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## **Measuring boat level efficiency in Commonwealth Fisheries**

An example using the Commonwealth Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery

Green

Contributed presentation at the 60th AARES Annual Conference,  
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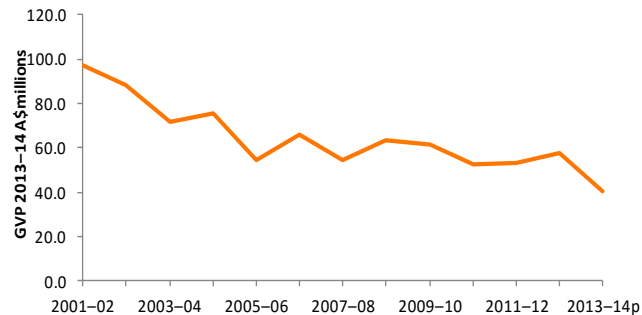
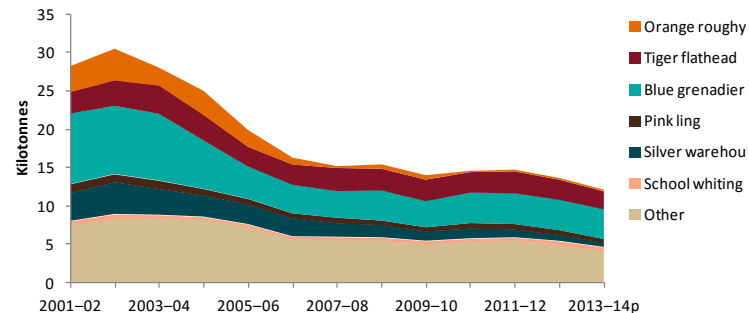
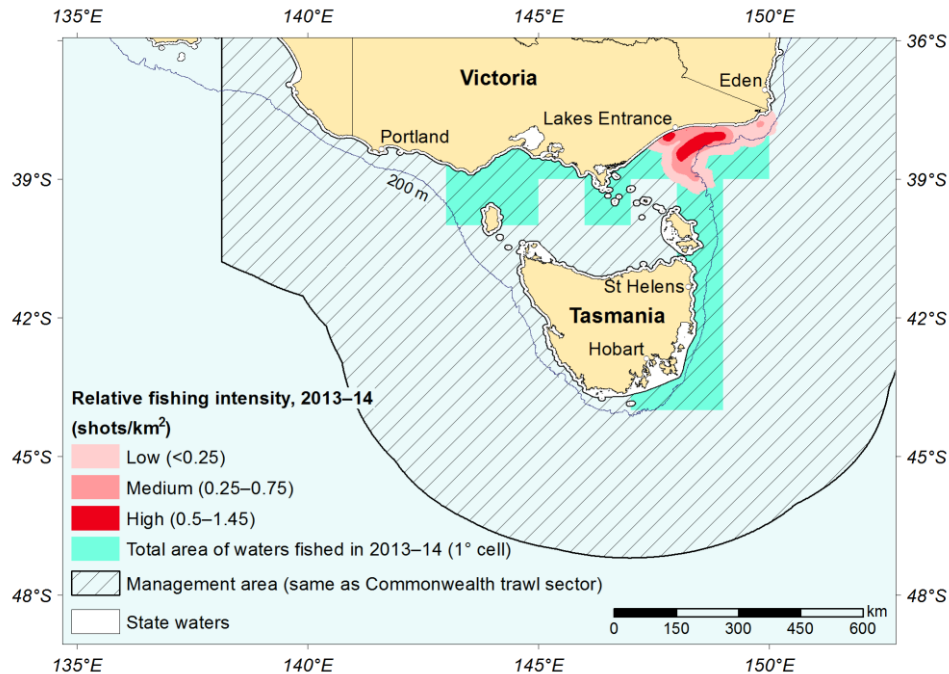
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# Measuring boat level efficiency in Commonwealth Fisheries

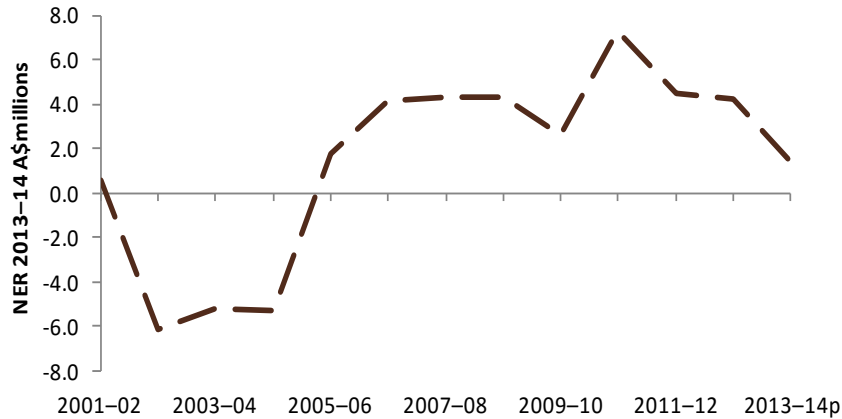
An example using the Commonwealth Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery



# The Commonwealth Trawl Sector



# The management objective



Managers responsible for economic returns, but need to distinguish between:

- Effects of management (spatial closures, structural adjustment, quota regimes, gear restrictions)
- Effects of fisher's activities and characteristics (efficiency)
- Effects from other factors (seasonal conditions)

Stochastic frontier analysis has the potential to do this

# Data

- AFMA logbook and registration data
  - Landed catch per species
  - Effort (days fished)
  - Other variables for future work
- ABARES survey data
  - Inputs (fuel, labour)
  - Other characteristics



Unbalanced panel data set

- 188 observations of 45 vessels
- Tenure in survey between 1 and 11 years, average of 4

Includes both trawl boats (the majority) and Danish seine vessels, as well as factory vessels

# Translog model

## Inputs

- Quantity of fuel
- Quantity of labour
- Total days fished (use of boat capital)

## Shifters

- Year proxies
- Factory vessel proxy

## Determinants of technical inefficiency

- Total boat capital



## Output

- Fisher index of catch, using single market prices for each year as weights

# Results



# Unrestricted model

Dependent variable - ln(Fisher EKS output index)					
	coefficient	standard-error	t-ratio	p-value	
constant	-6.3058	0.6723	-9.3802	0.0000	***
ln(fuel)	-0.4000	0.3960	-1.0099	0.3126	
ln(labour)	0.2865	0.3359	0.8529	0.3937	
ln(days fished)	2.2783	0.2405	9.4750	0.0000	***
ln(fuel)^2	-0.1052	0.0810	-1.2984	0.1942	
ln(fuel) * ln(labour)	0.3160	0.0679	4.6527	0.0000	***
ln(fuel) * ln(days fished)	-0.1385	0.0503	-2.7553	0.0059	**
ln(labour)^2	-0.5973	0.0512	-11.6610	0.0000	***
ln(labour) * ln(days fished)	0.3362	0.0487	6.9007	0.0000	***
ln(days fished)^2	-0.6361	0.1123	-5.6666	0.0000	***
Year = 2004	0.0830	0.0222	3.7422	0.0002	***
Year = 2005	0.1927	0.0131	14.7500	0.0000	***
Year = 2006	0.0967	0.0497	1.9471	0.0515	.
Year = 2007	0.2974	0.0099	29.9720	0.0000	***
Year = 2008	0.3996	0.0603	6.6283	0.0000	***
Year = 2009	0.7320	0.0907	8.0742	0.0000	***
Year = 2010	0.3165	0.0414	7.6496	0.0000	***
Year = 2011	0.1944	0.0252	7.7143	0.0000	***
Year = 2012	0.3683	0.0249	14.8170	0.0000	***
Year = 2013	0.2800	0.0294	9.5279	0.0000	***
factory vessel proxy	2.6875	0.1210	22.2140	0.0000	***
Delta^2	0.3671	0.0482	7.6206	0.0000	***
γ	1.0000	0.0000	152e <sup>5</sup>	0.0000	***
Technical inefficiency					
	coefficient	standard-error	t-ratio	p-value	
intercept	11.9750	1.0838	11.0500	0.0000	***
ln(total boat capital)	-0.8608	0.0794	-10.8380	0.0000	***
mean technical efficiency 0.67					

# Model with imposed monotonicity

Dependent variable - ln(Fisher EKS output index)

adjusted coefficients

difference

difference

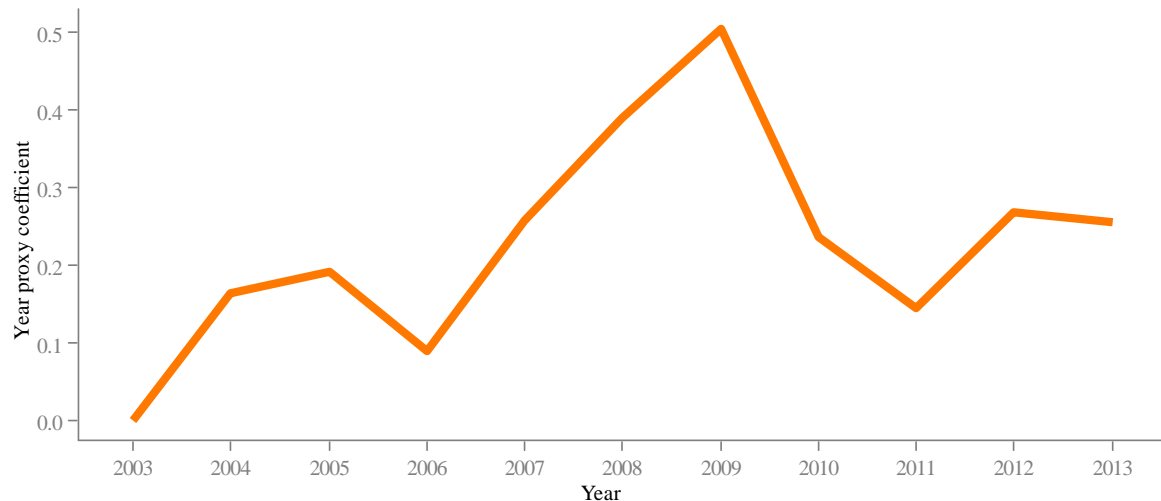
/standard error

constant	-9.5985	-3.2927	-4.8977		
ln(fuel)	0.9131	1.3131	3.3159		
ln(labour)	1.7224	1.4359	4.2748		
ln(days fished)	0.3467	-1.9316	-8.0316		
ln(fuel)^2	-0.1186	-0.0134	-0.1654		
ln(fuel) * ln(labour)	0.0122	-0.3038	-4.4742		
ln(fuel) * ln(days fished)	0.0061	0.1446	2.8748		
ln(labour)^2	-0.2124	0.3849	7.5176		
ln(labour) * ln(days fished)	-0.0390	-0.3752	-7.7043		
ln(days fished)^2	-0.0226	0.6135	5.4630		
Year = 2004	0.1644	0.0814	3.6667		
Year = 2005	0.1924	-0.0003	-0.0229		
Year = 2006	0.0893	-0.0074	-0.1489		
Year = 2007	0.2573	-0.0401	-4.0505		
Year = 2008	0.3900	-0.0096	-0.1592		
Year = 2009	0.5045	-0.2275	-2.5083		
Year = 2010	0.2361	-0.0804	-1.9420		
Year = 2011	0.1441	-0.0503	-1.9960		
Year = 2012	0.2675	-0.1008	-4.0482		
Year = 2013	0.2558	-0.0242	-0.8231		
factory vessel proxy	1.8195	-0.868	-7.1736	t-ratio	p-value
Delta^2	0.4504	0.0833	1.7282	5.0971	0.0000 ***
γ	1.0000	0	na	2263.9711	0.0000 ***

Technical inefficiency

	coefficient	difference	t-ratio	p-value	
constant	10.5738	-1.4012	7.1574	0.0000	***
total boat capital	-0.7524	0.1084	-7.1387	0.0000	***

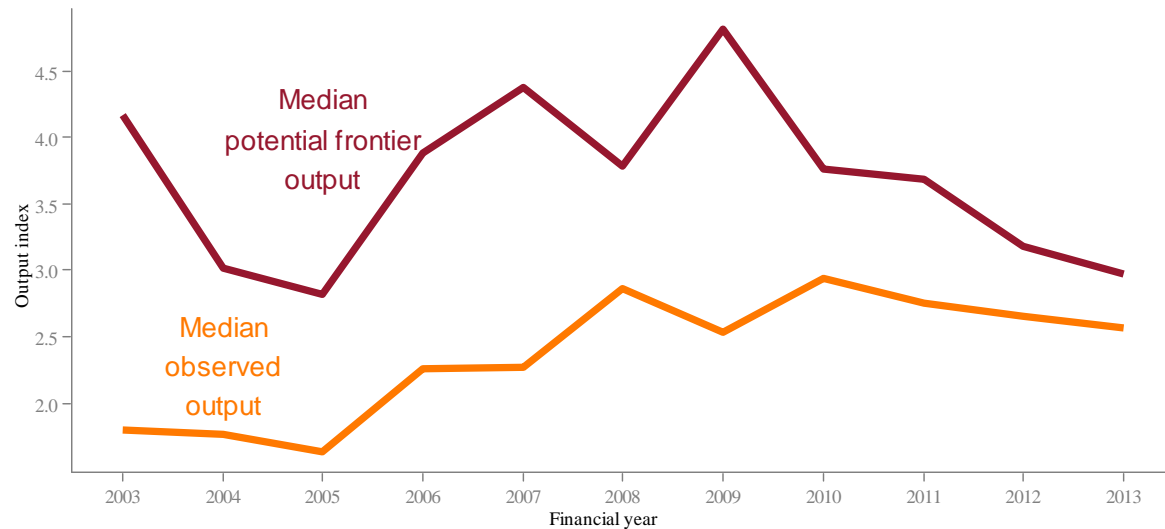
mean technical efficiency (restricted) 0.63



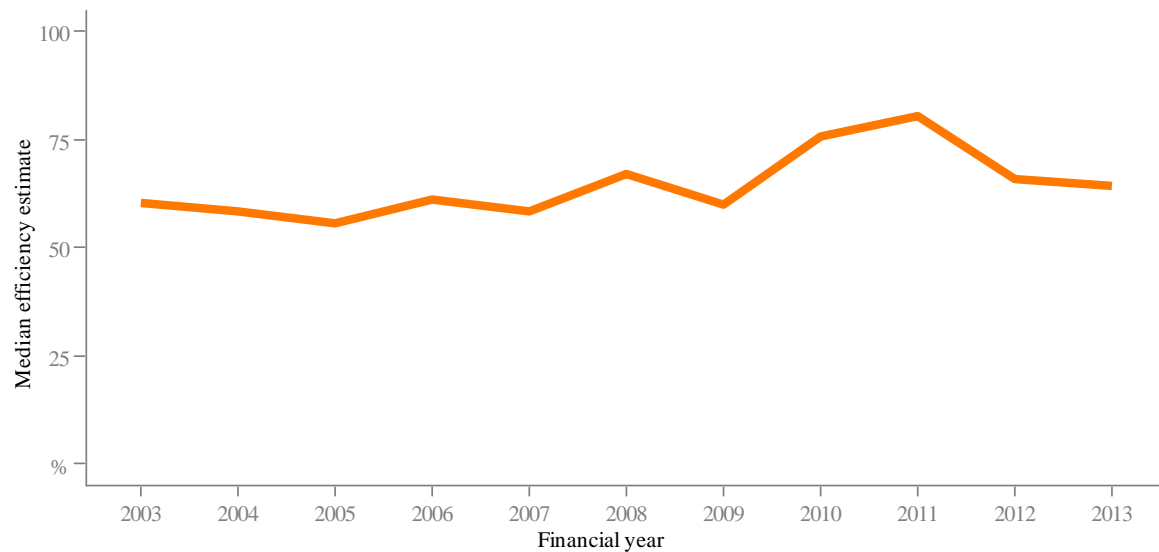
Year proxies  
are  
important

The contribution of  
the year proxy  
changes over time,  
but seems to be  
increasing

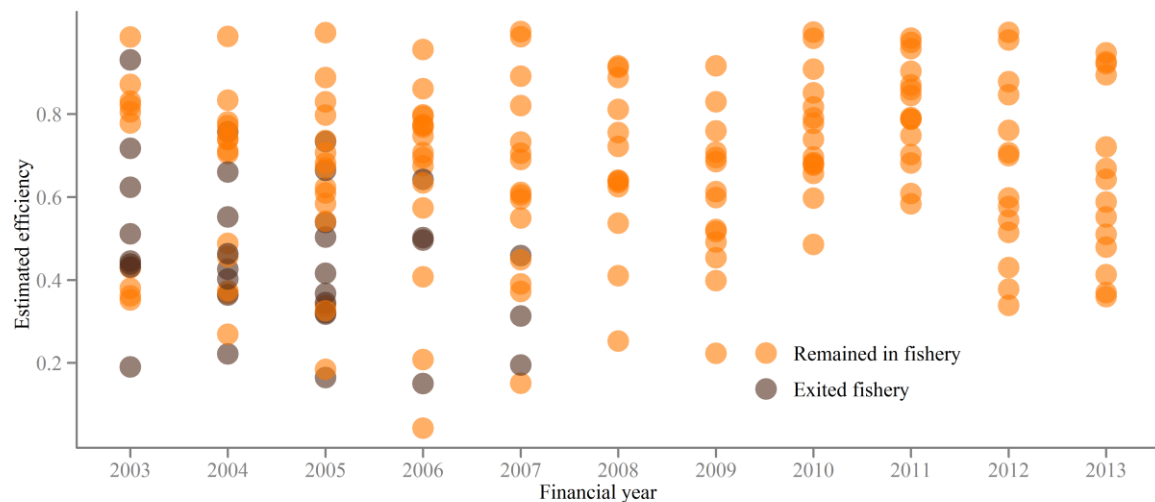
# Median frontier and observed output



# Median efficiency estimates over time



# Structural adjustment



mean efficiency estimate (restricted model)			
exiting boats			0.48
remaining boats (<2007 only)			0.65
Welch two sample t-test - alternative hypothesis that difference in mean is less than 0			
t-value	degrees of freedom	p-value	lower bound difference at 95 percent confidence interval
-3.738	69.531	0.0002	-0.0937

# Next steps

## Improvements to be useful to managers

- New variables to distinguish between year effects
  - Management changes
  - Stock availability
  - These may resolve some of the year proxy issues
- More determinants of inefficiency
  - Skipper characteristics
  - Vessel characteristics

## Things to consider

- Complications of using SFA at a boat, rather than firm, level, where some technology is fixed
- Negative coefficients for fuel use are found in most model specifications.
- Incorporating different technologies (trawl and Danish seine in the CTS, but a problem in other fisheries) in a single frontier because of sparse data



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