

Science, Service, Stewardship



*Productivity Change with ITQ's: Do
the predictions come true?*

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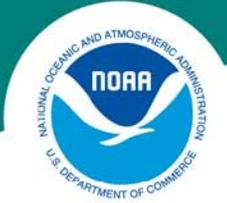
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**NOAA
FISHERIES
SERVICE**



Genesis

- Performance metrics for catch shares
- Productivity was identified as a metric under Financial Performance
 - Productivity is a measure used to explain trends in the economy.
- Malmquist index was thought to be the appropriate way to measure productivity
 - Index is easy to estimate in the absence of economic data.
 - Needed to test methods before catch shares were implemented



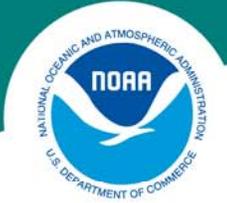
Why is Productivity Important?

$$\Pi_t = R_t / C_t$$

$$R_t \equiv p'_t y_t ; C_t = w'_t x_t$$

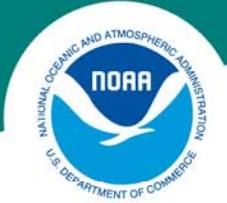
$$\Pi_{0t} = \frac{R_{0t}}{C_{0t}} = \frac{P_{0t} Y_{0t}}{W_{0t} X_{0t}} = TFP_{0t} \times \frac{P_{0t}}{W_{0t}}$$

(see O'Donnell 2009)



Catch Shares

- **Fisheries present a common pool problem, with associated externalities.**
- **There has long been a recognition of environmental problems by economists and the externalities they impose on society.**
- **Pigou (1932) and Coase (1960) proposed very different ways of dealing with externalities.**
- **Command and control has given way to a preference for market based solutions.**
- **Most economists would argue that mandated Government controls reduce productivity for the firms in question.**



Catch Shares

Market Based Mechanisms

- Generally, the economics literature has established that systems such as “cap and trade” allow a given standard to be met at a lower cost than traditional command and control systems.
- Some studies have found that firms also lowered costs under a command and control system.
 - California Oil refineries.



Cap and Trade

**..”From a theoretical point of view, the method of controlling total catch through a total quota or total allowable catch, allocated among fishermen as individual transferable quotas (ITQ’s) is preferred as most likely to promote economic efficiency.”
(Wesney, 1989)**

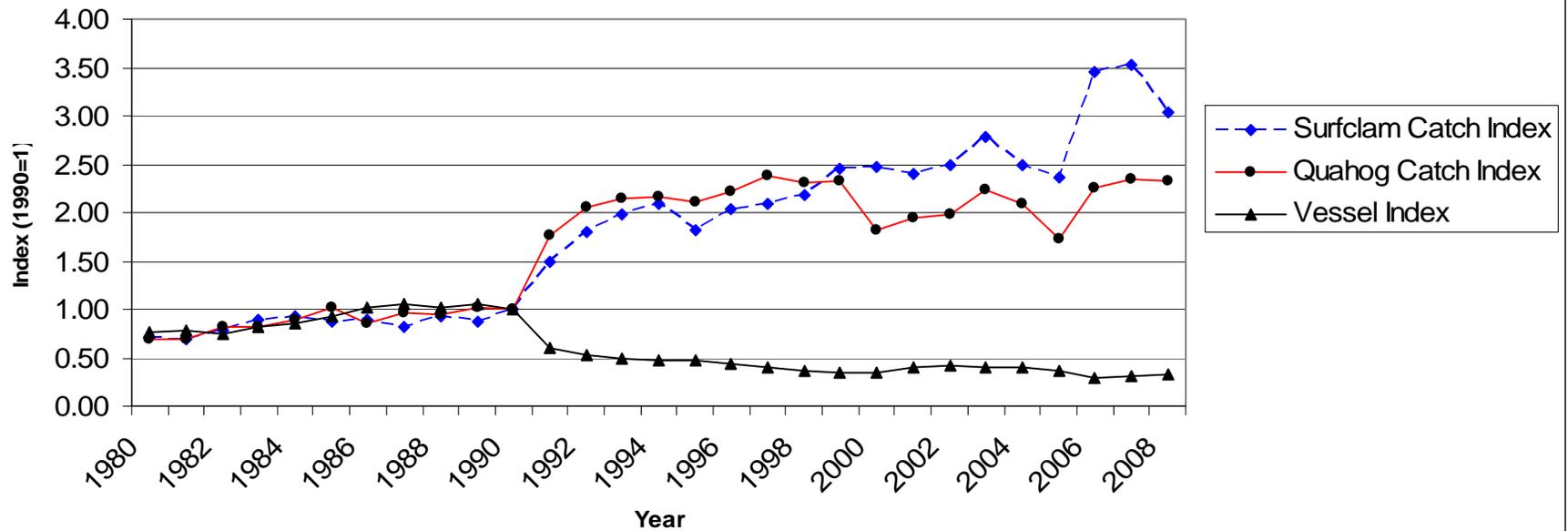


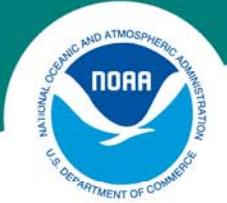
The Mid-Atlantic Surfclam and Ocean Quahog ITQ Fishery

- ITQ fishery since 1990.
- Previously was under a “command and control” management system where time at sea was regulated.
- Previous studies have shown an increase in productivity immediately after the implementation of the ITQ system.



Vessel Catch and Vessel Index (1990=1)





Vessel productivity

- Earlier studies of the SC/OQ ITQ fishery showed an initial gain in vessel productivity immediately after implementation of the ITQ system (Weninger, Brandt).
- No studies have examined whether those productivity gains had been sustained.
- Want to examine productivity change and also changes in efficiency and technical change.



Malmquist Index

One nice feature of the Malmquist Index is that it can be decomposed into different components. We decompose the index into an efficiency change component, scale change component and technical change component:

$$Mo = ECv * SC * TCc$$



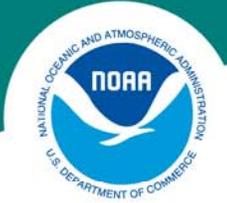
Technical Change

$$TC = IBTC * OBTC * MA$$

Input Biased Technical Change = reflects the ability to decrease inputs, rather than increase outputs.

Output Biased Technical Change = reflects the ability to increase outputs, rather than decrease inputs.

Magnitude = reflects a pure shift in the production frontier.

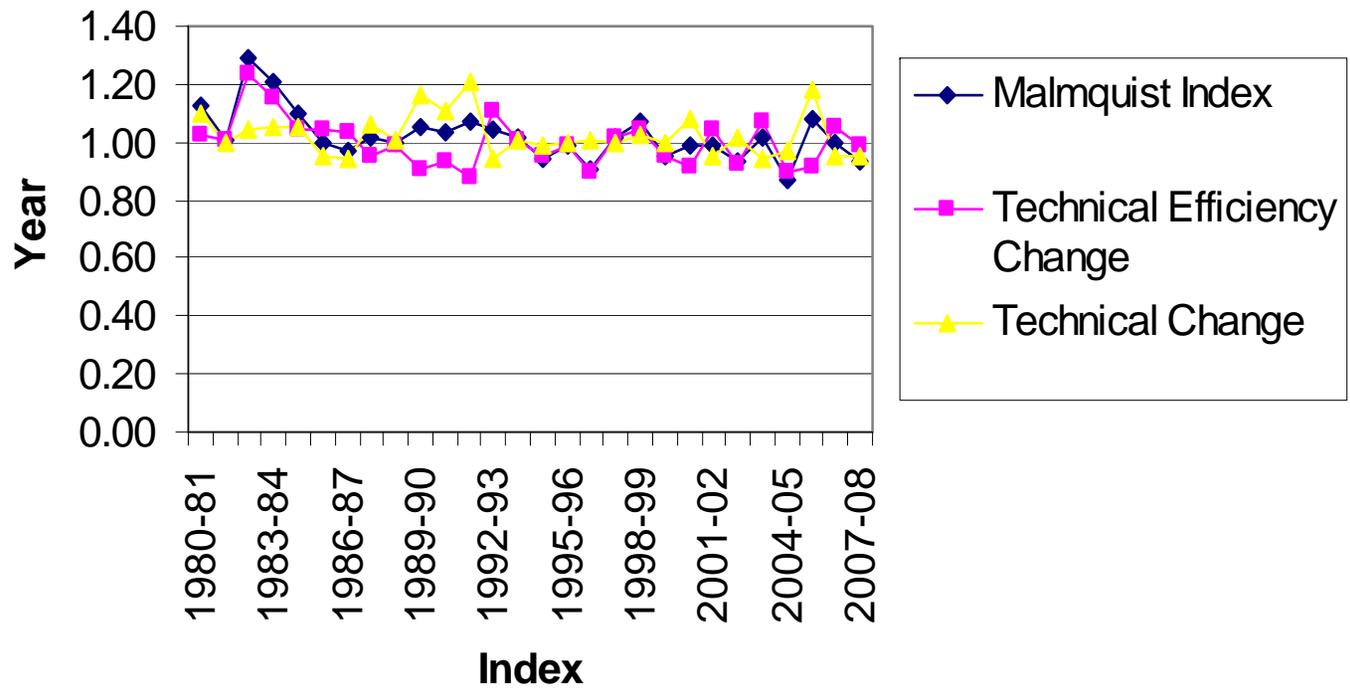


Calculation of Distance Functions

- Data Envelopment Analysis was Used
- Cross-period distance function calculations meant that vessels had to appear in consecutive years.
- Estimated Output oriented distance functions.
- Time period 1980-2008
- Inputs: Vessel Length, gross tonnage, horsepower, time at sea, surfclam biomass, ocean quahog biomass.
- Outputs: Bushels of Surfclams and Ocean Quahogs.

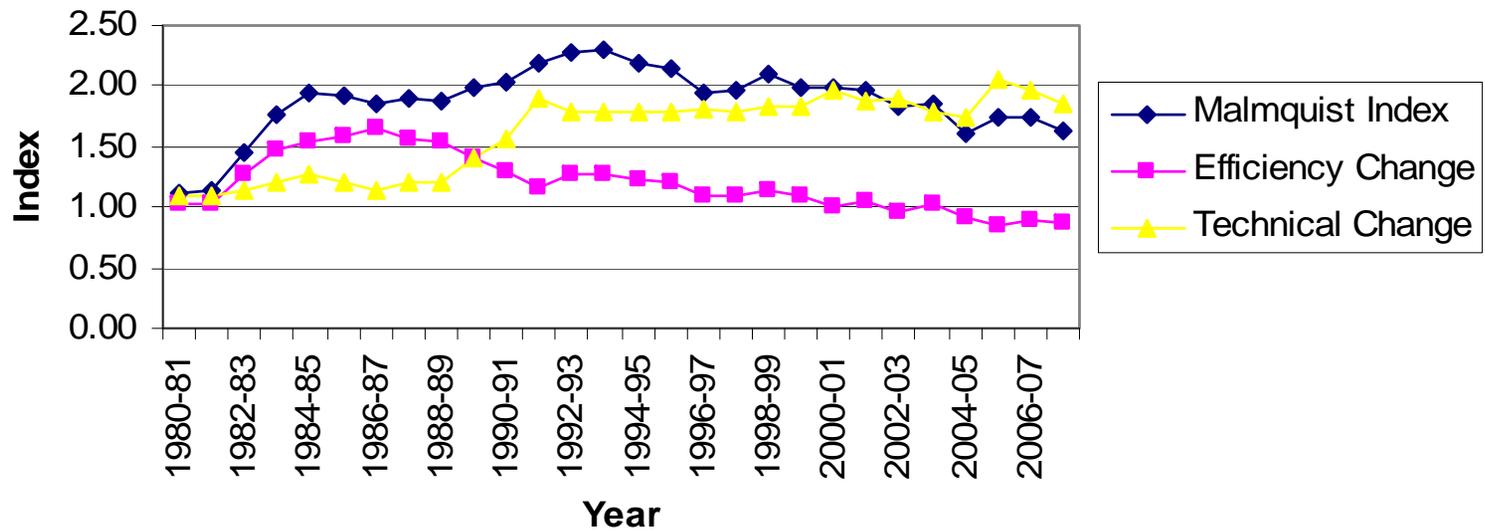


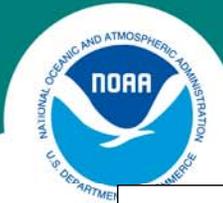
Malmquist Index, Technical Efficiency Change and Technical Change 1980-2008



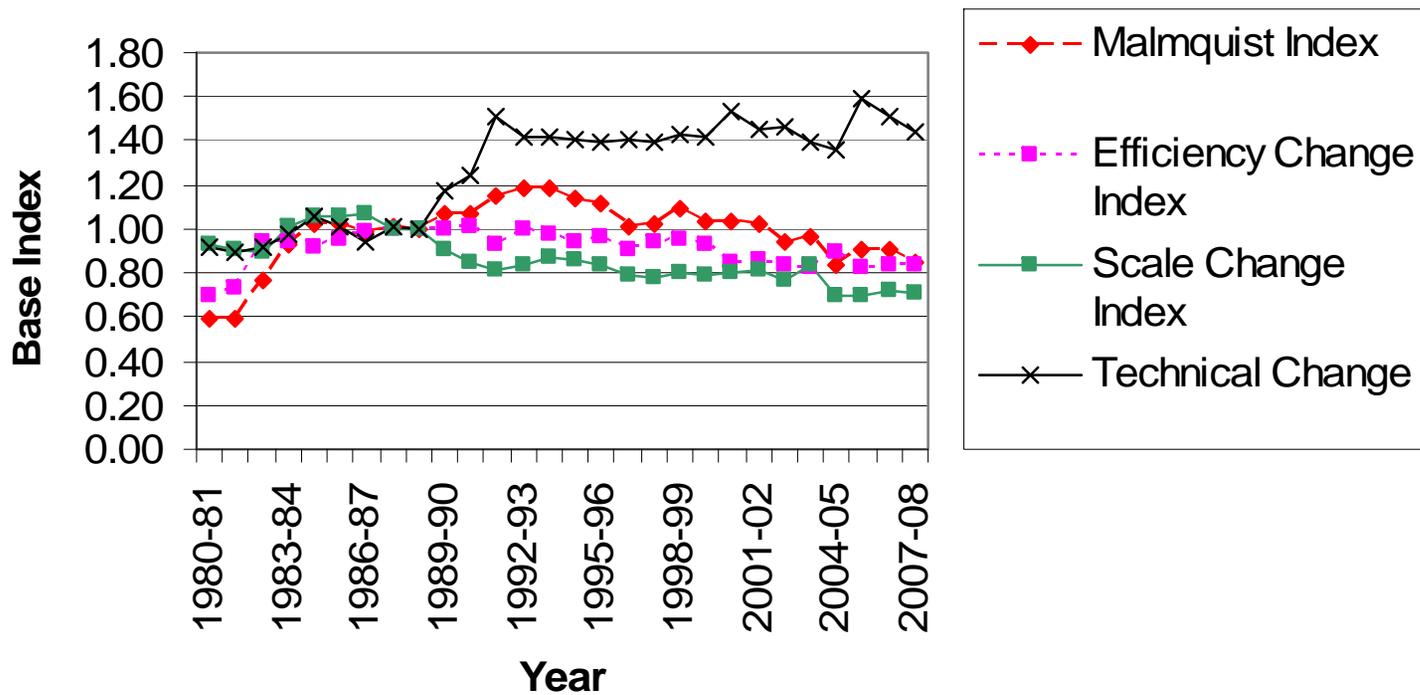


Chain Index (1980 base), Malmquist Index, Technical Efficiency and Technical Change



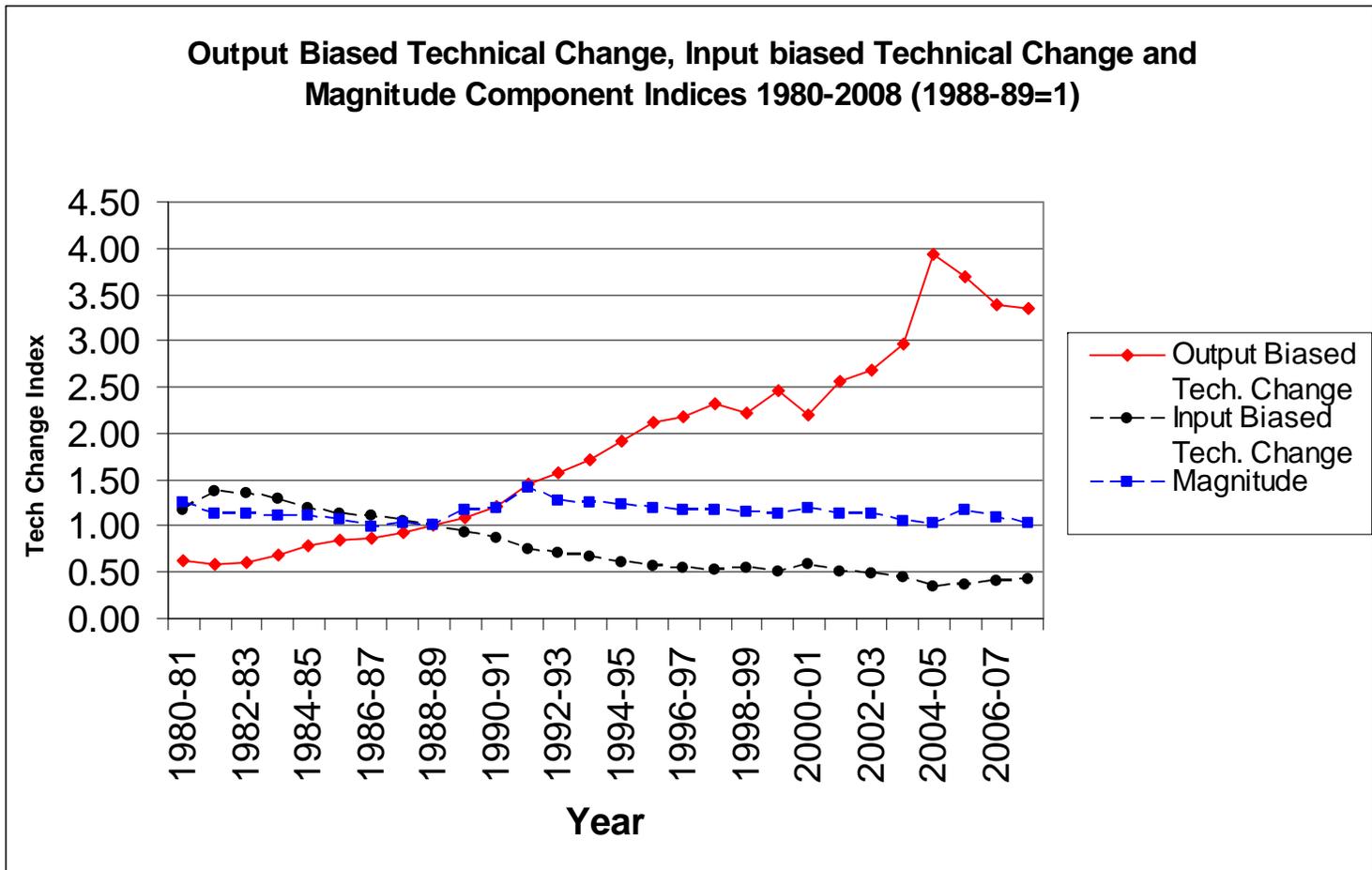


Malmquist, Efficiency Change, Scale Change and Technical Change Indices 1980-2008 (1988-89=1)



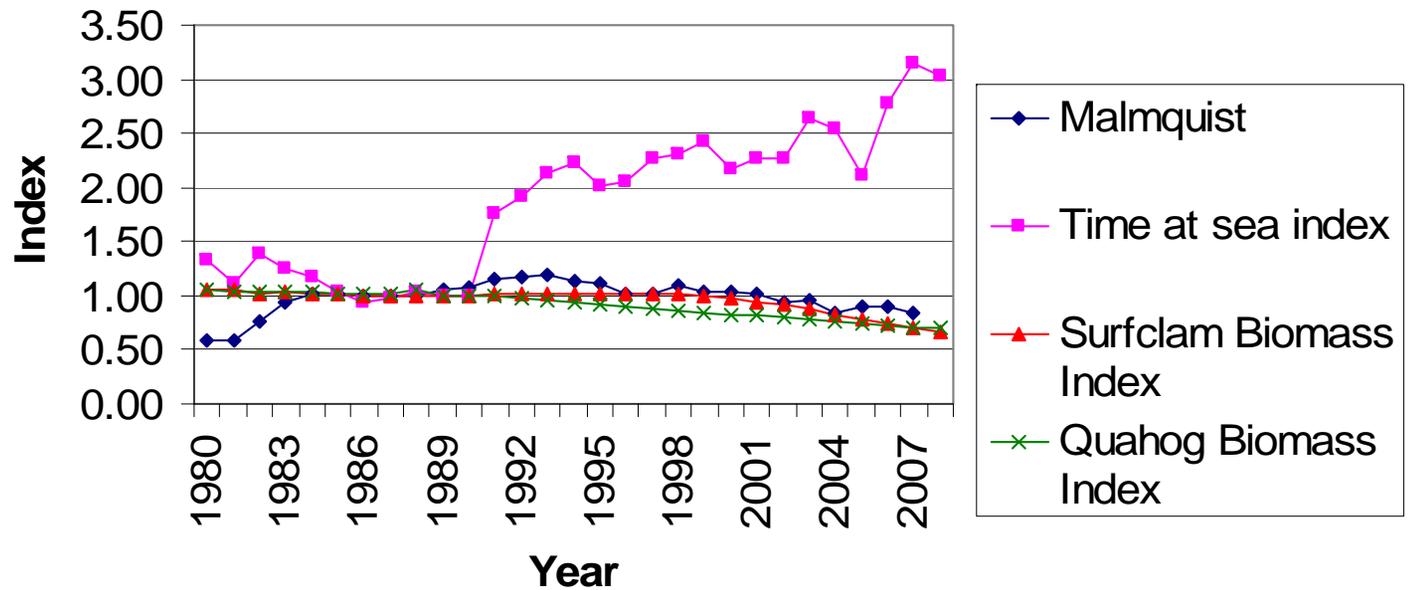


Output Biased Technical Change, Input biased Technical Change and Magnitude Component Indices 1980-2008 (1988-89=1)



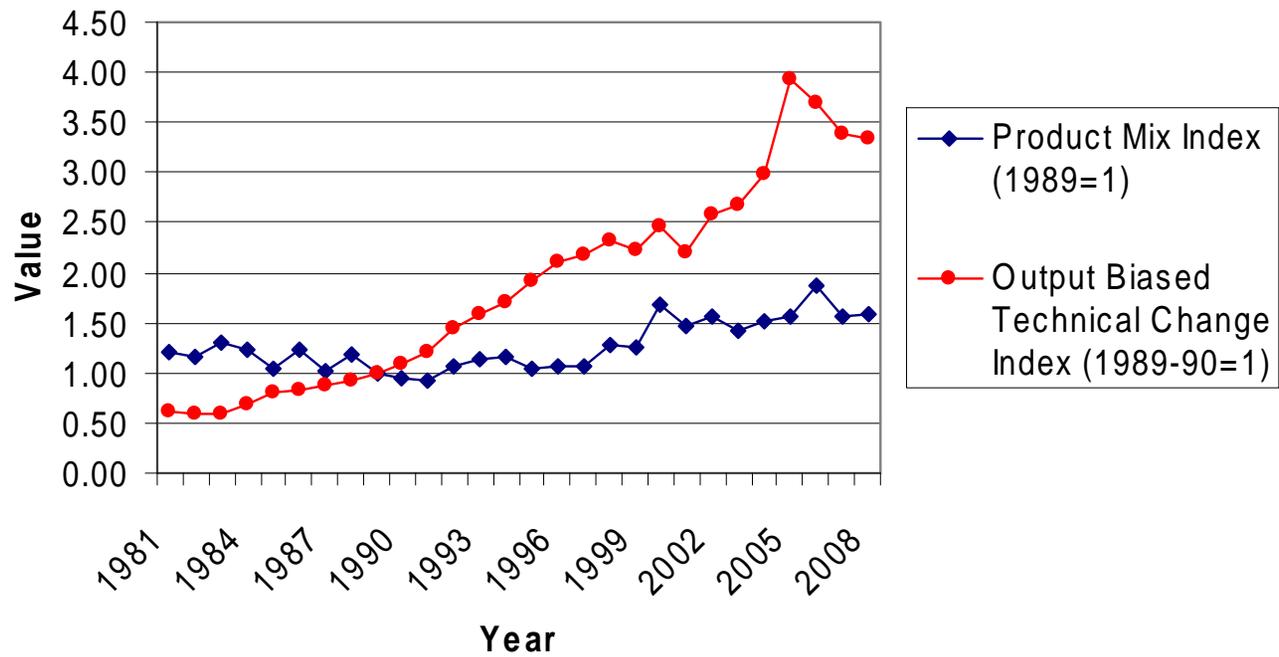


Malmquist Index, Time at Sea Index, Surfclam Biomass Index and Quahog Biomass Index (Base Year=1989)





Product Mix Index and Output Biased Technical Change Index 1980-2008





Why aren't we seeing gains in productivity?

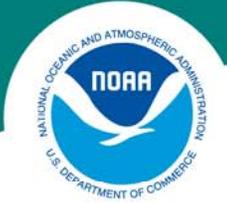
Possible reasons:

- The institutional setting. For example, more vertical integration of the firms.**
- Shifting of the available resource stock.**
- Increasing fuel costs**
- Shift in production to surfclams and away from quahogs**
- An ITQ is not a complete property right, and we never totally internalize externalities.**



Policy Implications

- **After implementation of the ITQ system, there was an initial gain in productivity. However, since then productivity has been slowly declining. Is this consistent with the rationale for ITQ's?**
- **There is no evidence for increased efficiency at the vessel level with the adoption of the ITQ regime. Less vessels does not mean increased efficiency, only less vessels.**
- **Results may be due to the market structure, the incomplete nature of the property right, or some unknown factor. Do we need to better understand the market structure before implementing ITQ's?**
- **Do the vessels need to be more productive?? Does this depend on market structure?**



Final Question??

Policy Paradox: The Art of Political Decision Making
(Stone, 1997, Chapter2)

Five concepts that dominate the language of policy discourse: Equity, Efficiency, Security, Liberty and Community.

If ITQ's don't deliver on the promise of efficiency then should we pursue ITQ's (or catch shares) as a policy??