

# Credit Market Development and Resource Extraction: Evidence from Global Fisheries

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## Discounting and resource use

- ▶ Credit markets developed rapidly over the last decades reducing the discount rates of resource harvesters.
- ▶ Lower discount rates
  1. Increase the value of future resource stocks and encourage conservation (environmental economist's view).
  2. Incentivize investment in harvesting capital and leads to increased harvesting (development economist's view).
- ▶ *Does credit market development lead to more resource conservation or increased resource extraction?*
- ▶ We derive testable predictions using a dynamic model of resource use with credit market imperfections and insecure property rights.
- ▶ Test the predictions using data from global fisheries, property rights security and credit market development.

# Summary

- ▶ Our model predicts that credit market development incentivizes more resource extraction under open access and can either increase or reduce resource extraction under secure property rights over resources.
- ▶ We estimate the impact of credit markets on resource harvesting using
  1. data on harvests and stock sizes of  $\sim 8,600$  commercially harvested fish stocks over 65 years,
  2. exogenous changes in property rights security induced by the implementation of exclusive economic zones and
  3. changes in lending interest rates and total volumes of credit to the private sector.
- ▶ We find that credit market development increase resource harvesting under open access and reduces resource harvesting under secure property rights.

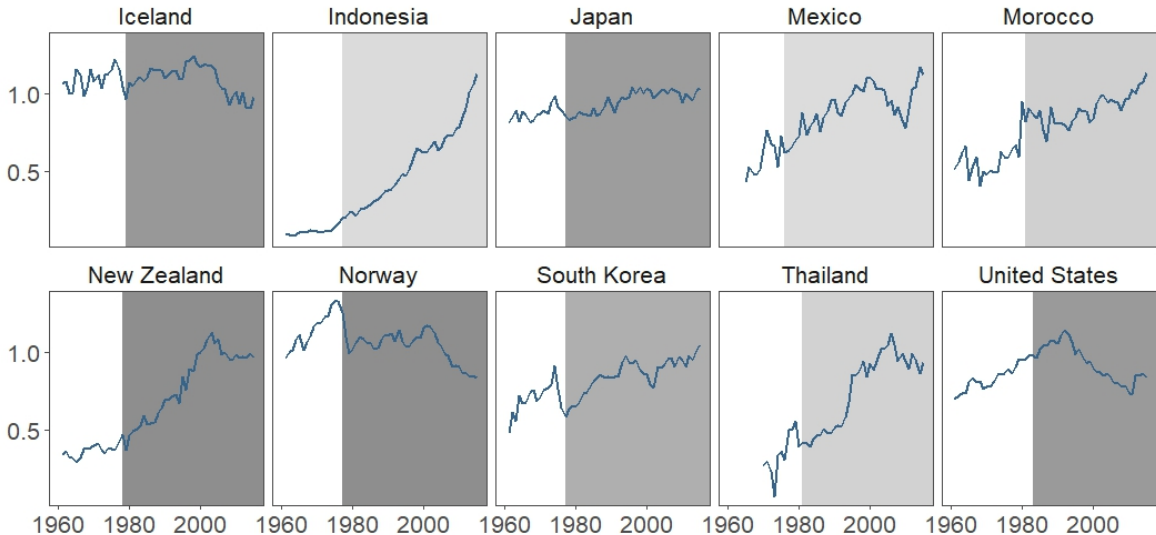
# Resource Extraction

- ▶ We measure resource extraction as the fraction of the resource stock that is harvested (fishing mortality) relative to the level that maximizes long-term harvest (maximum sustainable yield).
- ▶ Catch and stock data are from the FAO and the RAM legacy database.
- ▶ The RAM legacy database includes stock assessments and catch data.
- ▶ The FAO database includes only catch data. Stock data for the FAO catch data are simulated using the method of Costello et al. (2016, PNAS).

## Data: Property Rights Security

- ▶ Marine resources were mostly open access before  $\sim$  1982.
- ▶ Countries suddenly gained exclusive rights over marine resources within a 370 km zone (EEZ).
- ▶ The time of implementation and the ability to enforce these rights differed between countries.
- ▶ Our property rights security measure equals 0 before the implementation of the EEZ and the normalized Rule of Law Index from the World Bank afterwards.

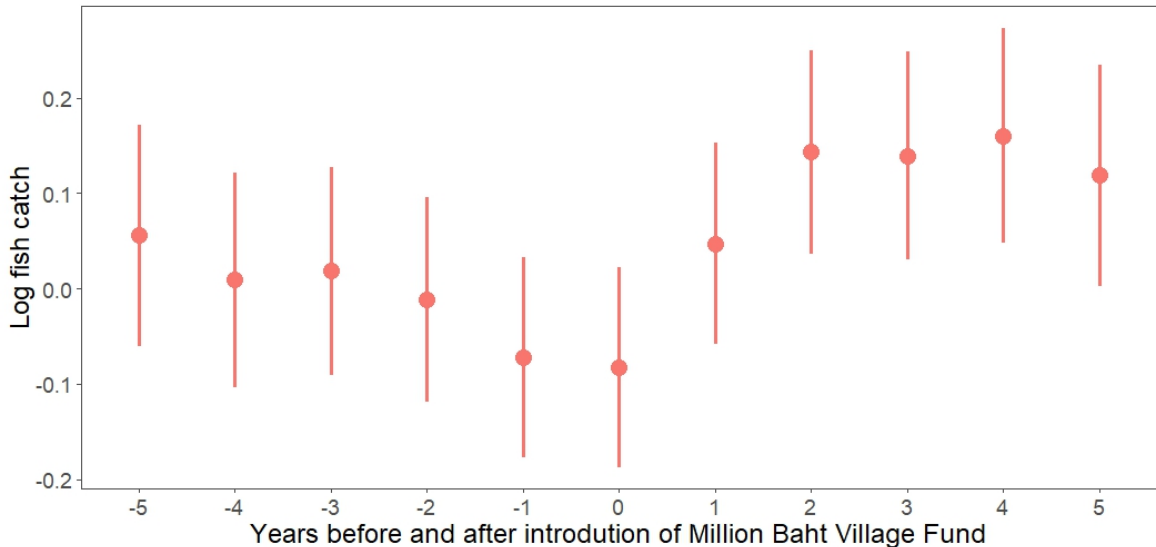
# Property Rights and Resource Extraction



# Data: Credit Market Development

- ▶ We define credit market development as a reduction of the interest rate or an increase of the borrowing limit.
- ▶ Data
  1. Harvester's interest rates: Lending interest rate to the private sector from the International Monetary Fund, International Financial Statistics.
  2. Regulator's interest rates: Interest rates for government bonds from the International Monetary Fund, International Financial Statistics.
  3. Borrowing limit: Volume of private credit to the private sector relative to GDP levels from Beck et al. (2010).

## Event study: Thai Million Baht Village Fund (Year 0 = 2001)





## Empirical approach

- ▶ Regression equation:

$$\begin{aligned} \text{harvest}_{ijt} = & \gamma_1 \text{rights}_{ijt} + \gamma_2 \text{credit}_{jt} + \gamma_3 \text{rights}_{ijt} \times \text{credit}_{jt} \\ & + \text{inflation}_{jt} + \text{gdp}_{jt} + \text{gdp}_{jt}^2 + \mu_{ij} + \nu_t + \varepsilon_{ijt} \end{aligned}$$

- ▶  $\mu_{ij}$  and  $\nu_t$  are stock country level and year fixed effects.
- ▶ All variables are transformed using inverse hyperbolic sine transformation demeaned at the stock-country level (except for the property rights indicator).
- ▶ GDP levels and inflation rates are from the World Bank World Development Indicators.
- ▶ Controlling for autocorrelation and country level trends in robustness checks.
- ▶ Standard errors are clustered at the country level.

## Results: Private Sector Interest Rates and Resource Extraction

	Baseline	Main	Trend	AR
Lending interest	0.05 (0.03)	-0.11** (0.05)	-0.10* (0.06)	-0.05** (0.02)
Property rights	-0.15*** (0.05)	-0.24*** (0.06)	-0.22*** (0.07)	-0.11*** (0.02)
Lending interest × Property rights		0.25*** (0.05)	0.20*** (0.08)	0.10*** (0.02)
Stock & Year FE	✓	✓	✓	✓
GDP, GDP <sup>2</sup> , Inflation	✓	✓	✓	✓
Country trends			✓	
Autoregressive term				✓
Observations	89,199	89,199	89,199	89,199

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

## Results: Private Credit and Resource Extraction

	Baseline	Main	Trend	AR
Private credit	-0.09*** (0.02)	0.12** (0.05)	0.05 (0.06)	0.04** (0.02)
Property rights	-0.15*** (0.04)	-0.21*** (0.06)	-0.18*** (0.06)	-0.09*** (0.02)
Private credit × Property rights		-0.40*** (0.12)	-0.29** (0.14)	-0.15*** (0.04)
Stock & Year FE	✓	✓	✓	✓
GDP, GDP <sup>2</sup> , Inflation	✓	✓	✓	✓
Country trends			✓	
Autoregressive term				✓
Observations	89,199	89,199	89,199	89,199

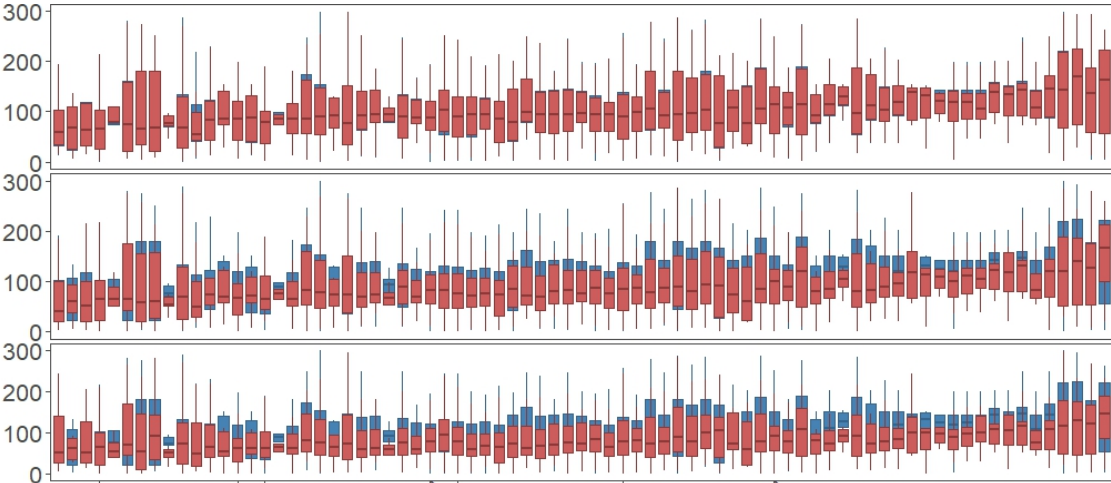
\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

## Results: Government Interest Rates and Resource Extraction

	Baseline	Main	Trend	AR
Interest bonds	0.16*** (0.06)	-0.08 (0.09)	-0.01 (0.10)	-0.06 (0.05)
Property rights	-0.02 (0.07)	-0.20*** (0.07)	-0.11* (0.06)	-0.11*** (0.04)
Interest bonds × Property rights		0.33** (0.14)	0.11 (0.15)	0.14** (0.06)
Stock & Year FE	✓	✓	✓	✓
GDP, GDP <sup>2</sup> , Inflation	✓	✓	✓	✓
Country trends			✓	
Autoregressive term				✓
Observations	37,349	37,349	37,349	37,349

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

# What if interest rates drop to US levels and property rights were



United States

Indonesia  
Mexico

Iceland  
Japan

South Korea

Thailand

# Conclusions

- ▶ Credit markets develop fast around the globe while many resources are harvested beyond sustainable levels.
- ▶ Credit market development leads to increased harvesting rates when property rights over resources are weak but reduces harvesting rates when property rights over resources are strong.
- ▶ Increasing property rights security over resources can reverse the negative impact of economic development on resource conservation.