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Chapter 11.2

Introduction of innovations

# Outline

- Problem and model assumptions
- Controversial innovations
- Phasing of innovations
- Selling innovations
- Optimal strategy for small banks
- Summary

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# Phased introduction and sale of innovations

- ▶ Financial innovations can be copied by other investment banks, but there might be a time delay
- ▶ Clients delaying adoption might lose some benefits, such as tax avoidance or circumventing regulations
- ▶ Regulators might intervene to prohibit an innovation
- ▶ Innovations might be split and introduced in phases
- ▶ Investment banks are competing and clients might be switching to take advantage of innovations
- ▶ They might also sell innovations to other investment banks

# Costs and benefits of innovations

- ▶ Value of an innovation to the client is  $V$
- ▶ Delaying the adoption of the innovation costs the client  $C_D$
- ▶ Switching investment banks imposes costs of  $C_S$  on clients
- ▶ An innovation is rendered worthless by regulators after one time period with probability  $p$

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# Equilibrium adoption

- ▶ The investment bank charges a price  $P$  for the innovation
- ▶ Adopting the innovation gives the client benefits  $V - P$
- ▶ If delaying the adoption, the innovation can be obtained for free
- ▶ The benefits are only available if the regulator does not interfere, and the delay costs are incurred
- ▶ Delayed adoption is only considered if it is profitable
- ▶ Equilibrium condition:  $V - P = \max \{(1 - p) V - C_D, 0\}$

# Equilibrium price

- ▶ This gives 
$$P = \begin{cases} V & \text{if } C_D \geq (1 - p) V \\ pV + C_D & \text{if } C_D < (1 - p) V \end{cases}$$
- ▶ The price increases in the likelihood the regulator intervenes
- ▶ If costs to develop innovations are fixed, this is an incentive to develop controversial innovations



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# Dividing innovations

- ▶ Innovations can be split into  $T$  steps and  $V = \sum_{t=1}^T V_t$
- ▶ Delaying the adoption each step costs  $C_D$
- ▶  $T$  is such that  $V = TC_D$
- ▶ Waiting for the full innovation eliminates all benefits to clients

## Investment bank profits in each step

- ▶ Maximum price that can be charged for each innovation phase is  $\min \{V_t, C_D\}$ , otherwise delaying is more beneficial
- ▶ They can attract new clients from investment banks not innovating by charging a lower price that is reduced by the switching costs:  $\max \{ \min \{V_t, C_D\} - C_S, 0 \}$
- ▶ We have  $N$  clients and a market share  $\alpha_i$ , and they can attract all remaining clients
- ▶ Profits:  $\Pi_B^{i,t} = \alpha_i N \min \{V_t, C_D\} + (1 - \alpha_i) N \max \{ \min \{V_t, C_D\} - C_S, 0 \}$
- ▶ Innovation steps are all of equal size in equilibrium, hence  $V_t = C_D$
- ▶ This gives  $\Pi_B^{i,t} = \alpha_i N C_D + (1 - \alpha_i) N \max \{C_D - C_S, 0\}$

## Total investment bank profits

- ▶ If the innovation is prohibited in each time period with probability  $p$ , the investment bank can continue to sell it with probability  $1 - p$  until  $T$  steps are used
- ▶ Total profits:  $\Pi_B^i = \sum_{t=0}^T (1 - p)^t \Pi_B^{i,t}$
- ▶ If selling the innovation in one step, they can gain the whole market if  $V > C_D + C_S$
- ▶ They charge  $C_D$  to prevent clients delaying adoption
- ▶ Investment bank profits:  $\hat{\Pi}_B^i = NC_D$

## Choosing to introduce innovations phased

- ▶ Investment banks phase innovations in if  $\hat{\Pi}_B^i \leq \Pi_B^i$
- ▶ This gives  $\alpha_i \geq \alpha^* = \frac{pC_D - (1-(1-p)^T) \max\{C_D - C_S, 0\}}{(1-(1-p)^T) \min\{C_D, C_S\}} < 1$ .
- ▶ Small investment banks prefer to introduce innovations in one step, large investment banks prefer to phase in innovations
- ▶ Small investment banks attract the large remaining market, even though they make little profits from the single step
- ▶ Large investment banks do not gain that much market share and prefer to make multiple profits from phasing in the innovation

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# Sale price

- ▶ An investment can sell an innovation to another investment bank rather than introducing it itself
- ▶ The most it can be sold for is the profit it gives the buyer, who has market share  $\alpha_j$
- ▶ Maximum price for selling the innovation to clients is  $C_D$  to avoid then delaying adoption
- ▶ It can also not be over  $C_S$  as otherwise they would be switching to the original innovator
- ▶ Price:  $P = \alpha_j N \min \{C_D, C_S\}$

## High switching costs

- ▶ If  $C_S > C_D$ , no clients will switch, seller  $i$  obtains  $\Pi_B^{i,t} = \alpha_i N C_D$  if retaining the innovation
- ▶ If selling, they obtain  $P = \alpha_j N C_D$
- ▶ They sell to the largest bank with  $\alpha_j > \alpha_i$
- ▶ Except for the largest bank making the innovation, the innovation will always be sold



## Low switching costs

- ▶ If  $C_S \leq C_D$ , then the revenue from not selling is  $\Pi_B^{i,t} = \alpha_i N C_D + (1 - \alpha_i) N \max \{C_D - C_S, 0\}$
- ▶ If selling they obtain  $P = \alpha_j N C_S$
- ▶ The investment bank sells the innovation is  $P > \Pi_B^{i,t}$
- ▶ This requires  $\alpha_i \leq \alpha^{**} = 1 - (1 - \alpha_j) \frac{C_D}{C_S} < 1$
- ▶ Small banks will prefer to sell the innovation
- ▶ The larger the buying investment bank, the larger the seller can be

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## Selling, phasing in, immediate release

- ▶ If  $C_S \leq C_D$ , then  $\Pi_B^{i,t} = NC_D \geq \alpha_j NC_D$  and the innovation is not sold but immediately introduced
- ▶ If  $\alpha_i \geq \alpha^*$ , innovations are phased in
- ▶ If  $\alpha_i \leq \alpha^{**}$ , innovations are sold
- ▶ If  $\alpha^* \leq \alpha^{**}$ , innovations are not phased in, but sold, this requires  $\alpha_j \geq \bar{\alpha} = \frac{p}{1-(1-p)^T}$  to be feasible

# Sale and introduction strategy

	$C_S > C_D$		$C_S \leq C_D$
	$\alpha_j \leq \bar{\alpha}$	$\alpha_j > \bar{\alpha}$	
$\alpha_i \leq \alpha^*$	immediate introduction		
$\alpha^* < \alpha_i \leq \alpha^{**}$	phased	sale	
$\alpha_i > \alpha^{**}$	introduction		

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# Strategies for banks of different sizes

- ▶ Investment banks with small market share will always seek to introduce innovations immediately to gain market share
- ▶ Medium-sized investment banks will either phase in any innovations to extract more surplus from their clients, or if a sufficiently large investment bank buys their innovation, sell it
- ▶ Large investment banks will phase in innovations but not sell it
- ▶ If switching costs for clients are low, phased introductions are not feasible

# Innovative investment banks

- ▶ Small investment banks are seen as offering significant innovations
- ▶ Larger investment banks are only making incremental improvements to existing processes and products
- ▶ Mid-sized investment banks are cooperating with larger competitors to spread an innovation



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