

# The Economic Impact of Multiple Standards in Information Communications & Technology

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## ABSTRACT

*Standards impact the economy in various ways. Moreover, intense competition exists between a variety of standards in this era of globalization. This paper quantifies the economic effect of multiple standards in the Information Communications and Technology (ICT) sector. Thus, it identifies and specifies which standard applies when economic gains exist. A model is developed which quantifies the magnitude of the economic effect of multiple standards as compared with a single standard or no standard. The model allows for both the micro- and macroeconomic gains from standardization to be quantified. Preliminary estimates indicate that at the macro level the multiple standards multiplier is approximately three. That is for every dollar invested, the gain is on the order of three dollars. Although not as robust, preliminary results indicated a similar economic gain at the micro level Overall, multiple standards dominate a single standard. This paper applies the model to IMT-2000, an example of multiple standards, to demonstrate this approach to quantify the standards economic effect.*

**Keywords:** scale gains, variety gains, innovation gains, network gains, IMT-2000

## 1. INTRODUCTION

The standards affect our modern economic life in various ways. The traffic flows in right side of the road in most countries, as we may know. It has been known that the Swedish suffered from a tremendous social cost paid to switch from keep-left to keep-right.

This paper explores a qualitative analysis in terms of economic effect of multiple standards, especially in the field of Information Communications & Technology (ICT). It means the comparison analysis between single and multiple standards rather than between standard and non-standard. This kind of study is important because there are intense competitions between multiple standards, especially in the era of globalization.

Before analyzing the economic effect of the above agenda, let me identify, in the section 2, the standard gains in ICT industry and define them if necessary. Let me do a comparison analysis between the gains of single standard and those of multiple standards in the section 3. In the end, let me examine the applicability of this approach to IMT-2000, a representative case of multiple standards, along with some guidelines for quantitative analysis.

## 2. STANDARD GAINS

Let me identify which standard gains there exist in ICT industry in case of existence of only single standard and then define them in this section.

### 2.1 Coordination gain

The standard helps reduce the search cost that users are willing to pay to choose their preferred one. The standard helps also to overcome the potential inefficiencies existing between excess inertia that users wait to adopt a new technology and the excess momentum that they rush to an inferior technology for fear of getting stranded.<sup>1</sup> Let me define as coordination gains the benefit obtained by overcoming the potential inefficiencies existing between the excess inertia and excess momentum.

### 2.2 Scale gains

The economies of scale exist dominantly in monopoly or oligopoly market such as automotives, TV and some ICT service industry. The existence of standards is closely related with the increase of network size that is represented by the decrease of LRAC due to economies of scale. There exists "learning by doing" effect in the case that costs vary with the level of output. The existence of learning by

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<sup>1</sup> Refer to Tirole, J[1988], pp405.

doing shows that the higher a firm's rate of output, the higher its efficiency.<sup>2</sup> In addition, the experience of developing products leads to the reduction of the production costs. This means that learning curve is another way of showing the effect of learning by doing.

The decrease of cost is caused by the total effect of the economies of scale, learning by doing and learning curve. Let me also define as the scale gains the benefit represented by the cost reduction resulting from this total effect (Fig. 1).

**2.3 Innovation gains**

It is indispensable to secure the compatibility (or interoperability) between a variety of equipments and software programs, for example in ICT industry. As the associated technology demands more complex and sophisticated technological knowledge, a firm tends to realize de facto standardization, by preempting the market.

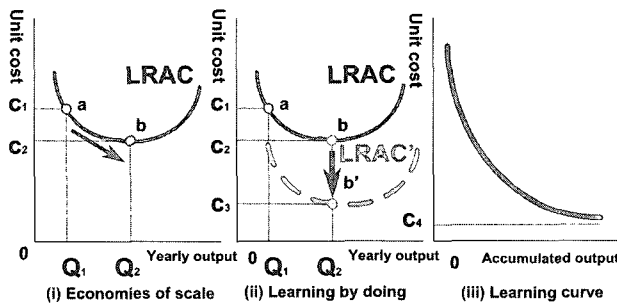


Fig. 1. scale gains

Let me define as the innovation gains the benefit obtained by leading technological innovation. The achievement of de facto standard through the market preemption accompanied by technological innovation determines technological trajectory, while causing lock-in phenomenon of the other technological evolutions.<sup>3</sup>

**2.4 Variety gains**

Let me define the variety gains as the increased consumer utility accompanied by the increased variety of consumer choice. The standardization leads to an obstacle to the emergence of various technologies, thus resulting in the loss of variety.

**2.5 Network gains**

The gains above mentioned are applicable to any industry associated with the standard. On the contrary, there is another effect called as network effect in ICT industry, more exactly in

network industry.<sup>4</sup> The existence of network effect means that there is the network externality based on the inter-dependency of consumer choice, irrespective to the firm's effort. Let me call as the network effect the benefit occurred by network externality. The network gains can be direct and indirect as the same way that network externality can be direct and indirect.<sup>5</sup> The direct network gains means the benefit arising from the increasing network size.<sup>6</sup> Such gain is represented both by the reduction of firm level and by the utility enhancement due to a lower price on consumers. The indirect network gains are based on the fact that a greater number of complementary products can be supplied at a lower price. The positive direct network gains mean the increased opportunity of choice due to a greater number of complementary products as well as to a price decrease by their cost reduction.

**2.6 Firm(or Industry) and consumers**

We have showed that the gains of standardization are comprised of coordination gains, scale gains, variety gains, innovation gains and network gains. The firm, that has achieved de facto standard, benefits from coordination gains, scale gains, innovation gains and network gains, but not a variety gains. The coordination gains for the firms are obtained by reducing the search cost paid to know about which technology will be used or not.

The consumers benefit from coordination gains, variety gains and network gains. The network gains are obtained directly by the increase of consumer utility resulting from a greater number of network size and indirectly by a greater number of complementary products supplied at a lower price.

**3. ECONOMIC EFFECT OF MULTIPLE STANDARDS**

We have identified and defined, in the above section, what are the gains from having single standard. Let me now compare the gains components of single standard with those of multiple standards.

**3.1 Choice problem in case of the existence of two standards**

For analytic simplicity, we suppose that there exist only two potential standards. Let me consider the choice problem between the single and multiple standards in case of the existence of two standards in Fig. 2. Let me denote by "C" the case that there are compatibility between two technologies and "NC" otherwise.<sup>7</sup> The C and NC are both state variables.

<sup>2</sup> There is substantial evidence that the learning by doing occurs in a wide range of industries. It is particularly important in many of knowledge-intensive, high-tech products.  
<sup>3</sup> Refer to OECD[1992] to know more about technological trajectory.

<sup>4</sup> A network industry can be described as an industry having network externalities. The network industry covers the railway and highway sectors as well as many of ICT sector.  
<sup>5</sup> The externality can be indirect; because of increasing returns to scale in production, a greater number of complementary products can be supplied at a lower price when the network grows. (J. Tirole[1988])  
<sup>6</sup> Refer to Economides[1996] for further detailed explanation of network externalities.  
<sup>7</sup> There are three alternatives in case of IMT-2000.  
 I : choice only of synchronous mode

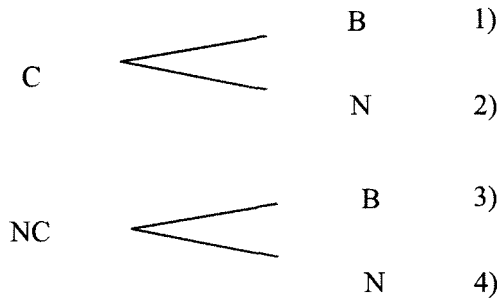


Fig. 2. choice problem in case of the existence of two standards

Let me also denote the choice of only single standard by “N” and the choice of both standards by “B”, which are all choice variables.

We also suppose that an industry is composed only of a service sector and a systems sector. Therefore, the latter comprises three sub-sectors such as the transmission, switching and terminal.

**3.2 Gains of multiple standards**

Now, we further analyze how much gains there is in case of multiple standards and then compare its volume with the volume of gains obtained by choosing single standard.

1) Coordination gain

The coordination gains in multiple standards are offset partially by the reduction of search cost, as compared with a single standard. This is because users should pay search cost as they choose any one between two technologies, in case of the existence of multiple standards. or because the firm must pay for search as it tries to know about which system or service will be deployed.<sup>8</sup>

2) Scale gains

The scale gains in case of multiple standards are smaller as compared with that in case of single standard. It is due to the diminution of network size in terms of both system manufacturers and service providers. It is applicable irrespective to the existence of compatibility.

Table 1. synthetic comparison

	Coordination gain	Gain of variety	Innovation gain	Gain of scales	Network gain
Single Standard	Large	X	O	Large	Large
Multiple standards	O	O	O	O	O

II : choice only of asynchronous mode  
 III : both choice of synchronous and of synchronous mode

3) Innovation gains

It is arguable which innovation incentive is greater. Let me assert for the moment that the innovation incentive of multiple standards is greater than that of single standard.

4) Variety gains

The existence of a variety of standards leads to more fruitful products or services. It is because the number of standards results in the corresponding number of products or services.<sup>9</sup>

5) Network gain

The network gains is reduced by the diminution of network size in the case of multiple standards as compared with single standard. This explanation is only applicable to the absence of compatibility between systems. The larger degree of compatibility between systems, the smaller difference of network gains between single and multiple standards. This is because the utility of incumbent increases in the same way as the utility of subscribers of the other system increases according to the increase of its new comers, if there exists a complete compatibility.

The complementary products are supplied in a smaller amount from the reduction of the scale gains in the case of multiple standards, causing the reduction of indirect network gains.

6) The synthetic comparison

<Table 1> summarizes the synthetic comparison between single and multiple standards.

<sup>8</sup> The coordination gains may become the same as in the single standard if there exists complete compatibility between the two technologies, even in case of multiple standards. It is because users tend to be indifferent to choose any one of the two.

<sup>9</sup> The variety of standards does not necessarily mean the variety of products and services. There can exist a variety of services even if there is only one standard.

### 3.4 Standard gains in terms of national level

Let me now distinguish the national welfare in the narrow sense from that the broad sense. The national welfare in the broad sense can be defined by the summation of competitiveness of industry and the quality of life of domestic consumers.<sup>10</sup> Recall that the industry is divided by the system industry and service industry.

The national welfare in the narrow sense is associated only with the competitiveness of system industry. It is because the service industry covers only a set of domestic service providers due to the national supremacy in most countries. The service providers are also excluded from the risk of getting out of the market because the standard of next generation is also determined by the principle of backward compatibility. From this point of view, let me say the service industry is not directly related with national welfare.

The analysis of national welfare in the narrow sense makes exclude the consideration of qualitative components such as the variety gains, as well as the service industry. So, we have only to consider the factors: affect the competitiveness of system industry.

The analysis of national welfare in the narrow sense shows that the gains of a single standard is greater than that of multiple standards because the gains of all components in a single standard is greater than the gains of each corresponding component in multiple standards.

## 4. REPRESENTATIVE EXAMPLE

The radio sector such as IMT-2000 and Digital TV system takes the form of de jure standardization before the service introduction and of de facto standardization after the service introduction. Let me here consider the applicability of IMT-2000, the most representative example of multiple standards, and show the conflicting issues from the quantitative viewpoint.

### 4.1 IMT-2000

We have supposed the symmetry between two (transmission) modes, of which the one is synchronous and the other asynchronous. In Korea, the both modes were chosen as multiple standards under the circumstance that the technological knowledge and know-how of synchronous mode is more accumulated than the other.

What is more important may be which is at a more predominant position in the marketplace between the two modes. Currently, it is reported that the market ratio of asynchronous mode is about 80%.

### 4.2 Quantification problem

The qualitative approach shown in above sections enables the comparison of the economic effects by each components of the simple standard and multiple standards. However, there is more concern about the economic effect by quantitative approach.

#### 1) Difficulties of quantitative analysis

We compared above by each component the economic gains of simple standard with of multiple standards. However, most data are kind of "qualitative" and hard to obtain if they are quantitative.

#### 2) Pure effect of standardization

The components of economic gains obtained by standardization are a coordination gains, a scale gains, a variety gains, an innovation gains and a network gains. The quantifying itself of these components does not necessarily mean the economic gains from standardization. It is because the gains of each component are also affected by any other than standardization.

The number of service providers is limited due to radio frequency limitation in case of radio sector such as 2G and IMT-2000. It is highly probable that a scale gains in this instance was affected by resources limitation better than by standardization.

#### 3) Cost reduction

We showed above in the qualitative approach that the direct network gains are represented by the cost reduction followed by the increasing network size. In terms of quantitative analysis, it is overlaid by scale gains, which is also represented by cost reduction.

#### 4) Cost of standardization

We should consider the cost side as well as the benefit side. Firms try to standardize their own innovative technology through strategic tools such as penetration pricing. They also should achieve the advanced technology level needed to adapt to change and participate consistently in standardization forum, if necessary, establish the strategic alliances with others.

<sup>10</sup> The competitiveness of industry corresponds to the producer surplus in economic welfare paradigm. The quality of life of users is also similar to the consumer surplus in economic welfare paradigm. Therefore, the national welfare concept introduced here corresponds to the economic welfare concept represented by the summation of consumer and producer surplus in the economic welfare paradigm.

Table 2. Comparison in terms of alternatives (unit : \$ billion)

	total benefit		total cost		net benefit		benefit/cost ratio			
	multiple standard	simple standard	multiple standard	simple standard	multiple standard	simple standard	multiple standard	simple standard		
2002	-	-	6.5	4.3	-	6.5	-	4.3	0.0	0.0
2003	0.2	0.3	3.6	2.4	-	2.8	-	2.1	0.1	0.1
2004	1.2	2.0	10.7	7.2	-	7.9	-	5.1	0.1	0.3
2005	4.4	6.3	6.2	4.1	-	1.5	2.2	0.7	1.5	
2006	8.6	11.6	4.3	2.8	3.6	8.7	2.0	4.1		
2007	15.0	18.3	10.1	6.7	4.1	11.6	1.5	2.7		
2008	28.0	32.6	2.7	1.8	21.1	30.8	10.3	18.0		
2009	45.3	51.4	1.0	0.7	36.9	50.8	45.7	78.1		
2010	75.1	84.0	0.3	0.2	62.3	83.7	230.9	387.5		
NPV	119.2	139.3	38.2	25.4	67.5	113.8	3.1	5.5		

The cost components of standardization are largely classified by innovative expenditure, market expenditure and negotiation expenditure. The innovative expenditures are related with the R&D expenditure and training expenditures for personnel of standardization sector, etc. Market expenditures mean the expenditures paid to preempt the market or maintain leadership in the market. They also include the expenses to maintain the industry leadership and brand's capacity to maintain and develop. The negotiation expenditure is composed of the operating fee of standardization team or the international conference related fee and etc.

#### 4.3 Quantitative approach (cost-benefit analysis)

Based on the statement above mentioned, we can quantify the cost and benefit of each factors.<sup>11</sup> Let us summarize the outcome of cost/benefit analysis, which is represented in the <table 2>. It was calculated by Net Present Value (NPV) method.

Let us firstly consider the net benefit criterion. The net benefit is obtained from the total cost subtracted by total benefit. If we consider the year 2002 as a base period, then the net benefit amounts to 67.5 billion \$ in terms of the choice of multiple standards and that of single standard 118.0 billion \$.

The second criterion is benefit/cost ratio. The ratio is 5.5 in the choice of simple standard and that of multiple standards is 3.1. We can confirm that the simple standard is better choice than multiple one.

### 5. CONCLUDING REMARKS

The standards affect our modern economic life in various ways. This paper showed that the gains obtained by network effect should be included in ICT industry. The introduction of national welfare concept, especially in the narrow sense makes

clear the possibility of quantitative analysis in the simple and multiple standard as well as its comparison. It also showed that the economic gains in a single standard is greater than that in multiple standards. It is also applied to each of all components.

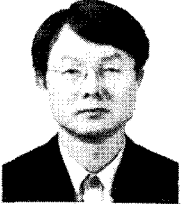
The quantitative analysis must be elaborated by taking account of changing circumstances and remains for further study. For the case of IMT-2000, we should consider an asymmetry between the technological knowledge of each of multiple standards each country has. The policy decision towards single standardization must be made taking account of the uncertainty of technological trajectory, especially in small country. This kind of analyses may be conducted using more sophisticated analysis before applying to policy prescription.

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<sup>11</sup> The methodology and data used can be various, cumbersome and may depend on subjective judgment of analyst as well. So, let me omit them in this paper.

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He received the B.A., M.A in economic science from Korea university, Korea in 1980, 1983 respectively and also received Ph.D. in economic science from Toulouse university, France in 1992. From then to 1997, he worked for ETRI as a researcher. Since then, he has

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