Transition to Property Rights in Common-Pool Resources: Evidence from Alaska Fisheries

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Motivation

- Theory of common-pool resources (CPRs) is well known.
  - Open access leads to over exploitation and complete rent dissipation (Gordon, JPE 1954).
  - Establishing property rights can solve the common-pool problem, but may be costly to implement (Cheung, JLE 1970).
- Empirical evidence that (property) rights-based management (RBM) approaches can alleviate common-pool problems.
  - **Fisheries:** Catch share programs improve biological and economic performance. Grafton et al. (JLE 2000), Newell et al. (JEEM 2005), Deacon et al. (JLE 2013), Costello et al. (Science 2008).
- Many CPRs managed with command and control regulation (CAC).
- Need for research on determinants of transition from CAC to RBM.

Research Question

Research Question

What are the determinants of the transition from command and control (CAC) regulation to rights-based management (RBM) in common-pool resources?

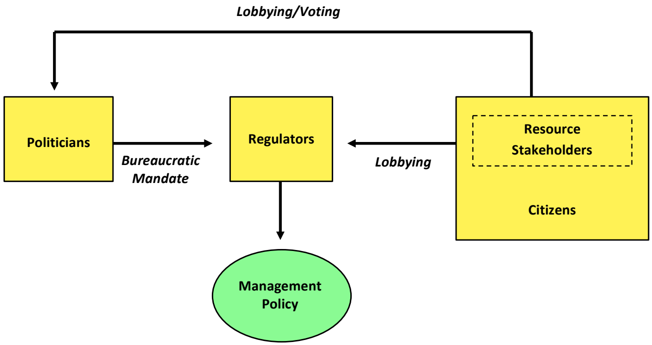
- **Conceptual framework**
  - Political economy of transition to RBM. Regulator's decision to adopt RBM regime in a common-pool resource currently under CAC.
- **Empirical application: Alaska fisheries**
  - Duration analysis of catch shares adoption in a group of federally managed Alaska fisheries.

▸ Evolution of CPR Management Institutions

Contribution & Preview of Results

- **Contribution**
  - Broadly applicable conceptual framework of RBM adoption with empirically testable hypotheses.
  - One of the first papers to identify empirical determinants of transition from CAC to RBM in a fisheries context.
- **Main empirical results**
  - RBM adoption more likely if there are large expected benefits of mitigating rent dissipation arising from **inefficient production**.
  - **Transaction costs** are barriers to RBM adoption.
  - Limited empirical evidence that the **resource depletion** is an important factor in RBM program adoption.

Political economy of CPR management



Regulators balance bureaucratic mandate with lobbying in setting management policy.

Bureaucratic mandate: statutes governing regulatory agency policy-making.
Lobbying: act of attempting to influence decisions made by officials in the government.

Cost-benefit framework for RBM adoption

Main argument: regulator will adopt RBM program if net benefits larger than status quo CAC regime.

- **Benefits:** mitigating rent dissipation along up to three dimensions:
    1. **Resource dimension:** forgone rents from suboptimal extraction behavior.
    2. **Cost dimension:** forgone rents from excess effort and capital investment relative to the social optimum.
    3. **Value dimension:** forgone rents from failure to realize full potential market value of resource when sold as lower-value product.
- **Transaction costs:** costs of establishing and maintaining a new management policy.

Transition from CAC to RBM: Four hypotheses

Hypothesis 1.

Rights-based management program adoption is more likely when the **resource dimension** of rent dissipation under the status quo regime is high.

Hypothesis 2.

Rights-based management program adoption is more likely when the **cost dimension** of rent dissipation under the status quo regime is high.

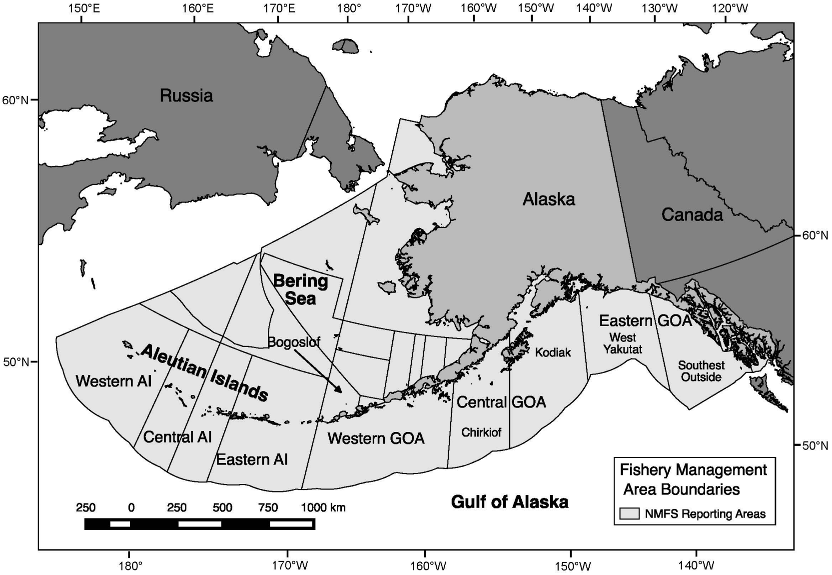
Hypothesis 3.

Rights-based management program adoption is more likely when the **value dimension** of rent dissipation under the status quo regime is high.

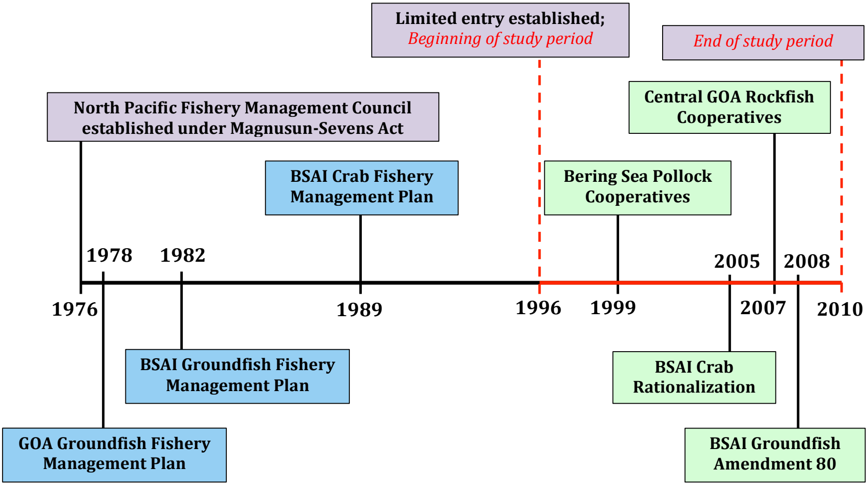
Hypothesis 4.

Rights-based management program adoption is more likely when the **transaction costs** of program adoption are low.

Alaska fisheries federal management areas



Federally-managed Alaska fisheries timeline



Bureaucratic Mandate

Mission Statement

Data

Panel data covering 68 groundfish and crab fisheries observed from 1996-2010; catch shares implemented in 18 fisheries.

Data Sources

- Stock Assessment and Fishery Evaluation Reports (SAFEs)
- NFMS Alaska Region Groundfish Catch Reports
- Groundfish ex-vessel production revenue data
- ADF&G Crab Annual Management Reports
- ADF&G crab fish tickets and eLandings
- NPFMC Fishing Fleet Profiles and Groundfish Species Profiles

Variables and Expected Signs

Category	Variable	Description	Sign
Resource dimension of rent dissipation	Stock status	B/B_{MSY} (or equivalent)	-
	Overfishing status	(Aggregate catch/OFL)$\times$100%	+
	Discard rate	% of total catch not retained	+
	Bycatch closure	'1' if fishery closed due to bycatch	+
Cost/value dimension of rent dissipation	Season length	Number of days fishery is open	-
	TAC Exceeded	'1' if aggregate catch $>$ TAC	+
Transaction costs	Vessels	Number of active vessels	-
	Sectors	Number of fishing sectors	-
	Gini coefficient	Vessel-level revenue equality (%)	-
Controls	Average price	Avg. ex-vessel price (2010$/lb)	
	Total catch	Total catch (thousand mt)	
	FMP FE	Fishery management plan fixed effects	
	AREA FE	Management area fixed effects	

Duration Analysis
Kaplan-Meier survival

Descriptive Statistics and Differences in Means

	All Fisheries	Catch Share Fisheries	Non-Catch Share Fisheries	Difference
Resource Dimension				
Stock status	1.59	1.49	1.65	-0.16
	(0.09)	(0.16)	(0.12)	(0.20)
Overfishing status	37.78	44.77	35.16	9.60
	(3.09)	(6.11)	(3.54)	(6.88)
Discard rate	21.99	21.89	22.02	-0.13
	(2.12)	(3.63)	(2.59)	(4.85)
Bycatch closure	0.29	0.17	0.34	-0.17
	(0.06)	(0.09)	(0.07)	(0.13)
Cost/Value Dimension				
Season length	157.5	66.3	190.3	-124.1***
	(15.30)	(17.72)	(17.68)	(31.42)
TAC Exceeded	0.21	0.39	0.14	0.25**
	(0.05)	(0.12)	(0.05)	(0.11)
Transaction Costs				
Vessels	120.6	107.1	125.6	-18.42
	(15.03)	(17.30)	(19.51)	(34.25)
Sectors	2.34	1.50	2.64	-1.14***
	(0.18)	(0.12)	(0.23)	(0.39)
Gini coefficient	75.24	61.83	80.07	-18.24***
	(2.15)	(5.81)	(1.62)	(4.38)
Controls				
Average price	0.77	1.33	0.57	0.77**
	(0.15)	(0.46)	(0.10)	0.32
Aggregate catch	28.48	81.10	9.54	71.55*
	(16.55)	(60.53)	(4.89)	(36.75)
Fisheries	68	18	50	

Means reported using1996 data. Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Cox Proportional Hazards Model		
	Assessed Fisheries		Full Sample
	(1)	(2)	(3)
Stock status	11.21***		
	(6.54)		
Overfishing status	1.035***	1.023*	1.029**
	(3.02)	(1.84)	(2.40)
Discard rate	0.968	0.973	0.948***
	(-1.51)	(-1.30)	(-3.33)
Bycatch closure	4.613***	11.90**	17.95**
	(2.72)	(2.50)	(0.71)
Season length	0.973***	0.979***	0.969***
	(-4.11)	(-2.69)	(-4.41)
TAC Exceeded	0.600	0.853	0.732
	(-1.43)	(-0.40)	(-0.59)
Vessels	0.990***	0.995*	0.994
	(-4.10)	(-1.73)	(-1.27)
Sectors	0.552***	0.467***	0.346***
	(-2.84)	(-2.96)	(-3.46)
Gini coefficient	0.976*	0.971**	0.959***
	(-1.94)	(-2.35)	(-2.91)
Average price	0.978	1.246	1.416
	(-0.11)	(0.83)	(0.93)
Aggregate catch	1.019***	1.014***	1.013***
	(7.29)	(8.50)	(5.79)
FMP FE	YES	YES	YES
Area FE	YES	YES	YES
Observations	612	612	914
Fisheries	47	47	68
Catch Share Programs	18	18	18
Log-likelihood	-34.48	-36.93	-28.13
Pseudo R-squared	0.481	0.444	0.615

Hazard ratios reported; *t*-statistics in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

▸ Catch shares redefinition

▸ More full sample results

Predicted Transitions to Catch Shares

Rank	Fishery	Predicted Adoption Year	Considering Catch Shares?
1	Norton Sound red king crab	2007	No
2	Central GOA (Kodiak) pollock	2010	Yes
3	Central GOA (Chirkiof) pollock	2010	Yes
4	Central GOA Pacific cod	2011	Yes
5	BS Pacific Ocean perch	2011	No
6	AI Greenland turbot	2011	No
7	BSAI Pacific cod	2013	No*
8	AI pollock	2022	No
9	Central GOA rex sole	2024	Yes
10	BSAI arrowtooth flounder	2024	No
11	Central GOA deep-water flatfish	2027	Yes
12	Central GOA shallow-water flatfish	2027	Yes
13	Central GOA flathead sole	2028	Yes
14	Central GOA arrowtooth flounder	2031	Yes
15	Pribilof Islands golden king crab	2032	No

Notes: Predicted mean year of catch share program adoption computed from estimated model parameters from a Weibull regression model and 2010 covariate values.

*Voluntary cooperative began in August 2010.

Weibull

Discussion

- **Summary:** empirical analysis generally verifies the conceptual framework hypotheses.
  - RBM programs are more likely to be adopted if there are large expected benefits of mitigating rent dissipation arising from **inefficient production**.
  - **Transaction costs** are barriers to RBM adoption.
  - Limited empirical evidence that the **resource depletion** is an important factor in RBM program adoption.
- **Future work**
  - Empirically identify role of other resource stakeholders (e.g., crew, processors, non-commercial sectors, communities, environmental groups).
  - External validity - similar patterns observed in other contexts?

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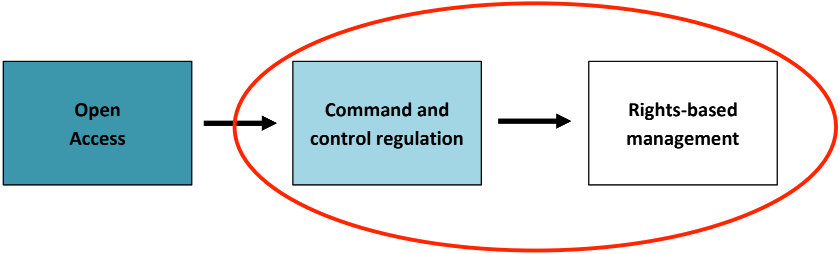
Evolution of CPR management institutions



- **Open access:** Unrestricted entry; no regulation possible.
- **CAC:** Uniform regulations to constrain user behavior.
- **RBM:** Exclusive use rights held by individuals or groups.

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The Councils' bureaucratic mandate

Councils must uphold the following statutes in considering adoption of RBM programs (catch shares):

1. Magnuson-Stevens Act 10 National Standards
2. Executive Order 12866 - Regulatory Planning and Review
3. National Environmental Policy Act (NEPA)
4. Regulatory Flexibility Act

In considering adopting a catch share program, the Council prepares an "Environmental Assessment/Regulatory Impact Review/Initial Regulatory Analysis" document. Back

North Pacific Fishery Management Council's "Mission Statement"

"In managing the fisheries under its jurisdiction, the North Pacific Fishery Management Council is committed to... **provide the maximum benefit to present generations of fishermen, associated fishing industry sectors, communities, consumers, and the nation as a whole.**"
(North Pacific Fishery Management Council, 1995)

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Catch Shares Redefinition

	Standard Model			Shared Frailty Model
	(1)	(2)	(3)	(4)§
Overfishing status	0.999	1.007	0.995	0.979
	(-0.09)	(0.82)	(-0.54)	(-1.11)
Discard rate	0.981**	0.980*	0.977	0.961
	(-2.09)	(-1.83)	(-1.56)	(-1.11)
Bycatch closure	1.111	1.357	0.890	0.261
	(0.14)	(0.39)	(-0.11)	(-1.27)
Season length	0.991*	0.991*	0.988**	0.993
	(-1.83)	(-1.89)	(-2.06)	(-1.12)
TAC Exceeded	1.538	0.957	1.071	0.727
	(0.83)	(-0.10)	(0.15)	(-0.39)
Vessels	0.999	1.002	1.001	1.008*
	(-0.24)	(1.04)	(0.62)	(1.87)
Sectors	0.942	0.867	0.999	4.956**
	(-0.30)	(-0.93)	(-0.01)	(2.26)
Gini coefficient	0.984	0.992	0.985	0.976
	(-1.55)	(-0.75)	(-1.09)	(-1.24)
Average price	1.817***	0.886	1.225	1.129
	(3.61)	(-0.53)	(0.82)	(0.30)
Aggregate catch	1.012	1.007***	1.007***	1.008
	(1.48)	(4.97)	(4.63)	(0.98)
FMP FE		YES	YES	
Area FE			YES	
Observations	899	899	899	899
Log-likelihood	-64.69	-60.39	-51.72	-56.85
AIC	149.4	144.8	129.4	133.7
Pseudo R-squared	0.269	0.318	0.416	

Hazard ratios reported; t-statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Efron approximation for tied failures. § The estimated frailty variance is $\theta = 10.75$ (SE $= 5.84$). The likelihood-ratio test of $H_0 : \theta = 0$ has p-value <0.01.

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Duration Analysis

Hazard function:

$$\lambda[t|\mathbf{X}(t)] = \lim_{h\to 0} = \frac{\Pr[t \le T < t+h | T \ge t, \mathbf{X}(t+h)]}{h} \tag{1}$$

Cox proportional hazards model:

$$\lambda[t|\mathbf{x}(t)] = \lambda_0(t)\exp[\mathbf{x}(t)\boldsymbol{\beta}] \tag{2}$$

Cox proportional hazards model with shared frailty:

$$\lambda_{ij}[t|\mathbf{x}_{ij}(t)] = \gamma_i\lambda_0(t)\exp(\mathbf{x}_{ij}\boldsymbol{\beta}) \tag{3}$$

$i = 1, ..., n$ groups with $j = 1, ..., n_i$ fisheries in the ith group.

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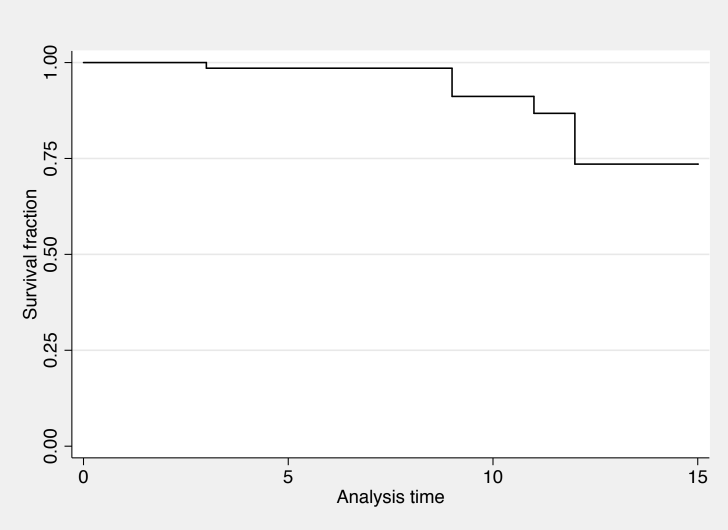
Kaplan-Meier survival estimate



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Cox Proportional Hazards Model Results

	Standard Model			Shared Frailty Model		
	(1)	(2)	(3)	(4)§	(5)†	(6)$^{\#}$
Overfishing status	1.008	1.045***	1.029**	0.990	1.045**	1.029
	(0.72)	(2.93)	(2.40)	(-0.54)	(2.02)	(1.15)
Discard rate	0.953**	0.959***	0.948***	0.942	0.959	0.948
	(-2.29)	(-2.60)	(-3.33)	(-1.22)	(-1.20)	(-1.27)
Bycatch closure	16.98**	46.92***	17.95**	2.493	46.92***	17.95*
	(2.31)	(2.96)	(2.29)	(0.71)	(2.76)	(1.78)
Season length	0.967***	0.965***	0.969***	0.982**	0.965***	0.969***
	(-3.23)	(-3.18)	(-4.41)	(-2.09)	(-3.27)	(-3.33)
TAC Exceeded	0.851	0.477	0.732	1.148	0.477	0.732
	(-0.23)	(-1.58)	(-0.59)	(0.15)	(-0.91)	(-0.35)
Vessels	0.992**	0.997	0.994	0.999	0.997	0.994
	(-2.15)	(-1.64)	(-1.27)	(-0.09)	(-0.75)	(-0.91)
Sectors	0.259**	0.252***	0.346***	0.299	0.252**	0.346**
	(-2.34)	(-4.19)	(-3.46)	(-1.39)	(-2.41)	(-2.23)
Gini coefficient	0.956***	0.955***	0.959***	0.970	0.955**	0.959
	(-3.32)	(-2.96)	(-2.91)	(-1.31)	(-2.12)	(-1.61)
Average price	2.611***	0.912	1.416	1.846	0.912	1.416
	(3.76)	(-0.38)	(0.93)	(1.29)	(-0.18)	(0.57)
Aggregate catch	1.026***	1.016***	1.013***	1.012	1.016**	1.013**
	(4.15)	(3.99)	(5.79)	(1.05)	(2.44)	(2.36)
FMP FE		YES	YES		YES	YES
Area FE			YES			YES
Observations	914	914	914	914	914	914
Log-likelihood	-36.06	-31.85	-28.13	-34.51	-31.85	-28.13
AIC	92.12	87.71	82.26	89.01	87.71	82.26
Pseudo R-squared	0.507	0.564	0.615			

Hazard ratios reported; *t* statistics in parentheses. * Significant at 10% level; ** significant at 5% level; *** significant at 1% level. Efron approximation for tied failures. The frailty variance is given by θ. § The likelihood-ratio test of $H_0 : \theta = 0$ has p-value = 0.388. † The likelihood-ratio test of $H_0 : \theta = 0$ has p-value = 0.500. $^{\#}$ The likelihood-ratio test of $H_0 : \theta = 0$ has p-value = 0.500.

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Weibull vs. Cox Models

	Cox (1)	Weibull (2)
Overfishing	1.029**	0.975
	(2.40)	(-1.64)
Discard rate	0.948***	0.964
	(-3.33)	(-1.64)
Bycatch closure	17.95**	8.233*
	(2.29)	(1.93)
Season length	0.969***	0.969**
	(-4.41)	(-2.09)
TAC Exceeded	0.732	0.877
	(-0.59)	(-0.28)
Vessels	0.994	1.001
	(-1.27)	(0.27)
Sectors	0.346***	0.489**
	(-3.46)	(-2.57)
Gini coefficient	0.959***	0.969
	(-2.91)	(-1.54)
Average price	1.416	1.227
	(0.93)	(0.33)
Aggregate catch	1.013***	1.014***
	(5.79)	(4.45)
FMP FE	YES	YES
Area FE	YES	YES
Observations	914	914
Fisheries	68	68
Catch Share Programs	18	18
Log-likelihood	-28.13	2.667
Pseudo R-squared	0.615	

Hazard ratios reported; t-statistics in parentheses;
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Efron approximation for tied failures.

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