

Coping with stochasticity in fish stocks under costly capital adjustment and high information costs

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Structure of the presentation

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 - History
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 - Bio-economic models
- Problem
- Central research problem
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 - Conclusions



Background - history

- Until 1954 research on the fishing industry focused on the field of biology
(Gordon 1954)
- Fisheries management was intended for the benefit of man and not fish
(Burkenroad 1953)
- Economic benefits from natural resource management depend on the biological response to changes in the methods of exploitation



Background – initial problem

- Open access fisheries operate in a socially suboptimal manner
(Gordon 1954)
- The resource stock is the factor of production for all fishermen
 - incentives for fishermen to operate with a short-term interest
 - fishing as much and as quickly as possible
 - overexploitation of fish stocks
 - to be a strong competitor → overinvest in capacity
 - higher costs and decreasing profits



Background – bioeconomic models

- Extensive number of models developed, integrating biological and economic aspects
 - analyse the fisheries management systems
 - how the economic and biological characteristics interact
- Parallel to the capital investment model was the biological growth of fish as the natural production function
 - if the biological part of the model was not well specified the economic part would have little value
(Munro 1992)



Background – bioeconomic models

- Problem of over-fishing → the impact of capital adjustment has become an important issue in fisheries economics
(Clark et al. 1979; Eisenack et al. 2006)
 - system of dynamically interacting fish stock and capital stock
- Fishery management may fail if the financial aspects and consequences are not analyzed (Bulte and Pennings 1997)
- Only recently...
 - stochastic characteristics of fish stocks and the socio-economic elements of fisheries management need to be addressed jointly
(Singh et al. 2006; Christensen and Raakjaer 2006)



Problem

- Many management systems have been proposed
 - restrictions on entry, restrictions on effort and landing rights
- However...
 - fish stocks are dynamic, uncertain and not well understood by decision makers
 - under harvest constraints, highgrading
- Therefore...
 - difficult for managers to set management regimes at the right level to prevent overexploitation and overcapitalisation



Problem

- In the EU primary focus of fisheries management
 - population biology
 - little attention for the economic aspects (*Grieve 2001; EC 2008*)

- Total Allowable Catch (TAC) levels annually adjusted
 - high public costs
 - to re-establish TAC levels, researchers, policy makers and stakeholder organisations need to come together
 - high private costs (*Singh et al. 2006; Christensen and Raakjaer 2006*)
 - continuously adjusting the fisheries capital stock or leaving the existing capacity inactive



Central research problem

- Do current fisheries management systems balance the need to regularly adjust fisheries policy to new information on one hand, and the costs of gathering information and adjusting fisheries capacity on the other hand?
 - multi-annual management plans, 2002 reform of the Common Fisheries Policy (*EC 2002*)



Research aims

- Yield knowledge on how existing fisheries management models account for stochasticity in fish stocks, information costs and capital adjustment costs
- Give new insights into the possibility of a multiannual quota system for single-species and multiple target species
- Provide perspective on how current annual quota systems perform relative to multi-annual quota systems



Research questions

- Taking into account fish stock uncertainty, information costs and capital adjustment, how can timing of changes in effort and annual changes in TAC levels be optimized in order to allow for sustainable fisheries?
- How can the analysis on optimal timing in policy making be extended to account for multiple target species fisheries?
- How can the study on single-species be extended to analyse the role of TAC and TAE in highgrading?



Model and preliminary results

Biological sub-model

Fish stock

Biological growth of fish

Economic sub-model

Effort

Harvest

Capital stock

Investment, Destruction, Overcapacity

Transaction costs

Find optimal policy that maximizes Net Benefit under annual and multiannual quota system

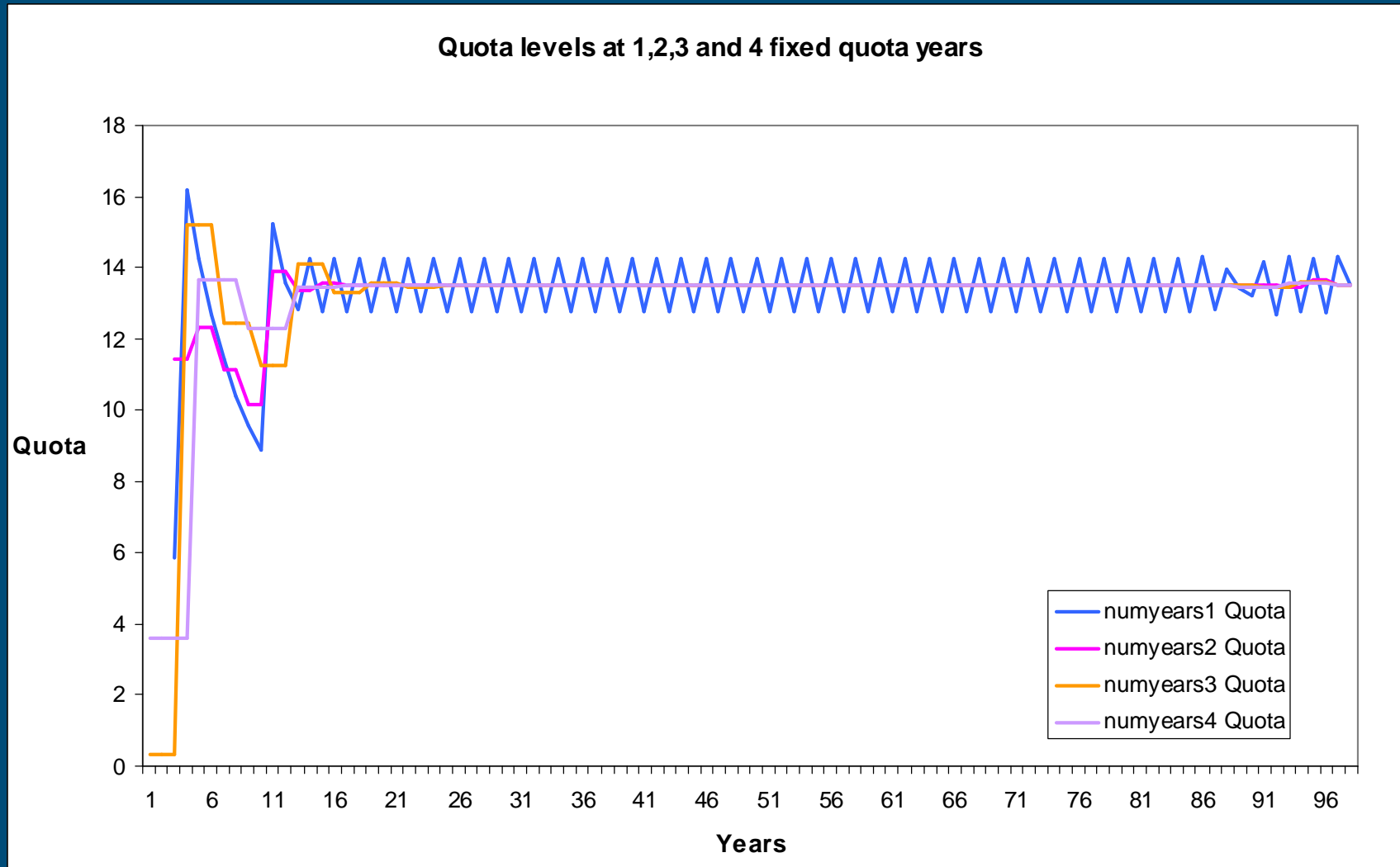
Optimal Quota

Optimal Investment path

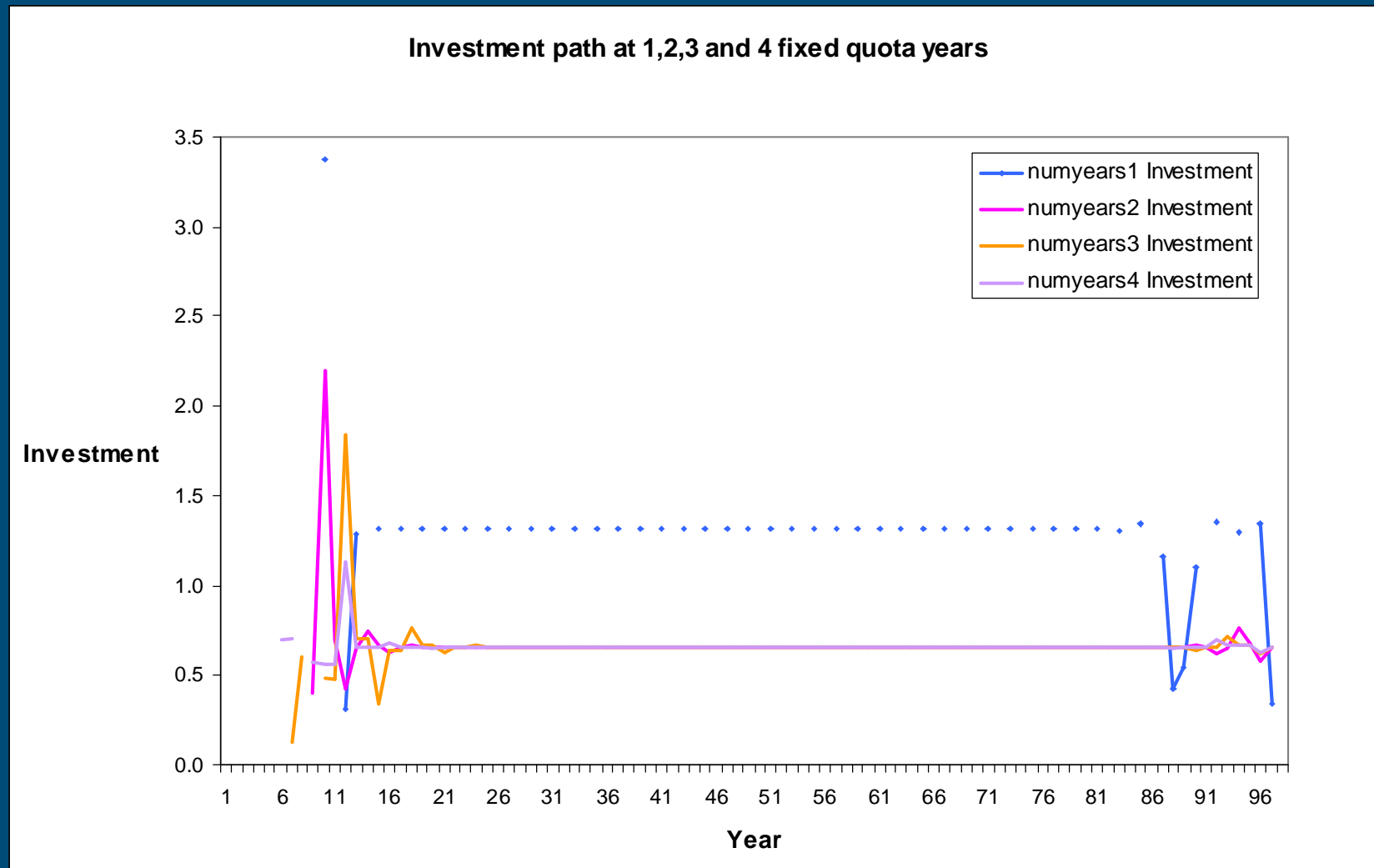
Total Net Benefit



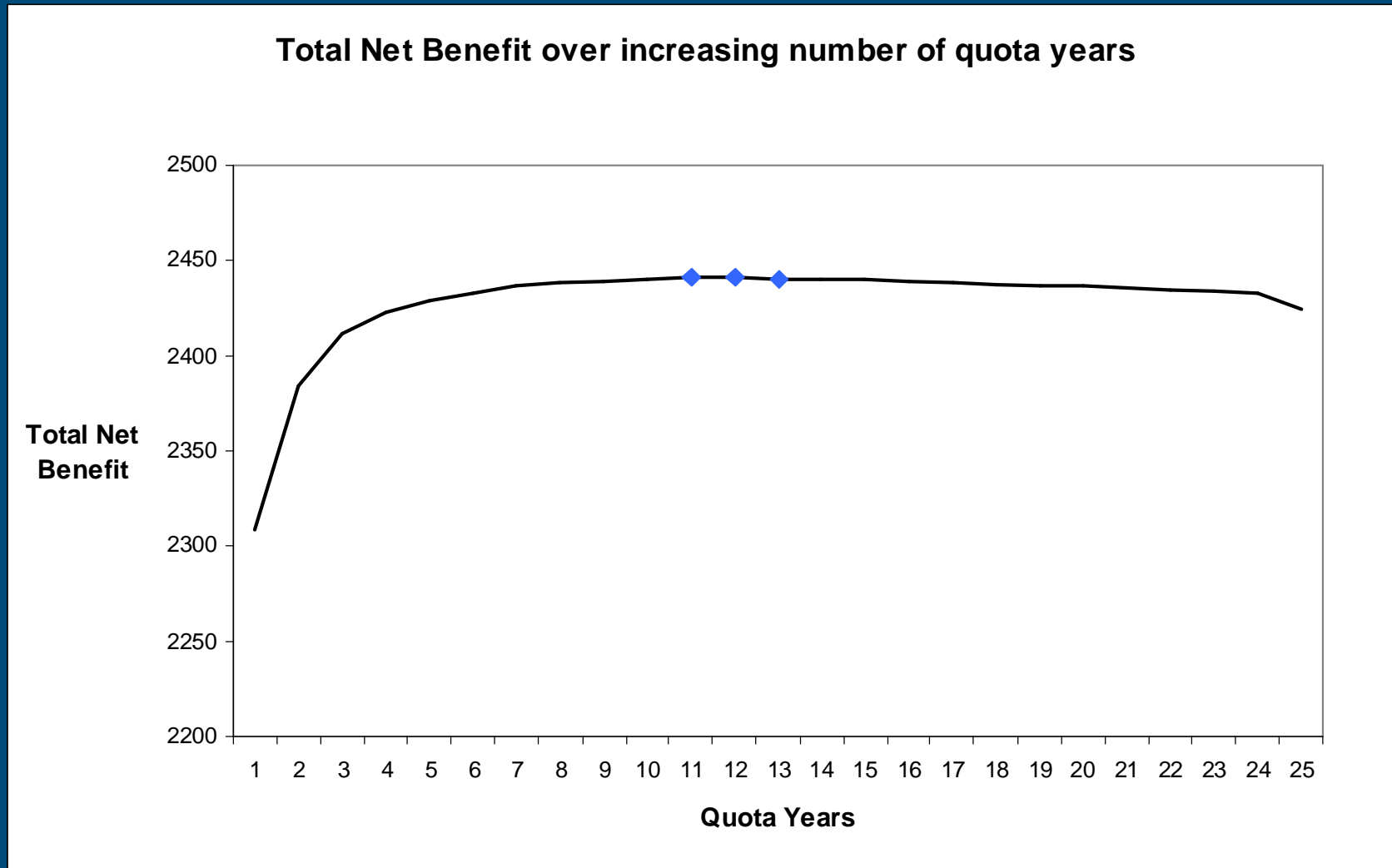
Preliminary results – North Sea plaice



Preliminary results – North Sea plaice



Preliminary results – North Sea plaice



Conclusions

- As number of quota years increases:
 - Optimal quota
 - less fluctuation and more stable path towards steady state (final year)
 - Optimal investment path
 - less fluctuation and more stable path
 - lower investments
 - Total net benefit
 - total NB increases
 - with highest values at 11, 12 and 13 quota years
 - marginal increase highest between 2, 3 and 4 quota years
 - annual transaction costs decrease



Thank you

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