Vertical Mergers in Platform Markets

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Introduction

Software platform industries: a move toward more integration?

- Google Nexus brand (2010-2015), acquisition and sale of Motorola (2011-2014), Pixel smartphone (2016)
- OEMs expressed concerns about risk of foreclosure; recurring rumors that Samsung, Huawei, etc. develop their own OSs

In April 2016, the EC has informed Google of its preliminary view that "the company has abused its dominant position by imposing restrictions on Android device manufacturers"

EC also analyzed risks of foreclosure in recent vertical mergers: Google/Motorola (2011), Microsoft/Nokia (2013)

→ Legitimate concerns. . . but lack of theory!

This paper

- Competitive effects of vertical integration in platform markets
- Role of network effects in the competitive analysis

Outline

Observation/Reminder

- "Traditional markets": key role of strategic interaction in merger analyses
- Vertical mergers analyses: strategic complementarity on the downstream market

Starting point of our analysis

- Network effects in two-sided markets: from strategic complementarity to strategic substitutability between downstream rivals

First task

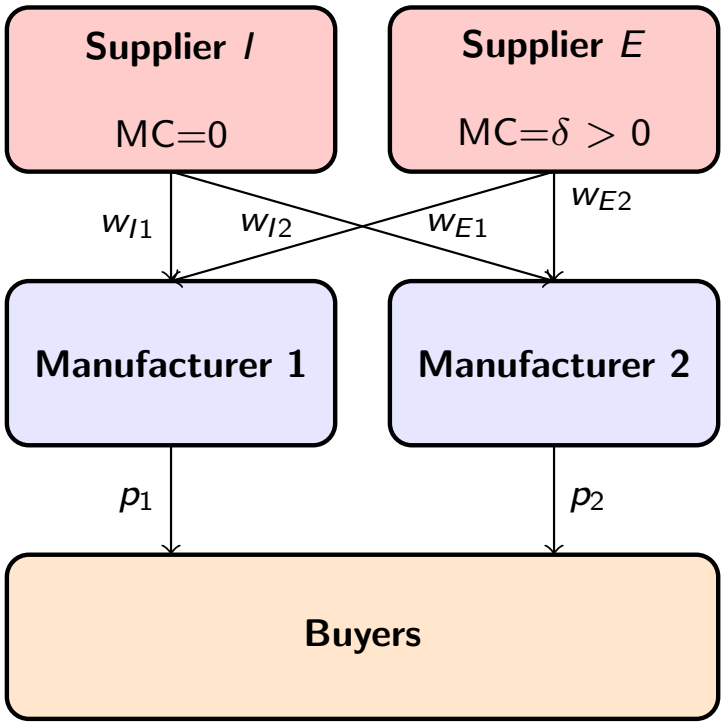
- Consequences of this change on equilibrium prices and profits

Second task

- Account for two-sided/digital markets specificities
- Extensions

Reminder: Vertical Mergers in "One-Sided" Markets

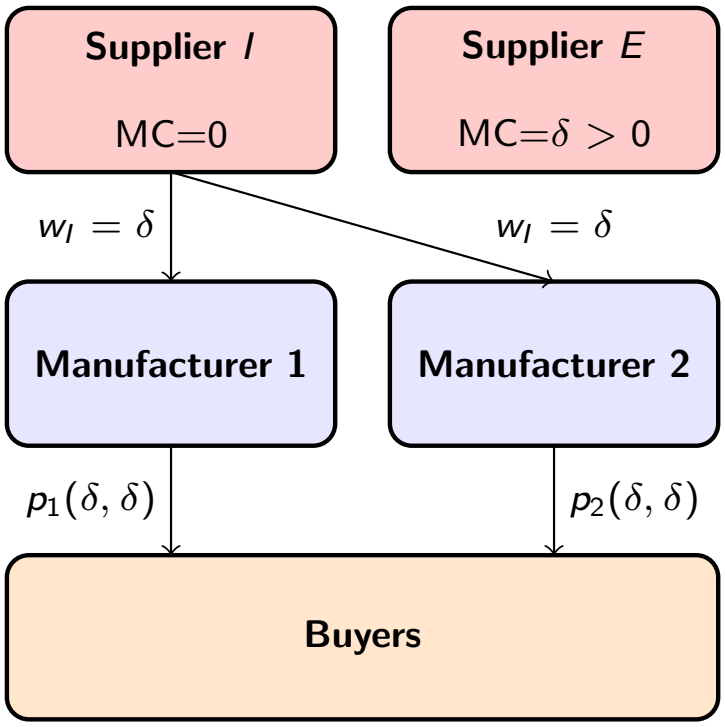
Ordover-Saloner-Salop (1990), Chen (2001)



Model

- Vertically-related industry: upstream suppliers sell an homogeneous input to downstream manufacturers, which then compete on a product market
- Upstream: Asymmetric Bertrand competition (δ small)
- Downstream: price competition with product differentiation implies strategic complementarity between manufacturers' prices (upward-sloping best responses)

Reminder: Vertical Mergers in "One-Sided" Markets

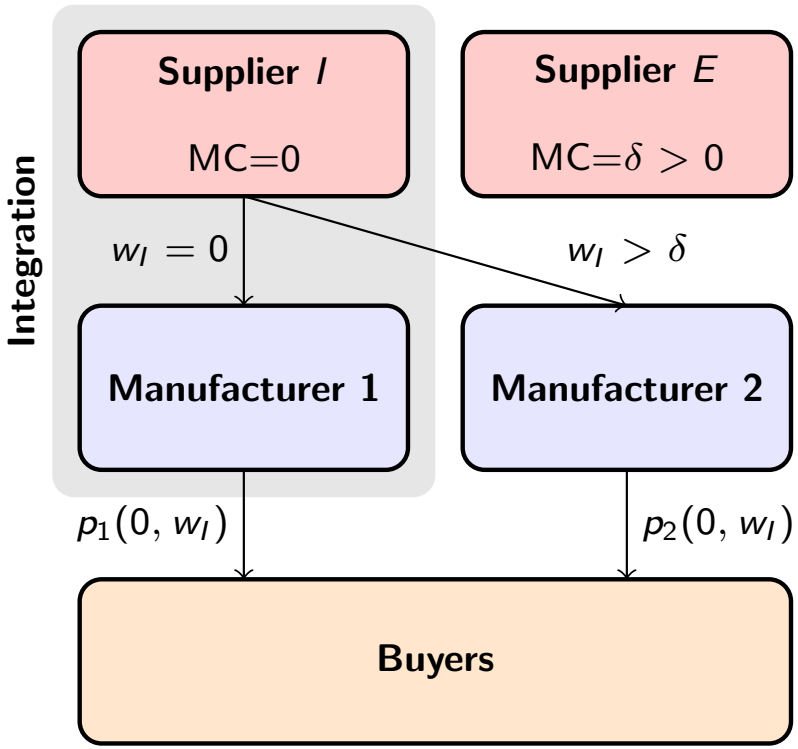


Separation (pre-merger situation)

- Both manufacturers buy from I at price δ
- Source of I's upstream market power: cost advantage (or efficiency gains)
- Inefficiency: input produced by most efficient firm but sold at price strictly above marginal cost: $\delta > 0$

Reminder: Vertical Mergers in "One-Sided" Markets

Integration affects downstream prices through 3 effects



Integration

- Efficiency effect. M_1's perceived marg. cost is now 0: $p_1 \searrow \Rightarrow p_2 \searrow$
- Accommodation effect. M_1's downstream pricing changes because integrated firm cares about upstream profit: $p_1 \nearrow \Rightarrow p_2 \nearrow$
- Upstream market power effect. Because integrated firm is more accommodating on downstream market, M_2 willing to buy from I even at $w_I > \delta$: M_2's perceived marg. cost $\nearrow$, implying $p_2 \nearrow \Rightarrow p_2 \searrow$

$\rightarrow$ Net effect: VI is profitable, leads to foreclosure and has an ambiguous impact on surplus

Model: Introducing "Two-Sidedness"

Two population of users: buyers and developers.

- Buyers and developers interact $\Rightarrow$ indirect network effects: buyers enjoy facing more application developers and reciprocally

Two manufacturers, M_1 and M_2, produce devices which must be acquired by buyers prior to buying applications.

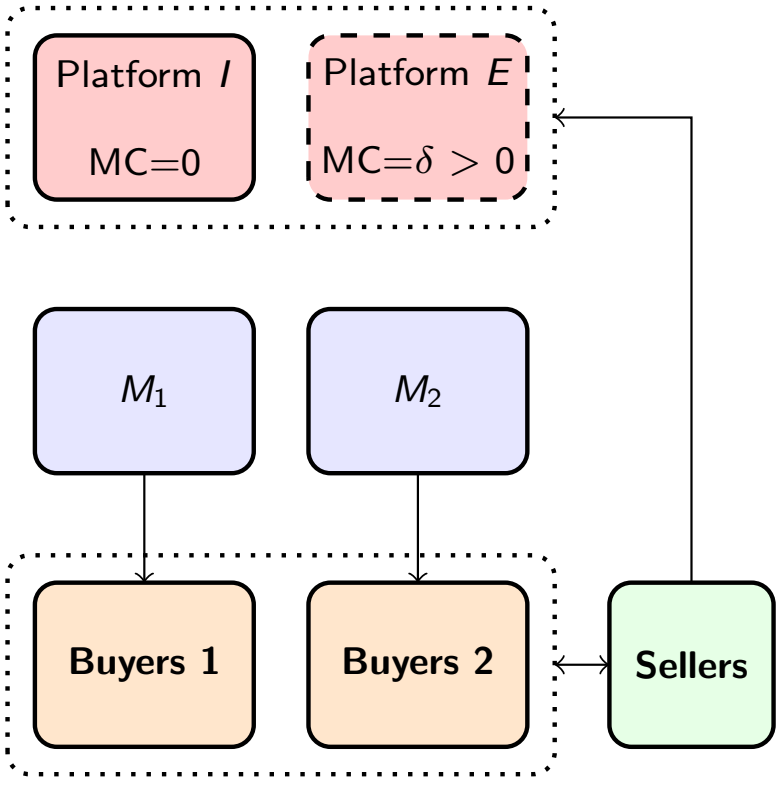
- marg. cost normalized to 0
- Manufacturers choose which OS to install on their devices
- (downstream) prices p_1 and p_2

Two software platforms (OS), I and E

- marg. cost 0 and $\delta > 0$ respectively
- no differentiation
- royalties w_I and w_E paid by manufacturers, no fees of developers

Timing: (1) royalties (2) affiliation (I or E), smartphones' prices (3) buyers' and developers' participation

Model: Main assumptions



A1: Applications available on both platforms

Only a development cost so that developers' participation depends on the total number of smartphone users $n_{B1} + n_{B2}$:

$$n_S = Q_S(n_{B1} + n_{B2}) \tag{1}$$

A2: Manufacturers are local monopolists

Buyers' participation depends on smartphones' prices and total number of developers n_S

$$n_{B1} = Q_B(p_1, n_S) \text{ and } n_{B2} = Q_B(p_2, n_S) \tag{2}$$

Network Effects & Strategic Interaction

Last stage of the game: Developers choose to develop or not and buyers decide to buy or not. Number of buyers of product $i = 1, 2$, $D_i(\cdot)$, and number of developers, $D_S(\cdot)$, solution of (1) and (2).

Proposition

Manufacturers are local monopolists but their demands depend on both prices through the developers' participation decision: $n_{B1} = D_1(p_1, p_2)$ and $n_{B2} = D_2(p_1, p_2)$.

Indirect network effects: $p_1 \nearrow \Rightarrow n_{B1} \searrow \Rightarrow n_S \searrow \Rightarrow n_{B2} \searrow$: $\frac{\partial D_i}{\partial p_j} < 0$.

But if $p_1 \nearrow \Rightarrow n_{B2} \searrow$, then we expect $p_2 \searrow$

A3: Strategic substitutability

Manufacturers' prices are strategic substitutes

No product market interaction but indirect network effects imply a form of "demand complementarity", which pushes toward strategic substitutability

A Linear-Uniform Example

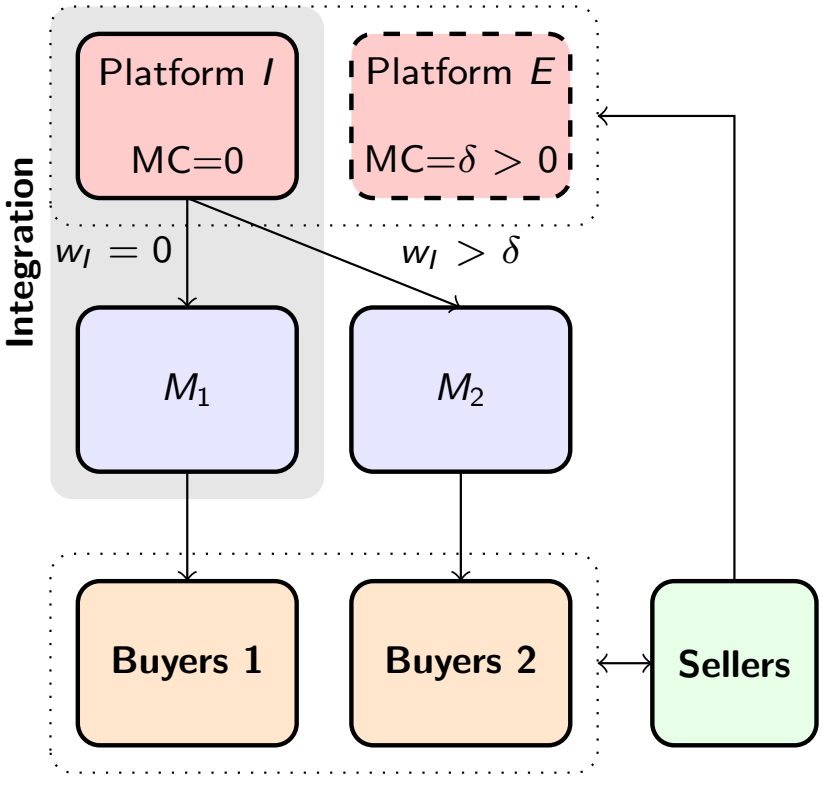
Main Example

- Mass of buyers with utility $U_B = v + u_B n_S - p_k - \tilde{\varepsilon}$, where $\tilde{\varepsilon}$ on $[0, \overline{\varepsilon}]$ according to a cdf $G(\cdot)$. Buyers' quasi-demand is $Q_B(p_k, n_S) = 1 - G\left(v + u_B n_S - p_k\right)$.
- Mass of developers, utility $U_S = u_S(n_{B1} + n_{B2}) - \tilde{f}$, where cost to develop an application $\tilde{f}$ on $[0, \overline{f}]$ according to a cdf $F(\cdot)$. Developers' quasi-demand is $Q_S(n_B) = 1 - F\left(u_S n_B\right)$.
- When $\tilde{\varepsilon}$ and $\tilde{f}$ are uniformly distributed on $[0, 1]$, provided that $\mu = u_B u_S < 1/2$, a unique interior solution of (1) and (2) exists and is given by

$$\begin{cases} D_1(p_1, p_2) &= \frac{1}{1-2\mu}(v - (1-\mu)p_1 - \mu p_2), \\ D_2(p_1, p_2) &= \frac{1}{1-2\mu}(v - (1-\mu)p_2 - \mu p_1), \\ D_S(p_1, p_2) &= \frac{1}{1-2\mu} u_S(2v - p_1 - p_2). \end{cases}$$

Prices are strategic substitutes, best responses have a slope < 1 in absolute value. The level of indirect network effects (μ) matters, not the structure.

Impact of Integration on Prices



Separation

- Both manufacturers buy from I at price δ.

Integration

- Efficiency effect: M_1's marg. cost is 0:

$$p_1 \searrow \Rightarrow \; p_2 \nearrow$$

- Accommodation effect: Since I and M_1 are integrated, p_1 is used to control upstream profits:

$$\max_{p_1} (p_1 - 0) D_1 + w_I D_2 \Rightarrow p_1 \searrow \Rightarrow \; p_2 \nearrow$$

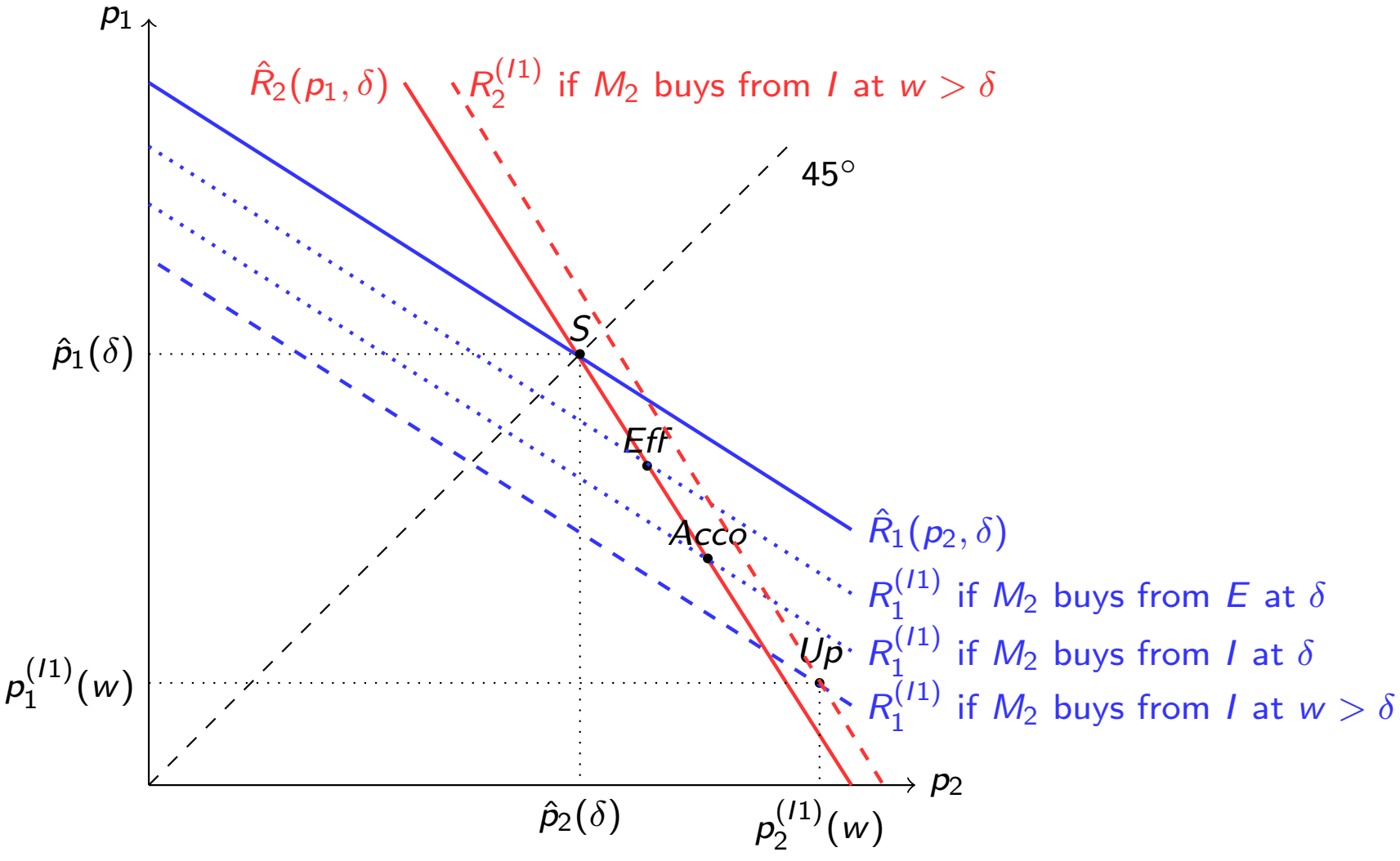
- Upstream market power effect: M_2's perceived marg. cost increases

$$w_I > \delta \;\Rightarrow\; p_2 \nearrow \Rightarrow \; p_1 \searrow$$

Proposition (Impact of VI on downstream prices)

In equilibrium, VI leads to a lower p_1, a higher p_2 and a higher royalty w_I.

Impact of Integration on Prices: Graphical representation



Impact of Vertical Integration on Profits

Proposition (VI is good news for M_2)

- The non-integrated manufacturer M_2 buys from the integrated firm $I1$ at a royalty above the pre-merger level...
- ... but M_2 gains from the merger!

Intuition

- Royalty increases but M_2 benefits from VI because M_1 is more efficient and M_2 has the outside option to buy from E

$$\underbrace{\pi_2^{(I1)}(0,w) \geq \pi_2^{(E)}(0,\delta)}_{\text{to ensure } M_2 \text{ buys from } I1} \geq \underbrace{\pi_2^{(E)}(\delta,\delta) = \hat{\pi}_2}_{M_2\text{'s profit under separation}}$$

Relevance of foreclosure concerns?

Impact of Vertical Integration on Profits

Proposition (Integration not always profitable)

VI is profitable iff network effects are not too strong ($\mu \leq \hat{\mu}$)

Intuition

- M_2 increases p_2: bad for the integrated firm's profit (a Cournot flavor)

Remarks

- Explain the tension between integration and separation in platform industries with manufacturers?
- Different from Chen (2001) where VI is always strictly profitable

OS Fragmentation as Motive for Coordination

Assumption 1 implies that if both platforms set the same royalty, then the total number of developers or of buyers does not depend on whether manufacturers affiliate with the same platform or not

In practice, it is costly to port applications on different operating systems: if manufacturers choose the same platform, this limits the cost to port applications across different systems

Same insight with direct network effects (across buyers or developers)

$\rightarrow$ Instances of motives for coordination across manufacturers: if manufacturers affiliate with the same platform, participation of developers or buyers increases

Cost to Port Applications: An Example of Motive for Coordination

Developers' total cost

- Development cost f
- A fraction α $(1-\alpha)$ of developers incur an infinite (nil) cost to port
- α is an inverse measure of scale economy in application development.

Motive for coordination

- If manufacturers coordinate on platform I

$$n_{SI} = Q_S(n_{B1} + n_{B2}) \text{ and } n_{SE} = 0$$

- If manufacturers choose different platforms

$$n_{SI} = \alpha Q_S(n_{B1}) + (1-\alpha)Q_S(n_{B1} + n_{B2})$$
$$n_{SE} = \alpha Q_S(n_{B2}) + (1-\alpha)Q_S(n_{B1} + n_{B2})$$

- $\alpha > 0 \Rightarrow Q_S(n_{B1} + n_{B2}) > \alpha Q_S(n_{B1}) + (1-\alpha)Q_S(n_{B1} + n_{B2})$

Impact of Motives for Coordination

Assume $\delta = 0$ (no efficiency gains form VI)

Separation

- $w_I = w_E = 0$: competition prevents platforms from capturing the gains associated to the coordination of manufacturers
- Those gains are fully pocketed by manufacturers.
- Manufacturers' gains $\hat{\pi}_i^{(I,I)}(0,0)$ (if coordination on I) with

$$\underbrace{\hat{\pi}_1^{(I,I)}(0,0) = \hat{\pi}_2^{(I,I)}(0,0)}_{M_1 \text{ and } M_2 \text{ on } I} > \underbrace{\hat{\pi}_1^{(I,E)}(0,0) = \hat{\pi}_2^{(I,E)}(0,0)}_{M_1 \text{ on } I \text{ and } M_2 \text{ on } E}$$

Impact of Motives for Coordination

Proposition (Integration with Cost to Port Applications)

- M_2 buys from $I1$ and pays a royalty strictly above the pre-merger level
- M_2 is harmfully foreclosed at equilibrium
- VI is always strictly profitable

Intuition

- VI forces coordination on platform I: M_2 accepts $w_I > 0$ to (i) benefit from a larger participation of developers and (ii) make the integrated firm accommodating
- At best, M_2 earns

$$\pi_2^{(I1)}(0, w_I = 0) = \hat{\pi}_2^{(I,I)}(0,0) > \pi_2^{(E)}(0,0) = \hat{\pi}_2^{(I,E)}(0,0)$$

- VI reduces M_2's outside option and some gains from coordination are now captured by the integrated platform through the royalty
- VI strictly profitable because $\delta = 0$ implies that integrated firm is not committed to reduce its price

Foreclosure concerns are reinstated, but for different reasons.

Impact of VI on Consumers Surplus and Developers' Participation

Surplus depends on (i) the smartphone's prices and (ii) the number of applications

- VI implies $p_1 \searrow$ and $p_2 \nearrow$
- Impact on developers' participation: $p_1 \searrow$ and $p_2 \nearrow \Rightarrow n_S$?

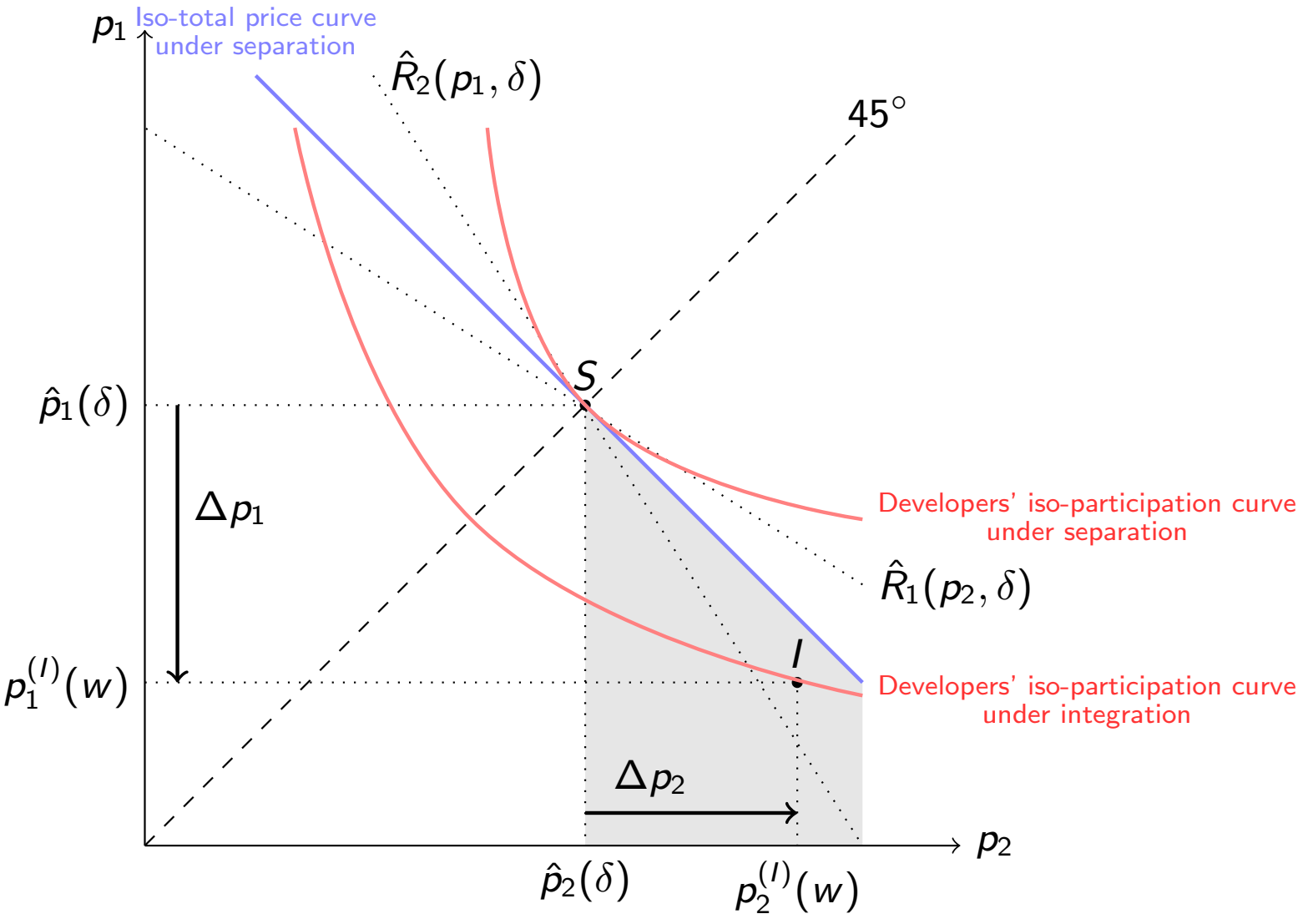
Specify a bit more the model: Main Example without any assumption on the distribution of heterogeneity parameters

Remind that $D_S(\cdot)$ solution of $D_S = Q_S(Q_B(p_1, D_S) + Q_B(p_2, D_S))$

Developers' iso-participation curves $\{(p_1, p_2) : D_S(p_1, p_2) = \text{const}\}$ are convex iff $G(\cdot)$ concave

Impact on Developers' Participation

Shaded area corresponds to $-\Delta p_1 > \Delta p_2$



Impact on Consumer Surplus and Developers' Participation

Proposition (Impact of VI on Developers Participation as Function of Prices)

If $G(\cdot)$ is concave (convex) and $-\Delta p_1 > \Delta p_2$ ($-\Delta p_1 < \Delta p_2$), then VI increases (decreases) developers' participation and total consumers surplus.

Intuition

- $G(\cdot)$ concave $\Rightarrow$ quasi-demand convex
- $-\Delta p_1 > \Delta p_2 \Rightarrow$ the increase of buyers in market 1 more than offsets the loss of buyers in market 2
- $n_{B1} + n_{B2} \nearrow \Rightarrow n_S \nearrow$ with $G(\cdot)$ concave
- Downstream markets are symmetric $\Rightarrow$ total consumer surplus $\nearrow$

How do prices vary at equilibrium?

Impact on Consumer Surplus and Developers' Participation

Proposition (Impact of VI on Developers and Consumer Surplus)

Consider the Main Example with uniform distributions ($G(\cdot)$ and $F(\cdot)$ linear).

- With efficiency gains and no cost to port applications ($\delta > 0$ and $\alpha = 0$), VI leads to $-\Delta p_1 > \Delta p_2$. Developers' participation and total consumer surplus thus increase.
- With no efficiency gains and a cost to port applications ($\delta = 0$ and $\alpha > 0$), VI leads to $-\Delta p_1 < \Delta p_2$. Developers' participation and total consumer surplus thus decrease.

Two opposite results on foreclosure and consumer harm (and welfare), both efficiency gains and motives for coordination lead to a higher royalty

Impact on Consumer Surplus and Developers' Participation

Intuition: Comparing how VI affects the best responses

- Best response of integrated manufacturer M_1 moves downward by an amount

$$\underbrace{-\ w\frac{\partial D_2}{\partial p_1}}_{\text{accommodation}} \underbrace{-\ \delta\frac{\partial D_1}{\partial p_1}}_{\text{efficiency}}$$

- Best response of non-integrated manufacturer M_2 moves upward by an amount

$$\underbrace{-\ (w-\delta)\frac{\partial D_2}{\partial p_1}}_{\text{upstream market power}}$$

- With uniform distributions/linear demands

$$\text{"donward} \geq \text{upward"} \Leftrightarrow w \leq \delta \frac{\frac{\partial D_1}{\partial p_1} + \frac{\partial D_2}{\partial p_2}}{\frac{\partial D_2}{\partial p_2} - \frac{\partial D_2}{\partial p_1}} \Leftrightarrow -\Delta p_1 \geq \Delta p_2$$

Downstream Competition

Accounting for price competition with product differentiation

- Weak competition/strong network effects $\Rightarrow$ prices are strategic substitutes $\Rightarrow$ our analysis
- Strong competition/weak network effects $\Rightarrow$ prices are strategic complements $\Rightarrow$ Chen (2001)

Illustration

- $n_{Bi} = v - p_i - \gamma(p_i - \frac{p_i+p_j}{2}) + u_B n_S$, $\gamma > 0$, and $n_S = u_S n_B$
- Manufacturers' prices are strategic substitutes if $\mu > \frac{1}{2}\frac{\gamma}{1+\gamma}$, and strategic complements otherwise

Application: Downstream expansion by a platform

- Initially, M_2 only
- I can expand downstream/create its own downstream product
- M_2 benefits $\Leftrightarrow \mu > \frac{1}{2}\frac{\gamma}{1+\gamma}$

Revenue from User-Centric Advertising and Monetization of Personal Data

Platforms collect user-data by recording activity on applications, web pages or internal system. Data is used to display targeted or contextual ads, improve applications, etc.

Contract between a manufacturer and a platform typically specifies which party owns the data and who can monetize it.

This amounts to assuming that each user generates a surplus s and that a share τ $(1-\tau)$ of this surplus accrues to the manufacturer (platform). Suppose that τ is chosen by the platforms.

Since revenue from data plays the role of a negative marginal cost for manufacturers, platforms compete in the share of surplus from data they leave to manufacturers: τ plays the same role as the royalty w in this model.

$\rightarrow$ A vertical merger leads to a decrease of the share of the revenue from data that accrues to independent manufacturers.

Developer Fee: An Endogenous Motive for Coordination

Suppose platforms charge fee a_I and a_E to developers. Assume that developer fees and royalties are non-negative and $\delta = 0$.

Endogenous motive for coordination

- If manufacturers affiliate with the same platform, say I, developers' quasi-demand

$$n_{SI} = Q_S(a_I, n_{B1} + n_{B2})$$

- If manufacturers affiliate with different platforms, developers' quasi-demand

$$n_{SI} = n_{SE} = Q_S(a_I + a_E, n_{B1} + n_{B2})$$

- Horizontal double marginalization on developer side between platforms $\Rightarrow$ Manufacturers have incentives to coordinate on the same platform

Developer Fee: Impact of VI

Separation

- $w_I = w_E = 0$ and $a_I = a_E = 0$
- Motive for coordination cannot be leveraged into an upstream market power
- Gains from coordination are fully pocketed by manufacturers

Developer Fee: Impact of VI on Equilibrium Royalties and Developer Fees

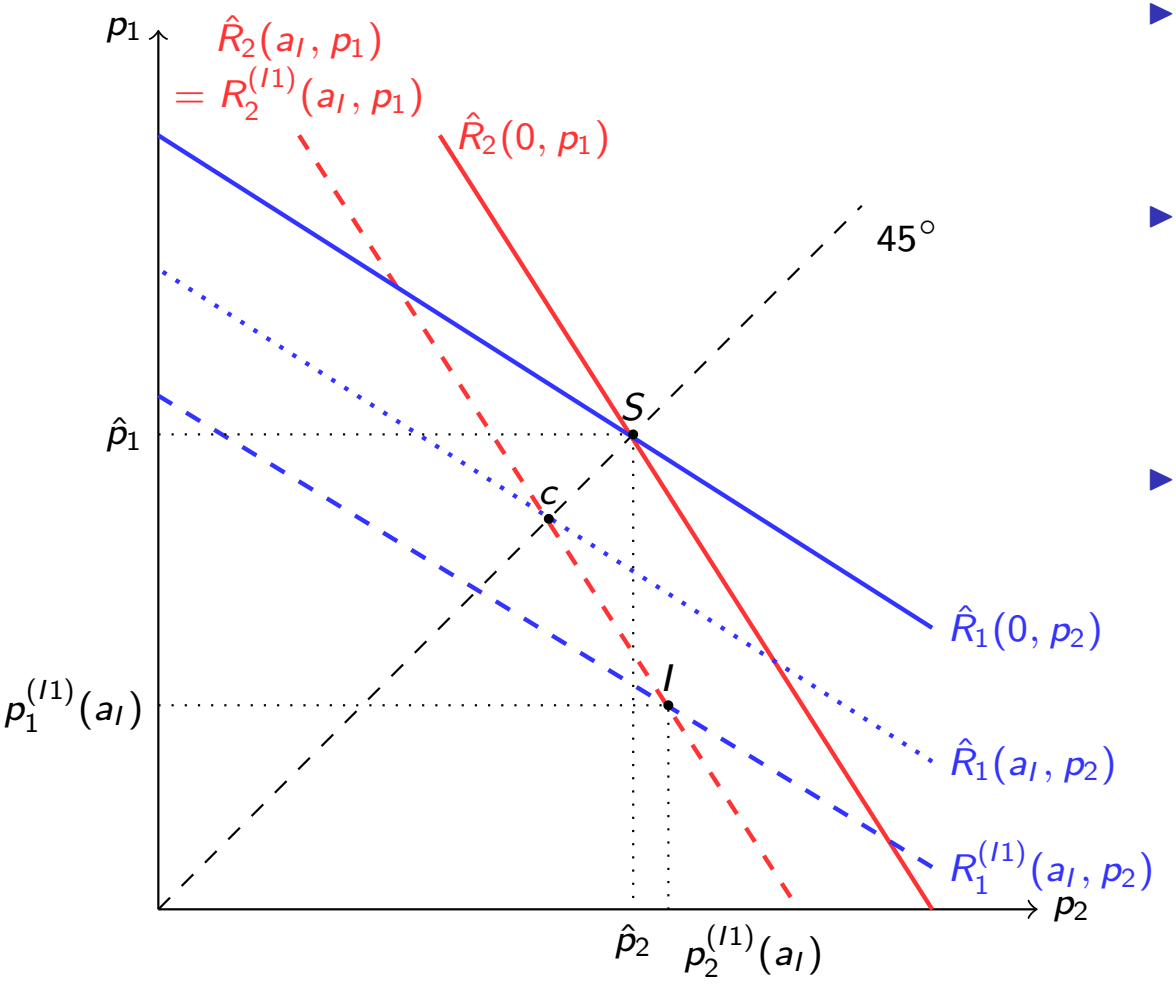
Royalty

- At equilibrium $w_E = a_E = 0$ and M_2 buys from the integrated firm
- $w_I = 0$: when $a_E = 0$, the motive for coordination disappears since developers must pay a_I to access all buyers whatever M_2's choice of platform
- VI provides some market power to I, which may now set $a_I > 0$ to developers for the access to M_1's buyers.

Optimality of charging developers $a_I > 0$

- allows to capture some profit from developers
- but reduces profit earned from buyers in market 1 from the indirect network effects
- Role of the structure of indirect network effects: $a_I > 0$ is optimal when developers gains more from the participation of buyers than the reverse (loosely speaking, when $u_S > u_B$)

Developer Fee: Impact of VI on Manufacturers' Prices



Manufacturers' prices

- The integrated firm's profit is $p_1 D_1 + a_I D_S$
- Accommodation effect with $a_I > 0$: $p_1 \searrow$ in order to boost the profit earned from developers
- Impact on p_2 is a priori ambiguous because $a_I > 0$ implies that the demande faced by M_2 is smaller

Developer Fee: Equilibrium Profits and Surplus

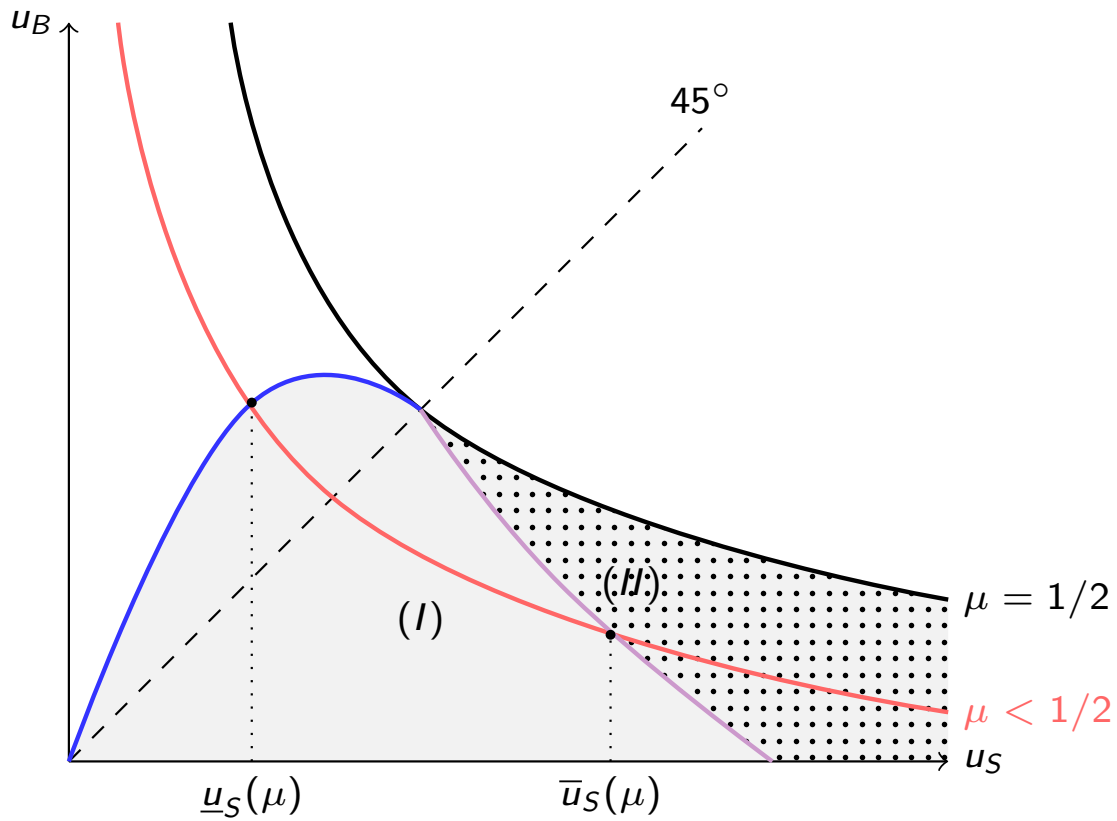
Proposition (Impact of VI with Developer Fee)

For any level of indirect network effects $\mu = u_B u_S \in [0, 1/2)$, there exist $\overline{u}_S(\mu) \geq \underline{u}_S(\mu)$, such that:

- VI is strictly profitable (and entails a strictly positive developer fee and a nil royalty) iff $u_S > \underline{u}_S(\mu)$.
- When VI is profitable
  - (i) consumers in market 1 are always better off
  - (ii) M_2 is foreclosed and consumers in market 2 are better off if and only if $u_S > \overline{u}_S(\mu)$
  - (iii) impact on total consumer surplus is ambiguous.

Developer Fee

Equilibrium Profits and Surplus



(I) & (II): $a_I > 0$ & $\mu < \frac{1}{2}$

(I): [$p_1 \searrow$, $SC_1 \nearrow$] [$p_2 \searrow$, $D_2 \nearrow$] [$D_S \searrow$, $\pi_S \searrow$] [$\pi_2 \nearrow$, $SC_2 \searrow$]

(II): [$p_1 \searrow$, $SC_1 \nearrow$] [$p_2 \nearrow$, $D_2 \searrow$] [$D_S \nearrow$, $\pi_S \nearrow$] [$\pi_2 \searrow$, $SC_2 \nearrow$]

Compatibility between Platforms

A platform provides developers with tools to help them port their applications (an "adapter" to use Katz and Shapiro, 1985)

- Microsoft's Project Islandwood translates the code of an application written for iOS (Apple) into a version that works in a Windows Phone environment; it reduces the development cost for those developers who are not familiar with the Windows Phone environment.

If I is compatible with E whereas the reverse is not true, then I receives a priori a higher demand from developers

$$Q_{SI}(n_B) \geq Q_{SE}(n_B) \quad \forall n_B$$

$\rightarrow$ A platform that is unilaterally compatible has a competitive advantage in the upstream market since it is more attractive for manufacturers
$\rightarrow$ Our analysis still applies, even if ($\delta = 0$) but I is unilaterally compatible with E

Coordination Failure and Incumbency Advantage

Assume $\delta = 0$.

With motives for coordination across manufacturers, the incumbent platform I may benefit from "favorable" expectations

- Manufacturers fail to coordinate on the entrant platform E when it is the cheapest platform
- I can charge a supra-competitive royalty: $\hat{w} > 0$ and $\hat{\pi}_I > 0$

Incentives to integrate?

- $w \nearrow \Rightarrow I$'s upstream profits $\nearrow$ but $p_2 \searrow$
- For a small increase in w, the positive effect dominates the negative one (similar insight in Ordover et al., 1990)
- Hence, the joint profit is higher under separation and incentives to integrate are weaker

Diseconomies of Scope in Operating System Dissemination

In practice, manufactures may lose from affiliating with the same platform (more intense competition, less possibilities to differentiate their products, etc.)

Suppose manufacturers receive zero demand if they affiliate with the same platform

- Under separation, platforms have monopoly power over manufacturers: $w_I = w_E > 0$
- Integration eliminates a double marginalization between I and M_1: this benefits both to M_2 and E
- M_2 and E capture part of this efficiency gain through higher prices: $p_2 \nearrow$ and $w_E \nearrow$

$\Rightarrow$ vertical integration triggers a negative reaction from both M_2 and E

Conclusion

Two-sidedness matters for the competitive analysis of vertical integration.

- Network effects generate strategic substitutability between downstream prices.
- VI creates upstream market power; but impact on non-integrated competitors/foreclosure depends on the source of upstream market power: efficiency gains vs. motives for coordination
- Managerial perspective: with strong network effects, keeping manufacturers at arm's length relationship; in more mature markets with less intense network effects, integration.
- Antitrust perspective: Foreclosure concerns less relevant
- With developer fee, further complication associated to the role played by the structure of the indirect network effects