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Elasticity Memo

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An Analysis of Price Response to New NMFS Quota

Introduction

In July of 2018, the National Marine Fisheries Service (NMFS) proposed a policy to increase the existing yearly quota of Atlantic bluefin tuna by nearly 18 percent (NOAA 2018b). Depending on the elasticity of demand for the fish, the increase in the quantity of Atlantic bluefin tuna in the U.S. market will decrease the price of tuna from the original price of $17,923.56 per metric ton to between $14,846.02 and $14,589.56 metric tons.

Policy Background

A shift in consumer preferences in the 1970s resulted in a significant increase in demand for Atlantic bluefin tuna, especially as it became an increasingly popular ingredient in sushi and sushi itself gained international interest. The rise in demand for Atlantic bluefin tuna contributed to overfishing, and the species is currently classified as endangered (National Geographic 2018). In an effort to prevent the fish populations in the wild from plummeting, both national and international agencies began to regulate fisheries' catch-limits to combat overfishing (National Geographic 2018).

The agency responsible for establishing fishing quotas in the U.S. is the National Marine Fisheries Service (NMFS). The goal of NMFS regulation is twofold: NMFS works to "recover protected marine species while allowing economic and recreational opportunities" (NOAA 2018a). NMFS policies are therefore a compromise between conservation and demand: the quota

must be sufficiently low to protect the fish population but also sufficiently high to ensure that the fishing industry remains profitable (NOAA 2018a).

In July of 2018, NMFS proposed a policy to adjust the existing baseline quota on Atlantic bluefin tuna. The policy will increase the existing annual baseline quota from 1,058.79 metric tons to 1,247.86 metric tons (NOAA 2018b). The proposed rule will result in an increase in the supply of Atlantic bluefin tuna in the U.S. market by 17.86 percent. This change is prompted and supported by the current presidential administration; President Trump has argued in favor of expanding the U.S. fishing industry to reduce the volume of seafood imported from international fisheries (King 2018). Fisheries and recreational fishermen, who see the quota increase as financially beneficial to the industry, broadly support the change in regulation. Opponents of the regulation include conservationists and environmentalists, who stress that the survival of the tuna species and long-term viability of the fishing industry are threatened by the administration's decision to weaken protections of the endangered species (King 2018; "US Tuna Fishing" 2018).

Methodology

The purpose of this paper is to examine how the increase in the quantity supplied will impact the price of Atlantic bluefin tuna. Subsequent calculations are made holding the following assumptions to be true: all suppliers in the market are NMFS-regulated and all fisheries and recreational fishermen will adhere to the quota. The effect that the proposed quota adjustment will have on price can be estimated by looking at the elasticity of demand for Atlantic bluefin tuna. The price elasticity of demand is equal to the percentage change in quantity over the percentage change in price:

$$E_D = \frac{\%\Delta Q}{\%\Delta P} = \frac{\frac{Q_n - Q_o}{Q_o}}{\frac{P_n - P_o}{P_o}} = \left(\frac{Q_n - Q_o}{Q_o}\right) * \left(\frac{P_o}{P_n - P_o}\right)$$

$$P_n = \left(\frac{P_o}{E_D}\right) * \left(\frac{Q_n - Q_o}{Q_o}\right) + P_o$$

Given this, the new price P_n can be calculated with the following information:

- *The original quantity,* Q_o. The original quantity is 1,058.79 metric tons of tuna, equivalent to approximately 2.33 million pounds (NOAA 2018b).[1]
- *The new quantity,* Q_n. The new quantity is 1,247.86 metric tons, equivalent to approximately 2.75 million pounds (NOAA 2018b).
- *The original price*, P_o. The original price for Atlantic bluefin tuna in the U.S. market was $15,500 per metric ton (mt.) in 2010. Adjusted for inflation, the original price in 2018-USD is $17,923.56 per metric ton (Conathan 2012, Bureau of Labor Statistics 2018).[2] This is equivalent to approximately $7.03 per pound.
- *Elasticity of demand,* E_D. Singh, Dey, and Surathkal found that the elasticity of demand for Atlantic bluefin tuna in the U.S. varies seasonally. From November through April, the elasticity of demand approximately is -0.96; from May through July, the elasticity of demand is approximately -1.03; and from August through October, the elasticity of demand is approximately -1.04 (Singh, Dey, and Surathkal 2014, 353). The average elasticity of demand over the course of the year is approximately -1.00. This means that, for a given 1 percent increase in price, the quantity of tuna demanded decreased by 0.96 percent, 1.03 percent, 1.04 percent depending on the season or 1 percent averaged across seasons. This paper will use all four elasticity estimates to show a range of price change estimates due to the increase in supply.

[1] All calculations will be made with the original and new quantities of tuna in metric tons and price per metric ton. The equivalent quantities and prices in terms of pounds are included for reference.

[2] See Appendix 1 for the expanded calculation of the original price.

Calculations

New price estimates:[3]

Estimate 1, low elasticity

$$P_n = \left(\frac{17{,}923.56}{-0.96}\right) * \left(\frac{1{,}247.86 - 1{,}058.79}{1{,}058.79}\right) + 17{,}923.56$$

$P_n = \$14{,}589.56$ per mt.

Estimate 2, mid-range elasticity

$$P_n = \left(\frac{17{,}923.56}{-1.03}\right) * \left(\frac{1{,}247.86 - 1{,}058.79}{1{,}058.79}\right) + 17{,}923.56$$

$P_n = \$14{,}816.14$ per mt.

Estimate 3, high elasticity

$$P_n = \left(\frac{17{,}923.56}{-1.04}\right) * \left(\frac{1{,}247.86 - 1{,}058.79}{1{,}058.79}\right) + 17{,}923.56$$

$P_n = \$14{,}846.02$ per mt.

Estimate 4, elasticities averaged

$$P_n = \left(\frac{17{,}923.56}{-1.00}\right) * \left(\frac{1{,}247.86 - 1{,}058.79}{1{,}058.79}\right) + 17{,}923.56$$

$P_n = \$14{,}722.92$ per mt.

Conclusion

The increase in the supply of Atlantic bluefin tuna will result in a decrease in price from $17,923.56 per metric ton to between $14,846.02 and $14,589.56 per metric ton.[4] The most accurate estimate is likely the averaged estimate: $14,722.92 per metric ton, calculated with the

[3] See Appendix 2, Table 1 for comparison.

[4] See Appendix 2, Figure 1 for illustration.

elasticity of demand equal to -1.00. Therefore, the shift in regulation should result in U.S. fishermen selling Atlantic bluefin tuna for $14,722.92 per metric ton in the U.S. market.

The NMFS establishes quotas with the intention of protecting both the financial stability of the fishing industry and promoting conservation. However, despite the increase in quantity supplied, the U.S. fisheries' revenue will decrease on account of the lower price; the original quota generated approximately $18.98 million in revenue, whereas the new quota will yield approximately $18.37 million.[5] Furthermore, the increase in quota will impede the recovery of wild tuna fish stocks and result in continued overfishing. The new NMFS quota therefore fails to achieve its goal of protecting the financial interests of U.S. fisheries and marine conservation efforts.

[5] See Appendix 1 for calculation.

Appendix 1: Additional Calculations

Original Price

One metric ton is equivalent to 2204.62 pounds. On average, Atlantic bluefin tuna for $15,500 per metric ton in the 2010 U.S. market, equivalent to approximately $7.03 per pound (Conathan 2012). Because the NMFS policy was proposed in 2018, the original price circa needed to be adjusted for inflation. According to the Bureau of Labor Statistics, $7.03 in July of 2010 is equivalent to $8.13 in July of 2018 (2018). The calculation is as follows:

$$\text{Original price in 2010 USD} = \left(\frac{\$15{,}500}{1\text{ mt.}}\right) * \left(\frac{1\text{ mt.}}{2204.62\text{ lbs.}}\right) = \$7.03\text{ per lb.}$$

$$\text{Original price in 2018 USD} = \left(\frac{\$8.13}{1\text{ lb.}}\right) * \left(\frac{2204.62\text{ lbs.}}{1\text{ mt.}}\right) = \$17{,}923.56\text{ per mt.}$$

Tuna Revenue

Assuming that price per metric ton is consistent, total revenue is calculated as follows:

$$\text{Pre} - \text{regulation revenue} = \left(\frac{\$17{,}923.56}{1\text{ mt.}}\right) * (1{,}058.79\text{ mt.}) = \$18{,}977{,}286.08$$

$$\text{Post} - \text{regulation revenue estimate} = \left(\frac{\$14{,}722.92}{1\text{mt}}\right) * (1{,}247.86\text{ mt.}) = \$18{,}372{,}142.95$$

Appendix 2: Tables & Figures

Figure 1

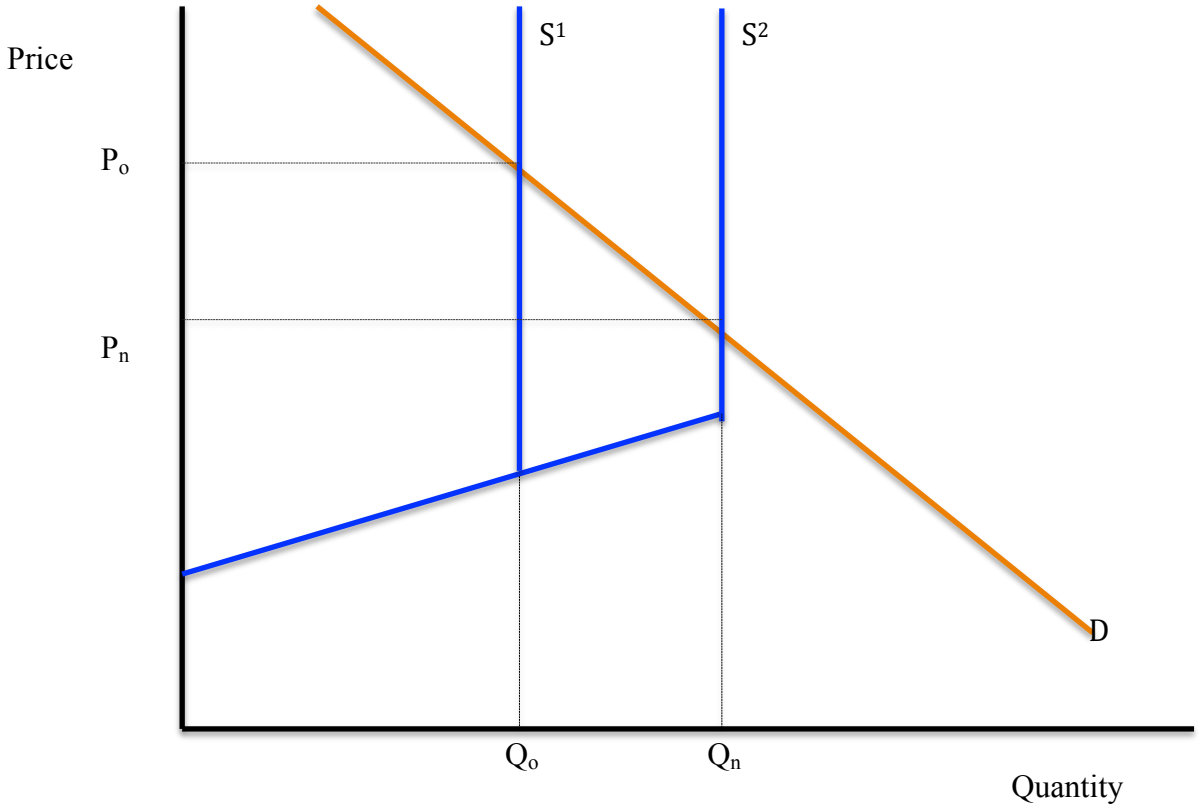

Table 1

E_D	P_n per mt.	Change in price per mt.	P_n per lb.	Change in price per lb.
-0.96	$14,589.56	- $3,334.00	$6.62	- $0.41
-1.00	$14,722.92	-$3,200.64	$6.68	$-0.35
-1.03	$14,816.14	- $3,107.42	$6.72	- $0.31
-1.04	$14,846.02	- $3,077.54	$6.73	- $0.30

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