Supply Chain Contracts
Overview
Goals of this lecture

• Define and explain what is a Supply Chain Contract

• Define and exemplify what is double marginalization

• Contrast and compare different types of contracts
What is a contract?

A contract is a (legal) agreement between a buyer and a seller that defines the terms and conditions of sales.
Why do businesses use contracts?

• They reduce uncertainty (both in demand and manufacturing cost)

• Help to share risk

• Incentivize sales efforts

• Important for information sharing
Why do businesses use contracts?

• Can you come up with examples of contracts in your projects?

• What are the risks/uncertainties in the supply chain?
Contracts in an abstract Sense

Manufacturer
Production Cost: $c/unit

CONTRACT

Retailer
Sale Price: $p/unit

Clients
Demand: D units
Contracts in an abstract Sense

Some ingredients of a contract:
- Unit price
- Transfer payment
- Returns payments
- Sales rebates
Contracts in an abstract Sense

• The more “ingredients” the more complicated to implement

Not all contracts are created equal
Motivating Example

• You were hired to design a wholesale-price contract for distributors of a Plumpy Nut type product in Ethipoia

• Each jar costs $2 to produce

• The shelf life of this product is 6 months, and the suggested retail price is $4

• The salvage (recycling) value for unused jars is $1

• Demand is Uniform[0,100]

• What is the wholesale price that maximizes your profit?
Motivating Example

Manufacturer
Production Cost: $c$/unit
Wholesale Price: $w$/unit

Retailer
Sale Price: $p$/unit
Salvage value: $s$/unit

Customers
Demand: $D$ units
Motivating Example – Part 2

Manufacturer = Retailer
Production Cost: $c/\text{unit}$
Sale Price: $p/\text{unit}$
Salvage value: $s/\text{unit}$

Customers
Demand: $D \text{ units}$

$p/\text{unit}$
$s/\text{unit}$
$+ c/\text{unit}$
What just happened?

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>Manuf. = Distributor</th>
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</thead>
<tbody>
<tr>
<td>Order quantity</td>
<td>33.3</td>
<td>66.6</td>
</tr>
<tr>
<td>Expected Profit Retailer</td>
<td>16.6</td>
<td>66.6</td>
</tr>
<tr>
<td>Expected Profit Manufacturer</td>
<td>33.3</td>
<td>66.6</td>
</tr>
<tr>
<td>Expected total Profit</td>
<td>50</td>
<td>66.6</td>
</tr>
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33% Loss due to lack of coordination
Fixed Price (wholesale) Contracts

• First case is an example of a Fixed-Price Contract

• This reduction in profit is called Double Marginalization:

If every firm chooses to maximize its own expected profit, the result is a higher market price, lower market demand, and lower total profit compared to the SC’s maximum profit.
What can we do to reduce Double Marginalization?

• We change the contract between manufacturer and retailer!

• The maximum profit that can be obtained is through perfect coordination
Buy Back Contracts

• Retailer receives credit from manufacturer on units leftover at the end of the selling season

• Reduces the risk for the retailer due to demand uncertainty (overstock)

• Do you know any real-world examples?
Impact of Buy Back Contracts

Manufacturer
- Production cost: $c$/unit
- Wholesale price: $w$/unit
- Salvage price: $s$/unit

Retailer
- Sale price: $p$/unit
- Buy back price: $b$/unit

$c$/unit

$s$/unit

$b$/unit

$w$/unit
## Comparison with Maximum Profit

<table>
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<th>Manuf. = Distributor</th>
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</thead>
<tbody>
<tr>
<td><strong>Order Quantity</strong></td>
<td>33.3</td>
<td>40</td>
<td>66.6</td>
</tr>
<tr>
<td><strong>Expected Profit Retailer</strong></td>
<td>16.6 (33%)</td>
<td>20 (36%)</td>
<td></td>
</tr>
<tr>
<td><strong>Expected Profit Manufacturer</strong></td>
<td>33.3 (66%)</td>
<td>36 (64%)</td>
<td>66.6</td>
</tr>
<tr>
<td><strong>Expected total Profit</strong></td>
<td>50</td>
<td>56</td>
<td>66.6</td>
</tr>
</tbody>
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### Drawbacks:

- Requires manufacturer to verify leftover units
- May reduce buyer selling effort
Wholesale price

Buy Back price = $1.5/unit
There are many others…

• Quantity Flexibility, Fixed price incentive…

Moral:

Working together with the other players in the SC can help increase the size of the “pie”, even if your slice is proportionally smaller.
You will operate here with 1 warehouse and 1 factory
The Supply Chain Game

• You sell foam for insulation
• Demand is highly seasonal but stable
• The game starts at day 730, two years after Jacobs began producing and marketing the chemical.
• Game ends at day 1460, when a new product is introduced and the foam becomes obsolete
Demand
Operations

• Single factory, single warehouse
• No backorders: when client doesn’t find product, he goes somewhere else

• Your team can make:
  – Capacity additions to the factory.
  – The finished goods inventory threshold that triggers production of a new batch in the factory.
  – The factory's production batch size.
  – Whether batches are transported to the warehouse by mail or by truck.
The winning team is the one with the highest cash position on day 1460.
Next steps

• Register your team (detailed instructions coming soon)

• Figure out how you will manage inventory

• Have fun!
Overcoming demand uncertainty

• Three examples of contracts
  – Buyback contracts
  – Quantity flexibility (option) contracts
  – Revenue Sharing contracts
Buyback contracts

• Manufacturer pays the distributor for leftover units at the end of selling season

• Encourages high buyer orders

• Examples:
  – Publishing industry
  – Music industry

• Disadvantages

• Would it work in an emerging marker?
Quantity Flexibility

• Manufacturer places an order at the beginning of the season, but the quantity can be adjusted up or down

• Also encourages higher ordering quantities

• Examples: Fashion industry
• Disadvantages
Revenue Sharing

- Manufacturer receives some fraction of sales revenue
- Both share risk due to demand uncertainty
- Example: Blockbuster
- Would it work in an emerging market?