

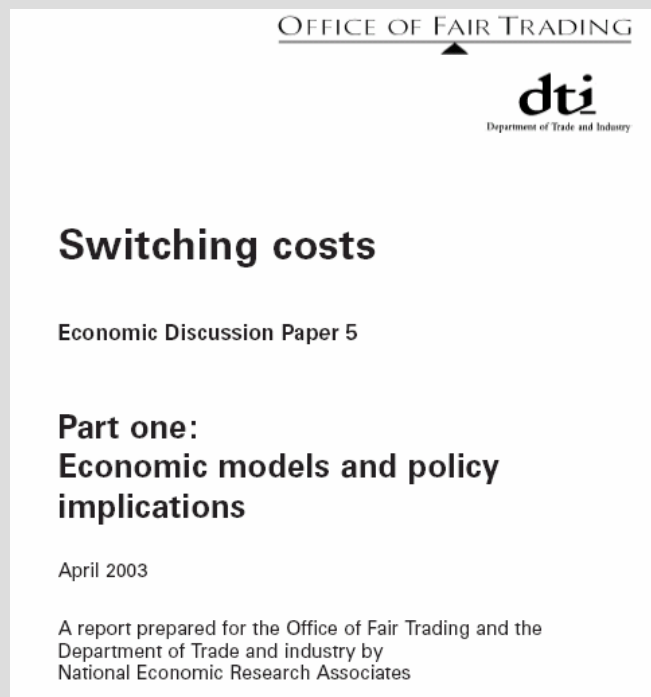
The value of switching costs

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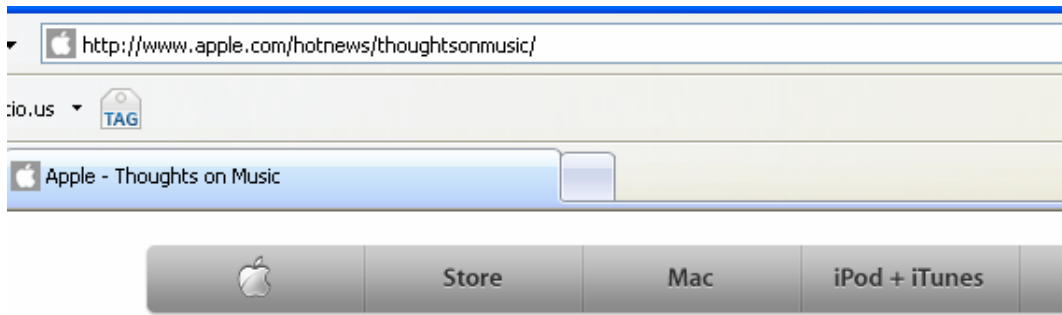
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Switching costs play an important role in current economic discussions.



CONTENTS

<i>Chapter</i>		<i>Page</i>
1	Frequent flyer programs	1
2	The UK retail gas and electricity markets	10
3	The UK mobile phone sector	25
4	Medical services	43



Thoughts on Music

Steve Jobs
February 6, 2007

With the stunning global success of Apple's iPod

Some have argued that once a consumer purchases a body of music from one of the proprietary music stores, they are forever locked into only using music players from that one company.

Or, if they buy a specific player, they are locked into buying music only from that company's music store.

On average, that's 22 songs purchased from the iTunes store for each iPod ever sold.

Today's most popular iPod holds 1000 songs, and research tells us that the average iPod is nearly full. This means that only 22 out of 1000 songs, or under 3% of the music on the average iPod, is purchased from the iTunes store and protected with a DRM.

It's hard to believe that just 3% of the music on the average iPod is enough to lock users into buying only iPods in the future.

The screenshot shows a web browser window with the address bar containing the URL <http://nanocrew.net/2007/02/06/steves-misleading-statistics/>. The browser's address bar also shows the domain del.icio.us and a TAG icon. The browser's address bar shows the breadcrumb [nanocr.eu](#) » [Blog Archive](#) » [Steve's misleading statistics](#). The page header features the logo **[nanocr.eu]** and the text "Jon Lech Johansen's blog". The page content includes a "Pages" sidebar with links to [About](#), [Contact](#), [Software](#), and [JustePort](#). The main content area shows a link [« Steve's Thoughts on Music](#) and the article title **Steve's misleading statistics**. The article text begins with "In his article "Thoughts on Music" Steve Jobs argues that people".

Many iPod owners have never bought anything from the iTunes Store. Some have bought hundreds of songs. Some have bought thousands. At the 2004 Macworld Expo, Steve revealed that one customer had bought \$29,500 worth of music.

If you've only bought 10 songs, the lock-in is obviously not very strong. However, if you've bought 100 songs (\$99), 10 TV-shows (\$19.90) and 5 movies (\$49.95), you'll think twice about upgrading to a non-Apple portable player or set-top box. In effect, it's the customers who would be the most valuable to an Apple competitor that get locked in. The kind of customers who would spend \$300 on a set-top box.

We will show that even the customers with low switching costs are valuable to 

... but this requires thinking in dynamic terms

When a consumer faces switching costs, the rational consumer will not switch to the supplier offering the lowest price if the switching costs in terms of monetary cost, effort, time, uncertainty, and other reasons, outweigh the price differential between the two suppliers. (Wikipedia)

dynamic aspects

distribution

In the simplest model, the profit margin is equal to switching cost

$$p = c + \sigma$$

The model:

- There is one consumer with switching cost σ (Ονε μακεσ ουρ λιφε σιμπλερ)
- There is an incumbent from whom the consumer has bought in previous periods
- There is free entry: “many” potential entrants, with same cost conditions as incumbent
- Marginal costs = c , constant returns to scale
- Incumbent and entrants set price simultaneously.
- Consumer chooses from whom to buy.

Solving the model

- Model equivalent to a Bertrand model with cost advantage.
- Bertrand competition to point at which entrant charges 0
- Incumbent charges σ

□ Προφίτ μαργιν ισ εθβαλ το σ .

$$\text{Profit} = \sum_{t=0}^{t=T} \delta^t \times \sigma?$$

Two period profits are equal to one period profits.

$$\begin{aligned} \text{Profit} &= (-\delta\sigma + \sigma) + \delta\sigma \\ &= \sigma \end{aligned}$$

We look for a static equilibrium of the game in which in each period there are new entrants. Compared to the literature

- Consumers are the same period after period;
- Consumers do not change switching costs from period to period
- There is no commitment on prices.
- Formally only one consumer makes things easier, but basic idea is that there can be no discrimination between old and new consumers.

The decision of the consumer is very simple, as he knows that in each period, he will face an incumbent and entrants.

He therefore considers only his current utility when deciding from whom to buy.

He is indifferent between buying from the incumbent and the entrant when the price differential is equal to σ .

Therefore,

in second period whoever has some consumers will gain $\delta\sigma$.
 therefore in first period, Bertrand competition will lead entrants to announce a price of $-\delta\sigma$
 Hence first period price is $(-\delta\sigma + \sigma)$
 Yields result

This is not very surprising: we know that rents are bidded away.

In the case of switching costs, this has been pointed out by Klemperer, in models with no incumbents.

Infinite horizon profits are equal to one period profits

$$\Pi = (-\delta\Pi + \sigma) + \delta\Pi$$

$$\implies \Pi = \sigma$$

We look for a Markov equilibrium of the same game.

The decision of the consumer is very simple, as he knows that in each period, he will face an incumbent and entrants.

He therefore considers only his current utility when deciding from whom to buy.

He is indifferent between buying from the incumbent and the entrant when the price differential is equal to σ .

Therefore,

entrant bids up to $-\delta V_0$.

Incumbent charges $-\delta V_0 + \sigma$.

Profit of incumbent from formula, only equal once to switching costs.

Stess we know exist other equilibria, focus on one of them.

You cannot get *rich*
by switching costs
alone

How does this generalize?

The static model with some zero switching costs consumers.

$$p = \sigma$$

$$\implies \Pi = \alpha\sigma.$$

We review the previous model, with following changes:

- Continuum customers;
- Proportion α with switching costs σ , proportion $(1-\alpha)$ with switching costs 0.
- From now on marginal costs = 0 (we will allow negative prices shortly)
- Price is going to be bid down to σ .
- Hence profits.

With an infinite horizon, the value of a σ -consumer depends on α and δ

$$V = (-\alpha V \delta + \sigma) + V \delta$$
$$\implies V = \frac{\sigma}{1 + \alpha \delta - \delta}$$

We now put the previous model in an infinite horizon model.

We call V the value of having one high switching cost consumer in once clientele.

Entrants are willing to price down to $-\alpha V \delta$.

Hence for incumbent.

Finish rhs first equation.

Lesson: in static model, the value of a σ customer depended only on σ , here it increases in α . Of course σ -customers are better than 0 switching costs customers, but when you decrease α , this is partly compensated by the fact that the value of high switching costs customers is increasing.

The profit is greater than the one period profit...

$$\begin{aligned}\Pi &= \alpha V \\ &= \frac{\alpha\sigma}{1 - \delta + \alpha\delta} \\ &> \alpha\sigma\end{aligned}$$

...but is smaller than an ∞ stream of one period profits.

$$\begin{aligned}\Pi &= \frac{\alpha\sigma}{1 - \delta + \alpha\delta} \\ &< \frac{\alpha\sigma}{1 - \delta}.\end{aligned}$$

Adding zero switching costs
consumers increase profits.

Add $\eta > 0$ zero switching cost
consumers.

$$\alpha \rightarrow \alpha' = \frac{\alpha}{1 + \eta} \cdot \frac{\alpha\sigma}{1 - \delta + \alpha\delta}$$

$$\begin{aligned} \Pi &\rightarrow (1 + \eta) \times \frac{\alpha'\sigma}{1 - \delta + \alpha'\delta} \\ &= \frac{\alpha\sigma}{1 - \delta + \frac{\alpha}{1 + \eta}\delta}, \text{ increasing in } \eta. \end{aligned}$$

When $\delta \rightarrow 1$, α does not affect profit of incumbent.

$$\Pi = \frac{\alpha\sigma}{1 + \alpha\delta - \delta}$$
$$\implies \lim_{\delta \rightarrow 1} \Pi = \sigma, \text{ whatever } \alpha.$$

At the limit profits are the same as if everybody had a switching cost of σ .

Lessons:

- Dynamic profits can be greater than static profits.
- Low switching costs customers are valuable: as valuable in the limit as high switching cost customers.

Explanation:

When there are low switching costs agents, an entrant will attract them, but they are not very valuable; therefore the entrant is less aggressive, which is good for the incumbent.

σ_H and σ_L

Two periods

We have not been able to solve problems with infinite horizon and different types, so we now turn to a two types model with two periods.

Game apart from that is exactly the same, except that it ends in period 2, in which there is always free entry.

We assume $\delta=1$.

$$\alpha\sigma_H > \sigma_L$$

We assume that the aggregate value of high switching costs is high enough that in static model price is σ_H and profits $\alpha\sigma_H$ (this generalizes the model we have just seen).

High σ consumers try to “hide” with low σ consumers.

The price charged by an entrant is low as long as the proportion of high consumers that it attracts is less than a cutoff value γ .

This creates complicated reaction functions, and discontinuities in second period prices as function of the difference in the first period price between an entrant and the incumbent.

There exist only mixed equilibria strategy

$$\Pi = \sigma_H \frac{\alpha\sigma_H - \sigma_L}{\sigma_H - \sigma_L} (1 + \delta - \alpha\delta).$$

$$\text{with } \alpha\sigma_H > \sigma_L \frac{1 + \delta}{\delta}$$

There exists a unique, mixed strategy, equilibrium.

For α close to 1, profit is close to one period profit

$$\Pi = \sigma_H \frac{\alpha \sigma_H - \sigma_L}{\sigma_H - \sigma_L} (1 + \delta - \alpha \delta).$$

$$\lim_{\alpha \rightarrow 1} \Pi = \sigma_H.$$

There exists a unique, mixed strategy, equilibrium.

The derivation is quite tricky. I will give some hints in a second.

Note that the profits are decreasing in σ_L . STRESS

We can go further: if both σ_H and σ_L are decreased by same amount, and $\alpha < 1/2$, then profits increase.

Profits are between 1 period profit
and $(1+\delta)$ 1 period profit

$$\Pi = \sigma_H \frac{\alpha\sigma_H - \sigma_L}{\sigma_H - \sigma_L} (1 + \delta - \alpha\delta).$$

$$\alpha\sigma_H < \Pi < (1 + \delta)\alpha\sigma_H.$$

Intertemporal profits are greater than 1 period profit, and less than a flow of one period profits.

A decrease in σ_L increases profits

$$\Pi = \sigma_H \frac{\alpha \sigma_H - \sigma_L}{\sigma_H - \sigma_L} (1 + \delta - \alpha \delta).$$

$$\frac{\partial \Pi}{\partial \sigma_L} < 0.$$

There exists a unique, mixed strategy, equilibrium.

The derivation is quite tricky. I will give some hints in a second.

Note that the profits are decreasing in σ_L . STRESS

We can go further: if both σ_H and σ_L are decreased by same amount, and $\alpha < 1/2$, then profits increase.

An decrease in all switching costs
increases profits

$$\Pi = \sigma_H \frac{\alpha \sigma_H - \sigma_L}{\sigma_H - \sigma_L} (1 + \delta - \alpha \delta).$$

$$\frac{\partial \Pi}{\partial \sigma_L} + \frac{\partial \Pi}{\partial \sigma_H} < 0.$$

There exists a unique, mixed strategy, equilibrium.

The derivation is quite tricky. I will give some hints in a second.

Note that the profits are decreasing in σ_L . STRESS

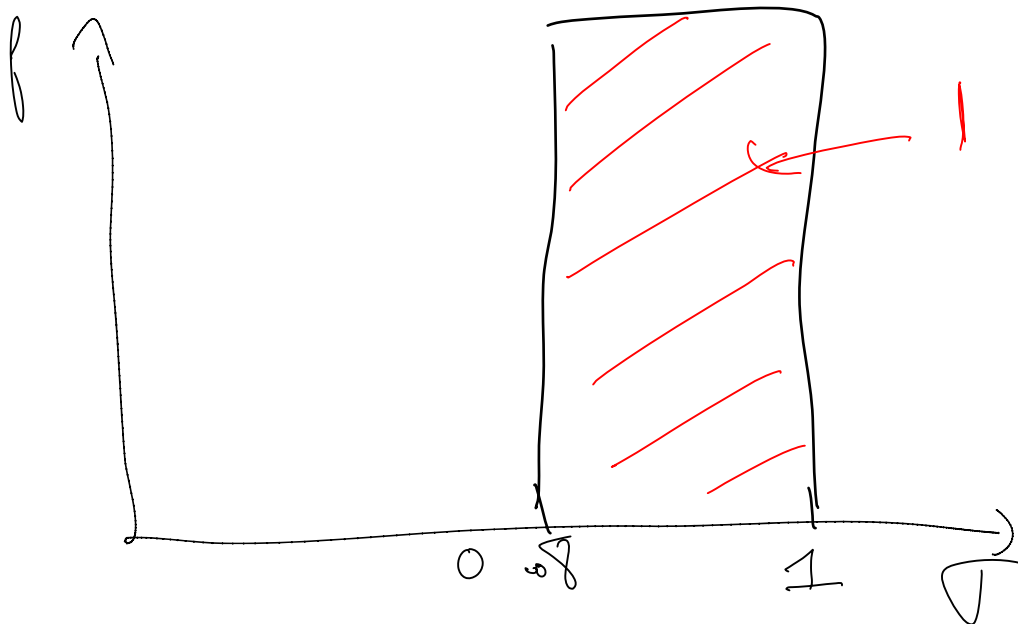
We can go further: if both σ_H and σ_L are decreased by same amount, and $\alpha < 1/2$, then profits increase.

A continuum of switching costs

We have not been able to solve problems with infinite horizon and different types, so we now turn to a two types model with two periods.

Game apart from that is exactly the same, except that it ends in period 2, in which there is always free entry.

Simplest model: σ uniformly distributed between 0.8 and 1



Equilibrium profit of incumbent is 0.8,
same as one period profit.

$$p^E = -0.8 \quad q^E = 0.8$$

$$p^I = 0 \quad q^I = 0.8$$

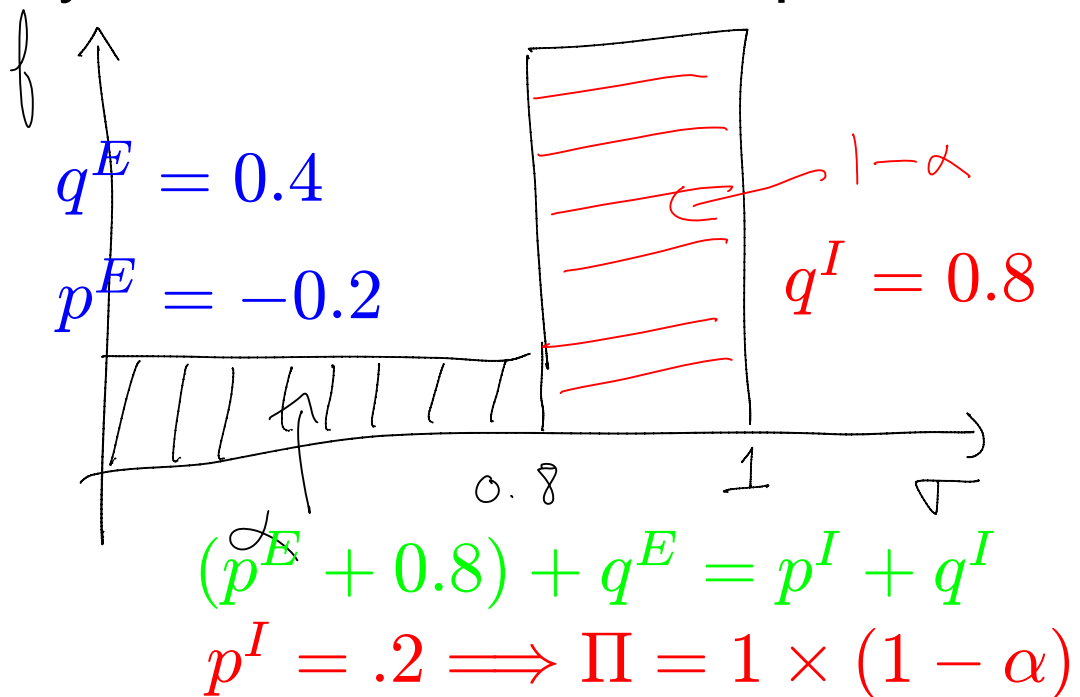
$$\implies (p^E + \sigma) + q^E \geq p^I + q^I$$

Easy to show that static profits are 0.8, with entrant offering price of 0.

In two period model:

- Entrant know that he will offer a price equal to 0.8 in second period if it attracts a positive mass of consumers.
- Hence, willing to offer price down to -0.8.
- Incumbent never finds it profitable to let some consumers go away.

A decrease in switching costs of every consumer increases profits.



Explain why this is a decrease in all switching costs.

There is an equilibrium (with 99% proba only one) such that all low σ consumers go to first period entrant, and all others stay with incumbent.

Explain in order (things come on one by one):

1. q^E ;
2. P^E (zero profit)
3. q^I ;
4. Green equation is behavior of marginal consumer
5. p^I is algebra, and profit is sum of prices multiplied by mass of consumers.

Remember profits before change of distribution were .8

If $\alpha < .2$, a decrease in switching costs increases profits.

Two different and related strategic effects.

- Increase in switching costs make entrants more aggressive.
- Low switching costs customers get in the way of entrants.

The general theory with a continuum of switching costs.

We assume that switching costs are distributed according to F ; conditions for sufficient and necessary conditions, etc.

Remember game.

$\delta=1$.

The cutoff consumer is indifferent between incumbent and entrant.

$$p^I + \tilde{\sigma} = p^E + \tilde{\sigma} + p^m(\tilde{\sigma})$$
$$\implies p^m(\tilde{\sigma}) = p^I - p^E$$

On LHS, tilde sigma is price paid second period if stays with incumbent, on RHS switching cost incurred if go to entrant.

Because of free entry, the entrants make zero profits.

$$\begin{aligned} p^E F(\tilde{\sigma}) + p^m(\tilde{\sigma})[F(\tilde{\sigma}) - F(p^m(\tilde{\sigma}))] &= 0 \\ \Rightarrow F(\tilde{\sigma}) &= F(p^I - p^E) \\ &\quad + (p^I - p^E) f(p^I - p^E) \end{aligned}$$

This fixes p^E given p^I .

The incumbent chooses p^I to maximize its profits.

$$\begin{aligned} & \max(p^I + \tilde{\sigma})(1 - F(\tilde{\sigma})) \\ & \text{subject to } F(\tilde{\sigma}) = F(p^I - p^E) \\ & \quad \quad \quad + (p^I - p^E)f(p^I - p^E) \end{aligned}$$

This fixes p^E given p^I .

Summary

We have shown that the dynamic nature of competition with switching costs had important economic consequences

- The whole distribution of switching costs in the population is important
- Higher switching costs do not necessarily translate into larger profits.
- Static models can be poor guides to the values of switching costs.

Conclusions

Network effects

continuum of types

infinite horizon

Entry costs

Asymmetric switch costs