~~Publish~~ Sell or Perish: Analysis of Japan's Fresh Fish Market as a Newsvendor Problem

Wilf Swartz | FISH500 Seminar Series | 30.01.15

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Market Failure 2:

MARKET POWER

Challenge

Q: If the market is not producing a "true" or "fair" price of fish, what needs to be done?

A: Examine all decisions influencing the market, bottom up.

Supply Chain Management

Supply Chain Management

- *Supply chain:* activities and infrastructure that move goods from the area of production to an area of consumption.

- *Supply chain management*: a set of management decisions required to ensure more efficient, less costly, and more profitable operation of the supply chain.

Supply Chain Management Research

- Local optimization of one element of the supply chain under specific constraints

- Broader analysis of the relationships between linkages and their coordination

Supplier → Manufacturer → Distributor → Retailer → Shopper

Supply Chain Components
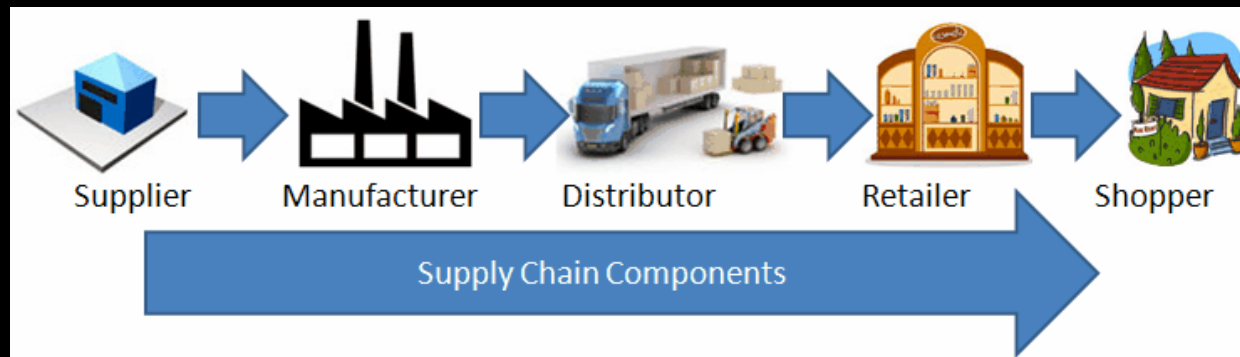
Supply Chain Research in Fisheries

- Historically, the boundaries of fisheries economics ended when the fish is landed:
  - Fleet dynamics
  - Game theoretical application
- And more recently, on the consumer end:
  - demand structure (e.g. price elasticity to supply, income etc),
  - impact of market integration (from globalization)

JAPAN'S FRESH FISH SUPPLY CHAINS

Japan's Coastal Fisheries

From Swartz & Ishimura. Fisheries Science (2014)
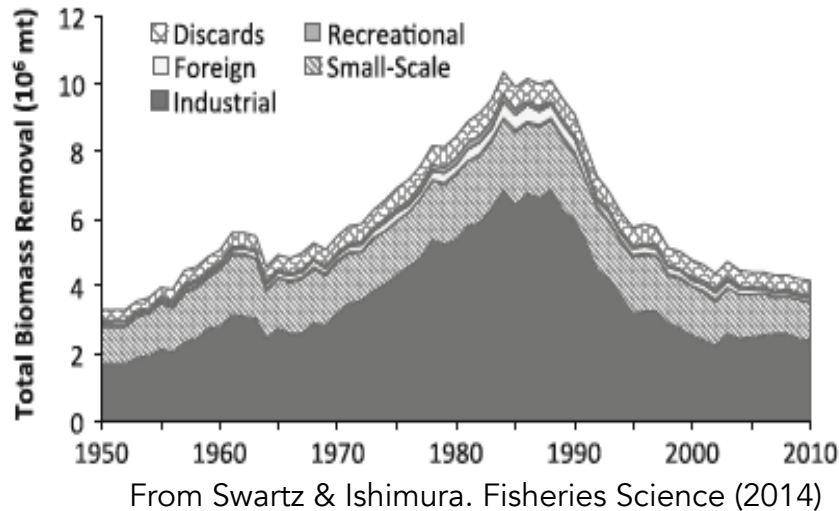
Average Coastal Fisheries Household Income
(in million JPY)

	Fisheries	Aquaculture	Average
2003	2.16	5.71	2.71
2004	2.15	6.26	2.82
2005	2.14	6.11	2.80
2006	2.47	5.08	2.97
2007	2.74	5.38	3.27
2008	2.39	3.66	2.63
2009	2.22	3.88	2.51

MAFF Fisheries Business Administration Survey (2010)

Employment

|	Total	Coastal	Industrial
1973	510,727	388,307	122,420
1978	478,148	361,767	116,381
1983	446,536	343,417	103,119
1988	392,392	313,912	78,480
1993	324,886	275,198	49,688
1998	277,042	237,507	39,535
2003	238,371	209,462	28,909
2008	221,908	194,996	26,912
2013	180,985	159,036	21,949

MAFF Fisheries Census (2013)

Coastal fisheries also have:
- Diverse gear types
- Catch composition that is highly variable, both seasonally and regionally
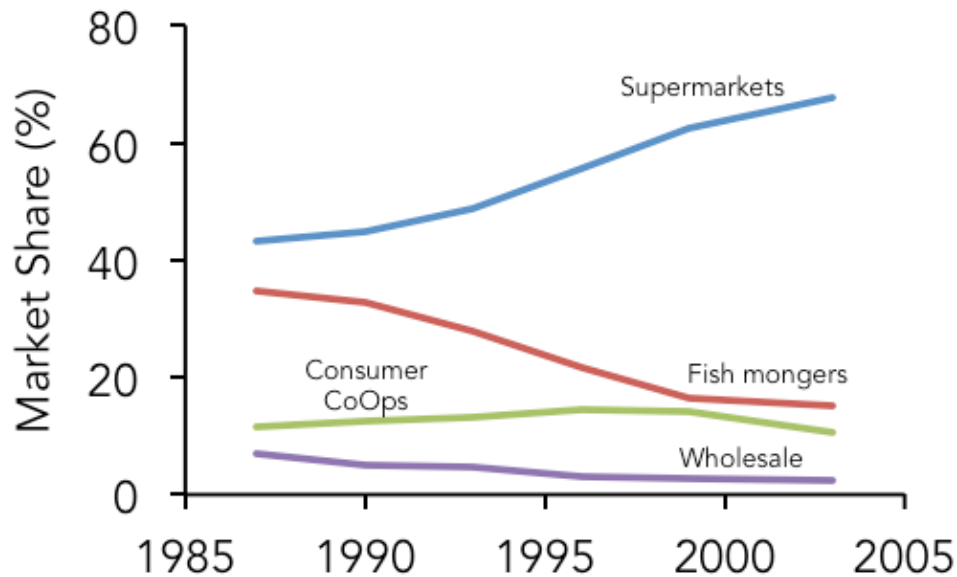
Japan's Fresh Fish Markets
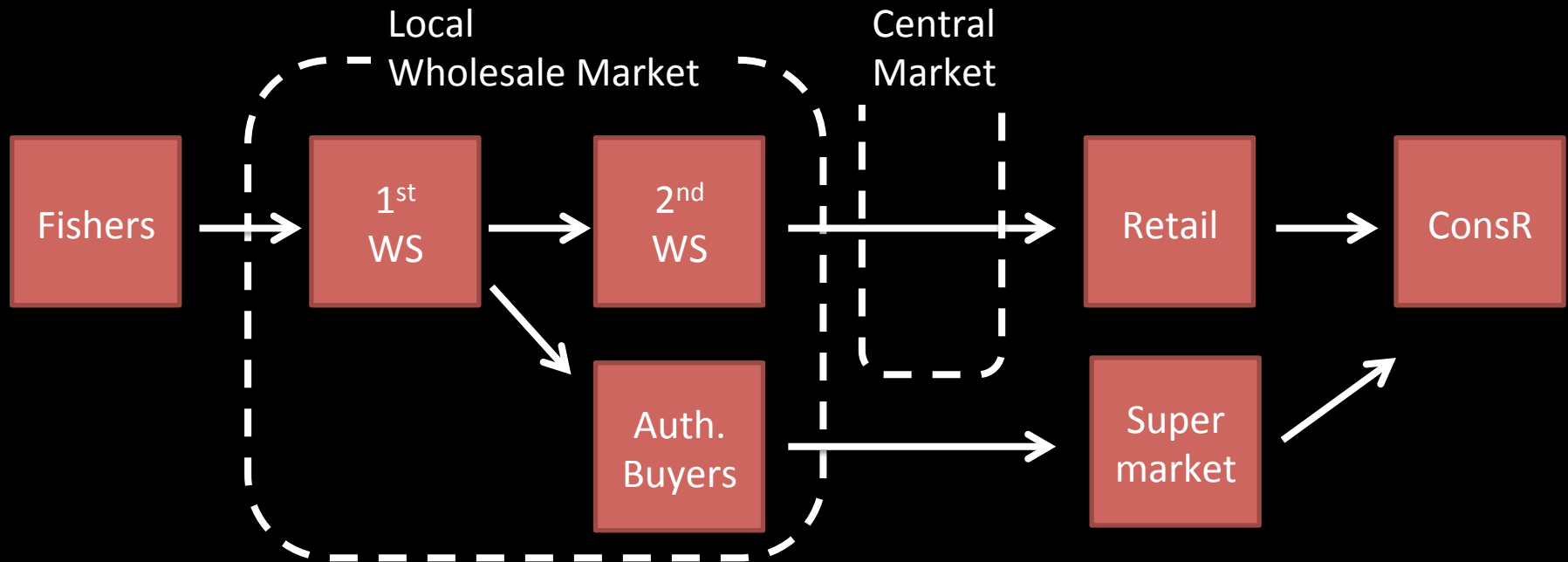
Japan's Fresh Fish Markets
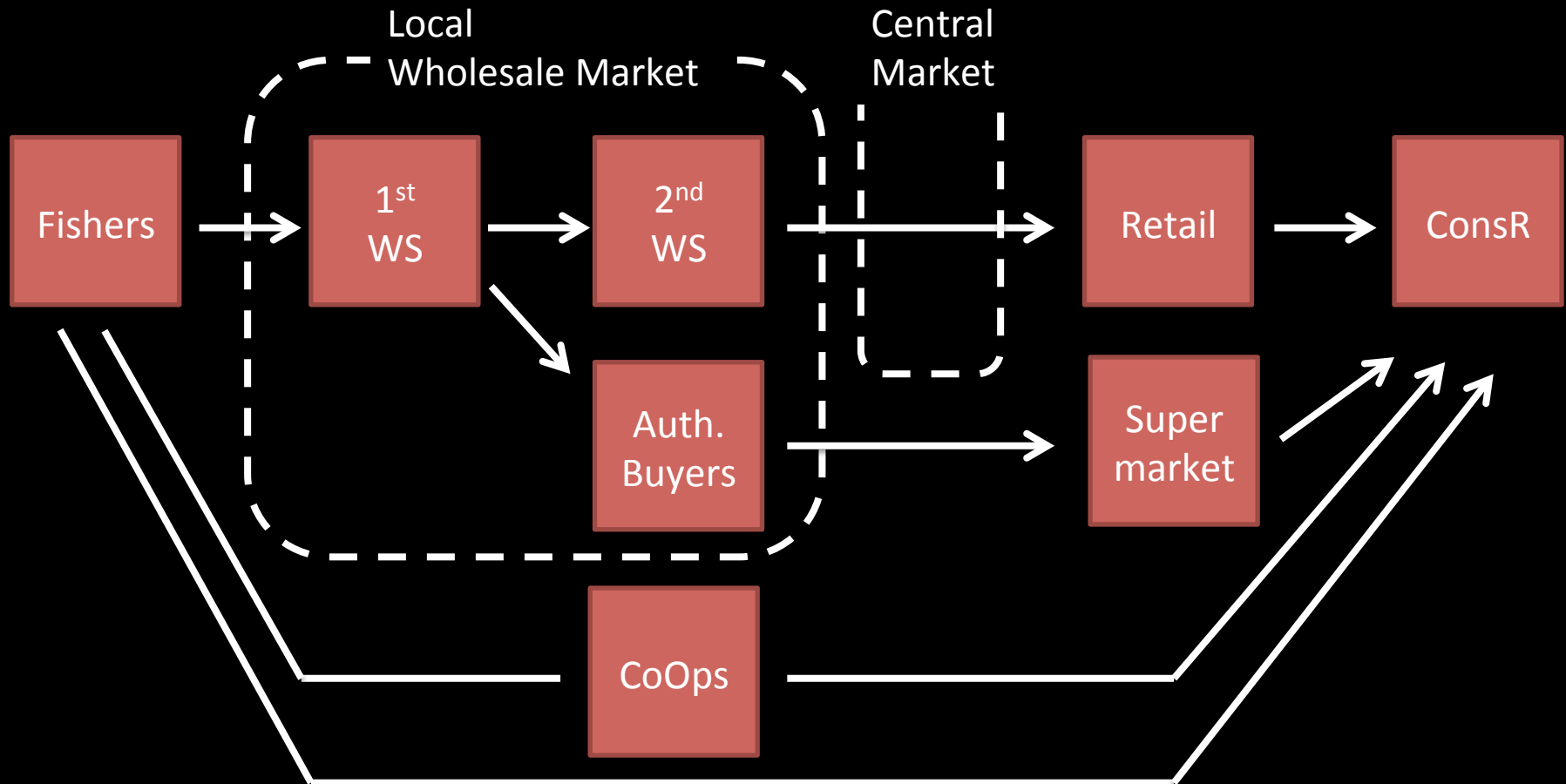
Differing Strategies at Retail

Market Shares of Fresh Fish Retailers

From MAFF 2003 Food Consumption Monitoring Survey

Value Distribution

Distribution of Retail Value Across the Supply Chain (%)

	Producer	Local		Central		Retailer
		1st WS	2nd WS	1st WS	2nd WS	
Fish	25	1.1	24	3	8.6	38.3
Fruit/Vegetable	42.9		19.3	4.9	8.4	24.4

- Distribution of the retail value in fresh fish, and its difference with fruits/vegetables, may be linked with how the risk of spoilage is captured across the supply chain.

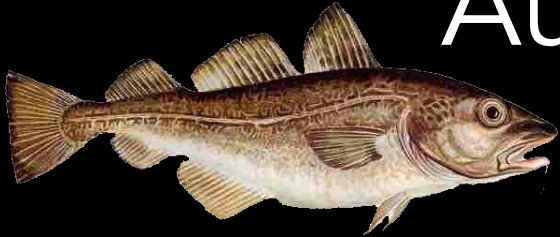# Fresh Fish Supply Chain

Key challenges:
- Uncertainties in production
- Diversity in product type
- Highly perishable goods
- Large number of independent producers

What are potential strategies to improve fishermen's bargaining power?

APPLYING SUPPLY CHAIN THEORIES TO FISHERIES

Auction strategies

- *English model*: Ascending price, public bids. The last bidder remaining wins.

- *Dutch model*: Descending price. The first to bid wins.

- *Japanese model*: Closed-seal bids. The highest bid wins.

Auctions: Fisheries Examples

1. Are auction prices optimal prices?
   – Ancona, Italy (Gallegati et al 2011)
   – "Declining price paradox"
   – Selling sequence matters and can be manipulated
   – Evidence of buyer loyalty to vessels

Auctions: Fisheries Examples

2. Greater product differentiation
   – Palamos, Spain (Fluvia et al. 2012)
   – Smaller, highly differentiated units signal quality and increase buyer pools

   *also, effort decision of fishers negatively linked to the prevailing price

Auctions: Fisheries Examples

3. Enlarging the buyer pool via electronic/ remote bidding
   – Lorient, France (Guillotreau et al. 2011)
   – Increased processing speed
   – Increased anonymity of bidders

Shifting the responsibility of quality assessment & assurance to sellers

The Newsvendor Problem

- Stochastic inventory model
- Perishable products
- Stochastic demand

The Newsvendor Problem (cont.)

Given:

x = demand, a random variable

$G(x)$ = cumulative distribution function of demand

$g(x)$ = density function of demand

c_o = cost of overstocking (unsold goods)

c_u = cost of understocking (lost sales)

Choose:

Q = purchasing quantity

The Newsvendor Problem (cont.)

Cost function:

$$Y(Q) = \text{expected overstocking cost} + \text{expected understocking cost}$$

$$= c_o E\big[\text{units over}\big] + c_u E\big[\text{units short}\big]$$

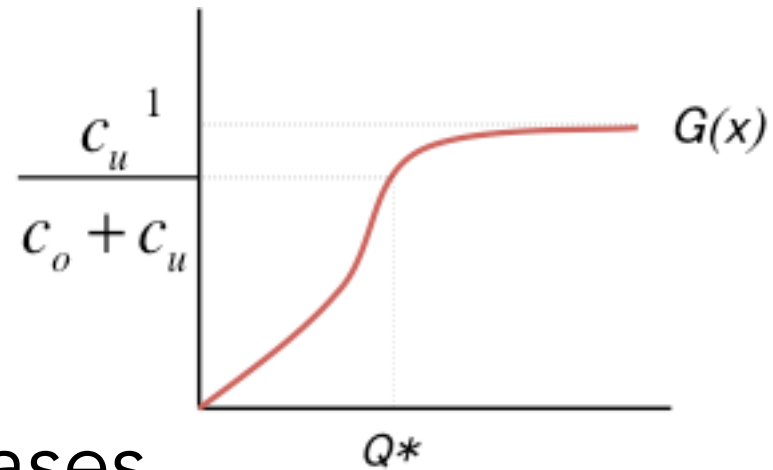$$= c_o \int_0^\infty \max\{Q-x,0\} g(x)dx + c_u \int_0^\infty \max\{x-Q,0\} g(x)dx$$

$$= c_o \int_0^Q (Q-x)g(x)dx + c_u \int_Q^\infty (x-Q)g(x)dx$$

The Newsvendor Problem (cont.)

Optimal purchasing quantity: Q*
(take derivative of Y(Q), setting it to zero and solve)

$$Q^* = G^{-1}\left(\frac{c_u}{c_o + c_u}\right)$$

as c_o increases, Q* decreases

as c_u increases, Q* increases

The Newsvendor Problem (cont.)

- Inventory can be decomposed into two components:
  - Cycle stock (to meet the expected demand)
  - Safety stock (to hedge against demand uncertainty)

- The amount of safety stock is dependent on overstocking and understocking costs, as well as the distribution of demand

Cost of *too much* and *not enough*

- Cost of overstocking:
  - Wholesale purchase price
  - Processing costs
  - Salvage value

- Cost of understocking
  - Lost sales (retail price – wholesale price)
 - Goodwill loss

Fresh Fish Wholesale Model

- Fishery
  - Quantity competition (Cournot competition)
  - Catch is given, but choose what proportion to deliver to the fresh fish market and to other (e.g. frozen, direct sale at fixed, discounted price)

- Buyers (retail/wholesale)
  - Multiple/competitive newsvendors (e.g. Jeong & Leon 2012)
  - Given expected consumer demand and retail price (fixed), compute aggregated wholesale demand curve.

Fresh Fish Wholesale Model

- Possible strategies/contracts:
  - Risk sharing/refund contracts (e.g., Webster & Weng 2000)
  - Revenue sharing (e.g. Giannoccaro & Pontrandolfo 2004)
  - Information sharing (e.g. Karabati & Sayin 2008)
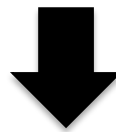
Outcomes: fisher/retail profit, waste, consumer satisfaction (i.e. demand met), etc.

Other possible outcomes

- Increasing the cost of wastage can alter the purchasing decision of retailers, reducing their demand

- Can the shortfall in their demand can be filled by small-scale buyers?

- What are the implications on the resource?

Sustainability & Social Responsibility

- Corporate Social Responsibility:

  – A set of actions aimed to further some social good, beyond the explicit pecuniary interests of the firm, that are not required by law (Carroll 2000)

"Make sure everything is done ethically. Within reason, of course."

Sustainability & Social Responsibility

- *Ethical argument* (corporate self-restraint, corporate altruism):
  - Windsor (2002): responsibility beyond "no harm", to be re-enforced by expansive public policy

- *Economic argument* (corporate competitive advantage):
  - Friedman (1971): social responsibility of business is to increase its profits
  - Suchman (1995): Pursuit of legitimacy or "social license"
  - Branco & Rodrigues (2006): corporate culture, reputations
  - Becker-Olsen et al. (2006): impact on consumer behaviour
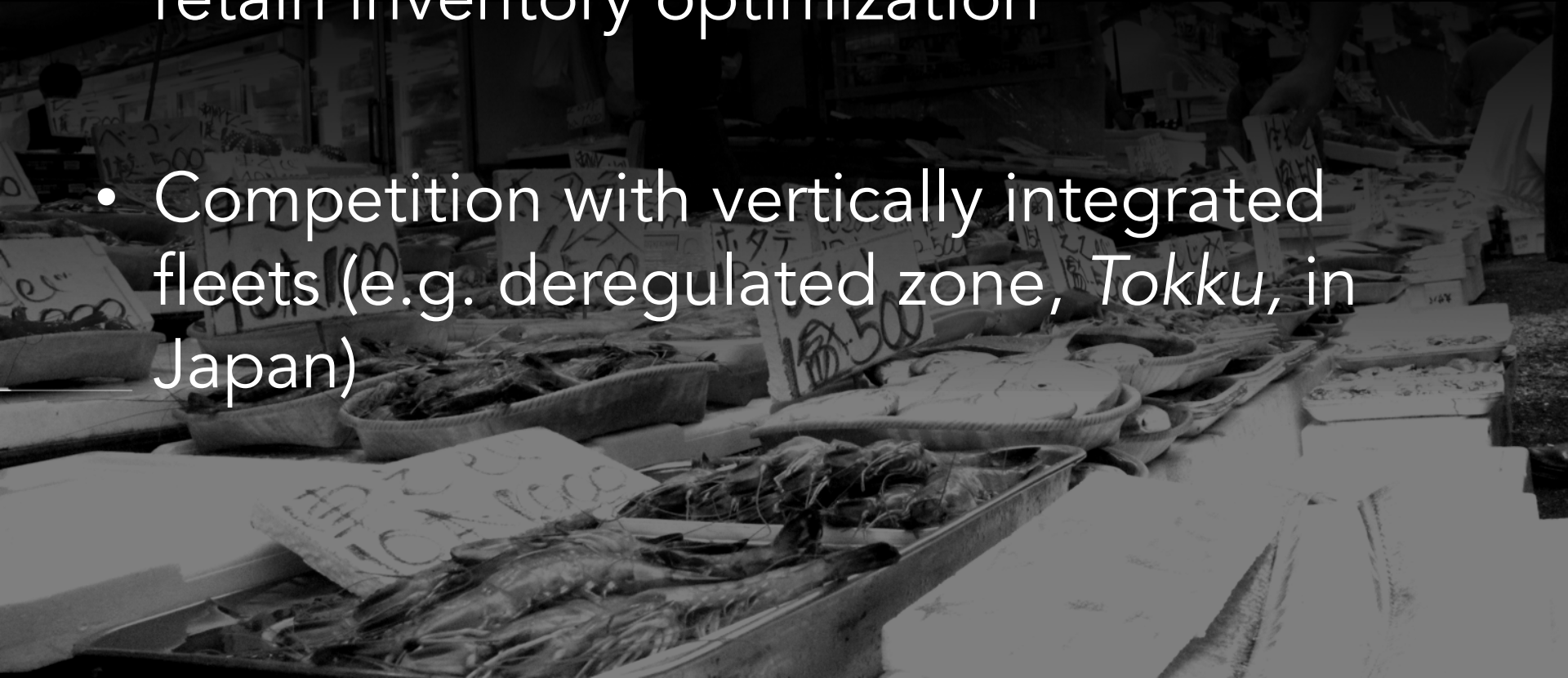
Sustainability & Social Responsibility

- Corporate Social Responsibility strategies in 130 publicly traded fisheries companies:
  - Characteristics of firm (e.g., nationality, fishing activities, scale, market share)

  - Characteristics of CSR (e.g., type of programs, social/environmental, NGO or public partnership, industry-based codes of conduct, auditing and reporting)

Sustainability & Social Responsibility

- Preliminary findings:
  - Extensive use of external standards such as MSC and ASC or ILO standards

  - Social programs and commitments more on prevalent in aquaculture firms

  - Lack of social considerations for local small-scale/artisanal fisheries

Other applications of supply chain management

- Implications of aquaculture (with greater certainties in production) to wholesale/ retain inventory optimization

- Competition with vertically integrated fleets (e.g. deregulated zone, *Tokku,* in Japan)

Questions?