A proposed Sustainability Insurance Fund (SIF)

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OCEAN CANADA

2018 IIFET Conference

Seattle, USA, July 16-20, 2018

Fisheries Economics Research Unit

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Outline of lecture

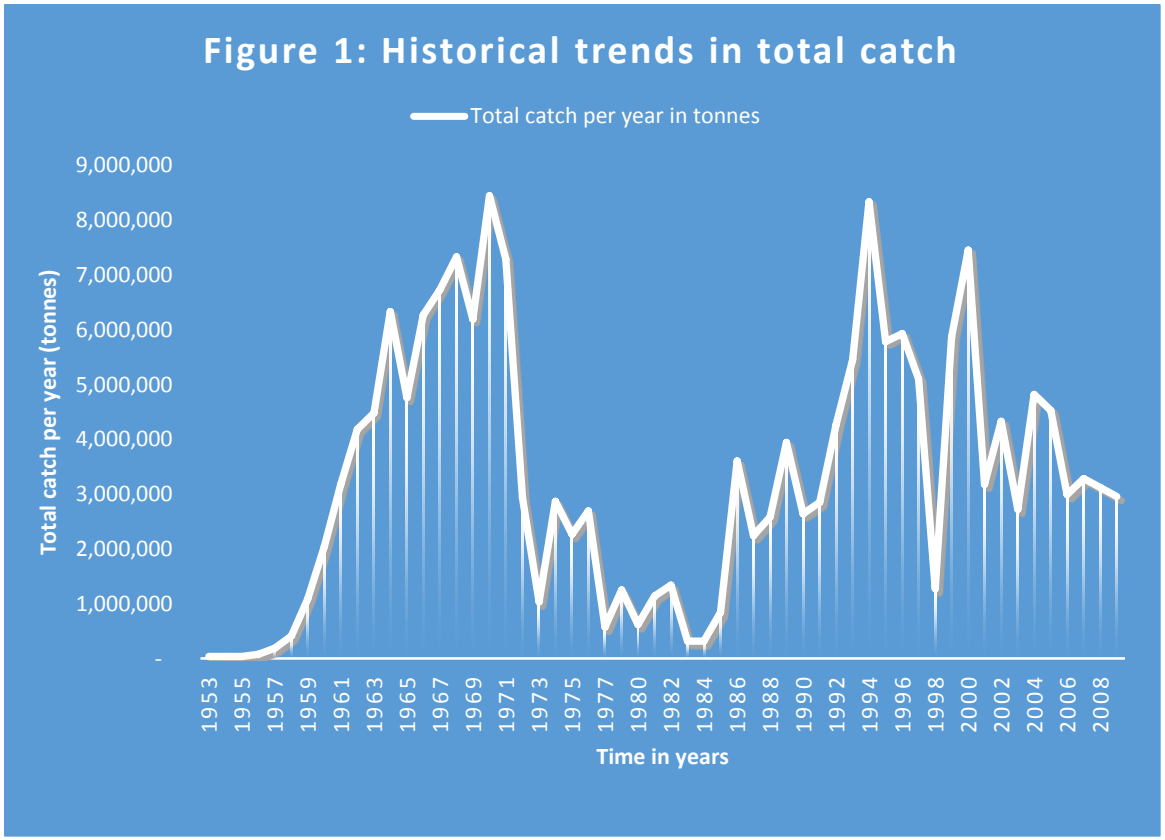
- The objective;
- The motivation;
- The model;
- The results;
- Closing remarks.

The objective

- To develop a SIF for fluctuating pelagic fisheries such as the Peruvian anchoveta;
- We investigate the feasibility of creating a SIF through a fee or tax charged to the industry in good years, and/or grants from private entities, e.g. NGOs.

The motivation for insurance

- Anchovy catches, like for many small pelagic species, fluctuates wildly;



The motivation for insurance

- Anchoveta is big in Peru:
  - 95 of catch in weight;
  - 80% of fish exports;
  - provides 1 in 3 jobs in the fisheries sector in Peru; and
  - supports ~35 % of the jobs in restaurants (Christensen et al. 2014).

The motivation for insurance

- Fisheries managers historically fail to stop fishing when the stock is low because of social, economic and political consequences;

The motivation for insurance

- Reduce the motivation of the government to continue allowing excessively risky fishing levels when the stock falls below the target reference level for sustainability;
- Insurance has been successfully applied to agriculture (Mumford et al. 2009).

The model

- Two components to the model:
  - The pay-out; and
  - The pay-in.

The Pay-out component

P-out=f(T, L, α, β), where

T=trigger catch level;

L is loss in catch/revenue relative to T;

α denotes % of L to be covered by SIF;

β is the probability that T is reached.

Expected pay-out (EPO)

- Let probability of reaching T = $\alpha \in [0,1]$;
- Let proportion of L to be covered = $\beta \in [0,1]$;
- Then $EPO = p\alpha\beta(T - C)$;
  - where EPO is the expected pay-out per year; and
- $TEPO = np\alpha\beta(T - C)$,
  - where TEPO is total expected pay-out for given period and n denotes number of years of pay-out.

The Pay-in component

- Expected pay-in:

  $TEPI \geq TEPO,$

  where TEPI is total expected pay-in:

  $TEPI = g(GG, PG, r),$

  where GG government grant/support; PG is private sector/NGO contributions; levy/contribution rate by fishing sector.

Peruvian anchovita application

- A biological model was:
  - fitted to 1950-2016 historical data;
  - used to predict future catches, for the 2017-2049 period;
  - under two different harvest control rules: (a) base biomass limit (BB) = 2 million t of escapement; harvest rate (U) = 0.5, and
  - (b) BB = 5 million tonnes and U = 1.

Peruvian anchovita application

- 66 different catch time-series were produced for each harvest scenario to allow for the cyclical projection of recruitment anomalies in the future catch;
- The catch time-series were used to determine the probability of having seasonal closures.

Peruvian anchovita application

Parameters	Harvest strategy 1 (U=0.5 | BB=2mmt)	Harvest strategy 2 (U=1 | BB=5mmt)
Average seasonal catch (mmt)	2.68 (±0.06)	3.01 (±0.09)
Average seasonal biomass (mmt)	15.94 (±0.23)	14.09 (±0.18)
Years where biomass < 2 mmt	0% (±0%)	0% (±0%)
Years where biomass < 5 mmt	4.2% (±1.1%)	3.1% (±0.7%)
Seasonal catches = 0 tonnes	0% (±0%)	7.8% (±1.2%)

Peruvian anchovita application

- Environmental variation is factored in:
  - probability of having strong El Niño (ICEN > 1.7) = 0.05; or
  - probability of having extreme El Niño (ICEN > 3) = 0.02.
- Expected pay in and pay out computed for different scenarios.

Table 2

Scenarios	Triggers	Average probability of trigger	Average expected loss in:		Average expected labor payout (in Mill. USD)		
			Landed Value (in Mill. USD)	Product Value (in Mill. USD)	Fishers	Fishmeal plant workers	Total
1d	Seasonal catch = 0 tonnes or ICEN > 1.7	0.049 (±0)	3,566 (± 191)	7,138 (± 383)	155 (± 8)	130 (± 7)	285 (± 15)
1e	Seasonal catch = 0 tonnes or ICEN > 3	0.015 (±0)	1,070 (± 57)	2,141 (± 115)	46 (± 2)	39 (± 2)	85 (± 5)
2d	Seasonal catch = 0 tonnes or ICEN > 1.7	0.123 (±0.012)	9,941 (± 579)	19,899 (± 1,160)	432 (± 25)	361 (± 21)	793 (± 46)
2e	Seasonal catch = 0 tonnes or ICEN > 3	0.091 (±0.012)	7,369 (± 429)	14,750 (± 860)	320 (± 19)	268 (± 16)	588 (± 34)

Table 2

Triggers	Required upfront contributions (in Mill. USD)			Seasons required to collect the SIF's 'seed money' under a USD 1 per tonne taxing system		
	SIF covers fishers salaries only	SIF covers fishmeal plant workers salaries only	SIF covers salaries of workers at sea and on land	SIF covers fishers salaries only	SIF covers fishmeal plant workers salaries only	SIF covers salaries of workers at sea and on land
Seasonal catch = 0 tonnes or ICEN > 1.7	15.5 (± 0.8)	13.0 (± 0.7)	28.5 (± 1.5)	6 (± 0.1)	5 (± 0.2)	11 (± 0.3)
Seasonal catch = 0 tonnes or ICEN > 3	4.6 (± 0.2)	3.9 (± 0.2)	8.5 (± 0.5)	2 (± 0.0)	1 (± 0.0)	3 (± 0.1)
Seasonal catch = 0 tonnes or ICEN > 1.7	43.2 (± 2.5)	36.1 (± 2.1)	79.3 (± 4.6)	14 (± 0.5)	13 (± 0.4)	26 (± 1)
Seasonal catch = 0 tonnes or ICEN > 3	32.0 (± 1.9)	26.8 (± 1.6)	58.8 (± 3.4)	11 (± 0.3)	9 (± 0.3)	20 (± 0.7)

Table 4

Triggers	High upfront contribution (25% of expected payouts)			Very high upfront contribution (50% of expected payouts)		
	SIF covers fishers salaries only	SIF covers fishmeal plant workers salaries only	SIF covers salaries of workers at sea and on land	SIF covers fishers salaries only	SIF covers fishmeal plant workers salaries only	SIF covers salaries of workers at sea and on land
Seasonal catch = 0 tonnes or ICEN > 1.7	0.66 (±0.02)	0.55 (±0.02)	1.21 (±0.04)	0.44 (±0.01)	0.37 (±0.01)	0.81 (±0.03)
Seasonal catch = 0 tonnes or ICEN > 3	0.20 (±0.01)	0.17 (±0.01)	0.36 (±0.01)	0.13 (±0.00)	0.11 (±0.00)	0.24 (±0.01)
Seasonal catch = 0 tonnes or ICEN > 1.7	1.63 (±0.06)	1.36 (±0.05)	3.00 (±0.11)	1.09 (±0.04)	0.91 (±0.03)	2.00 (±0.07)
Seasonal catch = 0 tonnes or ICEN > 3	1.21 (±0.05)	1.01 (±0.04)	2.22 (±0.08)	0.81 (±0.03)	0.67 (±0.03)	1.48 (±0.05)

The Pay-in component

$$TEPI \geq TEPO,$$

where TEPI is total expected pay-in:

$$TEPI = g(GG, PG, r),$$

where GG government grant/support; PG is private sector/NGO contributions; levy/contribution rate by fishing sector.

Closing: Possible risks & challenges for SIF

- Low tax base for the fisheries (for e.g., fishers income should be at least above the poverty datum line as a rule);
- Climate change can make it difficult to accurately predict the future as basis for developing SIF;
- Strong institutions & political from gov't and (IMARPE) to successfully implement SIF.

Acknowledgements

OCEAN CANADA

FISHERIES ECONOMICS RESEARCH UNIT

UBC

Social Sciences and Humanities Research Council of Canada

Conseil de recherches en sciences humaines du Canada

Canada

Thanks for your attention