The Japanese Future Elderly Model

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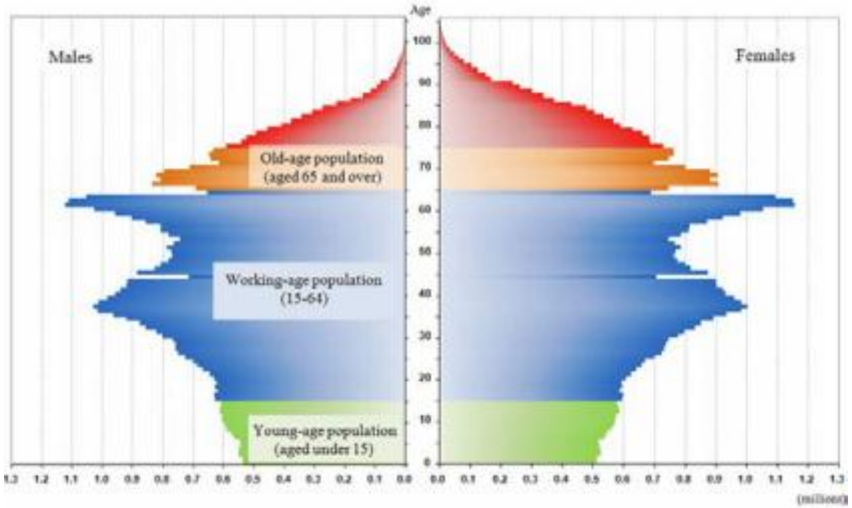
Background: Aging in Japan

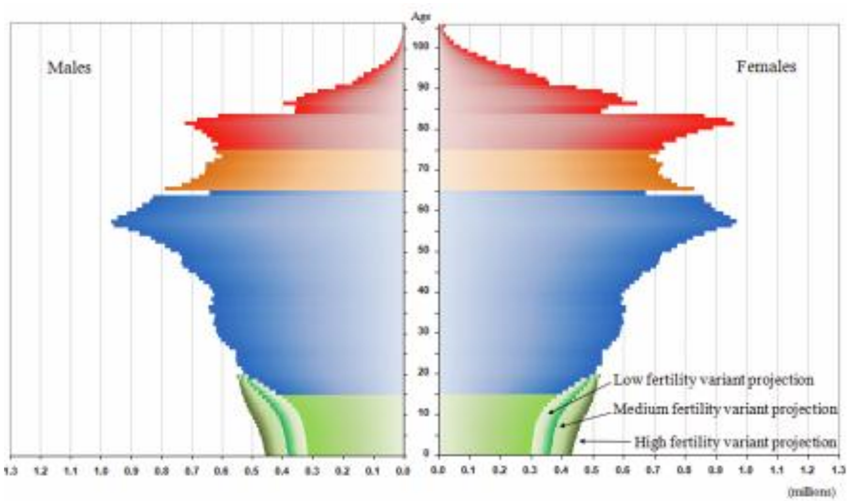
- **Pronounced population aging**
  - Low fertility and longevity → decline in population to 87 million by 2060 (currently ~127 million)
  - 40% of population over 65 by 2060
  - Highest proportion of elderly adults in the world

Japanese Population Pyramid, 2030-2060

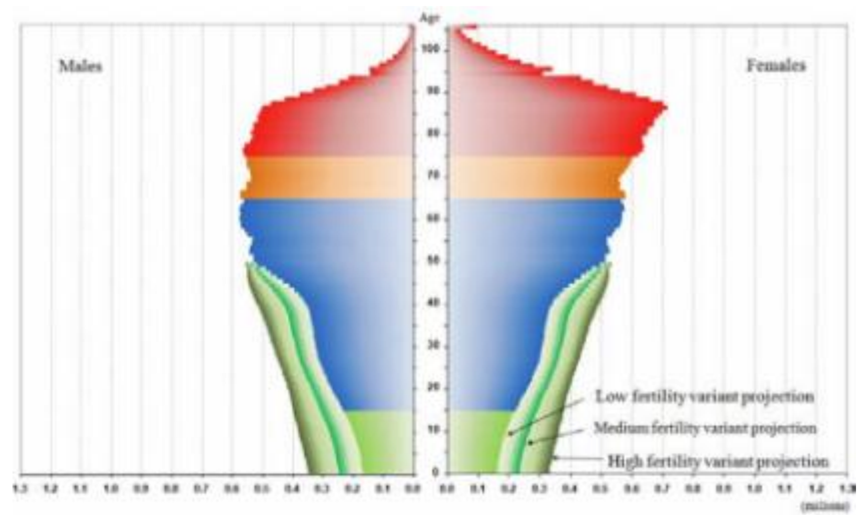
2010



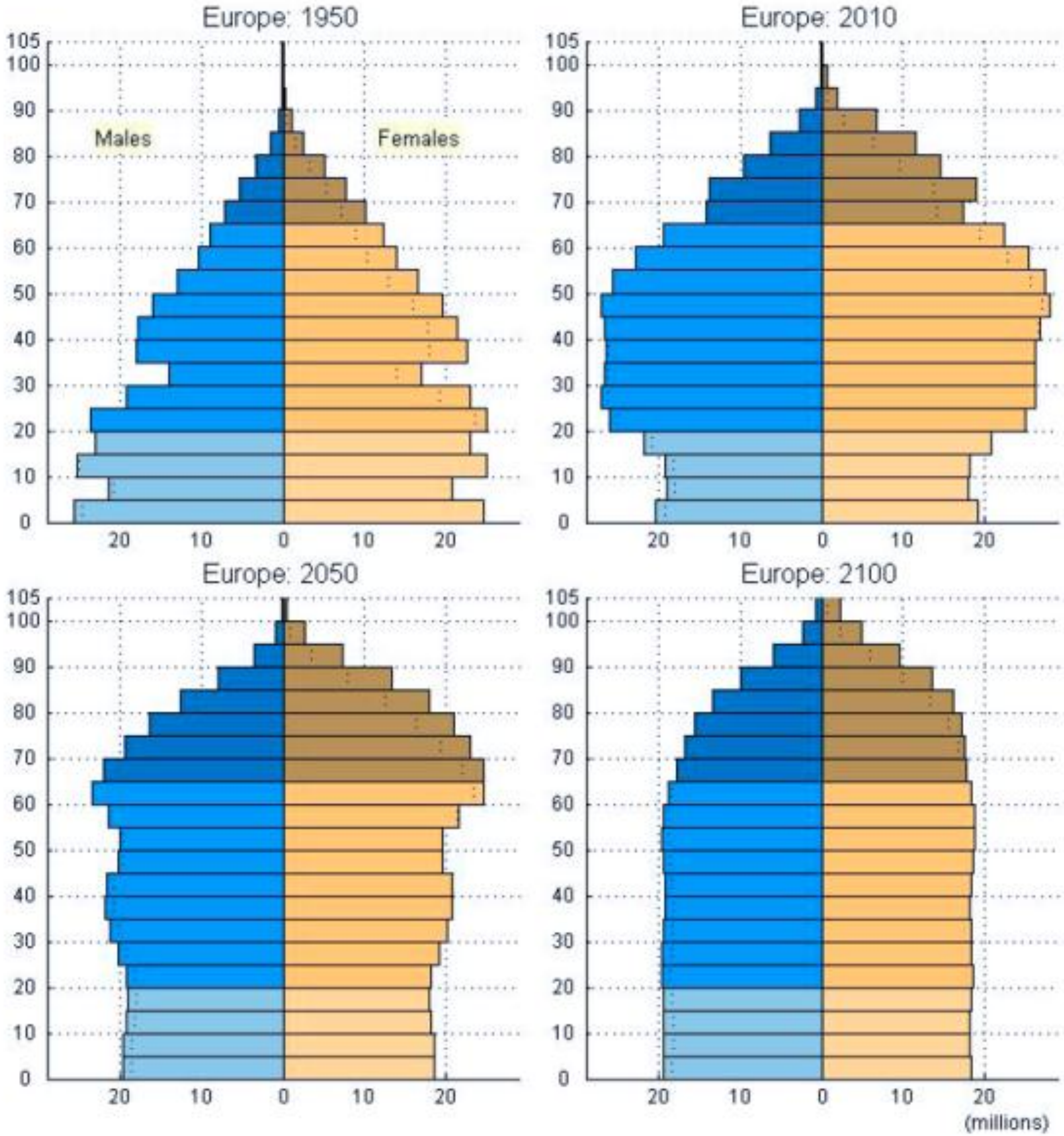
2030



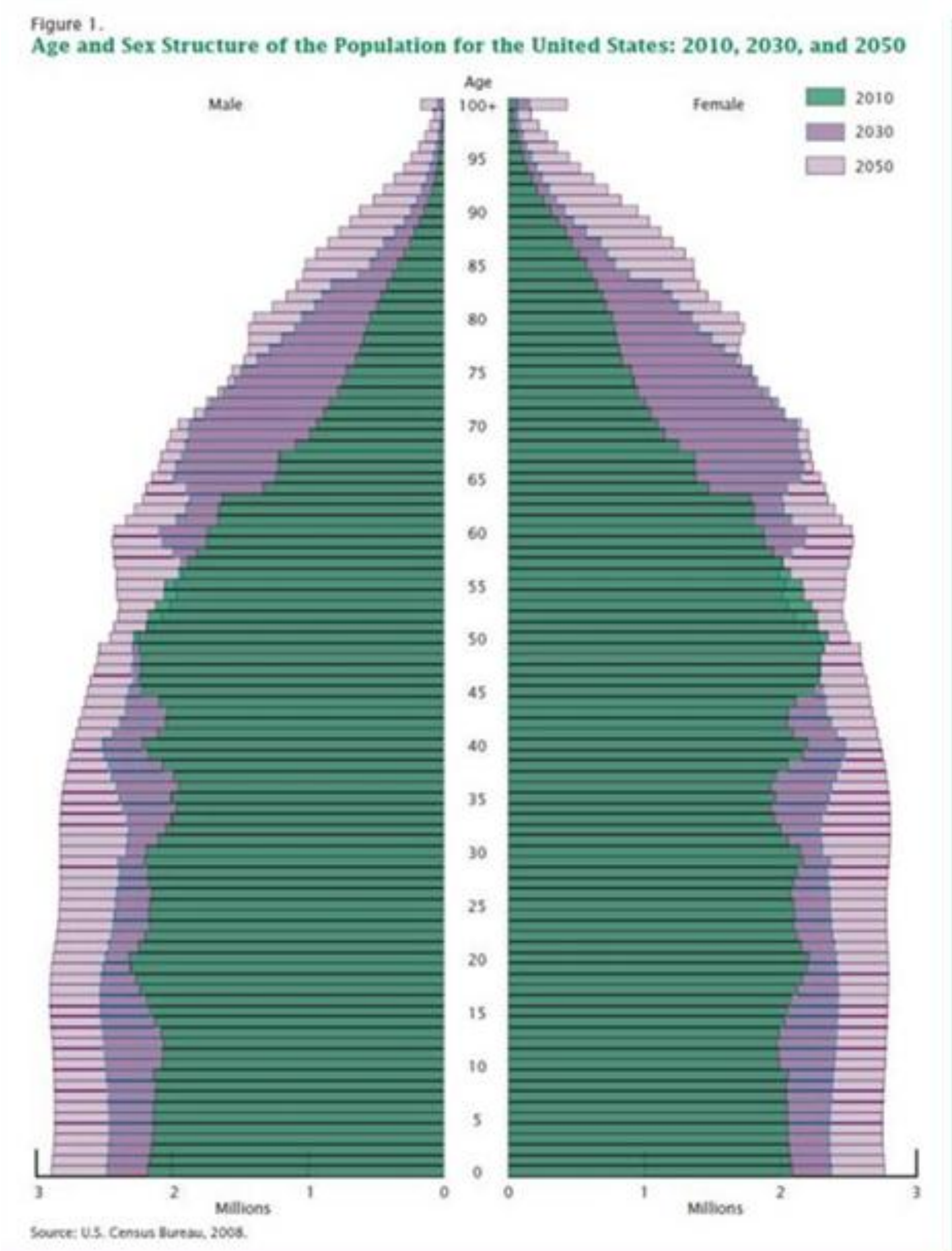
2060



Source: NIPSSR (2012)



European Population Pyramid, 2010-2100



US Population Pyramid, 2010-2050

Most Health Spending Forecasts Do Not Account For Health

- Most common approach: time series forecasts based on age and sex specific trends in health spending
- Most models do not explicitly address competing risks problem

Policy Uses for A Future Elderly Model

- Policy Simulation
  - Changes in medical technology
  - Changes in medical care delivery
  - Prevention programs
- Outcomes: population health, disability, long-term care, medical spending, work…

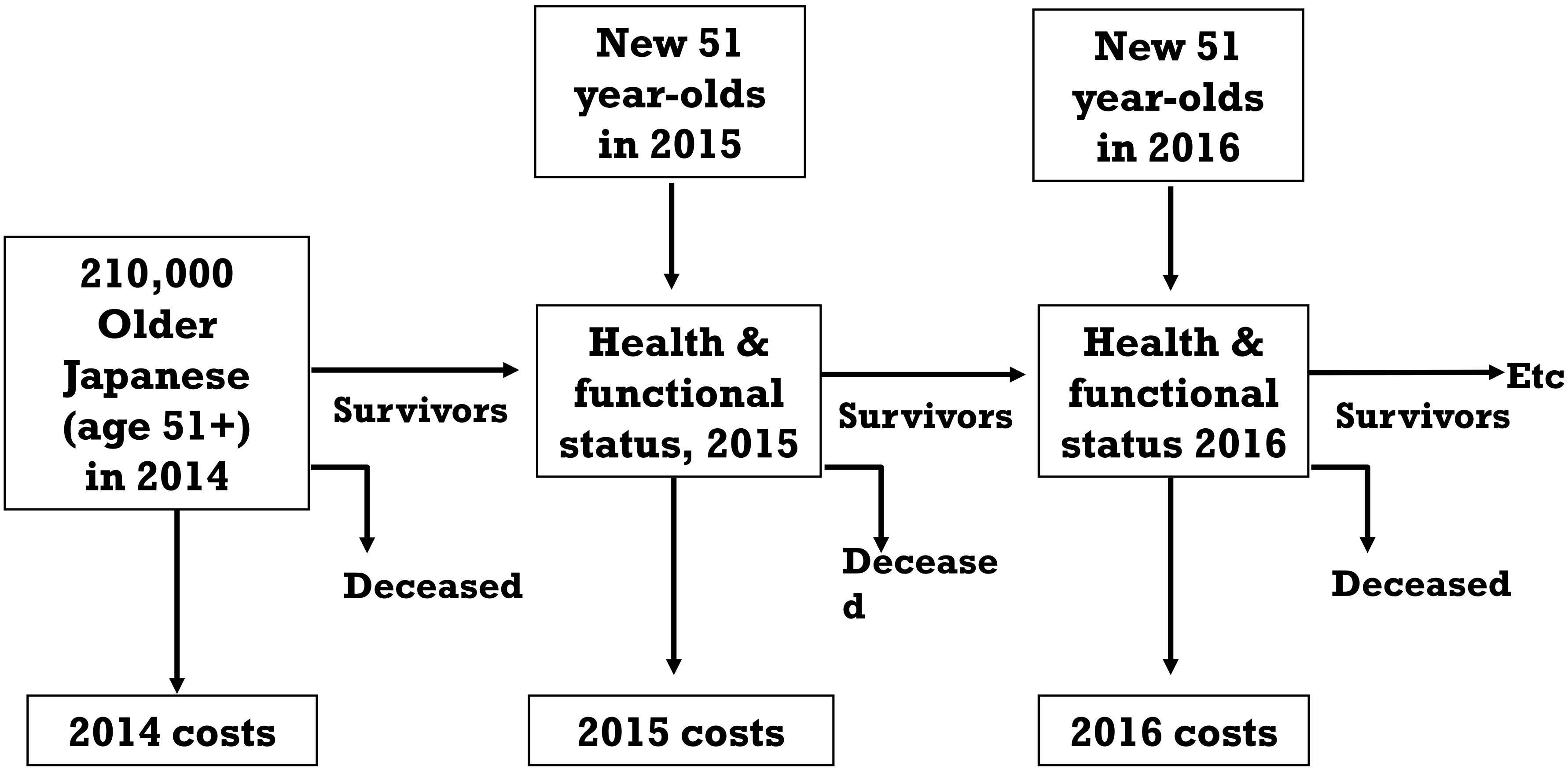
+ Previous research on medical spending projections for Japan

Author (year)	Method	Results (% of GDP)
Kitaura and Kyohtani (2007)	Following OECD (2006) • Using per capita cost by age group. • Estimating death-related costs and survivors’ cost separately.	6.5% (2006) →7.5-9.0% (2025)
Ueda et al. (2010)	Following EC (2009 & 2012b) • Using per capita cost by age group. • Per capita cost is assumed to rise at the growth rate of per capita GDP (pure demographic scenario).	7.0%(2008) →10.76% (2050)
Ueda et al. (2011)		7.1% (2008) →11.7% (2060)
Ota and Nakazawa (2013) and Ueda et al. (2014)		7.8% (2010) →10.0-14.4% (2060)
Iwamoto and Fukui (2012)	Following MHLW (2012)	Not shown as % of GDP

Research Goal

- To develop a demographic and economic **simulation model** to analyze impact of
  - Demographic change
  - Aging
  - Population Health
- On
  - Health spending
  - Disability
  - (Need for long-term care)
- The idea is to develop a way to explore the implications of the best available data

Microsimulation Tracks Simulated Individuals Over Time



Overall strategy

- Estimate **disease transition probabilities**
- Estimate **mortality rates** conditional on disease conditions
- Construct a **Markov microsimulation model**
- Project/simulate **future medical conditions** and **functional status/need for care** (ADLs, IADLs, cognition and social status measures) and other outcomes

Japanese Study of Aging and Retirement (JSTAR)

- First longitudinal dataset on middle-aged and elderly Japanese
  - Two waves of interviews in 2007 and 2009
  - 3,862 respondents between 47 and 75 in five Japanese cities
  - Survey questions mirror other surveys conducted internationally (such as the US Health and Retirement Study)
- Good information on physical and mental limitations

Nihon University Japanese Longitudinal Study

- 1,921 respondents over age 80
- Survey dates -- 1999 and 2001
- NUJLSOA also includes detailed information on ADLs and IADLs,
- Has only 14 of the 19 health conditions available in JSTAR.

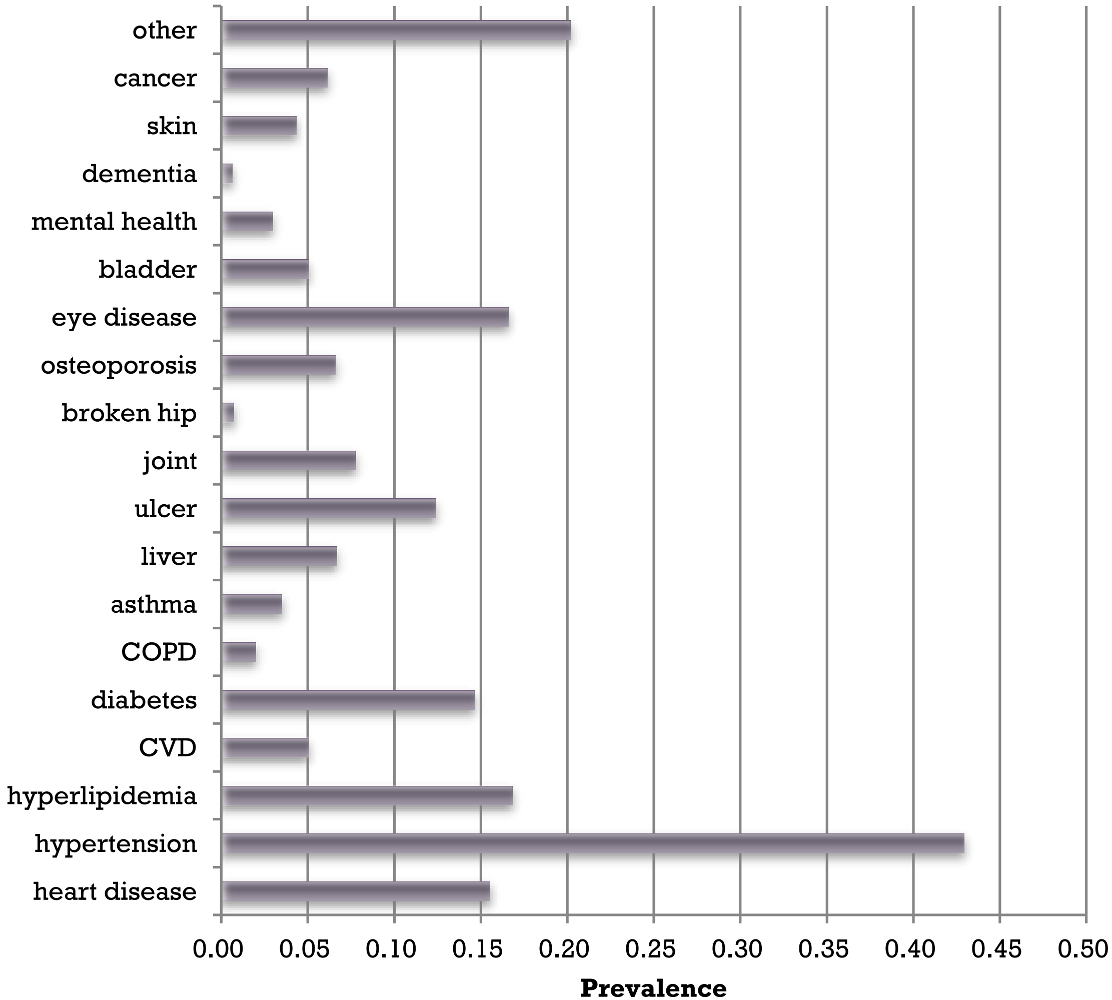
Methods: Future Elderly Model

- **Health Transition Model**
  - **Logistic regression** – to estimate probability of transitioning into 19 mutually exclusive health states from 2007 to 2009
  - Focus on diseases most relevant and costly in a Japanese population
  - Treat all diseases as absorbing states
- **Disability Model**
  - **Ordered logistic regression** to estimate ADLs/IADLs
    - Outcomes defined as having difficulty in 0, 1, 2, or 3+ (instrumental) activities of daily living

Methods: Health Transition Models

- **Health status measures**
  - Heart disease, hypertension, hyperlipidemia, cerebrovascular disease, diabetes, chronic obstructive pulmonary disease, asthma, liver disease, ulcer, joint disease, bone fractures/broken hip, osteoporosis, eye disease, bladder disease, mental health disorder, dementia, skin disease, cancer and all other diseases
- **Other covariates**
  - Age, age^2, sex, smoking history, obesity

Prevalence of Health Conditions



Disability Outcomes

- **ADLs** follow HRS definition
  - whether respondents are able to dress themselves, walk around in their room, bathe, eat, get in and out of bed, and use Western-style toilets
- **IADLs**
  - whether respondents are able to take public transportation alone, shop for daily necessities, prepare daily meals, pay bills, handle their own banking, make telephone calls and take medications
- **Social Engagement**
  - visiting friends, being called on for advice, visiting sick friends, and initiating conversations with younger individuals
- **Intellectual Engagement**
  - filling out pension forms, reading the newspaper, reading books or magazines, and taking interest in the news

+ Summary Statistics – - Disability Model

ADL	Prevalence
0	95%
1	3%
2	1%
3+	2%

IADL	Prevalence
0	93%
1	4%
2	1%
3+	2%

Receives Aid	Prevalence
Home Care	6%
Nursing Care	6%
Physical Help	22%
Help for Chores	43%

Mortality Data

- **Model requires estimates of mortality rates conditional on health status, age, and sex**
- **Vital Statistics (Japanese MLHW)**
  - Age/sex specific causes of death
  - But the available data provides a single cause of death, not the health status vector at death

Maximum Likelihood Model of Conditional Mortality Rates (I)

- A disease may be common in the population, but not on death certificates because:
  - The disease does not cause mortality
  - The disease contributes to mortality, but is not typically a proximate cause of death

Maximum Likelihood Model of Conditional Mortality Rates (II)

- Our approach is partly identified on the difference between disease prevalence in JSTAR and in Vital Statistics data
  - Diseases that co-occur commonly with diseases that show up on death certificates are assumed to contribute to mortality
- We compare results against a purely clinical approach to the problem
  - Both approaches yield similar rankings of conditional mortality rates

Replenishing the Model with New 50 year olds

- We draw new 50-year olds for future years by assuming that future 50-year olds will have the same health distribution as current 50-year olds
  - Incoming 50-year olds are drawn from JSTAR
- This assumption can be relaxed (as it has in the US version of the FEM)

Japan FEM Microsimulations

- Once the model parameters are estimated, we simulate
  - Health status
  - Physical/mental functioning
  - Health expenditures
- Of Japan's 50+ elderly into the future (2010-2040)

Model Checks

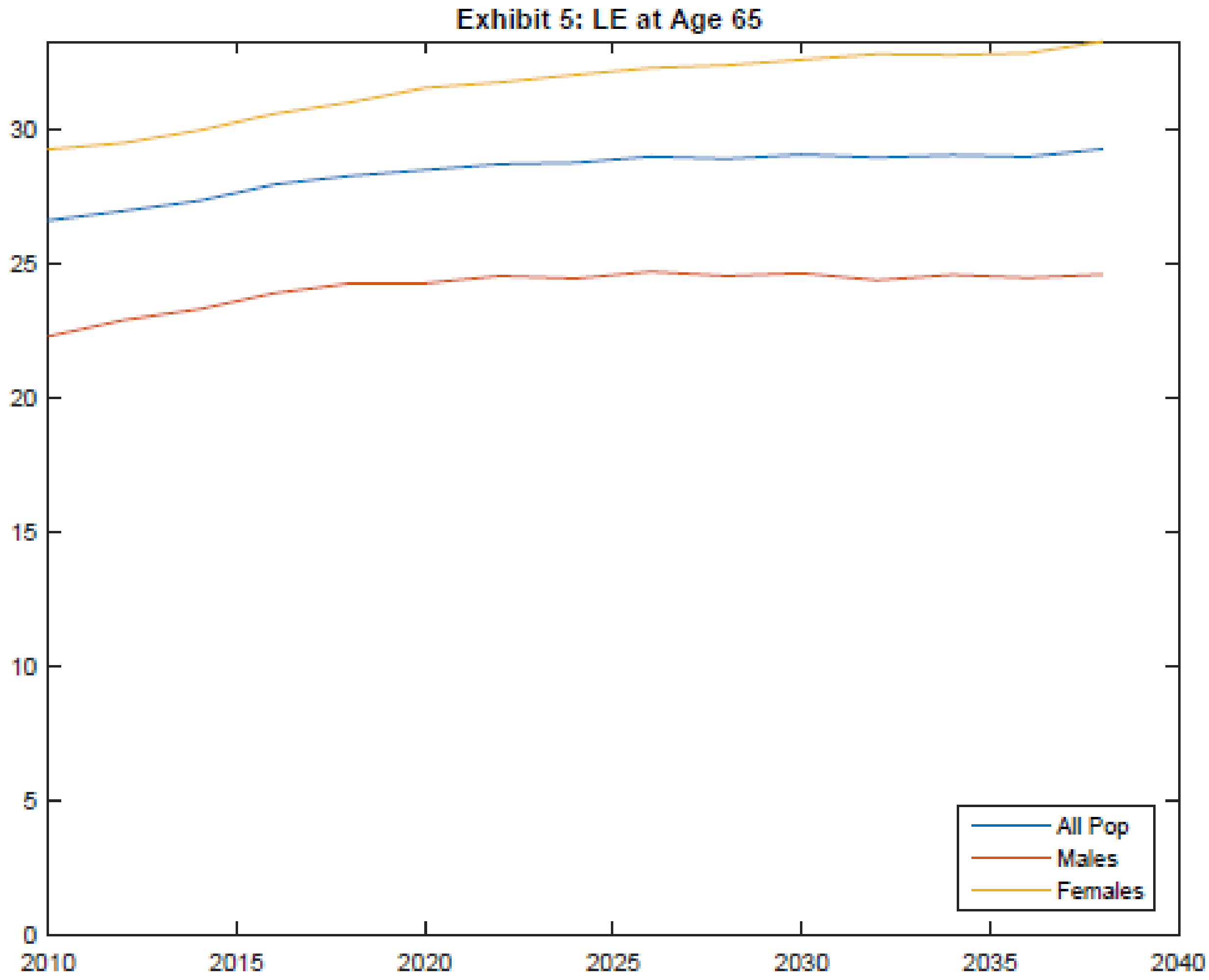
- Simulate age structure and health of the population for future years and check against official projections.
- Backcasting exercise
  - Start model in 2000 and backcast for years 2001-2010
  - Check population, mortality, and health predictions against actual data
  - This exercise is still in process

Results under two assumptions:

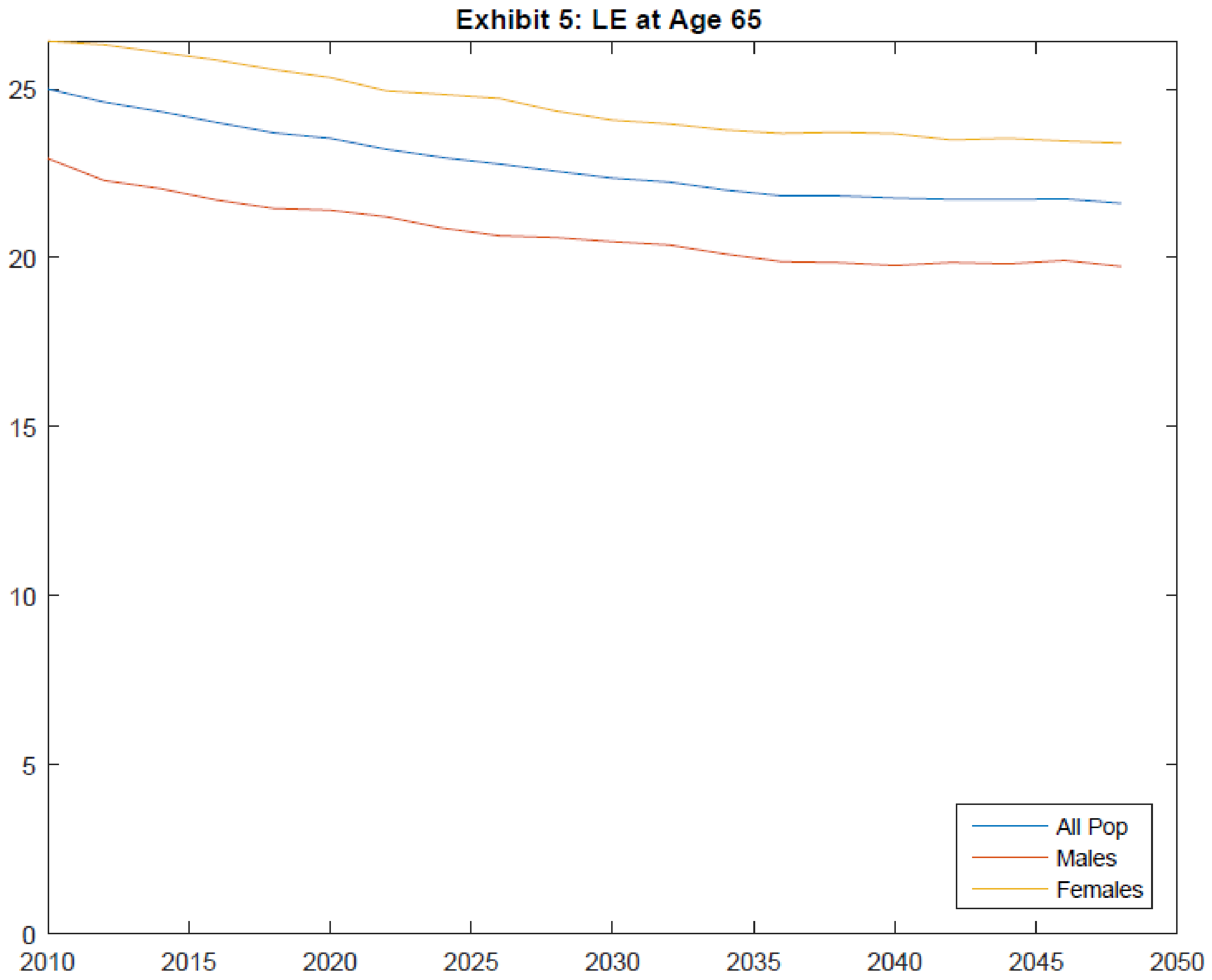
1. Optimistic life expectancy gain (official)

2. Pessimistic life expectancy gain

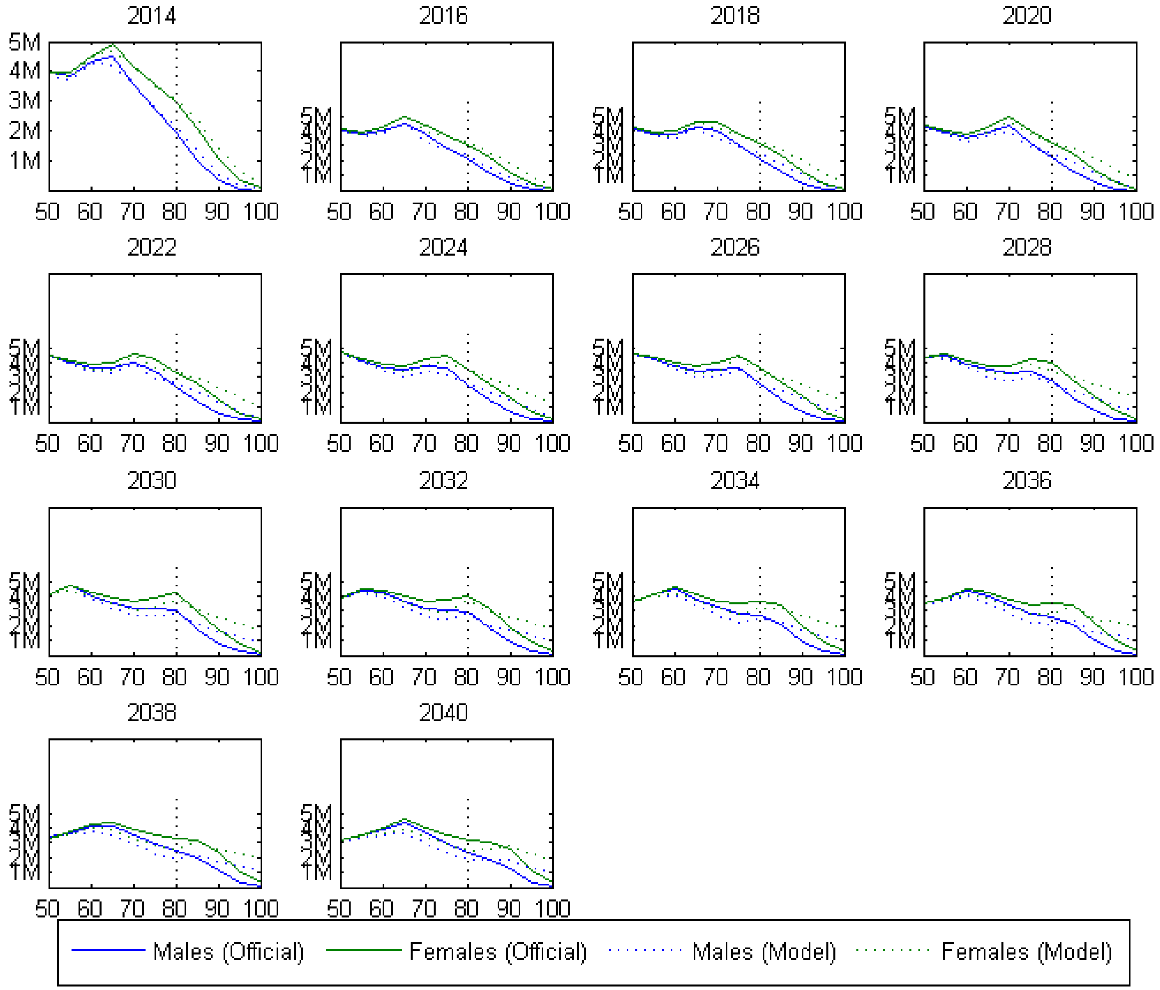
Life Expectancy at 65 Forecast (Optimistic Scenario)



Life Expectancy at 65 Forecast (Pessimistic Scenario)



Future Population vs. Official Projections (Optimistic)



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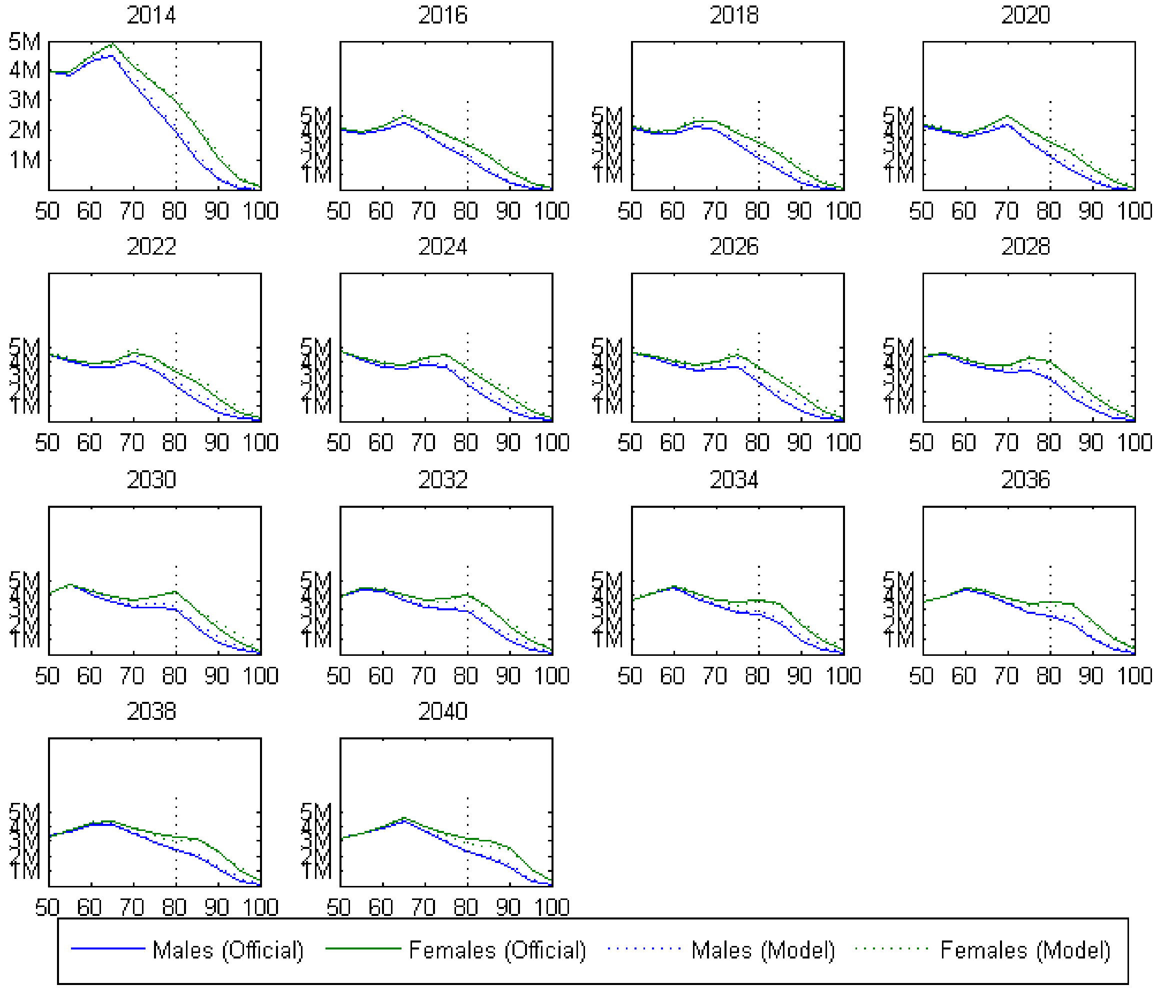
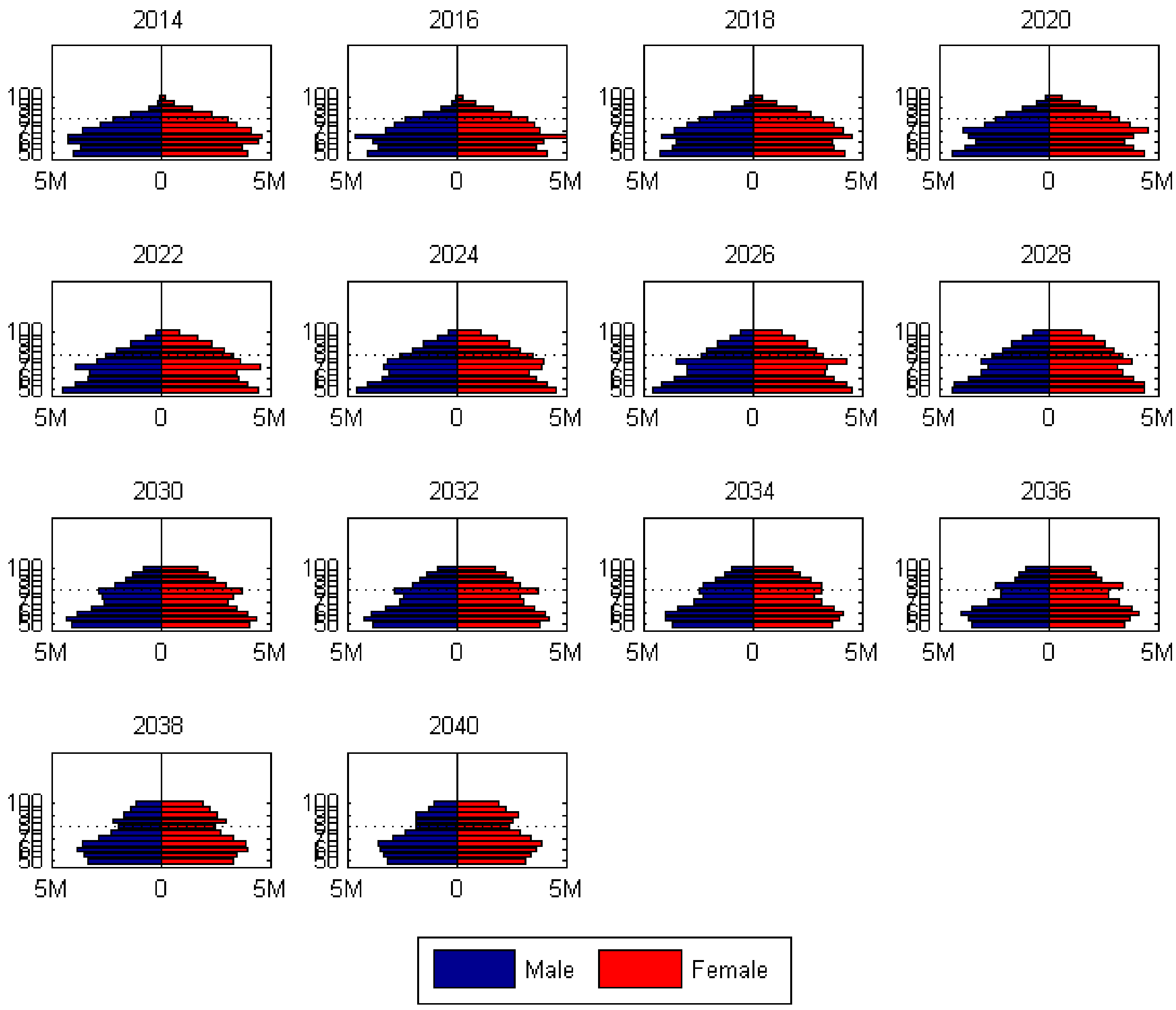
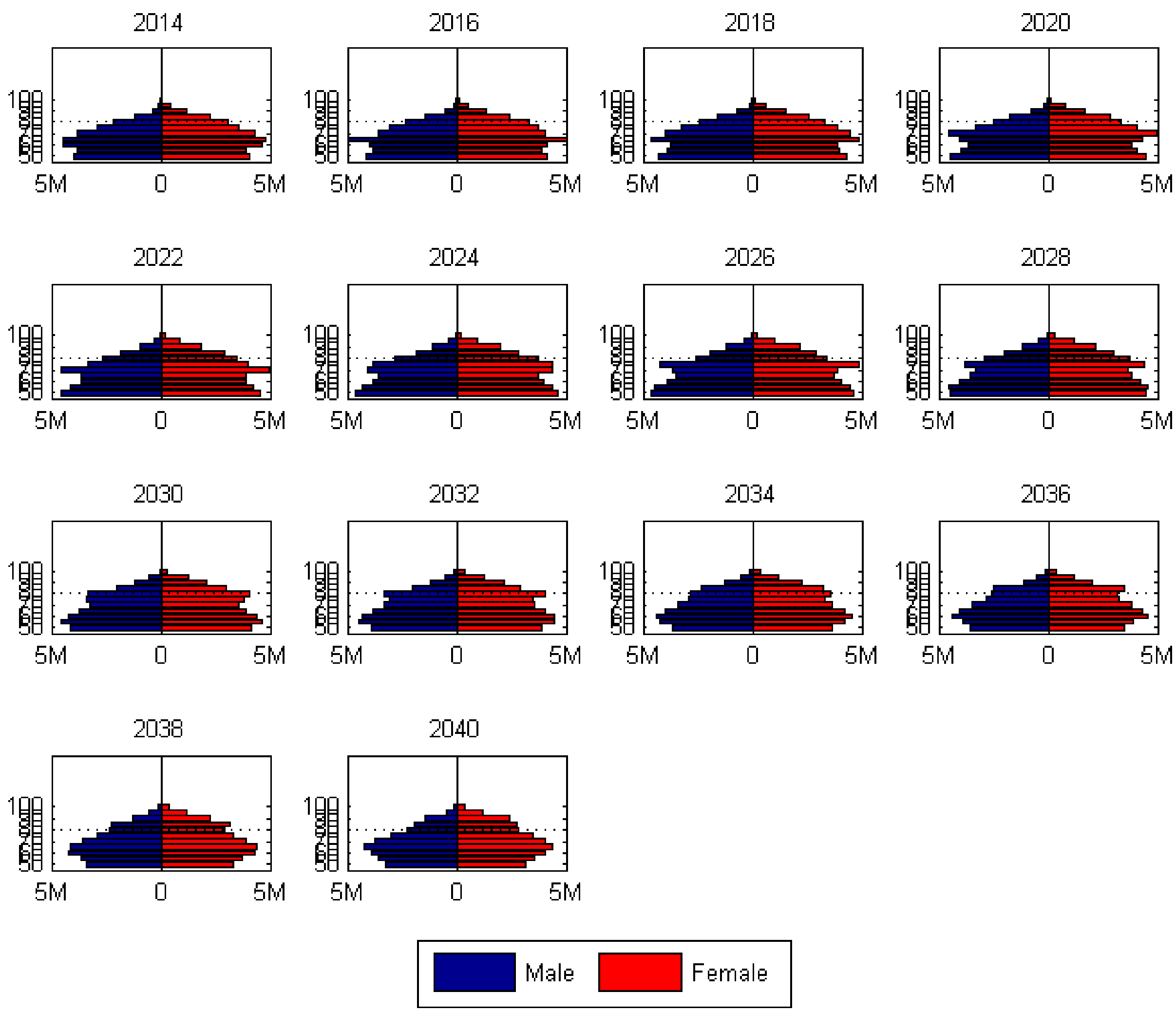


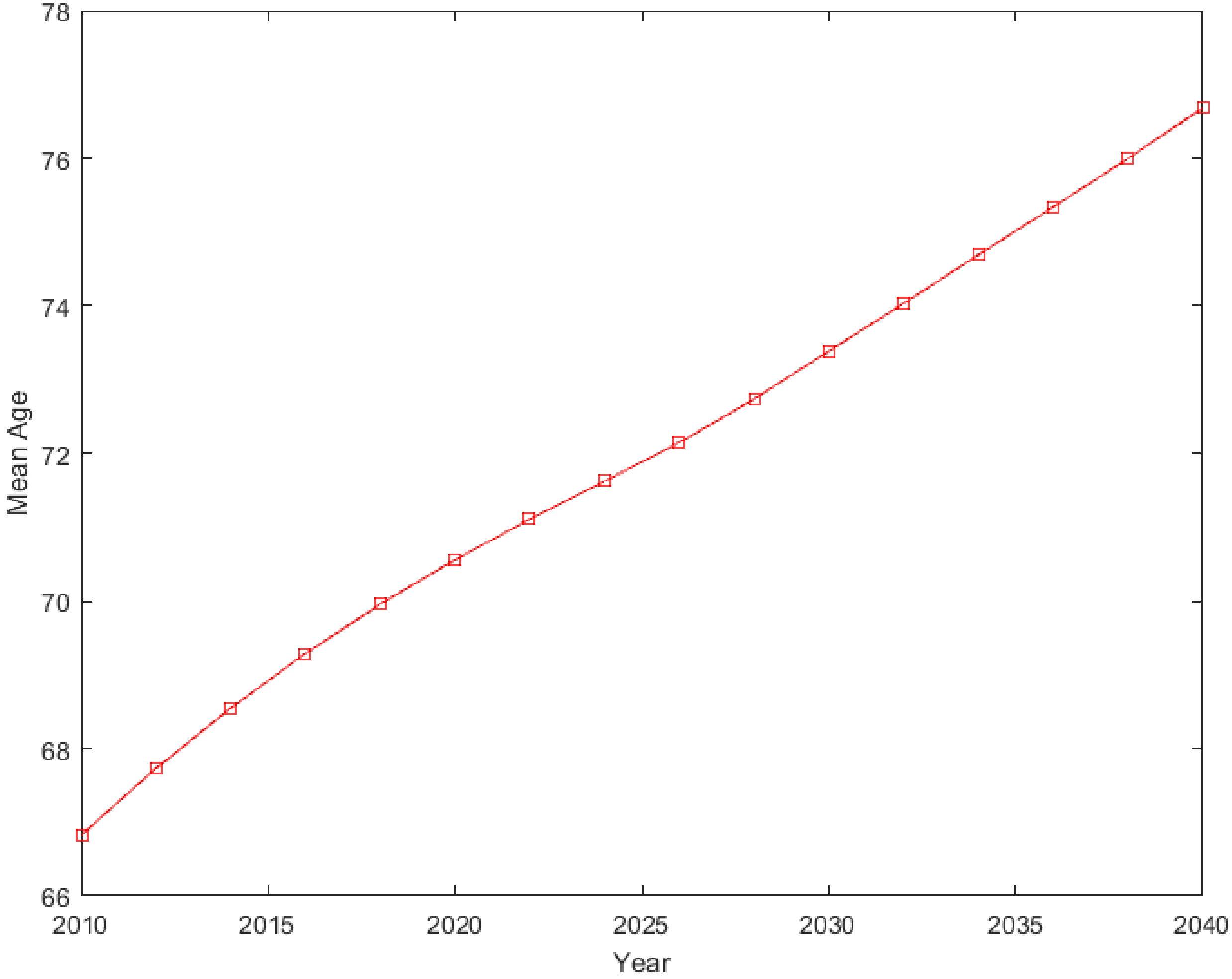
Population Age Structure (Optimistic)



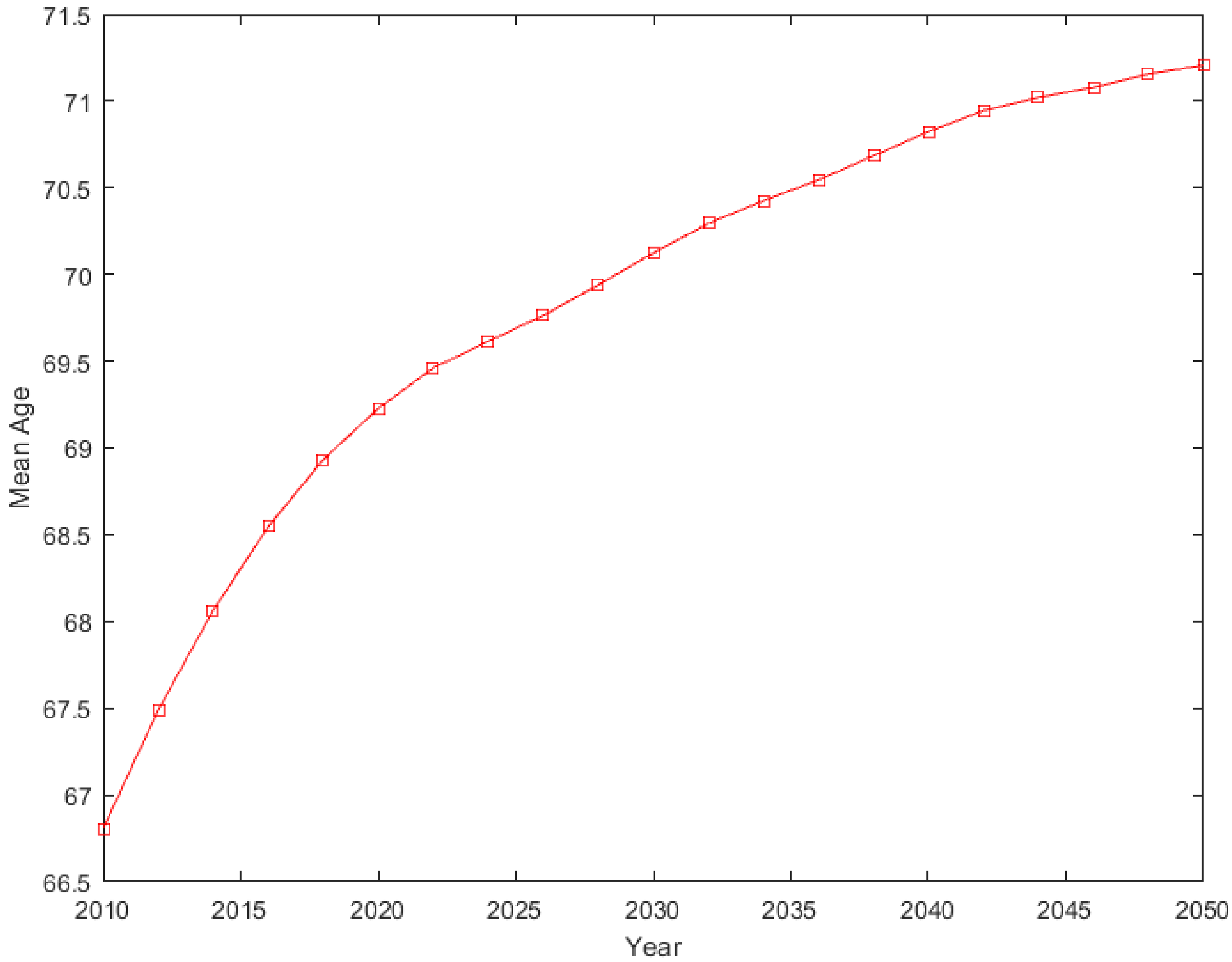
Population Age Structure (Pessimistic)



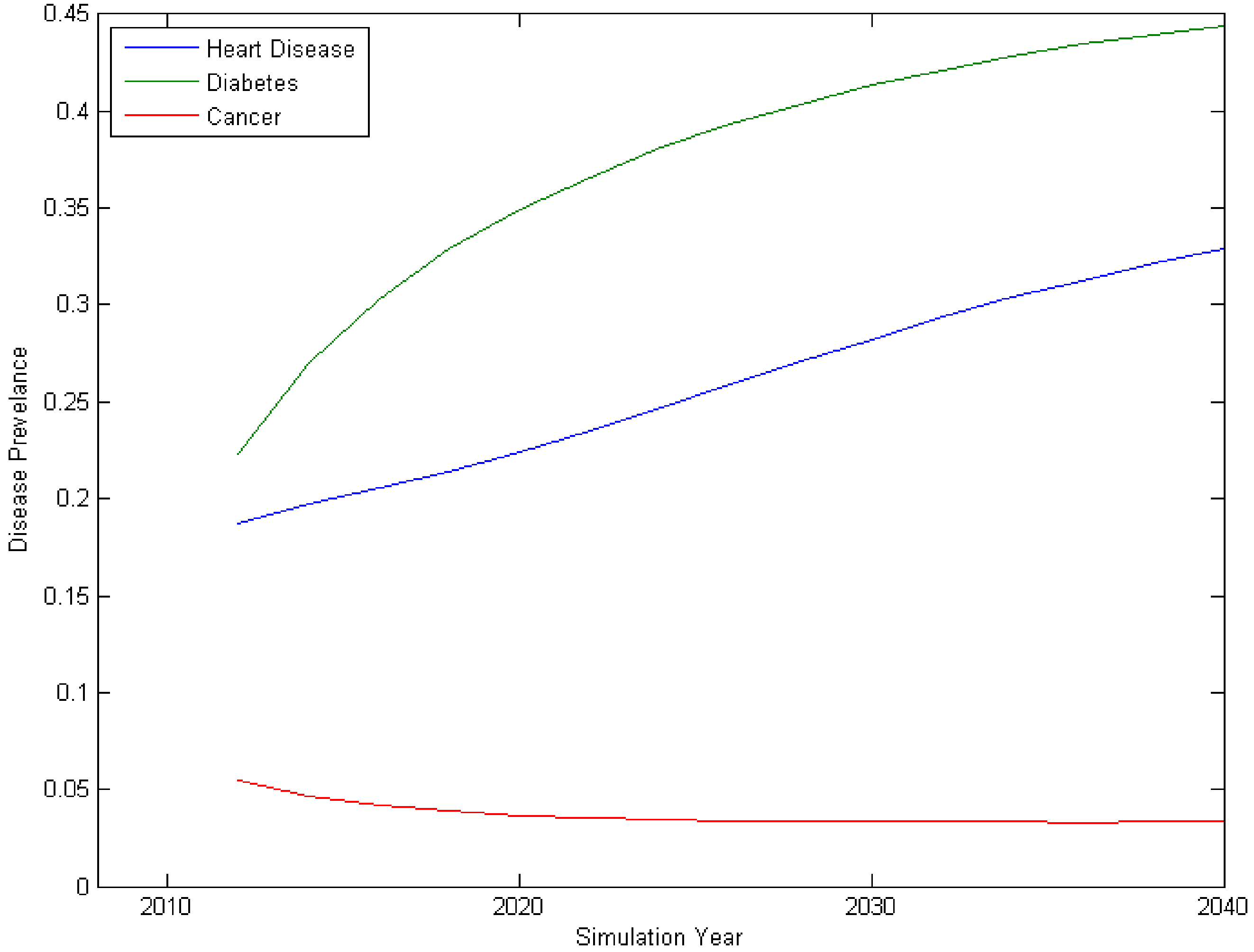
Mean Population Age (50+, Optimistic)



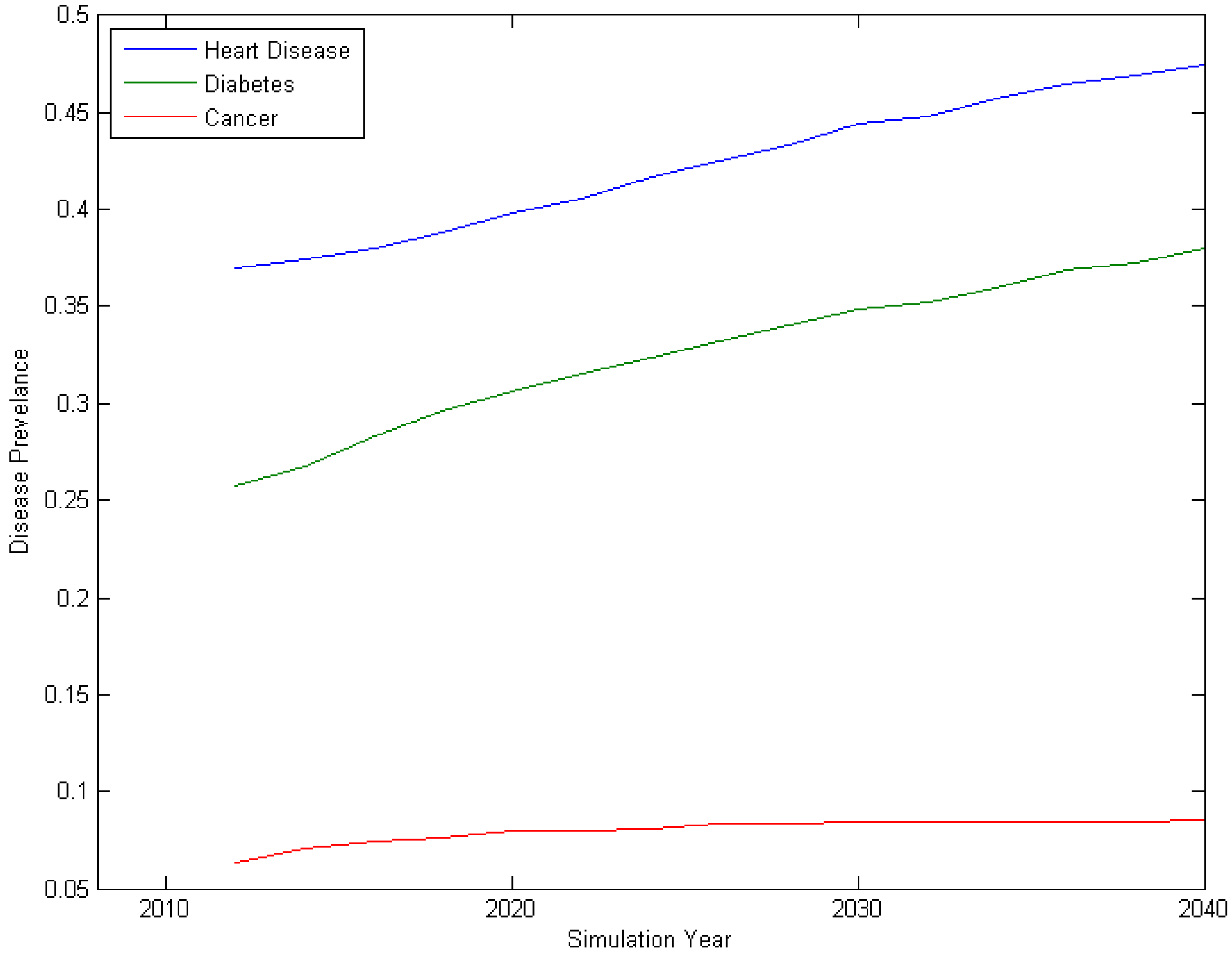
Mean Population Age (50+, Pessimistic)



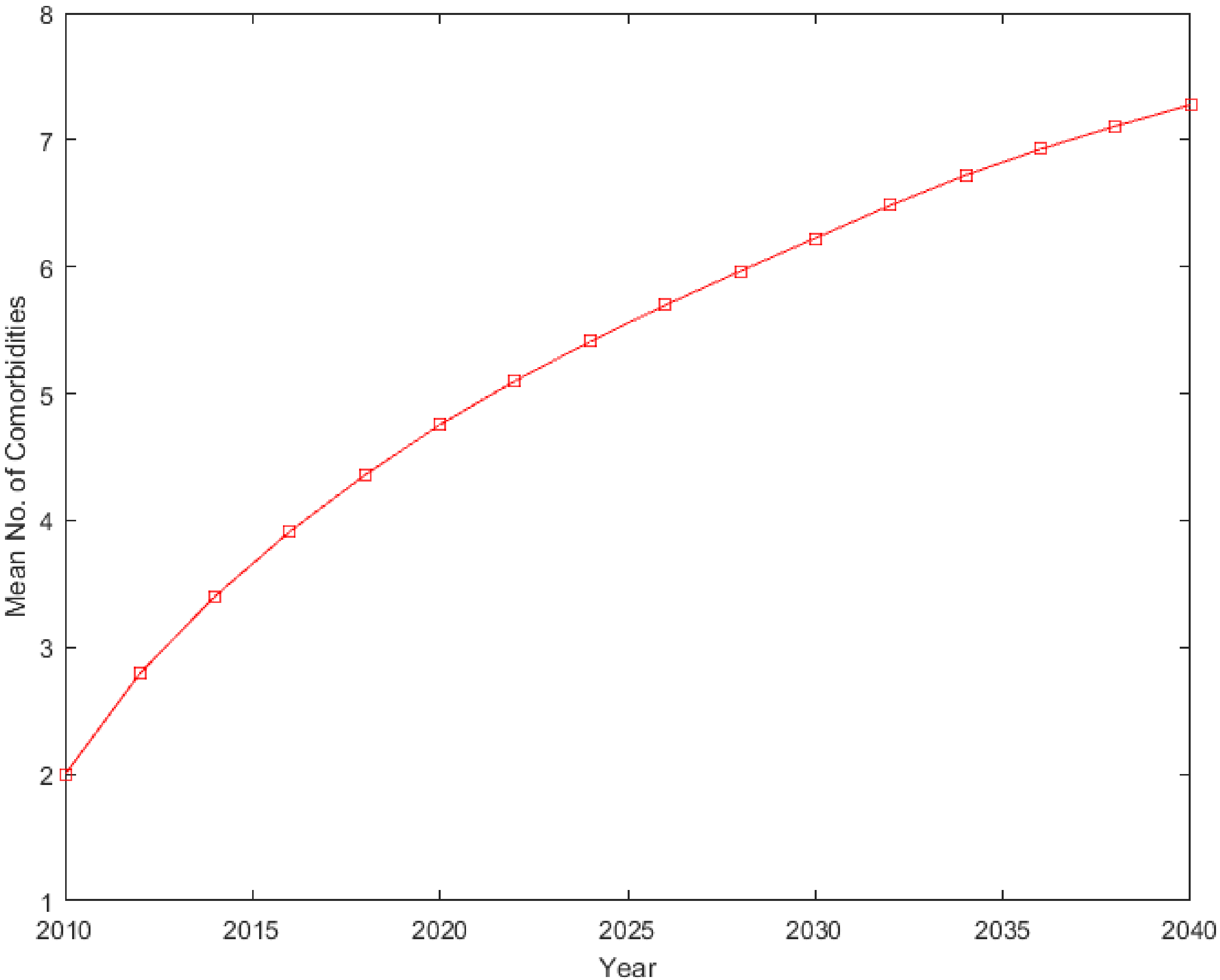
Future Disease Prevalence (Optimistic)



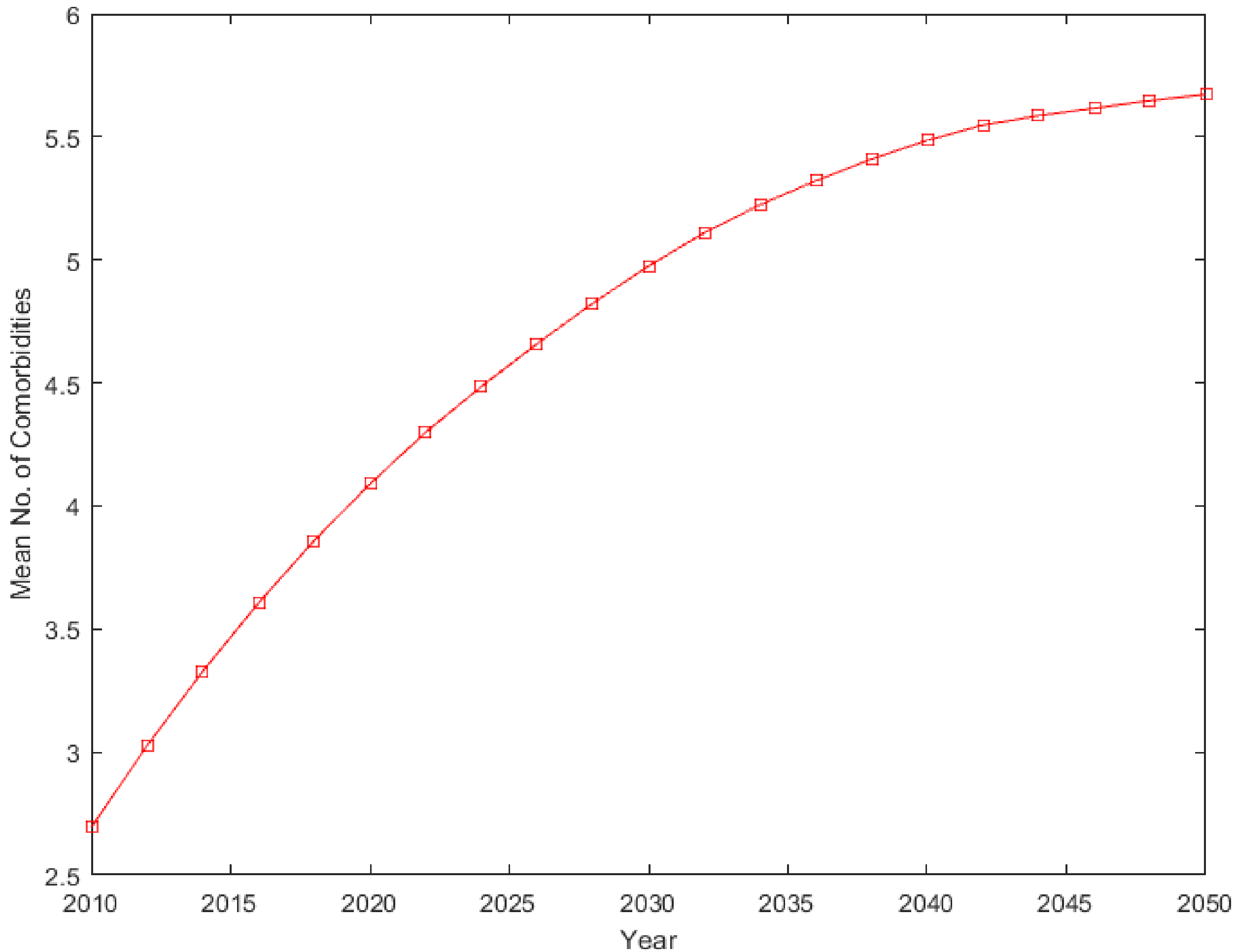
Future Disease Prevalence (Pessimistic)



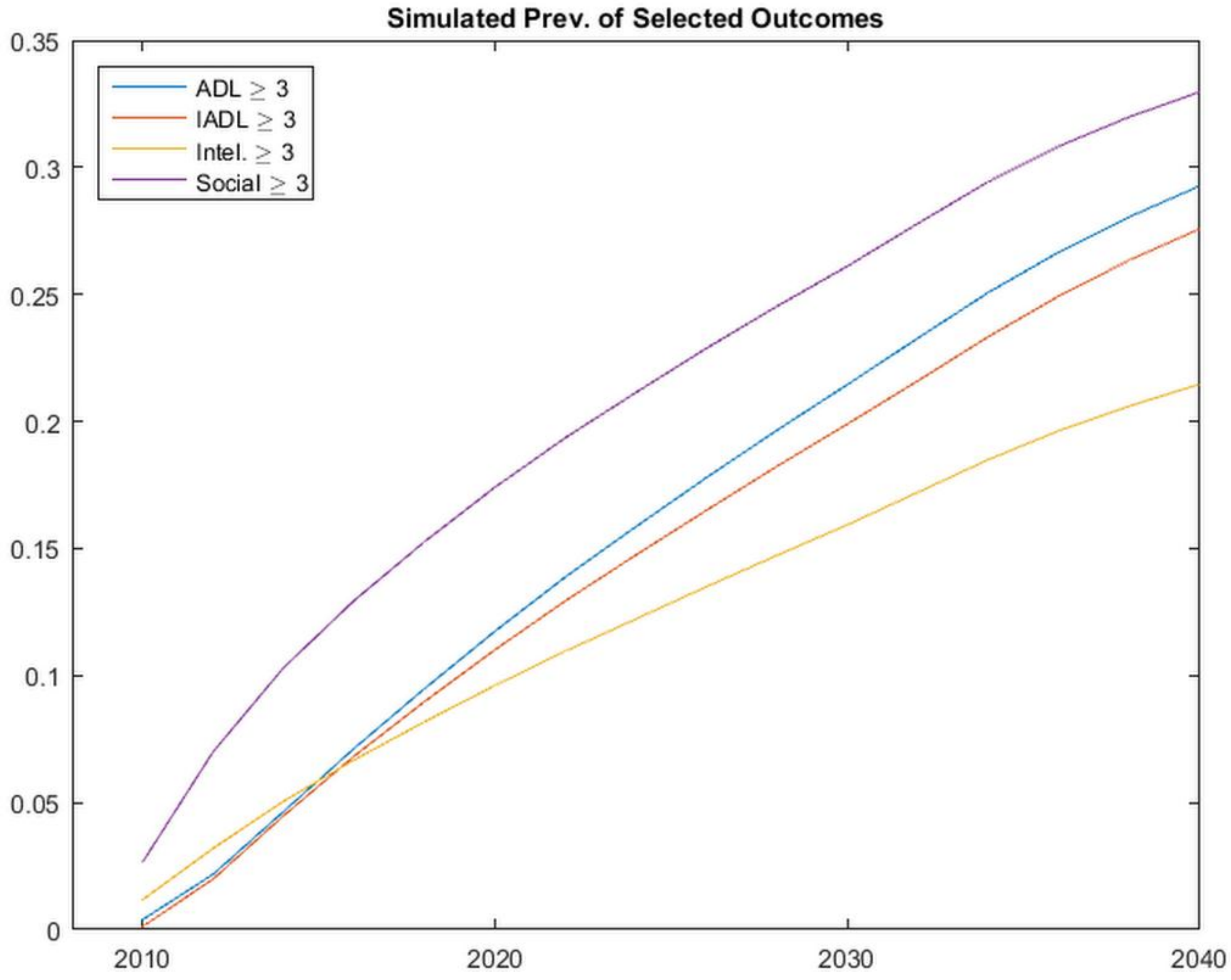
Projected Number of Comorbidities (Optimistic)



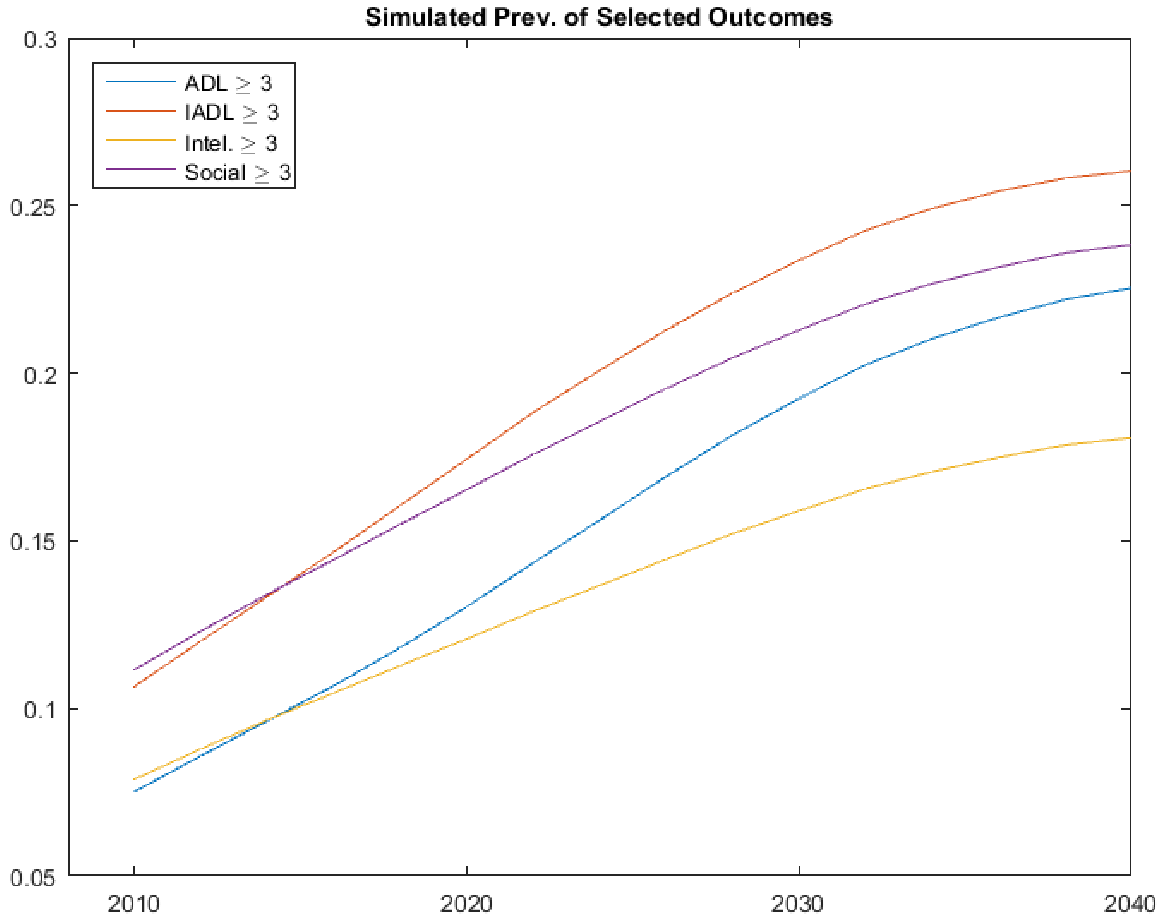
Projected Number of Comorbidities (Pessimistic)



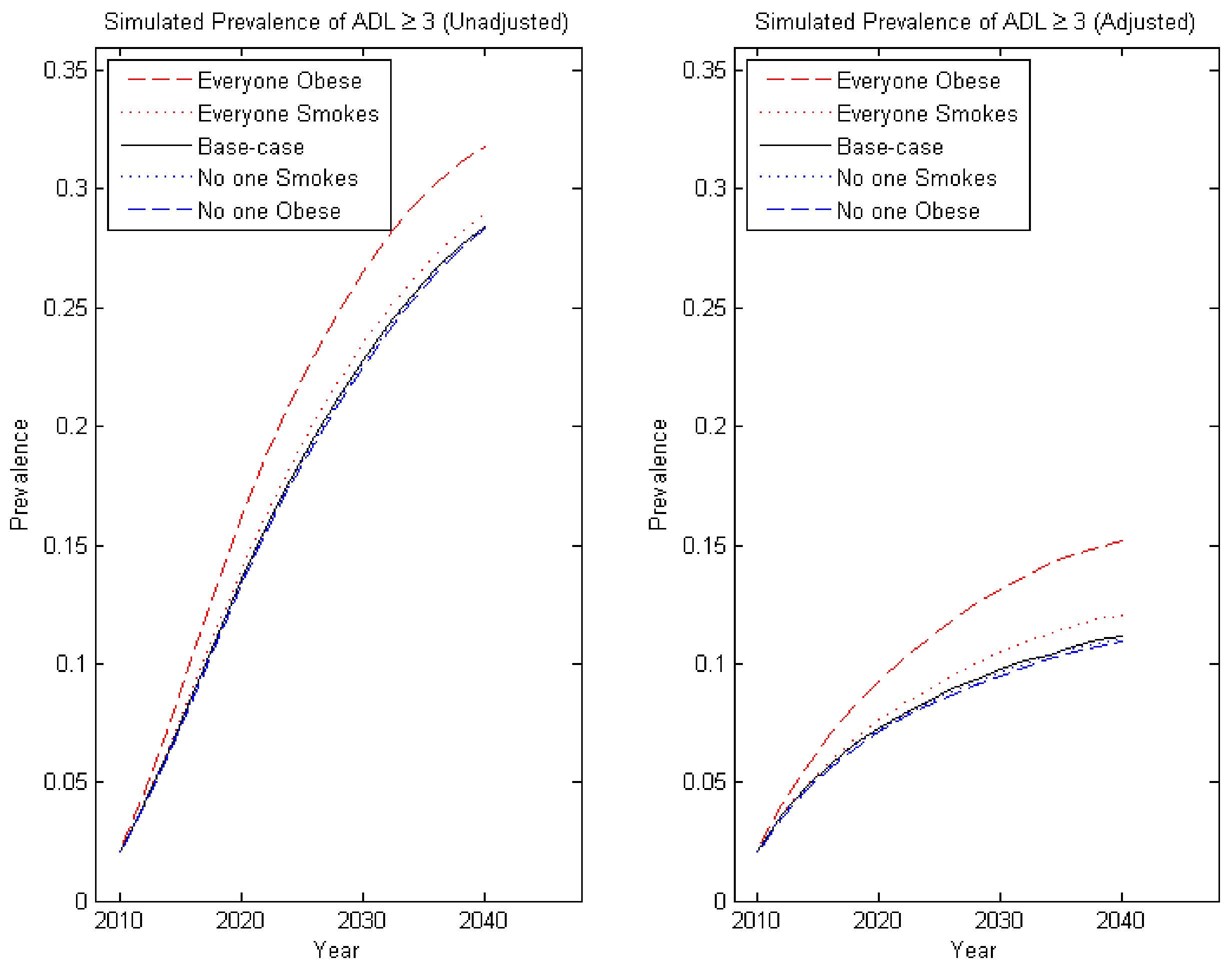
Disability Forecasts (Optimistic)



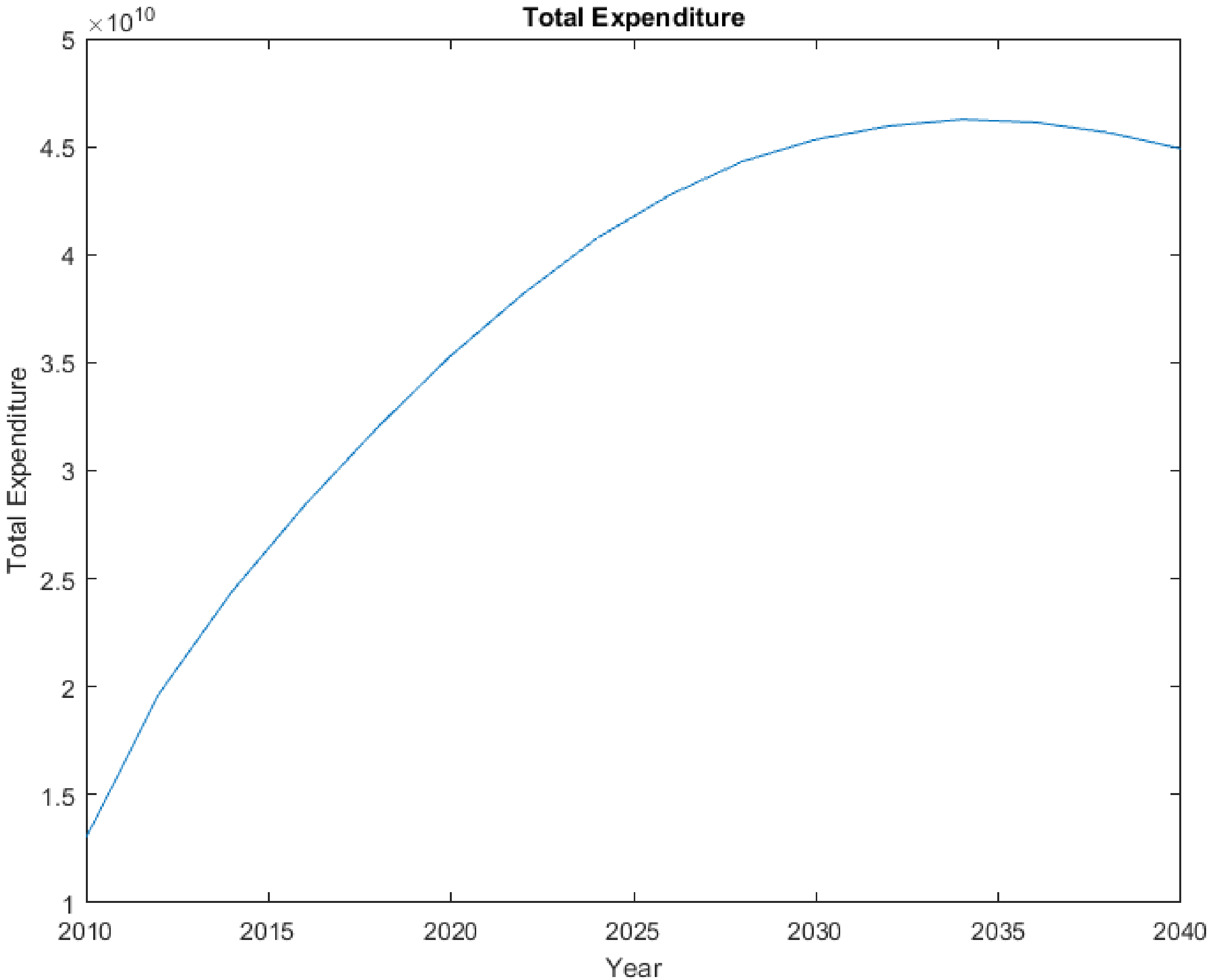
Disability Forecasts (Pessimistic)



The Impact of Obesity and Smoking on Future Disability: Simulating the Prevalance of ADL>=3 If All Japanese Quit Smoking and No One Were Obese, or If Everyone Smoked and Was Obese (Optimistic)



Health Expenditure Projections (Optimistic)



Summary

- In Japan, in contrast to the US, increasing life expectancy will bring increasing morbidity
- Prevention efforts have low yield given the low levels of obesity in the Japanese population
- Financing the care of the future elderly will be an enormous challenge in Japan and elsewhere

Limitations

- Will life expectancy increases continue into the 2050s?
- What will be the health of incoming 50 year olds in 2036?

Next Steps

- Backcasting exercise
- Probabilistic sensitivity analysis
- Incorporate official health care spending data
- Simulate long-term care use outcomes

Conclusions

- Population health status will have an enormous effect on future government outlays on medical care and on retirement
- The returns to prevention are highest in places where current lifestyles are relatively unhealthy