

*Science, Service, Stewardship*



# Measuring Productivity Change in the Northeast Multispecies Fishery

**John Walden**

**Northeast Fisheries Science Center**

**Woods Hole, MA**

**NOAA  
FISHERIES  
SERVICE**

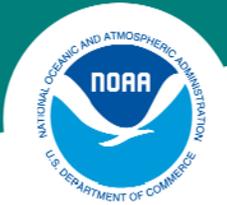


## Genesis

- Original idea was to create an “Economic Health Index” (EHI) for regional fisheries.
- Past studies have used index numbers to look at vessel performance (Norton et al. 1985, Squires 1987)
- $\pi_{it} = (P_{it} / W_{it}) * TFP_{it}$  (O’Donnell, 2008)
- $TFP_{it} = Q_{it} / X_{it}$  (i.e output index/input index)
- The Fisher Index was used to measure TFP.
- Goal was to combine private and public data to create the EHI.

# NOAA FISHERIES SERVICE





## The Multispecies fishery

- Species – cod, haddock, yellowtail flounder, pollock, American plaice, witch flounder, white hake, windowpane flounder, Atlantic halibut, winter flounder, Acadian redfish, wolfish, ocean pout, red hake, silver hake.
- Vessels also capture a variety of other species during fishing operations.
- Vessel types – Trawl, gillnet and longline gear.
- Vast Majority is landed by trawl gear.

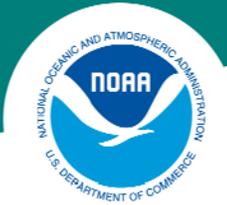


## Fisher Indices

Fisher Index is the Geometric Mean of the Laspeyres and Paasche Indices.

$$Q^L \equiv \frac{p_0' * q_1}{p_0' * q_0} \quad Q^P \equiv \frac{p_1' * q_1}{p_1' * q_0}$$

$$Q^F = (Q^L * Q^P)^{\wedge (1/2)}$$



## Data used for TFP Index.

- Output Quantity Index: Included all species caught by vessels using trawl gear on trips where one pound of groundfish was caught.
- Output Prices in each period are converted to 2005 levels using the GDP implicit price deflator.
- Inputs used in Input Quantity Index include fuel, labor and capital services.
- Problem with calculating input quantities is that the data are not available for every vessel, particularly fuel use.



## Fuel Use

Fuel – Estimated on a trip level basis using regression results based on sea sampling data.

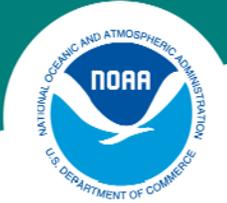
$\ln(\text{fuel used}) = \ln(\text{horsepower}) + \ln(\text{days at sea})$ .

Price for fuel was the average price paid by sea sampled vessels in constant 2005 dollars.



## Labor use

- Labor Use was taken directly from vessel logbooks and is equal to crew size times days at sea.
- For the opportunity cost of labor, the average hourly earnings for construction workers multiplied by eight was used.
- Food cost was also included since crew spends money on food for each trip.
- Average cost for food per crew day at sea was calculated, and then used to calculate food trip costs.

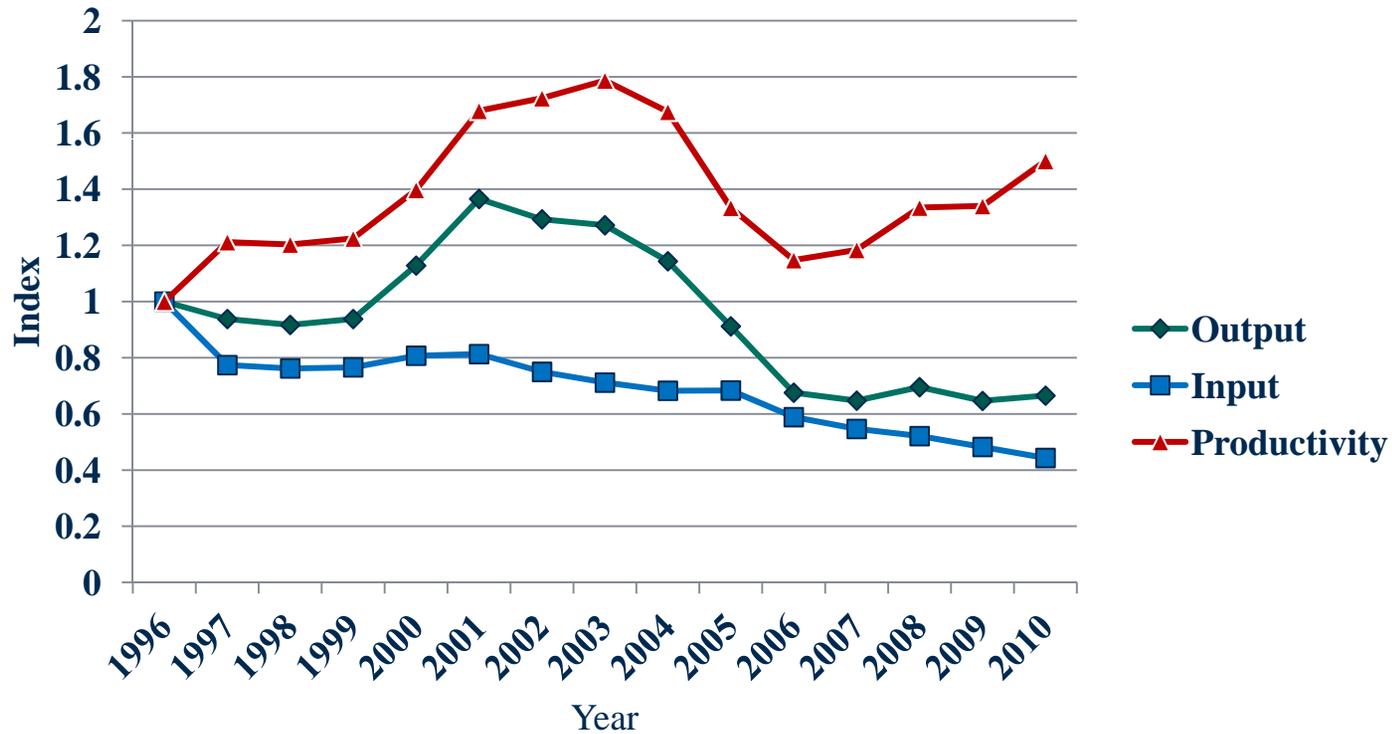


## Capital Services.

- Fishing vessel provides crew amenities, as well as fishing power so an appropriate measure of capital services is difficult to construct.
- Used the engine horsepower times days at sea as measure of capital services.
- Price of capital services is the yield for BAA rated bonds (Squires, 1987)

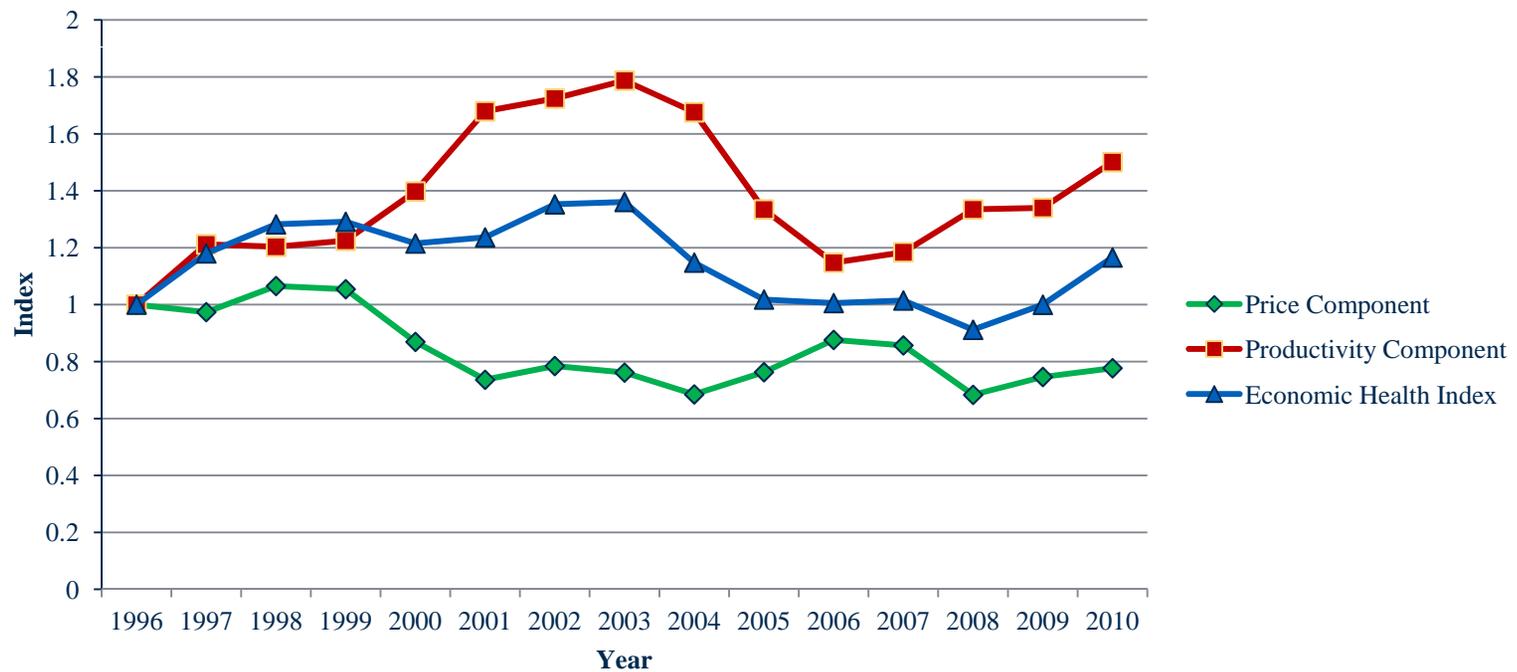


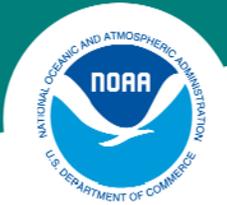
## Fisher Input and Output Quantity Index





## Components of Economic Health Index





## Conclusions

- Both publicly available data, and confidential vessel data can be used to construct the Fisher Productivity Index.
- Lack of input prices and quantities was the most difficult part of index construction to overcome.
- This index measured productivity for one component of the fishery. Need to include other sectors to complete productivity index.
- Fisher Index holds promise for fisheries with small number of vessels, as well as those with large fleets.