How Can a Community-Based Management Improve an Outcome? The Effects of Revenue Sharing and Social Capital in Fisheries

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Small-scale fisheries and community-based management

- 90% of the world's 39.4 million capture fishers are small-scale (FAO, 2014)
  - mostly in developing countries
- ITQ can solve the externality in fisheries
- Not all countries can afford ITQ (Copes, 1986)
  - Weak enforcement powers
  - Lack of well-established market institutions
- Self-governance literature suggests importance of community-based management (Baland & Platteau, 1996; Ostrom, 1990, 2002; Wade, 1989) in fisheries (Deaton, 2012; Townsend et al., 2008; Pinkerton, 1994)

Fisheries, management rules, and social capital

- Difference in institutions causes difference in economic performance
  - Revenue sharing arrangement (Gaspart & Seki, 2003; Heintzelman et al., 2009)
  - Harvesters share catch and/or revenue
- Social capital influences economic decision making
  - Empirically associated with economic productivity in fishery (Carpenter & Seki, 2011) as well as other workplace (Barr & Serneels, 2009; Karlan, 2005; Knack & Keefer, 1997)
  - Cooperation, trust, information network
- Our study: Heterogeneity in outcomes due to interaction of both factors

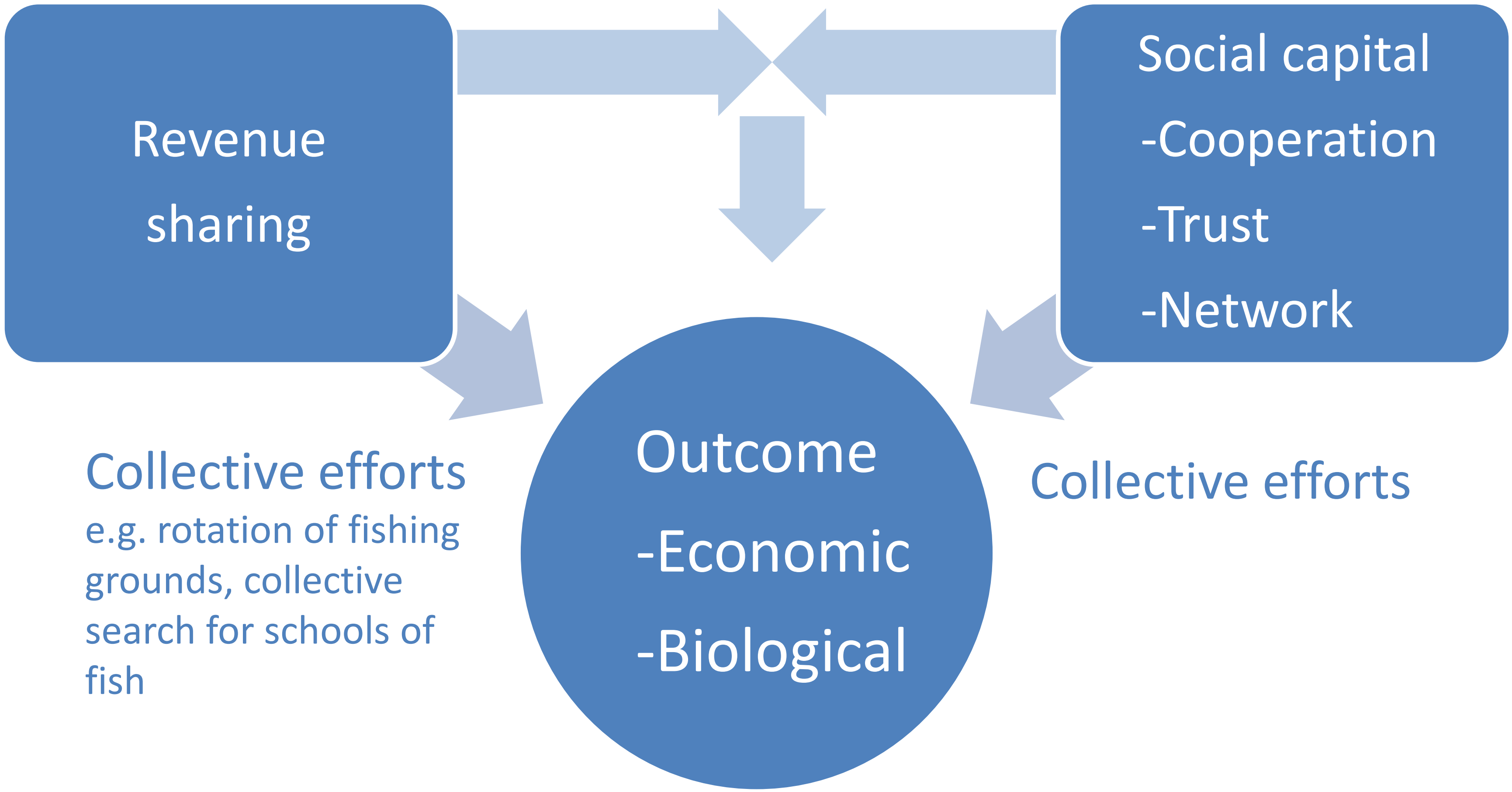
Research objectives

- Identify direct effect of management systems
- ---------- -------- -------- -- social capital
- ---------- indirect ------ -- management systems

Conceptual framework

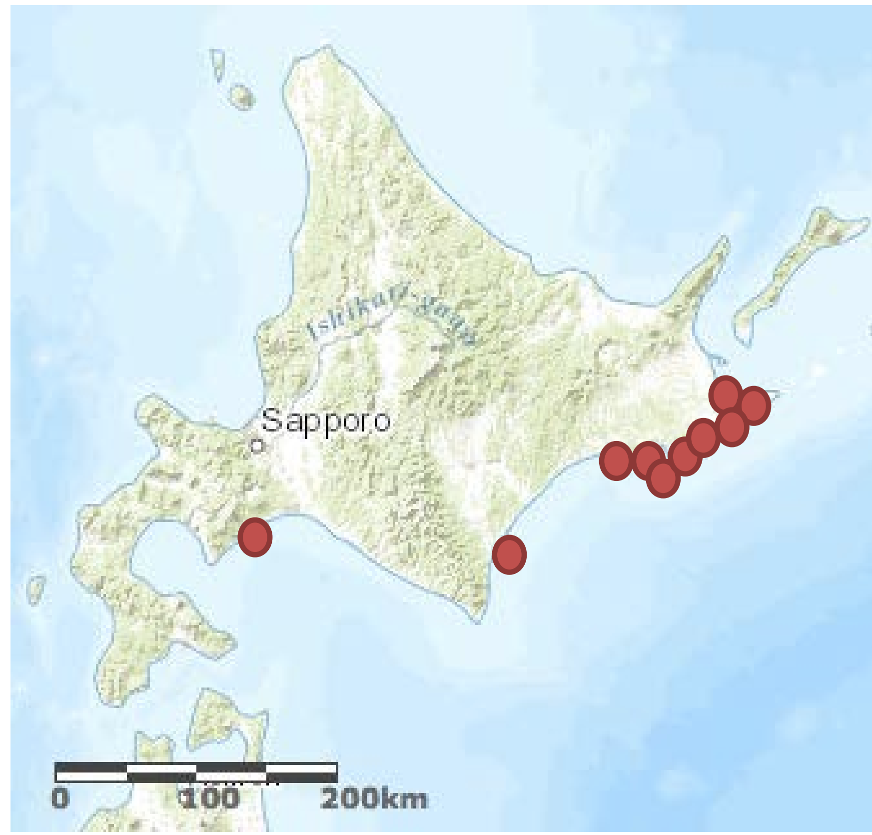
- Revenue sharing arrangement
  - Induces harvesters conflicting incentives (Kandel & Lazear, 1992)
    - free-riding on others' fishing effort (Gaspart & Seki, 2003) and maximizing collective value
  - Bringing synergy is key (Sherstyuk, 1998)
  - No insurance (Platteau & Seki, 2001)
- Collective fishing practices (Platteau & Seki, 2001)
  - e.g. rotation of fishing grounds, collective search for schools of fish

Conceptual framework



Japanese surf clam fisheries in Hokkaido

- 10 groups engaging in small-scale trawl fishery
- Unique field setting
- Collected to construct a statistical comparison groups.
  - Controlled on **region** (Pacific Hokkaido), **targeting species,** (=Japanese surf clam), **types of fishing gear** (=hydraulic jet dredges), **operational rules.**



Data

- Field experiment and survey conducted in 2013 and 2014
  - 79 skippers
- Group panel data
  - 10 groups, 1990 to 2012
  - Yearly average ex-vessel prices
  - Stock information
  - And more

Key variables

Variables of interest	Revenue sharing (1 if Rev. Sharing or 0)	FCA data
	Conditional cooperation parameter	Experiment
	Unconditional cooperation parameter	Experiment
	Trust index	Survey
	Information size	Survey
	Information density	Survey
	Varieties of Information shared	Survey
	Frequency of sharing information	Survey
Outcome variables	Price per kg (yen)	FCA data
	Resource stock density (grams per m^2)	FCA data
	Increase in income perceived by fishers	Survey
	Increase in resource perceived by fishers	Survey

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Estimation strategy

- Random-effects model (or OLS) with wild cluster bootstrapped p (Cameron et al., 2008)

$$y_{it} = \boxed{\beta_1}\mathrm{Mgmt}_{it} \qquad + \gamma Z_{it} + \alpha + u_i + \epsilon_{it}$$

y_{it} : prices

Mgmt_{it} : 1 if revenue sharing

SC_i : Social Capital parameters

Z_{it} : Control covariates

u_i : FCA random effects

i : FCA

t : time

Estimation strategy

- Random-effects model (or OLS) with wild cluster bootstrapped p (Cameron et al., 2008)

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Trust is important in prices

Dependent variable: *Real price* (yen per kg)

	(1)	(2)	(3)
Revenue sharing	2.8		14.5
	(0.88)		(0.27)
Trust (mean)		40.1*	40.8*
		(0.00)	(0.00)
		[0.07]	[0.07]
Observations	225	225	225
Wald Chi^2	14333	6201	6411

*** p<0.01, ** p<0.05, * p<0.1.
Notes: GLS estimates. Clustered s.e. p-value in parentheses and bootstrapped p-value in square brackets.

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Varieties of info improves income, further fostered by rev. sharing

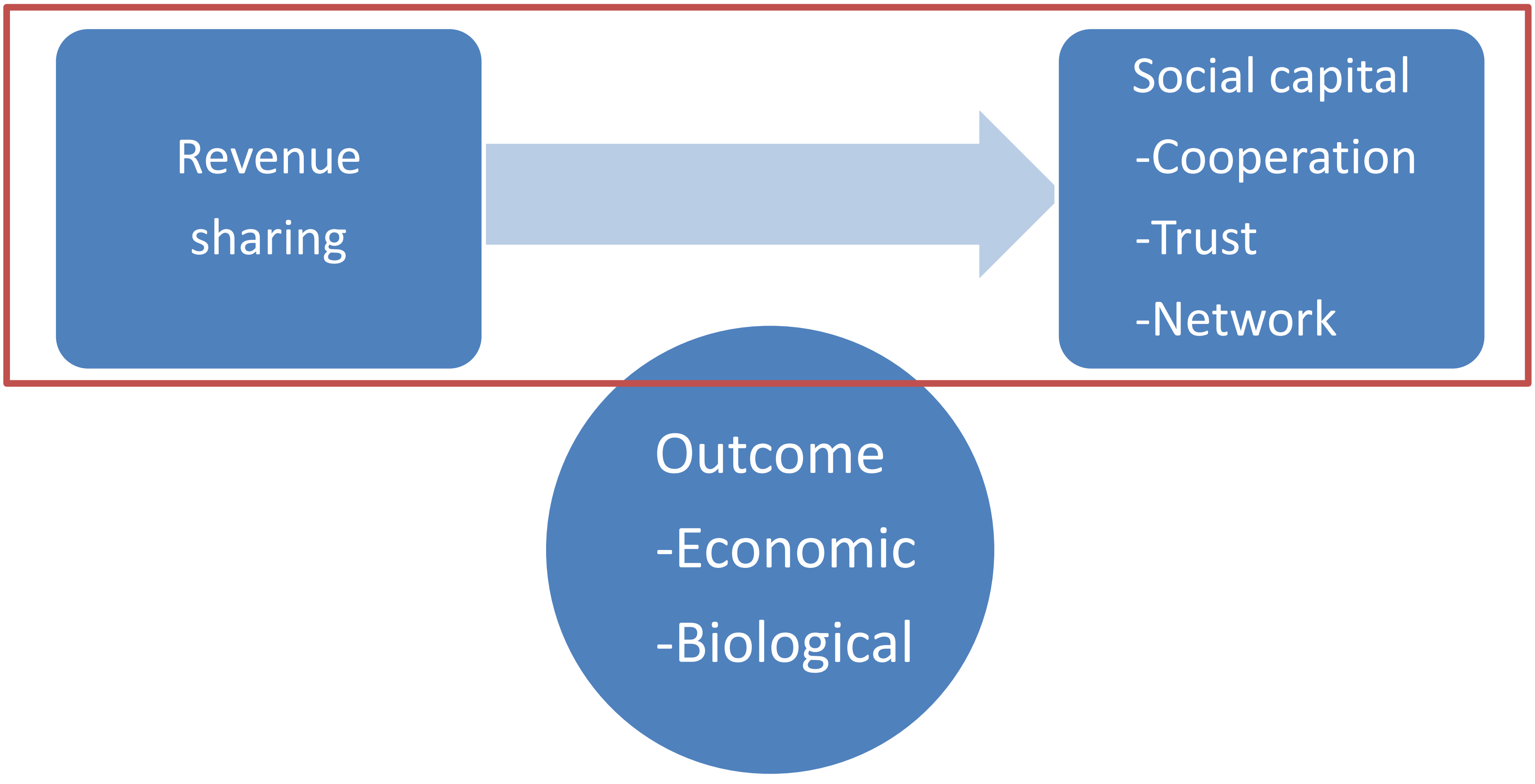
Dependent variable: Perceptions towards *economic* outcome

	(1)	(2)	(3)	(4)	(5)
Revenue sharing	0.18		0.45**		0.23
	(0.39)		[0.04]		(0.26)
Varieties of info		0.26**	0.22*		
shared		[0.04]	[0.06]		
Frequency of sharing				0.38**	0.33**
info				[0.01]	[0.03]
Observations	77	54	54	58	58
F	0.98	3.18*	4.89**	5.38**	5.21**

*** p<0.01, ** p<0.05, * p<0.1.

Notes: OLS estimates. Clustered s.e. p-value in parentheses and bootstrapped p-value in square brackets.

Conceptual framework



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Varieties of info improves income, further fostered by rev. sharing

Dependent variables:	**Conditional**	**Varieties of info shared**	**Frequency of sharing info**
1 if revenue	-0.01**	0.60*	2.02***
sharing	(0.04)	(0.07)	(0.00)
	[0.02]	[0.06]	[0.00]
Observations	71	55	57
F	9.82***	19.43***	6.65***

*** p<0.01, ** p<0.05, * p<0.1

Notes: OLS estimates. Clustered s.e. p-value in parentheses and bootstrapped p-value in square brackets.

Policy implications

- Revenue sharing arrangement may impact the management outcomes through augmenting social capital
  - Some evidence that revenue sharing arrangement can develop denser information networks among fishers
    - More varieties ➔ improve the economic outcome
    - More frequency
- However, revenue sharing arrangement solely does not improve any outcomes in a fishery.
  - Needs caution when implementing such arrangement

Thank you!

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Shellfish fisheries operation in Hokkaido

- Common operational rules for all FCAs in Hokkaido
  - Yearly stock assessment => Self-imposed TAC
  - Skipper leaders watch market prices => Self-imposed daily TAC/IQ
  - Stock enhancement (stocking and/or transplanting within the fisheries)

Sakhalin surf clam and the market

- Different prices for different sizes
  - Bigger the size, higher the price (yen per kilo)
- Different prices for different colours
  - Black shells receive higher prices than brown shells
  - e.g. in 2012 the Bekkai FCA received the average premium of 22% for black shells

Demographics of participants

	N	Mean	Std. Dev.	Min	Max
Age	78	53.24	10.21	26	79
Education (1: Junior high school - 6: Graduate degree)	78	1.73	0.60	1	4
Household size (persons)	77	2.77	1.72	0	6
Shellfish fishing experience (years)	73	23.93	13.87	1	55

Construct information network indices

(Holland et al., 2010 & 2013)

Network size	# of shellfish skippers an individual shares info with
Network density	# of shellfish skippers an individual shares info with / # of all shellfish skippers in FCA
Variety of information shared	Sum of 6 types of information shared: market, buyer, hot-spots, bycatch, gear density, boat&gear
Frequency	1: Everyday to 7: Once in season

	N	Mean	Std. Dev.	Min	Max
Network size (persons)	78	10.58	15.03	0	90
Network density (%)	78	31.08	34.50	0	100
Varieties of info (1-6 types)	60	2.05	1.27	1	5
Frequency (1: Everyday - 7: Once in season)	63	2.71	1.93	1	7

Construct trust index (Glaeset et al, 2000)

- Questions from General Social Survey

	N	Mean	Std. Dev.	Min	Max
Trust 1 *(These days you can't count on strangers)*	78	3.06	0.67	1	4
Trust 2 *(In dealing with strangers one is better off to be cautious until they have provided evidence that they are trustworthy)*	77	3.71	0.87	1	5

Notes: Subjects responded on a five-point scale from 1: strongly disagree to 5: strongly agree. Not all subjects completed all the questions in the survey.

Public goods game

- To measure cooperation among fishermen
- Asked how much they want to contribute to a public good from their own endowment
- Repeated 10 times
- Mean contribution to a public good: 54% (SE 1%)
- Revenue sharing: 52% (SE 2%)
- Non revenue sharing: 60% (SE 2%)

Estimate cooperation parameters

- Multilevel Tobit Model with Random Coefficient using Generalized Latent Variable Model

$$e_{itj} = \beta_0 + \beta_1 \sum \text{Contribute}_{-}$$

$$\cdot\, u^3_{ij} \sum \text{Contribute}_{-i(t-}$$

Unconditional cooperation parameter

Conditional cooperation parameter

Dependent variable: Amount contributed by i in session j at round t	
β_0: Constant	1,272.57***
	(0.00)
β_1: Total group contribution excluding oneself in the previous round	0.08**
	(0.01)
Variance of u_j^1 (Random intercept for sessions)	45,915.791
	(0.58)
Variance of u_{ij}^2 (Random intercept for individuals)	996,737.9**
	(0.05)
Variance of u_{ij}^3 (Random slope for individual β_1)	0.007
	(0.63)
Observations	666
Log-likelihood	-4,222.41

Notes: P-value in parentheses. Multilevel Tobit Regression.

Model assumptions

- Social capital does not change over time
- Composite error term ($u_i + e_{it}$) is uncorrelated with explanatory variables
- u_i is distributed normally
- Clustered variance estimate requires # of clusters goes to infinity (or at least > 30)
  - Wild bootstrapped p value (Cameron et al., 2008)

Wild cluster bootstrap

- Bootstrap approximates the finite sample of cdf of the coefficient
  - Form pseudo-samples
  - Use results for inference
- Wild cluster bootstrap-t procedure corrects for small sample inference (Cameron et al., 2008)
  - Use the Wald statistics rather than the OLS estimator
  - Form pseudo-samples based on residuals with six-point distribution
- Extends this method to GLS
- Shown to work better under heteroskadasticity than bias-adjusted linearization (Angrist & Pischke, 2008; Bell & McCaffrey, 2002)

Steps in wild cluster bootstrap

1. From the original sample, form the Wald statistics with cluster robust variance
2. Obtain the restricted GLS estimator that imposes the null hypothesis and the associated residuals
3. Do 999 iterations. For each iteration,
   a. Form a sample of G clusters by forming either $e_{it} = e_{it}$ with $p = 0.5$ or $e_{it} = -e_{it}$ with $p = 0.5$
   b. Construct new values of y
   c. Calculate the Wald statistics by estimating the coefficients and standard errors
4. Reject the null at level α iff $w < w^*_{[\alpha/2]}$ or $w < w^*_{[1-\alpha/2]}$