price of quota going forward.

During the first three years of the red snapper IFQ program the inflation adjusted

average lease price increase 40% from $2.14 per pound to $3.00 per pound (measured

in 2012 dollars), and has stayed at roughly $3.00 per pound since then (NMFS 2013).

The survey asked respondents about their expectations for changes in quota size

and quota lease prices in five years and ten years. A number of respondents provided

quota size and quota lease price estimates five and ten years from now that implied

different growth rates in the two time periods. Because of this two values were used for

both quota size growth (g_{qs}) and lease price growth (g_{lp}) to account for individuals with

changing growth rates.

Those respondents that answered that they did not know how quota size or

quota lease value would change through time were assumed to not be factoring growth

into their valuations and were treated as such ($g_{qs} = g_{lp} = 0$). A number of respondents

were unwilling to provide a numeric value on how they thought the quota size and lease

price would change but were willing to say whether they thought the value would go up

or down. These respondents were assigned the median value of the numeric responses

for the growth estimate given by other respondents. For instance, among those that

thought quota size would decrease over the next five years the median value was a

20% decline (g_{qs1}= 3.7%), so respondents that indicated they expected quota size to decrease over the next five years but did not provide a number were assumed to expect a 20% decline. Median values were used to mitigate the impact of outlier growth estimates given the small sample size. Summary statistics on growth estimates from the survey are presented in table 2.

The results of the discount rate calculations are presented in table 3. Potential sellers had the lowest average discount rate (11.3%), followed by pure fishers (15.7%) and potential buyers (22.9%). The different in mean discount rates between potential sellers and potential buyers was statistically significant at the 1% level, these findings indicate that participants that lease out quota (potential sellers) place a higher value on quota cash flows than those that lease in quota (potential buyers) after accounting for differences in estimates of market lease prices and expected growth rates.
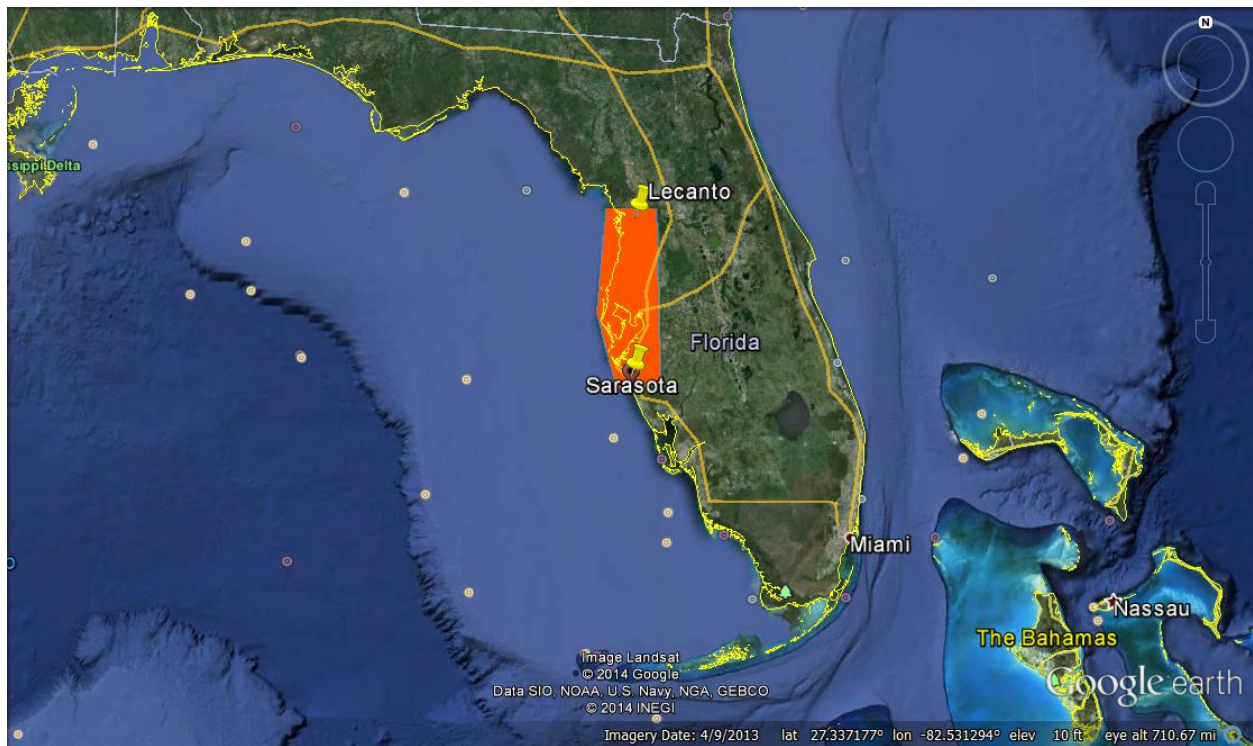
Figure 1. Survey area.

Table 1. Personal quota valuations by group

	Potential Buyers (N=40)	Potential Sellers (N=9)	Pure Fishers (N=7)
Personal Quota Value:			
Mean	$20.31	$43.00	$20.61
Median	$20.00	$35.00	$22.50
Standard Deviation	$8.98	$25.63	$10.69
Range	($5.00, $40.00)	($10.00, $100.00)	($3.50, $35.00)
Difference in Means Test	p-value		
Potential Buyer/Potential Seller	0.03		
Potential Buyer/Pure Fisher	0.95		
Potential Seller/Pure Fisher	0.04		

Table 2. Quota size and lease price growth survey results (N=56)

	Quota Size (Yrs 1-5)	Quota Size (Yrs 6-10)	Lease Price (Yrs 1-5)	Lease Price (Yrs 6-10)
No Change Expected (g=0)	21.4%	76.8%	30.4%	80.4%
Positive Growth Rate (g>0)	44.6%	5.4%	39.3%	1.8%
Negative Growth Rate(g<0)	16.1%	0.0%	14.3%	0.0%
No Expectation Given	17.9%	17.9%	16.0%	17.9%
Median Annual Increase	2.8%	1.9%	2.2%	1.5%
Median Annual Decrease	3.7%	-	2.8%	-

Table 3. Discount rate analysis results by group

	Potential Buyers (N=40)	Potential Sellers (N=9)	Pure Fishers (N=7)
Mean Discount Rate	22.9%	11.3%	15.7%
Median Discount Rate	18.1%	8.1%	11.6%
Standard Deviation	17.4%	9.2%	10.6%
Range	(6.8%, 93.7%)	(2.6%, 32.5%)	(7.7%, 33.3%)
Difference in Means Test:	p-value		
Potential Buyer/Potential Seller	0.01		
Potential Buyer/Pure Fisher	0.16		
Potential Seller/Pure Fisher	0.40		

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