

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



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-commerce, in-browser apps ...

The screenshot shows a Mozilla Firefox browser window. The address bar displays `http://www.google.co.uk/firefox`. The page content includes the "Firefox Start" banner, the Google logo, and search options for "the web" and "pages from the UK". A Zotero library interface is overlaid at the bottom, showing a table of items:

| Title | Creator | |
|---------------------------------|-----------------|---|
| A Model of Innovation, Techn... | Krugman | 1 |
| British Academy Reports: Co... | | 1 |
| Moral Hazard in Teams | Holmstrom | 1 |
| More is Different | Anderson | 1 |
| Patent Buyouts: A Mechanism... | Kremer | 1 |
| Quality Ladders and Product ... | Grossman et al. | 1 |
| The Economics of Invention L... | Wright | 1 |
| Zotero - Quick Start Guide | | |

Below the table, it indicates "No items selected". The Zotero interface also includes a "My Library" section, a "No tags to display" message, and a "Filter:" input field.

eBay and MercExchange

The screenshot shows the eBay UK homepage with the following elements:

- Header:** "eBay - The UK's Online Marketplace" and "http://www.ebay.co.uk/". Navigation links include "Buy", "Sell", "My eBay", "Community", and "Help".
- Search Bar:** A search input field with a "Search" button and a link to "Advanced Search".
- Left Sidebar:**
 - Have you visited?:** Links to "eBay Express.co.uk", "eBay Motors", and "eBay shops".
 - Categories:** A list of product categories including Antiques, Art, Baby, Books, Comics & Magazines, Business, Office & Industrial, Cars, Parts & Vehicles, Clothes, Shoes, Accessories, Coins, Collectables, Computing, and Consumer Electronics.
- Main Content Area:**
 - Register Now:** A red button for new users.
 - New to eBay? eBay Explained:** A link for new users.
 - How much MONEY are you sitting on? FIND OUT...:** A large red banner featuring images of a doll (£12), a MP3 Player (£51), a DVD (£9), and a Television (£217), each with a "average selling price" label.
 - Good deals:** A banner for "GRAB A BARGAIN" and "10p LISTING DAY".
- Footer:** "Find:" search bar, "Done" button, and "zotero" and "Adblock" extensions.

YouTube

The screenshot shows the YouTube homepage in a browser window titled "YouTube - Broadcast Yourself." The address bar shows "http://www.youtube.com/". The page features the YouTube logo and navigation tabs for Videos, Categories, Channels, and Community. Below the navigation, there are sections for "Director Videos" with thumbnails for "All-Access: Game 2", "The Band Behind The...", "Hollywood Shootout", and "Chocolate—A...". The "Featured Videos" section includes "NBA Finals Lebron Etch A Sketch" and "Sebastien Tellier - La Ritournelle". On the right, there is a "Most popular CHANNELS this week" section and a "Member Login" form.

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

Literature

The Model

Results

Results

Welfare

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

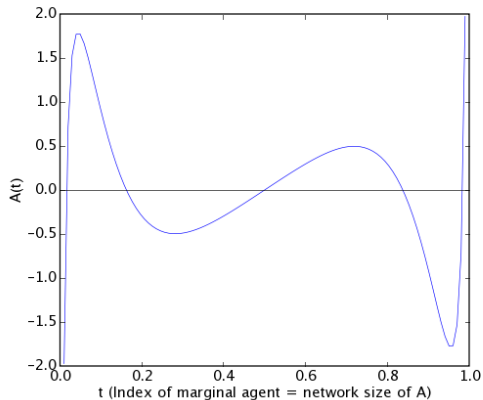


Figure: Utility advantage function, $A(t)$ when the access prices for the two networks are the same (0) and fixed costs (no porting) are also equal

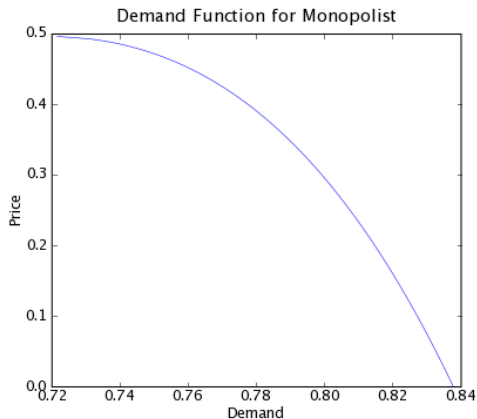


Figure: The Demand function for the monopolist in the neighbourhood of the stable equilibrium at 0.84.

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

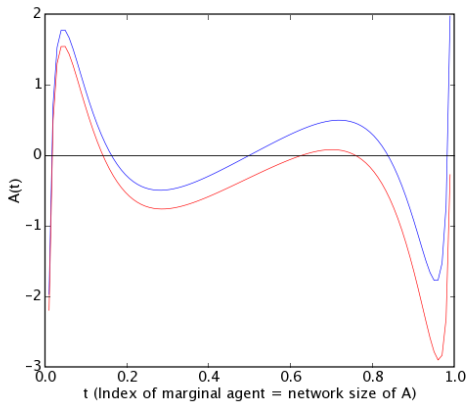


Figure: Effect of Porting Cost: Advantage Function when Porting Cost is 2/3 of Direct Cost of Production

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 | - | ○ |
| Direct Impact of Higher Porting Cost | - | - |
| Indirect Impact of Higher Porting Cost | + | - |
| Overall Impact of Higher Porting Cost | ○ | - |

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 equilibrium 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 when 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