Coordination effects in area-specific management regimes - empirical evidence from a Swedish shrimp fishery

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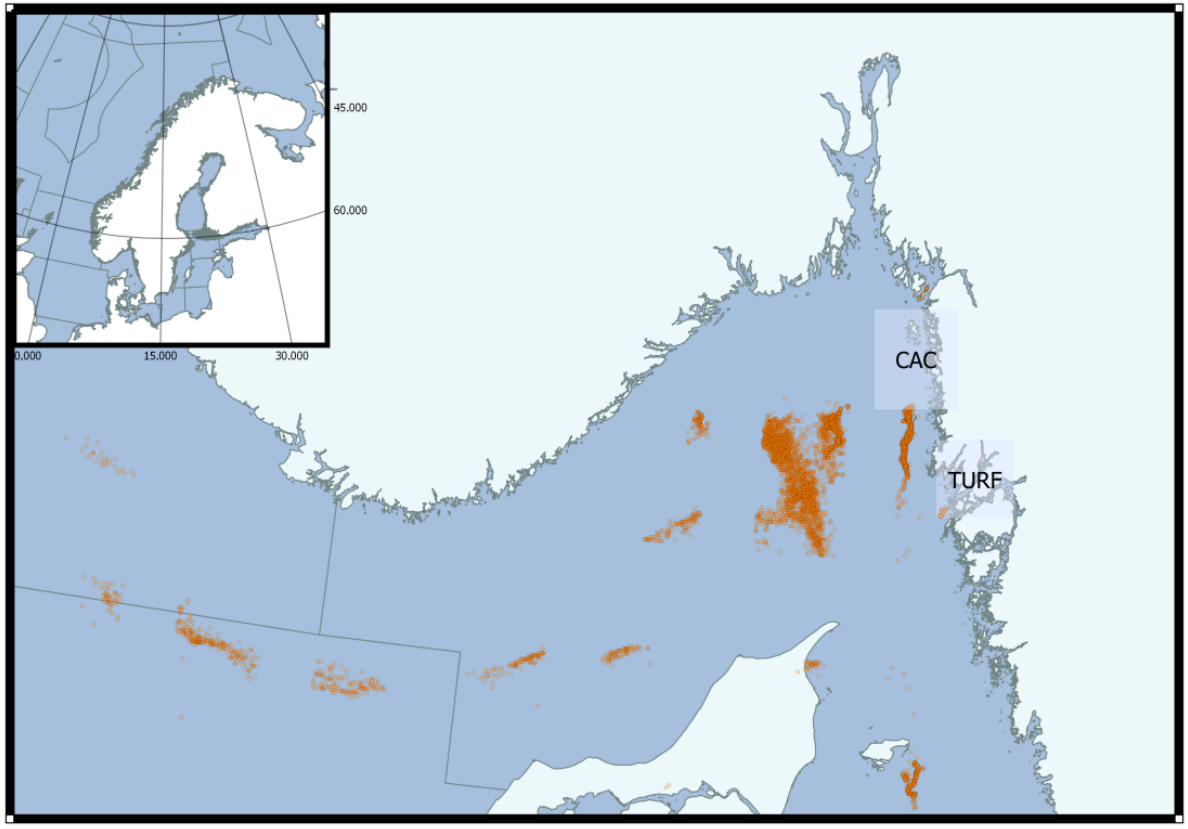
- Renewed focus on area-specific fisheries regulations, such as TURFs, Co-management areas, and area specific command and controls $\rightarrow$ balance socio-economic and conservation considerations
- Little scientific evidence of the comparative advantage of different area-regulations

Empirical setting - Swedish shrimp fishery, 1997-2013



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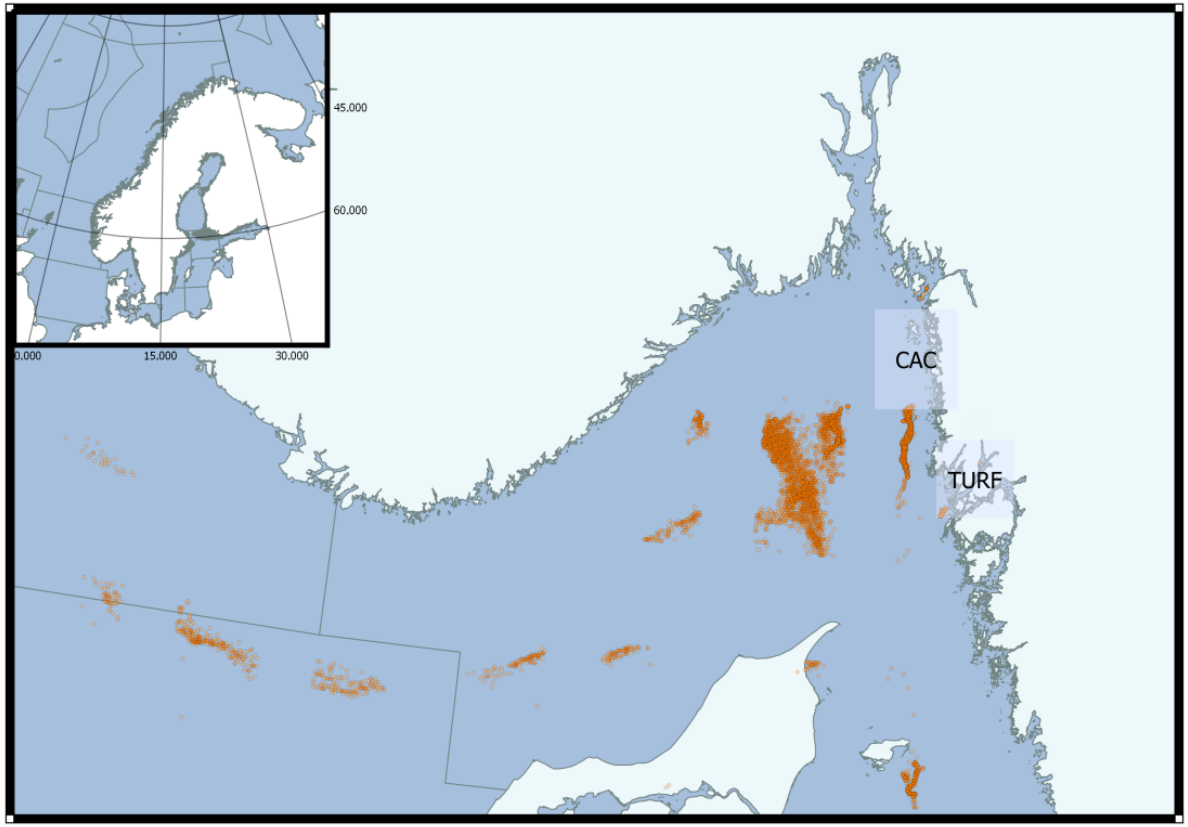

- Swedish shrimp fishery, 12 % of total annual landings value
- Quasi-natural experiment:
  - Overall fishery, voluntary 3 days/week, TAC
  - Command and control introduced in 2000 $\rightarrow$ 27, specific gear limitation, voluntary 3 days/week, TAC
  - Territorial user rights introduced in 2004 $\rightarrow$ 5, exclusive rights, 100 days/year, TAC

Data

- Data from Swedish Agency of Marine and Water Management SWAM + SMHI, SPBI, IMR
- Unique panel data set on all shrimp trips 1997-2013
- Geographical positions and dock-side prices
- Weather, fuel prices, and stock index

Outcome variables

	TURF		CAC		ROA
Variable	< 2004	$\geqslant 2004$	< 2000	$\geqslant 2000$	Full period
kW	177.9	197.04	**203.13**	**200.38**	380.1
	(47.81)	(66.78)	**(74.07)**	**(75.25)**	(187.4)
Length (m)	13.01	12.67	14.80	14.19	21.35
	(1.73)	(1.59)	(3.87)	(3.47)	(6.33)
Trip effort (h)	9.72	10.49	10.06	9.18	26.31
	(3.59)	(3.56)	(5.86)	(4.14)	(15.46)
Gross rev (SEK/h)	1091.78	1701.04	**1509.93**	**1441.97**	1867.53
	(876.37)	(1838.5)	**(1369.22)**	**(1344.19)**	(1566.86)
Net rev (SEK/h)	1033.30	1596.50	**1428.33**	**1254.70**	1570.21
	(866.74)	(1829.45)	**(1354.71)**	**(1316.82)**	(2107.27)
CPUE (kg/h)	**14.91**	**14.22**	38.02	26.51	37.2
	(12.94)	**(13.92)**	(40.13)	(.26)	(33.67)
Share large	**.82**	**.80**	**.56**	**.56**	.54
	(.23)	**(.24)**	**(0.29)**	**(.32)**	(.23)
Share bycatch	.07	.04	.13	.05	.15
	(.18)	(.14)	(.19)	(.14)	(.20)
Mesh size (mm)	37.7	44.8	35.87	36.94	35.77
	(4.27)	(1.06)	(1.75)	(2.84)	(2.09)
Within area (%)	84	67	54	62	-
	(36)	(47)	(50)	(49)	
Observations	268	686	1,552	9,675	33,720

Note: All prices have been converted to 2013's prices using CPI by Statistics Sweden

Main analysis - difference in differences

$$Y_{i,d,m,y} = \beta_1 treatloc_i + \beta_2(treatloc_i * post_y) + \chi_i\gamma + \theta_i + \tau_y + \tau_m + \tau_d + \epsilon_{i,d,m,y}$$

- Treatment and control groups based on location of trips
- χ_i Controlling for windspeed, tows, first haul CPUE
- θ_i Vessel fixed effects
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- Under parallel trend & exogeneity assumptions, β_2 identifies the average effect of the management regime

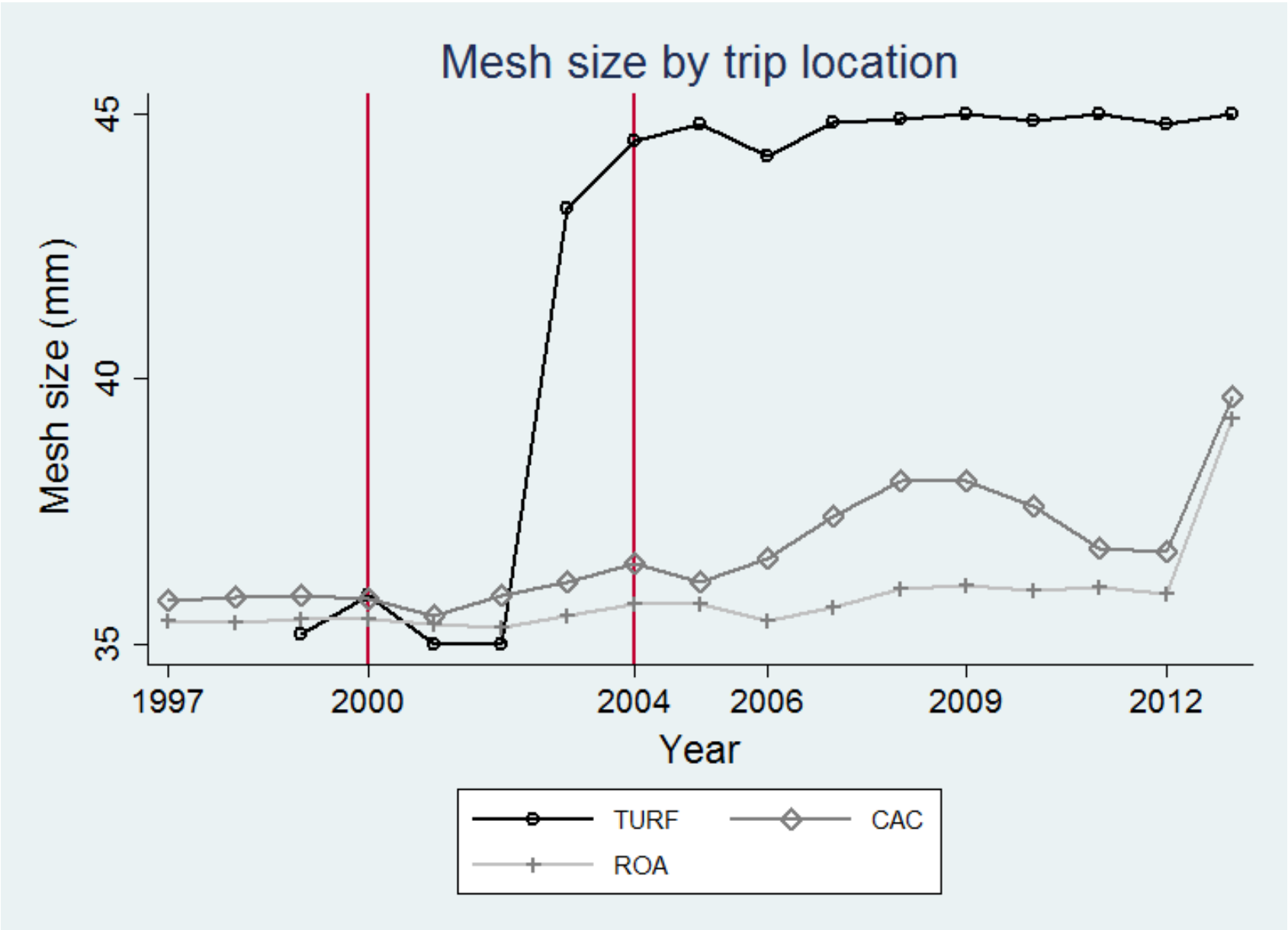
Results - Revenues

	Panel A: TURF **Treat: trips located within TURF** **Control: trips located in other areas**			**Panel B. CAC** **Treat: trips located within CAC** **Control: trips located in other areas, excluding TURF**		
VARIABLES	**(1)** **Gross rev**	**(2)** **Shrimp rev**	**(3)** **Net rev**	**(1)** **Gross rev**	**(2)** **Shrimp rev**	**(3)** **Net rev**
Treatloc	-0.08 (0.08)	-0.05 (0.08)	-0.09 (0.07)	0.22*** (0.03)	0.15*** (0.03)	0.23*** (0.03)
Treatloc*post	**0.15*** **(0.07)**	**0.14**** **(0.07)**	**0.12*** **(0.06)**	**-0.26*** **(0.03)**	**-0.19*** **(0.03)**	**-0.25*** **(0.03)**
Mean wind speed	0.02*** (0.00)	0.03*** (0.00)	0.03*** (0.00)	0.02*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
Cpue/first haul	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Constant	5.71*** (0.11)	5.62*** (0.11)	5.41*** (0.13)	5.64*** (0.11)	5.56*** (0.11)	5.37*** (0.13)
Vessel FE	YES	YES	YES	YES	YES	YES
Y, m, d FE	YES	YES	YES	YES	YES	YES
Observations	**40,942**	**40,807**	**36,279**	**40,094**	**39,960**	**39,998**
R-squared	**0.46**	**0.46**	**0.42**	**0.46**	**0.46**	**0.41**

Results - mechanisms

	Panel C: TURF Treat: trips within TURF Control: trips outside TURF by TURF vessels		Panel D: CAC Treat: trips within CAC Control: trips outside CAC by CAC vessels	
VARIABLES	(1) CPUE	(2) Share large	(1) CPUE	(2) Share large
Treatloc	-0.30 (0.20)	0.32** (0.13)	0.03 (0.05	0.09*** (0.03)
Treatloc*post	**-0.06** **(0.19)**	**-0.20*** **(0.12)**	**-0.07*** **(0.04)**	**-0.12***** **(0.03)**
Mean wsp	-0.02** (0.01)	0.004 (0.004)	-0.002 (0.003)	0.003 (0.002)
Crowding	-0.01 (0.01)	0.01* (0.004)	0.008*** (0.002)	-0.002* (0.001)
# tows	-	0.02 (0.02)	-	0.03*** (0.01)
Constant	2.21*** (0.55)	-0.89*** (0.19)	3.19*** (0.12)	-0.60*** (0.08)
Vessel FE Y, m, d FE	YES YES	YES YES	YES YES	YES YES
Observations R-squared	1,101 0.35	1,063 0.21	13,546 0.18	12,710 0.12

Mesh size


Mesh size by trip location
Mesh size (mm)
35
40
45
1997
2000
2004
2006
2009
2012
Year
TURF
CAC
ROA

Additional results - daily fishing decisions

- Reduced form model of daily fishing decisions
- Maximum likelihood assuming logistic errors
- Assume decision to fish = latent variable linearly related to observables (Karaca-Mandic et al., 2012):

$$P(fish_{i,d} = 1 | W_{i,d}, S_d, management) = \phi(\alpha + \beta_1 expW_{i,d} + \beta_2 post + \beta_{12}(expW * post) + \beta_3 S_d + \beta_{32}(S_d * post) + \epsilon_{i,d})$$

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- $expW$ is expected revenue per unit effort, modelled parametrically $expW = expPrice * expCPUE$
  - Myopic fishers; $expPrice$ = previous auction days average price
  - $expCPUE$ = linear function of stockindex, meshsize, area and area*year, sum of quota use of others, vessel capacity, year, month, day
- S an indicator variable for wsp $> 12 m/s$

Sample

- All vessel-date pairs 1997 – 2013
- Exclude from choice set:
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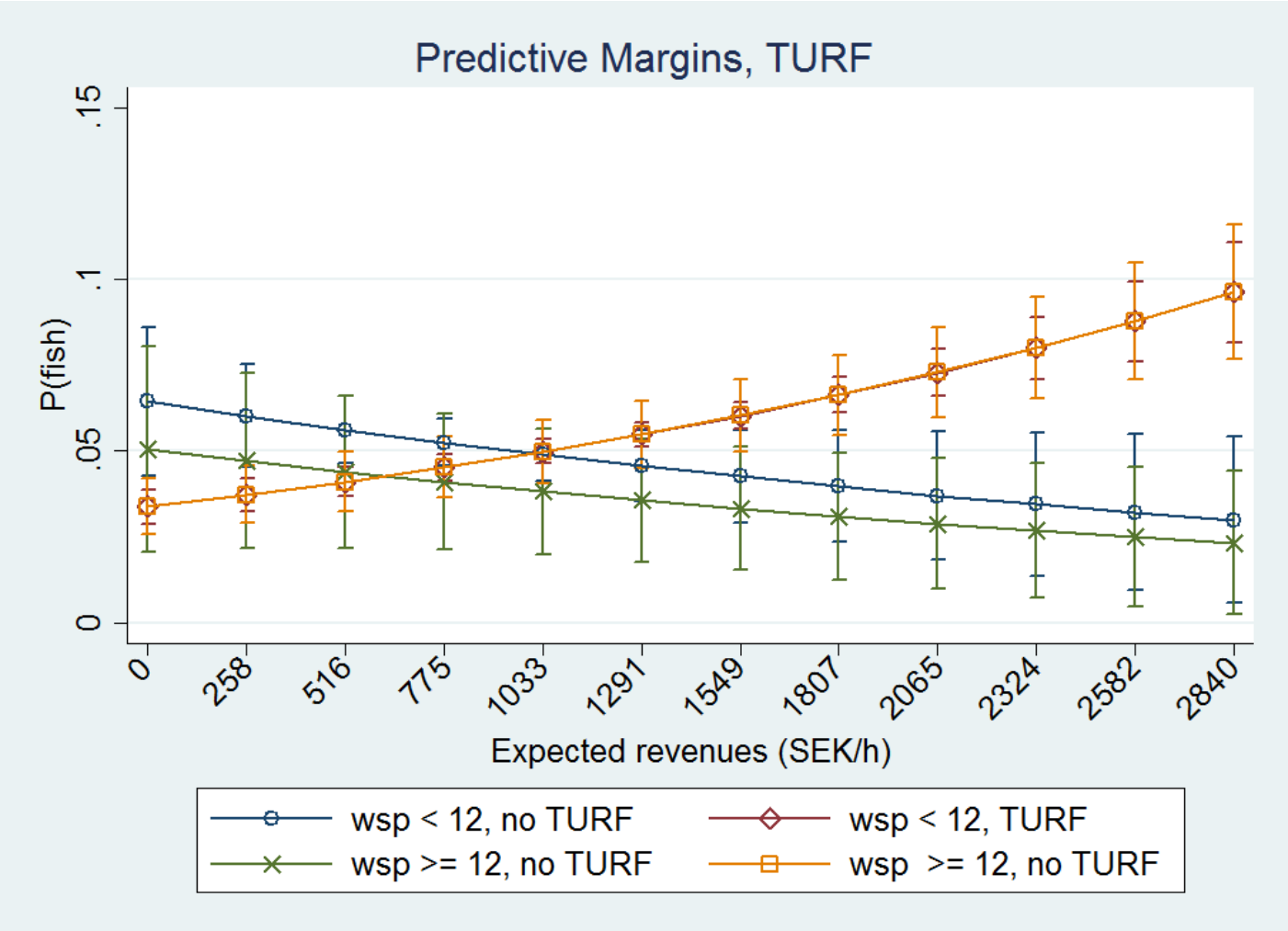
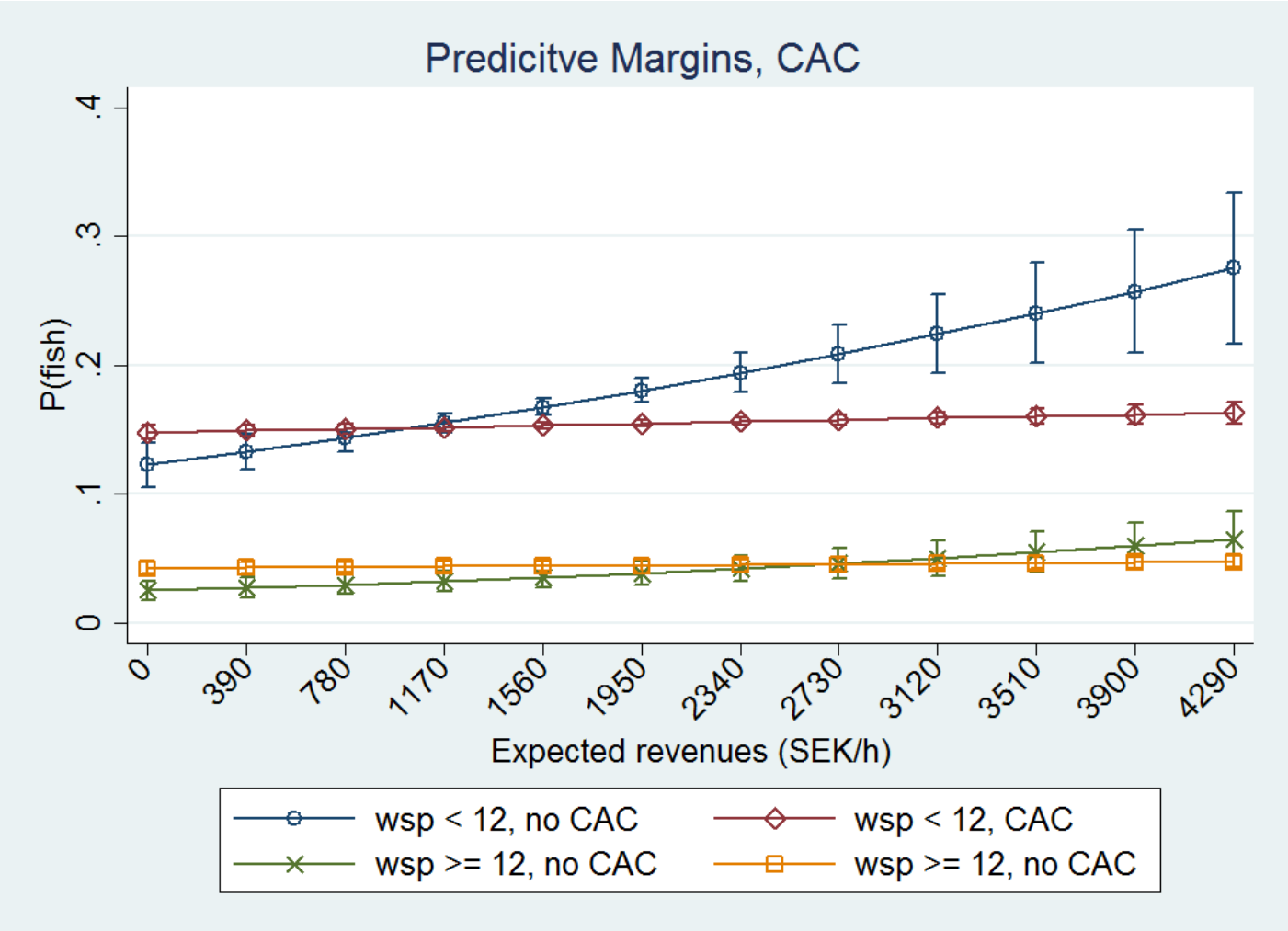
- Average 360 vessel-date pairs per year; mean participation rate 25 days (7 %); 2 % participation increase after introduction of TURF/CAC

Probability of fishing as expected revenues increases for TURF



Probability of fishing as expected revenues increases for CAC



Summary

TURF

- **Net and gross revenues ↑**
- **CPUE unchanged**
- **Share of large shrimp ↓ - less high-grading?**
- **Higher probability to target days when expected revenues ↑**
- **Quality?**

CAC

- **Net and gross revenues ↓**
- **CPUE & bycatch ↓**
- **Share of large shrimp ↓ - less high-grading?**
- **Lower probability to target days when expected revenues ↑**

Number of players → 5 v.s. 27

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Thanks for listening!

Questions?