

Future Prospects of the Demand for Telephone Subscription and the Telephone Subscription Supply Policy

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A. Introduction

The importance of communications as a social infrastructure and as a fundamental base of socio-economics has been growing in Korea. As a result, Korea has been rapidly expanding the supply and distribution of telephones. Yet, in comparison to other developed countries, the Korean telephone industry is still in the growing stages. Therefore, setting up a proper course for future development is necessary.

In previous studies, the econometric model was used to forecast the demand for telephone subscriptions. In order for the econometric model to be possible and to provide valid estimates, diverse explanatory variables must exist as well as a sufficient amount of statistical data on the variables that result from time lapse accumulation. Furthermore, the relationship between the explanatory (independent) variables and the dependent variables must be stable. Herein lie the basic difficulties in forecasting the demand for telephone subscriptions in Korea. There is a lack of data as well as an unstable relationship between the demand for telephones and the explanatory variables. This instability is a result of Korea being in a rapid growth stage. As a consequence, it is almost impossible to apply the econometric model to the Korean case and obtain a reliable estimate.

This study avoids the econometric model and suggests an alternative growth model for forecasting the demand for phones in Korea. The growth model results from an analysis of the growth pattern of developed countries.

B. Study on the Possession of Telephones and the Demand for Telephones in the Developed Countries.

1. Income and propensity to possess a telephone.

A nation's per capita income is the most important explanatory variable in

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determining the propensity to possess a telephone. Diagram 1, which is based on the 1981 data of 108 countries, shows an inverse relationship between a nation's per capita income and the number of people per one telephone subscription. Converting this outcome into a log function and utilizing regression yields the following equation:

$$\ln (\text{number of people/number of telephone subscriptions}) =$$

$$12.6 - 1.22 \ln (\text{per capita GNP}).$$

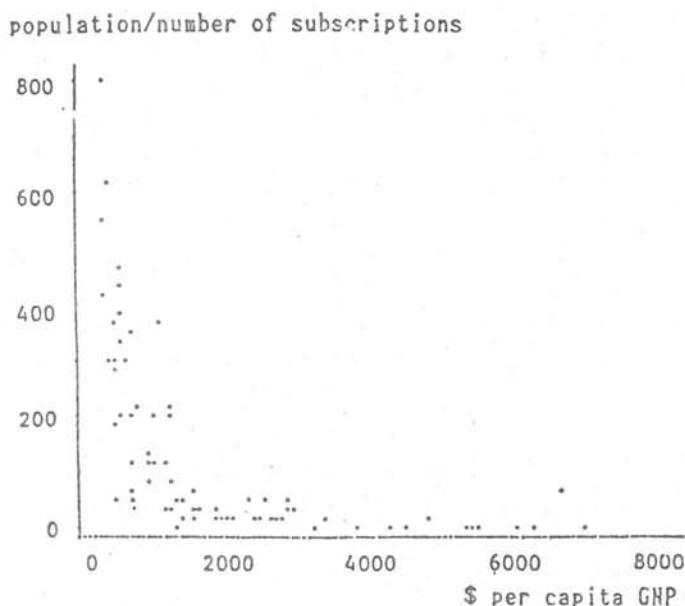
$$(30.8) \quad (-22.6)$$

$$R^2 = 0.83$$

$$(\quad) \quad t \text{ statistic}$$

The above method is similar to the method used in the author's previous study on passenger cars, which examined the relationship between income and the number of people per one passenger car in 126 countries. In both cases, the fact that the absolute values of the estimate coefficients for the explanatory variables are bigger than 1, showed the propensity of possessing a telephone as well as a passenger car to be elastic to income⁽¹⁾. The explanatory

Diagram 1: Income and the Number of People per Telephone Subscription in 108 countries (1981)



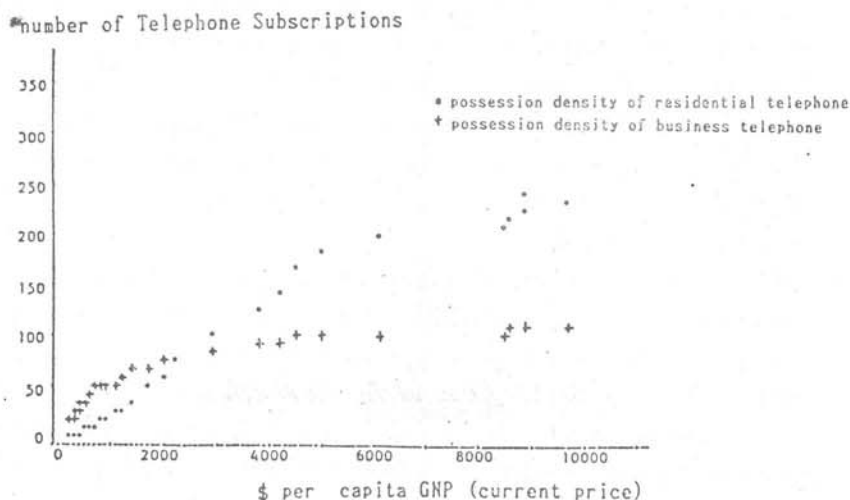
Data Source: Yearbook of Common Carrier Telecommunication Statistics, ITU
Major Foreign Economic Index, Economic Planning Board, 1984

variable, per capita GNP, ranges over a wide spectrum in both cases. The high R^2 value of over 0.8 demonstrates that income is an appropriate variable for determining the demand for goods such as the telephone and the passenger car.

2. Case study of Japan

In Japan, the relationship between the possession density of residential telephone subscriptions (number of residential telephone subscriptions (TS) per 1000 persons) and \$ per capita GNP (current prices) exhibits a log curve form. The possession density increases rapidly up to the level of 200 TS per 1000 persons, near the level of \$5,000 per capita GNP. After this level, the curve displays a stable tendency to increase and converge to a level of 250 TS/1000 persons.

Diagram 2: Comparison of Possession Densities of Residential and Business Telephone Subscriptions(1953-1983)



Data source: Report on Telegraph and Telephone Business, NTT 1972-1983

- (1) The regression equation for the demand for passenger cars is as follows:

$$\begin{aligned} \ln(\text{number of people/number of passenger cars}) \\ &= 12.3 - 1.18 \ln(\text{per capita GNP in \$}) \\ &\quad (31.3) \quad (-22.2) \\ R^2 &= 0.80 \\ &\quad () \quad t \text{ statistic} \end{aligned}$$

In comparing the equivalence of the two regression coefficient estimates, the null hypothesis that stated their equivalence could not be rejected at the 5% level.

This tendency may be determined by various factors but, in the case of residential TS, the biggest influence seems to originate from the distribution of family members in each household. In 1980, the number of households with more than 4 people constituted 45.3% of all households. Cases where one person alone constituted a family represented 20% of all households, but cases of single person households possessing a TS was relatively smaller. Considering that 4 persons to a household is the standard, the saturation level of the possession density of residential TS of 250 TS/1000 persons is quite reasonable, since one family possesses one TS.

The possession density curve of business TS, similar to that of residential TS, exhibits a steep logistic curve form. The curve displays a sharp increase until income reaches \$3,000 per capita GNP. After this point, the curve flattens out and steadily converges to a level of 120 TS/1,000 persons, near the \$5,000 per capita GNP level.

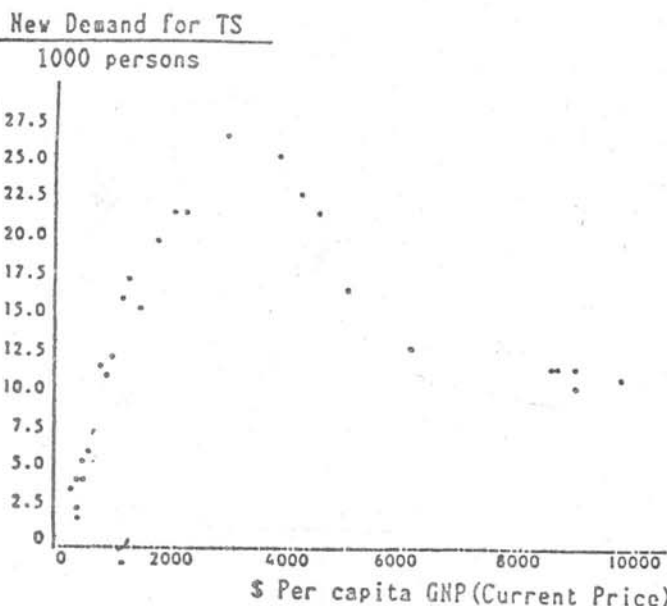
Diagram 2 illustrates the possession density curves of the residential TS and business TS. Here, the two curves can be compared at a glance. The possession density of business TS is higher than that of residential TS until the per capita GNP reaches approximately \$2,200, where the two curves intersect. At this point, the density of business TS begins to maintain a stable trend, converging to a saturation level. The possession density of residential TS, on the other hand, continues to grow to a level that is twice the density level of business TS.

This phenomenon indicates that the business TS is a necessary goods, even at low income levels. For residential TS, however, the TS becomes a necessity only after income has reached a high level. From the point of view of national policy and the telephone supply agency, this means that at low levels of income, the price elasticity of demand for TS is small. Further, as importance is placed on supplying business TS, which is a driving force in economic development, the gradual rise in income leads to a continuous expansion of residential TS.

Diagram 3 shows the density of new demand for TS from 1953 to 1983. The density of demand curve rises rapidly up to the density level of 26 TS/1,000 persons, at which point, income is near the \$3,000 per capita GNP level. Afterwards, the descending trend begins. By 1983, the declining density of demand reaches 10 TS/1,000 persons.

This curve captures a particular trait of the TS demand growth curve

Diagram 3: Density of New Demand for TS in Japan



Data source: Report on Telegraph and Telephone Business, NTT 1972-19

which is different from that of the passenger car demand growth curve. The passenger car demand curve converges to a stable level of demand after the low growth and high growth stages of demand. In contrast, the TS demand curve, after the high growth stage, does not converge to a stable level, but continues to decline. The reason for this distinction lies in the characteristic of passenger cars which maintains a basic level of demand through a continuing substitution demand. Furthermore, since the cost of purchasing and utilizing the telephone, compared to that of the passenger car, is very low, the possession density of telephones increases rapidly, starting from a low level of income.

The next issue is determining at what level the descending TS curve will stabilize and converge. The rate of population increase is gradually slowing down and, consequently, the residential TS have entered the saturation stage where the rate of increase has been slowly dropping. In addition, the rate of possession density growth of business TS has almost reached its limit. Therefore, in the long-run, the new TS demand density curve in Japan should drop below the level 10 TS/1,000 persons. To make an accurate determination, Japan's future industry structure, employment structure, and family structure

must first be researched.

Examining the number of backlogged demand and the number of TS installations per 1,000 persons reveal Japan's TS supply policy. Beginning in the 1950's, Japan largely expanded the volume of supply. However, the sudden increase in demand, near the \$2,000 per capita GNP level, could not be met, forcing the density of backlogged demand to reach its peak. In subsequent periods, the supply surpasses demand. By 1979, in step with the declining TS demand density, the backlogged demand was eliminated. As a result, the number of TS installations in 1980 equals the new demand. Japan's demand history is similar to the situation in Korea, where the demand and supply policy is seeking to expand the supply of telephones by a million circuits every year.

3. Case study of developed nations

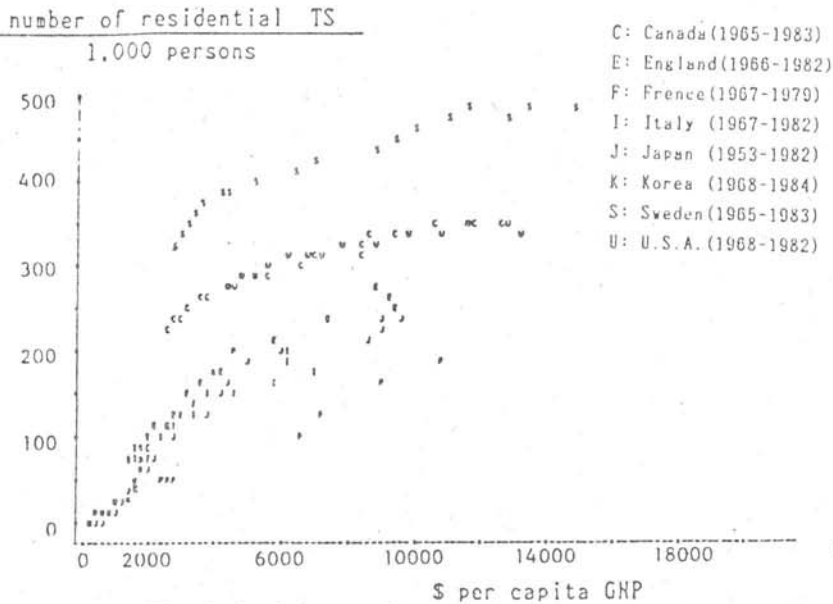
Diagram 4 displays the residential TS density curve of 7 developed countries along with the previously analyzed curve of Japan. Considering that most of the countries have approached the saturation level and that the focus of this study is on long-term forecasting, it is not very important that the lack of sufficient data lead to leaving out the beginning growth stages of several countries.

The object of forecasting the long-term demand for TS lies in estimating the saturation level of the possession density of TS. The saturation level of the possession density of residential TS in the eight developed countries fall into 3 classifications, as shown in list 1. Most of the developed European countries like England, France, Italy, and West Germany as well as Japan fall into one group, classified as the European type. For these countries, the saturation and convergence level is 250 TS/1,000 persons. The U.S and Canada fall into the group classified as the North American type. Their convergence and saturation level is 350 TS/1,000 persons. Sweden whose convergence and saturation level begins at 500 TS/1,000 persons, a level that is twice that of other European countries, is classified separately as the special type.

*[In the case of West Germany, there is no data that has classified the TS into residential and business groups. However, based on material about the total possession density of TS and the dispersion of family members in a household, it can be classified as a European type.]

The way the classification of the saturation levels of the possession density

Diagram 4: Comparison of Possession Density of Residential TS in Korea and in Seven Developed Countries.



Data source: Year book of Common Carrier Telecommunications Statistics. ITU Report on Telegraph and Telephone Business 1077, 1972-1983.

of residential TS fell into three categories is similar to the result of the passenger car study which also revealed three classifications.

The highest level of saturation is 500 cars/1,000 persons, a level that is two times the lowest level of 250 cars/1,000 persons. The middle level of saturation is 350 cars/1,000 persons. The countries that made up each category are different between the car study and the phone study. For passenger cars, the saturation level of the possession density is the highest in the continental countries. This indicates that the convergence level of the

List 1: Classifications of Saturation Levels of Possession Density of Residential TS.

Types	Saturation level	Countries
European	250 TS/1,000 persons	England, France, Italy, West Germany, Japan
North American	350 TS/1,000 persons	U.S.A., Canada
Special	500 TS/1,000 persons	Sweden

density of passenger car possession is closely related to geographical characteristics. However, in the case of TS, the convergence level of the possession density seems more closely related to a combination of various other factors. As previously stated, the most influential factor regarding the level of saturation and convergence of residential TS is the dispersion of household members. Although a lack of sufficient data prevented a uniform analysis, the following conclusions could be drawn regarding household composition and density. The higher the saturation level of the possession density of residential TS, the smaller was the number of members per household. Conversely, the lower the saturation level, the higher was the number of household members. In Sweden, for example, the proportion of households with one or two members is quite large as compared to Japan and Italy, where there are many households with more than four members. This difference in household composition may actually be larger because the for Sweden, whose households are getting smaller by the year, was several years older than the data for Italy and Japan. However, since the distribution of household members is similar in most European countries, a complete explanation is not possible based on only that one variable. Therefore in order to clarify the reasons underlying the 3 different levels of possession densities of TS, various other factors such as culture, society, geography, income distribution, industry structure and employment structure must first be examined. For the purpose of forecasting the future level of TS possession in Korea, a case study of Japan whose society culture and customs are similar to those of Korea will be of much assistance.

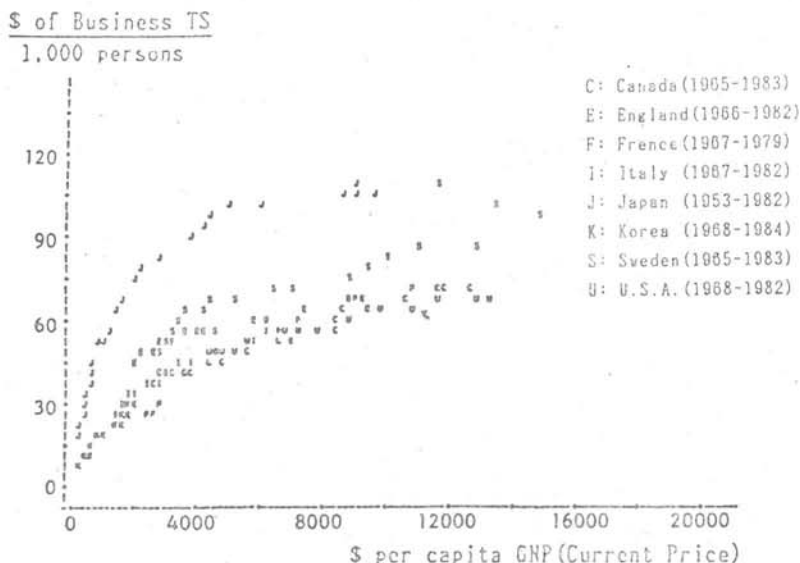
Diagram 5 shows the business TS possession density curves of 8 nations graphed as a function of \$ per capita GNP. As was the case with residential TS, insufficient data prevent a complete illustration of the beginning states of growth. The graph revealed the following information concerning the long-

List 2: Classification of Saturation Levels of Passenger Car Possession

Types	Saturation level	Countries
Penninsula	250 cars/1,000 persons	Japan, England, Italy
Middle	350 cars/1,000 persons	France, West Germany
Continent	500 cars/1,000 persons	U.S.A., Canada

Data Source: "Forecast of Passenger Car Supply and the Appropriateness of Small Passenger Car Production," KDI. Study on Korean Development, 1984, Fall.

Diagram 5: Possession Density of Business TS in Korea and Seven Developed Countries.



Data Source: Yearbook of Common Carrier Telecommunication Statistics, ITU.
Report on Telegraph and Telephone Business, NTT, 1972~1983.

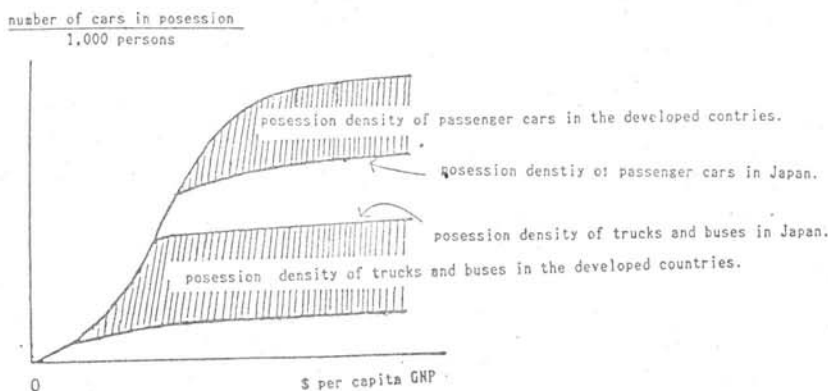
term prospect of TS possession saturation levels.

1) The saturation of level of the possession density of business TS for most of the developed countries is way below that of Japan whose level is 120 TS/1,000 persons. In most of these developed countries, a stabilizing trend first appears at 50 TS/1,000 persons, but the convergence level appears at about 75 TS/1,000 persons.

2) Sweden, which had the highest possession density level for residential TS, slowly surpassed the saturation level of the other developed countries and continues to display an increasing tendency. Although still lower than that of Japan, Sweden's possession density level of business TS is very close to approaching Japan's level. For business TS as well as for residential TS, Sweden shows different characteristics from the typical developed country.

3) In contrast to Japan's density level for residential TS which is one of the lowest among the developed countries, Japan's possession density of business TS is the highest. This situation is similar to the situation illustrated in diagram 6. The diagram shows Japan's possession density of passenger cars to be the lowest among the developed countries while Japan's density of

Diagram 6: Comparison of Japan's Possession Density of Passenger Cars to That of Trucks and Buses.



Data Source: "Forecast of Passenger Car Supply and the Appropriateness of Small Passenger Car Production".
Study on Korean Development, Fall 1984.

possession of non-residential cars, like trucks and buses, proves to be the highest saturation level among the developed countries.

4) For the eight developed countries, the total possession density curve of TS, which is the sum of the business and residential TS curves, looks similar to the possession density curve of residential TS. Therefore, the total possession density curves can be classified into three groups. Although there are slight difference during the early growth stage of TS, most of the European countries and Japan converges to a level below 370 TS/1,000 persons. In comparison, the supply of TS for the U.S. and Canada converges a little above the 400 TS/1,000 level and that of Sweden draws near to a much higher level of 600 TS/1,000 persons. The reason for the similarity between the total TS curves and the residential TS curves is without doubt because the possession densities of residential TS greatly surpass the possession densities of business TS in all the countries.

C. Possession of Telephones and the Long-term Prospect of Demand for Telephones in Korea

Part III forecasts, based on the conclusions obtained in part II, the long-

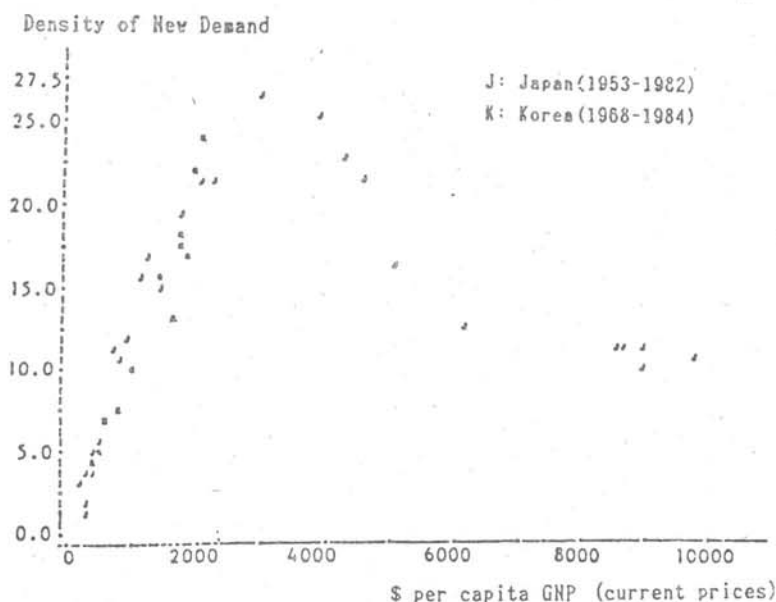
term demand for TS as well as the form which the development of the demand will take.

1. Prospect of TS demand in Korea

Korea's rate of increase in the possession density of residential TS has exhibited a peculiar growth pattern, showing a sudden increase in the recent years. The cause for this phenomenon is the policy of supply expansion which attempted to liquidate, in a short time, all the excess telephones that had accumulated over a long period of time. As a result, the possession density of residential TS is not likely to continue increasing at such a rate.

Examination of Korea's future demand for residential TS also points to a decline in the rate of increase. Diagram 7 compares the Korean and Japanese curves of the density of new demand for TS. The diagram shows that the Korean curve, which is following the Japanese parabola, is drawing near the peak. In 1984, Korea's density of new demand reached 23.63 TS/1,000 persons and the possession density of residential TS reached 108.8 TS/1,000 persons. Korea's present saturation level of residential TS is only 2/5 of

Diagram 7: The Density of New Demand Curves of Korea and Japan.

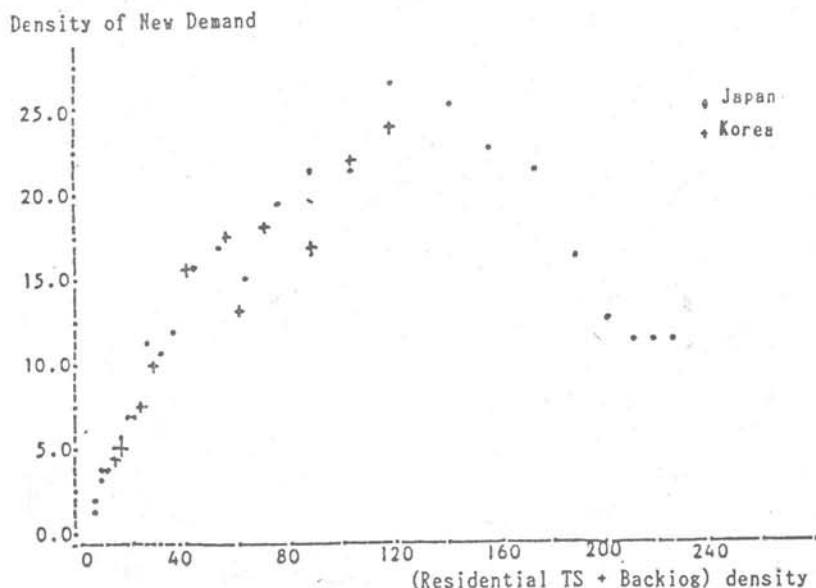


Data Source: Report on Telegraph and Telephone Business, NTT, 1972-1983
Yearbook of Telecommunication Statistics, KTA, 1983, 1984.

Japan's saturation level. As for the density of new demand, Korea has nearly reached Japan's peak level of density of new demand. If Korea's density of new demand curve follows the Japanese pattern, the density of new demand for TS in Korea should reach its peak in two to three years, after which the descending phase can be expected. A point to consider is substituting the horizontal axis with a variable other than income. Even at the same income level, Korea and Japan may differ in their cognizance and valuation of informationalization.

In diagram 8, the \$ per capita income variable, on the horizontal axis, is replaced with the possession density of residential TS. Here again, Korea's density of new demand curve develops in a pattern very similar to Japan. Taking all the facts into account, Korea's density of new demand curve will probably not deviate greatly from the growth pattern of Japan's density of new demand curve. Therefore, it is reasonable to expect that Korea's demand density will reach its peak in two to three years and, then, enter into a

Diagram 8: A Comparison of the Relationship Between the Density of New Demand and the Possession Density of Residential TS (TS+ backlog) in Korea and Japan.



Data Source: Yearbook of Common Carrier Telecommunications Statistics, ITU¹
 Report on Telegraph and Telephone Business, NTT, 1972~1983
 Annual Report on Telecommunications, KTA, 1983, 1984.

descending phase.

The density of residential TS curves of the 7 developed nations further support the above expectation. Korea's possession density of residential TS seems to be following the European growth pattern which has the lowest saturation level, 250 TS/1,000 persons. So far, there are no indications that Korea will break away from the European growth pattern. After a few more years of observation, a more definitive prediction can be made. If, in a few years, the slope of Korea's possession density curve decreases, then it will be more certain that Korea will follow the European growth pattern. A synthesis of diagrams 7, 8, and 4 shows that if Korea follows the European (Japanese) growth pattern, new demand will reach its peak around the mid 1980's and, in the second half of the 1980's when the accumulation of excess supply of telephones is expected to have been liquidated, the slope of the possession density of TS will decline.

Diagram 5 shows the possession densities of business TS of Korea and of seven developed countries. In 1984, the possession density of business TS in Korea was 31.6 TS/1000 persons. The current picture leads to the belief that the future growth pattern for Korea, which is determined by various factors, will be different from the Japanese pattern. Previously, it was seen that Japan, in comparison to other developed countries, exhibited a growth pattern with a much higher saturation level in the case of non-residential telephones and vehicles. When compared, the growth pattern of business TS of Korea appears to be clearly different from that of Japan. Accordingly, it is more reasonable, at the present, to assume that the density of business TS in Korea will follow the growth pattern of the developed countries, with Japan excluded, and converge to a level of 75 TS/1,000 persons.

In general, it seems that possession density of total TS will converge to the level of 330 TS/1,000 persons, with the density of residential TS at the level of 250 TS/1,000 persons and the density of business TS at the level of 75 TS/1,000 persons. It must be kept in mind that if there are significant changes in the function of telephones, people's expectations from telephones, the government's policy towards communications, and progress in the informationalization of society, Korea will deviate from these models of growth and the forecast will have to be revised.

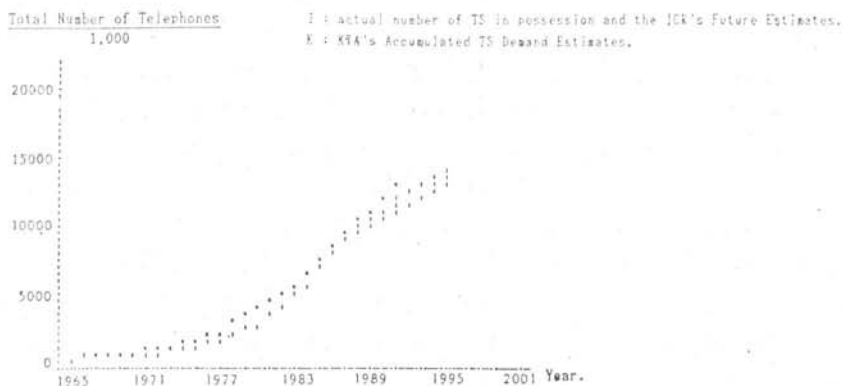
2. Forecast of the future situation in Korea

Among the various diagrams previously presented, the one which is the subject of the most controversy is diagram 8, which illustrates the relationship between the new demand density and the possession density of residential TS in Korea and Japan. By 1984, the Korean new demand density curve had already reached the peak of the Japanese curve. The point of interest lies in whether Korea's 1985 data will continue the present ascending trend, thereby surpassing the Japanese peak, or will break the ascending trend and begin the descending trend. This study is based on the point of view that the ascending force will break down after 1985 and the new demand will remain at the 1984 level. For the policy makers, who believe in the inexhaustibility of the new demand for telephones, this scenario comes as a surprise. However, based on the earlier conclusions of this study, it is reasonable to assume that new demand for TS will begin declining.

Assuming that the density of new demand for TS in Korea for 1985 will shift to a descending trend, this study has applied the Japanese curve of demand density in forecasting Korea's new demand density. In other words, this study has assumed that the new demand for TS in Korea which has, up to now, followed the Korean growth pattern of the possession density of residential TS will, from now on, follow the tendencies exhibited by the Japanese curve of new demand density. Of course, this kind of an assumption, based on various supplementary proofs, is not completely backed up by calculative analysis, but as much as the accumulation of the supply of telephones has been a problem, this approach is useful. A conservative forecast, considering that an excessive investment in telephones from now on could become a problem, is better suited for the times. Using this assumption, this study suggests a potential scenario of the future.

Diagram 9 compares the past values and future estimates of the total number TS in possession as estimated by the Institute for Communications Research (ICR) with those by the Korea Telecommunication Authority (KTA). The curve projected by the ICR lies completely below that projected by the KTA. In the second half of the 1980's, the difference between the two estimates grows extremely large. The curve estimated by the KTA extend, into the future, the slope of the curve of the early 1980's and, therefore, the increase in demand for TS shows no signs of slowing down.

Diagram 9: A Comparison of the Past Values and the ICR's Future Estimates of the Total Number of TS in Possession with the KTA's Accumulated TS Demand Estimates.



Data Source: "Report on Investigation of Telephone Subscriptions," KTA, 1985.6
 Yearbook of Telecommunication Statistics, KTA, 1983, 1984

The reason for the diverging estimates lies in differing points of view and differing points of origination. Whatever be the case, based on the various data and proofs presented in this study, it is not sound to assume that the current demand for telephones will continue its tendency to increase. Concerned business sectors will soon re-examine this subject.

D. Conclusion

Though the case studies of eight developed countries (U.S., Canada, Japan, Sweden, Italy, France, Germany, and England), where the possession of TS has nearly reached the saturation level, this study analyzes the growth patterns for TS and estimates the supply target for TS in Korea. The conclusions of the analysis were often similar to the results obtained in the study "Forecast of Demand and Supply for Passenger Cars and the Propriety of Small Passenger Car Production". Therefore, when necessary to clarify certain points, this study was referred to. [In the complete study, ways of developing the demand, possession, and convergence levels of TS were examined. Based on the analysis, 4 possible supply and demand scenarios were developed.] The condensed results of this study are as follows:

- (1) Because the cost of purchase, installation, usage, and maintenance of

a telephone is much lower than those costs of a passenger car, the critical level of income (the level of income at which demand suddenly and rapidly increases) was lower for telephones than for passenger cars. Further differences in the critical level of income and the rate of growth of telephones in comparison to those of passenger cars arise because an enormous amount of capital is necessary for the supply of TS and the supply is greatly influenced by the policies of the government or the TS supply agency.

(2) Analysis of the growth pattern of the eight developed countries reveal 3 groups of residential TS saturation levels. Sweden is the one-country group with the highest saturation level, the U.S. and Canada made up the group with the median saturation level, and England, France, Italy, West Germany, and Japan composed the third group. In the case of business TS, only Japan showed a particularly high level of possession density. All the other countries were grouped together as the main group.

(3) In order to illuminate Korea's long-term development outlook, the Korean situation was compared with the situation of these developed countries. The comparison revealed that, in the case of residential TS, Korea will develop like the majority of European countries and Japan. Accordingly, the estimated residential TS saturation level of 250 TS/1,000 persons is quite reasonable when considering the number distribution of households. In the case of business phones, Korea's saturation level was estimated to be is TS/1,000 persons, the level reached in the seven developed countries, with the exception of Japan.

(4) Taking into consideration the above supply targets and analyzing the new TS demand curves of Japan and Korea leads to concluding that the possession density of residential TS in Korea, around 1990, will reach 200 TS/1,000 persons. At this level, slope of the possession density curve will begin to flatten out. The great increase in the telephone supply in the most recent years in Korea lead to a sudden and rapid increase in the new TS demand curve. This phenomenon is different from what happened during the growth states of the eight developed countries. Nevertheless, it is expected that the new demand will begin to diminish in the mid 1980's and decline to a level of 10 TS/1,000 persons by the early 1990's.

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