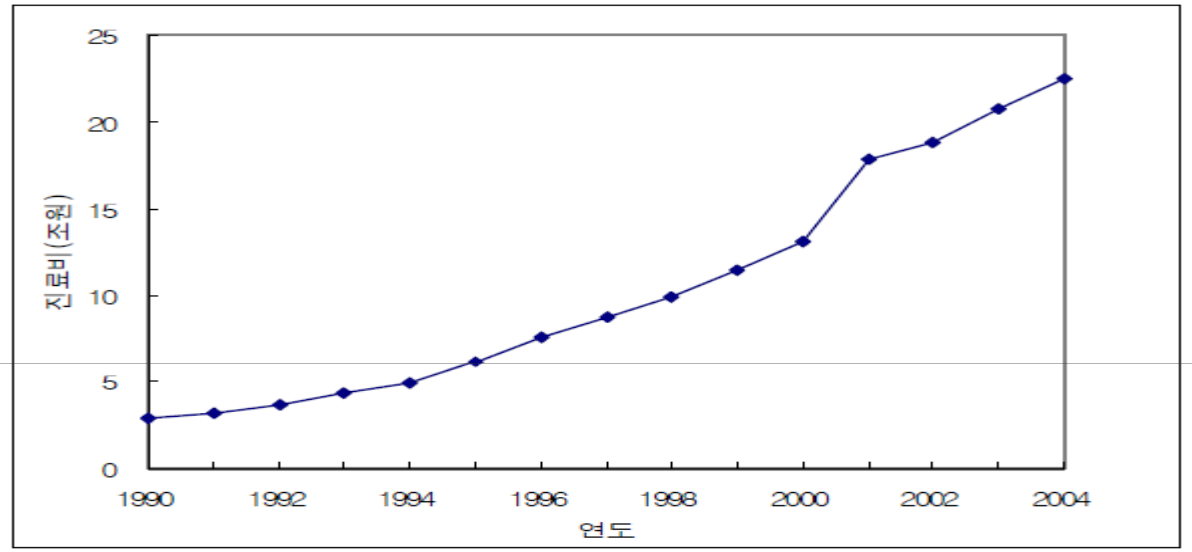
LECTURE NOTE (6): AGING AND HEALTH CARE COST

Economics of Aging

Introduction

- Rising trend of Medical cost



자료: 국민건강보험공단, 국민의료보험관리공단, 의료보험연합회

- 3 trillion won(1990) → 23 trillion won(2004)
- Financing: insurance premium and public transfer
- Need to forecast long-term medical cost
- Any problem with previous studies: based on deterministic assumption or simple underestimation of longevity

Basic Theory on forecasting

(출처: 인구고령화와 보건의료, KDI, 2005)

- Classification: cross-section data, deterministic time-series, stochastic time-series
- Basic Model : $H_{x,t}^{s}$ → per capita medical cost

$$H_t = H_t^m + H_t^f$$

$$H_t^s = \sum_x (P_{x,t}^s \cdot H_{x,t}^s)$$

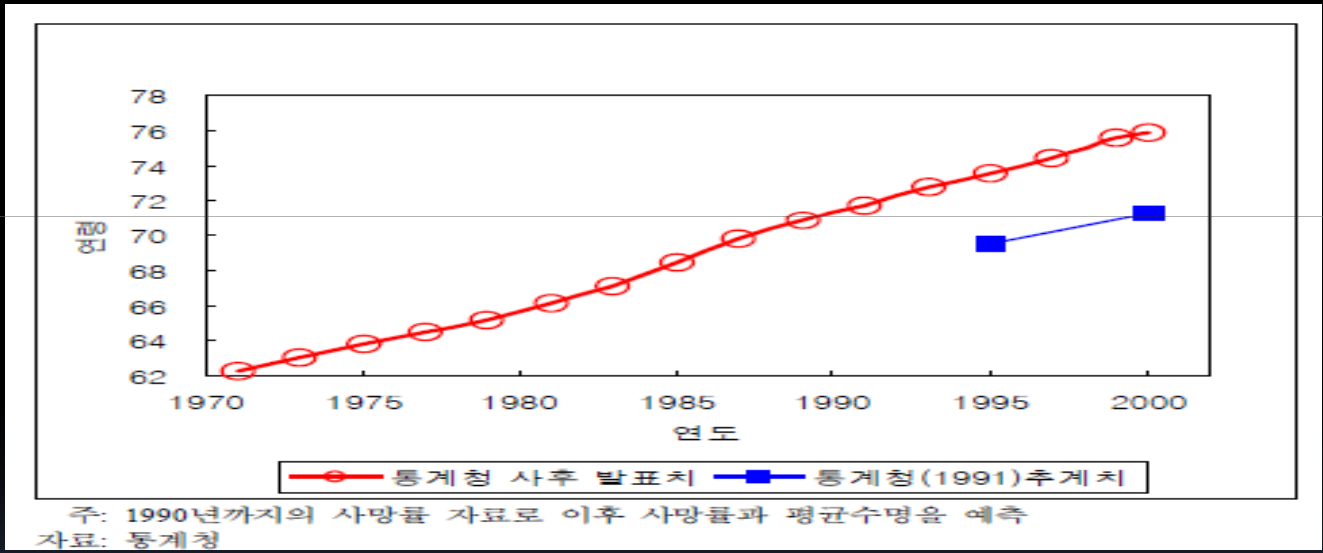
- $P_{x,t}^{s}$: number of population at t year, s gender and x age
- $P_{x,t}^{s} = P(ASDR_{x,t}^{s}, ASBR_{x,t}, ASNIR_{x,t}^{s}, SRB_t)$
- $ASDR_{x,t}^{s}$: mortality rate per age, gender and year
- $ASBR_{x,t}$: fertility rate per age
- $ASNIR_{x,t}^{s}$: net immigration rate per age, gender
- SRB_t : gender portion at t year

Basic Theory on forecasting

- Cross-section data: largely affected by demographic factor → medical cost data of specific age is used as weight to expected number of population of that age
- Deterministic time-series data: regress of medical cost on income, aging trend, and time trend → independent variables are treated as deterministic expectation value
  - Probabilistic change of them are not considered.
- Stochastic time-series
  - Stochastic factor on mortality rate
  - Stochastic factor on population structure
  - Stochastic factor on medical cost : coverage rate, tech.
  - Stochastic factor on health status within life-cycle

Forecasting death rate using stochastic time-series model(출처: 인구고령화와 보건의료, KDI, 2005)

- Bias of forecasting: due to underestimation of decrease of mortality rate and increase of avg. life year
- How precise is the data published by government?



- Model: mortality rate model with a form of logarithm

$$\ln(\mathrm{ASDR}_{x,t}) = a_x + b_x \cdot k_t + e_{x,t}$$

- a_x : constant per age, b_x : velocity of mortality rate change, k_x : index of level of mortality

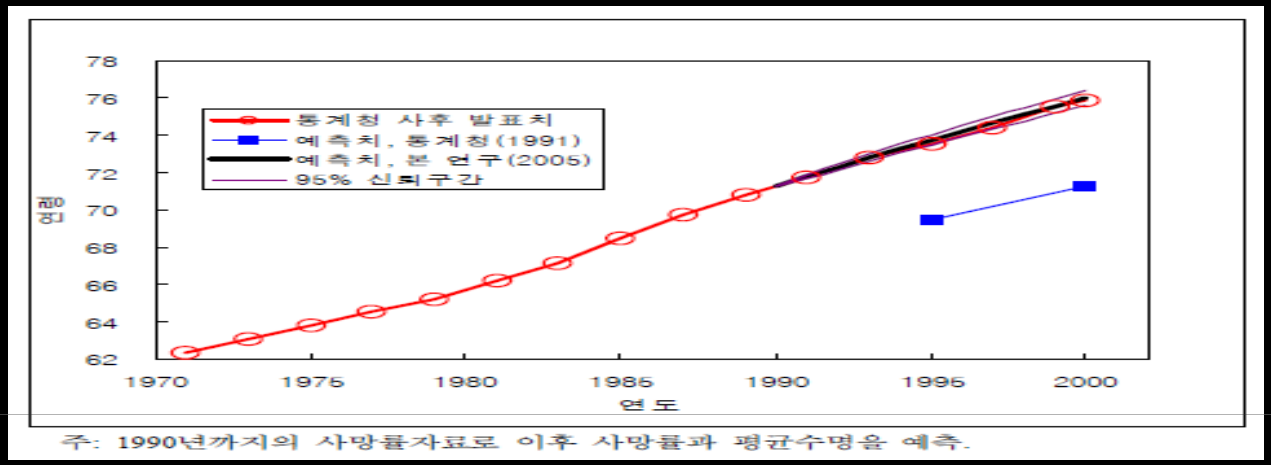
Forecasting death rate using stochastic time-series model cont.

- Estimation Process
  - Estimation of a_x, b_x, and k_x by SVD(singular value decomposition)
  - Estimation of avg. life year applying life table analysis
  - Get 2nd estimate of k_t using ARIMA(autoregressive integrated moving average) model by equalizing the estimate with announced value afterwards
  - Get expected value of $ASDR_{x,t}^{a}$ using a_x, b_x, and 2nd estimate of k_x

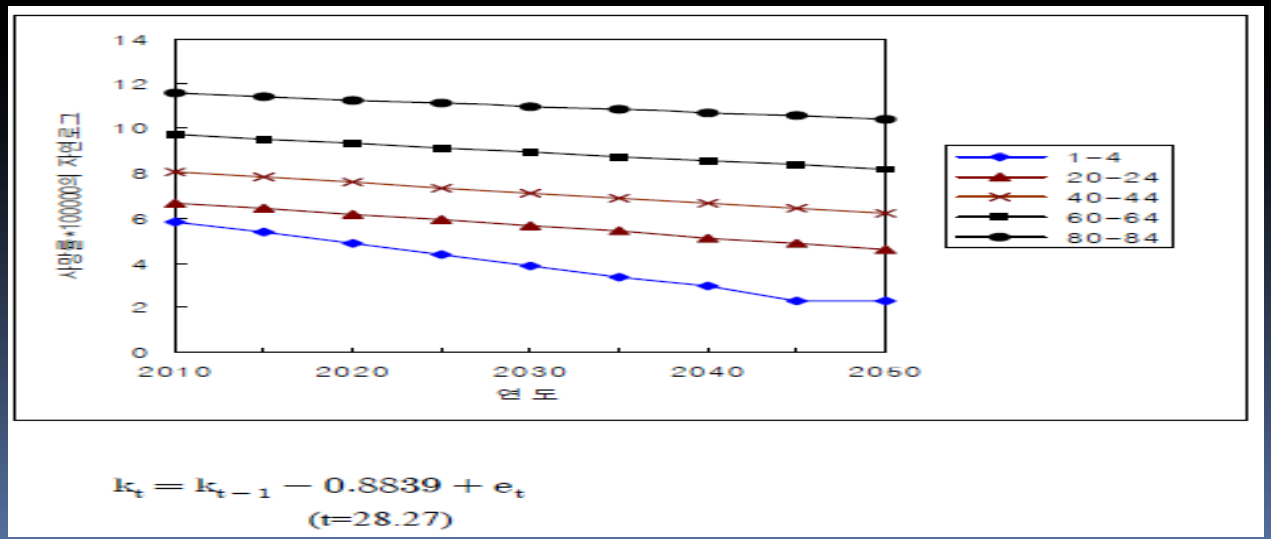
- Degree of preciseness
  - Comparison of expected value with announced value afterwards

Long-term forecasting of mortality rate

- Preciseness (출처: 인구고령화와 보건의료, KDI, 2005)

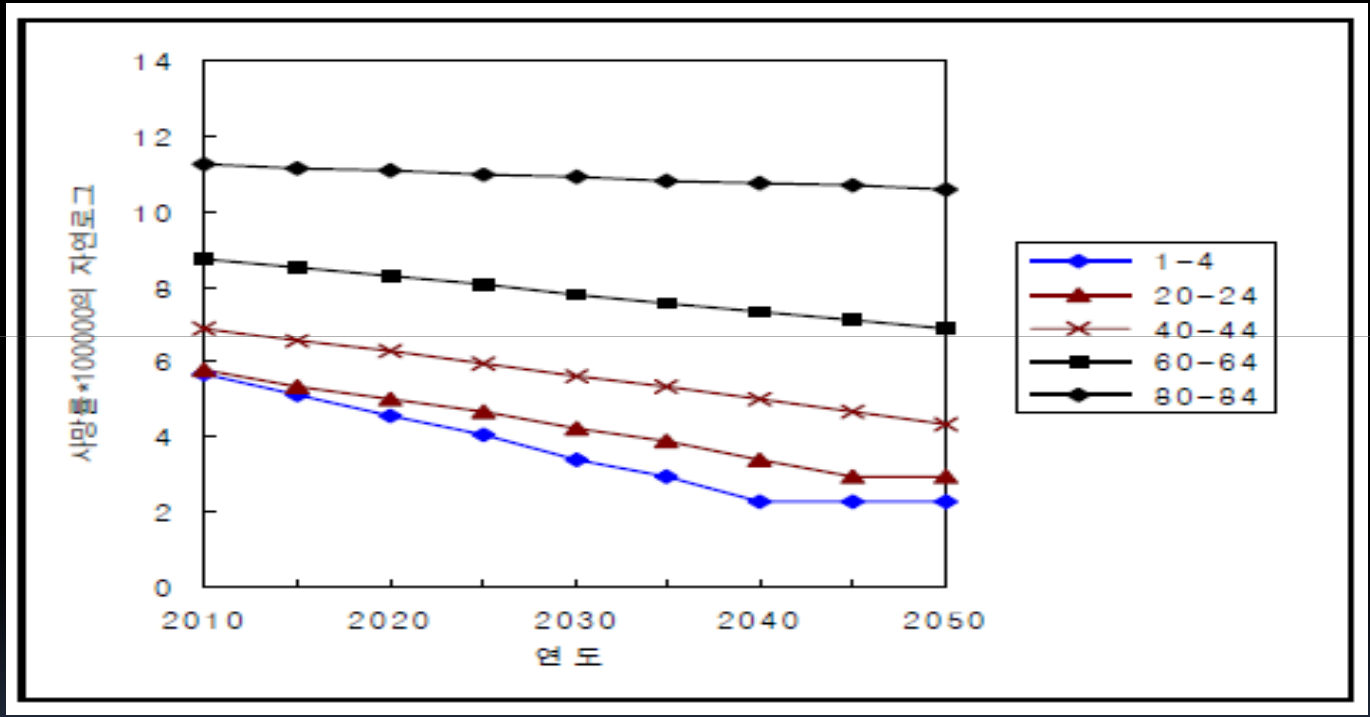


- Expected value of male mortality rate : random work model



Long-term forecasting of mortality rate

- Expected value of female mortality rate : random work model (출처: 인구고령화와 보건의료, KDI, 2005)



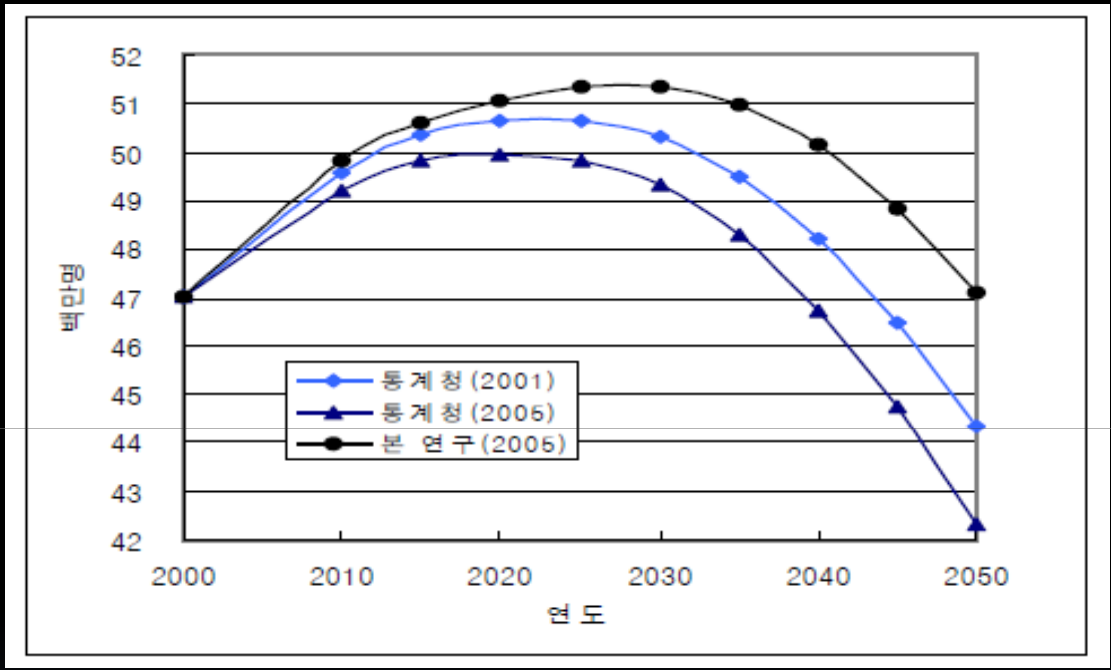
$$k_t = k_{t-1} - 1.0180 + e_t$$
$$(t=20.05)$$

Long-term forecasting of population
(출처: 인구고령화와 보건의료, KDI, 2005)

- Methods
  - Trend-extrapolation method : only use past data and standard level
  - Cohort-component method : under assumption that population components are constantly or stochastically preserved
  - Structural method : consideration of the effect of socio-demographic factor on population structure
- Process in detail
  - $ASDR_{x,t}^{g}$ is used by estimate of stochastic time-series model
  - Concerning rest of them, we adopt publicly announced ones
  - The forecasting period : by 2050

Long-term forecasting of population

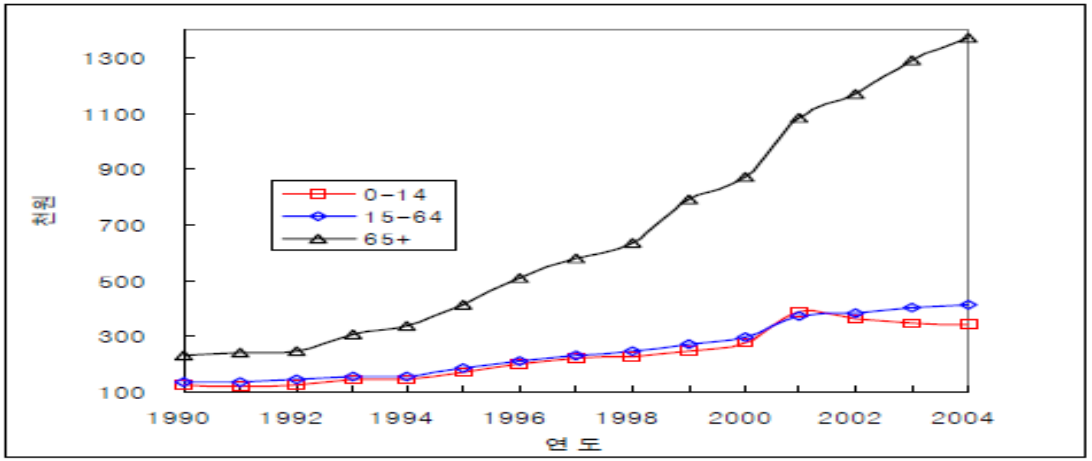
- Results (출처: 인구고령화와 보건의료, KDI, 2005)



- Somewhat overestimation of population reduction
- Due to underestimation of decrease of mortality rate and increase of average living year

Stochastic forecasting of per capital medical cost (출처: 인구고령화와 보건의료, KDI, 2005)

- Simple model $H^{s}_{x,t} = \alpha^{s}_{x,t} \cdot H^{s}_{x,0} \cdot P^{s}_{x,t}$
  - $H^{s}_{x,0}$: per capita medical cost at basic year
  - $\alpha^{s}_{x,t}$: stochastic factor attribute to population structure and attribute to other stochastic change of variables → change in coverage rate and in medical technology
  - We need to differently investigate per different aging group such as 0~14, 15~64, and 65 above



주: 2004년 불변가격 기준임.
자료: 통계청, 국민건강보험공단, 국민의료보험관리공단, 의료보험연합회.

Stochastic forecasting of per capital medical cost cont. (출처: 인구고령화와 보건의료, KDI, 2005)

- Estimation result of stochastic time-series model

0~14세 연령계급:

$$H^{\delta}_{x,t} = H^{\delta}_{x,t-1} + 15.607 + e_t \quad (t=1.84)$$

15~64세 연령계급:

$$H^{\delta}_{x,t} = H^{\delta}_{x,t-1} + 17.221 + e_t \quad (t=3.90)$$

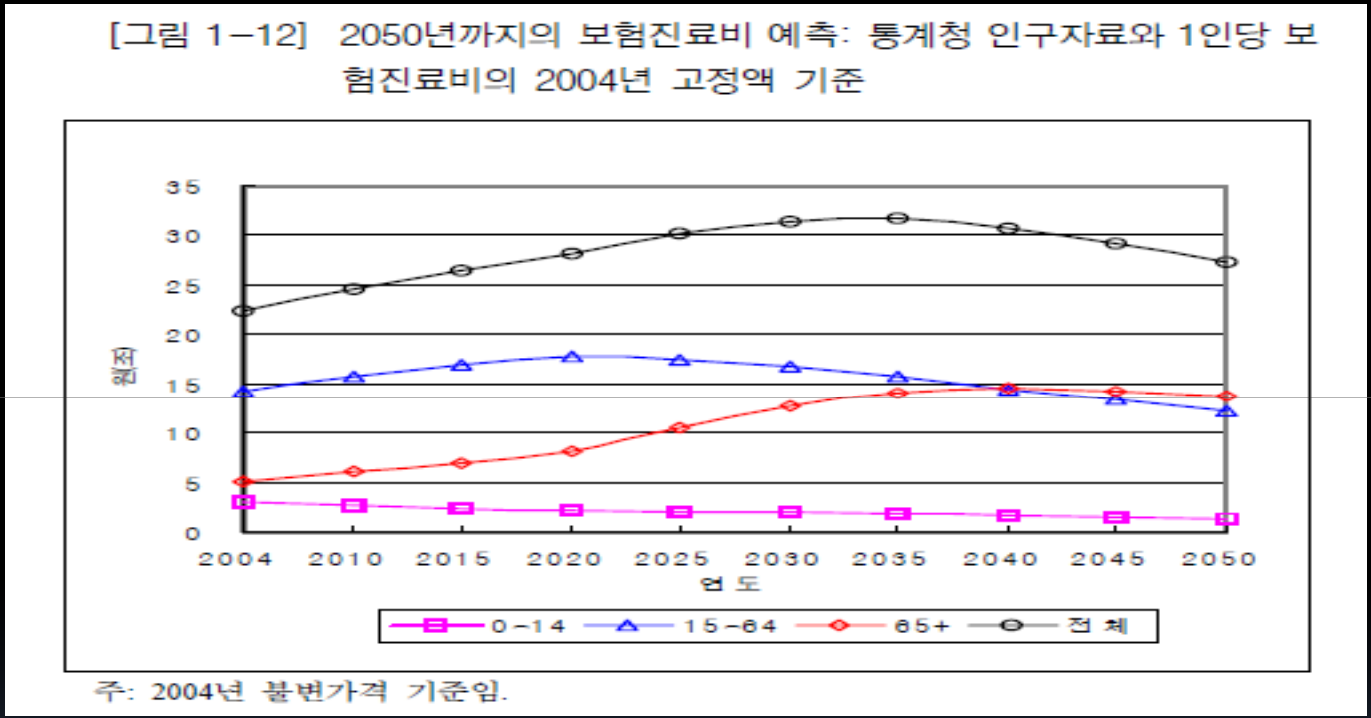
64세 이상 연령계급:

$$H^{\delta}_{x,t} = H^{\delta}_{x,t-1} + 70.950 + e_t \quad (t=5.54)$$

- We use different increasing rate of per capita medical cost for obtaining $\alpha^{\delta}_{x,t}$
- Four different scenario
  - 2004 as base year: increasing rate of medical cost is fixed at 2004 level
  - Average increasing rate of real per capita medical cost: increasing rate of real per capita medical cost is largely affected by health policy such as separation of drug dispensary from prescription at 2001. → avg. rate is 3.88% during 2002 and 2004
  - Average increasing rate of per capita GDP: avg. rate is 4.89% during 2002 and 2004
  - Stochastic expectation of increasing rate: different age group has different trend of medical cost. So we use different increasing rate of each age group.

Stochastic forecasting of per capital medical cost using expected population of Statistics Korea(KOSTAT)

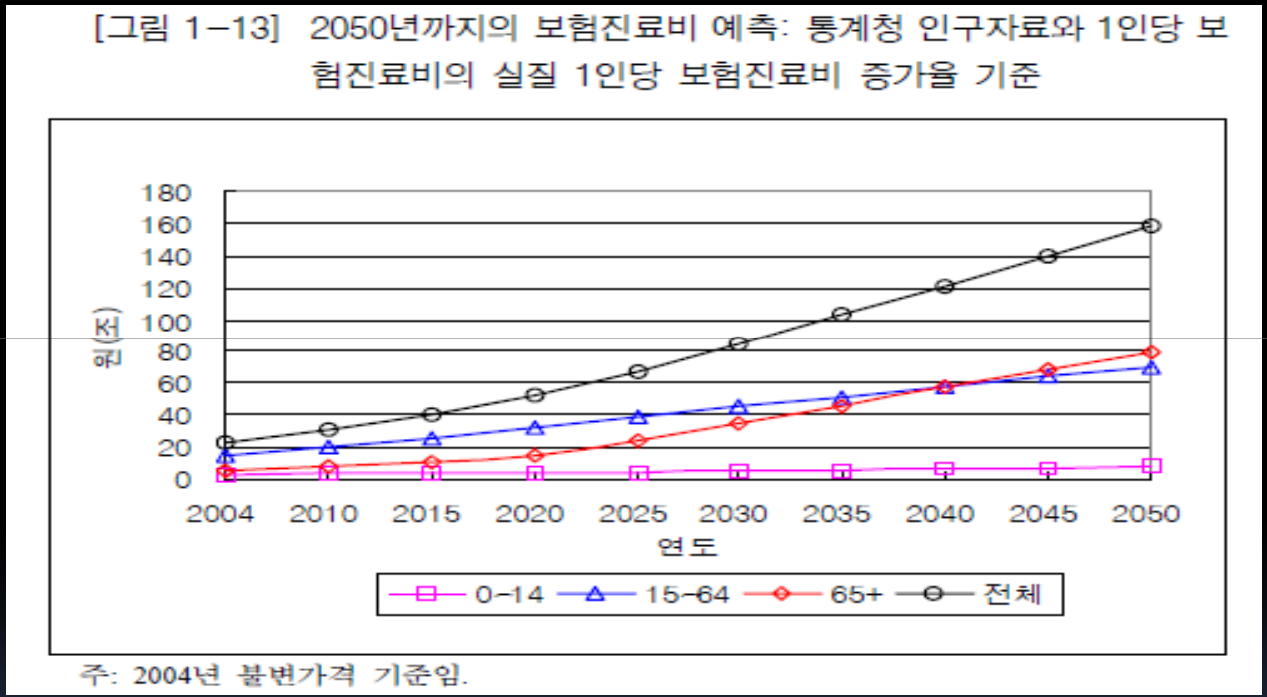
- 2004 as base year (출처: 인구고령화와 보건의료, KDI, 2005)



- 25 trillion won at 2010 → 35 trillion won at 2035 → 27 trillion won at 2050
- Medical cost of 65 above shows to decrease after 2040.

Stochastic forecasting of per capital medical cost using expected population of Statistics Korea(KOSTAT)

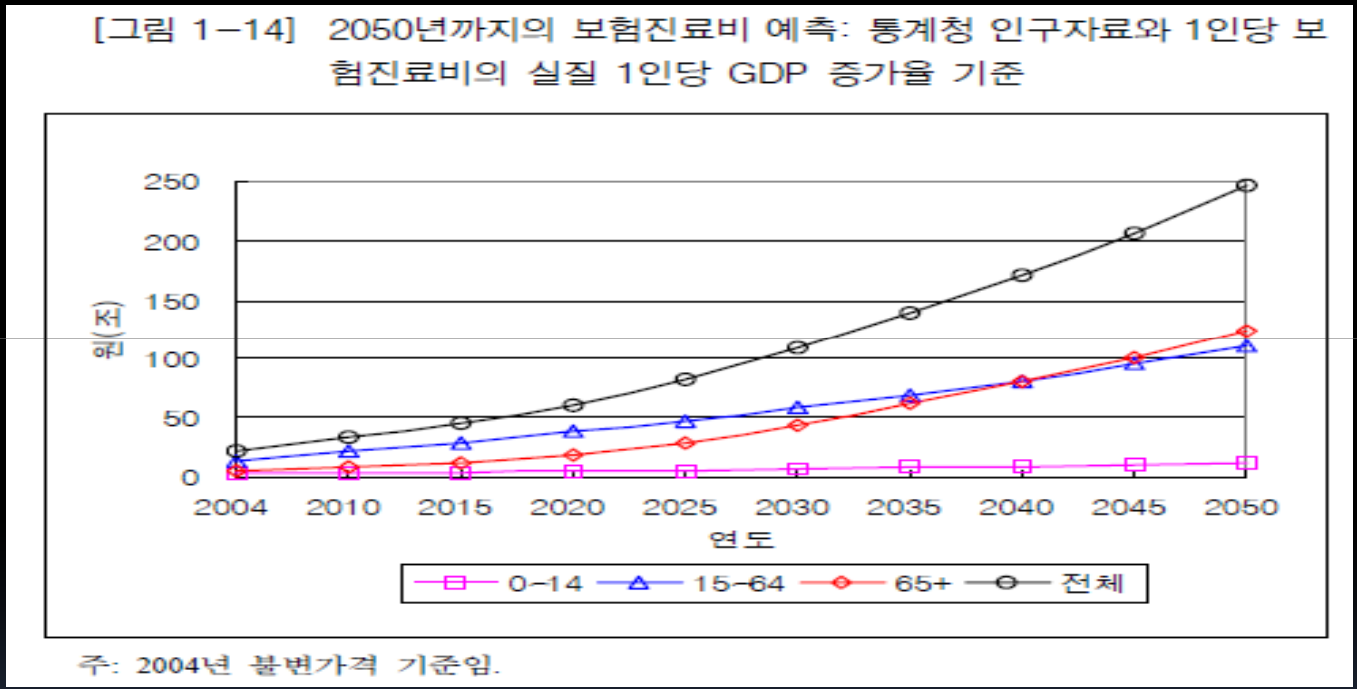
- Average increasing rate of real per capita medical cost (출처: 인구고령화와 보건의료, KDI, 2005)



- Strictly increasing pattern
- 31 trillion won at 2010 → 52 trillion won at 2020 and 85 trillion won at 2030 → 158 trillion won at 2050

Stochastic forecasting of per capital medical cost using expected population of Statistics Korea(KOSTAT)

- Average increasing rate of per capita GDP (출처: 인구고령화와 보건의료, KDI, 2005)

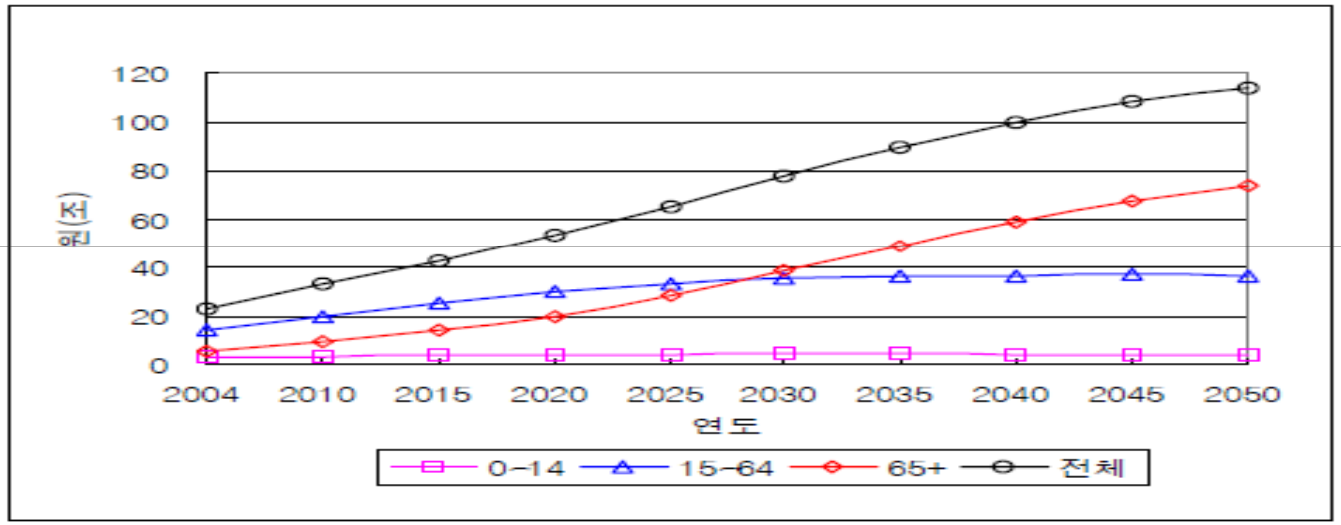


- Medical cost of 65 above excels to that of 15~64 at 2040.
- 33 trillion won at 2010 → 61 trillion won at 2020 and 109 trillion won at 2030 → 246 trillion won at 2050

Stochastic forecasting of per capital medical cost using expected population of Statistics Korea(KOSTAT)

- Stochastic expectation of increasing rate (출처: 인구고령화와 보건의료, KDI, 2005)

[그림 1-15] 2050년까지의 보험진료비 예측: 통계청 인구자료와 1인당 보험진료비의 확률적 증가율 기준



주: 2004년 불변가격 기준임.

- Medical cost of 65 above excels to that of 15~64 at 2030. → similar pattern with total trend which suggests this age group is leading sector.
- 33 trillion won at 2010 → 53 trillion won at 2020 and 78 trillion won at 2030 → 114 trillion won at 2050

Stochastic forecasting of per capital medical cost using expected population of this study

- Comparison with previous study (출처: 인구고령화와 보건의료, KDI, 2005)

(단위: 조원)

	통계청(2005) 인구예측자료 이용시				확률적 인구예측자료 이용시				차이
연도	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	최대치 - 최소치
2010	24.59	30.90	32.75	32.88	26.05	32.73	34.69	33.08	10.09
2015	26.45	40.21	44.73	42.40	28.51	43.34	48.21	42.68	21.76
2020	28.26	51.97	60.67	53.21	31.22	57.40	67.02	53.94	38.75
2025	30.17	67.11	82.23	65.39	34.00	75.62	92.66	66.90	62.49
2030	31.51	84.78	109.04	77.84	36.50	98.20	126.28	80.78	94.77
2035	31.82	103.54	139.76	89.46	38.39	124.94	168.64	94.50	136.82
2040	30.73	120.99	171.41	99.74	39.60	155.90	220.86	107.50	190.13
2045	29.23	139.21	206.99	107.94	40.16	191.24	284.37	119.08	255.13
2050	27.40	157.85	246.34	113.57	39.98	230.31	359.43	128.65	332.03

주: 1) 각 ( ) 안의 번호는 1인당 보험진료비 증가율 예측치에 대한 각 가정을 표시함: (1) 2004년 고정액, (2) 1인당 보험진료비 증가율 평균치, (3) 1인당 GDP 증가율 평균치, (4) 확률적 증가율
2) 2004년 불변가격 기준임.

- The difference between two expectation of population becomes larger as time goes by.

Stochastic forecasting of per capital medical cost using expected population of this study

- Graphically, (출처: 인구고령화와 보건의료, KDI, 2005)