Economic Evaluation in Health Care

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Outline

Economic Evaluation

- A way of ranking alternative projects (preventive care, acute care facilities, medical reserch etc.)
- It tires to provide some market signals for goods for which market do not exist (value of life, health etc.)

Cost-effectiveness analysis

- Cost-effectiveness analysis: choose an alternative with the lowest cost to achieve a given level of output(cases detected, cases prevented, a year of life, etc).

$$CEARatio = \frac{C_1 - C_0}{E_1 - E_0}$$

- Cost-utility analysis: special case of CEA where the output is measured in Quality Adjusted Life Years (QALYs) that takes into account individuals' preferences.

$$QALY = \sum_{t=1}^{t=max} \frac{F_i qi}{(1+d)^t}$$

F_i: probability of being alive at age i, q_i: quality weight between 0 and 1

Cost per Life-Year, US, $2010

The Cost of Saving Lives

The need to encourage rational social choice has been forcefully made by Harvard University's Center for Risk Analysis. After reviewing publicly available studies of life-saving interventions, the Center found enough data to compute the cost per life-year saved for 587 interventions representing an unprecedented range of both health and nonhealth programs. Estimates for selective interventions include:

Intervention	Cost per Life-Year ($2010*)
Medical	
Childhood immunizations	less than 0
Prenatal care for pregnant women	less than 0
Influenza vaccine for all citizens	210
Mammography for women age 50	1,215
Annual mammography for women ages 40–49	142,500
Intensive care for ill patients with major vascular operations	1,275,000
Nonmedical	
Random motor vehicle inspections	2,250
Water chlorination	6,300
Pneumonia vaccination	18,000
Construction safety rules	57,000
Home radon control	211,500

Resource savings are subtracted from costs. Thus, some programs, such as childhood immunizations and prenatal care, have negative net costs because the costs of the programs are more than offset by the subsequent savings from lower health care costs.

**Note:* The costs were originally estimated in 1993 dollars. These have been converted to 2010 dollars the CPI increased 50 per cent by 2010.

Source: Tengs, Tammy O., et al. "Five-Hundred Life-Saving Interventions and Their Cost-Effectiveness," *Risk Analysis 15* (1995): 369–384, with permission of the publisher.

Cost Benefit Analysis

- Cost-benefit analysis(health care, education, defense, etc.)

$$B - C, \frac{B}{C}$$

  - conceptual and practical problems to estimate monetary value of life
  - human capital approach (present value of future potential earnings lost), willingness to accept or willingness to pay approach
  - contingent valuation: "If you faced an X high risk of heart attack, how much would you be willing to pay for a medical procedure that would reduce your risk to Y?"

Value of Life, US, $2009

TABLE 4-1 How Much Is One Life Worth?

Meta analysis of wage based studies	Years covered by the studies	Value of Life in 2009 dollars
Miller (2009)	1974–1990	5.2 million
Mrozek & Taylor 2002	1974–1995	2.0 to 3.3 million
Viscusi & Aldy (2003)	1974–2000	6.9 to 9.5 million
Kochi et al (2006)	1974–2002	11.1 million
Meta analysis of stated preference studies	**Years covered by the studies**	**Value of life in 2009 dollars**
Kochi et. al. (2006)	1988–2002	3.5 million
Dekker et al. (2011)	1983–2008	2.7 to 8.5 million
Lindhjem et al. (2010)	1973–2008	3.2 million

Note: These data are from Maureen Cropper, James K. Hammit, and Lisa A. Robinson, (2011), "Valuing Mortality Risk Reductions: Progress and Challenges," Discussion Paper, Washington, DC: *Resources for the Future.*

A framework by Murphy & Topel (2003, 2006)

Expected lifetime utility

$$V = \int_0^{\infty} e^{-\rho t} H(t) u(c(t), l(t)) S(t) dt \tag{1}$$

H(t): quality of life, S(t): survivor function from birth to age t, c(t): consumption, l(t): nonmarket time

Willingness to pay for increased discounted present value of lifetime utility due to increased health

$$\frac{dV}{\mu} = \frac{\int_0^{\infty} e^{-\rho t} [H(t) u(c(t), l(t)) \Delta S(t) + u(c(t), l(t)) S(t) \Delta H(t)] dt}{H(0) u_c(c(0), l(0))} \tag{2}$$

A framework by Murphy & Topel (2003, 2006)

$$\frac{dV}{\mu} = \int_0^\infty e^{-rt}\theta C_F(t)\Delta S(t) + \int_0^\infty e^{-rt}\theta C_F(t)S(t)\frac{\Delta H(t)}{H(t)}dt \tag{3}$$

where

$$C_F(t) = c(t) + w(t)l(t) \tag{4}$$

Willingness to pay as of age a

$$\frac{dV(a)}{\mu(a)} = \int_a^\infty e^{-r(t-a)}\theta C_F(t)\frac{S(t)}{S(a)}dt = \lambda W(a) \tag{5}$$

where W(a) is the value of a statistical life

A framework by Murphy & Topel (2003, 2006)

Willingness to pay as of age a for increased longevity from S_1 to S_2

$$V_R(t) = V_2 - V_1 = \int_a^{\infty} e^{-r(t-a)}[S_2(t) - S_1(t)]\theta C_F(t)dt \tag{6}$$

and aggregated value over the current and future population

$$V_R(t) = \sum_{a=0}^{T} N(a,t)V_R(a,R) + N^*(t)V_R(0,R) \tag{7}$$

where $N(a,t)$ is the number of individuals of age a at date t, and N^* is the present value of the number of individuals that will be born in future years.

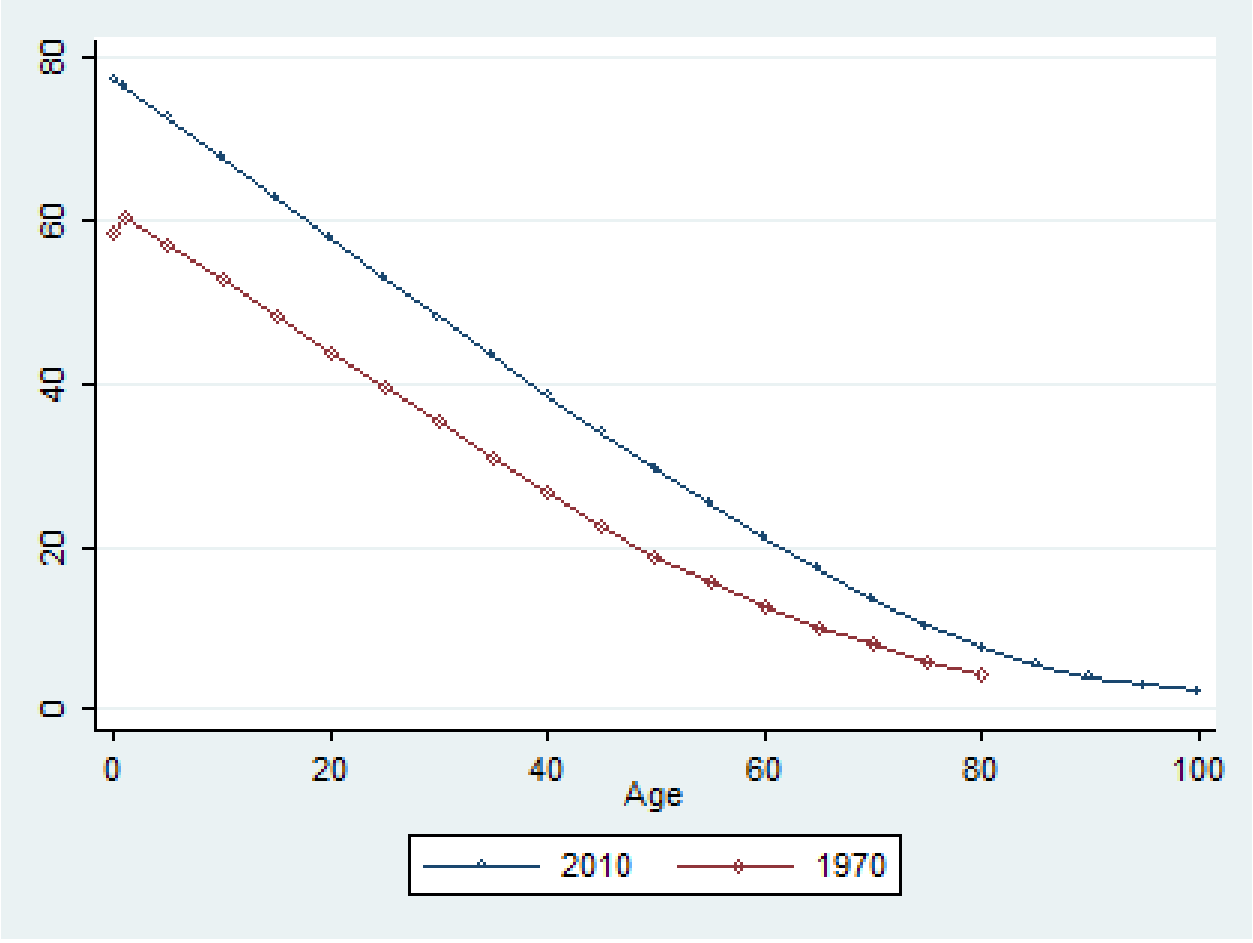
Implications

- Greater economic value as population grows,
- lifetime income grows,
- health level improves
- age distribution concentrates near but before the typical age of onset of the disease

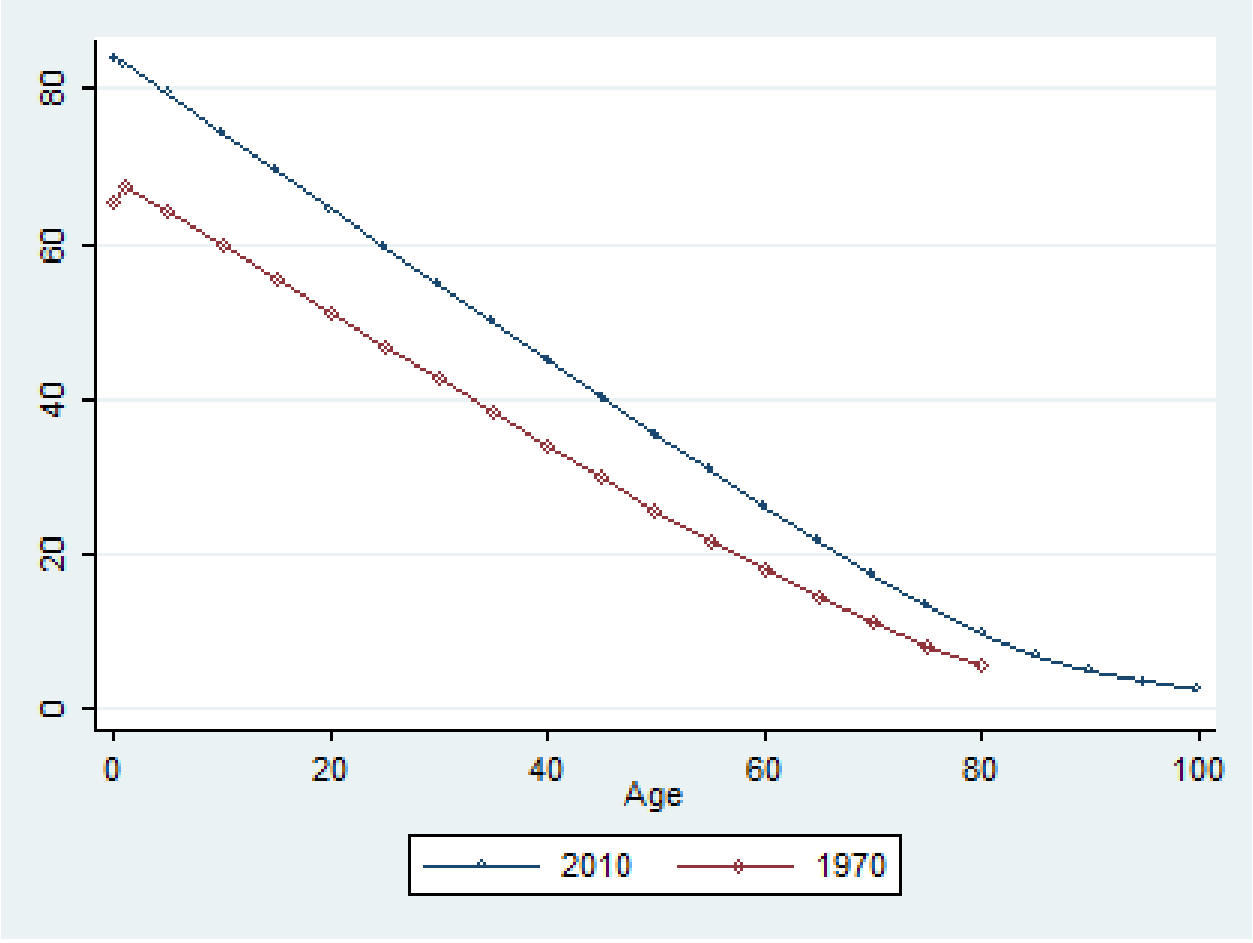
Economic Evaluation of Health in Korea (Chung 2014)

- to estimate the economic values of the increased longevity from 1970 to 2010.
- to estimate the potential gain from further increase in longevity

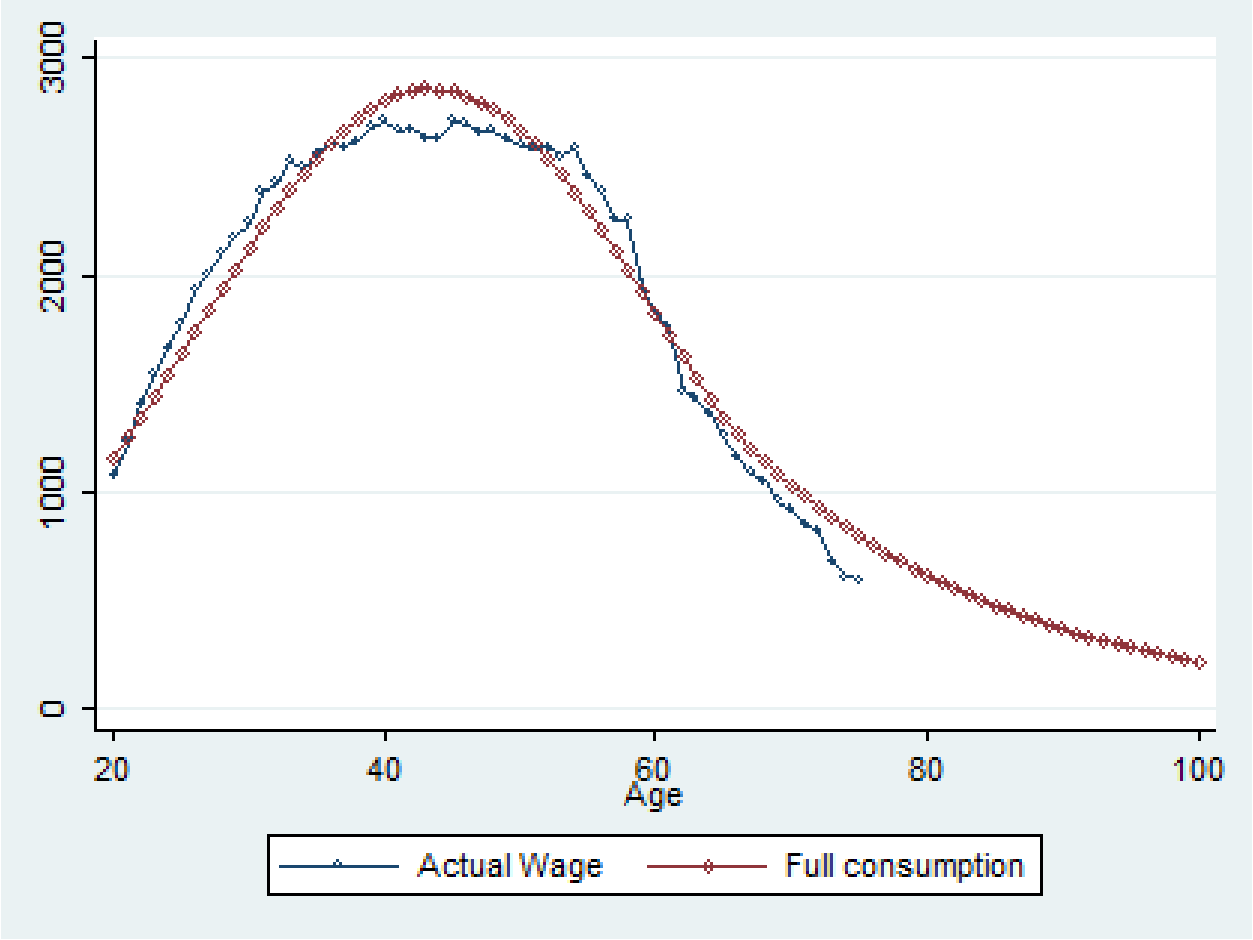
Male life expectancy by age, Korea, 1970-2010



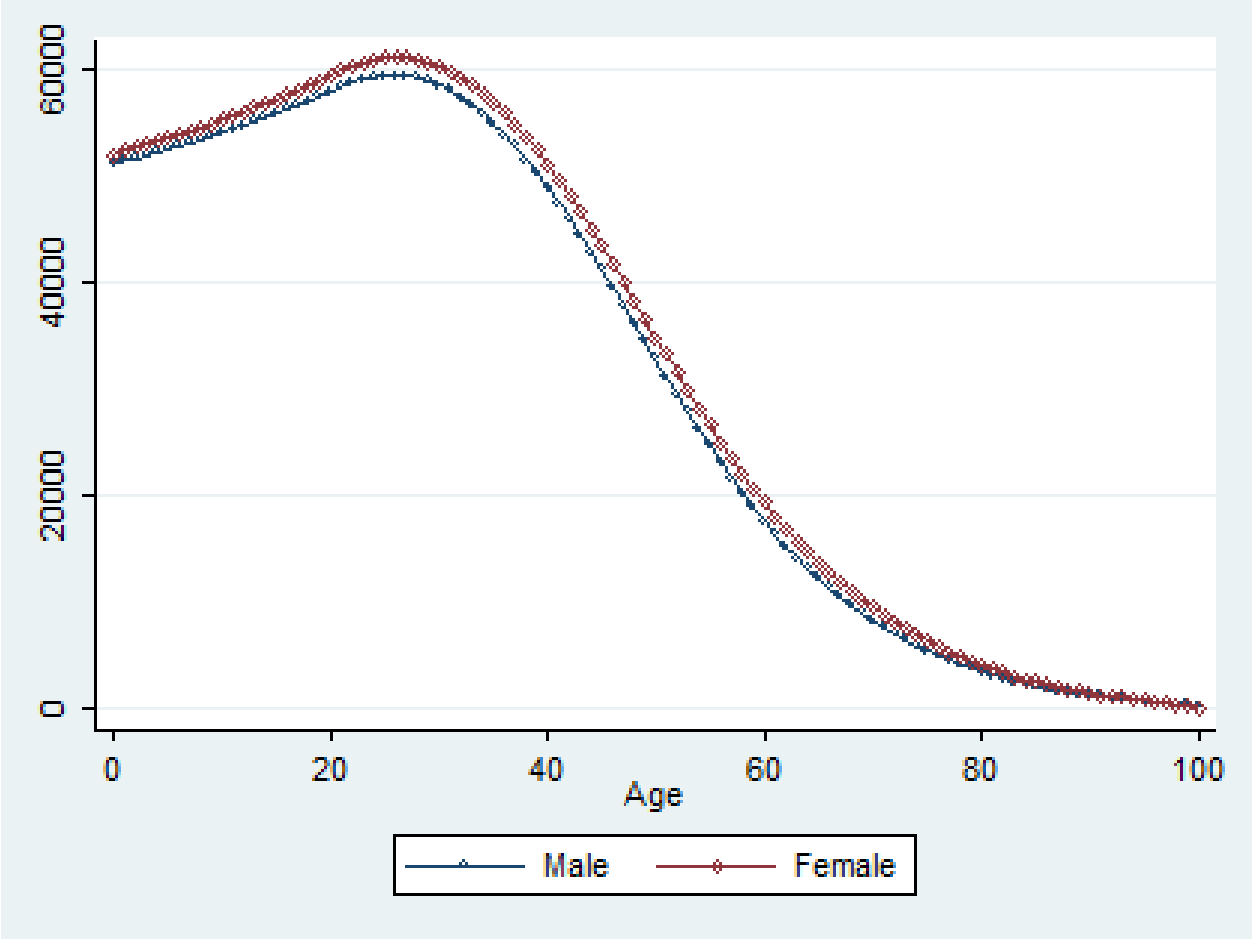
Female life expectancy by age, Korea, 1970-2010



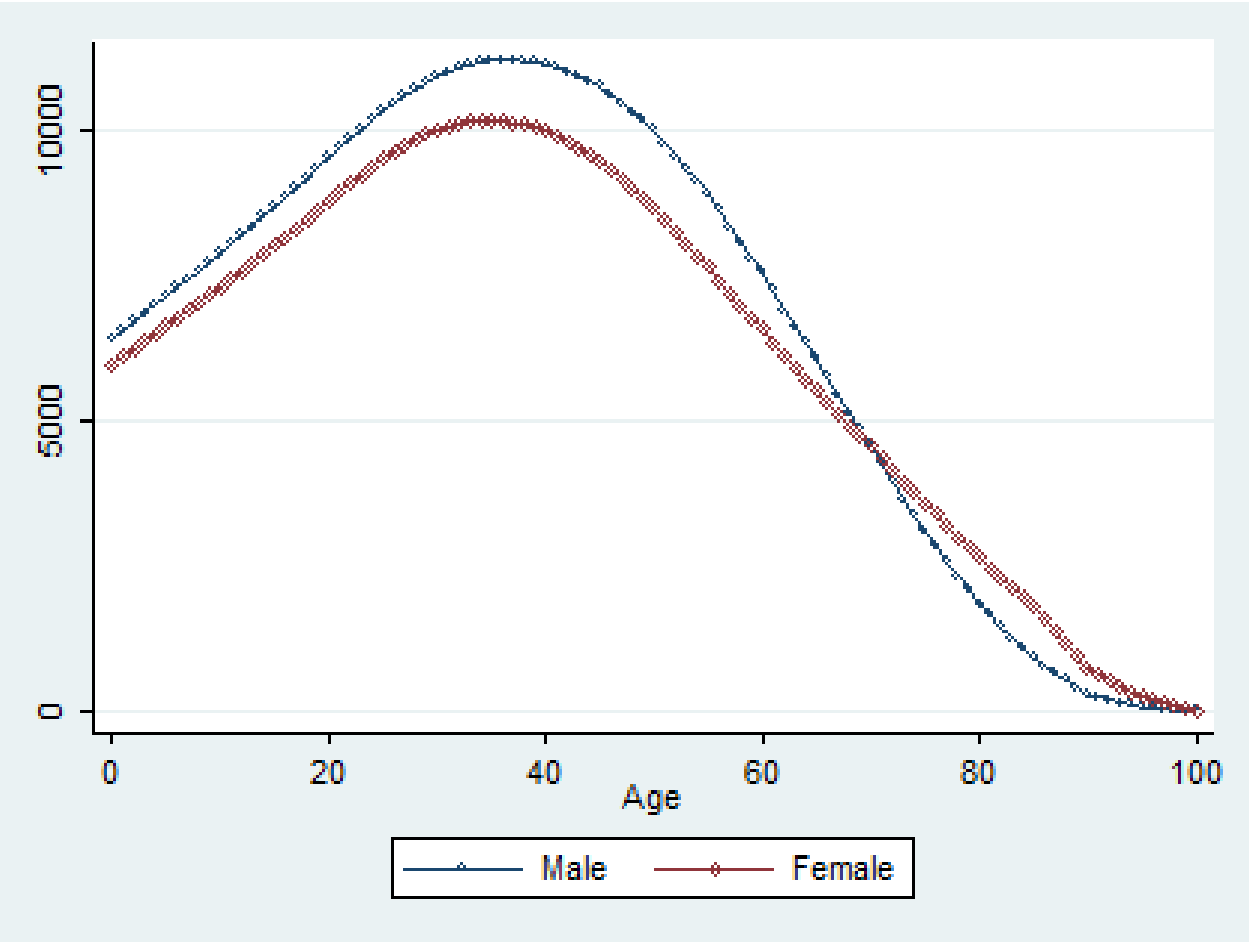
Full consumption by age, Korea, (2010, 10,000 Won)



Value of life by age, Korea, (2010, 10,000 Won)



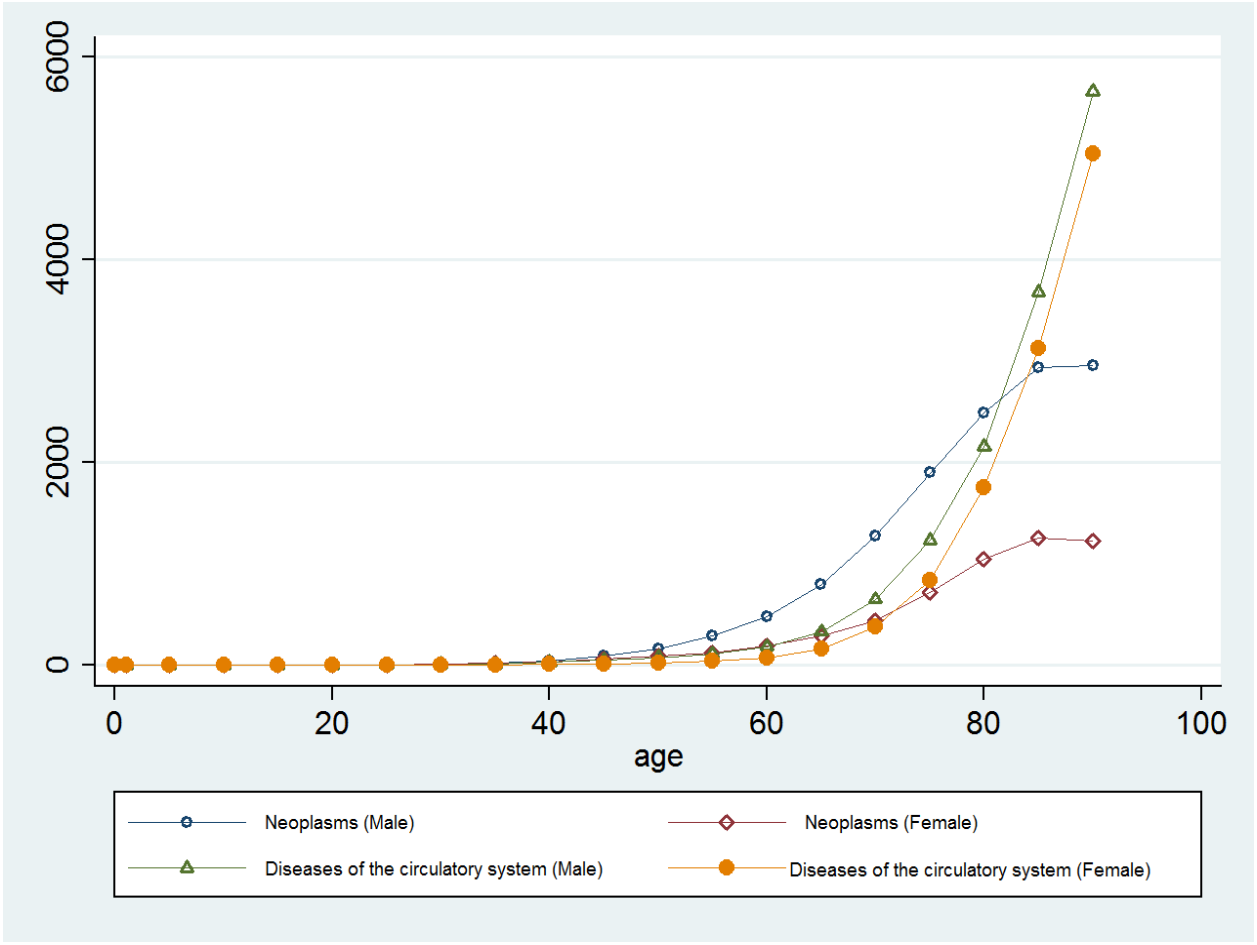
Economic gain from increased longevity by age, Korea, (2010, 10,000 Won)



Aggregate economic gains from increased longevity, Korea, (2010, trillion won)

	1970-2010	
Males	2,509	
Females	2,236	
Total	4,744	119 per year (vs. nominal GDP 1,173 in 2010)

Mortality caused by neoplasms and diseases of the circulatory system, Korea, (2010, per 100,000 people)



Potential economic gains from 10% mortality decline, Korea, (2010, trillion won)

Males	1,290	
Females	1,285	
Total	2,576	(vs. nominal GDP 1,173 in 2010)

Others and Conclusion

- Disease burden can be measured by prevalence, fatality rate, decline in health status and quality of life, and financial cost.
- Decision-analytic modelling
- Greater need for more economic evaluation and cost-effective health interventions especially under the Korean National Health Insurance.

Disease Burden, Korea, Chung 2015

Table 1. Types, description, and sources of cost data

Type of costs		Description	Data sources
Medical costs		Medical services covered by NHI	National health insurance statistical yearbook
		Medical services not covered by NHI	Survey on the benefit coverage rate of national health insurance
			Korea national health and nutrition examination survey
Non-medical costs	Transportation	Number of visits (outpatients)	National health insurance statistical yearbook
		One-way cost	National health panel survey
	Informal nursing	Daily cost	Korean health panel survey
		Daily cost	Korean patient helper society
		Days of hospitalization	National health insurance statistical yearbook
	Productivity costs	Potential earnings lost due to premature death	
		Number of deaths	Cause of death statistics
		Life expectancy and survival rate	Life tables
		Employment rate	Economically active population survey
		Wages	Survey on labor conditions by employment type
		Potential earnings lost to visit medical institutions (time costs)	
		Transportation time	Korean health panel survey
		Days of hospitalization	National health insurance statistical yearbook
		Number of visits (outpatients)	National health insurance statistical yearbook
		Wages	Survey on labor conditions by employment type

NHI, national health insurance.

Thanks (wankyo@snu.ac.kr).