Diversification, Efficiency and Productivity in Catch Share Fisheries

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DIVERSIFICATION, EFFICIENCY, AND PRODUCTIVITY IN CATCH SHARE FISHERIES

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Introduction

Fishing is a risky endeavor.

Fishermen's livelihood face high income variability driven by a combination of biological/ecological, economic, good/bad fortunte, management, and climatic factors.

As with other extractive industries such as agriculture, fishermen may resort to diversification as a means to reduce revenue variability by spreading their fishing activity across fisheries and/or fishing grounds.

Income diversification and risk for fishermen
Stephen Kasperski and Daniel S. Holland
nature COMMUNICATIONS
ARTICLE
Received 25 Apr 2016 | Accepted 22 Nov 2016 | Published 16 Jan 2017
Fisheries portfolio diversificatio
buffer Alaskan fishing commun
resource and market changes
Timothy J. Cline, Daniel E. Schindler & Ray Hilborn
Ocean & Coastal Management 88 (2014) 21–30
Contents lists available at ScienceDirect
ELSEVIER
Metrics to monitor the status of fis
of the state retrospective 1980–20
Suresh Andrew Sethi, William Riggs
ARTICLE INFO
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DOI: 10.1111/1365-2664.13058
RESEARCH ARTICLE
Journal of Applied Ecology
Effects of increased specialization on revenue of Alaskan
salmon fishers over four decades
Eric J. Ward | Sean C. Anderson
Milo D. Adkison | Anne H. Beaudreau
Alan C. Haynie | Benjamin C. Williams
Abstract
PNAS
Impact of catch shares on diversification of fishers' income and risk
Daniel S. Holland, Cameron Speir, Juan Agar, Scott Crosson, Geret DePiper, Stephen Kasperski, Andrew W. Kitts, and Larry Perruso
Significance

RECENT WORK ON FISHERIES DIVERSIFICATION

Author	Fishery	Findings
Kasperski & Holland (2013)	US West Coast & Alaskan fisheries	Specialization rose in last 30 yrs. Diversification reduces rev. CV
Sethi et al (2014)	AK fishing communities	Communities with larger and/or more diversified portfolios have lower rev. variability.
Cline et al (2017)	AK fishing communities	85% communities had large rev declines following oceanographic regime and market shifts; however, diversified communities saw smaller changes in revenue and had greater opportunities to adapt to changes.
Anderson et al (2017)	AK fisheries	Specialization rose in last 34 yrs. Permits that fish variety of species lowers rev. volatility, and adding a permits increases revenues and decreases volatility.
Ward et al (2017)	AK Salmon fisheries	Specialization rose in last 34 yrs. Mean revenue rose w/specialization
Holland et al (2017)	US “Catch Share” fisheries	Specialization rose post-CS Mixed change rev CV post-CS

RESEARCH QUESTION

This study investigates the relationship between diversification, efficiency and productivity following the adoption of catch shares.

Because catch shares afford fishing vessels greater flexibility to harvest, process, and market their catch, it is useful to understand whether the technology lends itself to diversification (or specialization), which in turn can influence the potential for efficiency and productivity gains.

FISHERY BACKGROUND

In 2016, 430 vessels landed 6.1 mp of red snapper valued at $28 m. dockside.

Resource shared with recreational sector (49% of TAC)

Multispecies, multi-gear fishery.

Federal management history:

- <u>Command and control era (1984-2007)</u>
- <u>IFQ era (2007-present)</u>: Amendment # 26

COMMAND AND CONTROL ERA

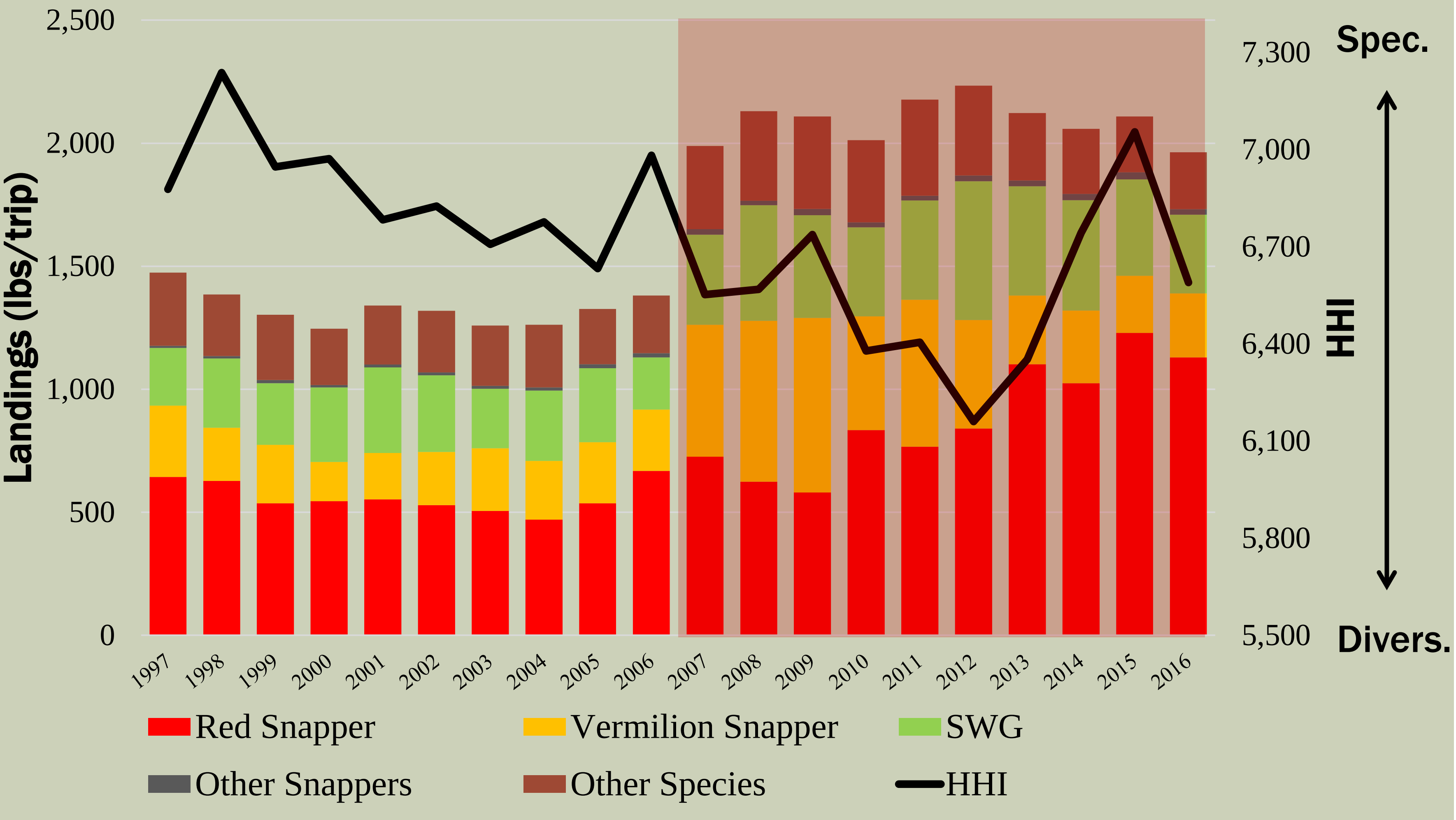
Regulations

1984: Minimum size
1990: Annual quotas
1992: Limited access
1993: Trip limits
1996: Spring and fall quotas
1998: Class 1 and 2 permits
1999: 10/15 day fishing seasons

Outcomes

Derby fishing (short seasons, congestion, market gluts)
Overcapacity
Quota overages
High discard rates
Over-exploitation
Unsafe fishing conditions

CATCH COMPOSITION OVER TIME

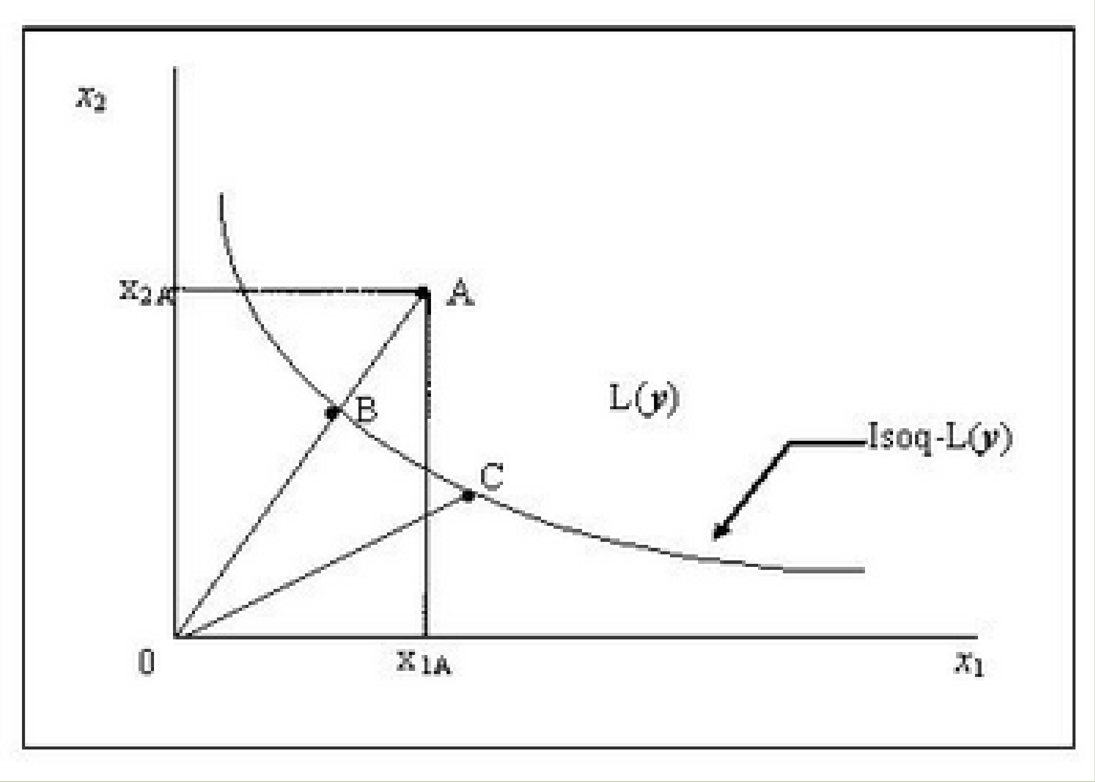


FRAMEWORK

Traditionally, measurements of ‘economies of scope’ are derived from cost functions. However cost data in fisheries is not readily available.

Hence, we resort to an input-oriented distance function (IDF). The input orientation assesses the proportional reduction in all inputs that would bring a fishing vessel to the frontier isoquant.

FRAMEWORK



The value of the Distance Function is ρ = 0A/0B

TE = $1/d_i(x,q)$=0B/0A

DATA

- **Analysis period: 1997-2016 (10 yrs. command & control *vs.* 10 yrs. IFQ)**
- **Sources: Coastal fisheries logbook, dealer reports and PIMS**
- **Sample included 1,255 vertical line vessels that landed at least 1 lb. of red snapper/year (N=12,717 quarterly vessel-level observations).**

INPUT STOCHASTIC DISTANCE FUNCTION

$$-\ln x_{1i} = \alpha_0 + \sum_{m}^{M} \alpha_m \ln y_{mi} + 0.5 \sum_{m_1}^{M} \sum_{m_2}^{M} \beta_m \ln y_{m_1 i} \ln y_{m_2 i} + \sum_{n}^{N-1} \beta_n \ln\left(\frac{x_{ni}}{x_1 i}\right) +$$

$$0.5 \sum_{n_1}^{N-1} \sum_{n_2}^{N-1} \beta_n \ln\left(\frac{x_{n_1 i}}{x_{1i}}\right) \ln\left(\frac{x_{n_2 i}}{x_{1i}}\right) + \sum_{n}^{N-1} \sum_{m}^{M} \delta_{nm} \ln \frac{x_{ni}}{x_{1i}} \ln y_{mi} + \sum_{s}^{S} \omega_s d_s + v_i - u_i$$

v_i is a random variable reflecting noise and other stochastic shocks, and u_i captures the TE relative to the stochastic frontier.

TECHNICAL INEFFICIENCY (TI) MODEL (CAUDILL ET AL 1995)

Caudill et al. (1995) proposed a framework to analyze the extent to which certain variables influence the inefficiency term u_i. They developed a model in which the determinants of inefficiency are evaluated using a multiplicative heteroscedasticity framework.

$$\sigma_{ui} = \sigma_u \exp(Z_{mi}; \alpha)$$

where Z_{mi} is a vector of management interventions (IFQ) and fishing practices (catch diversification, namely HHI and Berger-Parker index)

MODEL

- TL Input-oriented SDF (ISDF) estimate with ML
- Outputs (5, y_i): red snapper, vermilion snapper, shallow water snappers, other snappers, and miscellaneous species
- Inputs (3, x_i): days away, crew size, and vessel length
- Other variables: Red and vermilion snapper biomass, ENSO index, time trends (t and t^2 for technical change) and quarter and area dummies
- TI equation: *f*(IFQ, HHI, B-P)

RESULTS

Impact on production

- Red & vermilion abundances (SS, +)
- ENSO index (NSS)
- Area and quarter dummies (SS; LA(+), FL (-), Lenten (+))

$\gamma = \sigma_u^2/(\sigma_v^2+\sigma_u^2)$=>0.54*** Reject that TI does not exist (frontier is better than regular production function)

$\lambda=(\sigma_u/\sigma_v)$=1.1*** => implies existence of SDF and skill (efficiency) is more important than randomness explaining landing differences

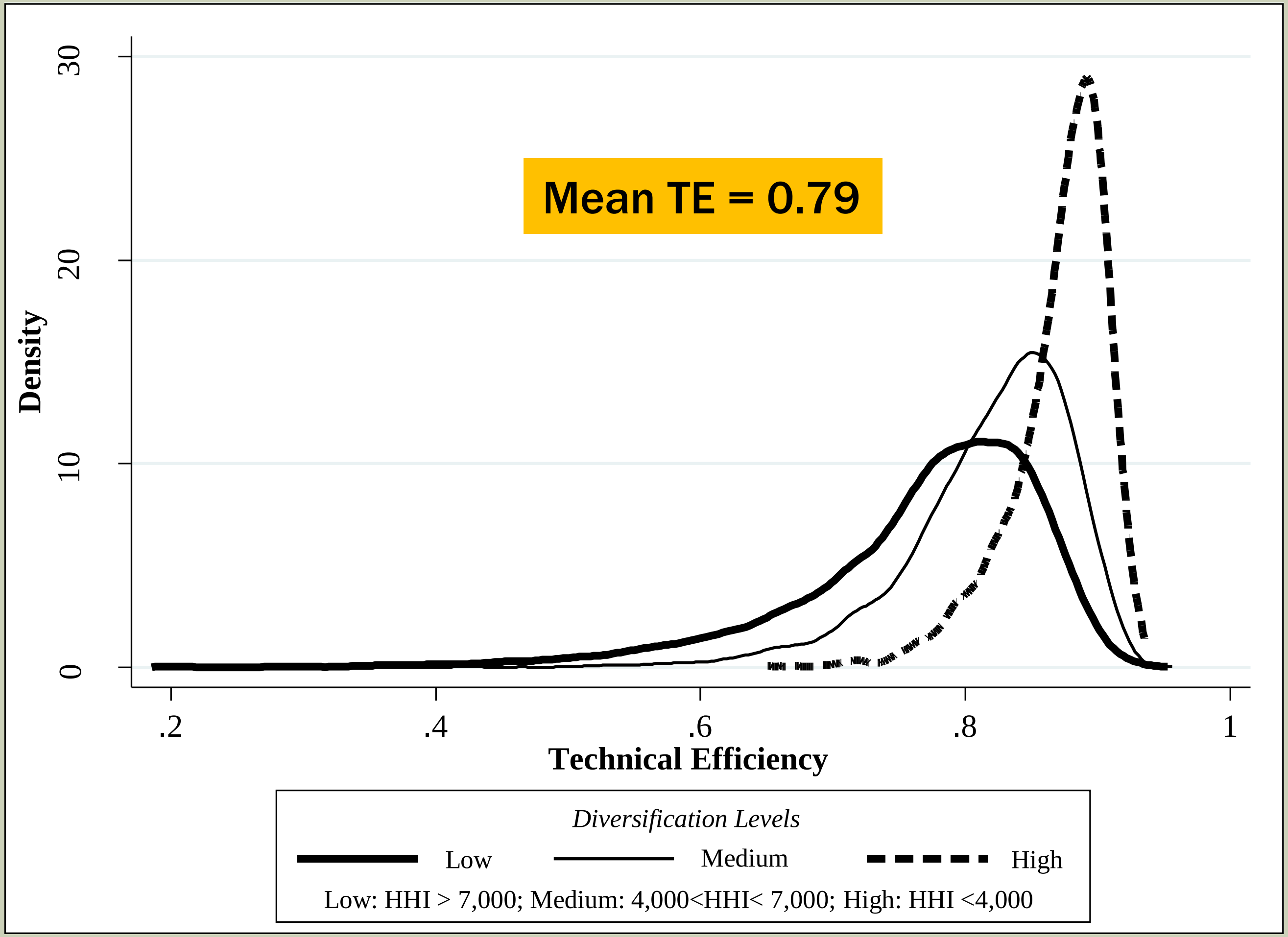
TI model = HHI(+), B-P (+), IFQ(-)   All SS.

DIVERSIFICATION ELASTICITIES

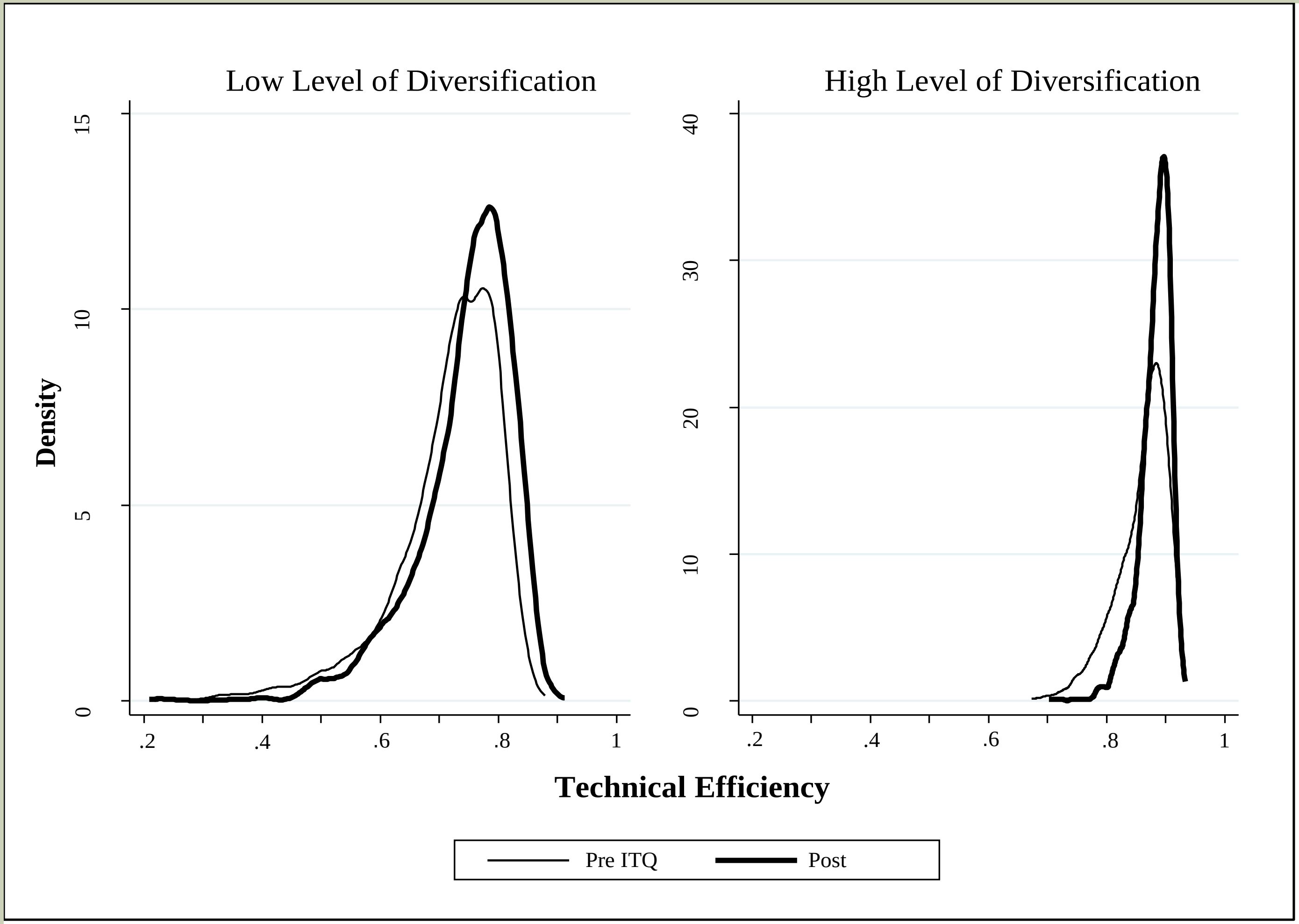
Species	Vermillion snapper	SW Groupers	Other snappers	Other species
Red snapper	0.0004***	0.0001	0.0003*	0.0017***
Vermillion snapper		0.0014***	0.0001	0.0013***
SW Groupers			-0.0001	0.0026***
Other snappers				0.0009***

* 10% level of significance, ** 5% level of significance, ***1% level of significance.

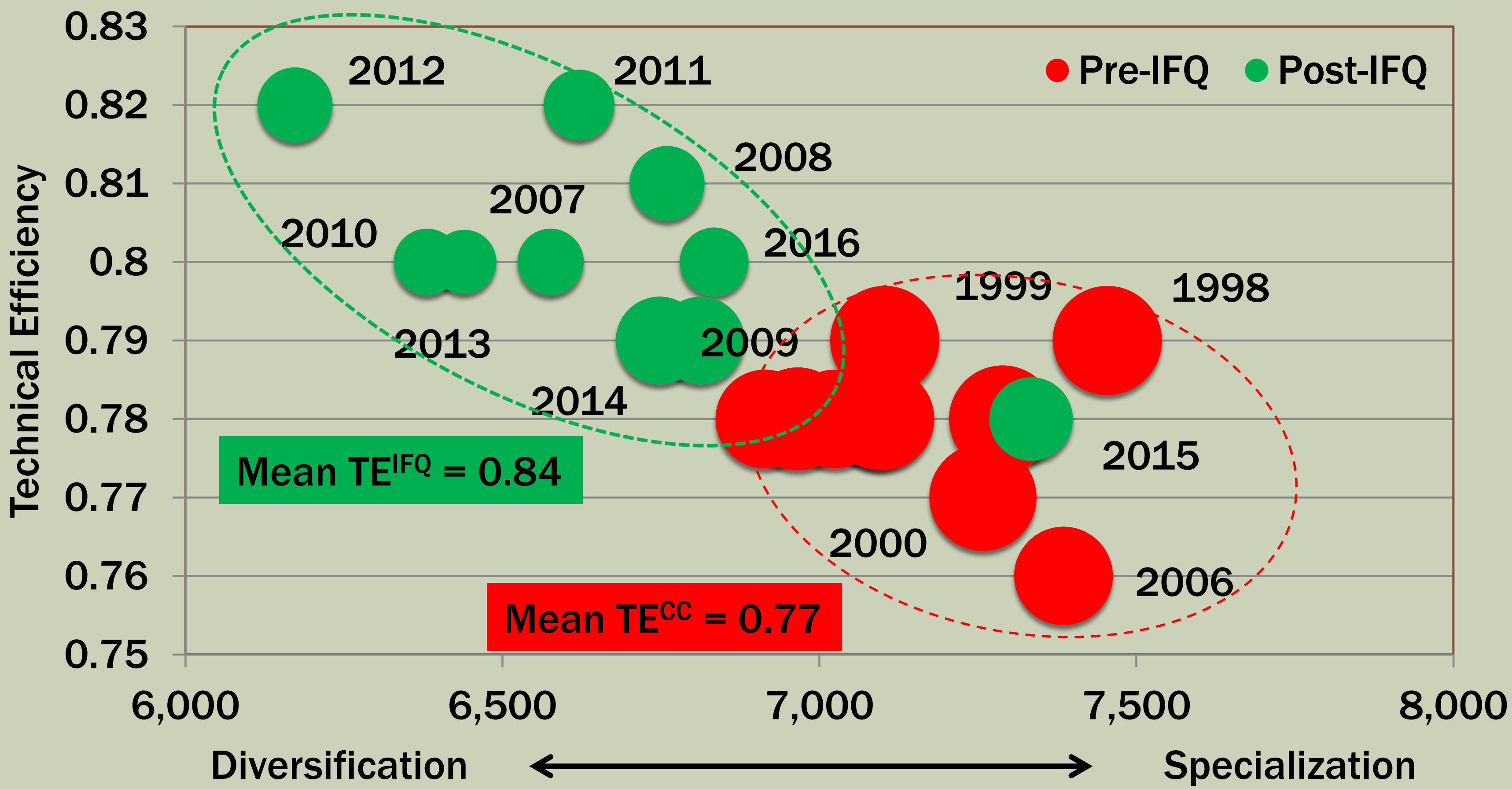
TE VS DIVERSIFICATION (ENTIRE SAMPLE)



TE VS DIVERSIFICATION (CC VS IFQ)



TE VS DIVERSIFICATION



PRELIMINARY CONCLUSIONS

- Preliminary results show that TE increased following the implementation of catch shares (from 74% to 84%).

- There is a positive correlation TE and catch diversification (TI equation).

- Productivity gains due to catch diversification are positive (but low; ED) suggesting that the CS "specialization" trend may be explained by the attributes of the harvesting technology.

Thank you