An Estimation of Market Scale For The Elderly Friendly Automobile

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Abstract: Korea have gone into aging society in 2001 with over 7% of the proportion of the elderly, and it is estimated that Korea is going into aged society in 2018, most rapidly in the world, with over 14% of the proportion of the elderly, and also going into hyper-aged society in 2026 with over 20% of the proportion of the elderly. As Korea is going into aged society in near future, importance of the elderly friendly automobile is getting more, since automobile would be the most adequate transit mode for the elderly for various reasons. A main purpose of this study is to estimate of market scale for the elderly friendly automobile. In this study, aged drivers by each scenario are estimated and market demand of elderly friendly automobile is estimated considering statistic characteristic of the elderly (proportion of driving and type of automobile).

Key Words: *The elderly friendly automobile, market scale, sensitivity analysis, aging society*

1. INTRODUCTION

1.1 Background and Purpose

1.1.1 Going into Aging Society

Korea have gone into aging society in 2001 with over 7% of the proportion of the elderly, and it is estimated that Korea is going into aged society in 2018, most rapidly in the world, with over 14% of the proportion of the elderly, and also going into hyper-aged society in 2026 with over 20% of the proportion of the elderly. Now the proportion of the elderly over age 65 is about 9.1% which is below to other developed countries such as Japan, Italy and France. To make matters workse, it is estimated that this proportion is going to be 24.3% in 2030 and 38.2% in 2050. (25.9% in developed countries) The period which the proportion of the elderly goes into 14% (aged society) from 7% (aging society) is 18 years and 20% (hyper-aged society) from 14% (aged society) is only 8 years, which means Korea goes into aged society much more rapidly than any other developed countries in the world.

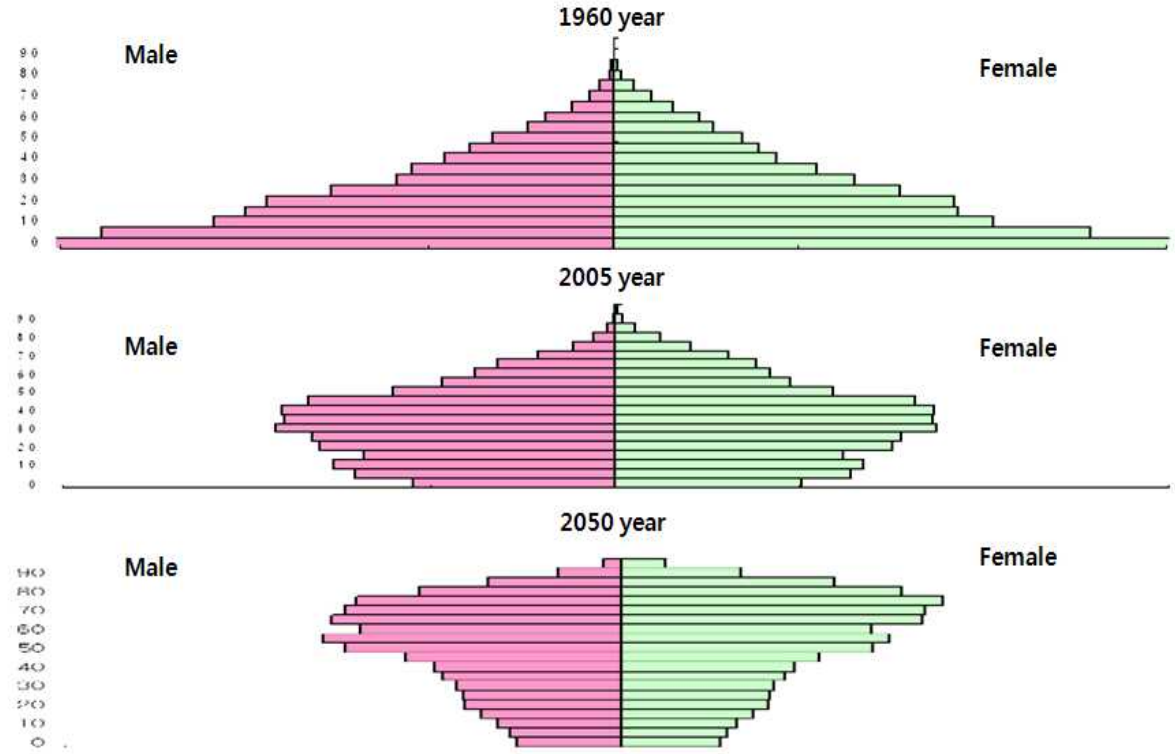


Figure 1 A variation status of population pyramid

1.1.2 Increasing in Aged Drivers

With great number of automobile increased explosively since the late 1980's in Korea, it is estimated that quite a number of drivers who is in their thirties ~ fifties anticipate to drive their own car even when they become the elderly in the future. According to an official announcement of MLTM (Ministry of Land, Transport and Maritime Affairs), it is estimated that the elderly occupy more than 20% of market demand of automobile industry. In 2004 the population between 65~74 was about 0.54 million, but now in 2008 that population become 0.94 million which shows explosive increase.

1.1.3 Increasing in Trip Desire of The Elderly

As the average length of life has been extended, the elderly are growing more and more interested in use of leisure and life quality. Recently social activity desire (gratuitous service, economic activity and so on) of the elderly is growing and it causes outside activities for the elderly, and these growing outside activities cause to extend trip area of the elderly. In the developed countries, trip area of the elderly currently is different from those in the past and a way of thinking of the elderly also shows big difference between present and past. With these reasons, trip desire of the elderly is continually growing, but traffic environment of today is not enough to satisfy desire of the elderly.

1.2 Purpose and expected effects of this study

As mentioned earlier, it is estimated that the demand of transportation for the elderly would be rapidly increased considering increasing number of the elderly drivers and trip desire of them. In case of Japan, they correspond to trip desire of the elderly by introducing Wel-cab into automobile market. In this study, as one corresponding way to aged society, the demand of the elderly friendly automobile is roughly estimated based on data of physics & social characteristics of the elderly. It is expected that these demand forecasting could be used as basic data of national industry for preparing aged society and also policy data for preoccupying elderly friendly automobile market.

1.3 Process and Contents

This study processed based on statistic population data and behavior data of a characteristic of the elderly. With estimated population by UN and OECD, aged drivers by each scenario are estimated and market demand of elderly friendly automobile is estimated considering statistic characteristic of the elderly (proportion of driving and type of automobile). At this time, each scenario is set up using statistic data and also sensitive analysis is achieved designation type of automobile. Also growth rate of automobile market is estimated based on recent data of domestic sales of automobile market and the proportion of the elderly friendly automobile to whole market is estimated. This process is also carried out by every scenario and sensitive analysis is also achieved.

2. AN ESTIMATION OF MARKET SCALE OF THE ELDERLY FRIENDLY AUTOMOBILE

2.1 An Establishment of Concepts of the Elderly and the Elderly Friendly Automobile

2.1.1 Necessity of An Establishment of Concepts

For estimating market scale of the elderly friendly automobile in this research, first of all, a concept of the elderly is necessary, However, the concept of the elderly is necessary is applied differently depends on needs in the world. In this research, standards of the elderly are investigated, and the standard for age of the elderly is suggested to estimate market scale. After this, before analyzing market scale and economic ripple effect, exact concepts (final goal of R&D), difference with general automobile and expected effects of the elderly friendly automobile should be investigated.

2.1.2 An Establishment of Concepts of the Elderly

As investigating basic laws related to the elderly, welfare law for the elderly in Korea, and global standards, it is known that people over 65 are regarded as the elderly in many countries. Even though 60 had been regarded as the elderly in Korea in old times by traditional custom,

it is judged that 60 is more adequate age regarded as the elderly these days because of the effects of extended retirement age and average life span. When considering physiological, psychological and social age, these standards are considered more reasonable. With these backgrounds, the elderly is defined as people whose age is over 65 in this research.

2.1.3 An Establishment of Concepts of the Elderly Friendly Automobile

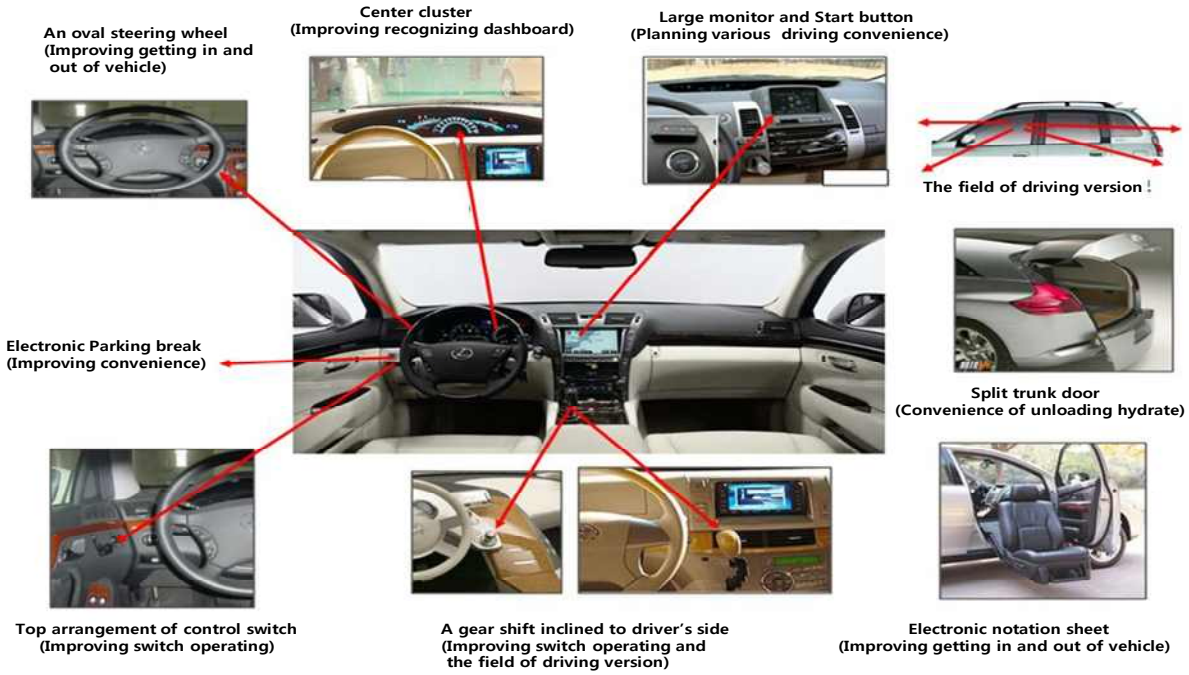


Figure 2 Introduction of the elderly friendly automobile

In this research, the elderly friendly automobile is defined as the automobile which is designed for convenience of the elderly, especially equipped with lots of facilities to improve getting in and out of vehicle, driving convenience, the field of driving version unloading hydrated and so on.

In the elderly friendly automobile, it is arranged to fitted with lots of the most advanced facilities to convenient the elder's driving such as an oval steering wheel, center cluster, large monitor, start button, electronic parking break, split trunk door, electronic rotation sheet and so on.

2.2 A Study For Characteristics of The Elderly

2.2.1 Characteristics of Trip

Choi et al. (2001) analyzed characteristics of trip of the elderly and those are described below. First, the elderly is as getting old, trip frequency is becoming low, total travel time is becoming short, women and household possessing automobile show high trip frequency more than men and household not possessing automobile, and trip departure time is concentrated on daytime avoiding peak hour. Second, the elderly prefer choosing bus and walking to driving because of decrease in social activity and weakening in mental & physical function. In research results in Norway shown in figure 3, it is showed that the proportion of trip using automobile is decreasing as the elderly getting old.

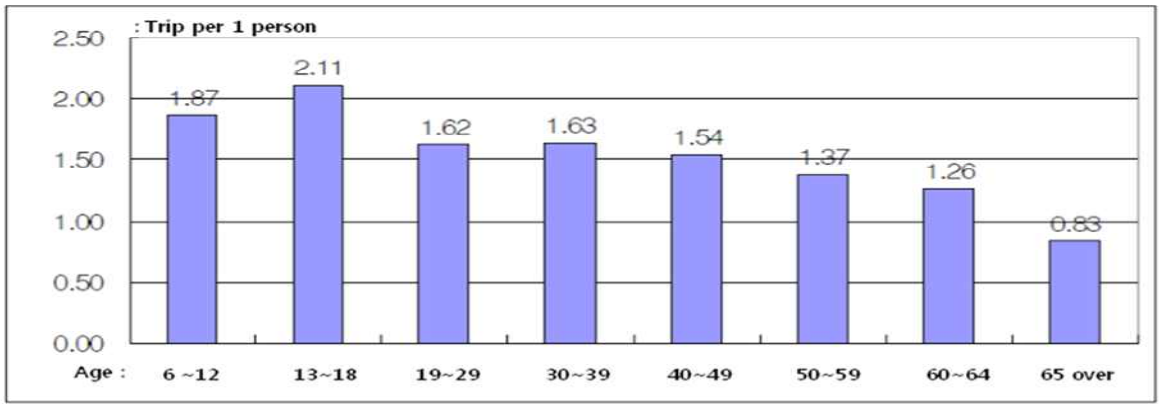
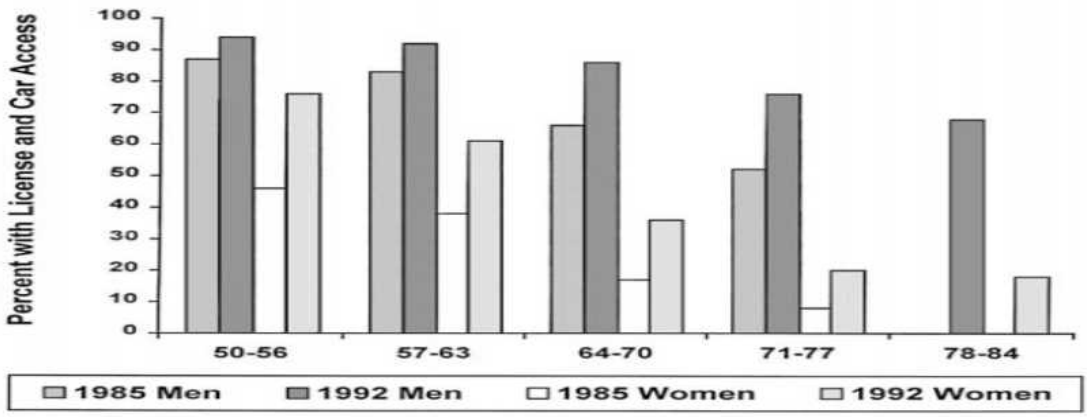


Figure 3 Trip Production by age structure



Source: Hjorthal, 1998.

Figure 4 Variation of automobile (Norway)

2.2.2 Characteristics of Traffic Accident

The elderly have almost double fatality of traffic accident comparing to other age group, and they bring about traffic accident daytime more than at nighttime. Also the cause traffic accident when driving long distance more than short distance and where driving curve section more than straight line.

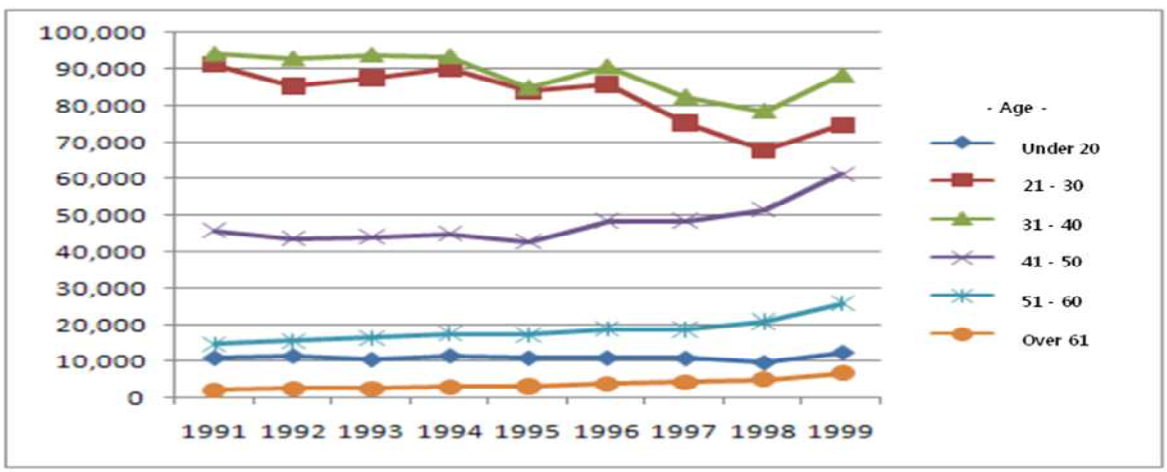
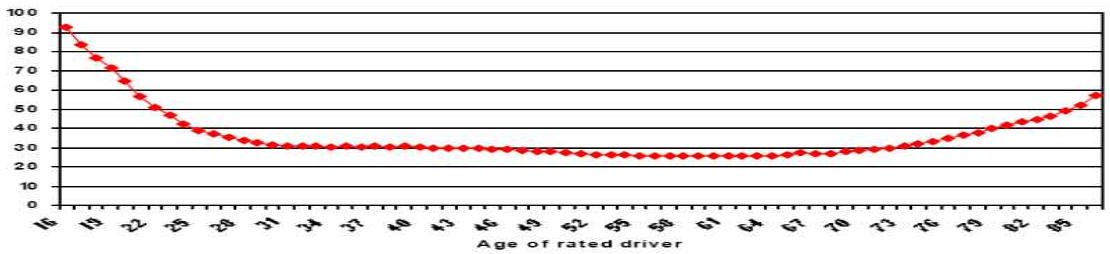


Figure 5 A status of traffic accident by age structure



Source: Insurance Institute for Highway Safety
Notes: Claims relate only to vehicles manufactured between 2001-2004; 'Rated drivers' is the person who is considered to represent the greatest loss potential, associated with the insured vehicle.

Figure 6 Insurance claims per 100,000 insured vehicle years and age of driver

2.2.3 Characteristics of Driving Behavior

As getting aged, the elderly is getting shortsighted, narrow vision and require more time to adapt bright and dark place. Lots of the elderly experience decrease in physical function such as perception, judgment, machine control ability and many of them reduce driving themselves.

2.2.4 General Characteristics

It is known that the elderly participating social activity show high life satisfaction. Also, in one study, it is analyzed that driving own automobile is one of the most necessary factor for life satisfaction of the elderly

2.2.5 Summary & Implications

The characteristics of the elderly are summarized in <Table 1 >. The elderly hope to join in social activity to improve their life quality and satisfaction, but their trip is reducing due to weakening in physical function and constraint in mobility. Preparing aged society, it is the most important to make traffic environment which the elderly could join in social activities without constraint in their physical function and mobility which is called 'barrier free'. Therefore, the elderly friendly automobile should be developed to help active social activity and improve life satisfaction for the elderly.

Table 1 Characteristics of the elderly

Characteristics	**Contents**
Characteristics of Trip	- Decrease in trip frequency and total travel time - Sensitive to traffic environment - Involuntary decrease in trip due to constraint of mobility
Characteristics of Traffic Accident	- High fatality of traffic accident and frequent traffic accident in daytime more than at night time - Causing traffic accident when driving long distance more than short distance and where driving curve section more than straight line.
Characteristics of Driving Behavior	- Getting shortsighted, narrow vision and requiring more time to adapt bright and dark place - Decrease in driving due to decrease in physical function
General Characteristics	- The elderly participating social activity show high life satisfaction - Driving own automobile is one of the most necessary factor for life satisfaction of the elderly

2.3 Forecasting Future Population

In this study, it is examined various forecasting future population of domestic and international organizations. As a result, forecasting values of international organizations are based on values offered by the National Statistics Office of each country.

It is estimated that total Korea population is increasing for next few years then decreasing. Population is increasing up to 49 million by 2020 and decreasing after 2030. In this study, population is forecasted based on 4 scenario described below, and with these estimation, number of the elder driver is estimated which is latent demand of market of the elderly friendly automobile.

- Scenario for a medium degree : According to birth rate variation of age category, birth rate reach to 1.28 in 2040 reflecting childbirth tendency decrease in 25~29 and increase in over 30.
- Scenario for a high degree : As first marriage age is not rise in the future, birth rate in both age category(25~29, 30~34) increase, reach to 1.58 in 2040
- Scenario for a law degree : Birth rate reach to 0.97 in 2040, decrease in 25~29, constant on 30~34
- Scenario for current level : Average birth rate (2001~2005) is persisting

Table 2 Forecasting future population by scenario of age structure

(Unit : 1000 person)

	A medium degree				A low degree			
Year	**Sum**	**0-14**	**15-64**	**65+**	**Sum**	**0-14**	**15-64**	**65+**
2008	48,607	8,458	35,133	5,016	48,448	8,299	35,133	5,016
2010	48,875	7,907	35,611	5,357	48,506	7,538	35,611	5,357
2020	49,326	6,118	35,506	7,701	48,110	4,903	35,506	7,701
2030	48,635	5,525	31,299	11,811	46,642	4,357	30,474	11,811
2040	46,343	4,777	26,525	15,041	43,622	3,607	24,974	15,041
2050	42,343	3,763	22,424	16,156	38,784	2,501	20,127	16,156
	A high degree				**Current level**			
Year	**Sum**	**0-14**	**15-64**	**65+**	**Sum**	**0-14**	**15-64**	**65+**
2008	48,676	8,528	35,133	5,016	48,637	8,488	35,133	5,016
2010	49,026	8,058	35,611	5,357	48,915	7,948	35,611	5,357
2020	50,072	6,864	35,506	7,701	49,269	6,061	35,506	7,701
2030	50,148	6,652	31,685	11,811	48,297	5,176	31,310	11,811
2040	48,505	5,826	27,638	15,041	45,555	4,126	26,388	15,041
2050	45,354	4,996	24,202	16,156	41,240	3,231	21,853	16,156

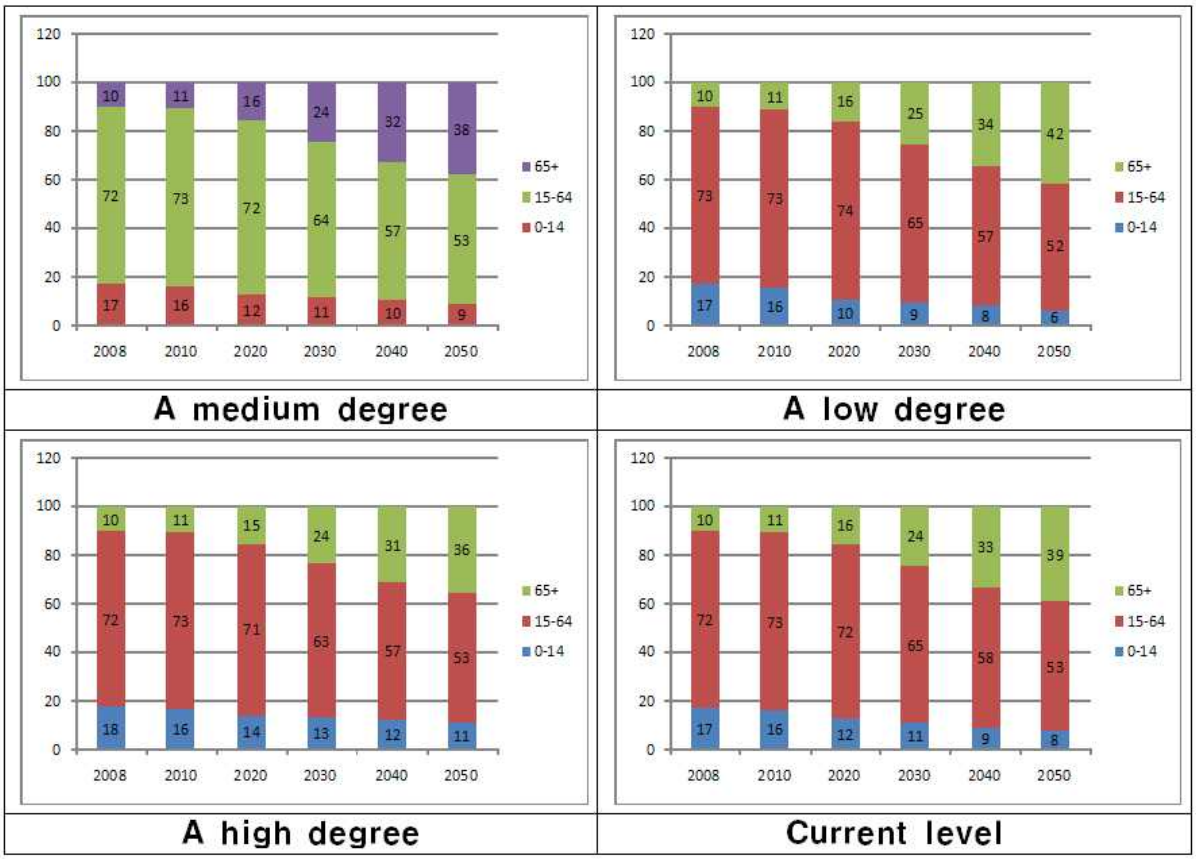


Figure 7 Population properties by age structure

2.4 Forecasting Future Driver's License Holders

2.4.1 Presumption of An Analysis

In this study, as recommended before, an analysis is process based on 4 scenarios of population statistics. However, estimated volume show similar degree, steps of forecasting future driver's license holders and demand are processed based on the scenario for medium degree.

2.4.2 Forecasting Methodology Using Cohort Component Model

One of methodology of forecasting future population is cohort component model. Cohort means a group of subjects — most often humans from a given population — defined by experiencing an event (typically birth) in a particular time span.

The cohort component method begins by assessing base data on population. For many developed countries, base data on population are taken from population registers or are current official estimates prepared by national statistical offices based on a census for an earlier year. For developing countries,

The base population for a projection is taken from the latest census, generally since 1980. However, census enumerations are not perfect, and reported data on population age and sex structure may be affected by age misreporting and by under enumeration of persons in certain ages. If the projection starts with errors in the base year, such errors will be carried throughout the projection period and will have an impact on the projected number of births as well.

Once base population by sex and age are accounted for, the population at each specific age is exposed to the chances of dying as determined by projected mortality levels and patterns by sex and age. Once deaths are estimated, they are subtracted from the population, and those

surviving become older.
Fertility rates are projected and applied to the female population in childbearing ages to estimate the number of births every year. Each cohort of children born is also followed through time by exposing it to mortality.
Finally, the component method takes into account any in-migrants who are incorporated into the population and out-migrants who leave the population. Migrants are added to or subtracted from the population at each specific age. The whole procedure is repeated for each year of the projection period, resulting in the projected population.

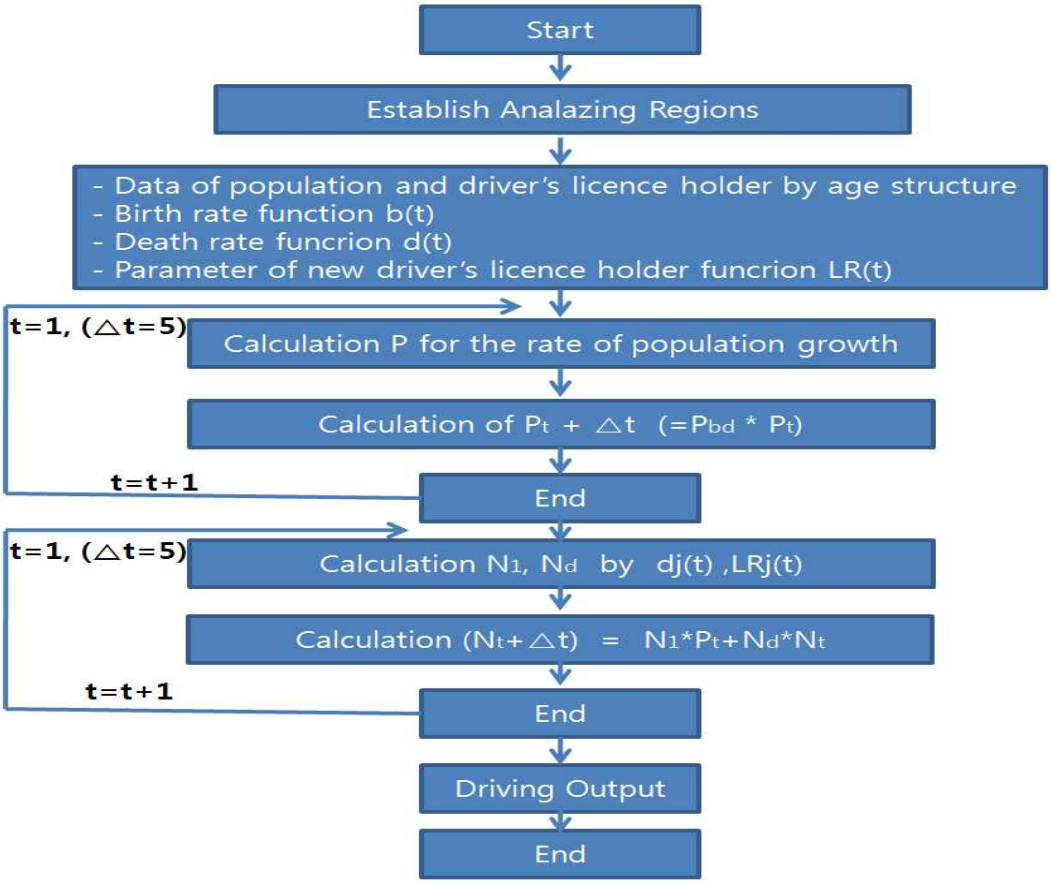


Figure 8 A forecasting methodology using Cohort Component Model

2.4.3 Forecasting Future Driver‘s License Holders

In this study, the number of driver's license holder over 65 is estimated based on Cohort Component Model using various social economic data. Driver's license holder over 65 is estimated using internal data of the National Police Agency and each group (age 65~69, 70~74) showed consecutive increasing tendency for 2004~2008. Variables and description used in estimating the number of driver's license holder over 65 are described below.

(1) Death: Death is decreasing factor of driver’s license holder, death rate of driver’s license holder is regarded as same death rate of total population.
(2) New acquisition: New acquisition means non driver’s license holder gets license for the first time, in this study, it is regarded as function of non driver’s license holder. That is the number of new acquisition is estimated by multiple the number of non driver’s license holder of each group by the rate of new acquisition.

(3) Non renewal license: Non renewal license means driver's license holder cannot or do not renewal license for some reasons like health. That is the number of new acquisition is estimated by multiple the number of driver's license holder of each group by the rate of non renewal license.
(4) Administrative measure: Administrative measure means driver's license holder could not drive any more by administrative measure. As a general rule, the number of administrative measure is excessively small, it is estimated that ignoring that number would be nothing in estimation accuracy.

It is estimated that driver's license holder is going to be 1.9 million, coming to head, and then going to be 1.7 million in 2050. The proportion of 65~74 to whole age structure is going into 4% in 2050, and proportion of driver's license holder in 65~74 is going into 26% in 2020. That fact is a matter of great import which means about 26% of the elderly could drive themselves and they could be potential user who have purchasing power in the future.

Table 3 Forecasting number of future driver's license holder

(Unit: 1000 person , %)

year	Total Population	Population of (65-74)	Number of driver's License holder (65-74)	The proportion of the elderly's drive license to total population	The proportion of the elderly's drive license to population of (65-74)
2008	48,606	3,252	533	1.10	16.40
2010	48,874	3,338	655	1.34	19.62
2020	49,325	4,488	1,206	2.45	26.88
2030	48,634	7,106	1,854	3.81	26.09
2040	46,343	7,421	1,915	4.13	25.81
2050	42,342	6,683	1,708	4.03	25.56

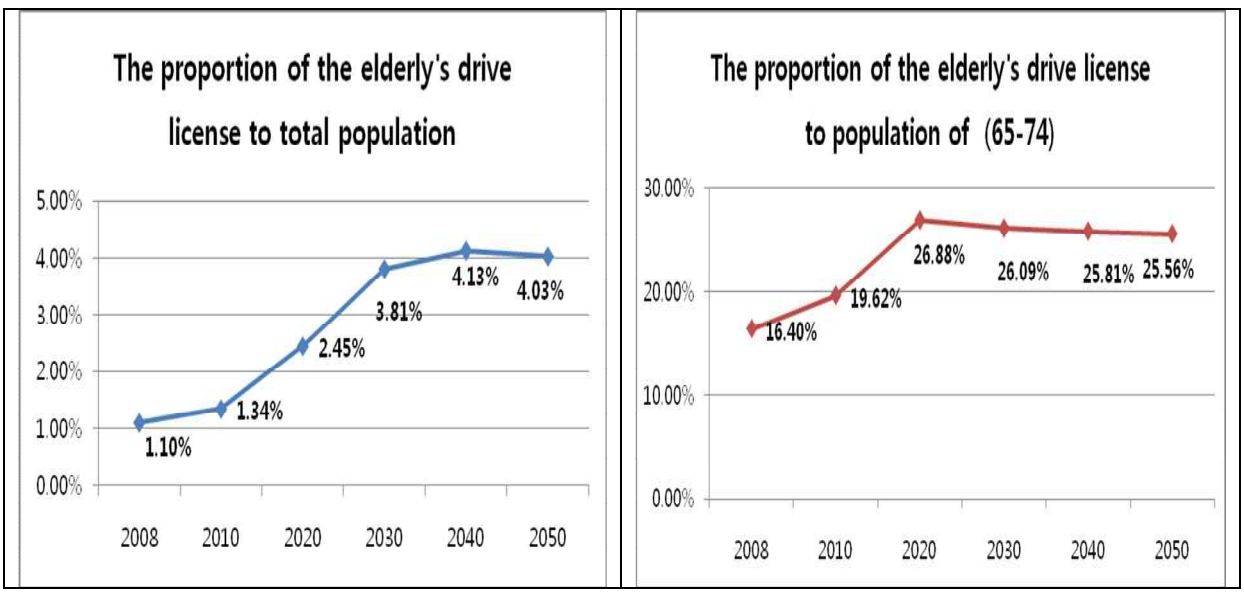


Figure 9 Tendency for proportion of the elderly drive license holder

2.5 Forecasting Market Demand and Domestic Sales Proportion

2.5.1 Forecasting Market Demand

To forecast marker demand, first step is to investigate the ratio of automobile possess of the elderly. In Korea, the proportion of the elderly possessing automobile is 10.7%, the proportion of the elderly possessing automobile whose spouse drive is 4.3%, the proportion of the elderly possessing automobile whose family drive is 24%, and the proportion of the elderly not possessing automobile is 65.3% more than half.

In this study, potential market demand is estimated regarding the elderly who he (or she) and his (or her) spouse drive as direct beneficiary. Also the type of automobile which is developing is medium-large size (at least over 2700cc) In the statistics, it is turned out that the elderly who possess automobile over 2700cc is about 13%, and under 2700cc is 35%. In this study, two groups are divided - one is market demand for medium-large size automobile and the other is market demand for medium-large and medium automobile.

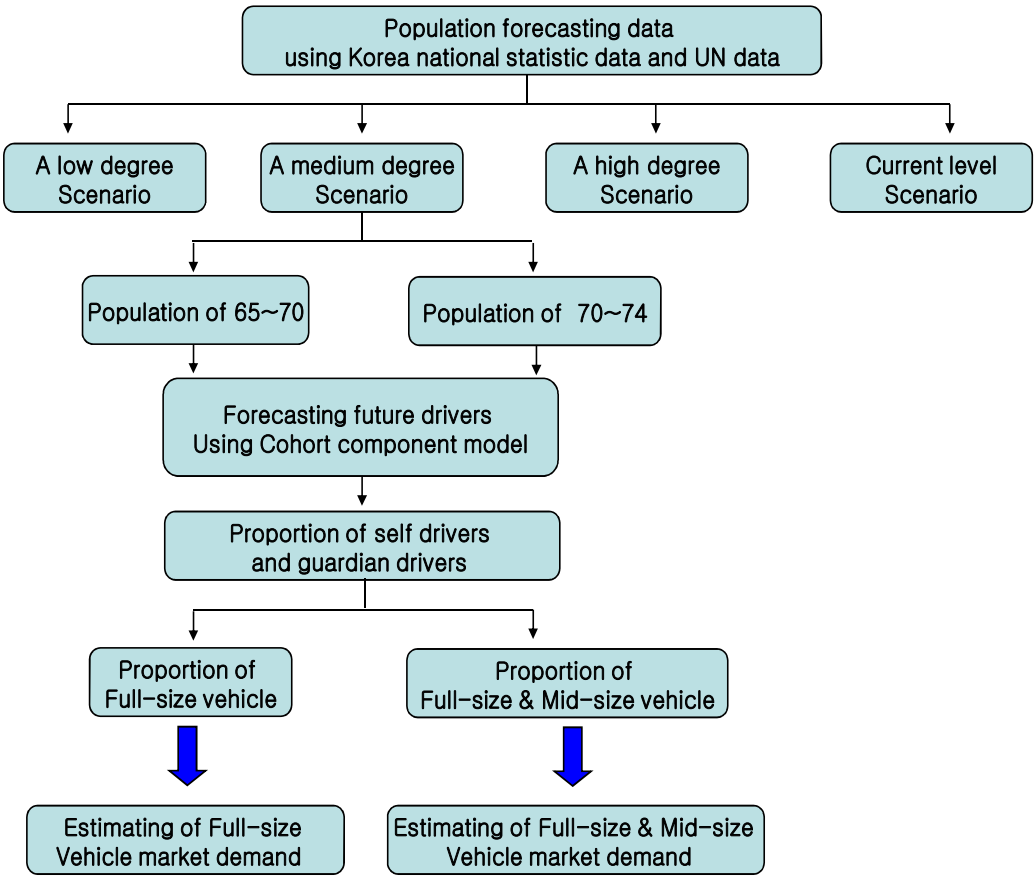


Figure 10 Flow chart for market demand forecasting methodology

Table 4 An Estimation of market scale for full-size automobile by each scenario

year	Positive	Neutral	Negative
2012	15,740	11,018	7,870
2020	23,530	16,471	11,765
2030	36,155	25,308	18,077
2040	37,348	26,143	18,674
2050	33,312	23,318	16,656

Table 5 An Estimation of market scale for full-size & mid-size automobile by each scenario

year	Positive	Neutral	Negative
2012	58,119	40,683	29,060
2020	86,879	60,815	43,440
2030	133,495	93,446	66,747
2040	137,900	96,530	68,950
2050	122,997	86,098	61,498

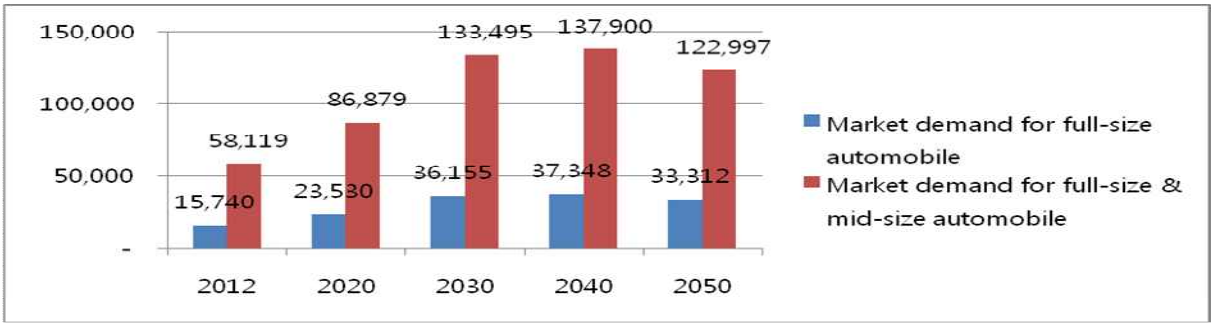


Figure 11 Comparison of market demand for each car size for future current level population

As a result of scenario analysis, it is estimated that there are not big differences between two groups. It is estimated that market demand for mid-size automobile would be 35,000~39,000 in 2040, and market demand for full-size & mid-size automobile would be 130,000~144,000 in same analysis year.

2.5.2 Forecasting Domestic Sales Proportion

To forecast domestic sales proportion, data during 2000~2006 is used. (In 1998, due to serious financial crisis, there were great reduction of total production) Based on total domestic sales during 2000~2026, market growth rate is supposed to 1.3%, and considering recent ballooning oil price and a world-wide depression, market growth rate of negative scenario is supposed to 0.65%. Also two scenarios are made up to divide size of automobile which would be developed. (mid-size automobile and full-size & mid-size automobile)

Table 6 Estimating domestic market of automobile based on 1.3% of market growth rate

year	Estimating domestic market of automobile	% of full-size automobile	% of mid-size & full-size automobile
2012	722,133	2.00	7.40
2020	800,742	2.94	10.80
2030	911,144	3.97	14.65
2040	1,036,767	3.60	13.30
2050	1,179,712	2.82	10.43

Table 7 Estimating domestic market of automobile based on 0.65% of market growth rate

year	Estimating domestic market of automobile	% of full-size automobile	% of mid-size & full-size automobile
2012	694,733	2.10	7.70
2020	731,734	3.22	11.87
2030	780,712	4.63	17.10
2040	832,969	4.48	16.56
2050	888,724	3.75	13.84

As a result based on 1.3% of market growth rate and Scenario for medium degree population, it is estimated that domestic sales in 2050 occupy 2.82% for mid-size automobile, and 10.43% for mid-size & full-size automobile. In case market growth rate is 0.65%, it is estimated that domestic sales production is rather higher because demand increase volume for the elderly friendly automobile is higher than domestic sales decrease volume.
In case widening range to mid-size automobile, market occupancy would be four times greater. This fact is quite meaningful considering the most popular automobile type in Korea is a two-thousand cubic centimeter displacement car. In summary, it is analyzed that domestic sales proportion would be greater when widening range to mid-size automobile than focusing only upon full- size automobile.

3. CONCLUSION

In this study, market scale for the elderly automobile is estimated based on data of the National Statistics Office focused on domestic market demand. It is estimated that market demand increase continuously by 2040, coming to head, and then going to be stabilization. With sensitivity analysis based on the elderly who have purchasing power, analysis is processed by each scenario. As a result, it is estimated that market demand for full-size automobile would be 35,000~39,000 in 2040, and market demand for full-size and mid-size automobile would be 130,000~144,000 in same analysis year.
As a result of forecasting domestic sales proportion based on 1.3% of market growth rate and Scenario for medium degree population, it is estimated that domestic sales in 2050 occupy 2.82% for full-size automobile, and 10.43% for full-size & mid-size automobile. Also it is analyzed that domestic sales proportion would be greater when widening range to mid-size automobile than focusing only upon medium-large size automobile.
The results of this study could be used for estimating market scale of manufacturing and parts of an automobile related industry of the elderly friendly automobile.
Developing new type of automobile require magnificent budget, it is expected that demand forecasting data like this study could be used for national industry development. Furthermore, it is also expected this study could be used to correspond to trip desire of the elderly.

4. FURTHER STUDY

As further study, through input-output analysis, related effects should be derived such as production inducement effect, value-added creation effect and employment inducement effect. These results of social & economic ripple effect could be applied to basic data of establishing national policy.

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