The Control of Porting in Two-Sided Markets

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Microsoft and its (Many) Antitrust Actions

The Browser ‘Wars’

The Control of Porting

- Perfect example of two-sided 'hardware/software' market
  - Platform ('hardware'): Operating system
  - One side ('software'): Applications
  - Other side (consumers): Want to use the 'software'
- Rents from feedback loop between consumers and applications (indirect network effects)
- Porting: conversion of 'software' from one platform to another (multihoming of software)
- Porting easy $\Rightarrow$ easy for consumer to switch $\Rightarrow$ lower rents

The Danger of Browsers

A cross-platform browser

$\Rightarrow$

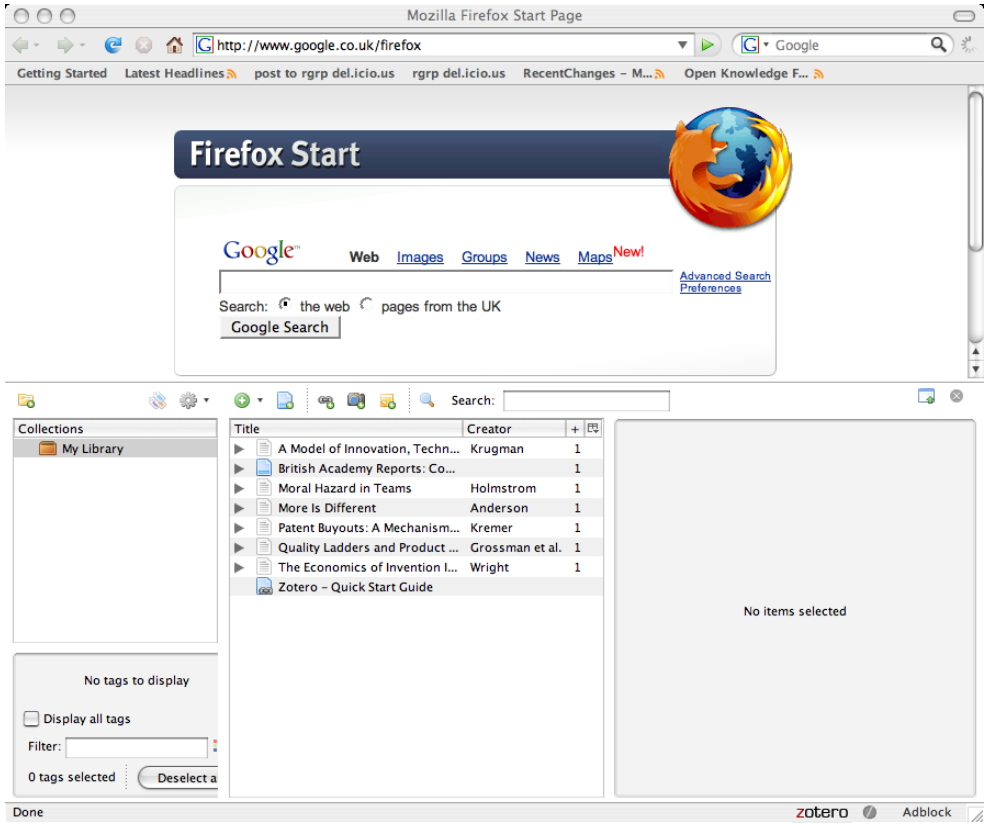
browser applications (e.g. websites) can be ported at zero cost

A new competitor 'born' on the Internet is Netscape. ... They are pursuing a multi-platform strategy where they *move the key API into the client to commoditize the underlying operating system* ...

– Bill Gates in the internal 'Internet Tidal Wave' Memorandum (1995)

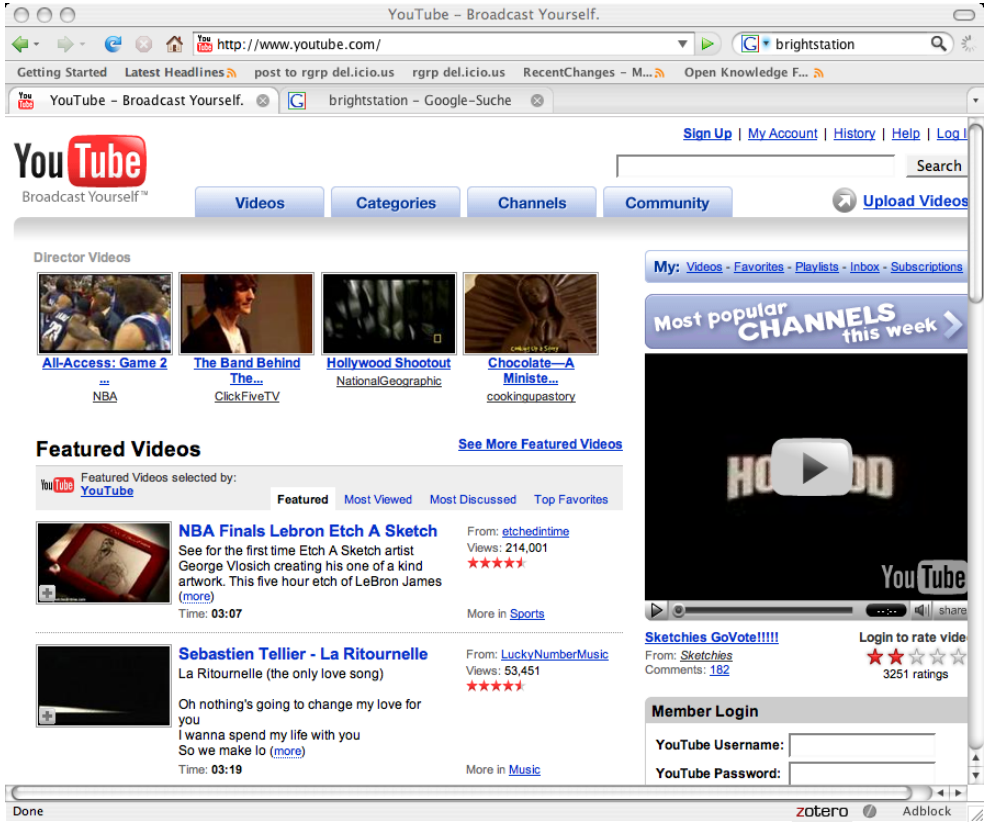
Bill Gates' Fears are Being Realized

Search Engines, Web Mail, e-commercem, in-browser apps ...



eBay and MercExchange

YouTube



Why Is It So Hard to Download?

What Do We Take From These Examples?

- Many examples of two-sided markets, especially online
- Platform owners: maximize their amount of ‘software’
- ... and minimize the amount on other platforms
- Specifically: want to prevent ‘software’ from being ported to another platform (want to ‘tie’ ‘software’)

The Impact of Porting

- Develop two-sided market model incorporating porting
- Look at a dominant firm who can (partially) control porting
- How important is control of porting for a dominant firm?
- What is impact on welfare of its actions?
- How does impact of pricing compare to that of porting?

Outline

Relation to the Literature

- Tying and Vertical Foreclosure (Whinston, 1990 and 2001, Gilbert and Riordan 2007)
- Indirect Network Effects (Church and Gandal 1992, Church et al. 2003)
- Converters (Farrell and Katz 1992)
- Two-Sided Market Models: Rochet and Tirole (JEEA 203, RJE 2006), Armstrong (RJE 2006)
- Multi-homing: Armstrong and Wright (2005) Choi 2006 (tying from outside monopolist)

The Model

Agents and Innovations

- All agents are risk-neutral
- Two platforms/networks A/B.
- Unit mass of agents labelled by index $t \in [0, 1]$
- Notation: n_X number of consumers choosing X (in equil.)
- 2 types of product provided for each platform/network:
  - 'Hardware' (platform itself)
  - 'Software'
  - Consumers must buy 'hardware' to use 'software'
- No multi-homing: consumers buy from only 1 platform

Consumer's Utility on Network X

$$u_X(t, p_X, s_X, p_X^s) = \phi - p_X - h_X(t) + u_X^s(s_X, p_X^s)$$

- p_X: price of hardware on network X
- $h_X(t)$: heterogeneity in platform preference (generic Hotelling)
- u_X^s: utility from software purchases
  - s_X: amount of software on network X
  - p_X^s the price (or vector of prices) of software
- 'Hardware' platform itself does not matter directly

Hardware Market

- Platform A is controlled by a monopolist M
  - M sets an access price p_A to consumers
- Platform B is competitively provided
  - Price normalized to 0

Software Market: Reduced Form Network Effects

- Use reduced form: $u_X^s = \nu(f_X, n_X)$
  - Fixed costs of software production f_X
  - n_X (expected) number of consumers on network X
  - $\nu_{f_X} < 0, \nu_{n_X} > 0$
  - Can derive this from explicit micro-founded model
- So: two-sided market gives rise to indirect network effects

$$u_X(t, p_X, n_X^e, f_X) = \phi - p_X - h_X(t) + \nu(n_X, f_X)$$

Software Production and Porting

- Software on A has exogenous fixed cost f_A
- Software on B all ported from A: $f_B = f^p$
- Monopolist may control cost of porting from its platform
  - Requires costly effort $e = e(f^p), e' > 0, e'' > 0$
  - Examples: Internet Explorer ($100M/year), .NET etc
- Paper endogenizes porting behaviour:
  - Direct production and porting on both platforms
  - All we need is that marginal piece of software on B is ported and marginal piece on A is directly produced

Sequence of Actions

1. M chooses values for control variables: p_A, f^p.
2. Consumers form expectations of network sizes (and hence level of software provision)
3. Consumers choose network to max expected utility
   - Resulting network sizes should be consistent with expectations
4. Payoffs received
   - M profits: $\Pi = p_A \cdot n_A(p_A, f^p) - e(f^p)$
   - Consumers receive their utility

Solving

- Standard 'network' effects model (general h and ν)
- Define 'advantage' function: $A(t)$
  - Utility advantage of A over B for agent t when $n_A = t$
- Equilibria (in interior) given by $A(t) = 0$
- Pick an equilibrium t^e with A dominant, then:
  - Well-behaved demand function as function of p_A, f^p etc
  - Monopolist then solves its maximization problem ...
- NB: there will be no closed form solution in general

An Example

- Symmetric network effects function and heterogeneity
- Network effects: $\nu(f_X, t_X) = C - \sqrt{\frac{f_X}{n_X}}$
  - Reduced form from locational model of product differentiation in software
  - Strongly diminishing 'network effects'
- Heterogeneity: $h_A(t) = 10t^{10}$
  - Large middle ground of consumers who are fairly indifferent
  - Small group of 'fans' who have strong preferences for nearest platform

Advantage Function

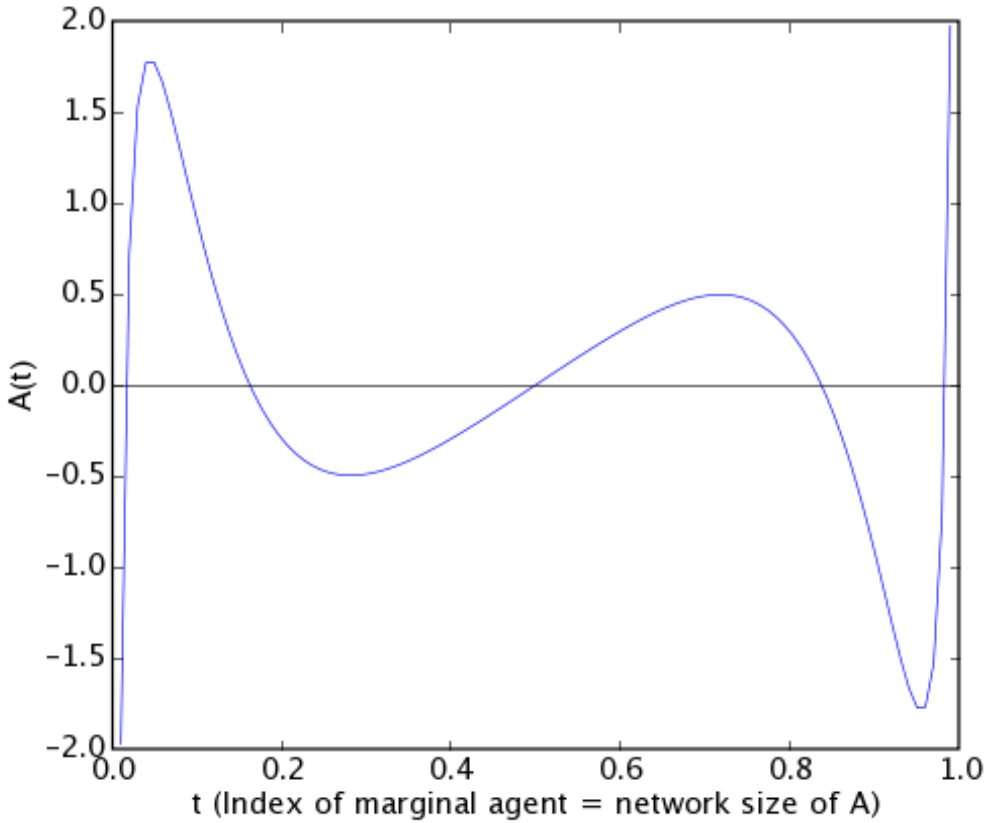


Figure: Utility advantage function, $A(t)$ when the access prices for the two networks are the same (0) and fixed costs (no porting) are also equal

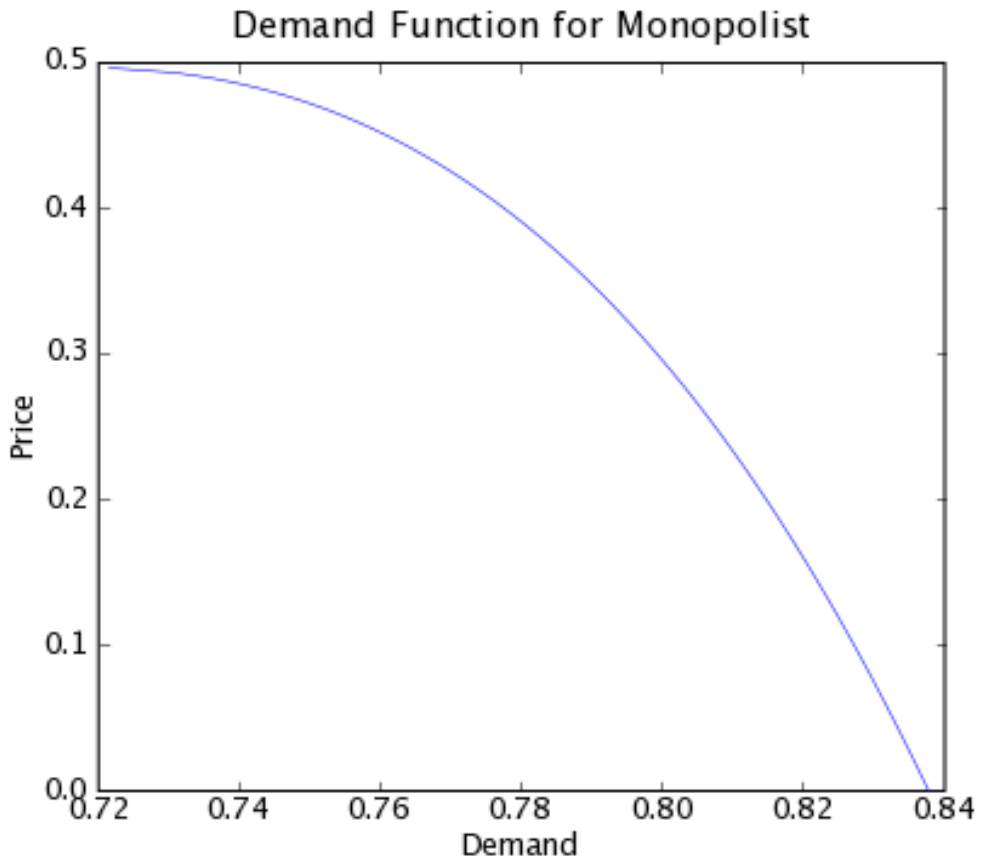


Figure: The Demand function for the monopolist in the neighbourhood of the stable equilibrium at 0.84. Demand is discontinuous at a price just below 0.5 (i.e. at the left edge of the diagram – the discontinuity itself is not shown as it distorts the scale).

Effect of Porting

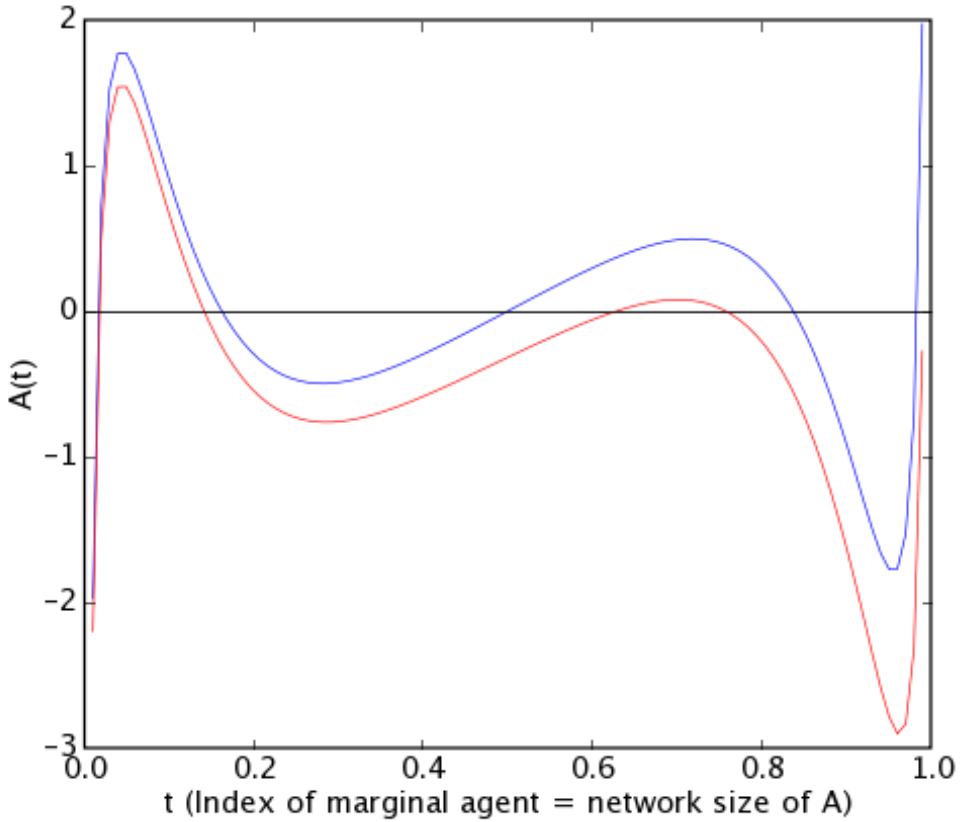


Figure: Effect of Porting Cost: Advantage Function when Porting Cost is 2/3 of Direct Cost of Production

Welfare

The Example Revisited

	Porting Cost	Price of A Hardware	A's market share	Net Profits for M	Consumer Welfare	Total Welfare
Initial porting cost, competitive prices	1.0	0	0.758	0	0.0	0.0
Initial porting cost, monopoly price on A	1.0	0.079	0.704	0.056	-0.046	0.010
Monopolist chosen porting cost, monopoly price on A	1.419	0.43	0.729	0.252	-0.406	-0.154

Table: Welfare Results at Various Prices and Porting Costs.

$e(f^p) \propto (f^p - 1)^4$

But One Special Case ...

General Results

- Recall: very weak assumptions on heterogeneity and 'network' effects
- No closed form solution for equil prices, porting cost etc
- Clearly will not be able to make quantitative comparisons in general
- But can do signing of welfare effects in neighbourhood of an equilibrium

Sources of Welfare Effects

- Price impact:
  - Direct: (for consumers) higher prices (no d/w losses though)
  - Indirect: higher prices $\Rightarrow$ A's platform shrinks, B's grows
  - Network effects (changed software availability) $\Rightarrow$ welfare impact
- Porting cost impact:
  - Direct: less software for platform B
  - Indirect: A's platform grows, B's shrinks

General Results

- Welfare impact of higher share for platform A?
- Curvature (rate of diminishing returns) of network effects ν is crucial
- Low curvature (e.g. linear): +ve impact (standardization is good)
- High curvature: -ve impact (symmetry good)
- Dividing line is natural log: $\nu(n_X) = ln(n_X)$
    - Common linearity assumption is not innocent

General Welfare Impacts

	Low Curvature	High Curvature
Direct Impact of Higher Price	-	-
Indirect Impact of Higher Price	-	+
Overall Impact of Higher Price	-	O
Direct Impact of Higher Porting Cost	-	-
Indirect Impact of Higher Porting Cost	+	-
Overall Impact of Higher Porting Cost	O	-

Table: Welfare Impact of Higher Price and Higher Porting Cost

Concluding Remarks

Summary of Results

- A two-sided markets models incorporating ‘porting’
- Existence of network equilbrium and solution of pricing problem for general heterogeneity and indirect network effects
- Welfare effects
  - Depend on degree of diminishing returns to network size
  - High diminishing returns: control of porting bad
  - Low diminishing returns: control of porting ambiguous
  - Simulation indicated that welfare impact could be significant

Policy

- Model relevant wher the control of porting is possible
  - Operating Systems (Microsoft), Auction Platforms (eBay), Video Sharing (YouTube), Music Platforms (Windows/Real/...)
- Show how and why indirect tying can be bad (and good)
- Bad: policy-makers should aim to reduce control of porting
  - Encourage use of open standards to make porting easier
  - Take account of porting issues when evaluating ‘tying’

Policy

- Would like to add dynamics and innovation
  - Dynamics can be hard to keep tractable but see e.g. Cabral 2007
  - Dominant firm will resist innovation that reduces cost of porting
  - Innovation is not porting neutral