

# The Interface of Operations Management and Economics

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## What is operations economics?

- The application of the tools of economics to problems in the management of operations.
- I will focus on:
  - Supply chain contracting.
  - Principal agent problems.
  - Strategic customers.
- Questions:
  - Why is this of interest?
  - What do we know?
  - Where do we go from here?

## What I will not talk about...

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- Optimal decision making for novel contracts.
- Revenue management and pricing.
- Auctions and procurement.
- Competing in inventory levels.

## A disclaimer:

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I sincerely apologize for failing to cite your paper.

# Supply Chain Contracting

## A basic example

- A retailer faces a newsvendor problem with fixed retail price  $r$ .
- A supplier produces at cost  $c$  and offers a buy back or returns contract.
  - Wholesale price  $w$  and buy back rate  $b$ .
- Suppose

$$w = \varepsilon r + (1 - \varepsilon) c \text{ and } b = \varepsilon r$$

for  $\varepsilon$  between 0 and 1. Then the retailer faces the same critical fractile as a single decision maker.

- i.e., nothing is lost.

## Pasternack (1985)\*

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- Results “rediscovered” by Kandel (1996) and Marvel & Peck (1995).
- Big insights:
  - The optimal contract is independent of the demand distribution.
  - The split of profit is independent of the demand distribution.
    - $1 - \varepsilon$  is the retailer’s share of system profit.
  - It’s good to be responsible.
    - Generous returns does not imply a strong retailer.

\* See also Pasternack’s 1980 *Interfaces* paper.

## What do we learn from this?

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- Double marginalization: A decentralized supply chain may under-perform a centralized one.
  - But this has been known in the IO literature since Spengler (1950).
- Adding a “side bet” can make both parties better off.
  - But side bets are common in economics and finance.
- There is a simple contract that addresses coordination issues.
  - But a two part tariff would also work.

## This work has been very influential

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- 10th most cited paper published in **Marketing Science** (according to Steve Shugan in 2008).
- Related work in practitioner oriented outlets.
  - Cachon and Lariviere, **HBR**, 2001.
  - Narayanan and Raman, **HBR**, 2004.
- It's discussed in textbooks.
  - Cachon and Terwiesch, 2009.
  - Beckman and Rosenfield, 2008.
  - Van Mieghem, 2008.
  - Chopra and Meindl, 2009.

## So why has this work been so influential?

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- The growing importance of outsourcing in the economy.
- A growing appreciation of the real world failings of poorly coordinated supply chains.
  - See Hau Lee's work.
- A clear tie to a standard operations problem.
- The analysis is straightforward and requires no new machinery.

## How has this work been extended?

- Other contracts.
  - Quantity discounts.
    - Monahan (1984); Lee and Rosenblatt (1986); Weng (1995).
  - Quantity flexibility.
    - Tsay (1999).
  - Options.
    - Barnes-Schuster, Bassok, and Anupindi (2002).
  - Price-only contracts.
    - Lariviere and Porteus (2001); Cachon (2004); Perakis and Roels (2007); Van Mieghem (1999).
  - Revenue sharing.
    - Dana and Spier (2001); Pasternack (2001); Wang, Jiang and Shen (2004); Mortimer (2008); Cachon and Lariviere (2005).
- Evolving markets.
  - Multiple order opportunities.
    - Donohue (2000); Tsay (1999); Barnes-Schuster, Bassok, and Anupindi (2002).
  - Price declines.
    - Lee, Padmanabhan, Taylor, Whang (2000); Taylor (2001).

## More extensions

- Actions affecting demand.
  - Pricing.
    - Emmons and Gilbert (1998); Wang, Jiang and Shen (2004); Song, Ray and Li (2008); Cachon and Lariviere (2005); Krishnan and Winter (2007).
  - Promotional effort.
    - Taylor (2002); Krishnan, Kapuscinski, Butz (2004); Cachon and Lariviere (2005); Sohoni, Chopra, Mohan, Sendil (2005).
- Multiple supply chain actions.
  - Cachon and Zipkin (1999); Li and Atkins (2002).
- Information.
  - Cachon and Lariviere (2001); Ozer and Wei (2006); Taylor (2006); Ferguson, DeCroix, and Zipkin (2005); Taylor and Xiao (2009); Shin, and Tunca (2009); Zhang, Nagarajan, Sošić (2009).
  - Survey: Chen (2003).

## Even more: Supply chain configurations

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- Serial systems.
  - Lee and Whang (1999); Cachon and Zipkin (1999); Chen (1999); Porteus (2000).
- Assembly systems.
  - Wang and Gerchak (2003); Bernstein and DeCroix (2006); Bernstein, DeCroix, and Wang (2007).
- Distribution systems.
  - Inventory and terms of trade.
    - Cachon (2001); Chen, Federgruen, and Zheng (2001); Bernstein and Federgruen (2003, 2004, and 2005).
  - Allocation systems.
    - Lee, Padmanabhan, and Whang (1997); Cachon and Lariviere (1999a, 1999b, and 1999c); Chen, Li, and Zhang (2007); Lu and Lariviere (2008).
  - With transshipment.
    - Anupindi, Bassok, and Zemel (2001); Granot and Sošić (2003); Sošić (2006).

## BUT WAIT! There's more!

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- Porting over ideas from economic ideas from economics
  - Renegotiation.
    - Plambeck and Taylor (2007a, 2007b).
  - Relational contracts.
    - Taylor and Plambeck. (2007a, 2007b).
  - Different risk preferences.
    - Spulber (1985); Gan, Sethi, and Yan (2004).
- Supply chain disruptions.
  - Babich, Burnetas, and Ritchken (2007); Yang, Aydin, Babich, and Beil (2009).





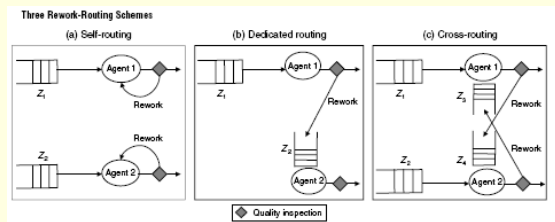
# Agency Problems

## The basic story

- An owner (or principal) hires a worker (or agent) to carry out some productive task.
  - Value of the enterprise depends on the effort exerted by the worker.
  - Worker effort is not directly observable but there is some noisy signal of effort.
- Standard results:
  - If the agent is risk neutral, the principal can achieve the first best by “selling the firm.”
  - If the agent is risk averse, there is a trade off between providing incentives and gaining participation.

## Relevance to operations management

- Applying PA models with more detailed assumptions about the operating problem.



Lu, Van Mieghem, and Savaskan, 2009

- Classics:
  - Atkinson (1979); Porteus and Whang (1991).

## Other applications

- Sales force incentives.
  - Chen (2000 and 2005).
- Controlling queues.
  - Plambeck and Zenios (2000 and 2003).
- Managing customer flow.
  - Shumsky and Pinker (2003).

## Where to go from here?

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- More specific operating environments.
  - Pai and Montagnas (2009)
- Integrating with supply chain management.
  - Fershtman and Judo (1987)
- Tournaments.
  - Lazear and Rosen (1981); Kepdis, Love, and Stein (2009).

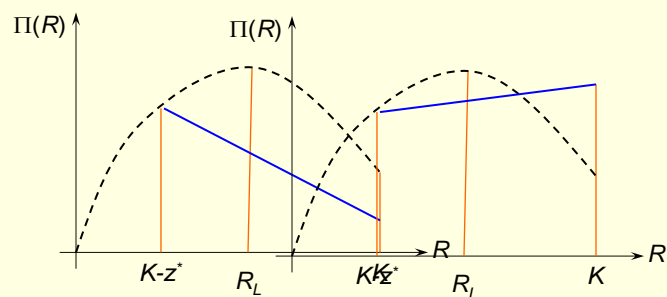


## Strategic Customers

## A motivating example

- Consider a variation of Littlewood's classic revenue management problem.
  - A seller with limited capacity faces two sequentially arriving segments of customers.
  - High value demand is uncertain and arrives late.
    - Walk-in customers vs. Reservation customers.
  - Suppose high value customers have a cost to request service.
- How does the firm's reservation policy affect walk-in demand?
- What are implications for the optimal reservation policy?

## When walk-in customers ration themselves



The firm saves more than the firm serves only reservation customers.  
 $K - R_L$  seats for walk-ins.

## “Standard” applications

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- Modeling queuing systems with self-interested customers.
  - Naor (1969); Mendelson (1985); Mendelson and Whang (1990); Afeche (2006).
  - Survey: Hassin and Haviv (2003).
- Transportation systems.
  - Braess (1968).
  - Survey: Roughgarden (2005).

## What’s currently hot...

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- Inventory systems.
  - Balachander and Farquhar (1994); Dana and Petruzzi (2001).
- Interacting with supply contracts or innovations.
  - Cachon and Swinney (2009a and 2009b); Su and Zhang (2009); Su (2009).

## More hot stuff...

- Pricing.
  - DeGraba (1995); Xie and Shugan (2001); Stock and Balachander (2005); Liu and van Ryzin (2007); Su (2009); Cachon and Feldman (2008); Shulman, Coughlan, Savaskan (2009).
- Managing services.
  - Glazer and Hassin (1983); Lariviere and Van Mieghem (2004); Alexandrov and Lariviere (2008); Çil and Lariviere (2008); Cachon and Feldman (2008); Allon, Bassamboo, and Gurvich (2008); Debo and Veeraraghavan (2009).
- Book: *Consumer-Driven Demand and Operations Management Models*, S. Netessine and C. Tang, eds. Springer, 2009.

## What else?

- Models of fashion goods.
  - Tereyagoglu and Veeraraghavan (2009).
- Hours of operation
  - “The Four Commandments: Is it Pareto Efficient?” --  de Meza, **The Economic Journal**, 1984.