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…

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

A disclaimer:

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
  
  $w = \varepsilon r + (1 - \varepsilon) c$ 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)*

- 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?

- 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

- 10th most cited paper published in *Marketing Science* (according to Steve Shugan in 2008).
- Related work in practitioner oriented outlets.
- It’s discussed in textbooks.
  - Cachon and Terwiesch, 2009.
  - Chopra and Meindl, 2009.

So why has this work been so influential?

- 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.
  - Price-only contracts.
  - 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.

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).
Even more: Supply chain configurations

- Serial systems.
  - Lee and Whang (1999); Cachon and Zipkin (1999); Chen (1999); Porteus (2000).
- Assembly systems.
- Distribution systems.
  - Inventory and terms of trade.
  - 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!

- Porting over ideas from economic ideas from economics
  - Renegotiation.
  - Relational contracts.
  - Different risk preferences.
    - Spulber (1985); Gan, Sethi, and Yan (2004).
- Supply chain disruptions.
Is supply chain contracting a dead field?

- Simple coordination issues no longer enough.
  - Double marginalization is well understood.
  - “Correcting” incentives by scaling profits or replicating first order conditions is now obvious.
- There are a limited number of bells and whistles left to be considered.
  - Obvious issues of pricing and retailer effort have been tackled.
  - That information considerations can lead to alternative contracts is well established.
- Extensions to other supply chain configurations have been explored.

Possible ways forward

- Service settings.
  - General setting.
  - Cachon and Harker (2002); Allon and Federgruen (2008).
  - Call centers.
- Environmental issues.
  - Corbett and DeCroix (2001); Savaskan, Bhattacharya, Van Wassenhove (2004).
- Empirical work.
- Design/collaboration
  - Kim and Netessine (2009); Feng and Lu (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.

  - Classics:

Other applications

- Sales force incentives.

- Controlling queues.

- Managing customer flow.
Where to go from here?

- More specific operating environments.
  - Pai and Montagnes (2009)
- Integrating with supply chain management.
  - Fershtman and Judd (1987)
- Tournaments.

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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 $K - R_l$ seats for walk-ins.
The firm serves only reservation customers.
“Standard” applications

- Modeling queuing systems with self-interested customers.
  - Naor (1969); Mendelson (1985); Mendelson and Whang (1990); Afeche (2006).
- Transportation systems.
  - Braess (1968).

What’s currently hot…

- Inventory systems.
- 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).


What else?

- Models of fashion goods.
  - Tereyagoglu and Veeraraghavan (2009).

- Hours of operation.