Forecasting the Consequences of Population Aging for Health: The Future Elderly Model

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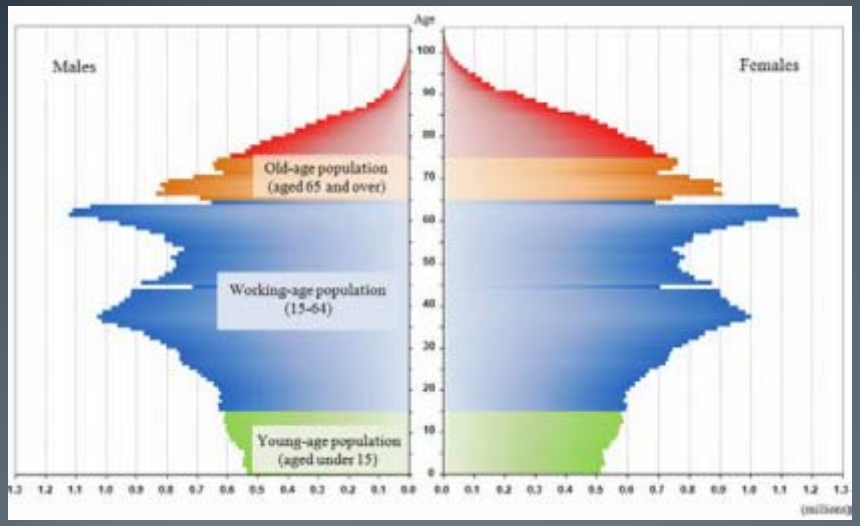
Pronounced Population Aging in Developed World

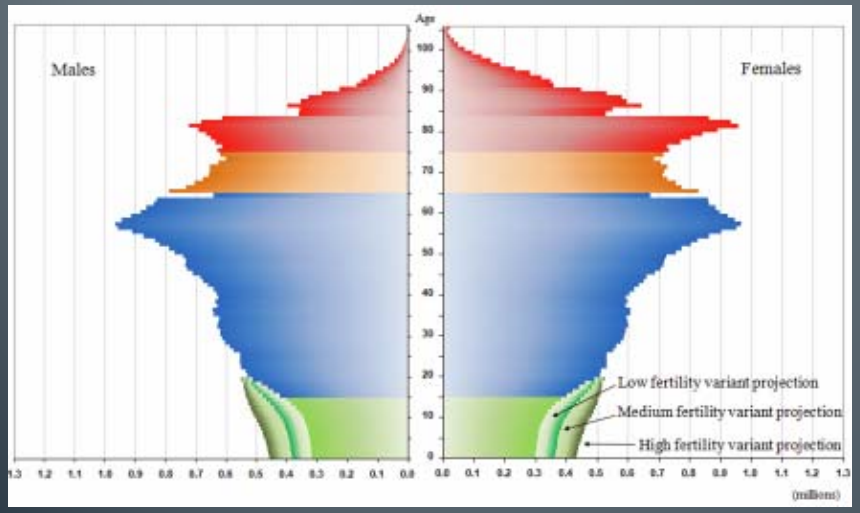
- Low fertility and longevity
- Japan → 40% of population over 65 by 2060

Japanese Population Pyramid, 2030-2060

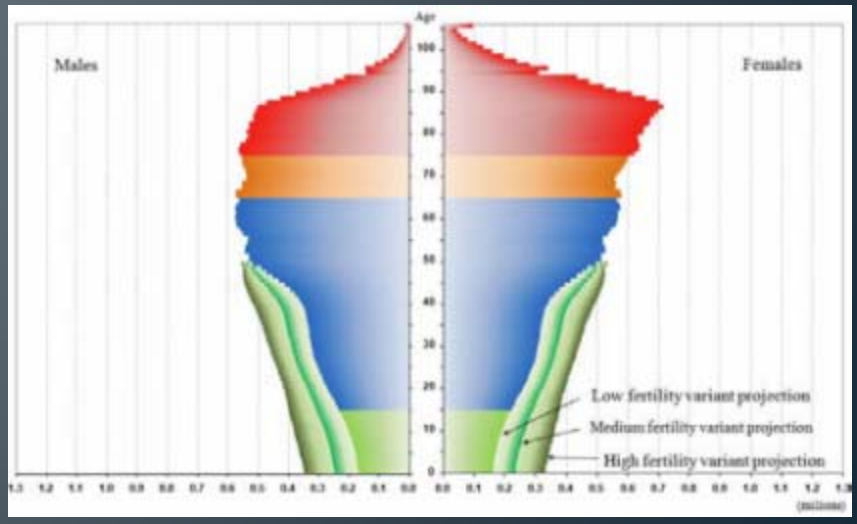
2010



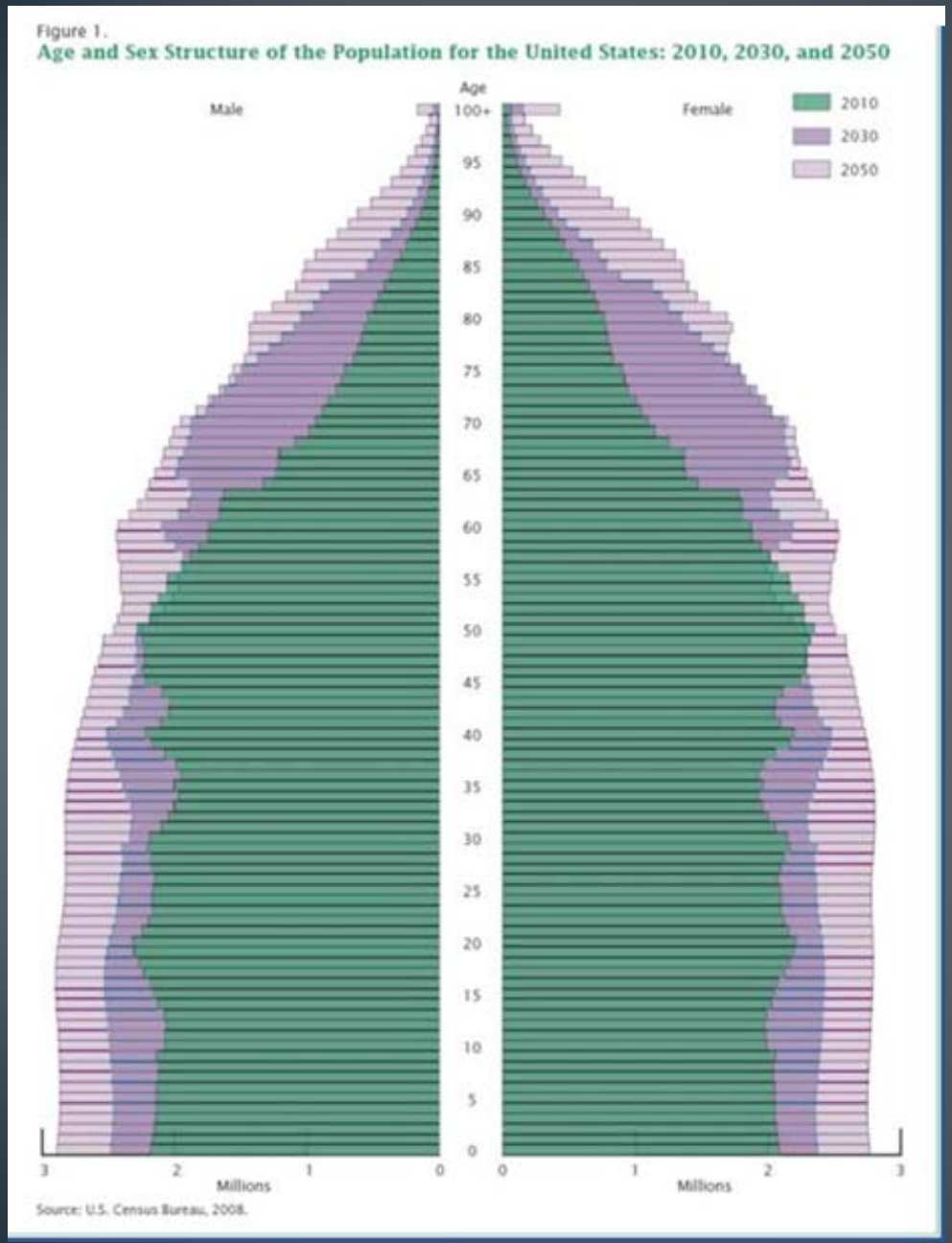
2030



2060



Source: NIPSSR (2012)



US Population Pyramid, 2010-2050

Forecasting Population Health Needs

- Traditional government forecasts of health expenditures do not forecast the future health of the the population
  - Most health expenditure projections forecast future spending based on age and sex, not health
  - But future populations may be healthier or sicker than the current population
- Accounting for future health allows forecasts of effects of future changes in technology or policy
  - For example: what will be the effect of technological change in cancer treatment?
  - For example, would support for smoking cessation program reduce future health spending?

Competing Risks

- Key observation: everyone will die from something
- Reductions in mortality from one cause mechanically increases the death rate from other causes
- The effect of technological advance on future health spending will depend on the relative costs of treating different diseases
  - For example, improved heart attack care will increase spending on cancer care
  - Longevity increases will increase overall health spending

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

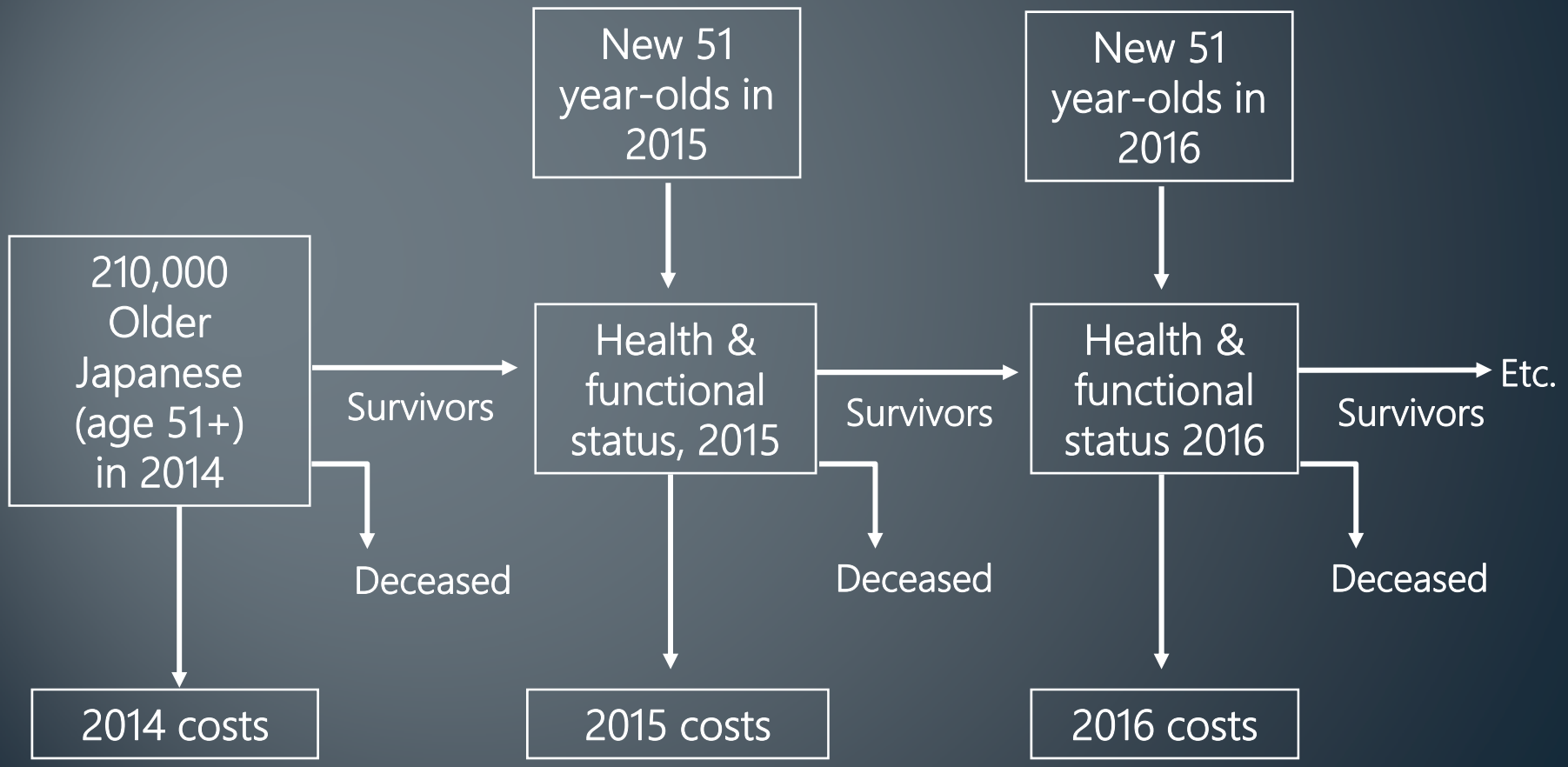
Policy Uses for A Future Elderly Model

- Policy Simulation
  - Changes in medical technology
  - Changes in medical care delivery
  - Prevention programs
- Outcomes
  - Disability and health status
  - Long-term care and medical expenditures
  - Fertility; immigration; economic policy and national security

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

Microsimulation Tracks Simulated Individuals Over Time



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

Mortality Data

- Model requires estimates of mortality rates conditional on health status, age, and sex
- Vital Statistics
- 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 to account for comorbid conditions
  - Diseases that co-occur commonly with diseases that show up on death certificates contribute to mortality

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)

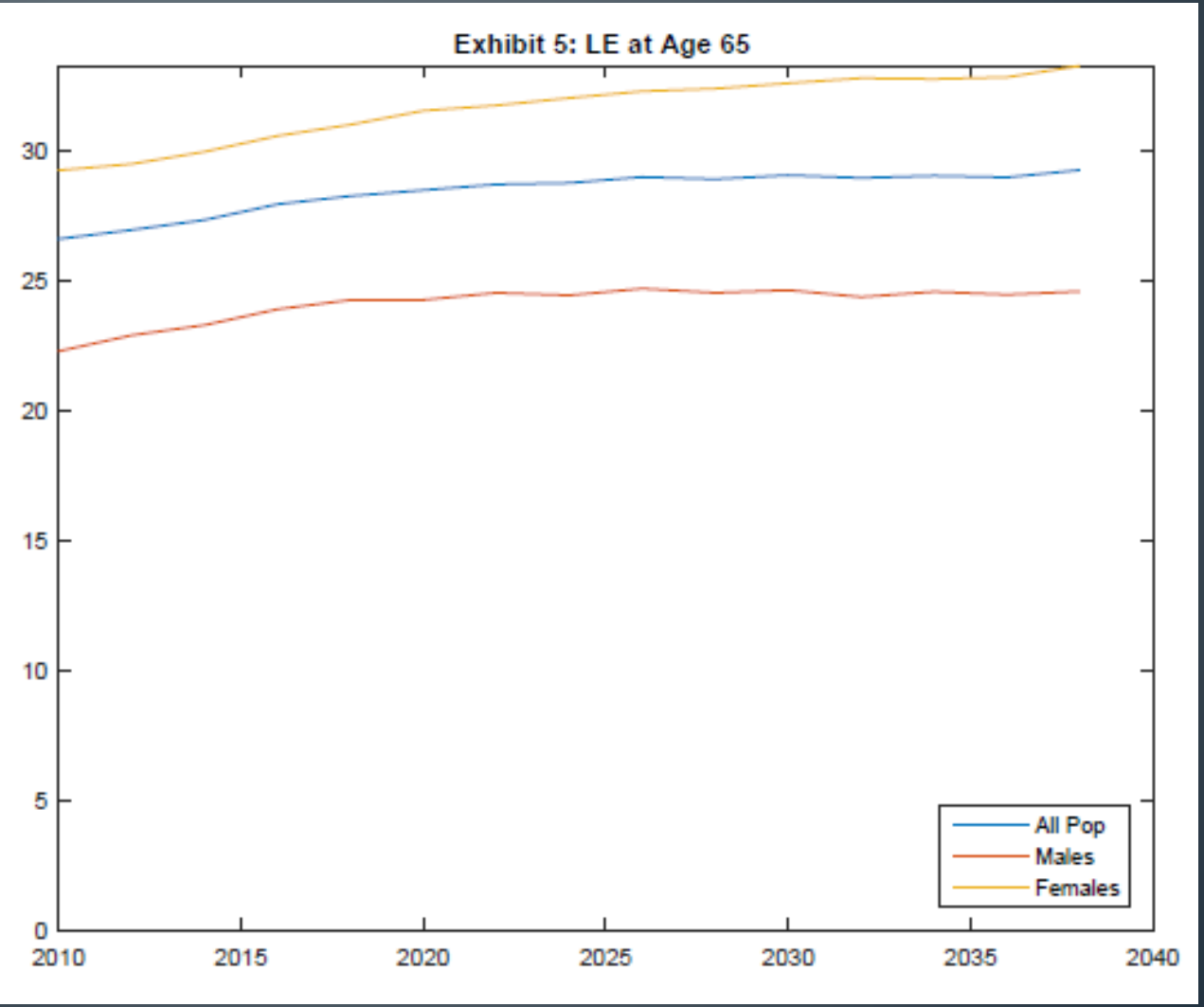
Modeling Future Changes in Life Expectancy

- While life expectancy has been increasing in the developed world over the last few centuries, it is not a law of nature that this continue
  - There is an active debate among biologists about the limits of human longevity
  - Future changes in life expectancy are thus *uncertain*

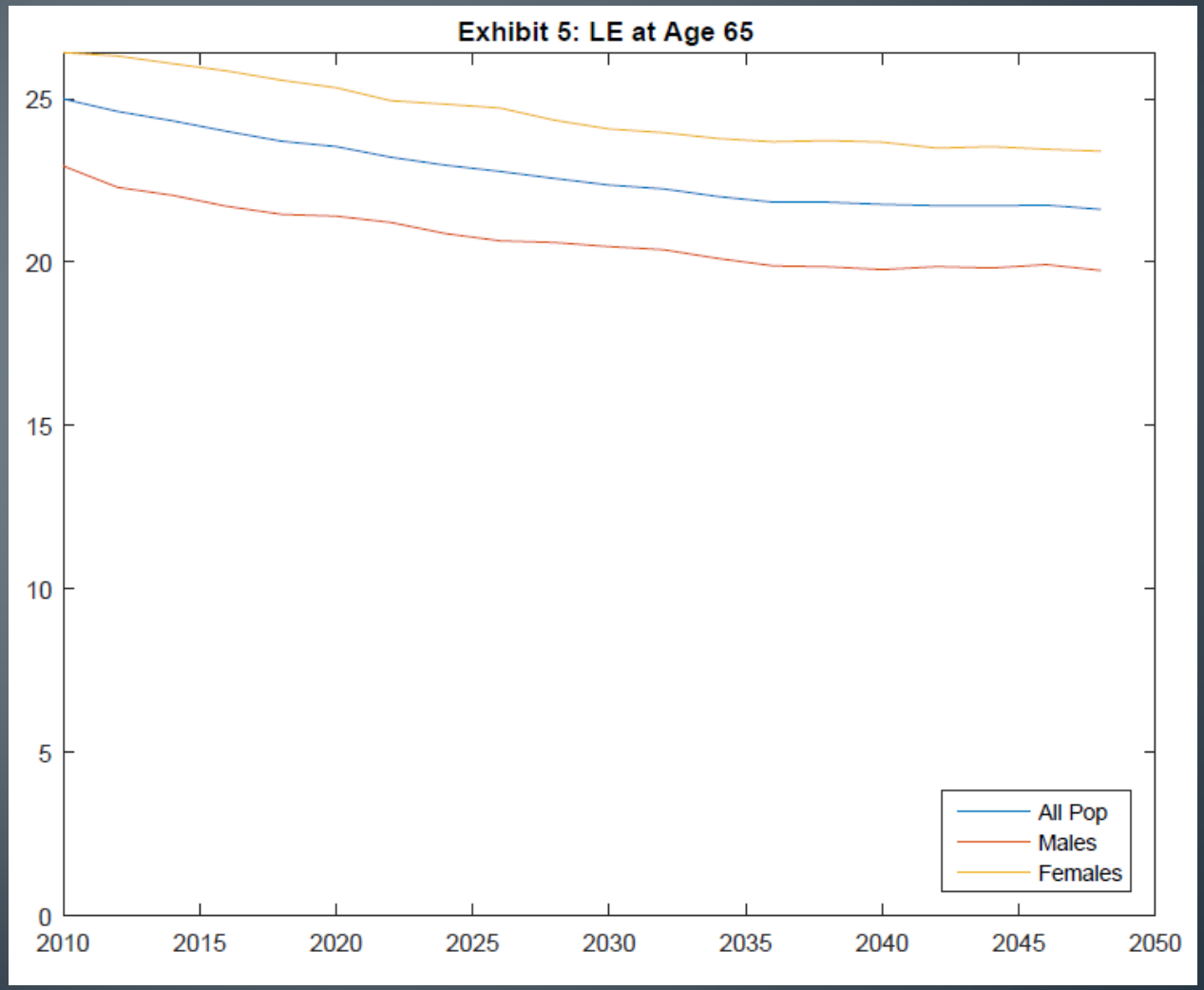
Two Alternative Life Expectancy Change Assumptions

- Optimistic life expectancy change 2010-2040
  - Coincides with official Japanese Census estimate of life expectancy gain
  - Assumption: Reductions in mortality for all disease conditions (perhaps due to technological improvements)
- Pessimistic life expectancy change 2010-2040
  - Declining life expectancy conditional on health at age 65
  - Assumption: Japanese life expectancy moves closer to American life expectancy

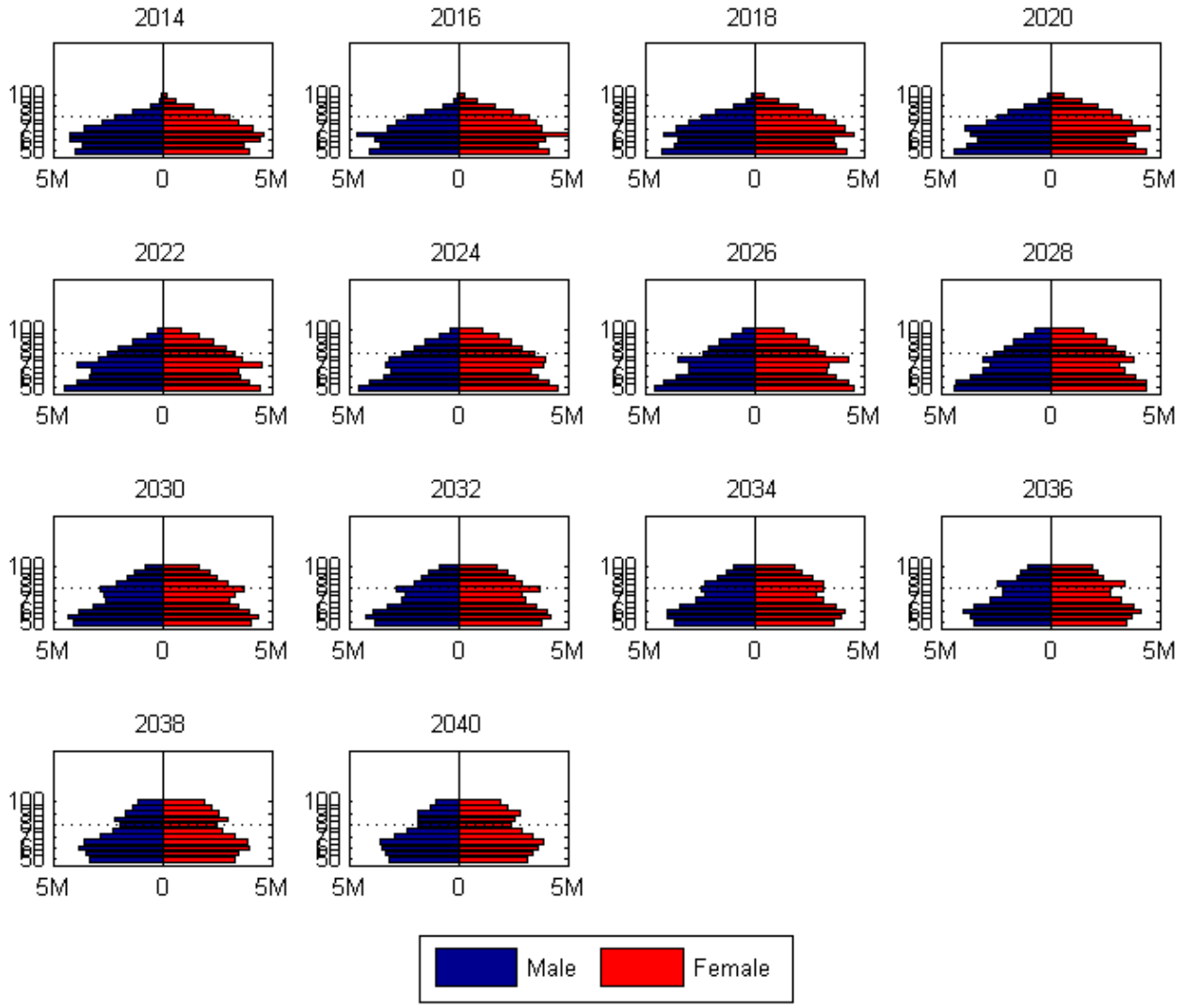
Life Expectancy at 65 Forecast (Optimistic Scenario)



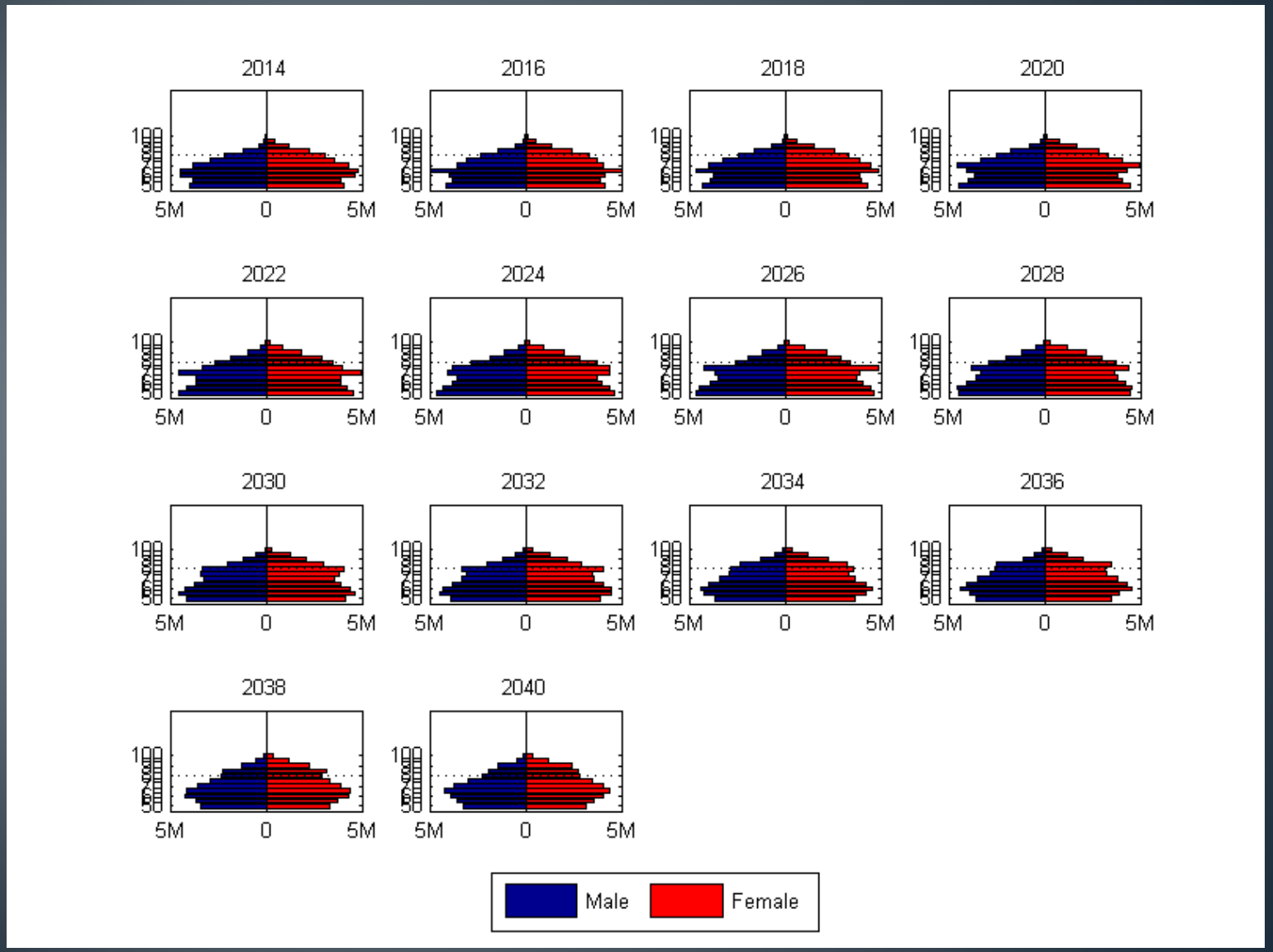
Life Expectancy at 65 Forecast (Pessimistic Scenario)



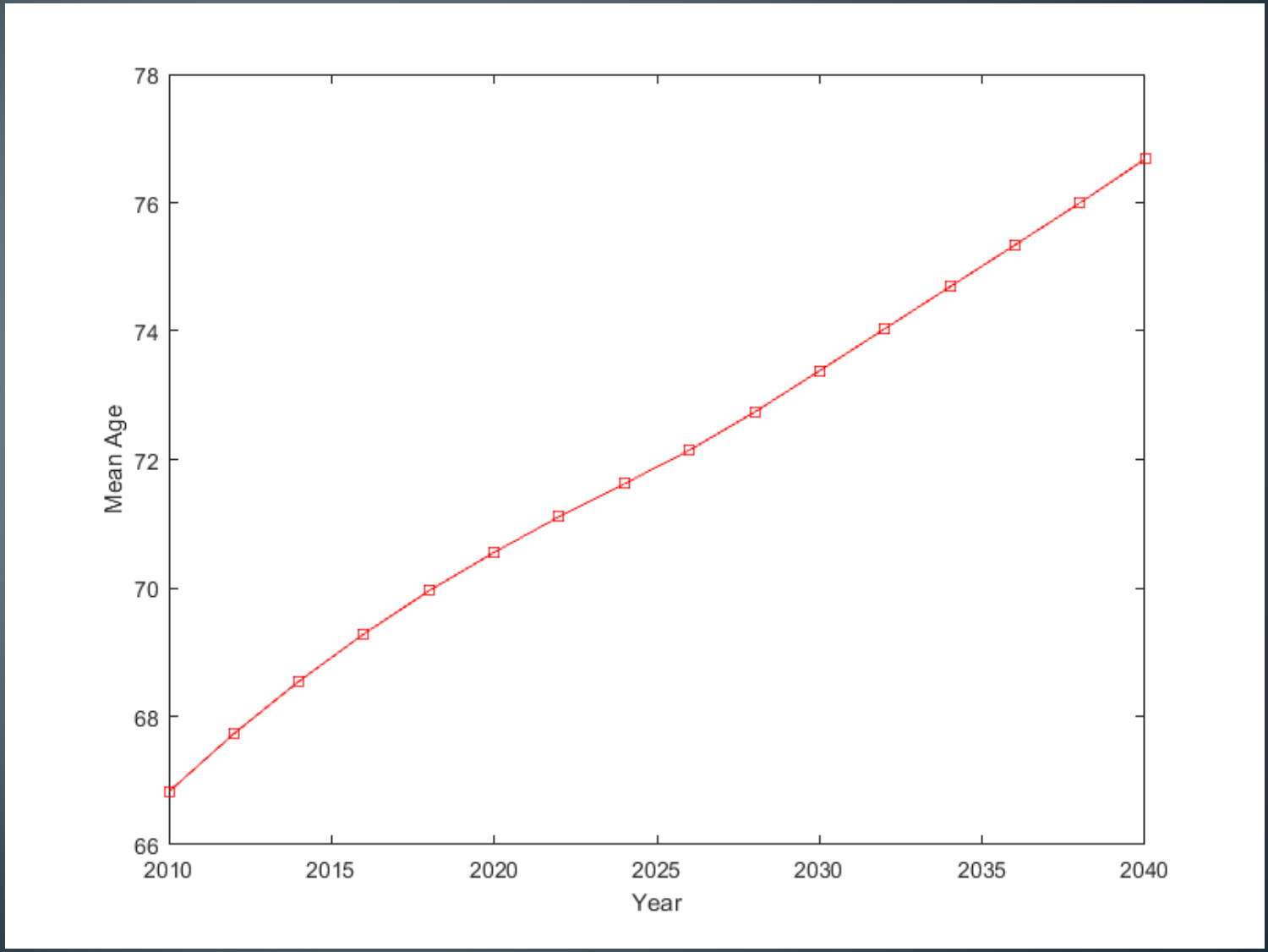
Population Age Structure (Optimistic)



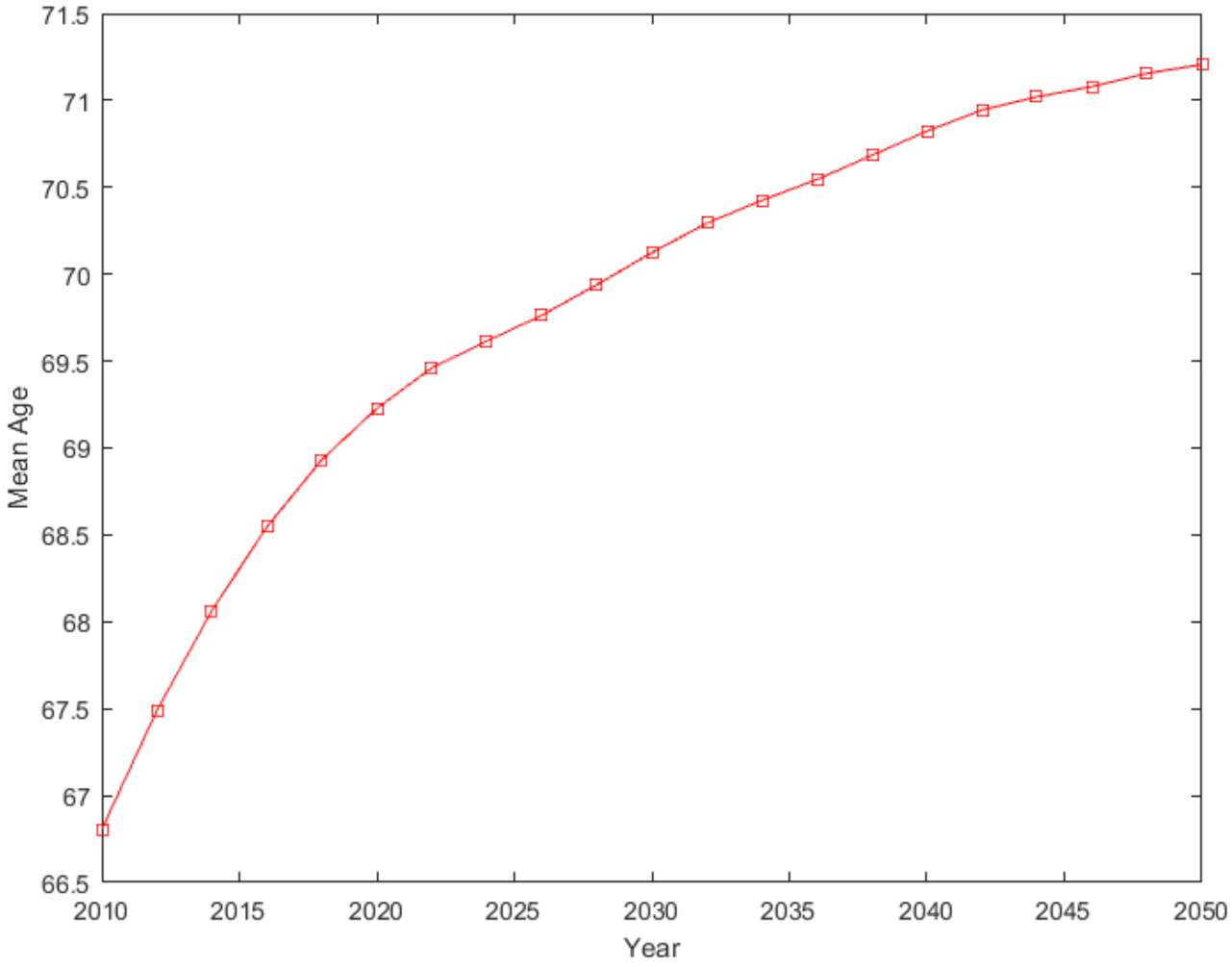
Population Age Structure (Pessimistic)



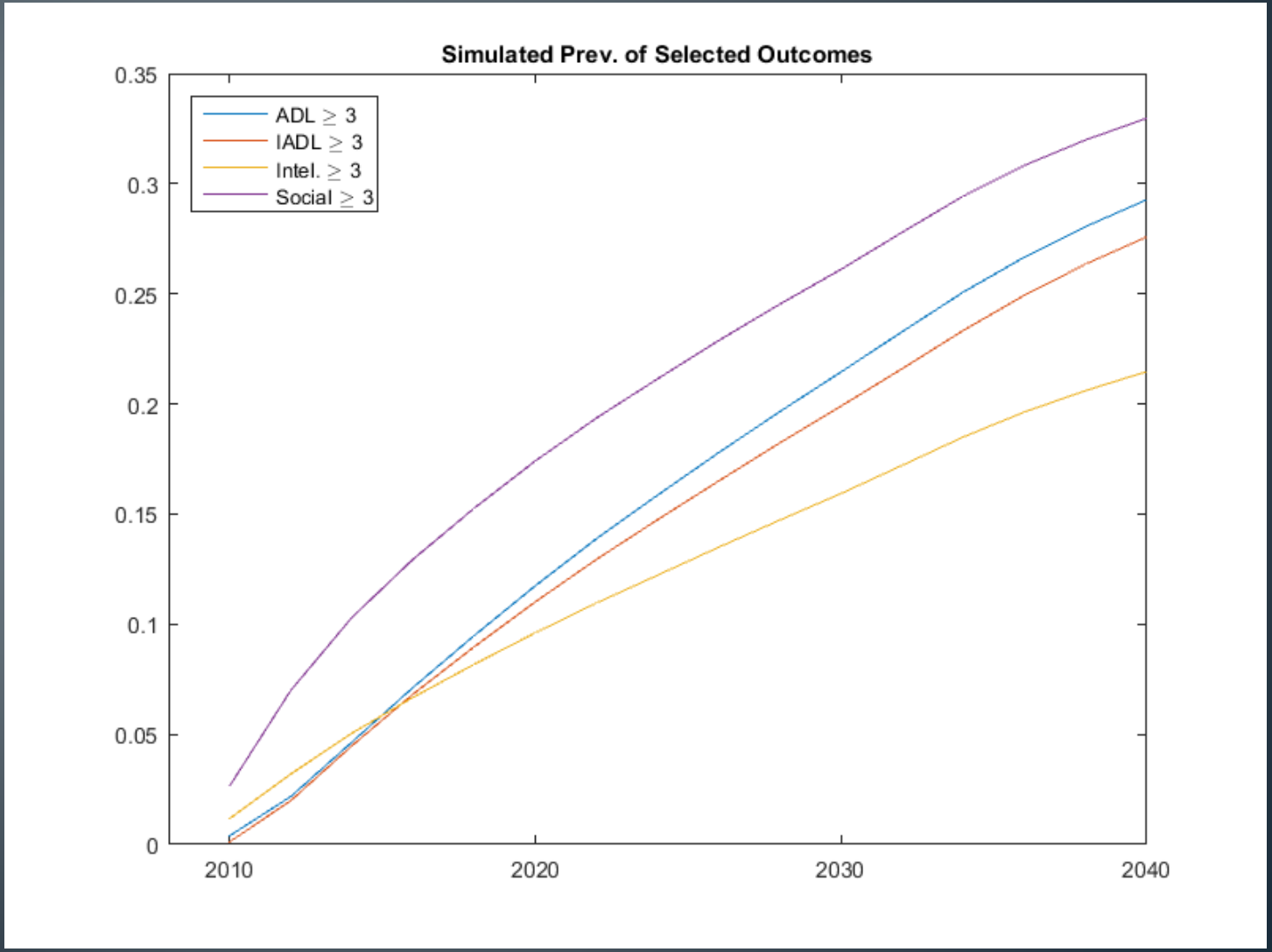
Mean Projected Population Age (50+, optimistic)



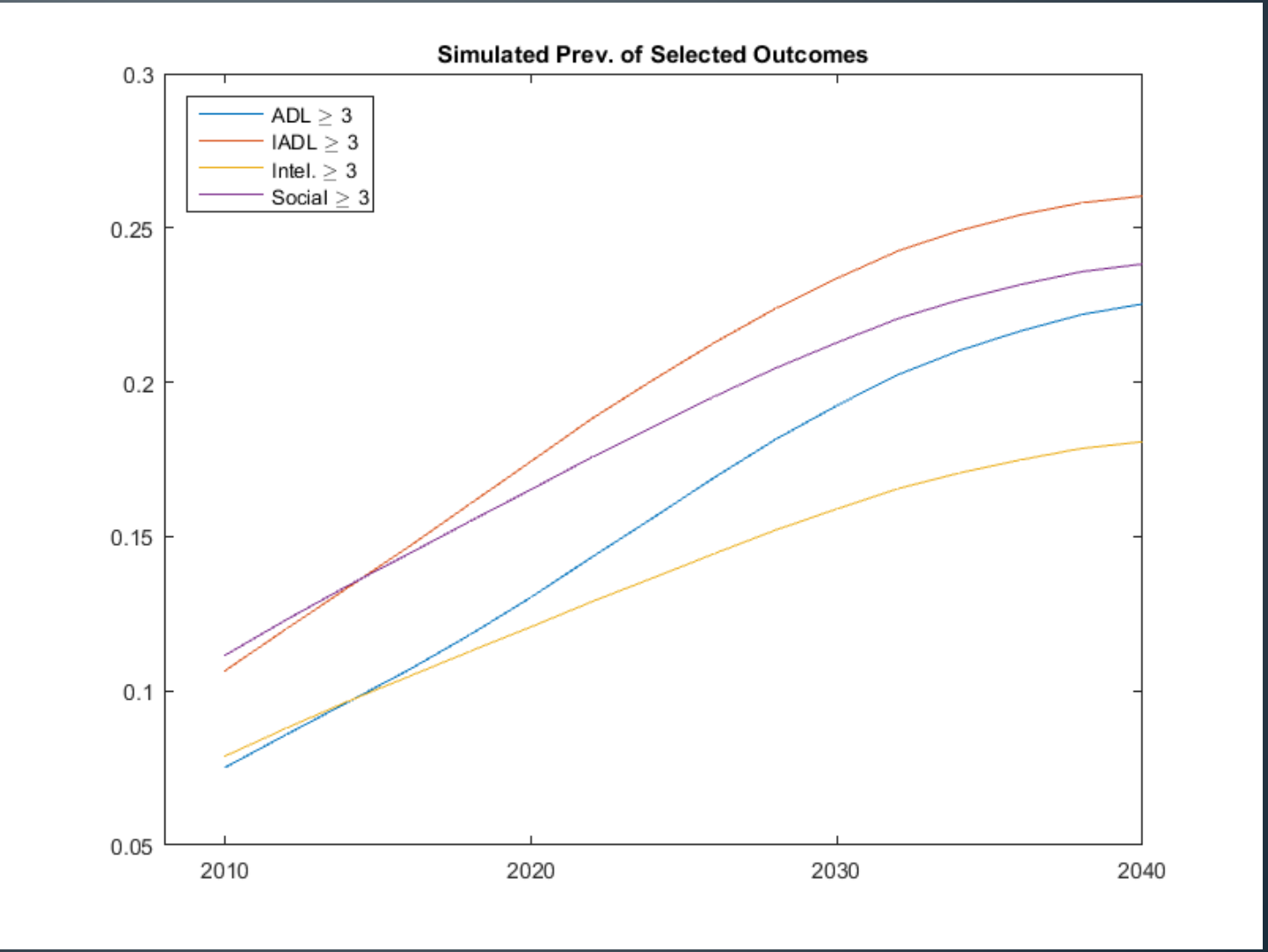
Mean Population Age (50+, Pessimistic)



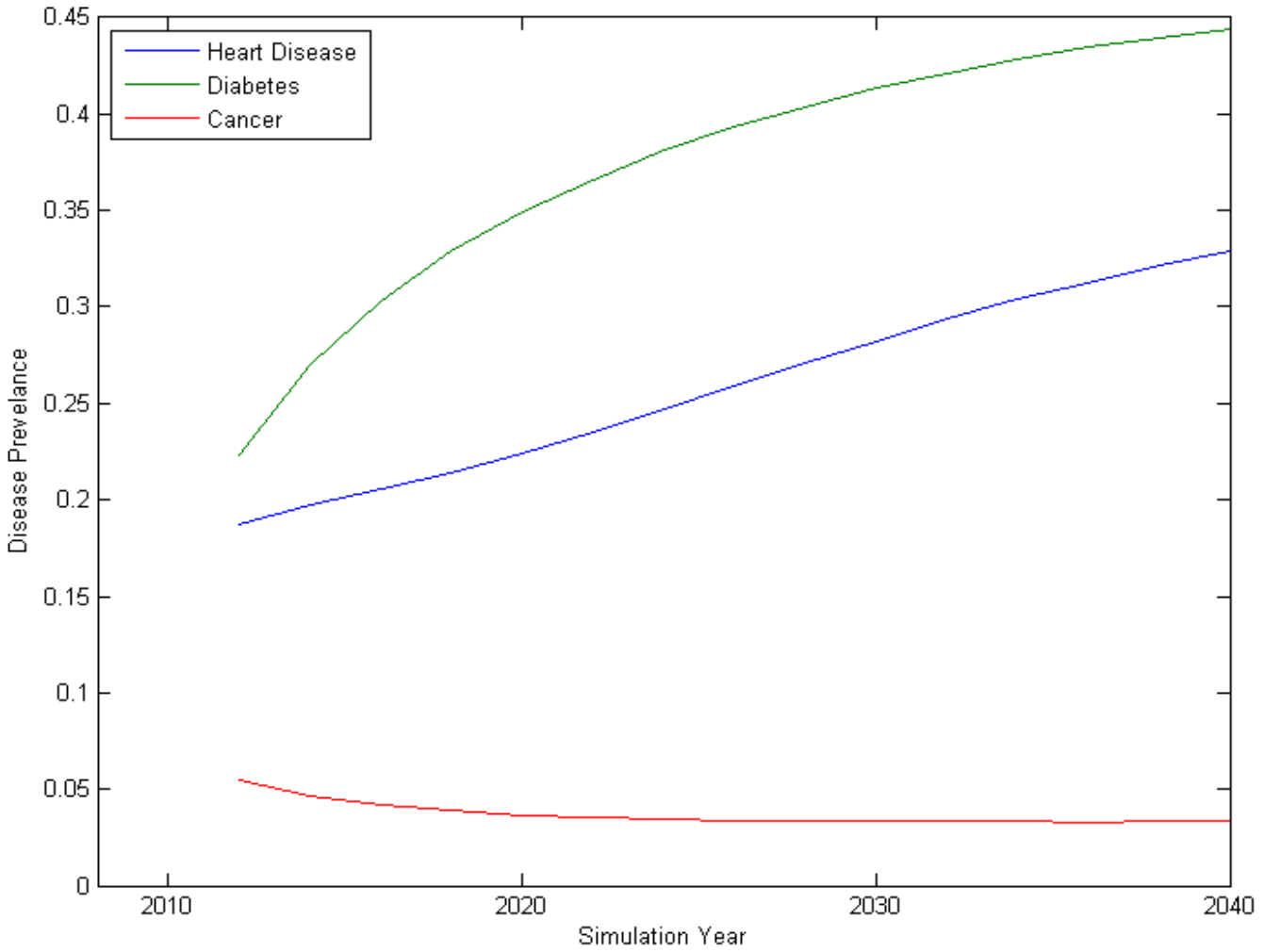
Disability Forecast (Optimistic Scenario)



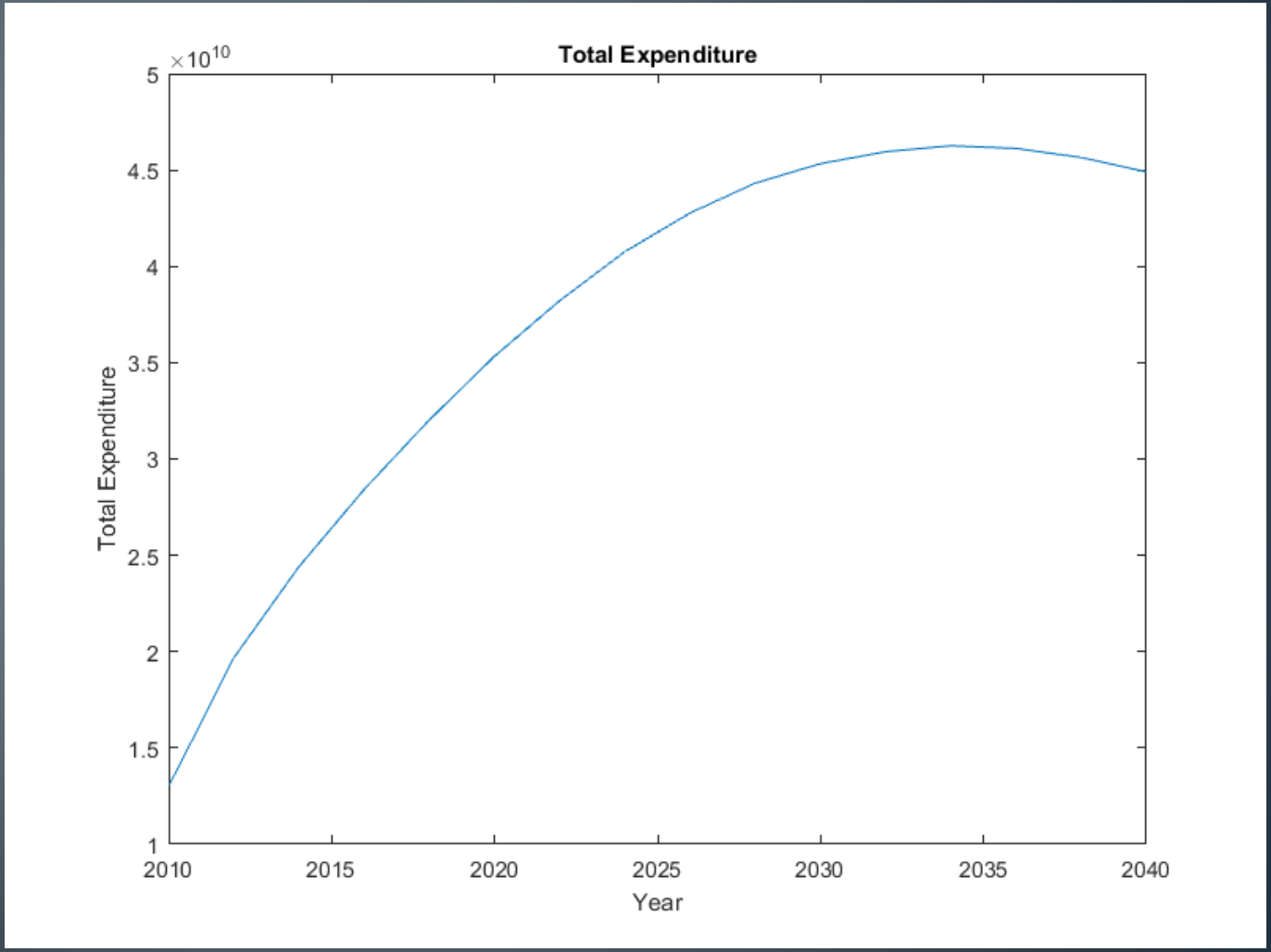
Disability Forecast (Pessimistic Scenario)



Future Disease Prevalence (Optimistic)



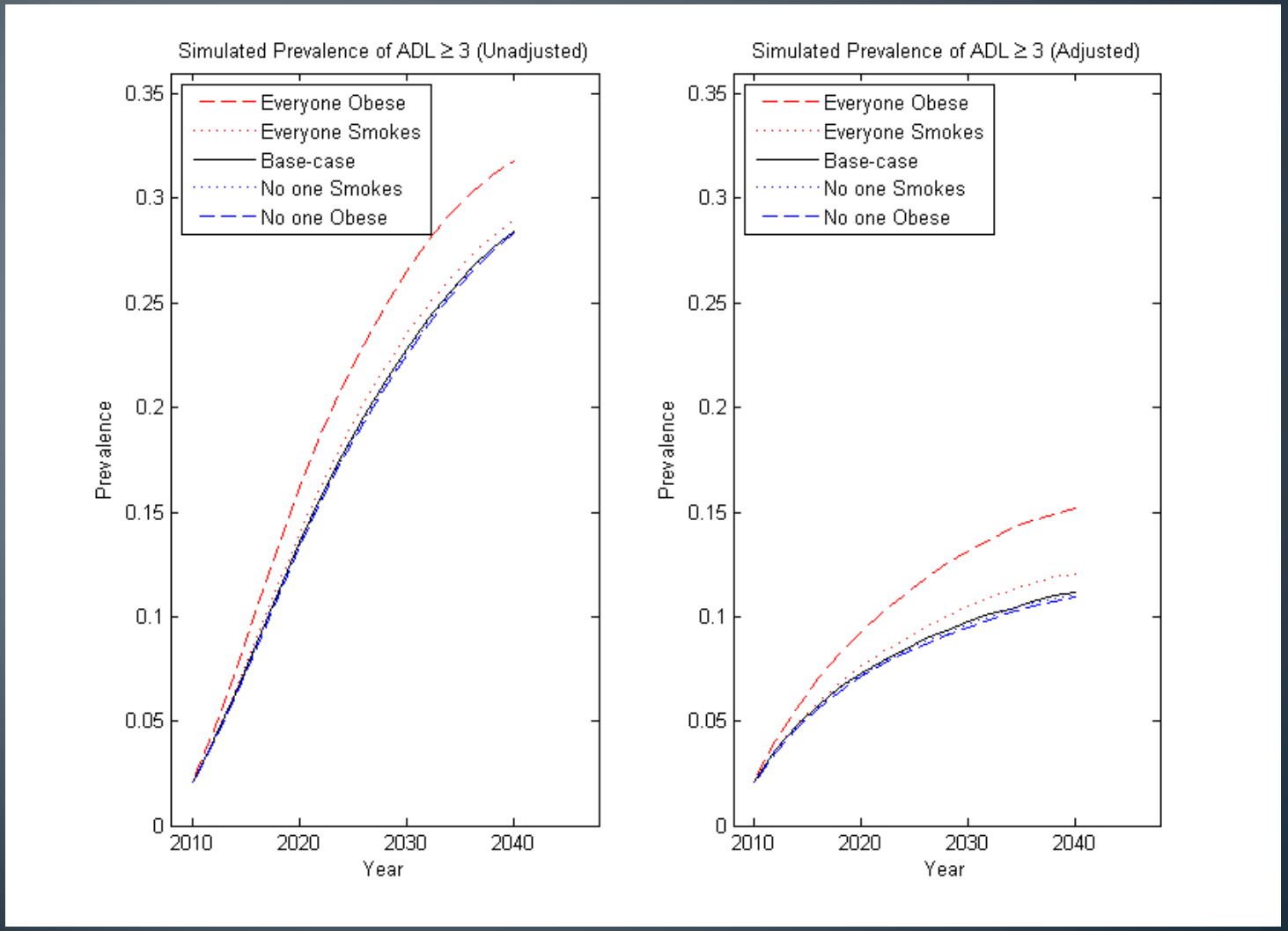
Health Expenditure Forecast (Optimistic Scenario)



Optimistic vs. Pessimistic

- Under the optimistic scenario:
  - Average age of the population will be older
  - A larger fraction of the population will be among the oldest old
  - The population will suffer from many more chronic diseases
  - The population will include many more severely disabled elderly people
  - Population health spending will be considerably higher

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)



Conclusion

- Increasing life expectancy will bring increasing morbidity
- Higher longevity → A large population of chronically ill and disabled people

- 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