CPRC

Competition Policy Research Center
Fair Trade Commission of Japan

Positive analysis of OS and the network externalities

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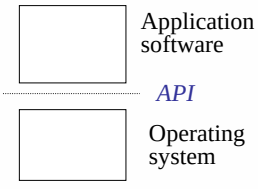
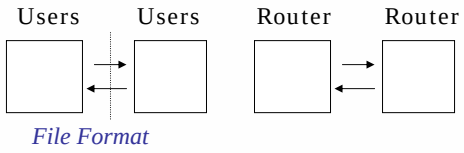
Network externality works in terms of the interface among modules or users.

- PC's OS
  - Modules are application software and OS.
  - Interface is API.



OS

- Word Processor and spreadsheet
  - Modules are users
  - Interface is file format (+ friends-are-teacher effects)
- Routers
  - Modules are users (or routers)
  - Interface is TCP/IP protocol and its implementation



Word processor and spreadsheet

Routers

Market structure : two contrary views

View I

- When interface is not open, there exists a tendency towards monopoly even if firms obey the fair trade rules.
  - Once the monopoly is established, no firm can challenge the monopoly firm unless there is a "huge" innovation that overcomes the benefit of the network externality. (so-called "lock-in")
  - Competition becomes weak. The price remains high and incentive for innovation becomes low. (Losses of monopoly)
  - The monopoly firm will try to extend the monopoly by bundling complimentary products to its monopoly module ("leverage")

View II

- Such "huge" innovations are common in the information technology related industries.
  - History shows successive changes of the dominant firms in the IT industries. Windows faces potential challengers such as Linux.
  - Decrease of price, enough incentive for innovations.
  - Bundling the compliments into the products is beneficial to the users

Solutions : two contrary views

View I

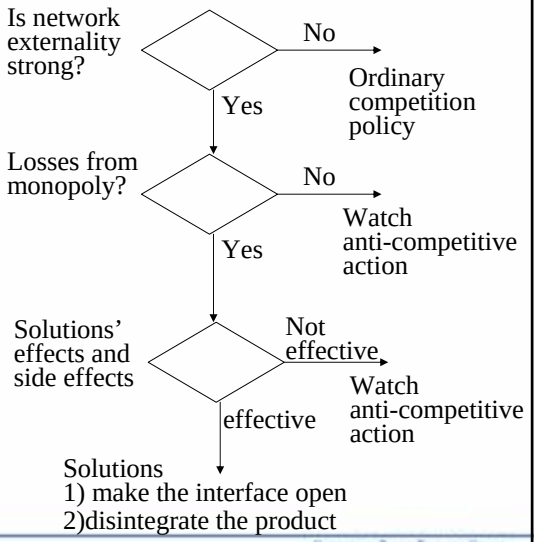
- [First best] Make the interface open so that other firms can reap benefits from the network externality.
  - In other word, the interface (e.g., API) should be unbundled from the specific products.
- [Second best] Disintegrate the product or company into the monopoly module and other modules.
  - In other words, the monopoly module (e.g., OS) should be unbundled from other modules (e.g., applications).

View II

- The first solution discourages the incentive for innovations.
- The second solution is harmful to users because bundling the products is beneficial to the users.

Our approach to this issue

- Start: High and stable share or profit. Strategic(predatory) pricing.
- Step 1: Estimate network externality
  - Compare the effect of network externality with functional changes by innovations.
- Step 2: Evaluate losses from monopoly
  - Price: Does price decrease continuously?
  - Innovations: Does the speed of innovation get slower?
- Step3: Consider solutions' cost and benefits
  - Make interface open
  - Disintegrate the product



Today's subject: OS

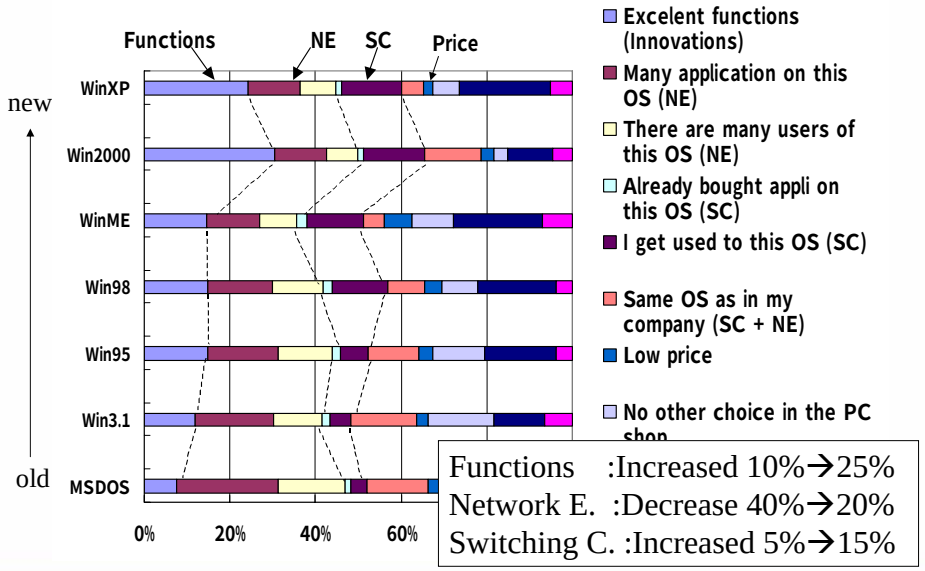
- User survey (n=3319)
  - History of OS usage during 1993-2004
  - Reason of choice of OS
  - Subjective evaluation of the OS
  - Number of application software he/she regularly uses.
  - Price of OS
- Presumption of this study
  - Users remember his usage history of OS well.

	93	94	95	96	97	98	99	00	01	02	03	04
OS	MacOS					W98			W2000			WXP
Reason	1					2			3			3
NofAppli	5					7			8			7
Price	NA					25k			NA			NA

Question:Why did you choose the OS?

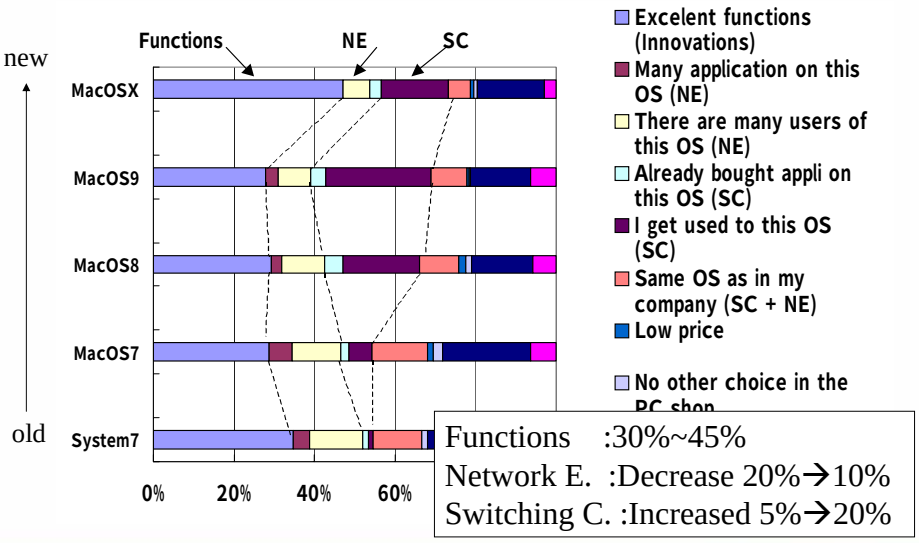
- Reason of Choice
  - 1)Excellent functions ---------- Functions(Innovation)
  - 2)Many application on this OS
  - 3)Many users to ask for advise ---------- Network Externalities
  - 4)Already bought applications on this OS
  - 5)I get used to the operation of this OS ---------- Switching Cost
  - 6)Same OS as in my company ---------- NE + SC
  - 7)Low price ---------- Price
  - 8)No other choice in the PC shop
  - 9)I just choose PC hard
  - 10)Other ---------- Others

Reason of OS choice:Windows



Functions :Increased 10%→25%
Network E. :Decrease 40%→20%
Switching C. :Increased 5%→15%

Reason of OS choice:Mac OS



Functions :30%~45%
Network E. :Decrease 20%→10%
Switching C. :Increased 5%→20%

Variables: how to measure

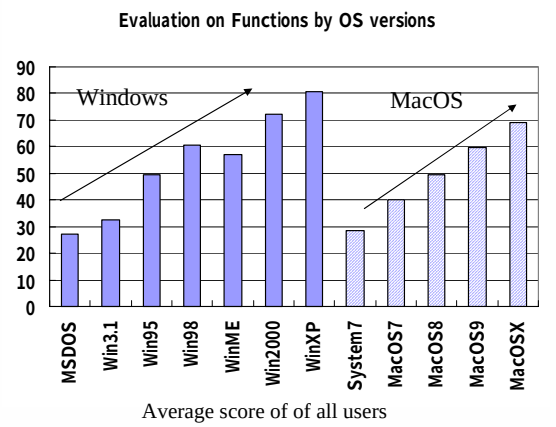
- Functions
  - Users' subjective evaluation of the OS
  - Q:"Please evaluate the OS by score 0 ~ 100"
- Network Externalities
  - Share of the OS
  - Dummy for the largest share OS
- Switching Cost
  - Number of application software in use.
- Price
  - Average of users' reports

Vij:utility when OS i's user chooses OS j as a new OS.

$Vij = a + b*Price_j + c*Function_j + d*Switching\ Cost_{ij} + e*Network\ Effect_j$

Functions:Subjective Evaluation of OS's functions

Q:" Evaluate the functions of the OS by score 0 – 100."



Average score of of all users

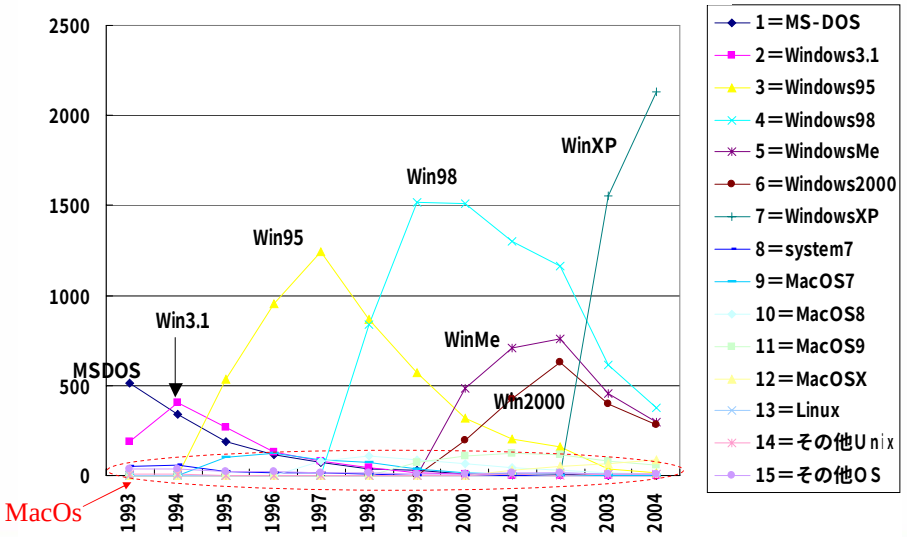
Functional evaluation has increased.

→Innovations continue.

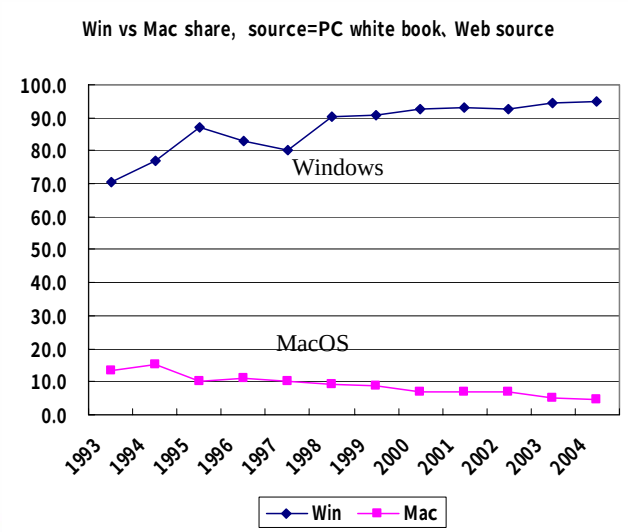
Windows' score is slightly higher than MacOS

→Functional difference can explain Windows' larger share to some extent.

Number of Users by OS versions (total=3319)



Network Externalities: Share of Windows and MacOS

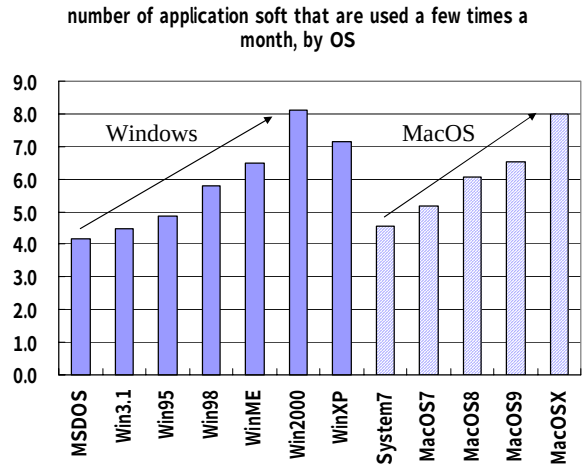


Windows share has increased steadily from 70-80% to 90%

→Network Externalities has increased. The difference of the share is over 80%

Switching Cost: Number of software

Q:" How many application software do you use regularly? "



Average number of software of the OS users

Number of software has increased to around 7.

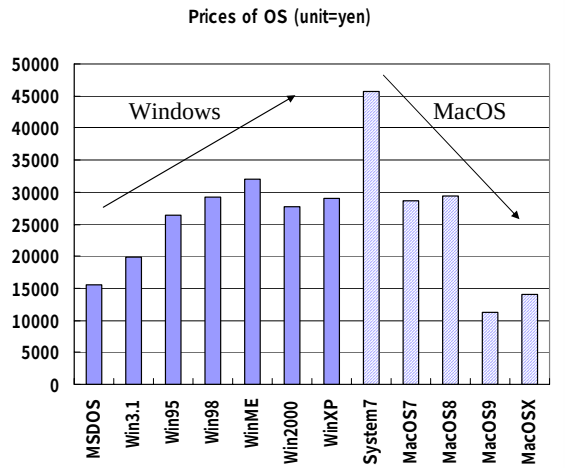
→Switching cost has increased

No difference between Windows' users and MacOS users.

Variance among users are very large.

Price of OS

Q:" Write your OS's price if you purchased it"



Price of Windows increased, whereas price of MacOS decreased.

Since MacOS9, Windows are more expensive than MacOSs

Model: OS i,j = Windows or MacOS

V_{kij}:utility when user *k* using OS *i* chooses OS *j* as a new OS.

V_{kij}=a + b*Function$_{kj}$ + c*Network Externalities$_j$
+ d*Switching Cost$_{kij}$ + e*Price$_j$

- Function$_{kj}$:user k's subjective evaluation of the OS j
- Network Externalities$_j$
  - (1) Market share of OS j
  - (2) Dummy for the Windows
- Switching Cost$_{kij}$:
  - If i=j, 0
  - if i is not equal to j, number of software in use of user k
- Price$_j$: average price of OS j

Users choose OS j that $V_{kij} > V_{kij'}$ for other OS j'

→Discrete choice model

Estimated result and interpretation

		Case1	Case2
Functions	Evaluation(0-100)	0.0522 (0.00)	0.0528 (0.00)
Network Externalities	Share of previous yea (unit=%)	0.0244 (0.00)	
	Dummy for Windows		1.8655 (0.00)
Switching Cost	Number of application software	-0.1589 (0.00)	-0.1612 (0.00)
Price	(unit=1000yen)	0.0123 (0.00)	0.0270 (0.00)
	quasai R2(no coefficient	0.670	0.670
	quasai R2(With constant	0.249	0.248
	Number of observations	6895	6895

p-value in the parenthesis

Significant, and sign is as expected except for price

Assume 80% difference in share. How much functional advance is necessary to beat Network E?
→(0.0244*80)=1.949 utility
1.949/0.0522=37.3

Assume 7 application software. How much functional advance is necessary to beat switching cost?
→(0.1589*7)=1.11 utility
1.11/0.0522=21.3

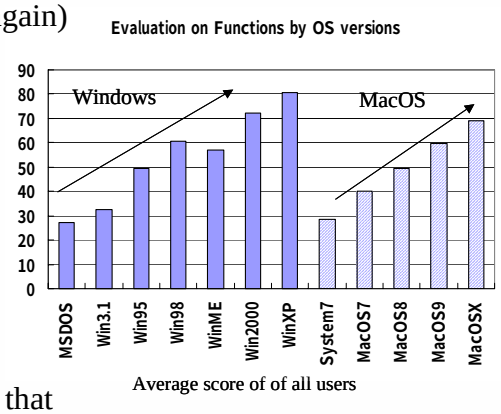
Need 37 points gain in function to beat network externalities.
Need 21 points gain in function to beat switching cost.

Does innovation beat the network externalities and switching cost?

- Need 37 points to beat NE, 21 points to beat SC. Total=58 points
- Increase of functional improvement of version-up has been about 10 points(See the graph again)

58 point is correspond to5.8 times version-ups. In other words, if we assume that version-up is done in 2.5 years, new OS maker needs to make OS with over 15-years advanced technologies.

It is almost impossible. Thus, there is entry barrier that is not likely to be overcome by innovations.



How to introduce competition

- (1) Compatibility: Opening the interface completely.
  - API of OS
  - File format of MS Word and Excel
  - Former Interface, Current Interface, Next Interface
- (2) Disintegration or Regulation of vertical integration
  - Separating the noncompetitive part (OS or Office) from the competitive part(other application software)

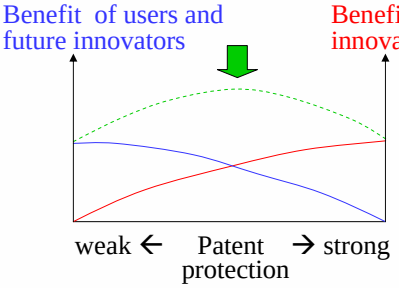
Critiques:
These policies harm the incentive for the innovation of new interface

Optimum level of incentive

Opening the interface → Discourage the innovation →welfare loss
Opening the interface → Competition is recovered → welfare gain

Which is large?

A special case of general question of incentive design for innovation



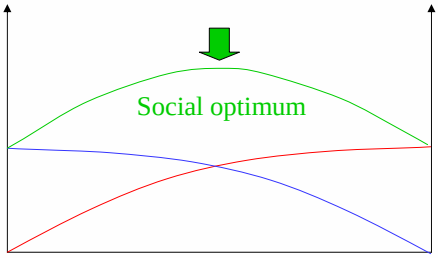
Patent scope: narrow --- wide
Patent period: short --- long

Interface:
How many years of monopoly is optimal?
#monopoly=single firm's control.

Case of Interface

User's benefit + Future innovator's benefit

Current innovator's benefit



Opening : Next Version | Current version | Former version | not open

Monopoly: 5years | 10years | 15years | unlimited period

Question:
Let's assume that we make Microsoft to open the interface.

Does it discourage critically potential innovators who want to be next Bill Gates?

Does it encourage innovators who want to challenge Microsoft by providing compatible goods?
If so, users also get the benefit.

Thank you for your attention!