New Methodology of Regulation Policy for Market Dominant Enterprise in Telecommunication Industry

In-Seong Cho[1]

Abstract

In Korea, regulation on market dominant enterprise is being implemented through "the Monopoly Regulation and Fair Trade Act". Criteria for estimation of the dominant operators are estimated for a corporate market share of over 50%, 3 less than the sum of the carrier's market share greater than 75%. However, these uniform standards that specify the market dominant enterprise have disadvantages that do not reflect the market situation. For example, it is difficult to predict accurately whether the dominant company's market share rising or falling, where market share of the future will go. Most importantly, understanding of the interrelationships between businesses more than anything else on this important consideration is not well known. To overcome this limitation by applying the diffusion theory in the biology of the future, this study finds the equilibrium and use it to predict the future market trends. Dominant operators and other companies' market share will be described as each species by analogy. Rather than simply diffusion from one species could be considered competition between different species Lotka-Volterra model is used. So, we can decide the appropriate regulatory timing with considering the trend rather than mechanically applying based on 50% market share. This more realistically reflect the market situation and could lead to more fair market competition will be. To use Lotka-Volterra model, this study identify the necessary prerequisites and then apply at the high-speed internet market. Also the effect of regulation is possible to measure by comparing between equilibrium point of regulation period and non-regulation period. The new methodology which is developed in this study could be used as secondary criteria to decide the market dominant enterprise in various industries.

Keywords: Telecommunication Policy, Market Dominant Enterprise, Anti-Trust Laws, Asymmetric Regulation, Lotka-Volterra Model, High-speed Internet market

1. Introduction

In Korea, the Monopoly Regulation and Fair Trade Act was enacted and implemented to regulate market-dominant enterprises in various markets. Particularly for the telecommunications market, the Telecommunications Business Act is additionally implemented to regulate market dominance. The Monopoly Regulation and Fair Trade Act is designed to prevent abuse of market dominance and concentration of excessive economic power, to regulate wrongful and collusive action and unfair trade, and to promote fair and unconstrained competition as well as creative business activities in an endeavor to protect consumers and promote a balanced growth of national economy.

As mentioned above, there is an additional law designed to regulate the telecommunications market: the Telecommunications Business Act. This Act is

[1] Graduate School of Management of Technology, Korea University, Chang-Eui Hall, Natural Science Campus, Korea University, Anam-dong 5 ga, Seongbuk-gu, Seoul,136-713, Republic of Korea
Email: choinseong@gmail.com

intended to promote adequate operation and efficient management of the telecommunications market and to facilitate the sound development of telecommunications business and user convenience, thus contributing to enhancing public interests. These two laws are different in many aspects. The Monopoly Regulation and Fair Trade Act is a general law controlling unti-competitive activities while the Telecommunications Business Act is more of an industry-specific law applied to limited fields of particular markets. The former focuses on implementing corrective regulatory measures to control the monopolistic activities while the latter put much emphasis on preventative measures such as interactive connection and imposition of obligations on facility provision (Shin, 2006).

Under the Monopoly Regulation and Fair Trade Act, market dominance is determined mainly by market share, which is considered one of the most definite indicators of market dominance (according to Article 4 of the Act). However, in many cases, it is difficult to determine market dominance simply by market share because there are many other factors involved in the market activities. In addition, the different boundaries of related markets and the various degrees of market barriers make it more difficult to determine the level of market dominance (Lee, 2006). In order to look into the level of competition in the telecommunications market, Park et al. (2006) tried to develop appropriate index for evaluating competition in the telecommunications market on the basis of Clark-Sosnick's criteria of market structure, market activities and market performance.

In this research paper, Lotka-Volterra model of biological communities is used to predict the future expansion of competition between the two different species and compare the market share in a state of equilibrium to determine the level of dominance in the market. This new method is expected to serve a pivotal role in determining the selection and lifting of dominant enterprises. For a better understanding of this method, Lotka-Volterra model is applied to analyze the designation and lifting of KT as the dominant service provider in the high-speed internet market in an attempt to see whether it is relevant and applicable to the analysis of the telecommunications market.

Moreover, the analysis of the equilibrium point between the regulated period and the unregulated period can enable us to measure the effects of regulations indirectly. Although the existing researches fell short of analyzing the effects of regulations, some researchers attempted to analyze financial performance of companies (Kim, 2001; Park, 2007) and other researchers used the regression analysis to measure sales performance in order to analyze the effects of market regulations (Park & Seok, 2009). However, most researchers were focused on case studies of enterprises to figure out the problems with the regulations, rather than the effects of regulations (Lee, 2006).

In order for the country's development of science technology which become the competitive edge in the industry, the fair competition among diverse market participants must be guaranteed. If the market is in a state of effective competition, regulations should be lifted. If the market is not in a state of effective competition, however, preemptive regulations should be strengthened to boost competition in the market (Park et al., 2006). A sound and fair competitive market environment is able to be created by preemptively regulating dominant enterprises. In this paper, the new method of integrating the analysis with biology is expected to shed a new light on market competition and policy implementation.

2. Related Researches

2.1 Regulations on Market-Dominant Enterprises

2.1.1 Regulations Introduced under the Monopoly Regulation and Fair Trade Act

The Monopoly Regulation and Fair Trade Act is designed to prevent abuse of market dominance and concentration of excessive economic power, to regulate wrongful and collusive action and unfair trade, and to promote fair and unconstrained competition as well as creative business activities in an endeavor to protect consumers and promote a balanced growth of national

economy (under Article 1 of the Act). According to Paragraph 7, Article 7 of the Monopoly Regulation and Fair Trade Act, market dominant enterprises are defined as "monopolistic or oligopolistic suppliers or consumers in a particular industry that can determine, maintain or change price, quantity, quality and other transaction conditions of products or services". In determining market dominant enterprises, market share, the existence and degree of market barriers and the relative size of competitors in the market are all factored in. In other words, market dominant enterprises are defined as companies that do not accept the given market conditions and have the ability to influence market behaviors, performance and competitive conditions (Kwon, 2005).

Under the Monopoly Regulation and Fair Trade Act, the Fair Trade Commission imposes obligations on monopolistic or oligopolistic enterprises to comply with regulations for products or services that are traded in a monopolistic market so as to facilitate fair competition in the market (According to Paragraph 1, Article 3 of the Act) and suggests opinions on how to boost competition and improve market structure to the heads of relevant administrative agencies if necessary (According to Paragraph 2, Article 3 of the Act) while having the right to call for the submission of enterprise documents to be investigated and disclosed (According to Paragraph 3, Article 3 of the Act). In Article 4 of the Act, Paragraph 1 and Paragraph 2 define market dominant enterprises as companies that have market share of more than 50% and three or fewer companies that have the total market share of over 75%. Anti-competitive activities of those monopolistic or oligopolistic enterprises are subject to regulations in accordance with Paragraph 2, Article 3 of the Act since only monopolistic or oligopolistic enterprises in the market are capable of abusing market dominance. Meanwhile, the Paragraph on estimation of market dominance is introduced to complement intrinsic limitations of determining market dominant enterprises - the main targets of the regulations – by using the market share as the sole criterion to assess market power (Lee, 2011).

2.1.2 Regulations Introduced under the Telecommunications Business Act

The Telecommunications Business Act is intended to promote the reliable operation of telecommunications business and efficient management of telecommunications, facilitate a sound development of telecommunications business and boost user convenience, thus contributing to public interests(According to Article 1 of the Act). Under the Act, the term 'market dominant enterprises' is not explicitly adopted to describe monopolistic entities but asymmetric regulations –such as price cuts, facility provision, interactive connection, the joint use of facilities, information provision and authorization of terms - are applied to key telecommunications service providers that meet certain legal criteria.

According to Article 34 of the Telecommunications Business Act, the Fair Trade Commission should strive to create an efficient competitive system and fair competitive environment in the telecommunications industry. In the following Articles of the Act, it is stated that key telecommunications service providers are obliged to provide telecommunications facilities interactive connection, guarantee the joint use of facilities and information sharing and authorization of terms. To elaborate further, when key telecommunications service providers receive requests from other telecommunications service providers on wholesale provision of telecommunications services (Article 38), interactive connection (Article 39), the joint use of telecommunications facilities (Article 41) and on information provision (Article 42), they are obliged to sign agreementsand report those agreements to the Fair Trade Commission. Under the Act, key telecommunications service providers are defined as 1) key telecommunications business operators that have essential facilities required to provide telecommunications services, 2) key telecommunications business operators and facility management agencies that meet the criteria of business size and market share prescribed under the Presidential Decree. 2) are stated in the enforcement ordinance of the Telecommunications Business Act. "Key telecommunications service providers prescribed under

the Presidential Decree" refer to telecommunications business operators who have the market share of 50% and over in terms of the gross sales in the previous year, which are the requirements per each service sector established by the Fair Trade Commission (According to Article 39 of the Act).

2.1.3 Definition of Market-Dominant Enterprises

The regulations introduced under the Telecommunications Business Act are basically asymmetric regulations and thus are inadequate as a regulation model. In addition, there are no stipulated definitions of market-dominant enterprises under the Act. There are only regulations on dominant telecommunications business operators who have the market share of 50% and over in terms of the gross sales in the previous year, which are the requirements per each service sector established by the Fair Trade Commission. Those regulations include requirements on interactive connection, facility provision and on authorization of terms. In other words, asymmetric regulations are discriminately enforced against market dominant enterprises, which are designated based only on their market size and market share, although there are no stipulated definitions of market-dominant enterprises under the Act (Shin, 2006).

It is too simplistic to define market dominant enterprises based merely on market share as in the Monopoly Regulation and Fair Trade Actand the Telecommunications Business Act, thus failing to reflect various market conditions. Moreover, there could possibly be fairness issues because external political factors and stakeholders are able to exert their influence on designation of market dominant enterprises under the current circumstances. There is always room for subjective factors to play a role in selection of market dominant service providers although it is stipulated that market dominant enterprises are selected based on not just market share but also other market conditions.

In determining the degree of market dominance, market share, market barriers, regulations against competitive service providers should all be considered. When the market share of enterprises reaches a certain criterion, those enterprises are designated as market dominant entities under the current Act. Nonetheless, it is very difficult to define 'relevant markets', which need to be clearly defined in order to calculate the market share of enterprises and could become a central issue in heated legal disputes. Determining the degree of market barriers and other market factors is also very difficult in the process of designating enterprises as market dominant entities (Lee, 2006). The standards and index on market competition have been established mainly in advanced countries. The EU and OECD proclaimed index schemes and subsequently the US, Australia and other advanced countries began to modify their rather basic index focusing mainly on market share to systematically reflect the market structure (Park et al., 2006).

2.2 Diffusion Theory

When enterprises are liken to species in biology, various biology theories can be applied to enterprises. In particular, when the change in the market share of enterprises is likened to the diffusion of species, diverse correlations between entities in growth can be identified and applied to the actual industry to acquire a new perspective from which to view and better understand the industry.

2.2.1 Logistic Model

Based on the assumption that the number of species is the function on time (t), the growth speed (dN/dt) is proportional to the current size of group (N(t)) under the exponential growth. However, the number of real species cannot multiply exponentially because the environment is getting worse for each of the species and habitats and resources required for growth and reproduction become scarce, thus brining down the growth rate of species. The Logistic Equation is effective in explaining stoppage of proliferation of high density and is way more realistic (Leewasa, 2011).

$$\frac{dN}{dt} = aN\left(1 - \frac{N}{a/b}\right) = N(a - bN), \quad (a, b > 0) \qquad (1)$$

The formula above (1) is well known as Verhulst-Pearl's Logistic Equation (Pielou, 1969). Under the equation, a/b is called 'carrying capacity', referring to the number of species retained under the environment while a is called 'intrinsic rate of natural increase', which indicates the growth rate when there are sufficient resources in the environment in a low object density. When the system is maintained in a particular state, it is called the state of equilibrium in biology. In the Logistic Equation formula (1), there are two equilibrium points: N=0 and N=a/b. And those two equilibrium points can be obtained from dN/dt=0. At the equilibrium point of N=a/b, the number of species comes back to the equilibrium level even when the number of species gets changed. That is why N=a/b is a stable equilibrium point. On the contrary, at the equilibrium point of N=0, meaning there is no biological species, when species enter into the environment, the number of species grows accordingly and eventually the state gets moved to the other equilibrium point of N=a/b. That is why N=0 is referred to as an unstable equilibrium point. When integral calculus is used to calculate the formula above, the following equation can be obtained (Leewasa, 2011).

$$N_t = \frac{a/b}{1+e^{-1(t-t_0)}} \quad (2)$$

When the formula (2) is presented in the graph, it can be illustrated in the Figure 1. As shown in Figure 1, t is sent to infinity and only a/b is left in the formula above, restricting the number of species to a/b.

2.2.2 Lotka - Volterra Model

Species affecting each other's growth rate, survival rate, birth rate is referred to competition and competition is observed not just between the same species but also between many different species. Lotka-Volterra Model is a model indicating the movements between competitive species (Leewasa, 2011). This model was first established by Lotka in 1925 and has begun to be widely used not just in biology but also in many other researches on analysis of diffusion paths for competitive technologies and products. Particularly, Kim et al. (2006) used Lotka-Volterra Model to predict

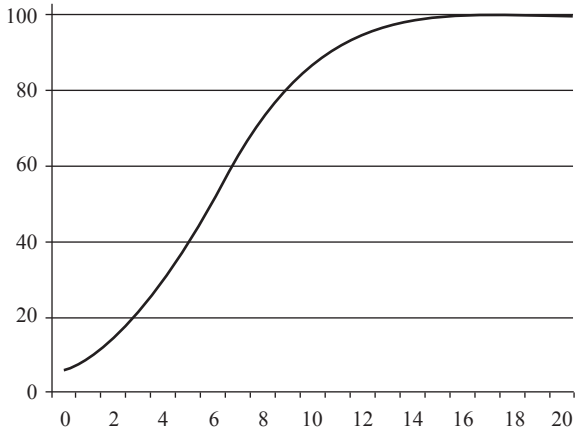


Figure 1 Logistic model's diffusion path (a = 0.5, b = 0.005, N0 = 5, t0 = 5.89).

the diffusion of cellular terminals and PCS in an effort to analyze dynamic competitive analysis. By comparing Lotka-Volterra Model and Logistics Model, the result of this research conducted by Kim et al. showed that Lotka-Volterra Model is more accurate in predicting the diffusion in the competitive environment. Furthermore, Michalakelis et al. (2011) used Lotka-Volterra Model to analyze the competitive relationships between service providers in the high-speed internet market. Lotka-Volterra Model is used not only in analyzing the status of the telecommunications market but also in analyzing competitive relationships in various markets (Modis, 1999). In this paper, Lotka-Volterra Model is used to analyze the competitive relationships between service providers in the high-speed Internet market.

When the number of species is considered N_i, the change in the number of species can be calculated in the following formulas (i = for 1,2).

$$\frac{dN_1}{dt} = N_1(a_1 - b_{11}N_1 - b_{12}N_2) \quad (3)$$

$$\frac{dN_2}{dt} = N_2(a_2 - b_{21}N_1 - b_{22}N_2) \quad (4)$$

In the formulas above, a_1 and b_{11} are the same variables as those in the Logistics Model when there is only one species. a_2 and b_{22} are the same variables when there are just two species. b_{12} refers to a variable when there is the effect of species 2 on the growth of species 1 whereas b_{21} refers to the opposite case.

2.2.3 Correlations

Modis (1999) summarized various correlations between variables using signs b_{12} and b_{21} in formulas (3) and (4) in Table 1 (Modis, 1999).

2.2.4 Equilibrium Analysis

By analyzingthe equilibrium in the formula (3) and (4), we can see where the diffusion between the two different species is headed for. Lotka-Volterra Model comprised of formula (3) and (4) is a simultaneous differential equation and means that there is no change in the number of the two species over time. For that, the following conditions must be satisfied.

$$\frac{dN_1}{dt} = 0 \text{ and } \frac{dN_2}{dt} = 0 \quad (5)$$

The following equation can be obtained from the formula (5) when calculated together with the formula (3) and (4).

$$N_1 = \frac{a_1 - b_{12}N_2}{b_{11}} \text{ and } N_2 = \frac{a_2 - b_{21}N_1}{b_{22}} \quad (6)$$

There are four equilibrium statuses between the two species in a competitive relationship as in Figure 2. (a) means that the first species defeats the second species and eventually survives and thus there exists an unstable equilibrium point for environmental capacity between 0 point and N_2, which is unrealistic. A stable equilibrium point N_1's environmental capacity is eventually converged. Unlike (a), (b) in Figure 2 collects N_2's environmental capacity. In Figure 2, there is a stable equilibrium point within the first quadrant and thus the two species can survive in an equilibrium state. Lastly, (d) in Figure 2 can result in the tipping effect since there exists an unstable equilibrium point within the first quadrant (Leewasa, 2011; Pielou, 1969).

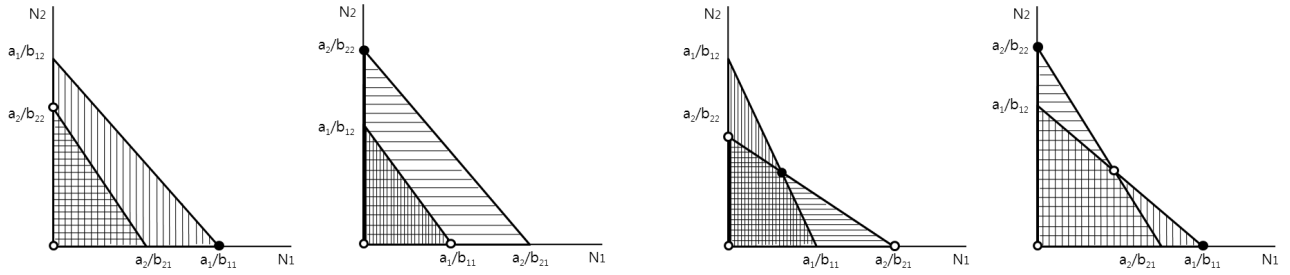
There are some prerequisites that must be fulfilled in order to utilize Lotka-Volterra Model. First, competitive species should compete within a confined space with the same amount of resources. Second, the competitive relationship should continue for a certain period of time. Then, it should be clearly recognized that all the factors affecting the diffusion of species are well reflected based on systematic and strategic decisions (e.g. advertisement, pricing policy, service quality) in order to utilize Lotka-Volterra Model for industry analysis. Plus, it is assumed that government regulations and all the other external environmental elements are included in the Lotka-Volterra Model. Because of the above-mentioned prerequisites, Lotka-Volterra Model can only be applied to industries with significant size (Michalakeliset al., 2011).

2.2.5 Discrete Model

In the previous chapters, we have looked into the time-series Lotka-Volterra Model. However, there is need to convert this model into a discrete model so that it can be utilized to analyze the actual industry environment. Leslie (1957) proved that the model can be turned into a discrete form.

Table 1 Correlation type between species

b12	b21	Competitive Relation Type	Description
+	+	Pure competition	A species is hampered by other species.
-	+	Predator-prey	A species falls prey to a predator species.
-	-	Mutualism	The two different species coexist in a symbiotic relationship.
-	0	Commensalism	A species benefits from the other species; yet the latter species receive no effects from the former species.
+	0	Amensalism	A species takes damage from the other species; yet the latter species receive no effects from the former species.
0	0	Neutralism	There are no correlations between the two different species.



(a) The first species definitely survives

(b) The second species definitely survives.

(c) The two different species coexist in a stable state.

(d) A species dominates the other species according to the initial values.

Figure 2 Four types of equilibrium states

$$N_1(t+1) = \frac{\lambda_1 N_1(t)}{1+\alpha_1 N_1(t)+\lambda_1 N_2(t)} \quad (7)$$

$$N_2(t+1) = \frac{\lambda_2 N_2(t)}{1+\alpha_2 N_2(t)+\lambda_2 N_1(t)} \quad (8)$$

Applying the following correlation formula, the formula (7) and (8) can be turned into the formula (3) and (4).

$$\lambda_1 = e^{a_1},$$
$$\alpha_1 = \frac{b_{11}(e^{a_1}-1)}{a_1}, \quad (9)$$
$$\gamma_1 = \frac{b_{12}(e^{a_1}-1)}{a_1}$$

In order to estimate parameters in the above formula (7) and (8), SPSS, a social scientific statistical package, is used to conduct the regression analysis.

3. Application to Practice

3.1 Regulations Imposed on Market-Dominant Enterprises in the High-Speed Internet Market

3.1.1 Overview of the High-Speed Internet Market

As of late 2010, the household penetration rate of the high-speed internet reached as high as 98.6%. Since Korea Telecom was privatized into KT in May 2002, it has been exerting significant clout in the market as a dominant enterprise.

The Korean high-speed internet market during the period from 2003 to Nov. 2011 can be divided into the two major periods. The periods are divided based on the fluctuating period, from Jan. to Jun. 2006 (Figure 3 & 4). This six months period is a period when many companies were involved in merger and acquisition transactions.

The reason we divide the overall period into the two major periods is that there must be constant relationships between the two different species in order to utilize Lotka-Volterra Model. KT is designated as the first species and other companies are designated as the second species since KT has a dominant market share before applying Lotka-Volterra Model for analysis.

3.1.2 Background of the Designation of KT as A Market-Dominant Enterprise

As KT was included in the list of 'target for authorization of terms' on Jun. 28, 2005, it was officially designated by the Ministry of Information and Communication as a 'market-dominant enterprise' in the high-speed internet market. That means when KT wants to change terms or modify prices, it has to obtain authorization of terms or price changes from the Korea Communications Commission and is subject to strong government regulations and monitoring - such as price cuts and the upward adjustment of the penalty amount. KT has been regulated as a market-dominant enterprise until Dec. 2009.

However, there are no definite standards on the timing of regulations and enforced regulations might be anti-competitive. In this paper, Lotka-Volterra Model is used to represent the competition between the two

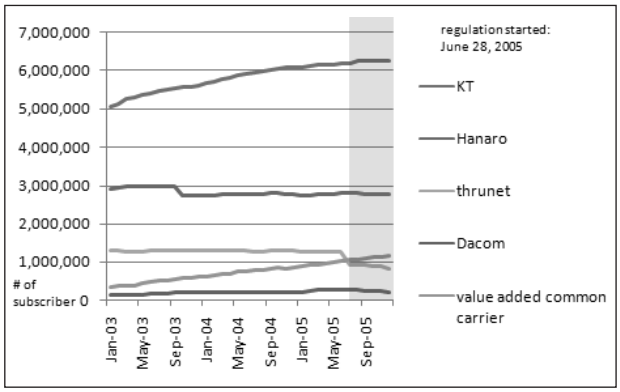


Figure 3 Change in the high-speed internet penetration rate during period A (Jan. 2003 - Dec. 2005)

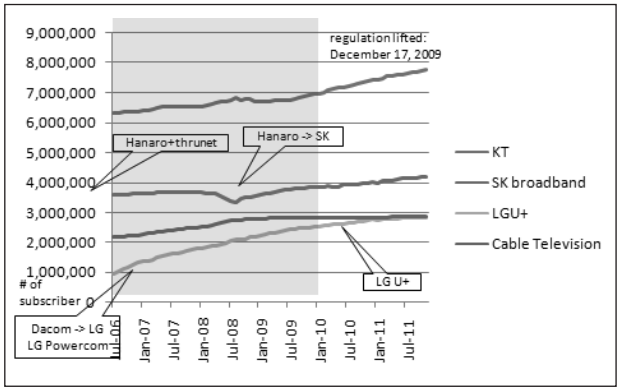


Figure 4 Change in the high-speed internet penetration rate during period B (Jul. 2006 - Nov. 2011)

different species and to predict the market share and diffusion paths at the equilibrium point in the coming years, thereby determining the timing of imposing regulations in a new approach.

3.2. Designation and Lifting of Market-Dominant Enterprises

3.2.1 Analysis of the Designation of KT as A Market-Dominant Enterprise

KT has been subject to various regulations since it was privatized in 2002. In 2004, it was included in the list of key telecommunications service providers. KT fulfilled the selection criteria on market-dominant enterprises by Jun. 2005 and thus it has begun to be regulated as market-dominant enterprises due to the strong demand of other companies in the market. However, using the market share as the sole criterion in determining market-dominant enterprises might fail to reflect the market circumstances in an accurate manner, which means failure to consider the direction of competition in market share between KT and other companies in the market. What it also means failure to reflect the increase and decrease rate of market share and the competitive relationships between companies.

In order to overcome such limitations, this research likens KT to the first species and likens the sum of other companies to the second species to analyze the competition for survival using Lotka-Volterra Model. To examine the adequacy of designation as market-dominant service providers, the statistical data on monthly change in market share during the period from Jan. 2003 to Dec. 2004 is used to estimate Lotka-Volterra Model equation.

$$\frac{dN_{kt}}{dt} = N_{kt}(2.1247734 - 0.0227726N_{kt} - 0.0196018N_{etc}) \quad (R^2 = 0.966) \tag{10}$$

$$\frac{dN_{etc}}{dt} = N_{etc}(2.116135 - 0.0226139N_{etc} - 0.0197146N_{kt}) \quad (R^2 = 0.966) \tag{11}$$

When b_{12} and b_{21}in the formula (3) and (4) are checked in the formula (10) and (11), they fall into the category of 'pure competition' in Table 1. That is, KT and other companies are in a competitive relationship to obtain significant market share. In Figure 5, formula (10) and (11) are used to compare the prediction data and the actual data during the

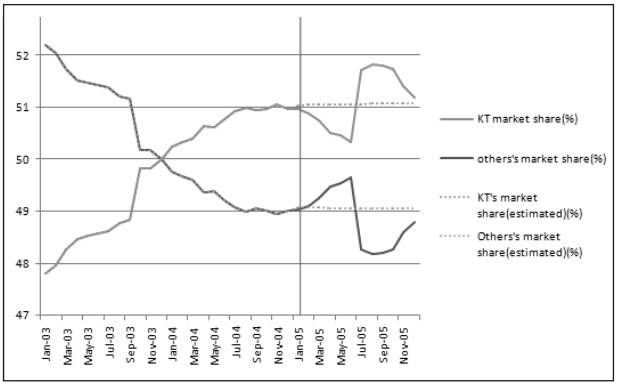


Figure 5 Comparison of the prediction data and the actual data for period A

period until Dec. 2005.

At the equilibrium point in the formula (10) and (11), KT has the market share of approximately 51.11% while others are estimated to have 49.02% (Table 2).

The market share of KT was 50.98% in Dec. 2004 and, under such correlative relationship, it could be predicted that the market share of KT was on the rise. It is understood that, reflecting such trends in the market, preemptive regulatory measures were able to be taken against KT in Jan. 2005 even before it was designated as a market-dominant enterprise in Jun. 2005. The period prior to Jun. 2005, when the actual regulations began to be imposed, was designated as the arbitrary period (here it is confined to the period until Dec. 2004) and the data for the previous period was used to analyze the correlation between different species and to figure out the results of diffusion, thus making it possible to introduce preemptive regulatory measures in the market.

Table 2 Equilibrium point in Lotka-Volterra Model based on the market share during Dec 2004 and the data from Jan 2003 to Dec. 2004

Estimated Market Share at the Equilibrium Point (%)	Actual Market Share in Dec 2004	Estimated Equilibrium Point based on the Data from 2003 to 2004 (R2=0.966)
KT	50.98	51.11
Others	47.828	49.02

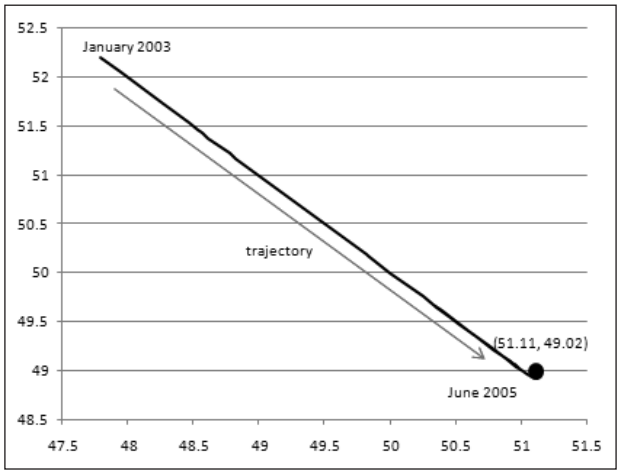


Figure 6 Trends of change in the equilibrium point (obtained from Table 1) and the actual market share during the period A

3.2.2 Analysis of Lifting of KT as A Market-Dominant Enterprise

Right before the high-speed internet period B, Thrunet was merged into Hanaro Communications, which was again merged into SK Broadband. In the meantime, Powercom became a subsidiary of LG while value added common carriers were recognized as part of composite cable broadcasting in statistical data. After undergoing such changes in the market, the four major large service providers eventually survived and began to coexist and compete in the market since Jul. 2006. Since then, the high-speed internet market has shown a stable trend in the change of market share.

The designation of KT as a market-dominant enterprise was lifted in Dec. 2009. In this research paper, therefore, lifting of the designation of KT is to be substantiated using Lotka-Volterra Model based on the data during the period from Jul. 2006 to Dec. 2007. The prediction of the future until Nov. 2011 is shown in the formula (12) and (13).

$$\frac{dN_{kt}}{dt} = N_{kt}(1.043 - 0.001N_{kt} - 3.224E^{-8}N_{etc}) \quad (R^2 = 0.947) \tag{12}$$

$$\frac{dN_{etc}}{dt} = N_{etc}(2.61 - 0.017N_{etc} - 0.015N_{kt}) \quad (R^2 = 0.947) \tag{13}$$

When b_{12} and b_{21} in the formula (3) and (4) are checked in the formula (12) and (13), they fall into the category of 'pure competition' in Table 1. It means that KT and other companies are in a competitive relationship to obtain significant market share. The comparison of the changing in market share shows there is no big difference between the two different species in terms of the market share or correlations Figure 7.

The equilibrium point in the estimated equation indicates the market share of KT is 43.00% while others account for 56.77% (Table 3).

The market share of KT was 44.29% in Dec. 2007 and the correlations between the two different species based on the existing data showed that KT's market

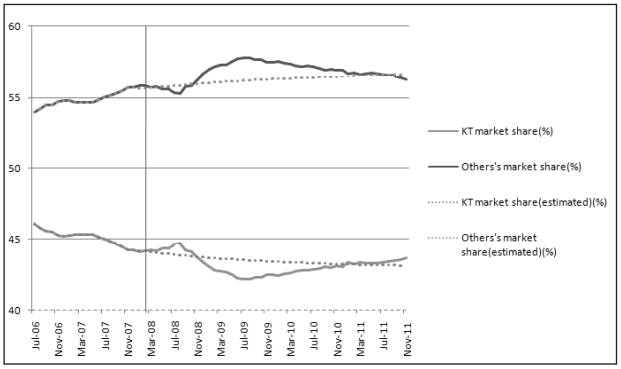


Figure 7 Comparison of the prediction data and the actual data for the period B

Table 3 Equilibrium point in Lotka-Volterra Model based on the market share during Dec. 2004 and the Data from Jan.2003 to Dec.2004

Estimated Market Share at the Equilibrium Point (%)	Estimation based on the Data from Jul. 2006 to Dec. 2007 (R2=0.980)	Actual Market Share in Dec. 2007
KT	43.00	44.29
Others	56.77	55.71

share is expected to decrease continuously. That is why the designation of KT as a market-dominant enterprise was lifted in Jul. 2008, not in Dec. 2009, and the regulations were no longer enforced against KT.

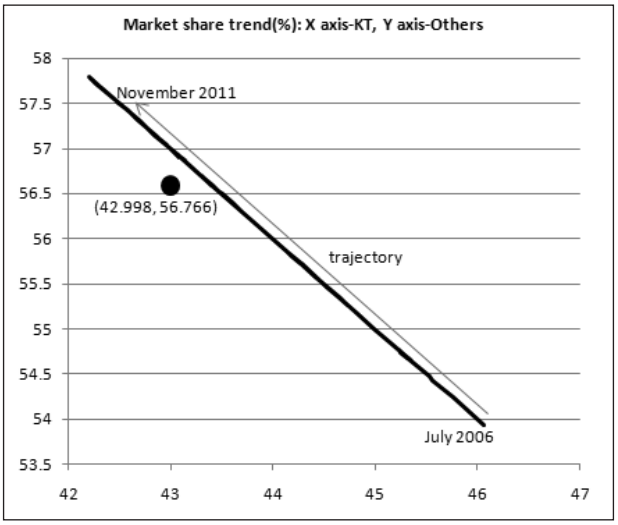


Figure 8 Trends of change in the equilibrium point (obtained from Table 3) and the actual market share during the period B

As in the above example, Lotka-Volterra Model can be used to determine the designation and lifting of regulations in order to predict changes in the market and to induce the fair market competition.

3.2.3 The Effects of Regulations Enforced Against KT as A Market-Dominant Enterprise

In order to measure the effects of designation of KT as a market-dominant enterprise and regulations enforced against KT, the period is divided into the two different periods. In the period A, the comparison of the data of the period from Jan. 2003 to Jun. 2005 (when regulations were uninitiated) and the data of the period from Jun. 2005 to Dec. 2005 shows the following results as in Table 2.

As illustrated in Table 4, the market share of KT has slightly dropped in a state of equilibrium, which could be attributable to regulations. Thus, it can be stated that regulations had been effective. KT's market share was 52.29% and 51.11% in a state of equilibrium based on the data before regulations and the data of six months before regulations in 3.2.1 respectively, indicating that the equilibrium point itself is moving into the direction of the increasing market share growth. Therefore, it can be assumed that more swift measures were able to be taken.

The equilibrium point can be obtained as in Table 5 when estimation is made based on the data of the period from Jul. 2006 to Dec. 2009 in the period B and the following period until Nov. 2011.

As shown in Table 5, KT's market share in a state of equilibrium has increased slightly, indicating the effectiveness of regulations. In the same manner, KT's market share was 38.61% in a state of equilibrium based on the data of the period right before

Table 4 Estimation of the equilibrium point before and after regulation during the period

Estimated Market Share at the Equilibrium Point (%)	Before Regulation (R2=0.965)	After Regulation (R2=0.709)
KT	52.29	51.35
Others	47.83	49.44

Table 5 Estimation of the equilibrium point while regulations are retained and after regulations are lifted during the period B

Estimated Market Share at the Equilibrium Point (%)	Regulations Retained (R2=0.980)	Regulations Lifted (R2=0.937)
KT	38.61	44.00
Others	61.78	54.82

regulations are lifted while it accounted for 43% based on the data of the two years before regulations are lifted in 3.2.2, indicating that the equilibrium point itself is moving into the direction of the decreasing market share of KT. Therefore, it can be assumed that more swift measures were able to be taken.

The period is divided into the regulated period and the unregulated period because we wanted to apply Lotka-Volterra Model and made the assumption that regulations affect the correlations between the two different species. It was not easy to measure the effects of regulations. In this paper, however, the period is divided into the regulated period and the unregulated period and the equilibrium point is estimated so it was possible to indirectly measure the changing competitive relationship between market-dominant enterprises and other companies in the market as well as the effects of regulations enforced against market-dominant enterprises.

3.3 A New Methodology for Designating and Lifting Market-Dominant Enterprises

Lotka-Volterra Model has two clear advantages in analyzing the effects of regulations enforced against market-dominant enterprises. By predicting the future diffusion in a competitive environment and calculating the equilibrium point in the future competitive relationship, preemptive regulatory measures were able to be taken to prevent market dominance. Rather than applying mechanical criteria such as market share, more reasonable criteria were able to be presented thanks to Lotka-Volterra Model. Moreover, Lotka-Volterra Model can be useful in presenting objective indicators compared with the current method, which can be heavily influenced by external political factors or stakeholders. Second, it measures the changes in competitive relationships in order to have an objective measure of the regulatory effects. The existing studies had their limitations in that they were focused on the regression analysis, which explains the relationship between corporate accounting performance such as sales or connection charge and actual regulations, or the qualitative effects. Furthermore, most studies fell short of analyzing the effects of regulations and just presented intrinsic problems with regulations or introduced methodologies on how to apply regulations. By contrary, this paper compared the equilibrium points in a competitive relationship to confirm the difference between the regulated and the unregulated period, thus presenting concrete figures on the regulatory effects.

The research method used in this paper might be able to be utilized as a supplementary material in addition to the current system and might enable us to take preemptive regulatory measures depending on the circumstances of the market. The research method introduced in this paper can be applied not just to the analysis of the high-speed internet market but also to the analysis of many different markets. The high-speed internet market is showing the shape of (c) out of the four categories in Figure 2, where an intuitive and stable equilibrium point exists. If the equilibrium point in other markets is more like (a) or (b) in Figure 2, the government should immediately intervene in the market and make efforts to change the relationship itself. If the equilibrium point in other markets is like (d), we first need to check where an unstable equilibrium point is and to make sure that there is no tipping effect taking place in the market while constantly inducing the relationship in the market into the direction of a stable equilibrium point.

4. Conclusions

We have looked into the estimation criteria of designating and lifting market-dominant enterprises. In doing so, Lotka-Volterra Model was introduced to resolve various problems in the process of estimating

the correlations between market-dominant enterprises and other companies and predicting the changing trends in the market share. The examples illustrated in this paper showed that preemptive regulatory measures can be adopted and enforced by checking the market share in an equilibrium state.

It is highly difficult to define the market and assess market barriers and other elements in calculating market share. Therefore, designating market-dominant enterprises for the purpose of enforcing regulations is very difficult and subject to external influences. In this paper, the competition theory in biology was introduced to determine whether coexistence between companies is possible, to predict the direction of competition between companies and to suggest the standards of designating market-dominant enterprises. This process enables us to take preemptive regulatory measures against market-dominant enterprises, thus contributing to the establishment of sound competition relationship. By doing so, we will be able to strengthen competition between companies and to promote fair competition, thus maximizing consumer welfare.

Also, the analysis of the equilibrium point between the regulated period and non-regulated period made it possible to indirectly measure the effectiveness of regulations. The existing reference studies simply pointed out the direction of regulations or problems with the regulations and failed to systematically analyzing the effects of regulations in various aspects. On the contrary, this paper presents the definite figures to show the effects of regulations and thus complements the weakness of the existing qualitative research studies.

This paper divided the high-speed internet market into the two different periods in an endeavor to ensure stability in the competitive environment and looked into the starting and finishing period of regulations. The analysis of the high-speed internet market based on a new methodology highlighted that the designation of KT as a market-dominant enterprise should have been made and lifted way earlier.

In order to apply the new methodology introduced in this paper to other markets, we first need to check the prerequisites to see whether Lotka-Volterra Model can be applied to those markets and to build a definite agreement on the time period of using the existing data. Nonetheless, the new methodology in this paper has clear advantages to be utilized as a supplementary policy tool in addition to the existing basic laws. Therefore, it is our hope that much more active discussions can be made on this methodology.

References

Fair Trade Commission. (2012). The Monopoly Regulation and Fair Trade Act. Seoul : Fair Trade Commission. Retrieved from http://www.law.go.kr/lsInfoP.do?lsiSeq=124077&efYd=20120530#0000

Kim, B. R. (2001). The research on the government's regulatory targets and price control in the telecommunications market. The Research on Industrial Economy, 14(6), 47-59.

Kim, J., Lee, D. J., & Ahn, J. (2006). A dynamic competition analysis on the Korean mobile phone market using competitive diffusion model. Computers & Industrial Engineering, 51, 174-182.

Korea Communications Commission. (2012). The Telecommunications Business Act. Seoul : Fair Trade Commission. Retrieved from http://www.law.go.kr/lsInfoP.do?lsiSeq=113195&efYd=20111120#0000

Korea Internet & Security Agency. (2012). Internet Statistics Search System - the number of high-speed internet subscribers. Retrieved from http://isis.kisa.or.kr/sub01/?pageId=010500

Kwon, O. S. (2005). Economic law. Seoul: Beopmunsa.

Kwon, O. S. (2005). Regulations on monopoly in the telecommunications market. Seoul National University's Research on Law, 46(4), 197-219.

Lee, H. S. (2011). Regulations on monopoly and oligopoly in the Market - the Discussion and Implications of the EU Competition Law. The Research on Regulations, 52(1), 145-170.

Lee H. Y. (2006). Major issues and challenges in regulations of market-dominant enterprises under the monopoly regulation and Fair Trade Act. Justice, 104, 75-99.

Leewasa, Y. (2011). Introduction to mathematical biology. Pusan Pusan National University Publishing Department.

Lee Worden. (2003). Evolution, constraint, cooperation and community structures simple models (Doctoral dissertation).

Princeton University.

Leslie, P. H. (1957). A stochastic model for studying the properties of certain biological systems by numerical methods. Biometrika, 45, 16-31.

Lotka, A. J. (1925). Elements of physical biology. Baltimore, MD: Williams and Wilkins.

Michalakelis, C., Sphicopoulos, T., & Varoutas, D. (2011). Modeling competition in the telecommunications market based on concepts of population biology. IEEE Trans. SMC-C, 41(2), 200-210.

Modis, T. (1999). Technological forecasting at the stock market. Technological Forecasting and Social Change, 62, 173-202.

Park, C. H., & Seok, W. H. (2009). The analysis on the regulatory performance in the telecommunications market: Focused on the sales figures. The Research on Internet E-Commerce, 9(2), 439-460.

Park, J. H. (2007). Measures to establish the efficient verification system for price control in the telecommunications market. The Research on Management Accounts, 7(1), 71-96.

Park, M. H., Oh, W. G., & Lee, C. S. (2006). The development and application of competition indicators in the telecommunications market. Technology Innovation Association Journal, 9(4), 769-811.

Pielou, E. C. (1969). An Introduction to Mathematical Ecology. New York: John Wiley & Sons, Inc.

Shin, H. Y. (2006). The regulations enforced on dominant carriers in the telecommunications market - focused on the 2003 EU regulatory schemes. The Research on Regulations, 16(4), 37-64.