

Presentation given at the Marine Katoomba meeting

**Katoomba XVI:
Building a Blueprint to Harness New Investment for the Protection
of Marine and Coastal Ecosystem Services**

February 9-10, 2010

Moore Foundation, Palo Alto, CA

Hosted by the Katoomba Group



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Fishing quota markets

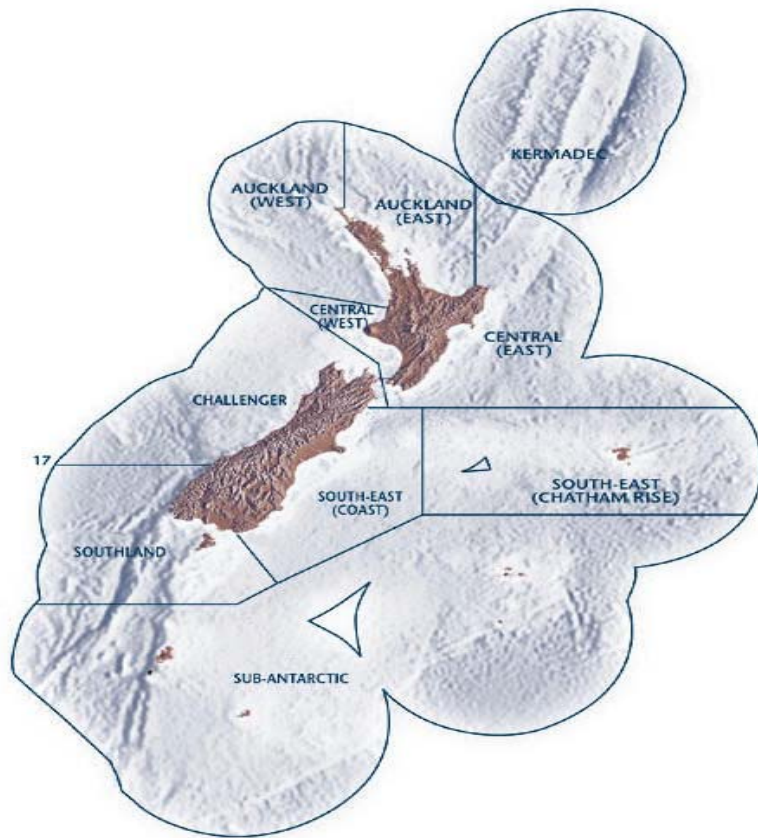
- Participation, activity, and economic returns
 - New Zealand
- Innovative trading rules
 - New Zealand and Iceland examples
- Evolution of rules
- Conclusion



Individual fishing quota systems

- Individual fishing quota (IFQ) systems
 - Cap and trade, like SO₂ tradable permit system
 - Set a total allowable catch (TAC)
 - Allocate quota (right to catch an amount of fish each year in perpetuity)
 - Based on past catch history and distributed free of charge
 - Permit quota trading

New Zealand's IFQ system

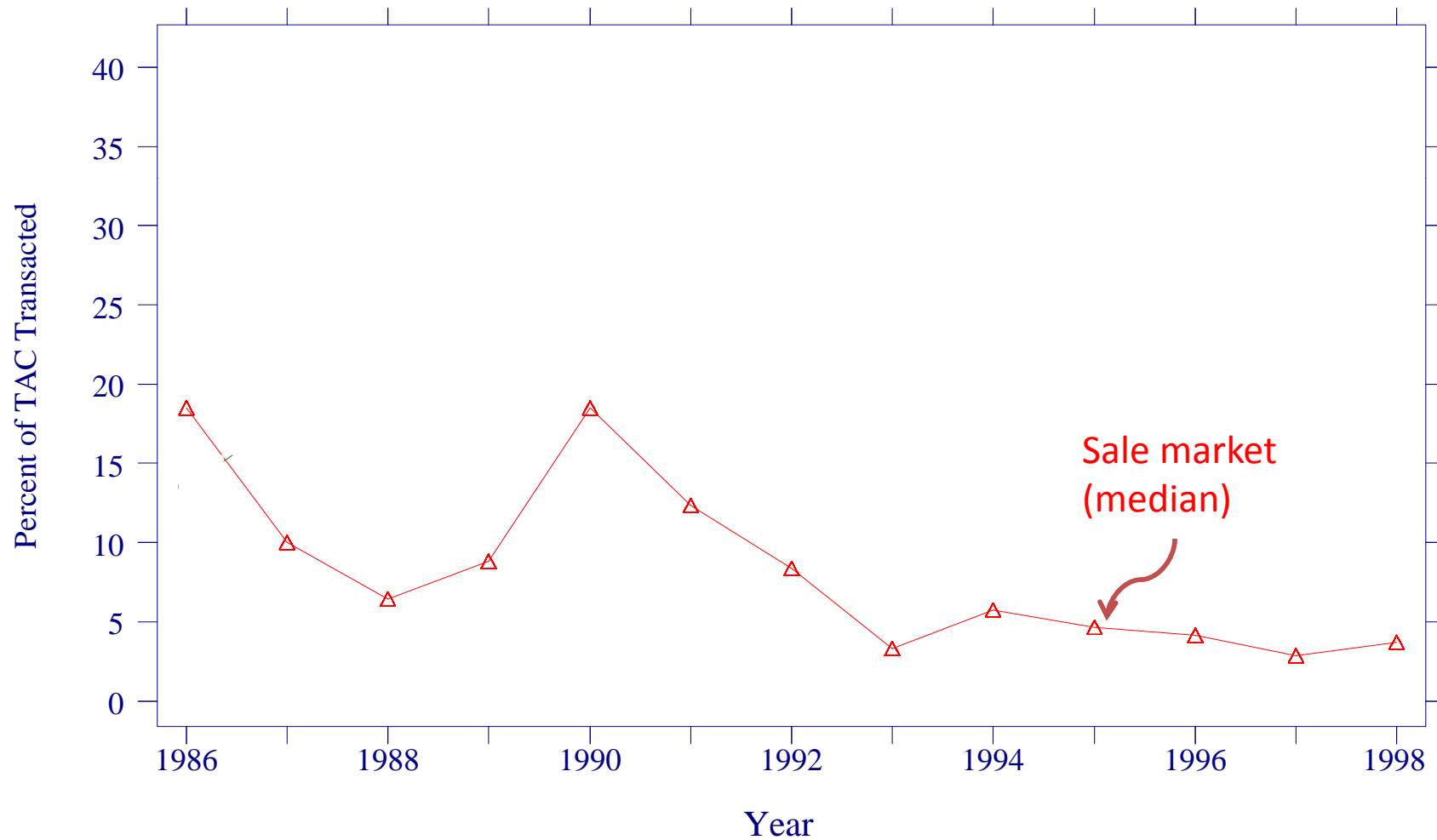


- Markets for both annual lease and sale of perpetual right to share of TAC
- Trading within species/region-specific markets
 - Over 100 species and 500 different markets
- Aggregation limits imposed on owning quota for some stocks and for some combination of stocks
- Compliance and enforcement: detailed set of record keeping, on-board observers, satellite monitoring

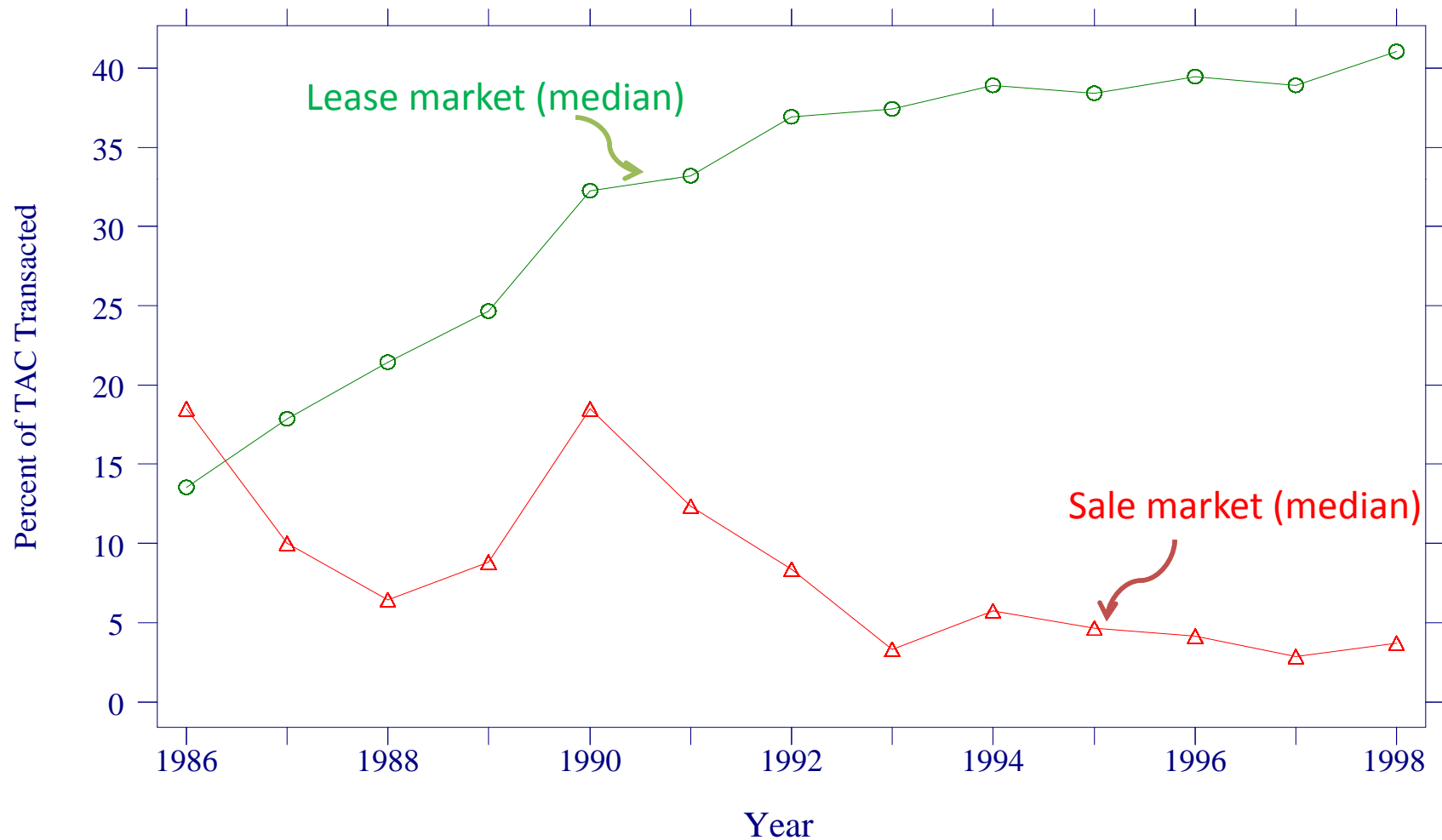
Market activity

- Brokers facilitate transactions between small and medium-size owners; large owners have quota managers and engage in bilateral trades
- Active markets overall
 - over 140,000 leases and 23,000 sales by 2000
 - median 760 leases (4,000 max.) and 110 sales (1,200 max.) in individual markets
 - markets with low participation and activity tend to be of low economic and biological importance

Trends in quota sales



Trends in quota sales and leases



Evidence of increased profitability

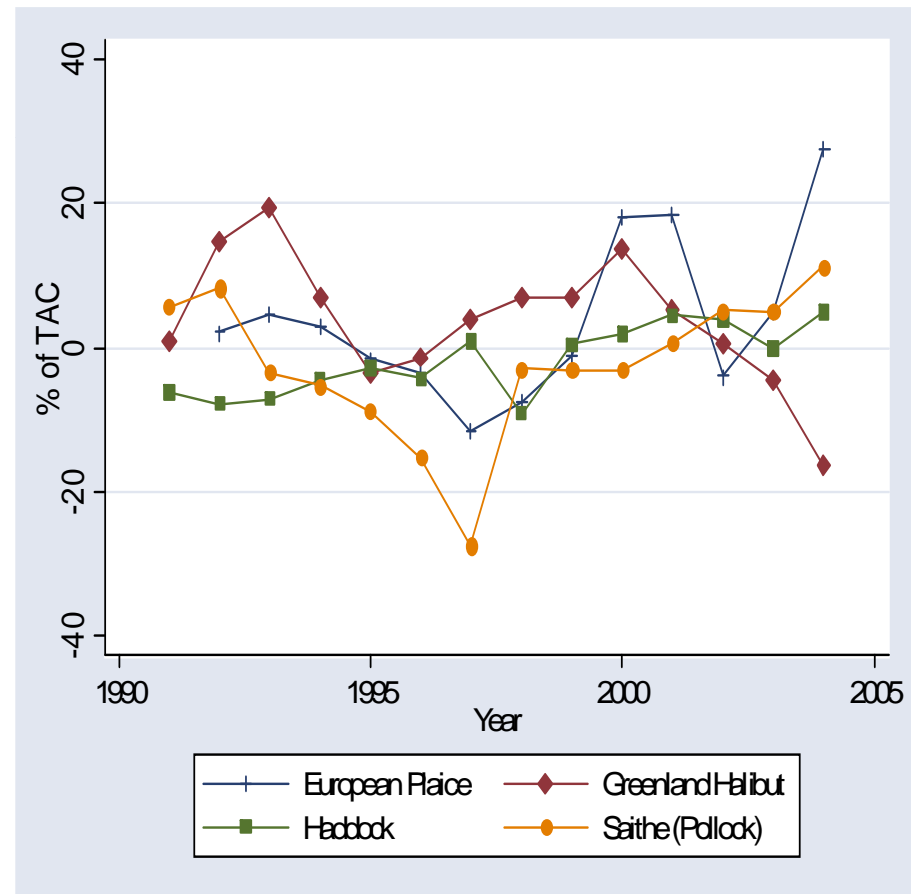
- Natural experiment in New Zealand: Certain stocks faced significant initial reductions in TAC when entering the ITQ system
 - Theory says we should expect greater rate of increase in profitability for stocks that faced significant cuts due to stock rebuilding and consolidation of quota
- After controlling for changes in fish prices, costs, and other determinants, we find
 - 4% vs 1% annual growth rate for leases
 - 9% vs 5% annual growth rate for sales

Innovative trading rules: species exchanges in Iceland

Rules of the exchange

- Cod can be converted at exchange rates into Greenland Halibut, Saithe, Plaice, and Haddock
- Other species can not be converted into cod
- Exchange rates set by government at beginning of season

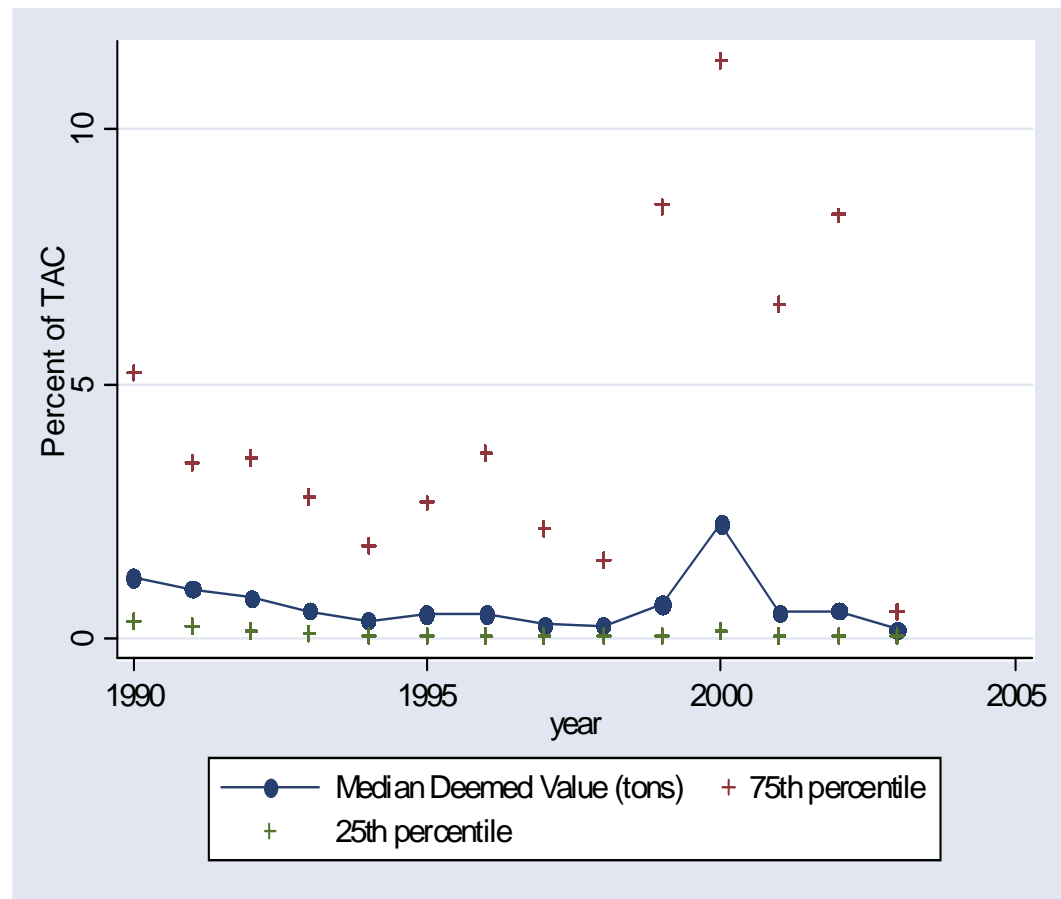
Percent of total allowable catch



Other flexibility mechanisms

- Balance catches with quota holdings
 - Deemed value payment (safety valve)
 - Pay a fee to cover your overage
 - Banking and borrowing
 - Borrow from next year's TAC allotment

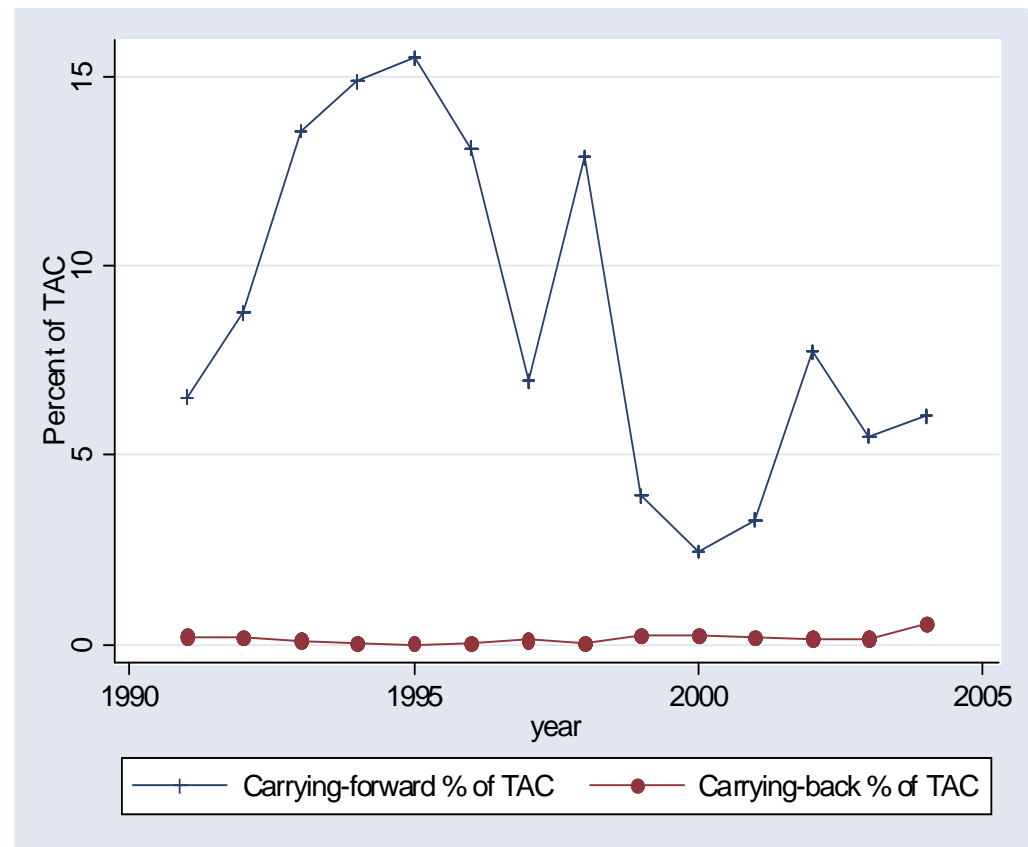
New Zealand



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New Zealand



Evolution of market designs

- ITQ programs are not static institutions
 - Nova Scotia had a species exchange but scrapped it because it was too complex and costly to manage
 - New Zealand has changed the way deemed value payments are structured
 - British Columbia started out by not permitting leasing but is beginning to introduce it
 - Many programs have changed the amount that can be banked or borrowed

Conclusions

- Fishing quota markets are performing well
 - Evidence of significant participation, market activity, increased profitability throughout the globe
- Market designs have been very progressive and evolve over time
 - Species exchanges, deemed values, baskets, banking, and borrowing
- Develop a constituency that could pay for protection of nursery habitat and improved water quality

Articles used in presentation

- Newell, R., Papps, K., and J. N. Sanchirico. Asset Pricing in Created Markets for Fishing Quota. ***American Journal of Agricultural Economics***. 89(2) (May 2007): 259–272
- Sanchirico, J.N., D. Holland, K. Quigley, and M. Fina. Catch-quota balancing in Multispecies Individual Fishing Quotas. ***Marine Policy*** 30(6): 767-785, 2006.
- Newell, R., J. N. Sanchirico, and S. Kerr. Fishing Quota Markets, ***J. of Environ. Econom. Management***, 49(3): 437-462, 2005.
- Kerr, S., R. G. Newell and J. N. Sanchirico. Evaluating the New Zealand Individual Transferable Quota Market for Fisheries Management. In Tradeable Permits Policy Evaluation, Design and Reform: OECD pp. 121–134, 2004.
- Sanchirico, J. N. and R. Newell. Catching Market Efficiencies: Quota-based Fishery Management, **Resources**, No. 150, Spring 2003.

IFQ systems

Potential benefits

- Gains from ownership
 - Reduce excess effort (e.g., redundant capital)
 - Shift from maximizing quantity to quality
- Gains from trade
 - Rationalize the fishery via market forces
- Rebuild fish stocks
 - If the TAC is set to allow recovery
- Each of these gains will increase profitability

Potential issues

- Biological
 - Total allowable catches set too high
 - Incentives to keep only the more valuable fish
- Economic
 - Performance of market
- Distributional
 - Consolidation and concentration
 - Wealth windfalls to initial quota owners

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New Zealand's IFQ system



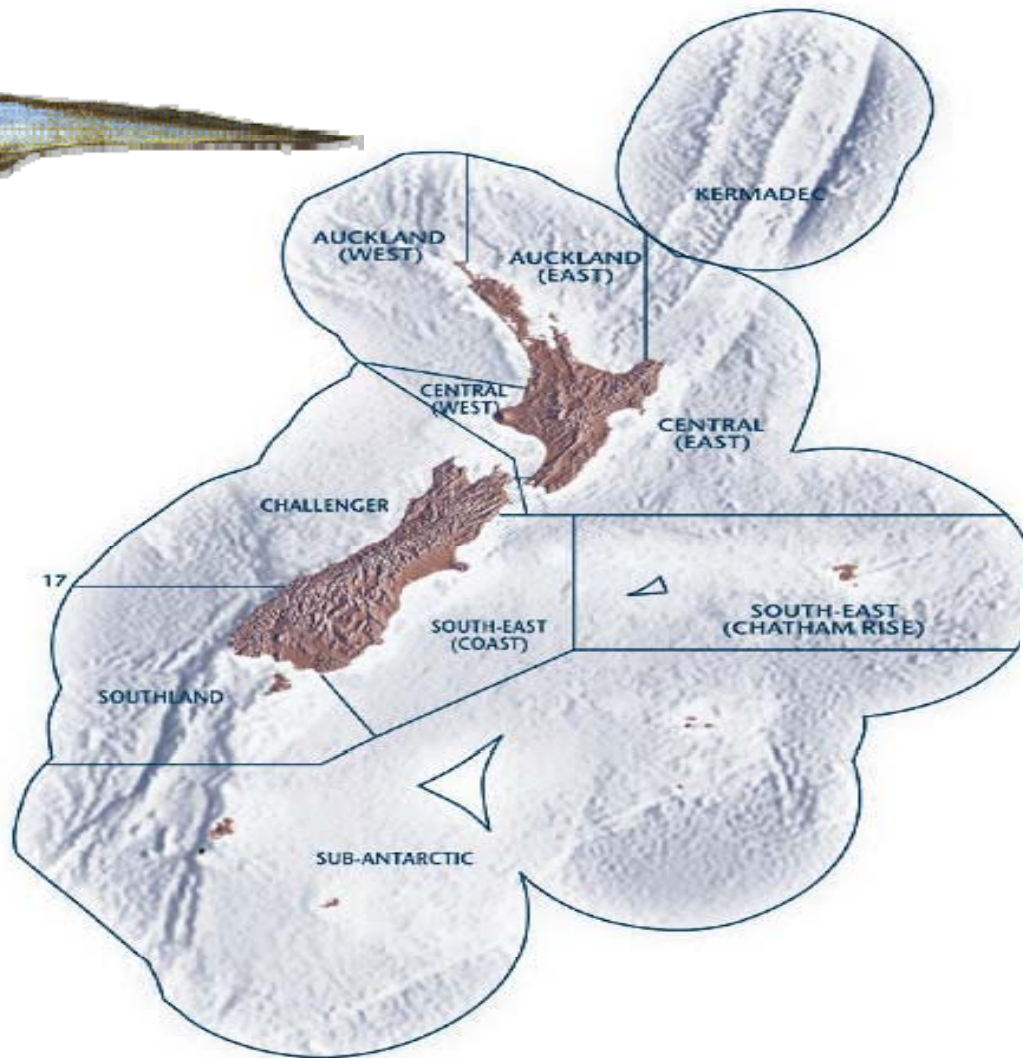
Hoki



Red Snapper



Orange Roughy



Paua



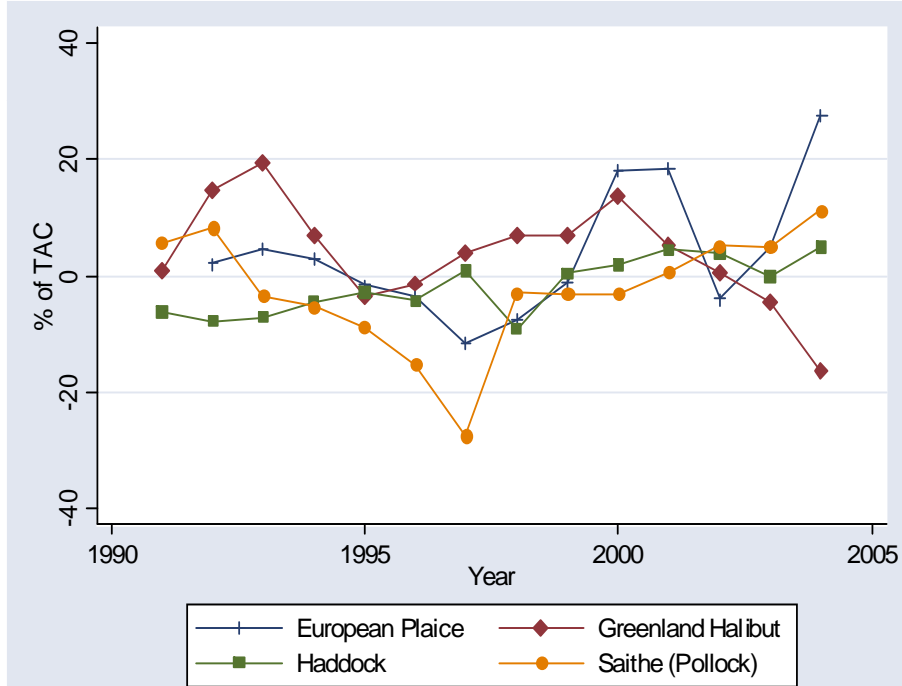
Squid



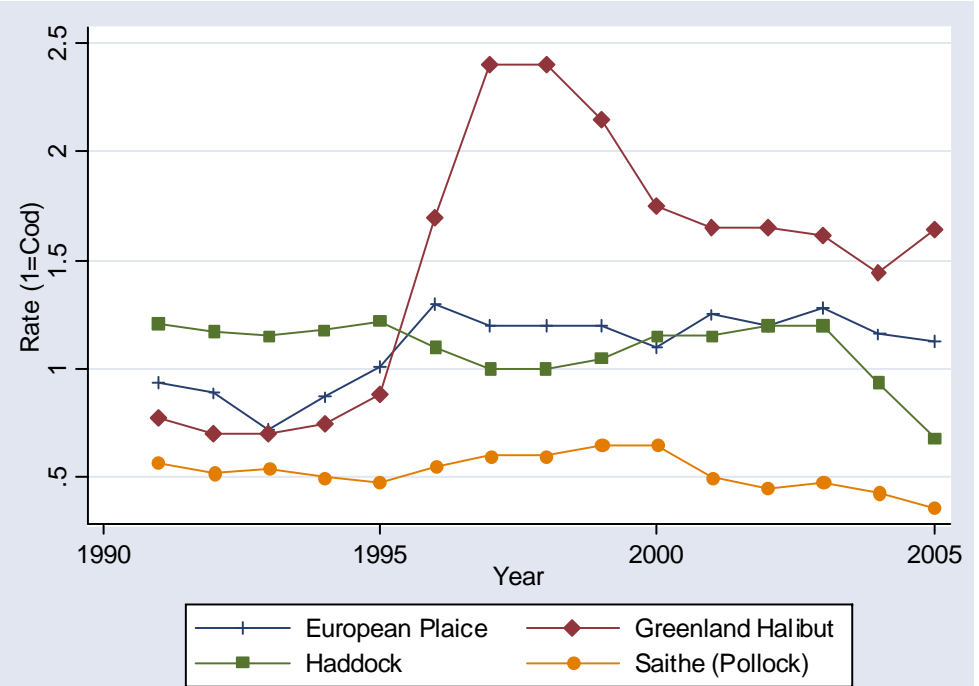
Rock Lobster

Innovative trading rules: species exchanges in Iceland

Percent of TAC



Cod equivalence rates



Current state of (many) fisheries

- Traditional focus on reducing fishing mortality
 - Gear and vessel restrictions
 - Closed seasons and areas
 - Industry catch quotas/“Total allowable catch” (TAC)
- “Too many boats *with too much fishing capital* chasing too few fish”
 - Fish stock levels driven below target levels
 - Excess fishing effort and overcapitalization
- Lower quality product for consumers, less product recovery
- Short-run perspective (no incentive to conserve)

Experience with IFQs

- New Zealand is the world leader in IFQs
 - more than 15 other countries have IFQs, but number of species in NZ greater than all others together
- U.S. has 4 existing IFQ programs
 - moratorium from 1996 to October 2002
 - ongoing debate about whether to adopt fishing quota systems and if so, whether to allow trading/leasing of quota
- While reviews are generally positive, anecdotes abound, and empirical record is lacking

N.Z. Fisheries

- Seafood is the 4th largest export earner
- More than 90% of the fishing industry revenue comes from exports
- N.Z. accounts for less than 2% of the world's fishing output
- Approximately 85% of the commercial catch is from fisheries under the quota management system

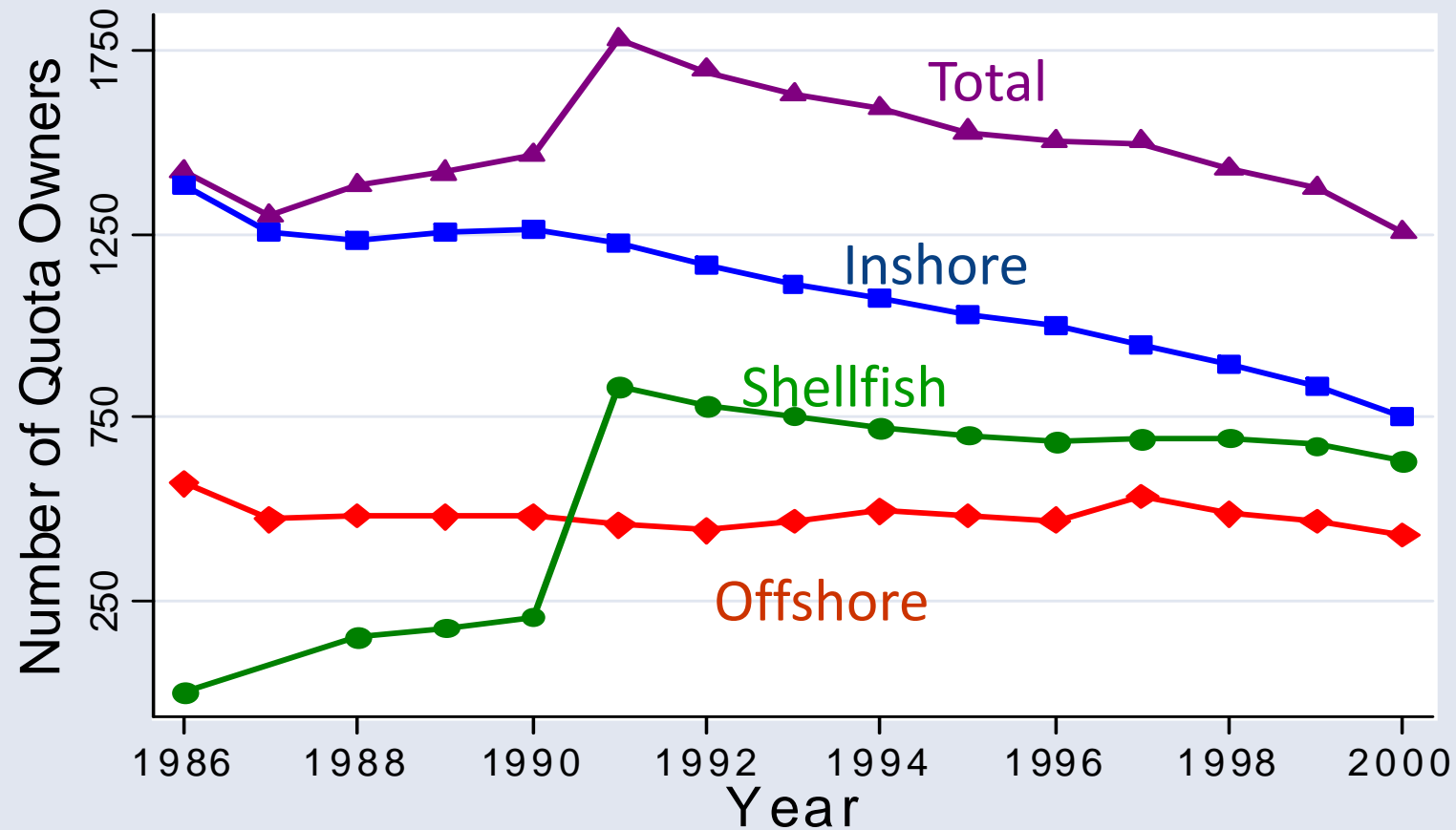
Evolution of N.Z. fishery policy

- 1970's: Domestic fleet operated mainly in inshore fisheries, foreign fleet in the offshore fisheries
- 1978: 200 mile EEZ declared
- 1979-1983: inshore fish stocks began to decline
- 1983: N.Z. government created limited quota system for 9 (offshore) species
- 1986: establishment of IFQ system for 26 species
- 2002: system grows to over 40 species and 225 markets

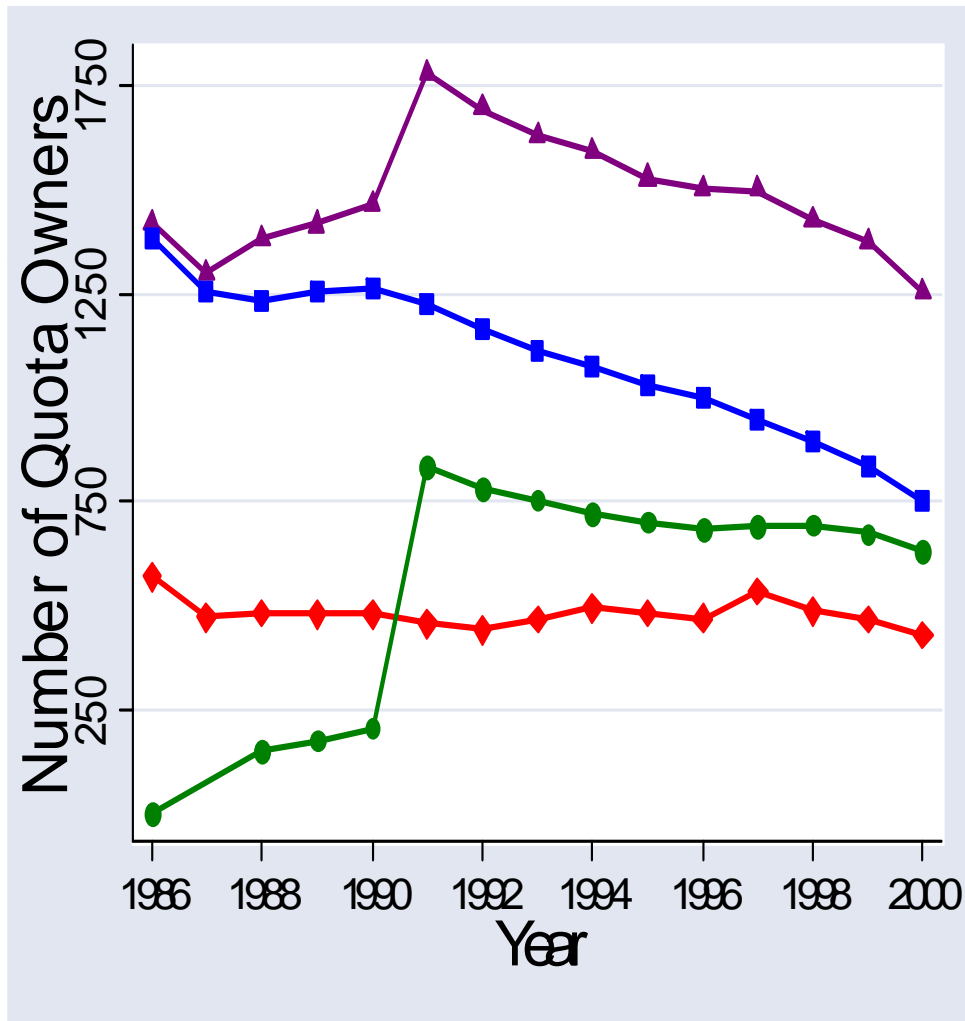
Innovative trading rules: species exchanges in Iceland

- Rules of the exchange
 - Cod is the basis
 - Cod can be converted at exchange rates into Greenland Halibut, Saithe, Plaice, and Haddock
 - Other species can not be converted into cod
- Fishing vessels can use their own holdings or purchase quota for converting to other species

Trends in Number of Quota Owners



Trends in number of quota owners



- Participation by a large number of quota owners
 - 1,400 total owners (historical average)
 - median 47 owners in individual markets (1-430 range)
 - 37% consolidation in number of owners since 1990
 - 90 new quota owners enter annually on average
- Median quota holdings: 3 fish stocks across 3 species in 1 region
- Largest quota holdings: diversified portfolio across all fish stocks and regions

Distribution of Owners over time

- In 1986, share of quota owners
 - Small operations: 50%
 - Medium operations: 35%
 - Large operations: 15%
 - Definitions based on amount of quota owned
- In 2002, share of quota owners
 - Small operations: 48%
 - Medium operations: 25%
 - Large operations: 27%

Part I: Quota lease prices in (simple) theory

- In a competitive market, annual quota lease price equals the annual marginal profit flow or *rent*
lease price = price of fish – marginal cost of catch
- Marginal cost depends on factors of production (labor, fuel, boat technology, gear), biological characteristics, and climatic conditions
 - Stock-dependent fishing costs → costs are lower, the larger the fish population size

Explanatory variables used in the analysis of lease and sale prices

- Price (+): export price of fish
- Input costs (-): NZ fishing input cost index
- Quota demand (+)
 - prior year annual % caught of the TAC
 - year-to-date % caught of TAC, relative to last year
 - interaction of export price and prior year % caught
- Ecological uncertainty (-)
 - climate variability and mortality rate
- Condition of fishery over time (+ for increased profitability)
 - time*stocks with significant initial TAC reductions
 - time*stocks without significant initial TAC reductions
- Other controls
 - GDP growth rate (+), seasonal effects, individual stock fixed effects

Evidence of increased profitability

- Natural experiment: Certain stocks faced significant initial reductions in TAC
 - theory says we should expect greater rate of price increase (profitability) for stocks that faced significant cuts due to stock rebuilding and consolidation of quota
- After controlling for changes in fish prices, costs, and other determinants, we find
 - 4% vs 1% annual growth rate for leases
 - 9% vs 5% annual growth rate for sales

Asset prices

- Under the present value model, quota asset price equals the discounted expected future stream of rents (assuming constant discount rate)

$$S_{ij,t} = \sum_{k=0}^{\infty} \left(\frac{1}{1+r} \right)^{k+1} E_t(L_{ij,t+k})$$

- Equation is derived from relation

$$\text{Stock price}_{ij,t} = \frac{E_t(\text{Stock price}_{ij,t+1} + \text{Dividend}_{ij,t+1})}{(1+r)}$$

and transversality condition (no speculative bubbles)

Rates of return

- Assuming constant expected rents (lease price) and discount rate, asset prices are

$$S_{ij} = \frac{L_{ij}}{r}$$

and the expected rate of return for quota for species i in area j is

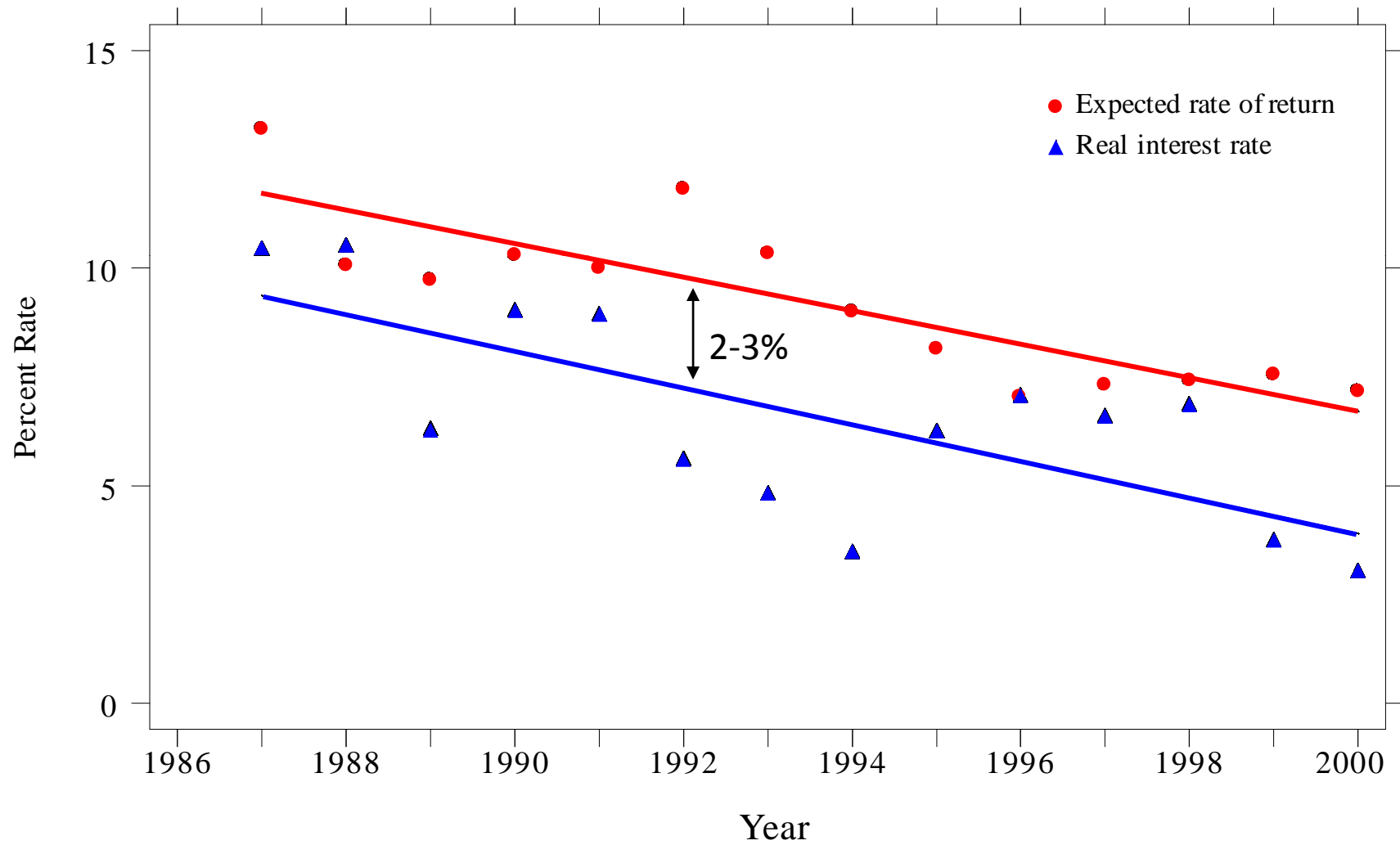
$$\frac{L_{ij}}{S_{ij}} = r$$

- Therefore, the expected rate of return should equal the discount rate (under these assumptions)

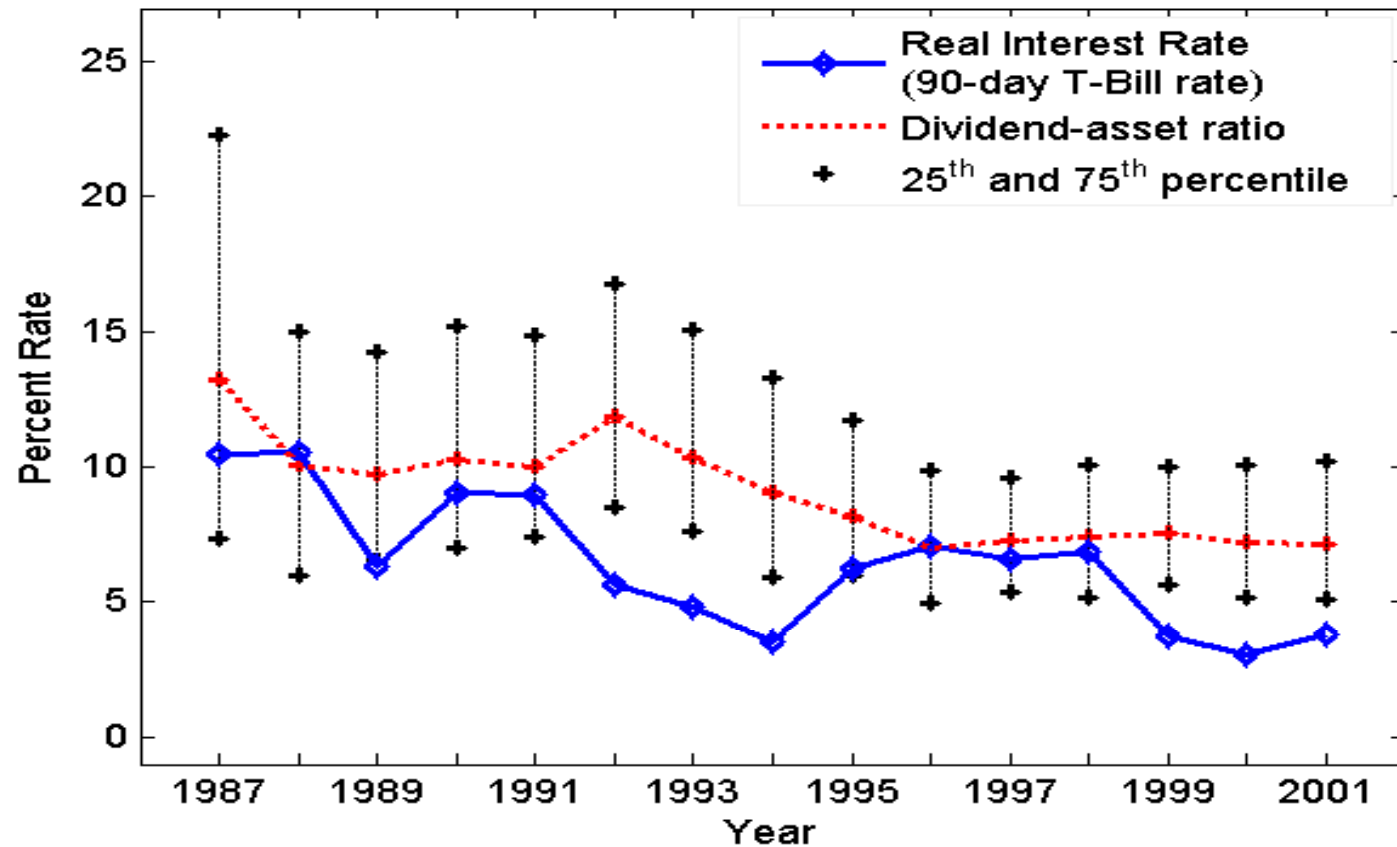
Quota markets “beta”

- What is the appropriate discount rate for fishing quota?
 - Estimated “beta” coefficient reflecting the risk of holding NZ quota relative to the NZ stock market
 - beta is less than one and not statistically different from zero, which implies that there is little undiversifiable risk to holding quota
 - Results consistent with Ellerman and Montero(2002) for SO₂ Allowance Market
- Relevant discount rate for quota is close to the risk-free rate.

Quota arbitrage



Variation in dividend-asset ratio



Concluding remarks

- Overall, evidence suggests a reasonably high level of liquidity and economic rationality in NZ ITQ markets
- Level of market activity is high, suggesting transferability has a high value
- Evidence is consistent with increased profitability, suggesting ITQ system is delivering on its promise
- Evidence also indicates the biological health of the fish stocks is certainly no worse off, in some cases shows recovery, and in other cases is likely to be improving given current TAC levels

Analysis of market performance

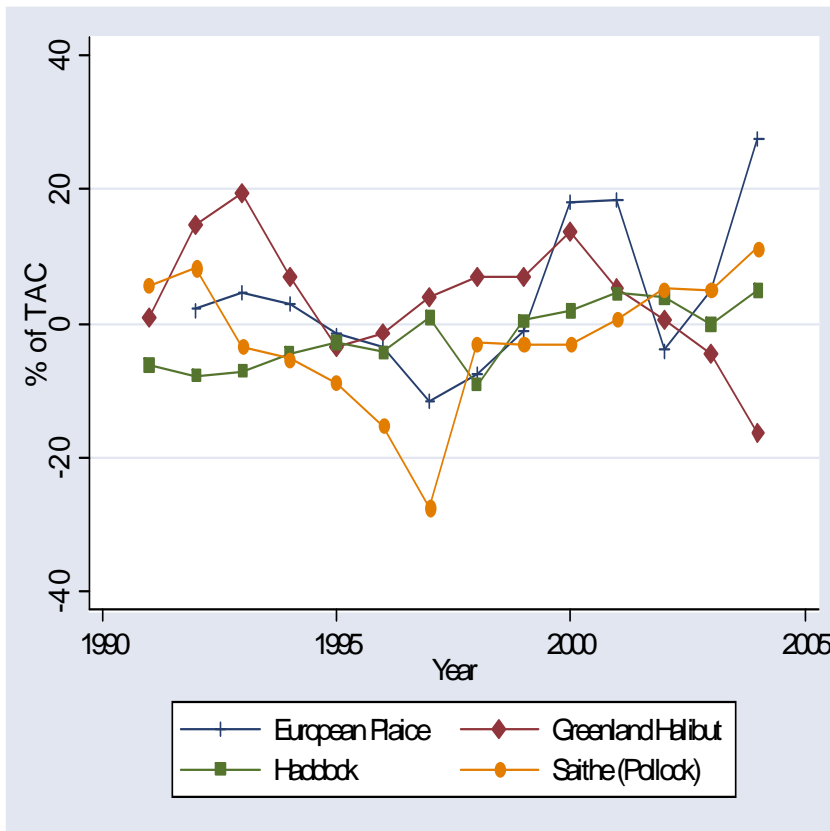
- Level of trading activity is high relative to other created markets
 - over 140,000 leases and 23,000 sales by 2000
 - over 40% of TAC is leased each season in median market
- Investigated whether lease price and sale price reflect underlying fundamentals
 - quota prices increase with increasing fish prices, decreasing costs, increased quota demand, and decreased ecological uncertainty

Managing quotas for multiple outputs

- Rules generally quite flexible
- Fishers can balance catch and quota up to 30 days past landing date
- Can lease or buy quota in market
- Can pay a deemed value to government, set to eliminate any incentive to “target” stocks without quota
- Until recently, could carry forward or borrow up to 10% of the quota owned (no longer allowed)

Innovative trading rules: species exchanges in Iceland

Percent of total allowable catch



Rules of the exchange

- Cod can be converted at exchange rates into Greenland Halibut, Saithe, Plaice, and Haddock
- Other species can not be converted into cod but they can be converted into other species

Data used for analysis

- Panel data for period 1986-2001
- Data on prices and quantities of transactions, export prices, input costs, quota ownership, TAC, catch, biological data, climate variation
- 33 species, 10 regions, 157 fish stock markets
- Over 170,000 market transactions
- Thousands of different quota holders

N.Z. IFQ system design features

- Quota in tons, based on share of TAC
 - TAC is set to move the populations towards maximum sustainable yield
- Markets for both annual lease and sale of perpetual right to share of TAC
- Trading within species/region-specific markets
- Aggregation limits imposed on owning quota for some stocks and for some combination of stocks
- Compliance and enforcement: detailed set of record keeping, on-board observers, satellite monitoring

Examples of species included



Hoki



Rock Lobster



Squid



Red Snapper



Paua



Orange Roughy