“Effects of Consumer Tastes in Markets with Network Externalities: An Empirical Study of the Competition between IBM PCs and the Apple Macintosh” by Kawon Cho

EEP 142 Presentation

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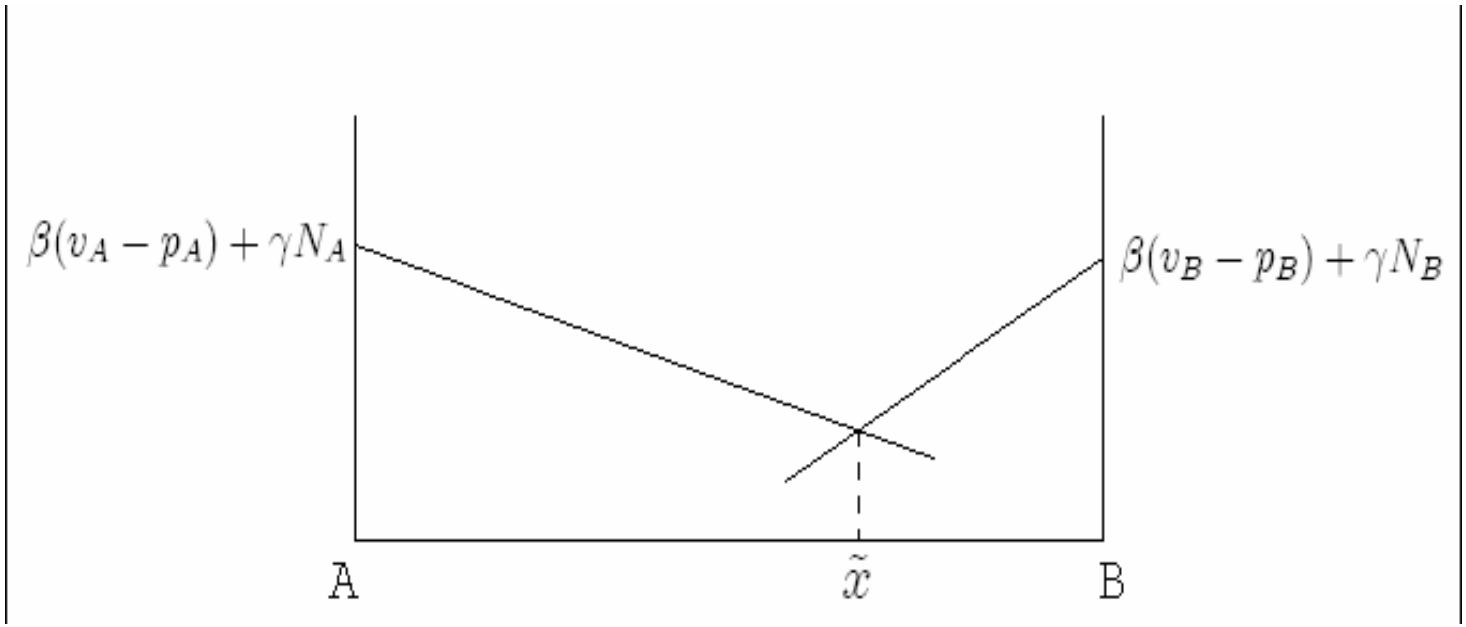
What's the Point?

- Whether variety or standardization will emerge as the market outcome
- Whether variety or standardization will be more desirable in terms of consumer welfare
- What is the underlying interaction between network externalities and market tastes under observed market share changes of an industry.

Hotelling Model

Consumer utility:

- ui(A) = β(vA − pA) + γNA − xi, and
- ui(B) = β(vB − pB) + γNB − (1 − xi)



Hotelling Model

- Indifference location

$$\beta(v_A - p_A) + \gamma N_A - \tilde{x} = \beta(v_B - p_B) + \gamma N_B - (1 - \tilde{x})$$

$$\tilde{x} = \frac{1 + \beta(\Delta v - \Delta p) + \gamma \Delta N}{2}$$

- Market shares:

$$S_A = F(\tilde{x})$$

$$S_B = 1 - F(\tilde{x})$$

- Consumer Density:

$$D = f(\tilde{x})$$

Firms/ Demand

$$\max_{p_A}(p_A - c_A)F(\tilde{x})$$

FOC: $$p_A = c_A + \frac{2F(\tilde{x})}{\beta f(\tilde{x})}$$

Differences in price and marginal cost :

$$\frac{[1-2F(\tilde{x})]}{f(\tilde{x})} = \frac{\beta}{2}\Delta c - \frac{\beta}{2}\Delta p$$

$$\Delta c = c^A = c^B$$

Demand Function: $$D_A = F(\tilde{x})$$

$$D_B = 1 - F(\tilde{x})$$

Variables (description; units)	IBM PC†	APPLE/Mac†	Difference††
income (annual household income; dollars)	66528 (41971)	73820 (44462)	7293 (929)*
age (age of household head; years)	39.41 (22.30)	41.65 (22.27)	2.24 (0.49)*
educ (education of household head; years)	15.06 (2.17)	16.09 (2.08)	1.03 (0.05)*
professional (=1 if professional occupation)	0.46 (0.50)	0.59 (0.49)	0.13 (0.011)*
white (=1 if white)	0.91 (0.28)	0.92 (0.26)	0.012 (0.006)
hsize (household size)	2.78 (1.29)	2.54 (1.21)	0.24 (0.028)*
kids (=1 if there exist kids under 12)	0.29 (0.45)	0.21 (0.41)	0.077 (0.010)*
city (=1 if lives in a city area)†††	0.65 (0.48)	0.71 (0.45)	0.060 (0.010)*
multicom (=1 if owns more that one computer)	0.38 (0.48)	0.48 (0.50)	0.11 (0.011)*
comatwork (=1 if uses a computer at work)	0.67 (0.47)	0.70 (0.46)	0.03 (0.010)*
workuse (=1 if uses the home computer for work)	0.30 (0.46)	0.39 (0.49)	0.096 (0.010)*
graphicuse (=1 if uses the home computer for graphics)	0.21 (0.41)	0.34 (0.48)	0.13 (0.009)*
educuse (=1 if uses the home computer for education)	0.33 (0.47)	0.31 (0.46)	0.026 (0.010)*
gameuse (=1 if uses the home computer to play games)	0.65 (0.48)	0.53 (0.50)	0.13 (0.011)*

† Standard deviations are in parentheses.

†† Standard errors are in parentheses. * indicate significance at 5%.

††† city indicates metropolitan statistical area (MSA).

Table 2: Summary Statistics II

Market Share

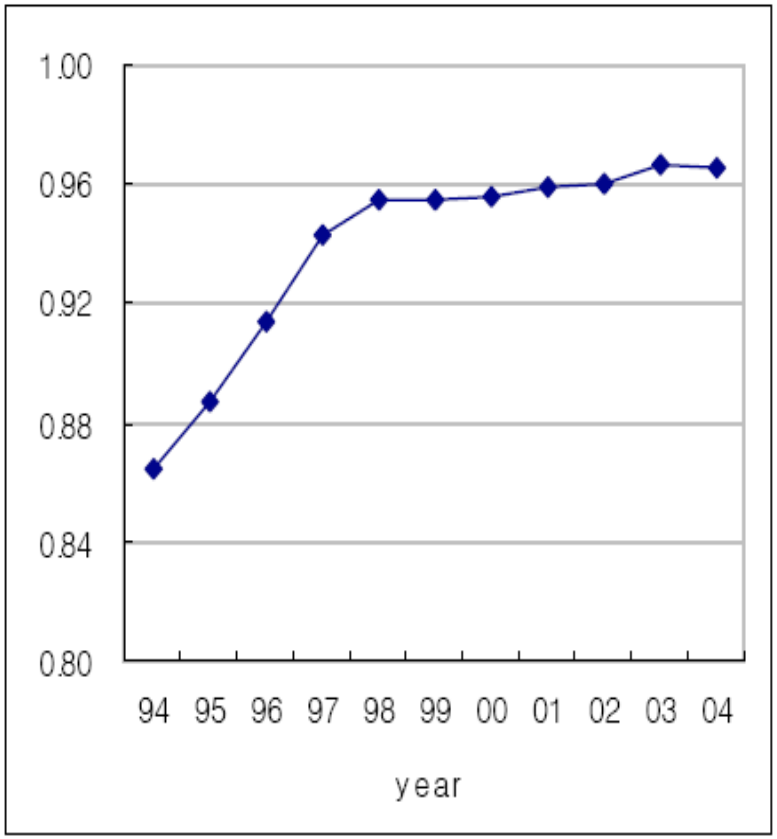


Figure 4: Sample Market Share of IBM PC

year	observations	Market Share of IBM PC (%)
1994	5724	86.41
1995	12893	88.73
1996	22924	91.37
1997	33703	94.25
1998	40735	95.50
1999	47905	95.52
2000	40703	95.64
2001	25790	95.92
2002	19278	96.03
2003	14626	96.69
2004	11289	96.55

Table 1: Summary Statistics I

year	Market Share Change (base year = 1994)			Market Share Change (base year = t-1)		
	Total Change	(1)†	(2)††	Total Change	(1)†	(2)††
1995	0.0232	0.1359	-0.1127	0.0232	0.1359	-0.1127
1996	0.0496	0.1359	-0.0863	0.0264	0.1127	-0.0863
1997	0.0784	0.1359	-0.0575	0.0288	0.0053	0.0235
1998	0.0909	0.0105	0.0804	0.0125	-0.2195	0.2320
1999	0.0911	-0.1392	0.2304	0.0001	-0.2234	0.2236
2000	0.0924	-0.1723	0.2647	0.0013	-0.1819	0.1831
2001	0.0952	-0.1386	0.2337	0.0028	0.0111	-0.0083
2002	0.0962	-0.1766	0.2728	0.0010	-0.2051	0.2061
2003	0.1028	-0.0346	0.1374	0.0066	-0.0066	0.0132
2004	0.1015	-0.2176	0.3190	-0.0014	-0.3163	0.3149

† Market share change due to the changes in EVVs.

†† Market share change due to the changes in the consumer taste distribution.

Table 4: Decomposition of Market Share Change of IBM PC

	Markups under (CA1)			Markups under (CA2)		
year	IBM PC	Apple/Mac	Difference	IBM PC	Apple/Mac	Difference
1994	28.45%	3.43%	23.99%	44.63%	5.38%	37.64%
1995	26.76%	2.84%	23.37%	41.98%	4.46%	36.66%
1996	26.86%	2.31%	24.31%	42.13%	3.63%	38.14%
1997	33.84%	1.81%	31.77%	53.08%	2.84%	49.84%
1998	19.65%	0.78%	18.71%	30.83%	1.23%	29.36%
1999	19.02%	0.64%	18.11%	29.84%	1.01%	28.41%
2000	12.17%	0.41%	11.60%	19.09%	0.64%	18.19%
2001	16.25%	0.47%	15.55%	25.49%	0.74%	24.40%
2002	10.56%	0.31%	10.11%	16.56%	0.49%	15.87%
2003	23.03%	0.50%	22.25%	36.12%	0.79%	34.90%
2004	5.55%	0.13%	5.35%	8.71%	0.21%	8.40%

† Percentage markups are estimated markups divided by observed prices.

Differences are markup differences divided by observed prices of IBM PC.

Table 6: Estimated Markup

Indifference Location

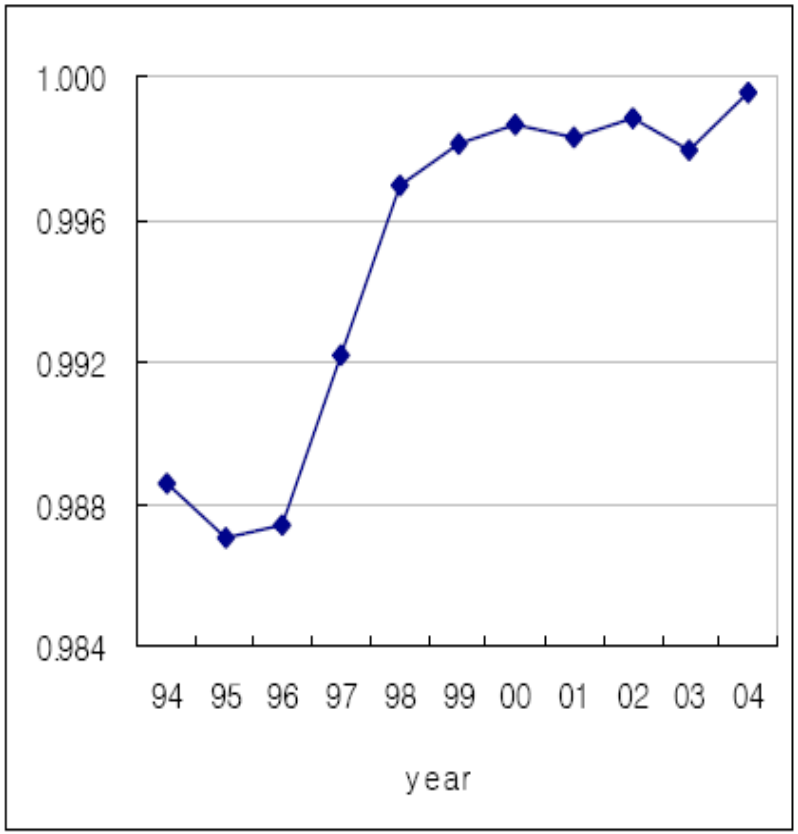


Figure 8: Indifference Location $\hat{\tilde{x}}$

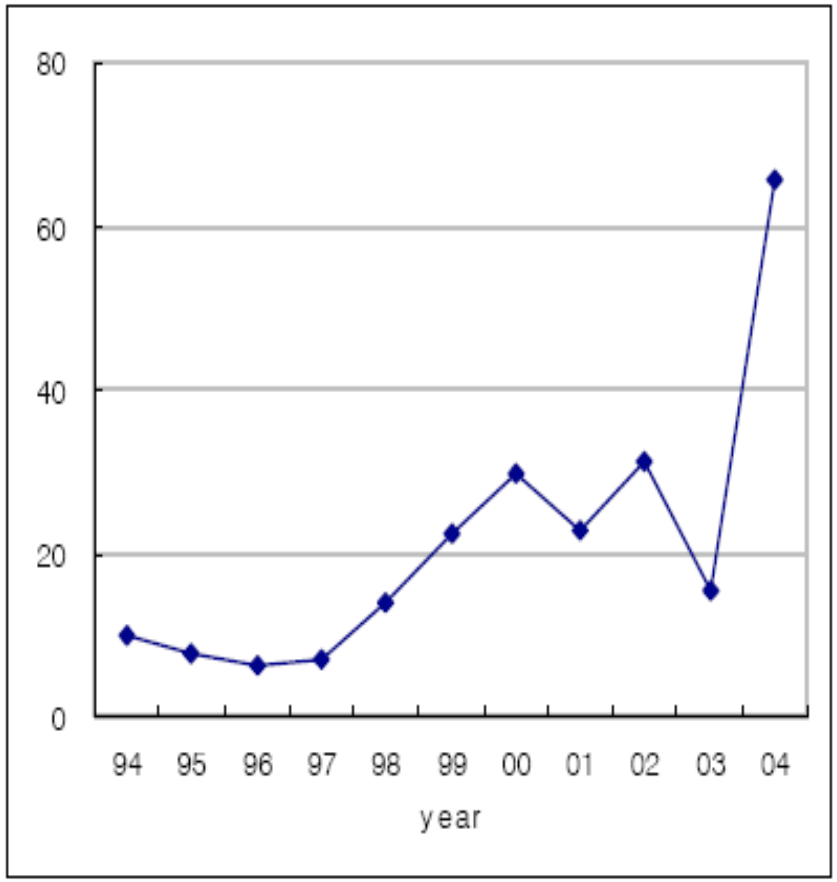


Figure 12: Consumer Density around Indifference Location $f(\tilde{x})$

year	Duopoly Markup$^{(1)}$	Monopoly Markup$^{(2)}$	Markup Increase (2)-(1)	Price Increase
1994	28.45%	30.97%	2.52%	3.65%
1995	26.76%	29.86%	3.10%	4.42%
1996	26.86%	30.26%	3.40%	4.88%
1997	33.84%	37.02%	3.19%	5.06%
1998	19.65%	23.84%	4.19%	5.50%
1999	19.02%	23.86%	4.84%	6.36%
2000	12.17%	17.99%	5.82%	7.10%
2001	16.25%	22.51%	6.26%	8.07%
2002	10.56%	17.45%	6.89%	8.35%
2003	23.03%	29.40%	6.37%	9.03%
2004	5.55%	13.75%	8.19%	9.50%

† Percentage markups are estimated markups divided by observed prices. Price increases are differences between counterfactual monopoly prices and actual duopoly prices of IBM PC devided by duopoly prices.

Table 7: Comparison of Duopoly and Monopoly: Markups and Prices of IBM PC

year	$\frac{SW_R}{SW_0}$	$\frac{SW_M}{SW_0}$
1994	59%	51%
1995	69%	56%
1996	77%	61%
1997	83%	69%
1998	83%	65%
1999	79%	63%
2000	79%	57%
2001	83%	60%
2002	82%	54%
2003	87%	64%
2004	83%	46%

† SW_0: consumer welfare in the actual duopoly. SW_R: consumer welfare from the regulated standardization under current prices. SW_M: consumer welfare in the counterfactual monopoly.

Table 8: Welfare Analysis

Conclusion

- There exist significant network externalities
- The general market taste has changed in favor of IBM PC over time
- Relative quality has changed in favor of Apple/Mac over time
- The final non-tipping outcome is explained by high valuation of Apple/Mac users for their variety, which limits the market power of IBM PC
- Variety has been not only the market outcome, but also the desirable outcome in terms of consumer welfare.

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