

One Step Forward, Two Steps Back: Foreclosure Dynamics in Tipping Markets

Matteo Courthoud, Gregory Crawford

October 14, 2020

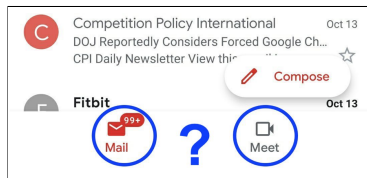
Motivation

- Many foreclosure concerns in recent merger cases
- And fear of mistakes in past cases (e.g. Google-DoubleClick)
- Common denominators:
 - Large tech companies: economies of scale
 - Quickly evolving markets
 - Product complementarities
 - Fear of firm dominance spreading across markets
- In particular: **data**, source of
 - economies of scale
 - complementarities (sometimes artificial)

Foreclosure definition: *“a firm’s restriction of output in one market through the use of market power in another market”* (Rey and Tirole, 2007).

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Example: Google fitbit

- Google has a recent history of foreclosure



US: Google hit by antitrust probe by 50 attorneys general

CPI - September 9, 2019
Texas Attorney General Ken Paxton on Monday, September 9, announced an antitrust investigation into Google, **with the participation of 50 attorneys general**. The probe comes as Silicon Valley faces increasing scrutiny from the government over what critics say are monopolistic business practices, reported CNBC.

- Fitbit business: wearables
 - new source of **consumer attention**
 - and health **data**
- Google business: monetizing **consumer attention** using **data**
- Google would have an incentive to favor its (Wear) operating system for all (non-Apple) wearables
 1. *establishing* a dominant position in *health* user data
 2. *protecting* its dominant position in *non-health* user data

Research Question

- Microsoft/Netscape case (2001) spurred rich research on foreclosure in complementary markets
- Theory focused on institutional details of that specific case: sequential entry in complementary markets with integrated monopolist
- How general are these insights?
- What is the role of increasing returns, e.g. economies of scale?
- What are the policy implications?

Research Question

- Microsoft/Netscape case (2001) spurred rich research on foreclosure in complementary markets
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- What are the policy implications?

This paper: computational model of dynamic competition (entry, exit, mergers) in complementary markets w/ increasing returns and foreclosure possibilities (with implications for pressing cases in competition policy)

Contributions

1. Endogenous market structure
2. Add economies of scale: learning-by-doing
3. Policy focus

Contributions

1. Endogenous market structure

- Instead of taking the market structure as given, we study the full dynamics of the market structure (distribution over market structures)
- E.g. classic foreclosure paper starts with "consider a monopolist facing a potential entrant..."
- Analyze a broader framework where firms can enter, exit, merge
- Nests classical foreclosure papers, e.g. Winston (1989), Carlton & Waldman (2002)
- Seek to trace out mapping of structural parameters governing economic environment into long-run equilibria (competition vs monopoly)

2. Add economies of scale: learning-by-doing

3. Policy focus

Contributions

1. Endogenous market structure
2. **Add economies of scale: learning-by-doing**
 - Mechanism: firms become more efficient through sales
 - Common framework to study market tipping
 - Compact model, only one decision variable (prices)
 - Results are robust to different forms of increasing returns (e.g. increasing returns in investment, network effects)
3. Policy focus

Contributions

1. Endogenous market structure
2. Add economies of scale: learning-by-doing
3. **Policy focus**
 - Maps into topical cases (Google-Fitbit, ...)
 - Captures main feature of big tech markets: data
 - High demand from policy
 - EC: gatekeeper regulations
 - UK: creation of digital markets unit
 - US: proposed new antitrust laws
 - Flexible model w.r.t. policy interventions
 - Merger policy
 - Data sharing
 - Ban below-cost pricing
 - Non-discrimination provisions

Results

1. Baseline: no learning-by-doing and no bundling

- Firms have little incentives to integrate

2. Bundling

- Bundling improves firm *ability* to internalize externalities
- Conventional comp. policy: mergers of complements increase welfare
- BUT market structure more likely to degenerate to monopoly

3. Learning-by-doing

- Learning-by-doing increases firm *incentives* to internalize externalities
- High incentives for “partial foreclosure”: exclusion through pricing

4. Learning-by-doing + bundling

- Firms have both the *incentives* (LBD) and *ability* (bundling) to integrate and be aggressive in pricing
- Market tipping extremely likely

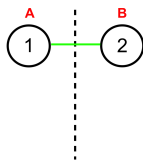
Literature

- Foreclosure
 - Literature: Rey, Tirole (2007)
 - Two-period models: Whinston (1990), Choi and Stefanadis (2001), Carlton and Waldman (2002)
- Learning-by-doing
 - Theory: Cabral and Riordan (1994), Cabral (2011)
 - Computation: Besanko, Doraszelski, Satterthwaite and Kryukov (2010), Besanko, Doraszelski and Kryukov (2014), Besanko, Doraszelski and Kryukov (2017)
- Computation Theory
 - Pakes and McGuire, (1994), Ericson and Pakes (1995), Doraszelski and Pakes (2007), Doraszelski and Satterthwaite (2010)
- Recent literature
 - Data: Hagiu, Wright (2020)
 - Google-Fitbit: Chen, Choe, Cong and Matsushima (2020), Condorelli and Padilla (2020a), Condorelli and Padilla (2020b)

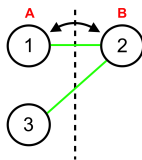
Model

Model

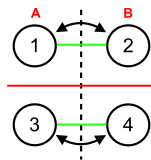
- Two markets: A and B
- Complements: consumers demand one unit of each product (system)
- At most two products per market (for now)
- Plus outside option (not in the figures)
- Firms can enter, exit and merge
- **No learning-by-doing (yet)**



a) 2 firms, 2 products,
1 system



b) 2 firms, 3 products,
2 systems

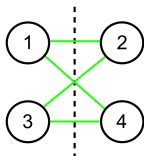


c) 2 firms, 4 products,
2 systems

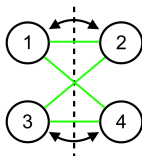
Internalizing Externalities

Two ways of internalizing pricing externalities on products in the other market:

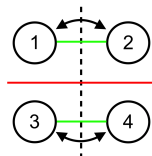
1. Ownership: through mergers or cross-market entry
2. Ownership + Bundling: own products incompatible with competitor's



a) no internalization



b) ownership



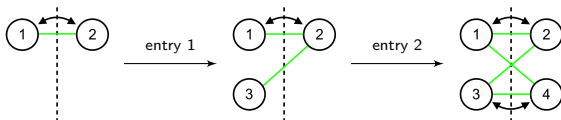
b) ownership + bundling

Difference:

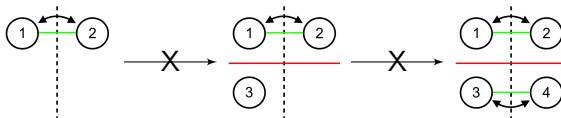
- Ownership only internalizes pricing incentives w.r.t. outside option
- Why? Own product can be bought in combination with competitor's

Predatory Bundling










- Side effect: bundling also implies zero profits for competitor facing an integrated monopolist
- Carlton & Waldman (2002): bundling to preserve monopoly power and prevent 2-step entry



- If entry is profitable only if entrant sells in both periods, bundling can prevent entry by negating sales in the intermediate period














Carlton & Waldman (2002)

From — To							
							
							1

Rows: initial state. Columns: asymptotic distribution over states.

1. If you start in integrated duopoly, you stay there













Carlton & Waldman (2002)

From — To							
							1
							
							
		0.8969					0.1031

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1. If you start in integrated duopoly, you stay there
2. If mkt A is competitive (i.e. browsers), mkt B is not (O.S.) and (1)-(2) is jointly owned (Microsoft), most likely outcome is monopoly

Carlton & Waldman (2002)

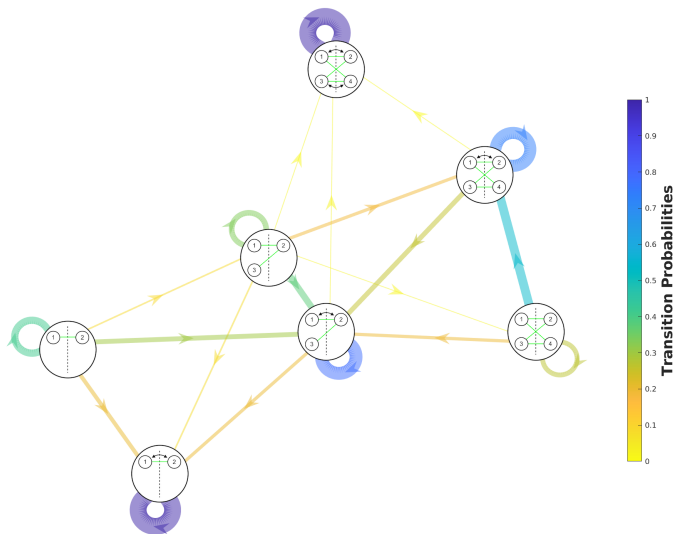
From — To							
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		0.8969					0.1031
							
		1					

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2. If mkt A is competitive (i.e. browsers), mkt B is not (O.S.) and (1)-(2) is jointly owned (Microsoft), most likely outcome is monopoly
3. What if A is not yet competitive? Bundling makes entry in A unprofitable in the first place and monopoly the only equilibrium











Market Transitions

Computational model allows us to look at the big picture.



Parameters: $s=[1:1,1:1]$, $\max=3$, $l=1$, $O=1$, $M=1$, $F=1$, $d=0.10$, $s=0.1$, $k=1$, $p0=3.0$, $r=0.7$, $mc=[1,10]$, $ec=[1,10]$, $ev=[0,1]$

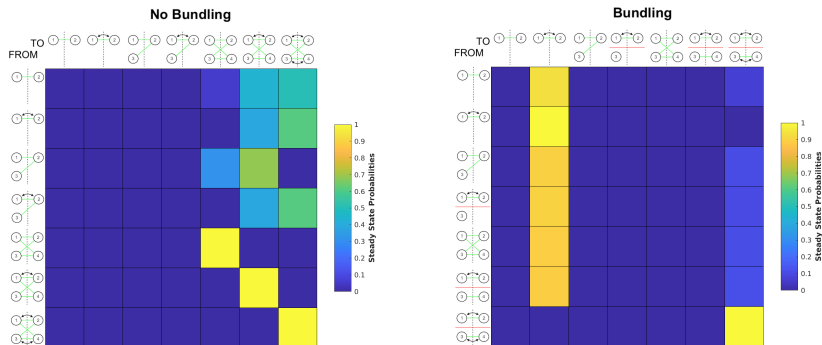
Carlton & Waldman - Without Bundling

From — To							
							1
						0.3896	0.6104
						0.3896	0.6104

Rows: initial state. Columns: asymptotic distribution over states.

- Concentration is not natural but a consequence of product bundling








Comparing Market Transitions










Key policy insights:

- Without bundling: market converges to competitive structure
- With bundling: market mostly converges to integrated monopoly
- Bundling does not just impact transitions but also welfare (next slide)








Welfare

No Bundling							
Price	2.2223	2.4562	2.4828	2.5096	2.3983	2.3981	2.398
Profits	0.6779	0.7047	0.7634	0.7514	0.3995	0.3994	0.3993
C Surplus	0.1479	0.2085	0.1964	0.2113	0.7389	0.7391	0.7392








Static: welfare increases
in integrated duopoly

Bundling							
Price	2.2223	2.4562	2.4828	2.4562	2.3983	2.2859	2.1996
Profits	0.6779	0.7047	0.7634	0.7047	0.3995	0.2867	0.1999
C Surplus	0.1479	0.2085	0.1964	0.2085	0.7389	0.7793	0.8694

Welfare

No Bundling							
Price	2.2223	2.4562	2.4828	2.5096	2.3983	2.3981	2.398
Profits	0.6779	0.7047	0.7634	0.7514	0.3995	0.3994	0.3993
C Surplus	0.1479	0.2085	0.1964	0.2113	0.7389	0.7391	0.7392








Dynamic: welfare decreases

Bundling							
Price	2.2223	2.4562	2.4828	2.4562	2.3983	2.2859	2.1996
Profits	0.6779	0.7047	0.7634	0.7047	0.3995	0.2867	0.1999
C Surplus	0.1479	0.2085	0.1964	0.2085	0.7389	0.7793	0.8694

Comment: 1 Step Forward, 2 Steps Back

- Conventional competition policy: mergers of complements lower prices (consumer welfare enhancing)
- True in the short run

Example: merger with 4 non-integrated products

Bundling							
Price	2.2223	2.4562	2.4828	2.4562	2.3983	2.2859	2.1996
Profits	0.6779	0.7047	0.7634	0.7047	0.3995	0.2867	0.1999
C Surplus	0.1479	0.2085	0.1964	0.2085	0.7389	0.7793	0.8694

→
1 step forward

Comment: 1 Step Forward, 2 Steps Back

- Conventional competition policy: mergers of complements lower prices (consumer welfare enhancing)
- True in the short run
- Dynamics: market structure most likely to degenerate to monopoly

Example: merger with 4 non-integrated products

Bundling							
Price	2.2223	2.4562	2.4828	2.4562	2.3983	2.2859	2.1996
Profits	0.6779	0.7047	0.7634	0.7047	0.3995	0.2867	0.1999
C Surplus	0.1479	0.2085	0.1964	0.2085	0.7389	0.7793	0.8694

1 step forward

2 steps back

Learning-by-doing

Endogenous Efficiency: Learning-by-Doing

- Learning-by-doing: firms decrease their marginal cost through sales
 - Only one firm gets a sale in each period
 - The firm that gets the sale decreases its marginal cost
 - Up to a lower bound
- Model: learning-by-doing *only in market A*
- Learning-by-doing introduces endogenous asymmetries
- ...and changes firms' **pricing incentives**
 - Lower price → higher probability of lower marginal cost in the future
 - Result: aggressive pricing behavior
- **Comments**
 1. *Without* bundling: learning-by-doing worsens partial foreclosure
 2. *With* bundling: encourages market tipping

Comment 1: Pricing Incentives *without* Bundling

- Partial foreclosure: excluding rival through pricing behavior
- Setting: integrated firm facing competitor in one market



- **Without learning-by-doing**
 - price at marginal cost in competitive market (product 1)
 - extract surplus from the other market (product 2)
 - product 3 partially foreclosed from the market

Comment 1: Pricing Incentives *without* Bundling

- Partial foreclosure: excluding rival through pricing behavior
- Setting: integrated firm facing competitor in one market



- **With learning-by-doing**

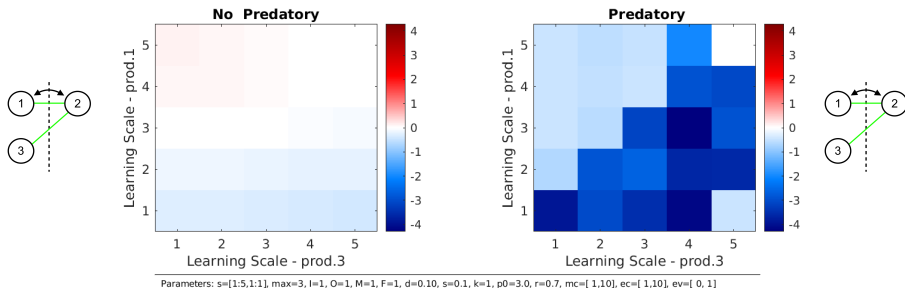
- Incentive to price below marginal cost
- **Result:** stronger partial foreclosure
- Note: it happens *even if predatory incentives are “shut down”*, i.e. even if the integrated firm does not internalize the effect of its own actions on the entry/exit/merger decisions of its competitor

To see it, we have to zoom in the dynamics *within market structure*

Comment 1: Pricing Incentives *without* Bundling

- Incumbent prices below marginal cost in market A even without internalizing predatory incentives (*left*)
- If the incumbent internalizes the effect of its pricing on the exit probability of its competitors, it will be much more aggressive (*right*)
- **Result:** learning-by-doing magnifies partial foreclosure incentives

Product 1: Price - Marginal Cost

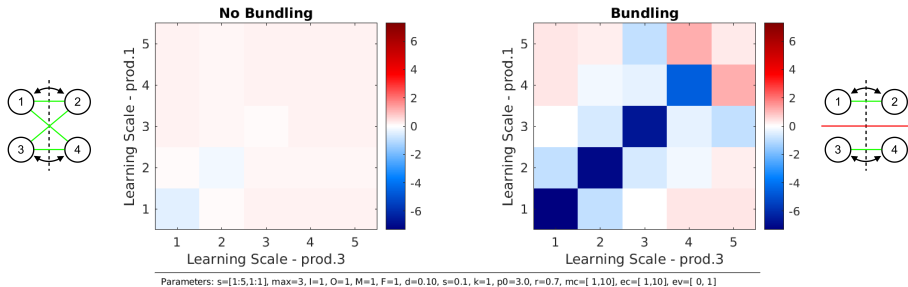


Learning-by-doing + Bundling

Comment 2: Pricing Incentives *with* Bundling

- With bundling, firms fully internalize pricing incentives
- **Result:** very aggressive pricing to climb the learning curve
- Setting: integrated duopoly

Product 1: Price - Marginal Cost

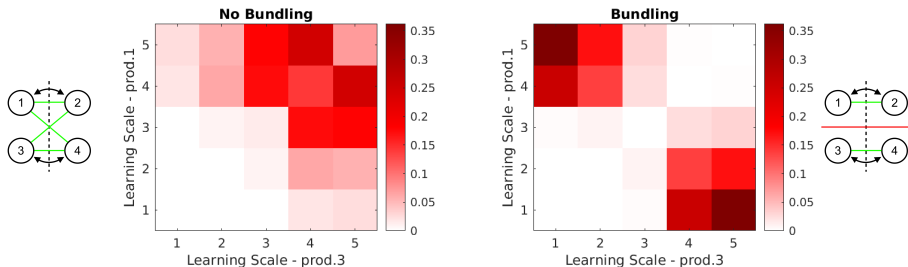


- How does it affect then *within market* state distribution?

Comment 2: Pricing Incentives *with* Bundling

- Steady state distribution *within* integrated duopoly
 - W/o bundling, both firms at the top of the learning curve \rightarrow no exit
 - With bundling, market tipping \rightarrow exit
- Result:** learning-by-doing + bundling can transform competition *in the market* to competition *for the market*.

Steady State Distribution



Parameters: $s=[1:5,1:1]$, $\max=3$, $l=1$, $O=1$, $M=1$, $F=1$, $d=0.10$, $s=0.1$, $k=1$, $p_0=3.0$, $r=0.7$, $mc=[1,10]$, $ec=[1,10]$, $ev=[0,1]$

Next Steps

Test policy interventions

- Merger policy
- Non-discrimination provisions
- Data sharing
- Ban below-cost pricing
- Ban product bundling

Next Steps

Test policy interventions

- Merger policy
- Non-discrimination provisions
- Data sharing
- Ban below-cost pricing
- Ban product bundling

Thank you!

Appendix

Baseline Model - Details

Example setting:

- 2 markets: A and B
- 4 products: A_1, A_2, B_1, B_2
- 4 systems: $A_1B_1, A_1B_2, A_2B_1, A_2B_2$
- Consumer i utility from system A_1B_1

$$u_{iA_1B_1} = v_i - \alpha(p_{A_1} + p_{B_1}) + \varepsilon_{iA_1B_1}$$

- Demand of product A_1

$$q_{A_1}(\mathbf{p}) = \frac{e^{-\alpha p_{A_1}}}{e^{-\alpha p_{A_1}} + e^{-\alpha p_{A_2}} + e^{-\alpha p_0} (e^{-\alpha p_{B_1}} + e^{-\alpha p_{B_2}})^{-1}}$$

Where v_i is the value of a product for consumer i , p_{A_1} is A_1 's price, $\varepsilon_{iA_1B_1}$ is consumer i shock for system A_1B_1 .

Objective Function

Firm that produces only product A_1

$$\pi_{A_1} = q_{A_1}(\mathbf{p})(p_{A_1} - c_{A_1})$$

Assume A_1 and B_1 are produced by the same firm:

$$\pi_{A_1} + \pi_{B_1} = q_{A_1}(\mathbf{p})(p_{A_1} - c_{A_1}) + q_{B_1}(\mathbf{p})(p_{B_1} - c_{B_1})$$

Assume A_1 and B_1 are produced by the same firm and bundled together¹:

$$\pi_{A_1} + \pi_{B_1} = q_{A_1 B_1}(\mathbf{p})(p_{A_1} - c_{A_1} - c_{B_1})$$

¹ p_{B_1} normalized to zero, i.e. $p_{A_1 B_1} \equiv p_{A_1}$.

Internalizing Externalities - Details

FOC of firm A_1 :

$$\frac{1}{\alpha} q_{A_1} (1 - q_{A_1}) (p_{A_1} - c_{A_1}) - q_{A_1} = 0$$

Assume A_1 and B_1 are produced by the same firm:

$$\frac{1}{\alpha} q_{A_1} (1 - q_{A_1}) (p_{A_1} - c_{A_1}) - q_{A_1} + \underbrace{\frac{1}{\alpha} (q_{A_1 B_1} - q_{A_1} q_{B_1}) (p_{B_1} - c_{B_1})}_{\text{partial internalization}} = 0$$

Assume A_1 and B_1 are produced by the same firm and bundled together²:

$$\frac{1}{\alpha} q_{A_1 B_1} (1 - q_{A_1 B_1}) (p_{A_1} - c_{A_1} - c_{B_1}) - q_{A_1 B_1} = 0$$

² p_{B_1} normalized to zero, i.e. $p_{A_1 B_1} \equiv p_{A_1}$.

Comments

Merging without bundling

- Extra term: $\frac{1}{\alpha} q_{A_1 B_1} (q_{A_1 B_1} - q_{A_1} q_{B_1}) (p_{B_1} - c_{B_1})$
- Firm internalizes the fact that lowering the price of product in market A increases demand (and profits) for product in market B
- But only for *joint product* $A_1 B_1$

Merging and bundling

- Higher margin: $(p_{A_1} - c_{A_1}) \rightarrow (p_{A_1} - c_{A_1} - c_{B_1})$
- Now firms sell only the *joint product*
- Firms fully internalizes impact on profits in the other market

Learning-by-Doing - Details

- Additional discrete state variable: e_n , firm n stock of know-how
- With probability q_n (demand), firm n wins a sale and increases its stock of know-how by one unit
- A firm-specific forgetting shock f_n decreases the stock of firm n 's know-how by one unit with probability

$$\Pr(f_n) = 1 - (1 - \delta)^{e_n}$$

- Law of motion of know-how:

$$e'_n = e_n + q_n - f_n$$

- Firm marginal cost depends on the stock of know-how through a concave learning curve:

$$c(e_n) = \kappa \max\{e_n, M\}^\rho$$

where κ is the maximum marginal cost, ρ is the learning rate and M is the know-how upper bound.

Maximization Problem: Learning-by-Doing

Objective function of firm producing A_1 before:

$$\pi_{A_1}(\mathbf{p}) = q_{A_1}(p_{A_1} - c_{A_1})$$

Objective function of firm producing A_1 with learning-by-doing:

$$\begin{aligned} V_{A_1}(\mathbf{p}) &= q_{A_1}(p_{A_1} - c_{A_1}) + \beta \mathbb{E}[V'_{A_1}] = \\ &= q_{A_1}(p_{A_1} - c_{A_1}) + \\ &\quad + \beta \left[q_{A_1 B_1} V_{A_1}^{A_1 B_1} + q_{A_1 B_2} V_{A_1}^{A_1 B_2} + q_{A_2 B_1} V_{A_1}^{A_2 B_1} + q_{A_2 B_2} V_{A_1}^{A_2 B_2} \right] \end{aligned}$$

Where $V_{A_1}^{A_1 B_1}$ is the conditional value function, on $A_1 B_1$ being sold.

Now winning a sale has an impact not only on current profits but also on future value.

Pricing Incentives: Learning-by-Doing

FOC of firm producing A_1 before:

$$0 = \frac{1}{\alpha} q_{A_1} (1 - q_{A_1}) (p_{A_1} - c_{A_1}) - q_{A_1}$$

FOC of firm producing A_1 with learning-by-doing:

$$\begin{aligned} 0 = & \frac{1}{\alpha} q_{A_1} (1 - q_{A_1}) (p_{A_1} - c_{A_1}) - q_{A_1} + \\ & + q_{A_1 B_1} (1 - q_{A_1}) V_{A_1 B_1} + q_{A_1 B_2} (1 - q_{A_1}) V_{A_1 B_2} - \\ & - q_{A_2 B_1} q_{A_1} V_{A_2 B_1} - q_{A_2 B_2} q_{A_1} V_{A_2 B_2} \end{aligned}$$

Now firms internalize the fact that by winning a sale today they not only get current profits, but also decrease their future marginal cost.