Trends in Disability in a Super-Aging Society: Adapting the Future Elderly Model to Japan

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+ Preliminary

- Please do not cite at this stage.

- Comments welcome to Jay Bhattacharya

Background: Aging in Japan

- **Pronounced population aging**
  - Low fertility and longevity → decline to 87 million by 2060
  - 40% of population over 65 by 2060
  - Old age dependency ratio – 70% by 2050 in Japan vs. 39% in the US
  - Highest proportion of elderly adults in the world

Policy Uses for A Future Eldery Model

- **Policymakers require projections of future need for**
  - Long-term care and medical insurance
  - And other far-reaching areas: fertility; immigration; economic policy and national security

Need to Account for Health Status of the Population

- **Few projections of Japan's future elderly population**
  - Re: disability, health, and need for long-term care
  - Most projections forecast age and sex ratios

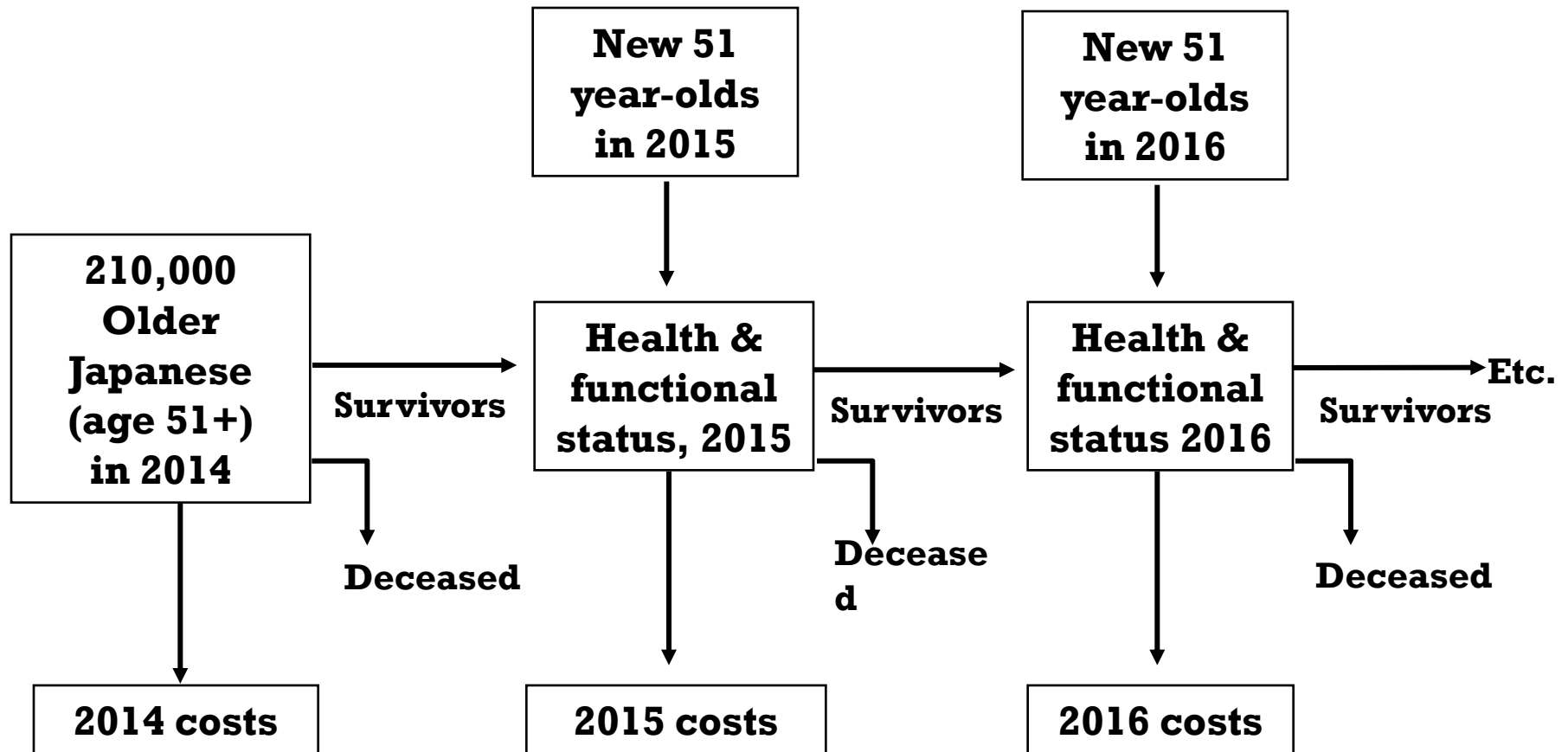- **Competing risks problem**

+ 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

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                    ┌──────────────┐              ┌──────────────┐
                    │   New 51     │              │   New 51     │
                    │  year-olds   │              │  year-olds   │
                    │   in 2015    │              │   in 2016    │
                    └──────┬───────┘              └──────┬───────┘
                           │                             │
                           ▼                             ▼
┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│   210,000    │    │   Health &   │    │   Health &   │
│    Older     │    │  functional  │    │  functional  │ ──── Etc.
│   Japanese   │────│ status, 2015 │────│  status 2016 │
│  (age 51+)   │ Survivors        │ Survivors        │ Survivors
│   in 2014    │    └──────┬───────┘    └──────┬───────┘
└──────┬───────┘           │                   │
       │ Deceased          │ Deceased          │ Deceased
       ▼                   ▼                   ▼
┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│  2014 costs  │    │  2015 costs  │    │  2016 costs  │
└──────────────┘    └──────────────┘    └──────────────┘
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Overall strategy

- Estimate **disease transition probabilities**

- Estimate **mortality rates** conditional on disease conditions

- Construct a **Markov microsimulation model** based on the Future Elderly Model (FEM)

- Project/simulate **future medical conditions** and **functional status/need for care** (ADLs, IADLs, cognition and social status measures)

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
  - 1,400 questions mirroring other surveys conducted internationally (such as the HRS)

- Self- reported information on physical or mental limitations

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 (demeaned), age^2 demeaned, gender, smoking, obesity

Sample Selection

- ≥ 45 years

- Non-missing variables in all outcomes and covariates

- 2,526 individuals for 2007, 2,659 for 2009, and 1,854 individuals and 3,708 interview years

Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
age	3,741	63.46	7.07	47.00	77.00
smoker	1,348	0.59	0.49	0	1
male if smoker		0.90			
bmi	3,667	23.22	3.15	13.78	64.92
% bmi>=23.5		0.43			
bmi if overweight	1,577	25.94	2.55	23.51	64.92
female	3,744	0.50			

Prevalence of Health Conditions
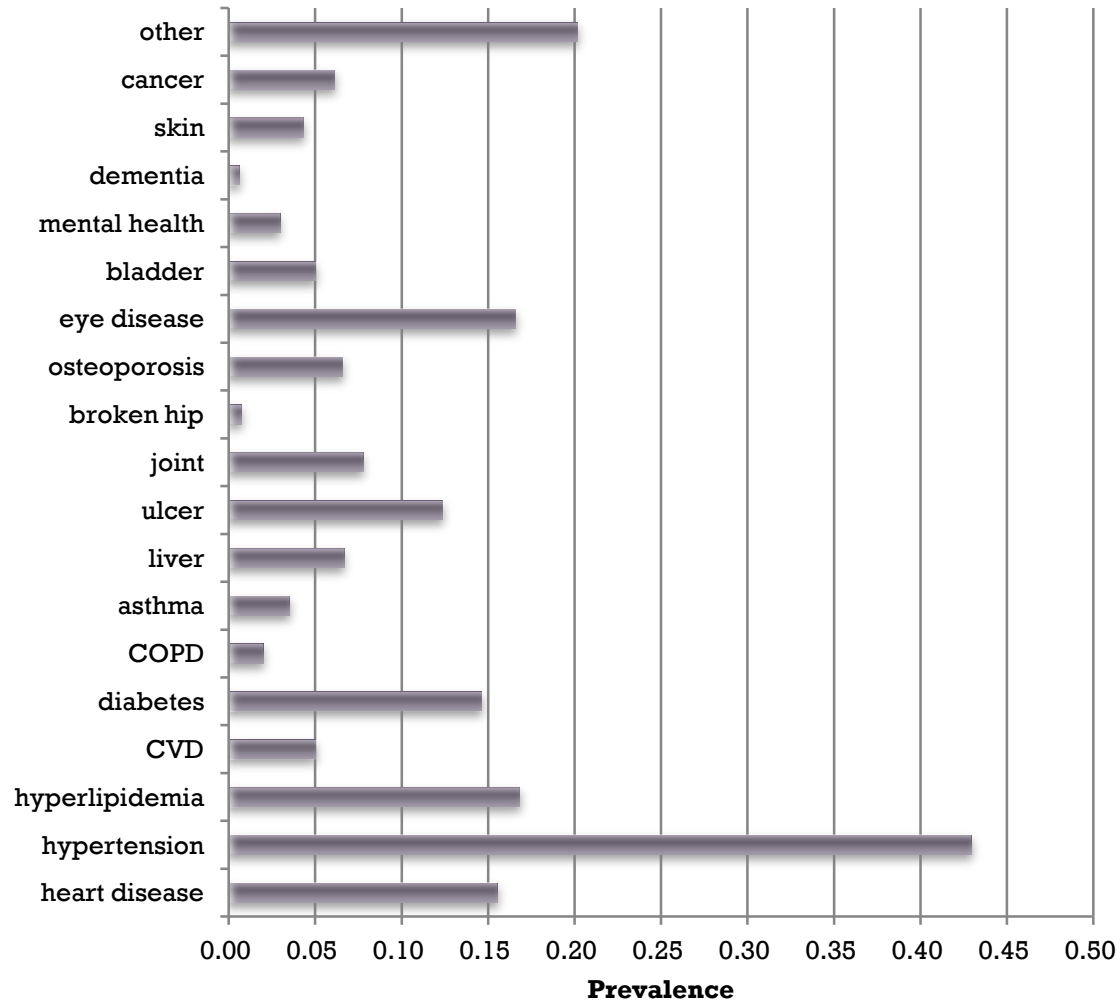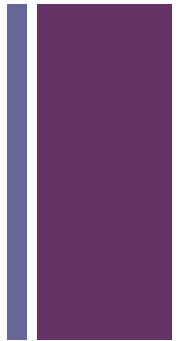
Disability Model

- **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
- **Care Receiving**
  - Any help, help with physical care, help with chores

+ 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

+ 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)

Cause-Specific Mortality Model

- **Steps to estimate conditional mortality model:**
  - Specify rankings of diseases based on priority in death certificate reporting
    - Clinical ranking
    - Maximum likelihood model
  - Specify mortality rate as a linear function of disease prevalence
    - Specify loss function to estimate disease weights in conditional mortality function
    - Estimate disease weights using MHLW mortality
    - Separately by age groups and sex

Japan FEM Microsimulations

- Once the model parameters are estimated, we simulate
  - Health Status
  - Physical/mental functioning

- Of Japan's 50+ elderly into the future (2010-2040)

- We are planning to extend the model to other outcomes (health expenditures, etc.)

Model Checks

- Simulate age structure of 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

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Results

Simulating Japan's Future Aging
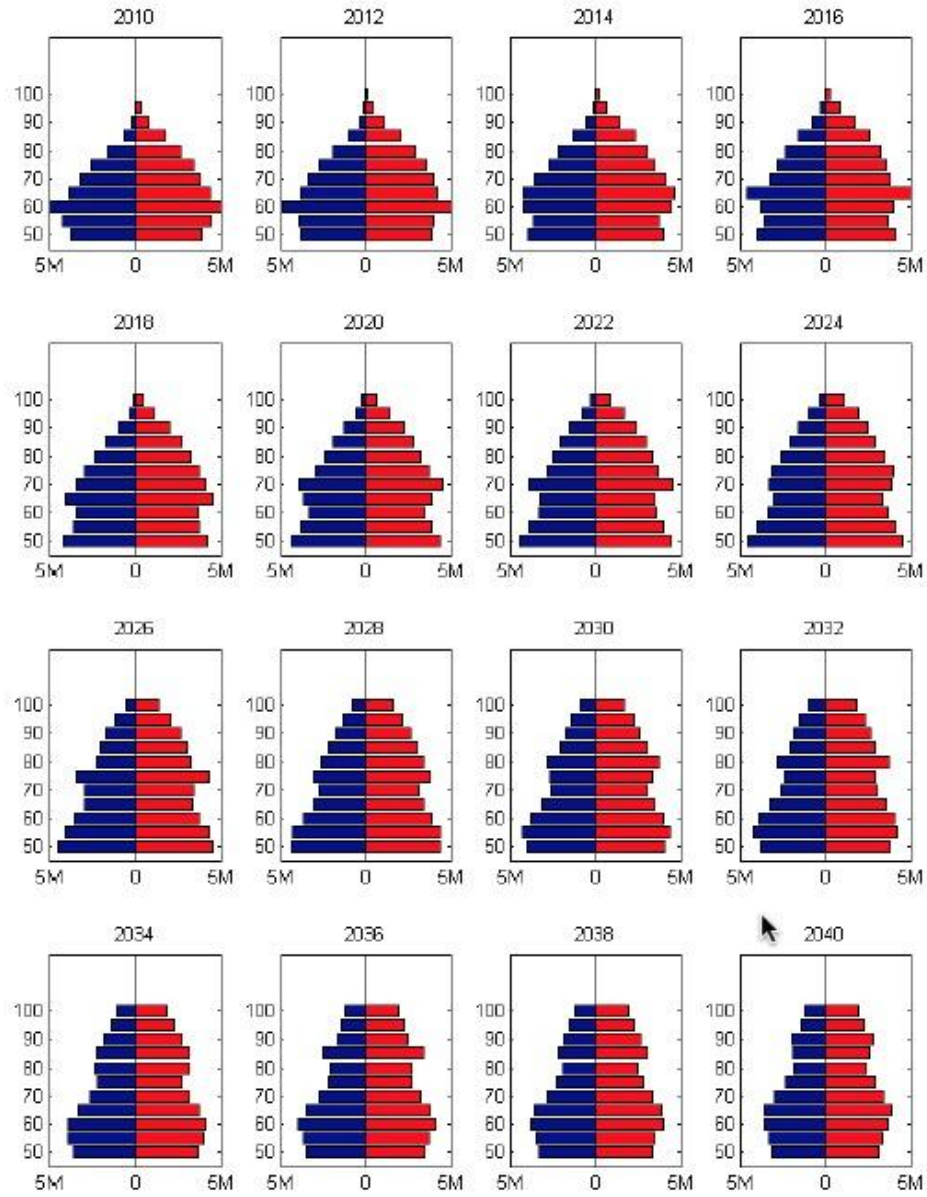
Simulating Japan's Future Population (vs. Official Projections)
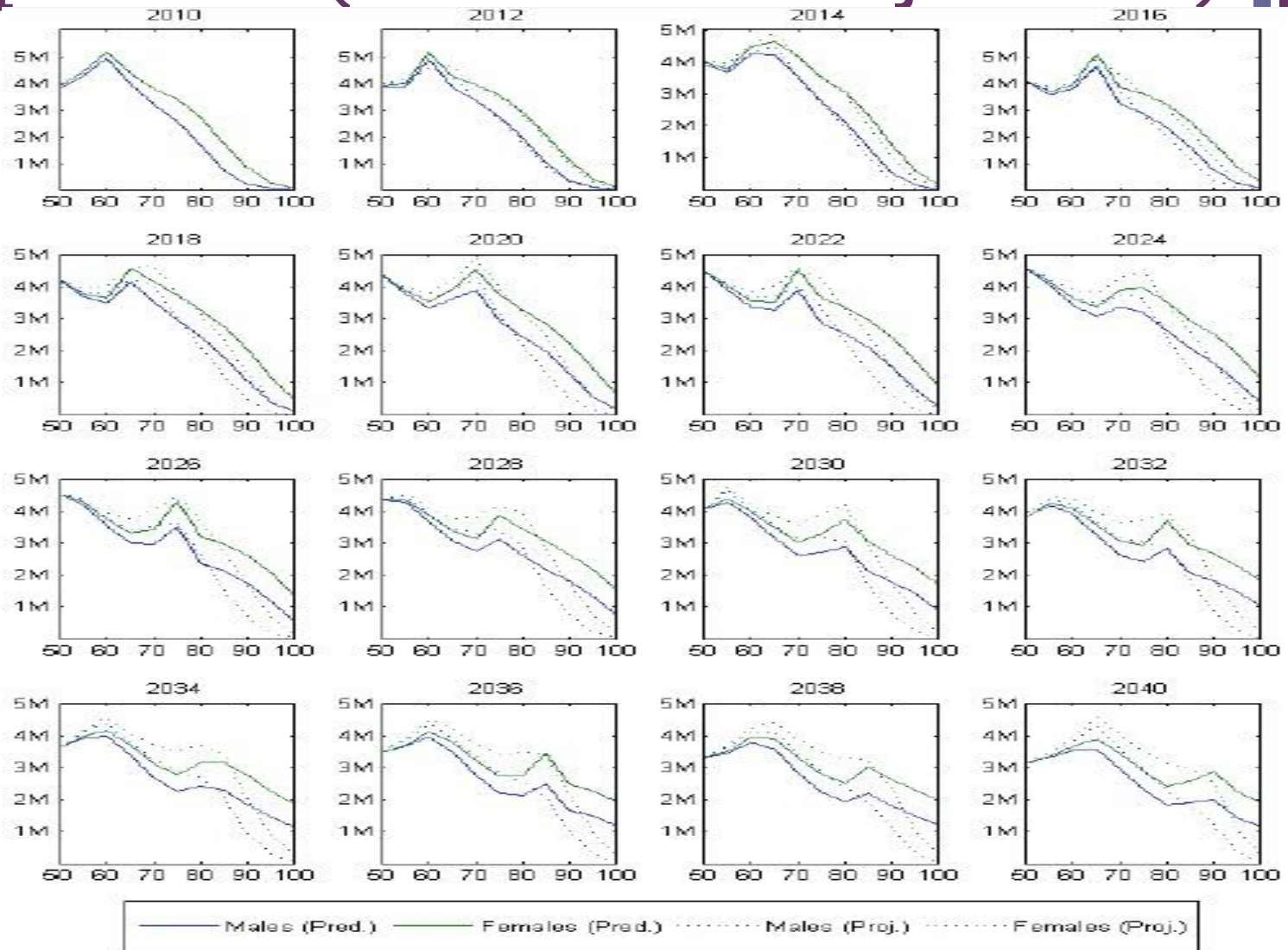
Simulating Future Disease Prevalence
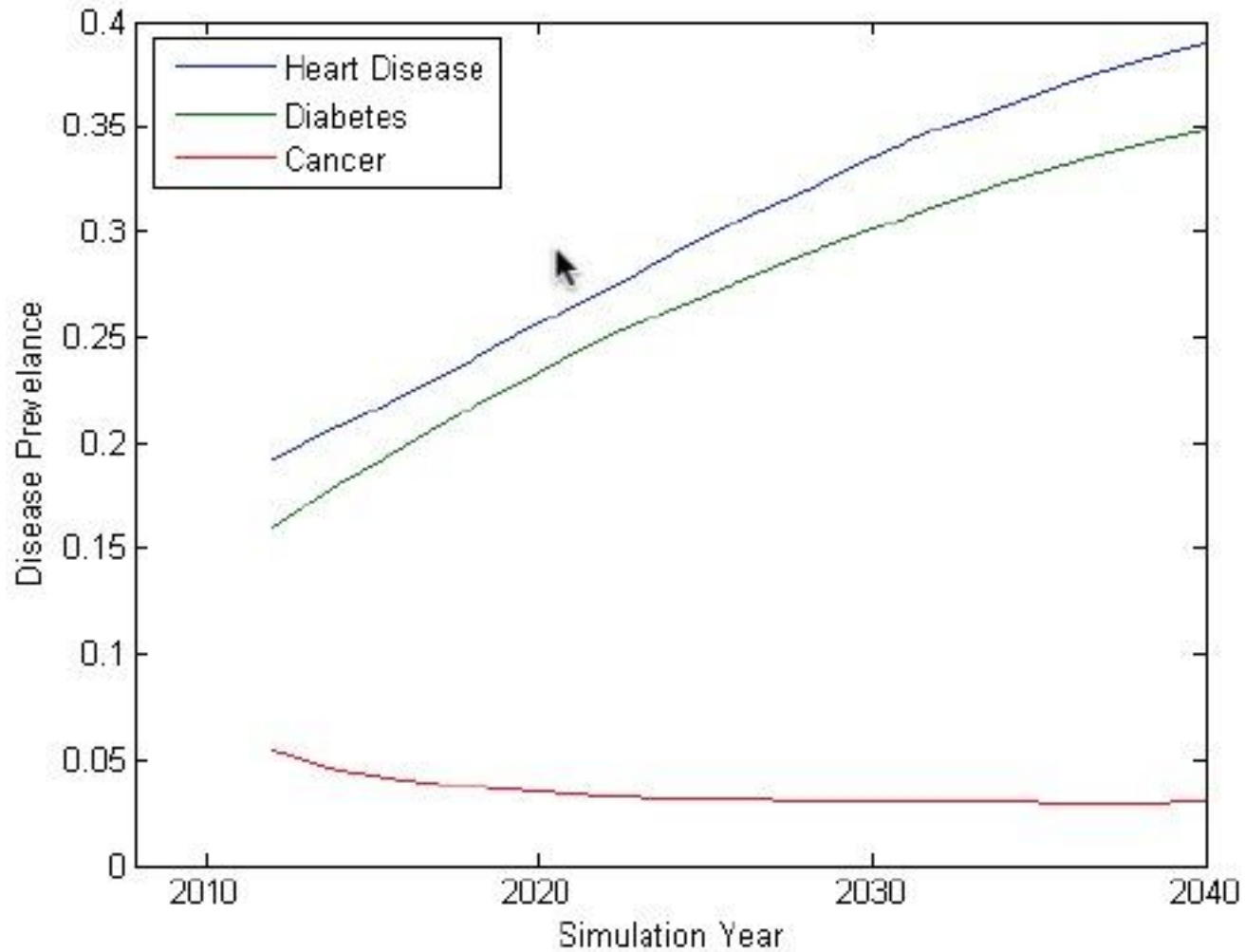
Simulating Average Population Prevalence of ADLs/IADLs/Others
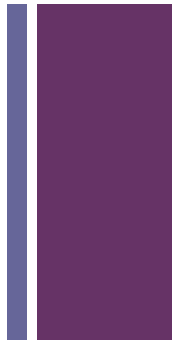
Simulated Prev. of Selected Outcomes
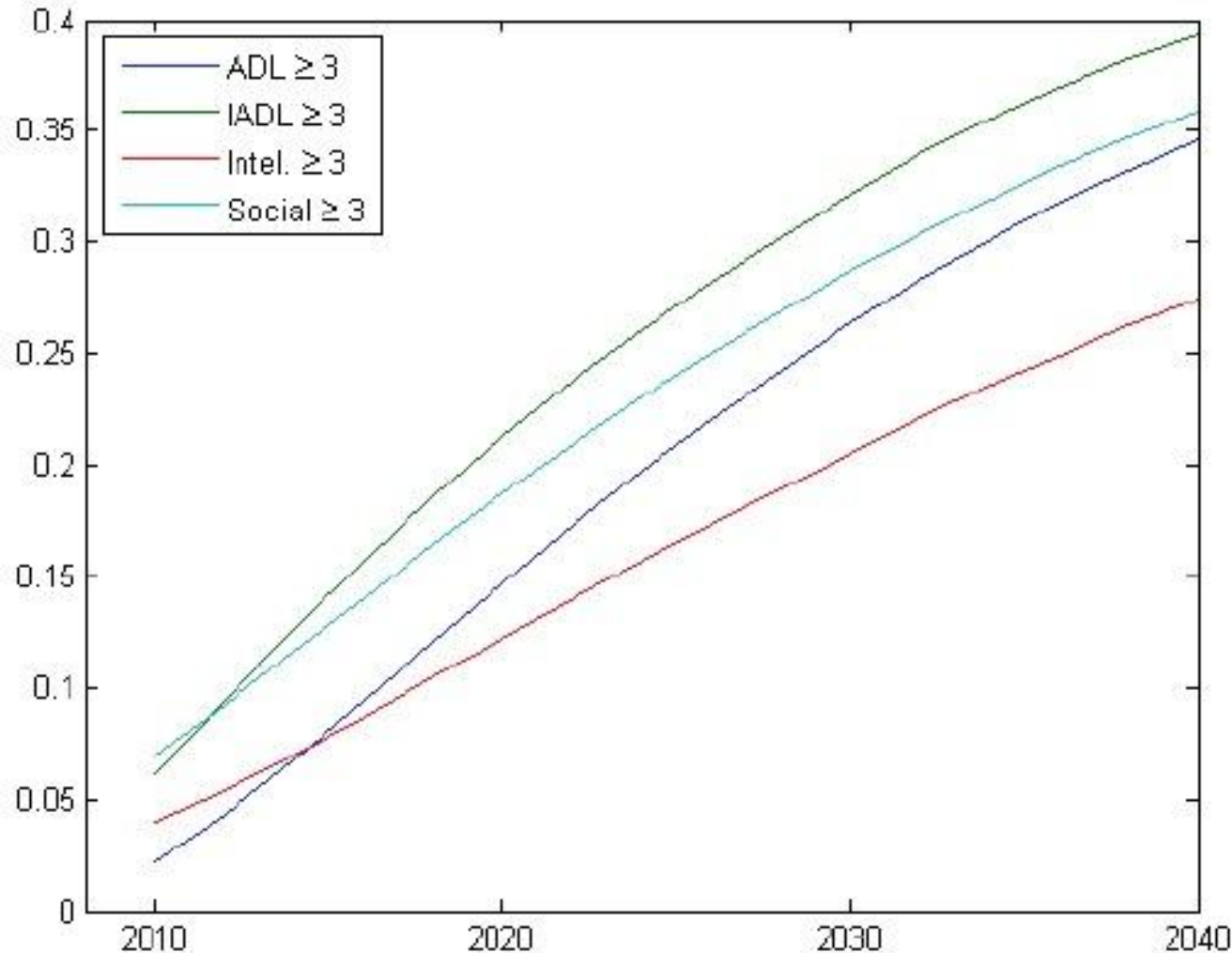
Simulating Average Population Prevalence of Three or More Disabilities Purely Due to Changing Cohort Health, Holding the Age Distribution Constant at the 2010 Age Distribution
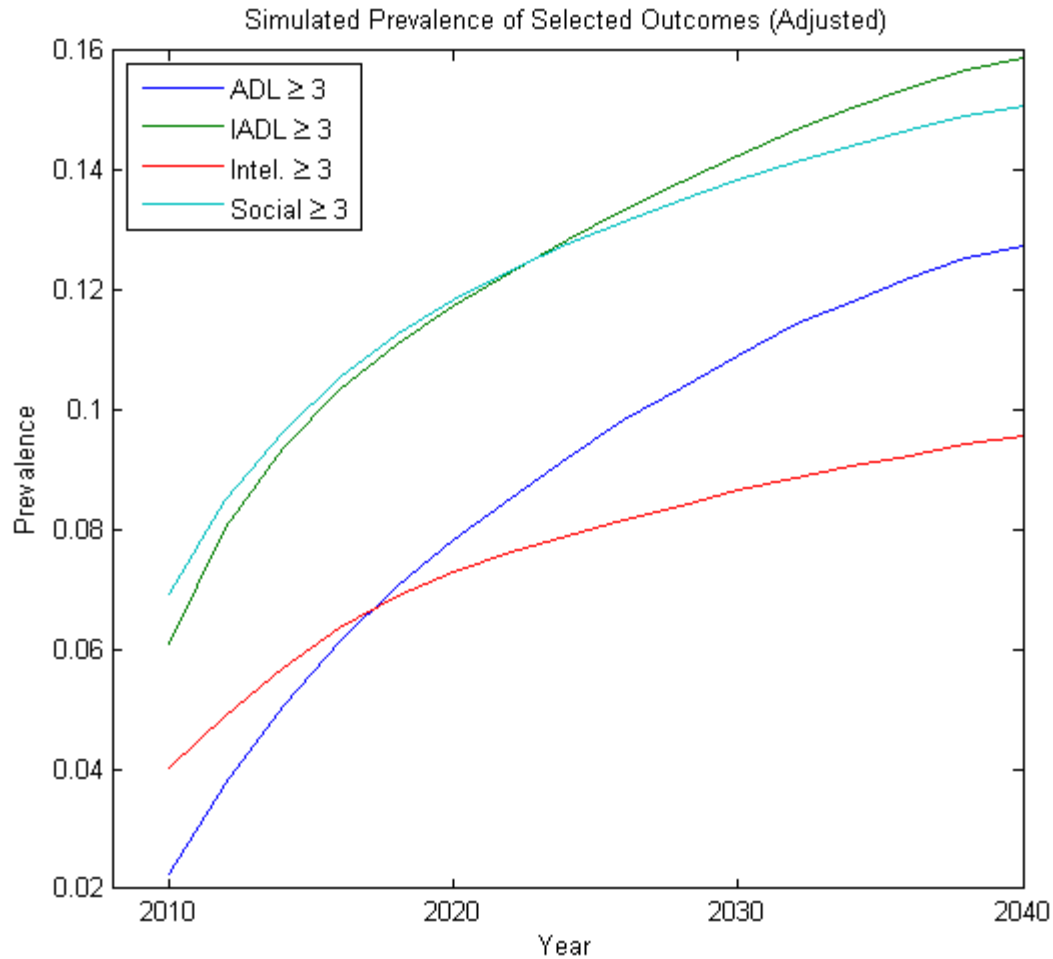
The Impact of Obesity and Smoking on Future Disability: Simulating the Prevalance of ADL>=3 If All Japanese Quit Smoking and No One Were Obese, or If Everyone Smoked and Was Obese
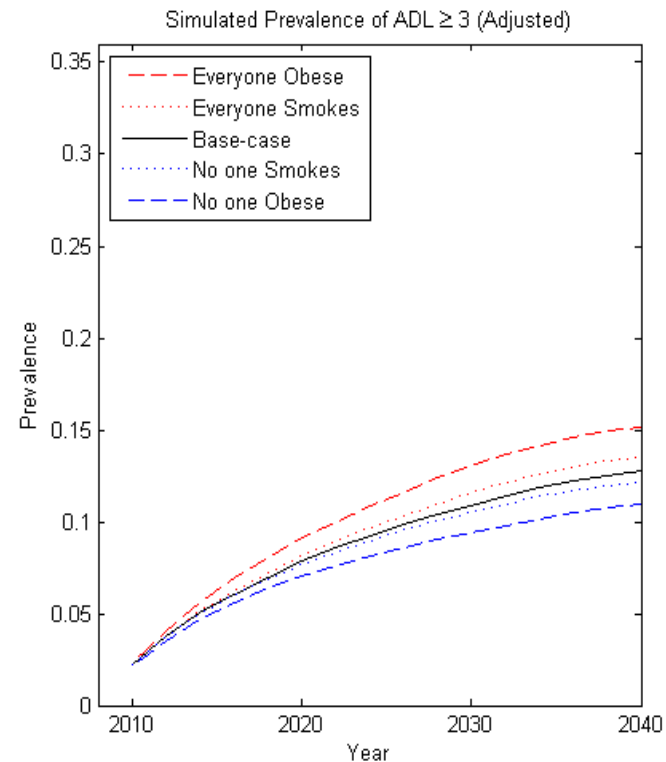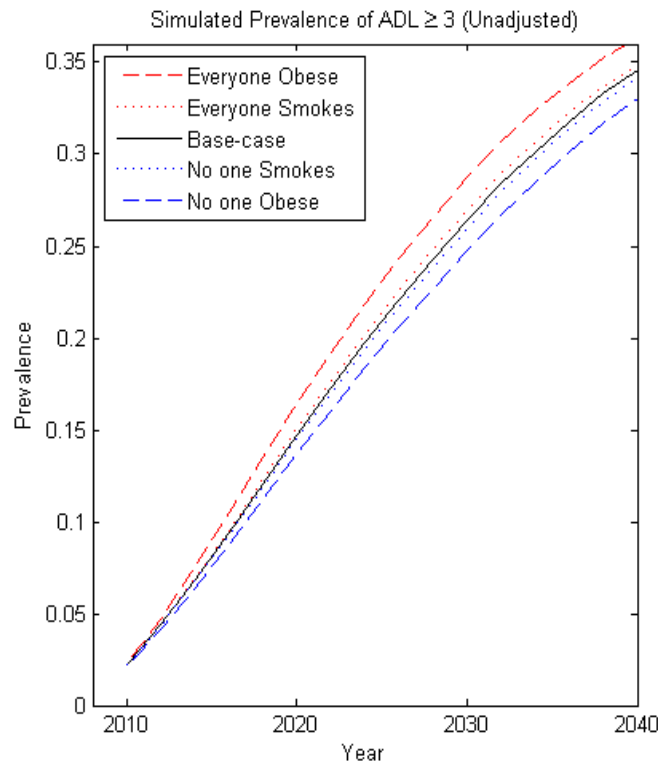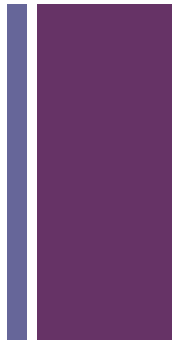
+ Limitations

- Data censored at age 75-80
  - Leads to poor population forecasts for the oldest old.

- Medical expenditures currently not available

Next Steps

- Additional data (NUJLSA)

- Highest security version of JSTAR with links to claims (expenditures) data

- Backcasting exercise

- More sophisticated model for incoming 50 year olds

+ Summary

- Population aging will lead to a much higher prevalence of chronic disease and disability in the coming years
  - Even in the absence of population aging, chronic disease rates would rise in the coming decades
  - Prevention measures would offset the trend only slightly

- Implications for policy
  - US FEM has already been presented to the US government and helps guide planning
  - We hope refined Japan FEM will also inform Japanese policy and planning