

13:10 ~ 13:50 Lecture 1

"Positive analysis of OS and the network externalities of application software"

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1. Lecture by Associate Professor TANAKA

I would like to talk about the effect of the externalities in the operating systems market, and I have done some researches in this area and I would like to share with you its findings. With regard to the network externalities, we are going to hear from the two foreign guests, right after me; so that being the case, I would be very brief.

When we talk about the network externalities, it works on the interface(Page 2*). The more people and more goods use an interface, the higher its utility goes up. So, one single interface will grow and to eliminate other interfaces, that is a mechanism at work and that is what we call network externalities. In case of the OS – Operating System, the interface is API (Application Programming Interface) which is a set of rules between the application software and OS. In case of word processors and spreadsheet, interface is file format by which we can exchange files with other people. If there is one single file format being dominant, then making use of that will become very convenient and useful which means that other products will find it very difficult to enter into that same market later.

If the interface is open, then there is no problem. By “open”, I mean that any businesses or firms can not to control its interface, which means that other companies can offer the compatible goods without any restraint so that competition will continue. And there are so many of such “open” interfaces like USB and Wi-Fi for the Wireless LAN and so forth. But if the interface is bundled together with a company’s products, then that product can claim a large market share. Then there will be a tendency to a monopoly (Page 3). So, this is the case in which network externalities and competition policy come into conflict..

What is important here is that even if a company obeys the rules of fair competition the market will end up to monopoly and it will be very difficult for other companies to break the monopolistic situation. In that case, the monopolistic component might be

* The number of the page in the parenthesis is basically the number in the presentation slides Mr. TANAKA used.

tied together with other goods (tying or bundling). Thus, the demerits of the monopoly can be extended to other market. Professor Gilbert will be talking about this later in more detail.

This may be too unilateral view, however. There are other opposing views as well saying that it will not be the case because if there is a major innovation, the monopoly could always be cracked. Historically speaking, what was thought to be a standard was overtaken by other standard overnight. There are certain cases like some software which used to be very dominant but lost their dominance overnight like Lotus; and also in Japan we have similar examples in the word processors standards. So, there are two conflicting views (Page 4); and with regard to the bundling or tying, there are also different views such that bundling can bring some benefits to the users.

And in corresponding to it, there are divided views for the policy recommendations in this area too. For one thing, if we resort in a monopolistic situation, then compatibility can be regained through making open the interface. For example API, or Word or Excel file format should be made open; that can be one of the measures to be taken. And with regard to the bundling or tying, maybe it can be prohibited or banned. More radical measure is that the sector making monopolistic goods and sector making competitive goods should be separated and divided up. That was actually one of the policies which were proposed in the court as you may know.

Other view opposes to these policies. One may argue that innovations merit can be lost as a result of these policies such as opening interface or separation of monopoly sector. That is, by gaining the dominance based on network externality, a company will be able to enjoy a good profit; that is the incentive for the competition. So, “competition for the market” might be undermined as a result of these regulations.

So there are divided views still. Now, how should we think about this issue (Page 5)? Firstly we need to look at the market share being enjoyed and estimate the size of the network externalities. If there is big innovation, the large market share can be cracked. We have historical examples of that, and if that is a case, there is no problem. So the size of network externalities needs to be estimated first of all. If the externalities are not so strong then there is no problem, and competition for the market will work; but if they are very strong or powerful, then the entry barrier is so high that it cannot be cracked. In that case we measure the demerits, that is, how much welfare is lost and

how innovation stagnates and so forth. So if there is such a loss, then solutions may be the prohibition of the tying or making open the interface.

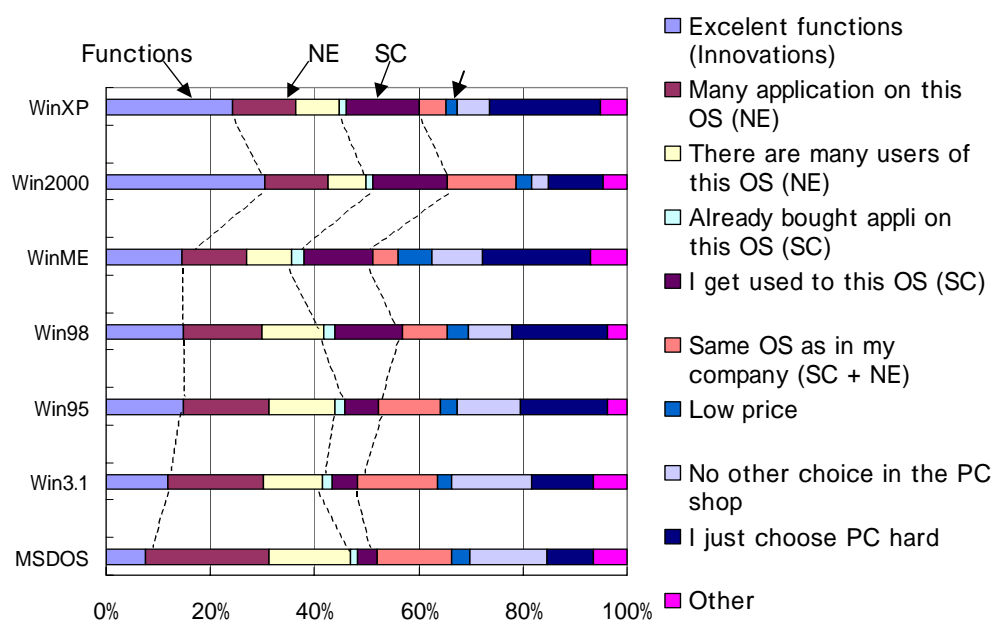
Today, I would like to mainly focus on the first point, how we can measure the strength of the network externalities. And lastly I would like to talk about solution.

Well, today's given topic is OS – Operating System and we are to measure the size of the network externalities for OS. What we have done here is to have conducted a questionnaire survey to users (Page 6). We directly ask the users because network externalities reflect subjective judgment of the users. The users would make a choice as to which interface they would like to use according to the market share of the interface, so we thought that questionnaire survey on users would give us direct information. We asked the history of the use of the OS amongst the respondents. We asked the reasons for choosing a particular OS; and also asked for the subjective evaluation to OS, how excellent users have thought about specific OS and also how many application software they used and so forth. As a result of this, we were able to get this sequence. A respondent, for example, bought Mac OS in '93 and used for some time, but in '97 he switched to Windows 98 and have continued to use that Windows with version-ups. He must respond the reasons for the choice, prices, how many the application software he used, and so forth in each period. So, this is a questionnaire survey we had conducted and we assume that the user's memory is very fresh and intact.

Now, first of all, let's see the reasons why each particular user chose particular OS (Page 7). We had given them 10 choices and important ones are listed on the top column. The first reason is "Excellent functions". The second and third choice reason had to do with the network externalities. The second one: "there are many applications on this OS"; and the third one: "there are many users so that it is easy to ask any user for advice if required"; and fourth one and fifth one had to do with the switching cost. "There are so many applications soft being bought so no way it can be switched to elsewhere"; "got used to particular operations of the OS and no way to depart that". And the sixth reason is a mixture of network externalities and switching costs: "same OS as in my company"; and the seventh one is the low price. And the other choices were also listed there for the remainder. Functions and the network externalities and the switching costs and the price, those are the four major elements

which we have chosen to focus ourselves. And I wanted to analyze the relative importance of those reasons.

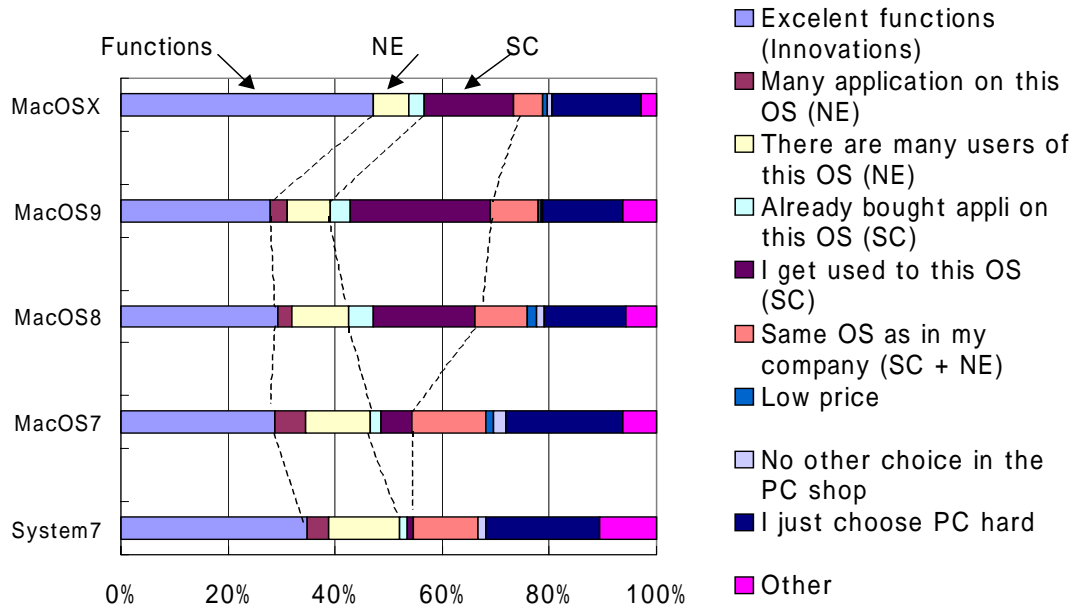
Now, very roughly, those were the responses we had received (Page 8) (See the graph below). The below one is MS DOS and the top is the Windows XP and there are new ones and older ones being listed there. And we have come to notice that in terms of the functions on the left hand side, the functions are getting larger in its importance. It used to be much lower initially, but it's more than 20% now. Microsoft often claims that OS function is so good that they are being chosen. This result shows that's one of the reason, I agree.



As for the network externalities, there were two responses received, largeness of members and the largeness of the application software, but these reasons are being on the decline. It used to be 40% but now it's about 20%, but it still holds up to 20%. And the third has to do with a switching cost, which is on the increase gradually. Initially it was 5% but now it is 15%; people has increasingly feel that they bought so many applications already e and got used to the operations of the OS, thus no way to depart from that.

Now, in case of Mac (Page 9), comparatively speaking, similar responses have been obtained. (See the graph below) Compared with the Windows, it can be said that there are so many people who had made a choice (30% to 40%) said they chose it because of

the function's excellence. Network externalities have effect to the certain extent but it's on the decline, down to 10% from the 20%. As for the switching cost, it is on the increase; it was initially 5%, but now has climbed to 20%. That is the general picture.



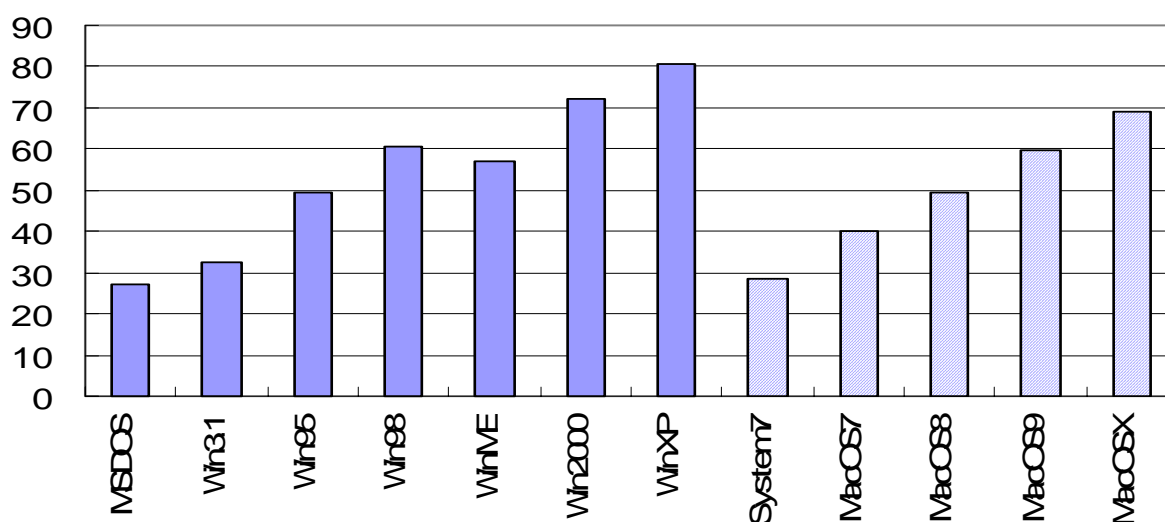
But those are not the only analysis we had conducted. We wanted to know quantitatively how much these factors played in choosing particular OS. So, we made some variables based on user survey; as far as functions are concerned, we looked at users' subjective evaluation of the OS. We have asked the user to score the OS from 0 through 100 scale. How much score would you give to Windows 98? How much score to Windows 2000, how about Mac OS and so forth. Since we asked each user to come up with a score; users are assigned each different score. As for the network externalities, it can be represented in the share of the previous period. We asked them about the switching cost by the number of application software being used. If a user converted to different OS, switching cost would emerge but if he stays with the same OS, no switching cost would arise, and the price was average price. We use the linear formula⁺ for the utility, so the utility can be determined by linear combination of factors, and based on this utility, OS will be chosen.

⁺ $V_{ij} = a + b \times \text{Pr}_j + c \times \text{Function}_j + d \times \text{Switching Cost}_{ij} + e \times \text{Network Effect}_j$
where V_{ij} means "the utility when OSi's user chooses OJ j as a new OS", and Pr means "Price"

Before showing the estimation result I would like to review each movement of the variables first.

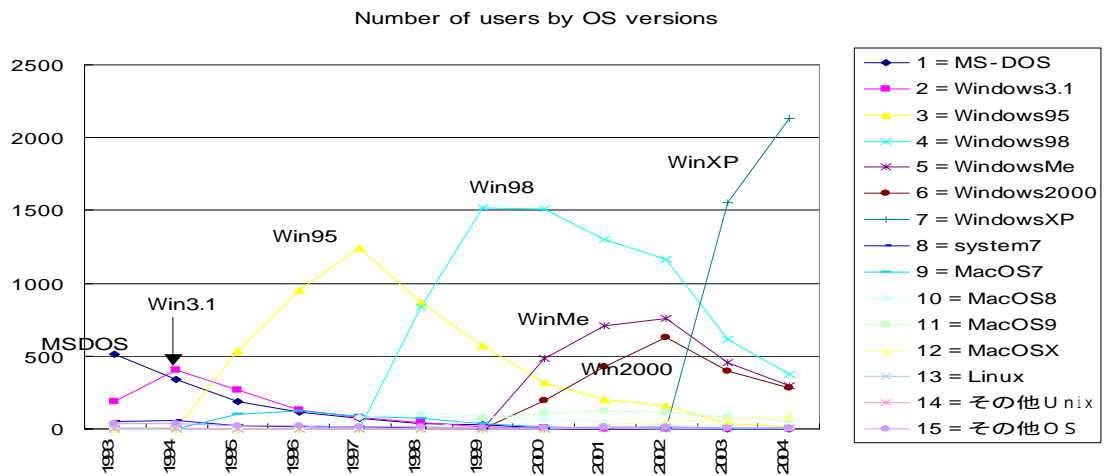
This is the functional evaluation (Page 11); by and by functions are on the increase naturally in case of Windows from the MS DOS and up until WIN 2000. (See the graph below) Steadily the scores by the user have become larger. When Windows is up from 3.1 to Windows 95, functional evaluation increased by nearly 20 points but otherwise a 10 point increase. As for Mac OS by 10 percentage points each the score had gone up.

Evaluation on Functions by OS versions

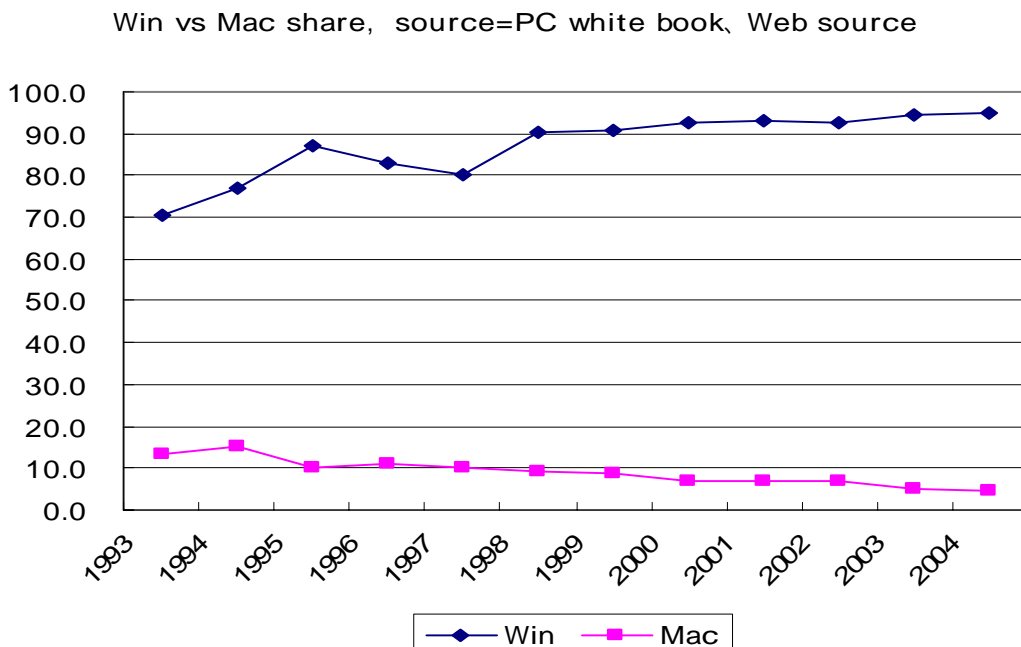


So, in terms of the innovation, the OS has continued to make further innovations; it is continuous. Windows base score is higher than Mac so you can say that there is a reason why Windows people claim that they are being chosen because of their higher performance or functions.

Now, let me go on to the number of users (Page 12). In terms of the number of users, it's not easy for you to see. It goes up and down with generations changing.(See the graph below)

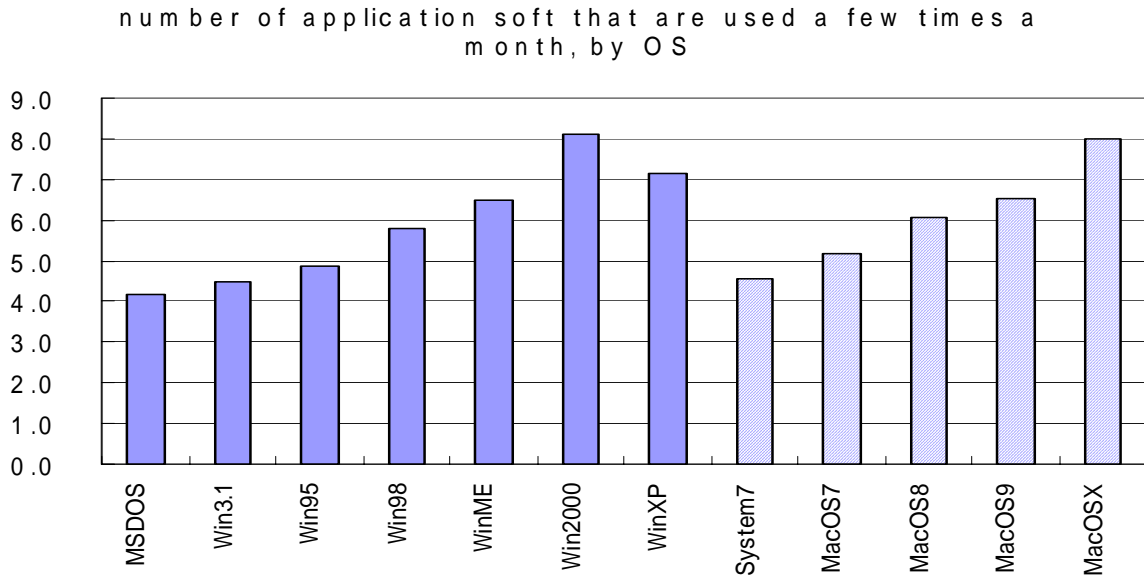


If we aggregate them into the Windows and Mac OS (Page 13), you can see the simple picture of the shares and Windows share is edging up; it used to be 70% but now it's nearly 90%. (See the graph below) In case of Mac, it is edging down. That's the picture. So, the gap between the two OS is about 80%. Please remember that this figure, 80 to 90 percentage points.

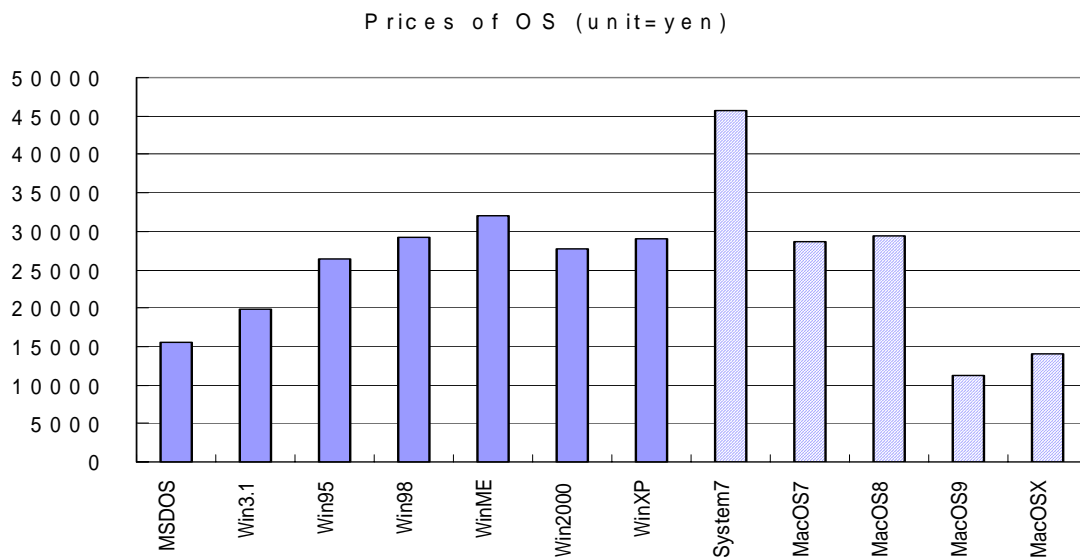


Now, let me touch upon the switching cost (Page 14); how many software are being used. It is on the rise; initially it was 4 but now it is 7; the number of software being used daily is on the increase. On average, it is about 7 points now; 7 different

softwares are used at the same time. (See the graph below) Please remember this number as well.



Now, let us go on to the price in case of Windows and Mac (Page 15).(See the graph below) For Windows, the prices had gone up for a while, and then it had become more stable, whereas in case of Mac OS, it has been on the decline throughout. So there is a difference of the prices between the two. It is not true that Windows are selling well and enjoy a high share because of the low price.



So, this is the estimation results which I will like to share with you (Page 16). I showed you this formula[#] before. Each of the elements has been factored in to decide on the utility. I will skip over the details. I assume that the users choose the highest utility OS and estimate the coefficients using discrete choice model. And as a result we have arrived at this (Page 17). This is estimation results. (See the table below) The estimated coefficients are statistically significant. Although there is one departure from the theory in price, but otherwise everything was in accordance with the theory.

		Case1	Case2
Functions	Evaluation(0-100)	0.0522 (0.00)	0.0528 (0.00)
Network Externalities	Share of previous year (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

Let's look at the size of the network externalities (Page 18). In evaluating this, there is a gap in actual share by 80% between the Mac and Windows. So, how much functional advantage is necessary in order to beat these network externalities? We can make a calculation of it. 37 point means that by the functional advance of 37 point, 80% gap in terms of network externalities can be removed and eliminated.

In the same way, we can calculate for switching cost which is 21 points. So, if you have functional advance of 21 points, then you can just overturn the switching cost and

[#] See the footnote + on page 5 in the minute.

get the customers from the other opponents' camp. What does it mean by 37 and 21? They are really large if you add them together, it is going to be 58. Our survey suggests that one can achieve a functional increase by some 10 points by one version up, which means that gaining 50 points by one version up is nearly impossible. If we suppose that version ups are made every 2.5 years, the firm has to achieve innovation of 15 years, otherwise it cannot overturn the current situation. So, necessary technological innovation is too large to overturn the network externalities.

If this assumption is correct, then how can competition be ensured; that's the next point, how to introduce competition (Page 19). If compatibility is introduced; that's the best way and that would mean interface to be open. API of OS has often talked about, but Word or Excel file format are also important. And I think there are many ways to open up, such as the current interface or the former interface. The next interface can be made open as well; that would be quite a strong openness. And the second would be prohibition of bundling or tying. In other words, the monopolized and non-monopolized portion can be split and separated.

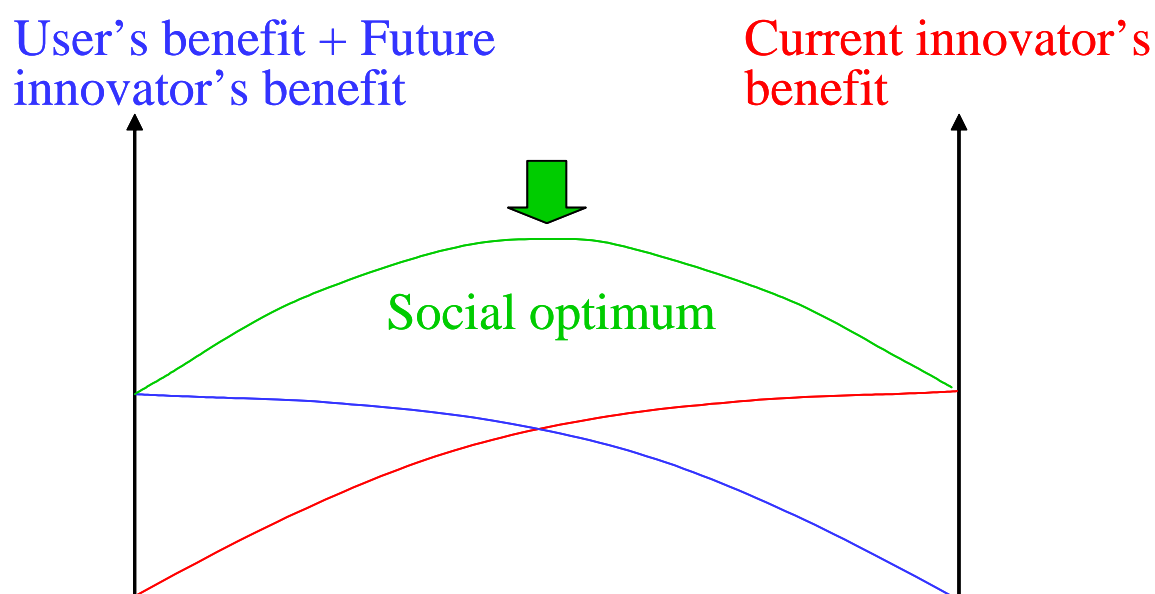
But when this topic is raised, there are rebuttals always because they say that that would hinder the incentive for innovations. It is true that if interface is made open, the revenue gained by developing interface will be leaked out to competitors and therefore that would hinder the incentive to innovate. However, although that's true, that does not mean that this solution is automatically and immediately bad measure. What we should ask is how much incentive is the right one.

In the current case, if the interface is made open to ensure compatibility, it is true that there would be harm to incentive to develop an interface, which would lead to welfare loss. But that policy would lead to competition being resumed and there will be welfare gains. So, which is large, the welfare loss of the former or the welfare gain of the latter (Page20)? It depends on the optimum level of incentives set when incentive is designed, so the interface problem could be considered as special case of incentive designing.

Interface is considered as one of IPR, so, I think a similar debate as a patent protection is applicable here. In the case of patent protection it is not true that the stronger the better. May researcher agree that there is an optimum level; the stronger the protection, the more innovator of that technology would enjoy the incentive. But at the same time,

for the sake of the technology users, the lesser the protection the better; users include not only those who literally use their technology but users who may innovate in the future by using the current technology; so, for that future innovator, the weaker the better. So there could be a social optimum level of protection or incentive and therefore if I may use a symbolic expression, to what extent monopoly should be admitted to provide for optimum level; so, that would be the empirical issue.

In the case of the interface (Page21), if we draw the same diagram (See the diagram below), extreme options would be complete openness and complete closeness, and somewhere between a next version or the current version are open. Regarding monopoly period, we could ask how many years would be allowed for innovator of the interface. Now there is no rule for openness. As for OS API of current OS is open; in the case of file format it is not completely open. So we can raise the question: is this situation the optimum situation?



I think it's necessary to debate whether this is the optimum situation. In other words, if we make Microsoft open the interface, to what extent incentive of the potential innovators who want to be the next Bill Gates will be harmed? To what extent incentive of those who want to make compatible goods and enter into the once monopolized market will be enhanced? Which effect is bigger? We need to compare the effects.

This is a question that needs to be taken empirically and it's not a question where a theoretical solution can be provided for at the beginning and therefore this is one of the points that need to be researched empirically. And at the moment, I have no knowledge of any empirical studies being done on this front. And with this I would like to conclude my presentation.

2. Q & A

Questioner A:

Can I ask you a technical question about the characteristics of the sample's demographic issues that you had looked at and what was the sampling method you used?

Professor Tanaka:

This is not a random sample and that is a weakness of this research. We used a web monitor system, but as for the monitors, we checked sample's demography, the ratio of male and female and the age and the profession. We made sure that these demographics are not different from the population distribution. We used the web-monitoring company which has a pool of monitors. They have a pre-selected sort of pool of the monitors and we used them.

Questioner B:

Let's look at your page 9 about the Mac OS user. (Refer to the graph on the page 5 in the minute) During this given period, have the users used Mac throughout the periods or was it just for this particular time period? I don't think that there were many switchers from Windows to Mac, but if you are talking about continuous users, how many of the users you had surveyed were continuous users and what was the reason given by those continuous users of a particular OS because they were the diehard Mac fan or any other reasons such as preference for specific applications of desktop publishing and so forth.

Going on to your last page 21 (Refer to the graph on the page 10 in the minute), about this monopoly period, it has nothing to do with the chart on the top, i.e. it's not linked, right? I was disturbed by one thing here. If it goes with a dog year speed which means that the speediness of the lapse of time also needs to be taken in account.

Professor Tanaka:

I would like to respond one by one about the Mac OS, I have asked the users for that particular given time period so we are not only looking at the continuous Mac user. There were some switchers in between but we just focus on particular given time period. And as you had pointed out here, there are so many switchers from Mac to Windows but reverse is much less in number. I am sorry but I am not sure about the exact number of the switchers. So, I would like to explore this point we haven't. As for the diagram on the page 21, it's just a conceptual diagram so the one on the top and one below are not linked together; it's just a concept, so it has no linkage in terms of social optimum.

Questioner C:

I have a follow up question. In the samples that you used, you said that users are locked into a certain OS. So, in terms of a larger effect, one can think about the following. Thus far, there are people who have been completely stranger to OS who we may not find in large number nowadays in advanced countries. But with the Mac or the Windows, if a fresh choice is given to a complete stranger to OS, then maybe the results could have become different; then network effect could have been measured much more precisely, would you agree with me?

Professor Tanaka:

I think you had made a very good point out, thank you. We had included some users who had made a choice for the very first time. But it's mixed, so some of the users are continuous users and some of the users are fresh users. But, I can say that as you can see from this diagram (Refer to the diagram on page 6 in the minute), there are considerable people who have come to become a user on the way, so in 1994, it was only about 1000 people who were the user of some kind of OS but by and by the number had increased to reach 3000; so those people who have come new on the way are the new users.

As for the switching cost, we use that factor as a variable because there were already users who had made a choice; in order to separate the switching cost from the network externalities, we used this variable to distinguish between the two. Just two years ago, we made a similar sample survey, but at that time we had a criticism that switching cost was not separated, and switching cost and network effects were mixed up. So we tried to separate them out with this. Even with switching cost separated out, we had found out that effect of network externalities was very large and sizable.

Questioner A:

I have a question about the estimation. The function versus network externalities, and also you used the switching cost. But from the economic point of view maybe all these three are linked with each other. With a larger population of users, firms are eager to improve the product, so that it would lead to the enhanced function. With a large network externalities then the reverse will be the switching cost, which means that the incentive for the switching will become less and undermined. So, from the longer point of view, maybe you need to also look at the economic mechanism involved for each of the three elements; any reaction to this please?

Professor Tanaka:

Well, you asked me a very difficult question. I understand that you mentioned that functions, externalities and switching costs can be endogenous. Perhaps these variables should be internalized to the estimation, but we looked at the traits of each user here and we thought that our users were given the variables when making decisions as to which OS to buy. But this is as far as I can say at this time, sorry.