

Optimal Inspection Strategies For Coast Guard Operations

**CREATE Economics Symposium:
Economic Costs & Consequences of a
Terrorist Attack**

August 20, 2005

**Niyazi Onur Bakir,
University of Southern California**

US Coast Guard



US Coast Guard Efforts For Modernization

■ Deepwater Acquisition Program

- *is a major effort to replace and modernize the aircraft and cutter fleet over the next 20 years.*
- *seeks to develop an improved and integrated system of aircraft, cutters and unmanned aerial vehicles that enhance command control, communications, intelligence, surveillance, reconnaissance and logistics.*

■ Rescue 21

- *is the second largest procurement program to update the current coastal communication system.*
- *will improve search and rescue and illegal drug and migrant interdiction missions.*

Vessel Information

- 24-hour rule
- 96-hour rule
- Foreign Vessels

- According to Code of Federal Regulations, vessels entering US waters must provide in advance data on cargo, crew members, owners of the vessel and recent ports visited.

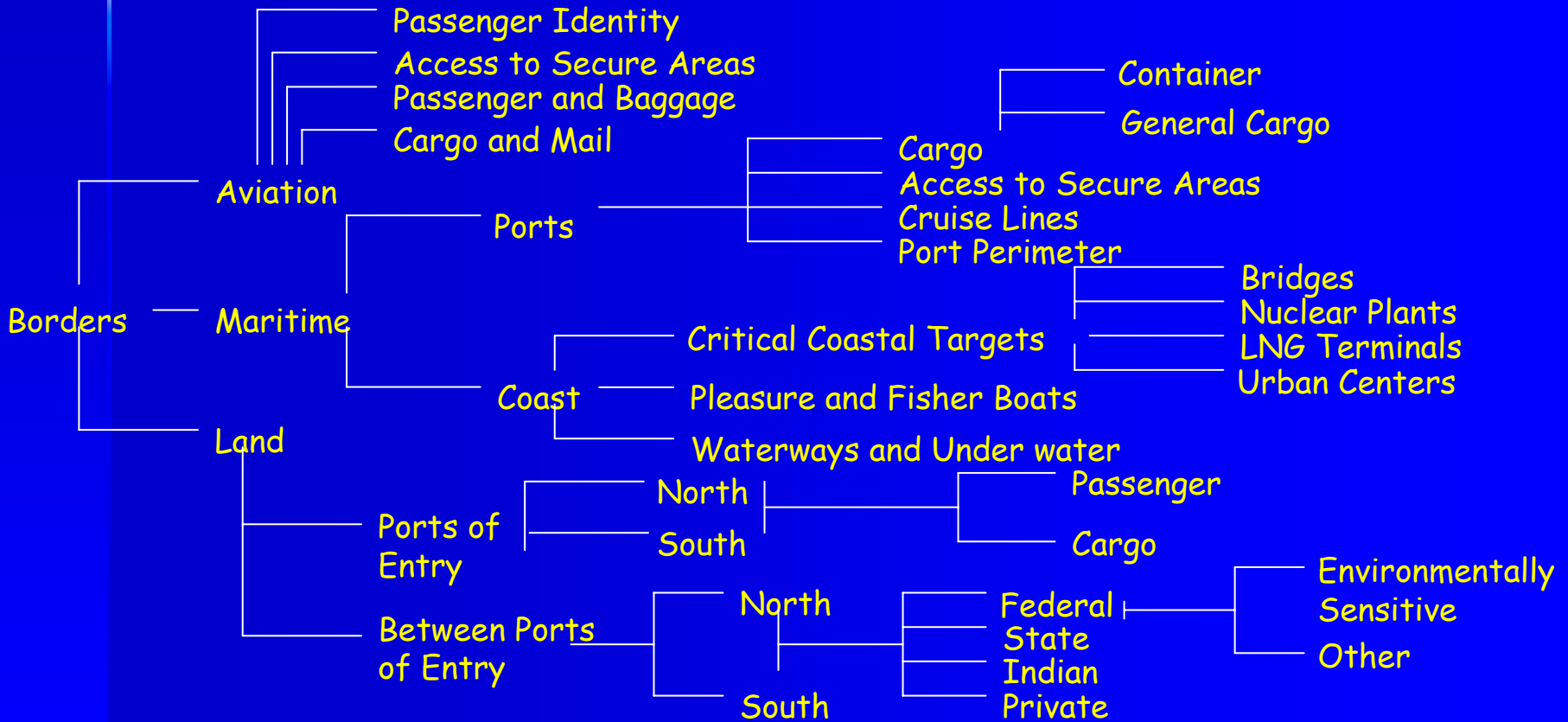
- US Flag Vessels

- There is no regulation that requires vessels less than 300 gross tons to report information about cargo and schedule of arrival.

Previous Literature

- Becker (1968)
- Epple and Visscher (1984), Cohen (1987)
- Landsberger and Meilijson (1982), Harrington (1988)
- Livernois and McKenna (1999), Innes (1999), Raymond (1999)
- Brams and Kilgour (1987) (1988), Wittman (1989)

Border Security



Risks

- Illegal importation of weapons and explosives.
- Attacks on coastal targets.
- Attacks on other commercial vessels.
- Laying mines at ports or coastal waterways (Underwater Security).
- Illegal immigration and drug smuggling.

Inspection without Risk Classification

q : fraction of vessels inspected

$c(\cdot)$: cost of inspection, $c'(q) > 0$, $c''(q) > 0$

π : USCG's belief that weapons/explosives will be smuggled across maritime borders

p : probability that weapons/explosives will be used in a successful terrorist attack after smuggling

E : economic consequence of a terrorist attack

$v(\cdot)$: disutility of a terrorist attack that costs $\$E$ total to the economy

Inspection without Risk Classification

B : monetary payoff of smuggling

S : years of prison sentence

$f(\cdot)$: disutility of prison sentence, $f(0) = 0$

USCG solves,

$$\min_q c(q) + \pi p(1-q)v(E)$$

$$\text{s.t. } B(1-q) - f(S)q \leq 0,$$

$$0 \leq q \leq 1$$

Inspection without Risk Classification

- Results consistent with Becker
 - the optimal fraction of vessels inspected is increasing in B and decreasing in S
 - if $\pi=1$, then every vessel will be inspected if $c'(1) < pv(E)$
- Under certain conditions, as the disutility function in economic losses exhibits higher degree of risk aversion, the optimal fraction of vessels inspected increases.

Inspection with Risk Classification

π_i : USCG's belief that weapons/explosives will be smuggled in a vessel of risk type i , $\pi_1 > \pi_2$

t_i : fraction of vessels of type i

USCG solves,

$$\min_q c(t_1q_1 + t_2q_2) + [t_1\pi_1(1-q_1) + (1-t_1)\pi_2(1-q_2)] pv(E)$$

$$\text{s.t. } B(1-q_1) - f(S)q_1 \leq 0, \quad B(1-q_2) - f(S)q_2 \leq 0$$

$$0 \leq q_1, q_2 \leq 1$$

Inspection with Risk Classification

- The optimal fraction of vessels inspected for high risk types is at least as high as that of low risk types.
- Fraction of vessels inspected are non-decreasing in π_i , ρ and E .
- Inspections should be performed on both risk types to prevent terrorists from shifting risk from high risk to low risk vessels.
- Results consistent with Becker due to adversarial nature of the risk.

Implications

- Funds should be appropriated to increase the number of cutters and aircraft in USCG fleet and deter terrorists.
- For better surveillance, investment of radar technologies and AIS should be promoted.
- Coastal communication systems should enable effective coordination between command authority and USCG fleet.