Consequences of Recovering Enforcement Costs in Fisheries

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Outline

- Management expenditures and cost recovery
- Issues & purpose
- Bioeconomic models of cost recovery, policy & outcomes
- Results & Discussion
- Other issues & research directions

Management Expenditures

- Governments spend significant financial resources on fisheries management,
  - especially on enforcement, research, and management administration
- Sumaila, et al. (2016) estimate governments spend about USD 12.0 billion per year on management costs
  - Administration, research and enforcement

Cost Recovery

- Most fishery management programs are entirely financed by general taxpayers
- A few countries have implemented user charges to recover the costs of management
  - Australia
  - Canada
  - New Zealand

Recovery of fishery management costs

- Reasons & considerations
  - Raise revenue
  - Fairness
  - Economic efficiency
    - Improved cost-efficiency in provision of management services
    - Improved efficiency in mix of management services

Issues

- Getting the prices (cost recovery rates) ‘right’
  - Not straightforward in theory or practice
  - Eg. Canada, New Zealand difficulties
  - Ill designed programs can be detrimental
- Careful analysis of cost recovery design needed

Issues

- What are the advantages and disadvantages of different cost recovery methods?
  - User charges
  - Other financing methods (lump sum payments)
- What methods can best improve efficiency?
- How should charges be set & collected?

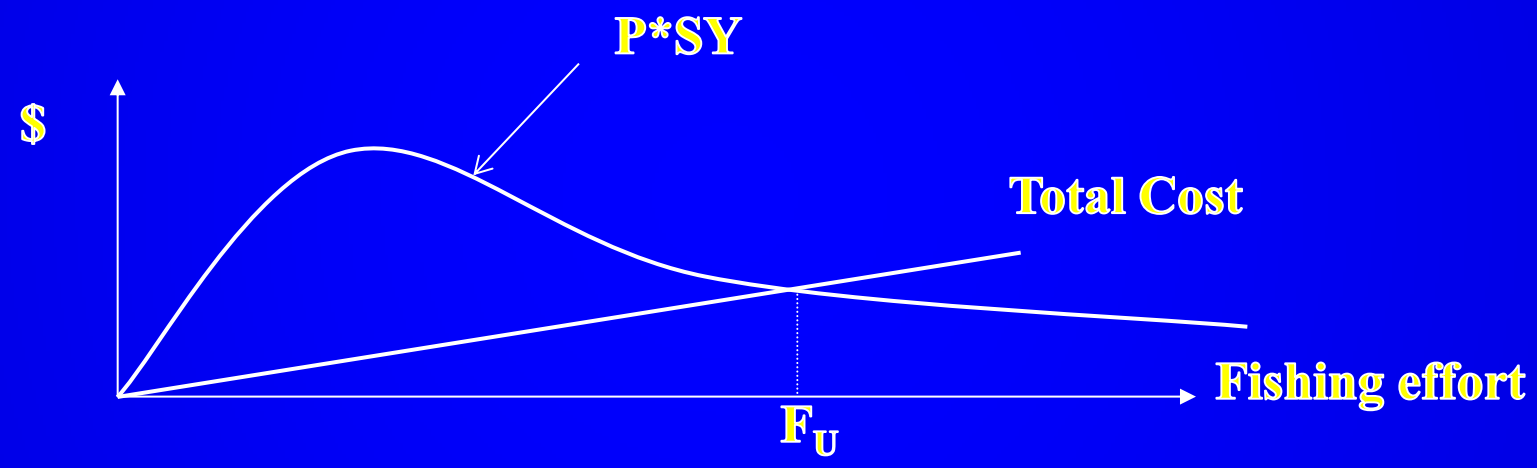
Purpose of this study

- To examine the consequences of applying a royalty to recover enforcement costs
  - By developing formal bioeconomic models to assess consequences for policy & outcomes
- To determine how a royalty r to recover costs affects
  - Policy
  - Biological and economic outcomes

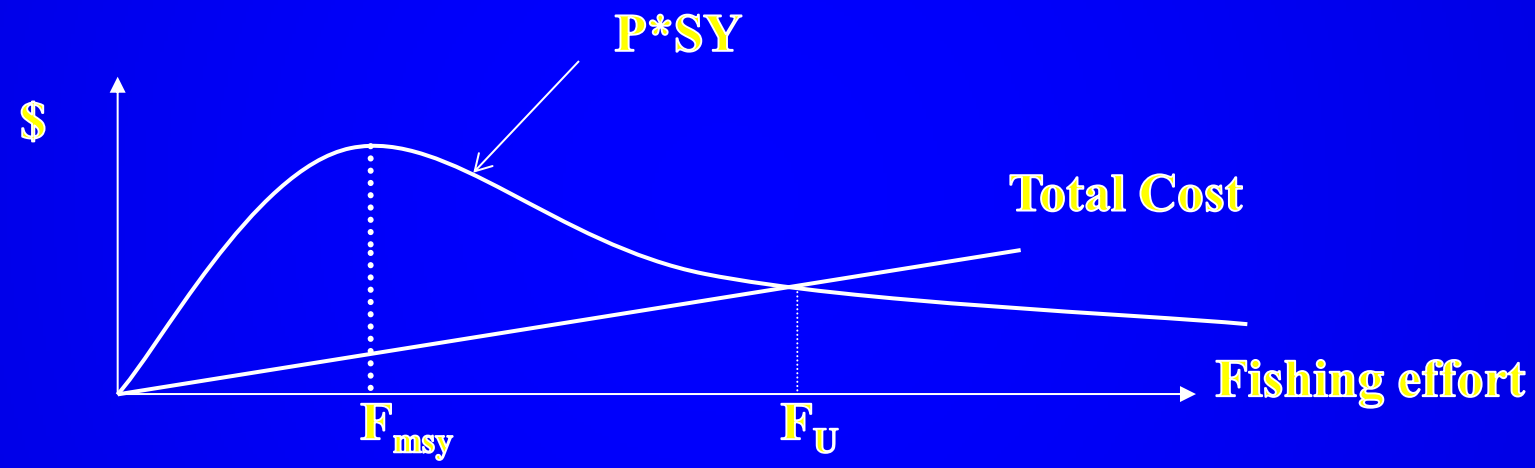
Bioeconomics
Part I

- Basic static bioeconomic model
  - Single species
  - Equilibrium
    - Fish stock
    - Fleet
    - Market
  - Fishery management authority
  - Fisheries enforcement agency

A static bioeconomic model



A static bioeconomic model



Enforcement & Compliance

- Each firm's effort above e_{msy} is illegal
  - *MSY* is management's target level of effort
- Penalty given by

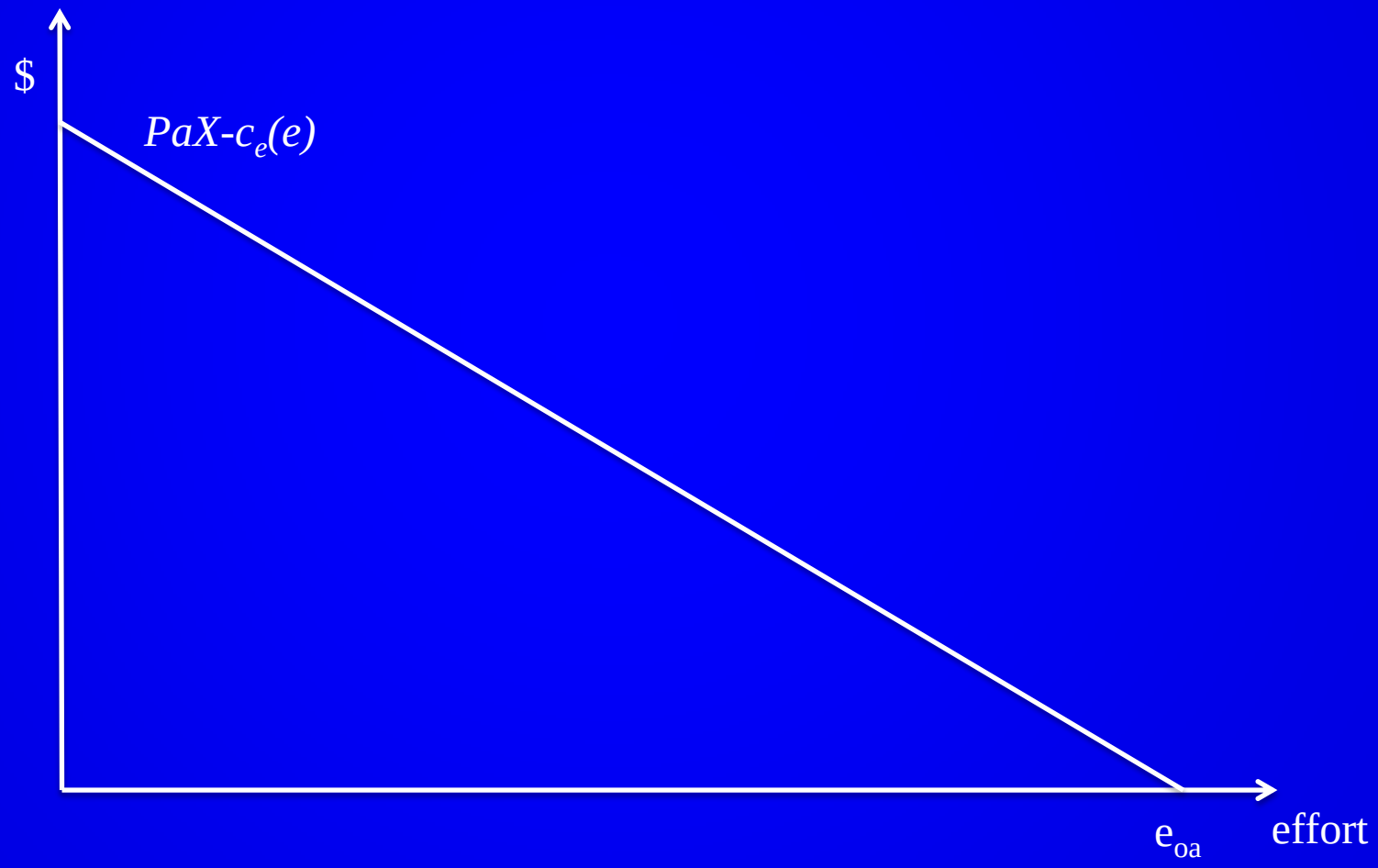
  $f = f(e\text{-}e_{msy})$, where $f_e > 0$ when $e > e_{msy}$

  $f = 0$ otherwise, and $f_{ee} \geq 0$
- Probability of detection & conviction given by

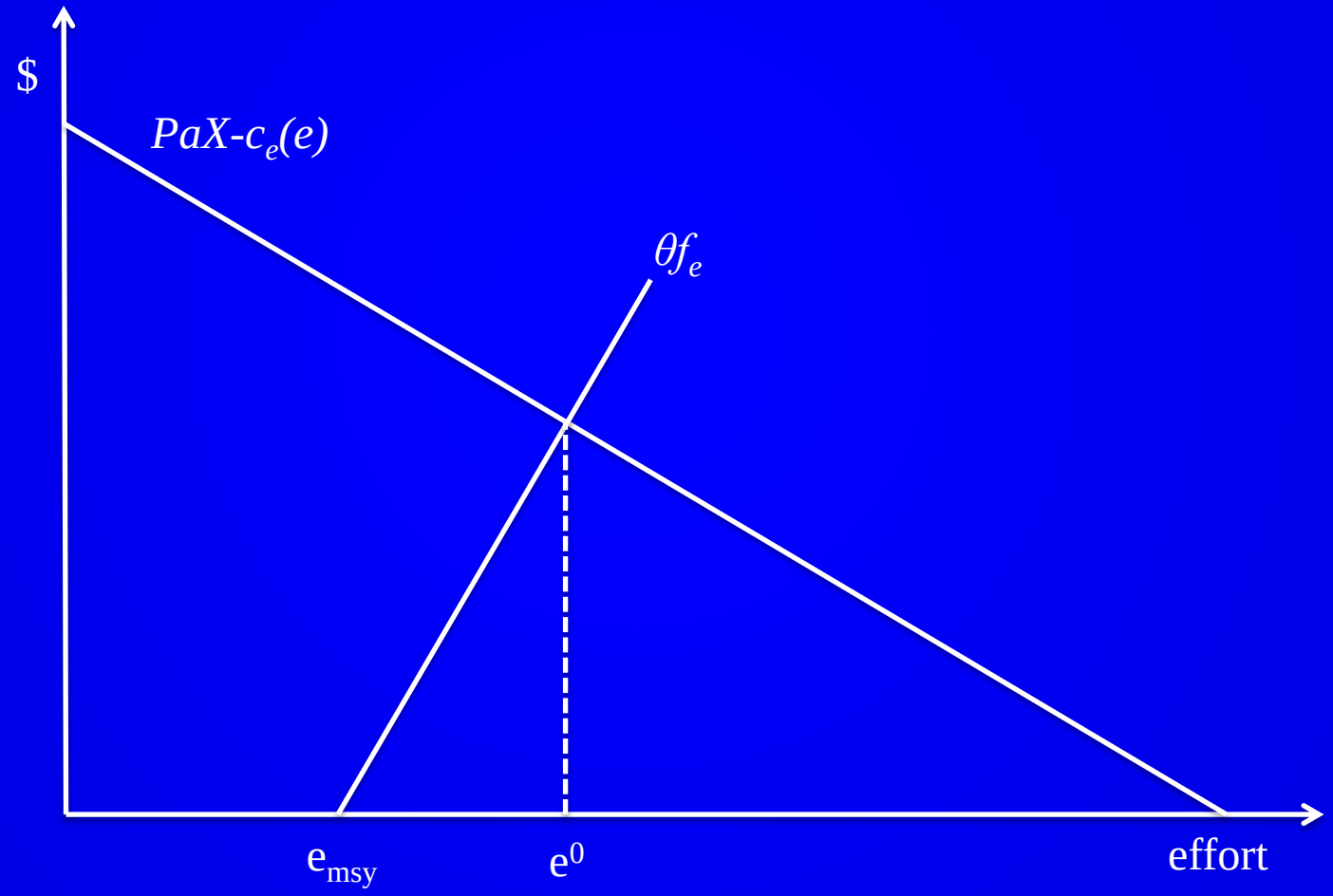
  $\theta = \theta(S)$, where $\theta_S > 0$, $\theta_{SS} \leq 0$, and

  S represents enforcement services, e.g. surveillance

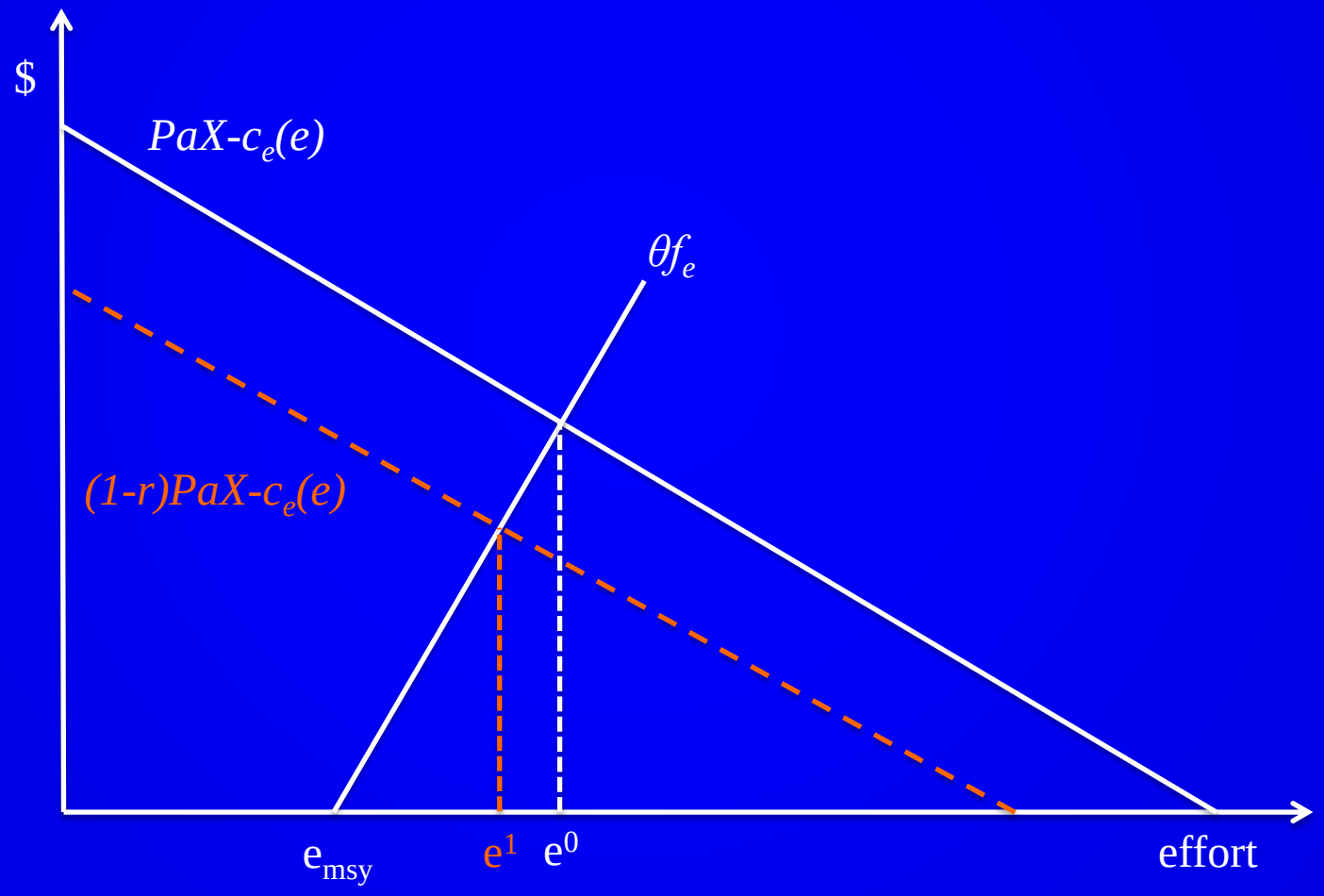
Firm's effort – open access



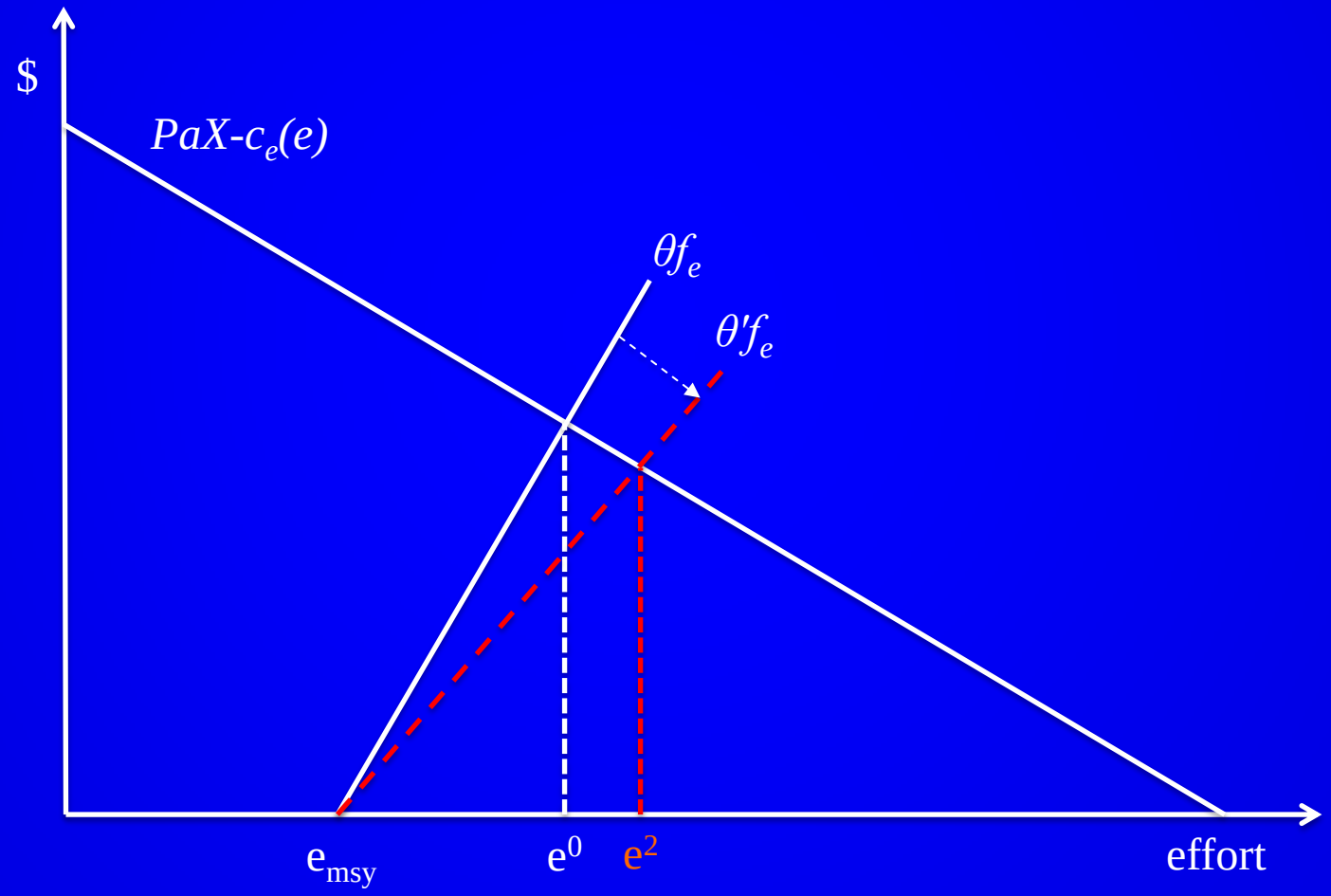
Firm's effort
costly, imperfect enforcement



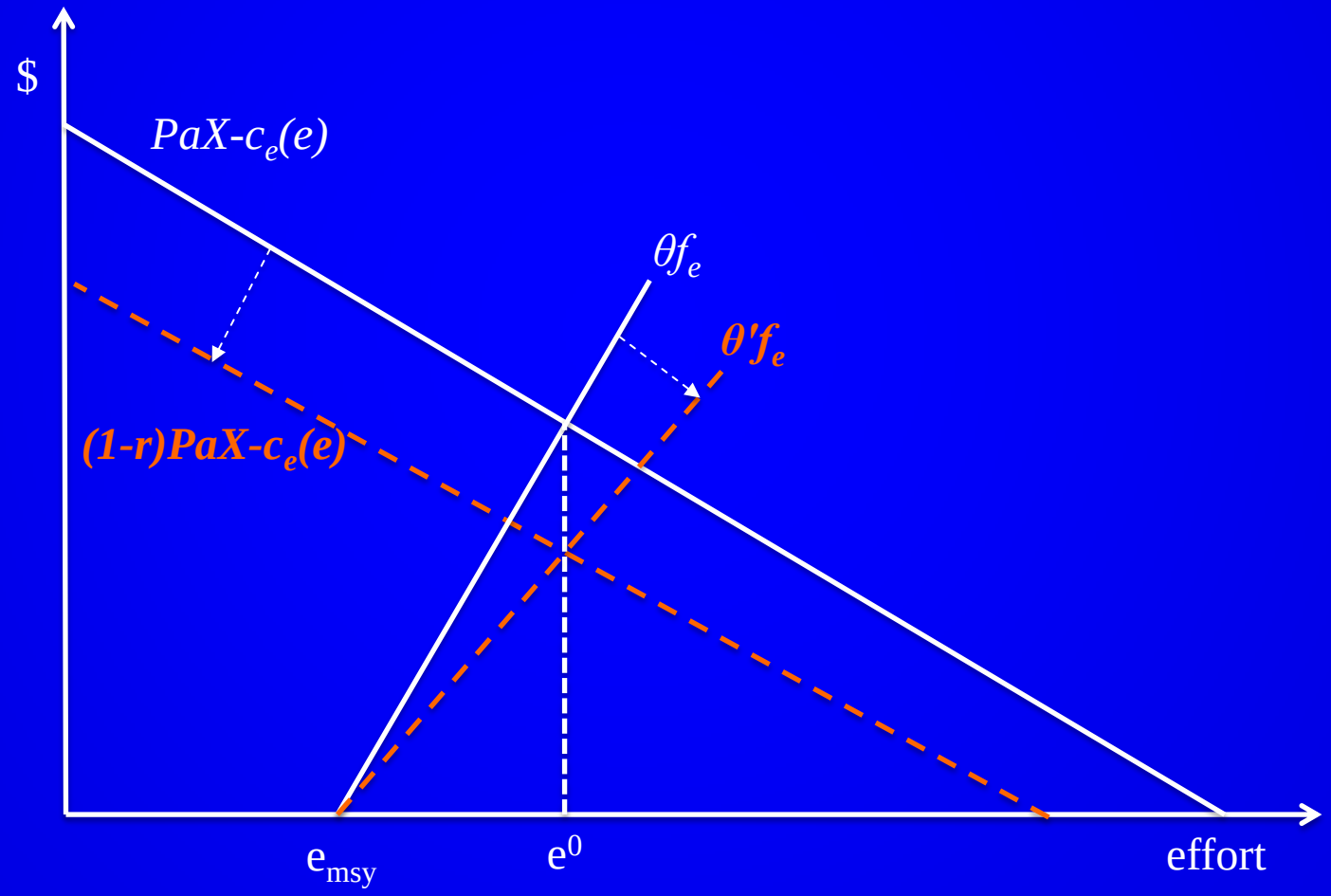
Firm's effort - with royalty, r>0



Firm's effort
Lower enforcement



Firm's effort with royalty, less enforcement



Enforcement & Compliance

- Aggregating each firm's effort rate across all firms results in the aggregate effort function

$$F = F(S,r,X)$$

- Using the population equilibrium function

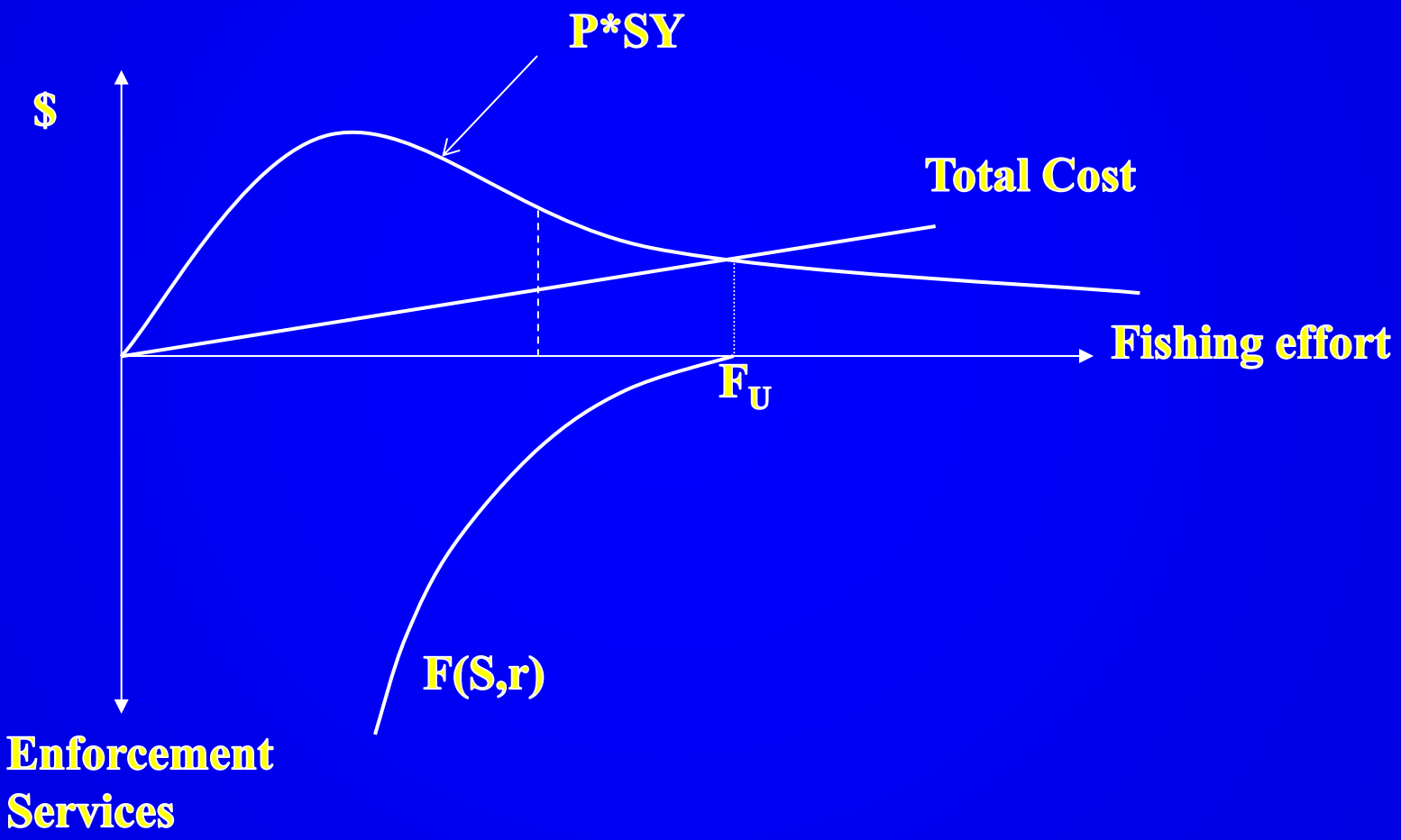
$$X = X(F)$$

- The aggregate effort function becomes

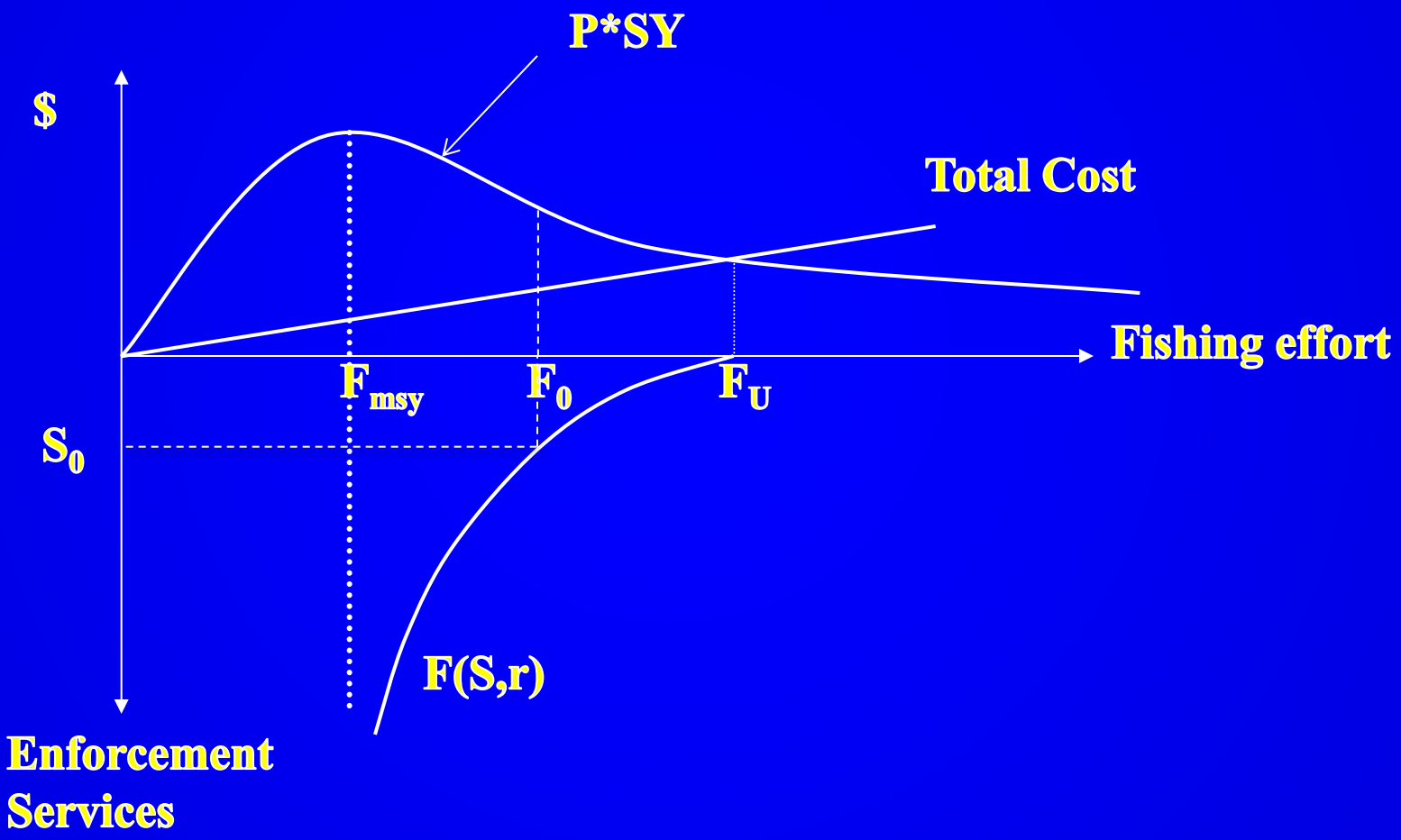
$$F = F(S,r)$$

Which is the relationship between aggregate effort, *F*, and enforcement services, *S*, and the royalty rate, *r*

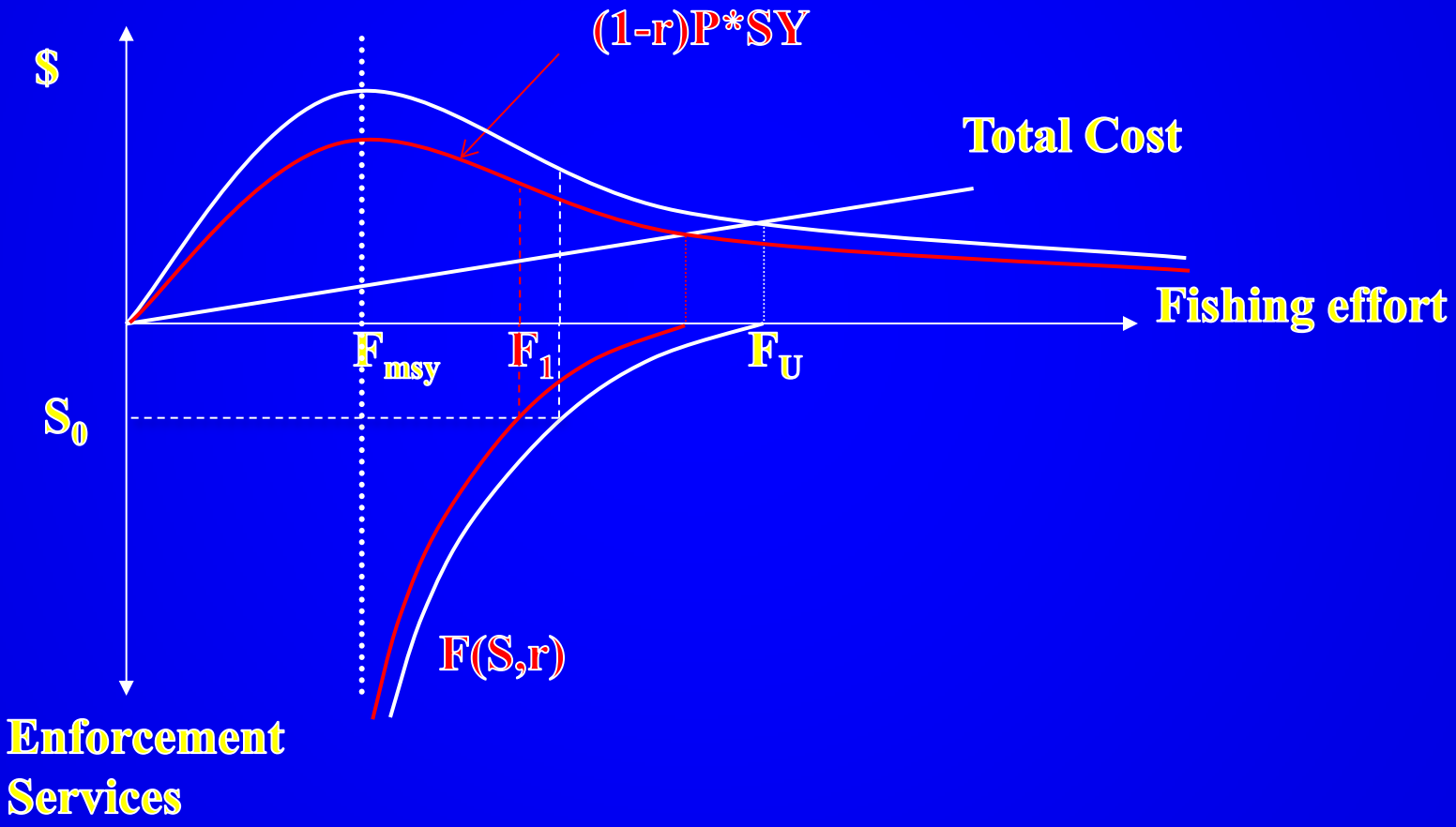
Bioeconomic outcomes, no royalty, $r = 0$



Bioeconomic outcomes, no royalty, $r = 0$



Bioeconomic consequences of a royalty, r > 0



Bioeconomics
Part II

- Dynamic optimal bioeconomic model
  - In terms of output, *Q*, not effort
  - Extension of the Sutinen and Andersen (1985) paper: The Economics of Fisheries Law Enforcement, *Land Economics*
  - Costly, imperfect enforcement

Enforcement Costs

- Enforcement costs are denoted by $E(\theta)$

  Where $E_\theta > 0$ *and* $E_{\theta\theta} > 0$

- Using the inverse form of the aggregate output function, $\theta = Q^{-1}(Q,r,X)$

$$E(\theta) = E(Q,r,X)$$

Where $E_Q < 0$, $E_r < 0$, $E_X > 0$

Optimal Policy

- The management authority is assumed to maximize net social benefits subject to
  - The stock constraint, and
  - A cost recovery constraint
    - All enforcement costs are recovered via a royalty

Optimal Policy

In earlier work (Sutinen and Andersen 1985) we derived optimal policies by maximizing the discounted sum of net social benefits over time,

$$\int_0^\infty \left[\int_0^Q p(s)ds - C(Q,X) - E(r,Q,X) \right] e^{-\rho t} dt$$

Subject to the stock constraint

$$\dot{X} = h(X) - Q$$

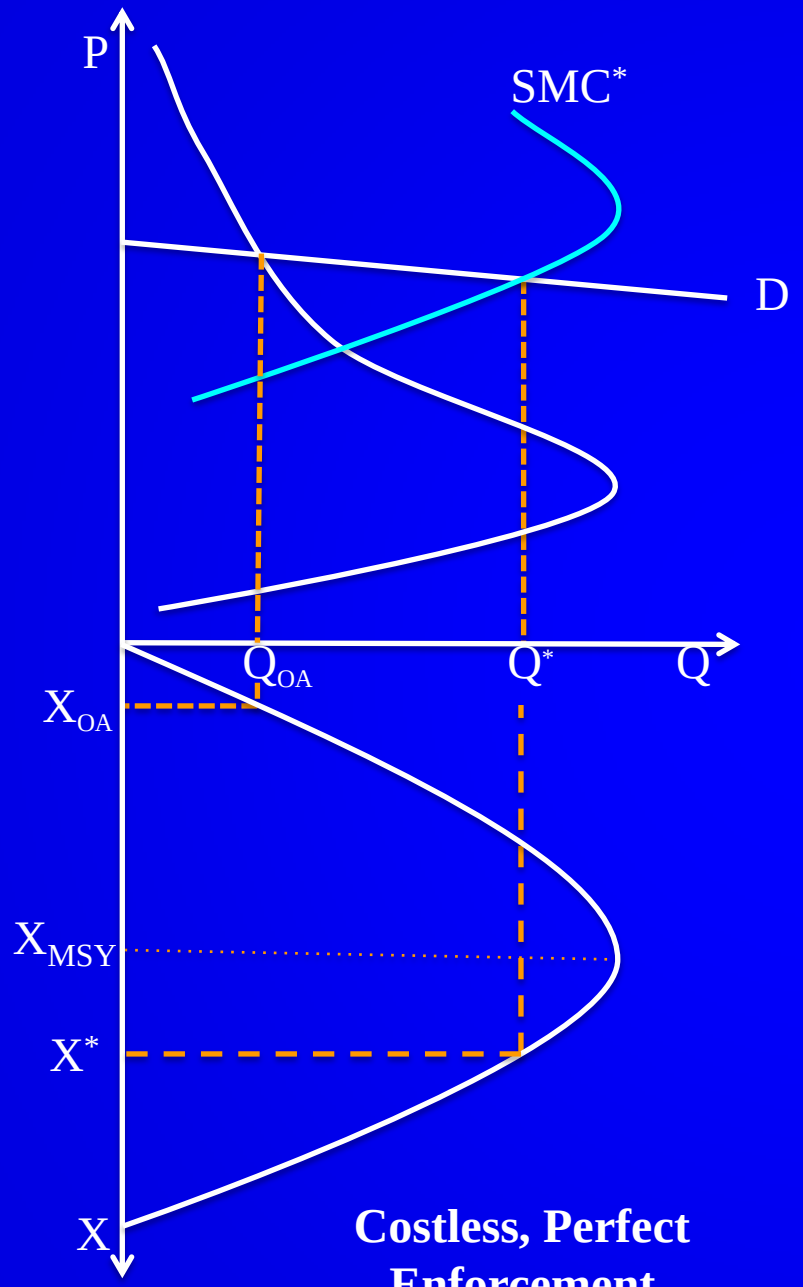
Optimal Policy
without cost recovery, *r=0*

The optimal stock size when enforcement costs are not recovered (*r=0*) is determined by

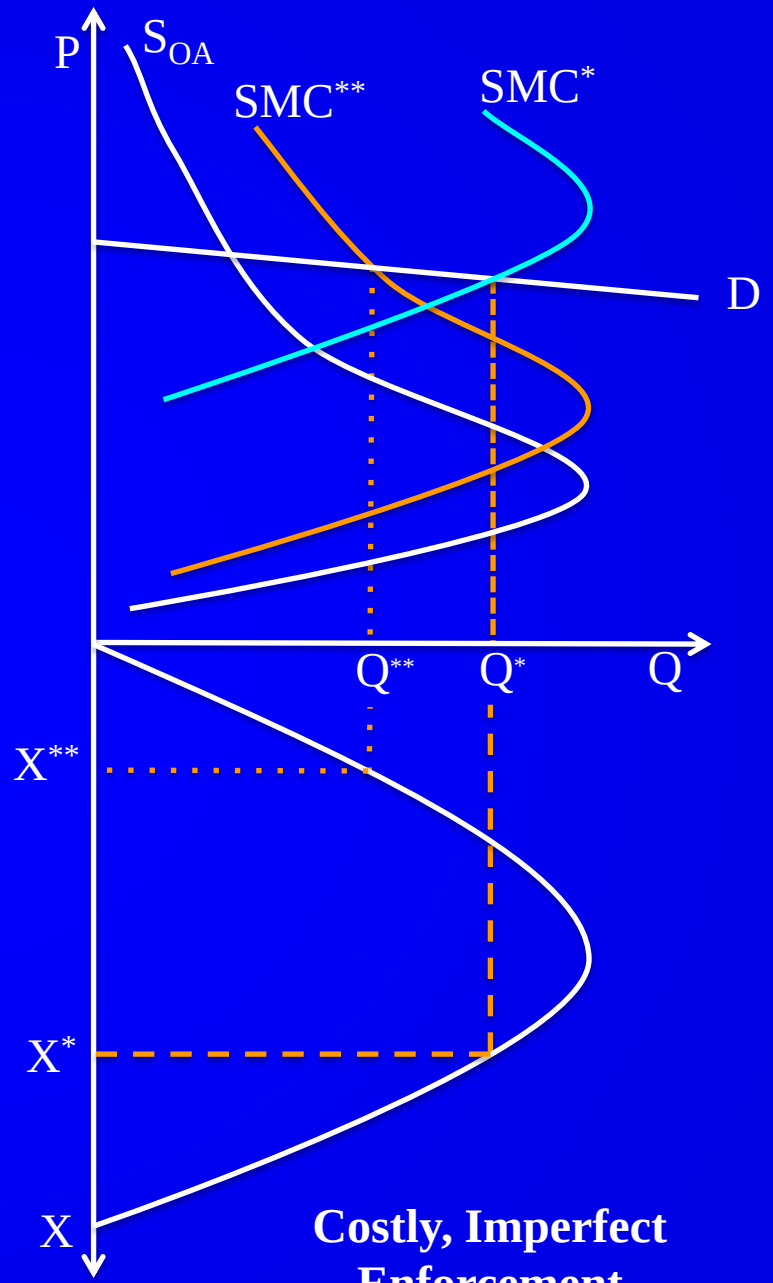
$$[\rho - h_x] = \frac{-(C_x + E_x)}{\{p - (C_Q + E_Q)\}}$$

which results in a SMC** that lies below the costless, perfect enforcement SMC* and a lower optimal stock size.

This result is illustrated in the following two graphs.



Costless, Perfect Enforcement



Costly, Imperfect Enforcement

Optimal Policy with cost recovery, r>0

Optimal policies are found by maximizing the discounted sum of net social benefits over time,

$$\int_0^\infty \left[\int_0^Q p(s)ds - C(Q,X) - E(r,Q,X) \right] e^{-\rho t} dt$$

Subject to the stock constraint

$$\dot{X} = h(X) - Q$$

and cost recovery constraint

$$rpQ = E(r,Q,X)$$

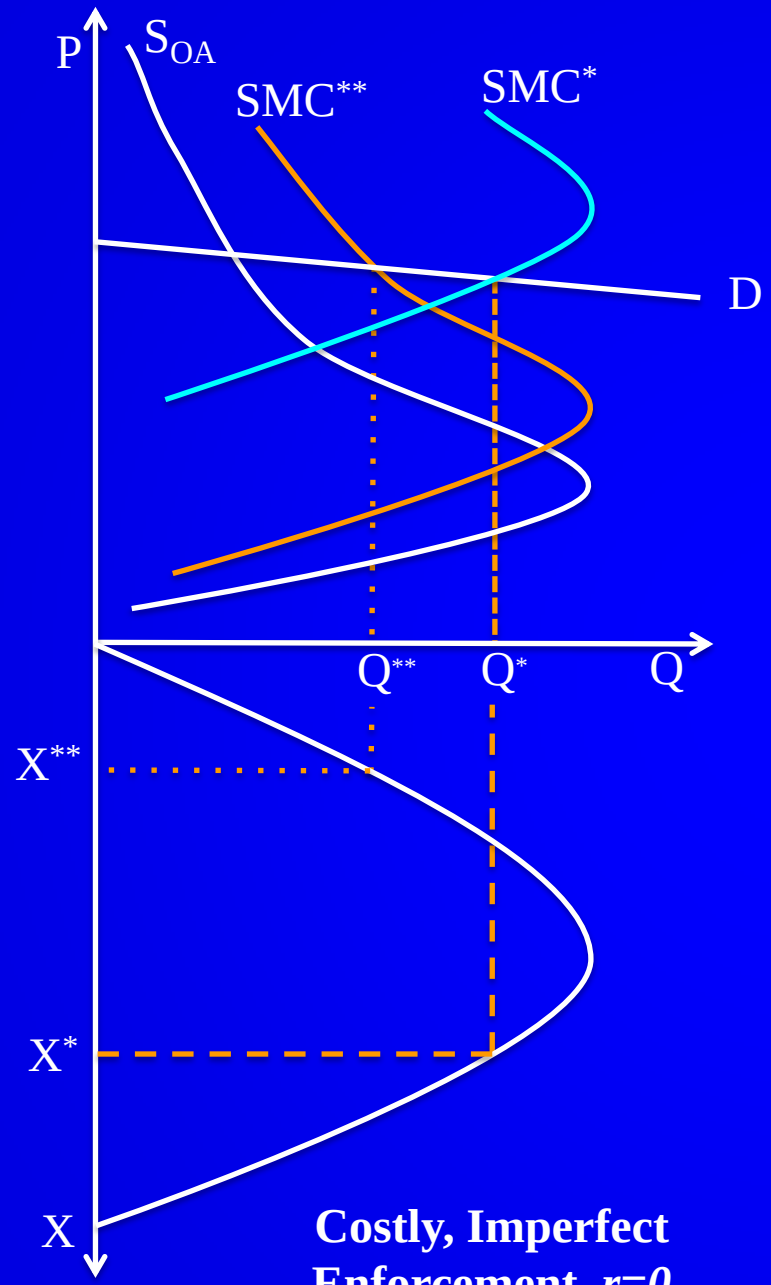
Optimal Policy
with cost recovery, *r>0*

When enforcement costs are recovered with a royalty (*r>0*), the optimal stock size is determined by a far more complex condition:

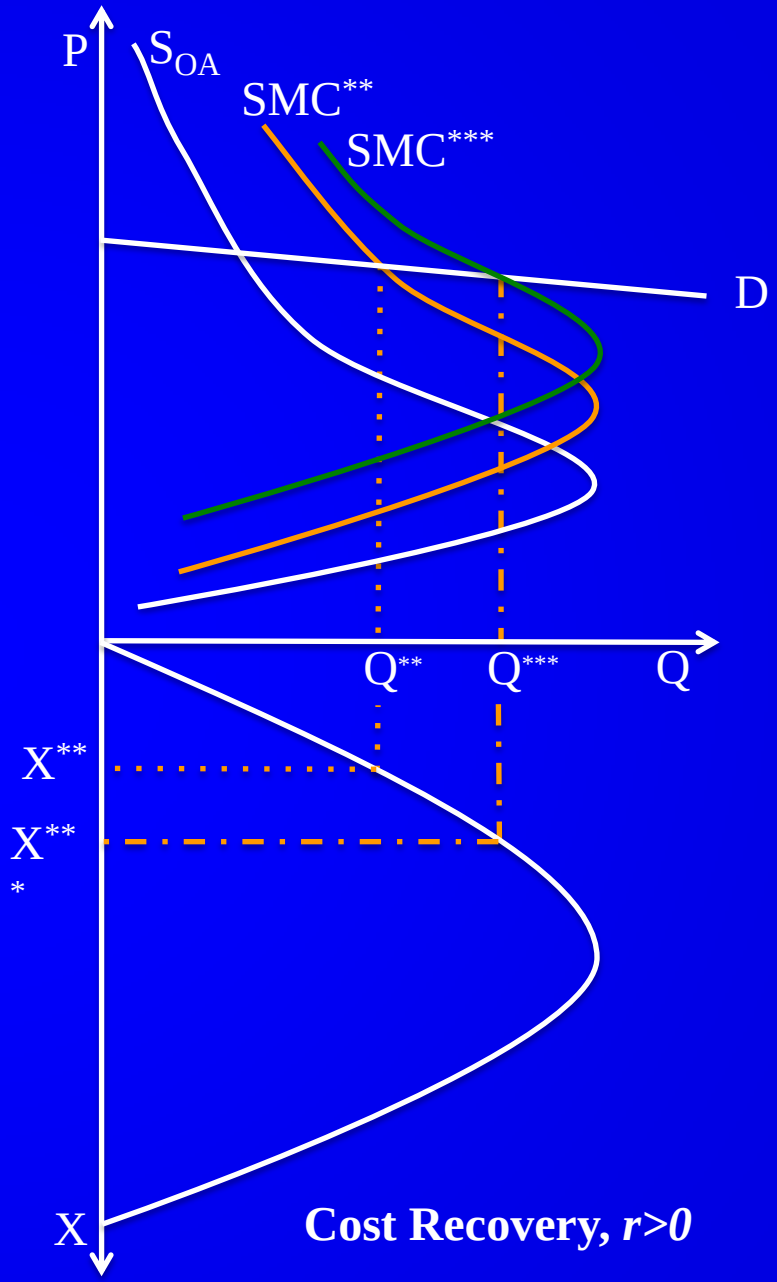
$$[\rho - h_x] = \frac{\{(E_r E_x)/[\, pq - E_r]\} - (C_x + E_x)}{\{p - C_Q - E_Q + E_r \left[rp - E_Q\right]/[pq - E_r]\}}$$

This shifts the SMC up towards the costless enforcement SMC* resulting in an optimal stock that is larger than when enforcement costs are not recovered with a royalty.

This is illustrated in the following graph.



Costly, Imperfect Enforcement, *r=0*



Cost Recovery, *r>0*

Results & Discussion

- A royalty to recover enforcement costs
  - Reduces the incentive to produce & violate
  - Can lower the cost & amount of enforcement for a given level of production
  - Has a conservation payoff
    - A result not heretofore understood
    - In addition to other efficiency payoffs

Results & Discussion

- Our results are further evidence that

  'Who pays and how they pay'

  – Influences policies and performance of a fishery

  – Specifically, producers paying via a royalty appears to be one of the best methods to recover costs of management

Limitations

- Limitations of our analysis
  - Other management costs need to be considered
    - Research, observers, administrative, etc.
  - Only licensed, authorized producers are considered

Other Issues

- Pros & cons of different types of user charges?
  - User fees
  - Regulatory fees
  - Beneficiary-based taxes
  - Liability-based taxes
- How should user charges be set?
- How best to collect user charges?