

# RIETI BBL Seminar Handout

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July 30, 2015

Speaker: KITAO Sagiri

<http://www.rieti.go.jp/jp/index.html>

The frontier of economic analysis of aging  
demographics and social security reforms:  
An introduction to the state-of-the-art macro models

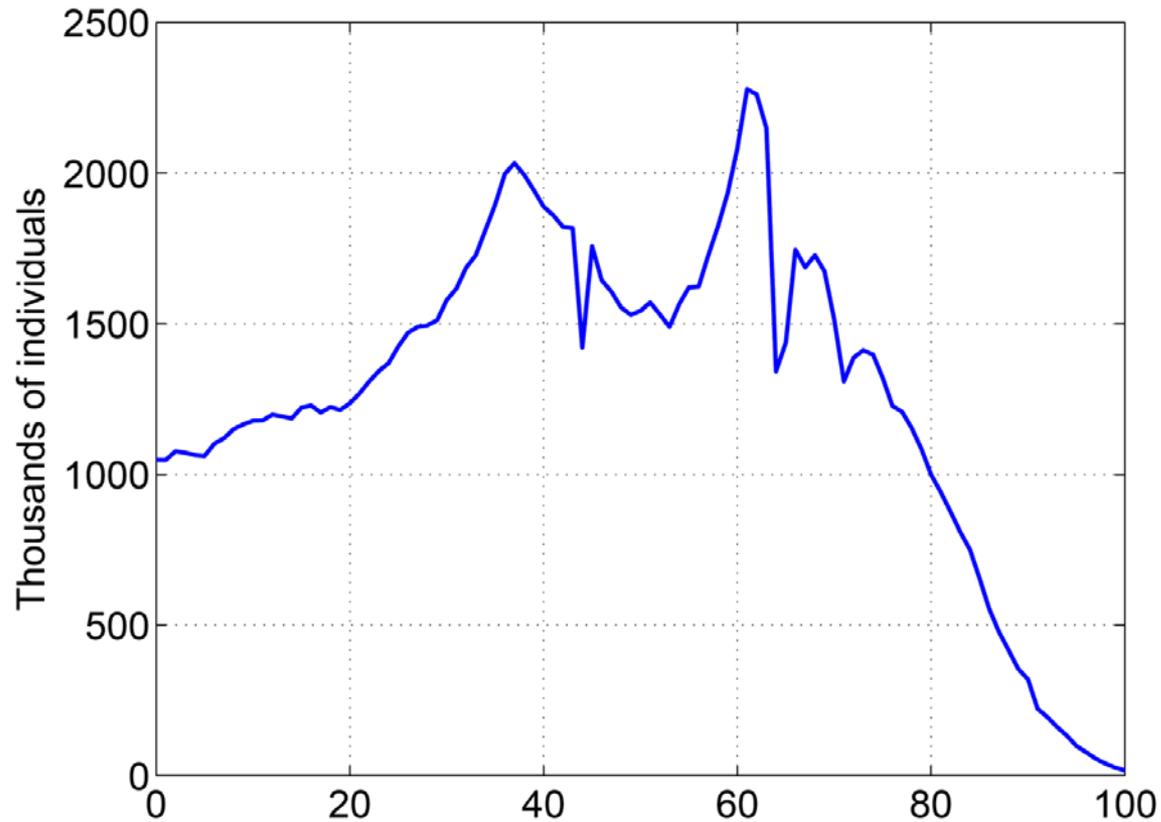
高齢化と社会保障制度分析のフロンティア：  
最先端のマクロ経済研究の紹介

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July 30, 2015

# Age distribution in 2010

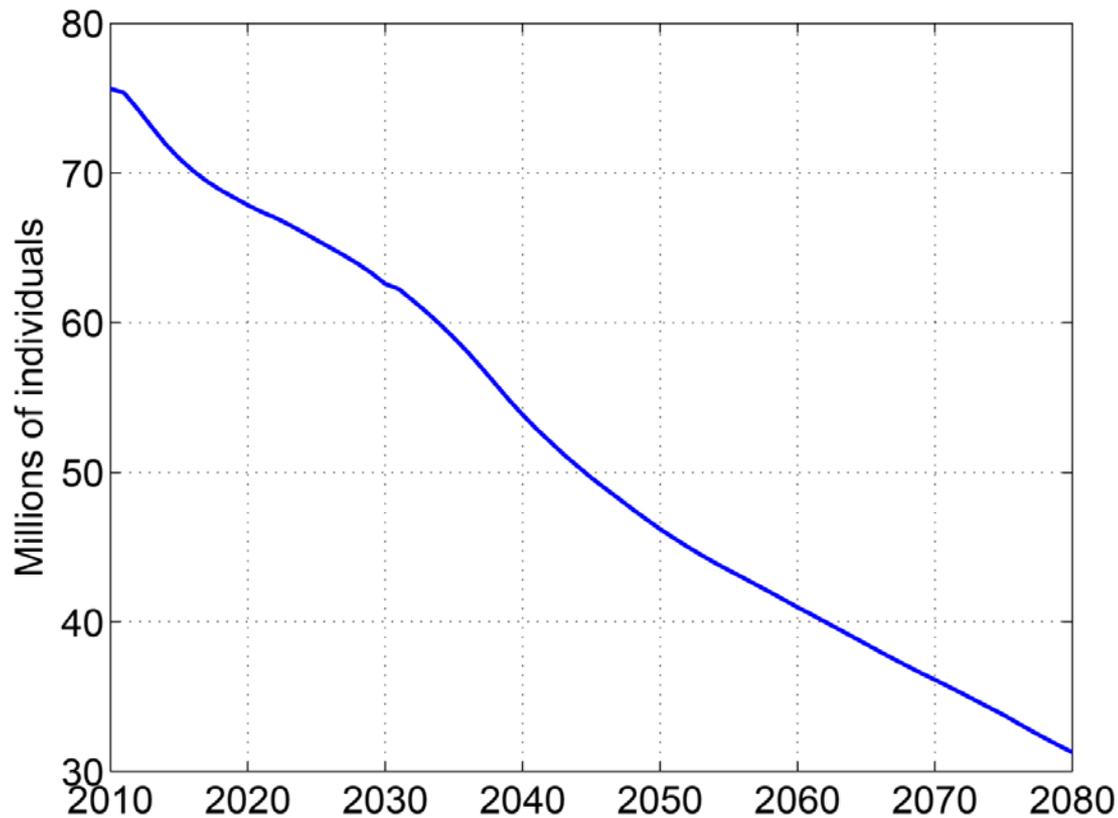
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Source: IPSS (2012)

# Population at age 20-64: projections

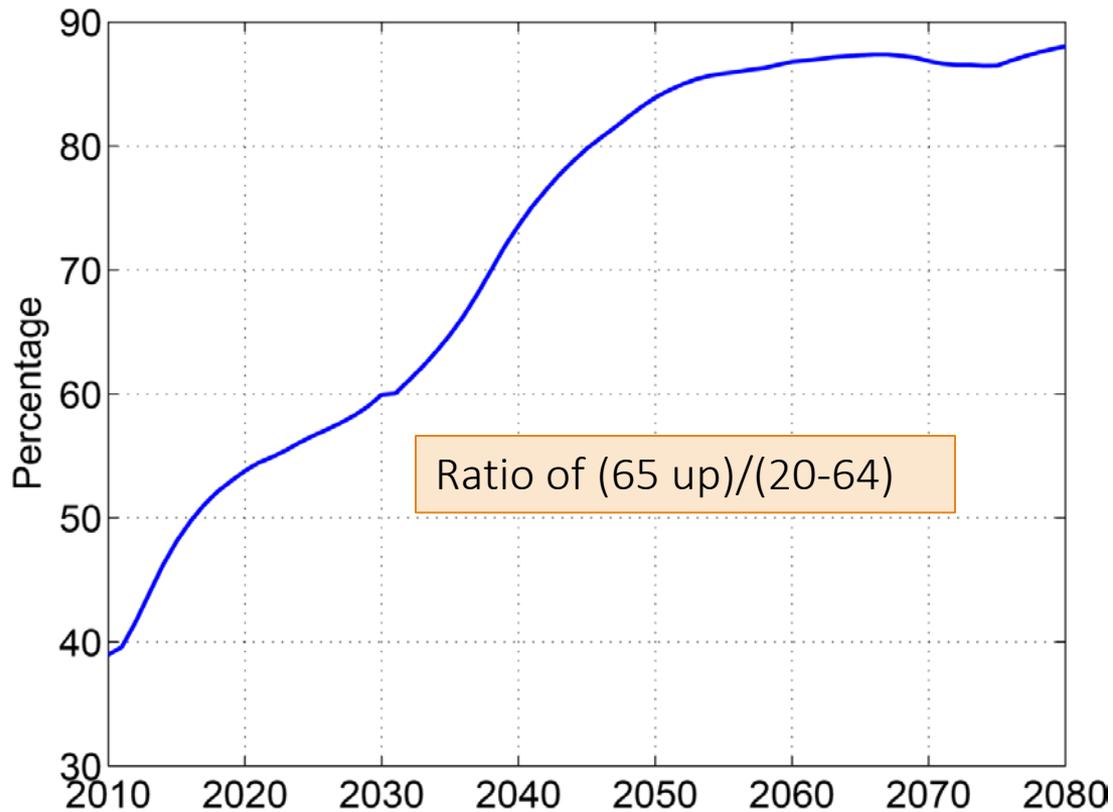
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Source: IPSS estimates and projections(2012)

# Old-age dependency ratio: projections

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Source: IPSS estimates and projections (2012)

# Introduction

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- The ratio of the working-age population (20-64) to retirees (65 and up) will fall from 2.5 in 2010 to 1.2 in 2050.
- Rapidly aging demographics in Japan imply a major increase government expenditures and a decline in revenues.
  - Rising public pension and health care and long-term care insurance payments
  - Shrinking labor force and tax base
- A significant increase in taxes is inevitable without a major cut in expenditures.

# Introduction

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- We all know that!
- Key “economic” questions are --
  - How large is the fiscal cost of demographic transition?
    - What are the required tax rates without reform?
    - What reform would achieve the fiscal balance without tax increases?
  - How does the economy respond to changes in demographics and policies?  
(Economy = Individuals, firms, macroeconomic variables...)
  - What happens to our welfare? How do we like one reform vs another?

# Introduction

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- We need **an economic model** (a framework of analysis) to answer the questions.
- Key ingredients of the model are
  - Mechanism to quantify individuals' response to the change in economic environment (demographics, policy, etc).
    - Life-cycle saving, consumption, labor supply
  - Firms' reactions
    - Changes in factor prices (interest rate, wages)
  - Endogenous changes in macroeconomic variables
    - Aggregate output (GDP), capital, labor, Interest rate, wages
  - Government policies
- A tough problem to handle

# Outline of the talk

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- Introduction – our big questions
- Frameworks of analysis
- Recent research
- What's next?

# Frameworks of analysis

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- Micro-founded **dynamic** (stochastic) **general equilibrium** model of heterogeneous agents
  - A standard and well-established approach in macroeconomic studies of redistributive policies in the U.S.
  - **Micro-founded** vs aggregate – based on individual's optimal decisions
  - **Dynamic** vs static
  - **General equilibrium** vs partial equilibrium – prices are determined in the markets
  - **Heterogeneous agents** vs representative agent (RA)
  - **Stochastic** vs deterministic

# Frameworks of analysis

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- Recent advancement in computational technology and capacity enabled researchers to solve complicated models.
  - Classic micro-founded dynamic models developed in 1970s and 80s.
  - Extended as life-cycle or overlapping generation (“OLG”) models, pioneered by Auerbach and Kotlikoff (1987). Numerous papers published in 80s to 90s.
  - Mostly in the context of the U.S. economy. Several recent papers on Japan (as we discuss later).

# Frameworks of analysis

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- If one wants to understand macro-economy, why not focus on aggregates?
  - To understand changes in “big” numbers (GDP, labor, capital, deficit, etc), we need a model of individuals.
    - Big C is a sum of small c and big Y is a sum of small y, etc.
  - A behavioral model of individuals and firms (as opposed to accounting exercises) is desirable to quantify effects of major changes in economic environment. For example...
    - If income taxes are 10% higher, can we raise 10% more revenues? → change in T and L
    - If pension benefits are reduced by 50%, should I keep saving the same amount? Do people want to work more? → change in K and L
    - If people save so much more given the rise in longevity, what happens to the return to savings? → change in r

# Frameworks of analysis

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- Are accounting exercises/simulations or partial equilibrium analysis useless?
  - Not entirely.
  - Given the complexity of behavioral equilibrium models and limitation in the dimensionality, it may be computationally difficult to incorporate various features that represent the actual economy.
  - If so, accounting studies can give a useful guidance or a first step before exploring a full-blown equilibrium model.
  - We keep in mind, however, a model that fails to capture behavioral responses of individuals and firms could significantly under/over estimate effects of changes in economic environment.

# Recent papers : simulation models

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- Hoshi and Ito (2013)
  - Simulation of fiscal policy through 2055. A major increase in consumption taxes (20%) needed to stabilize the debt.
- Imrohoroglu, Kitao and Yamada (2014)
  - Quantify the fiscal cost (rising expenditures and declining tax revenues) due to the demographic transition.
  - Builds a detailed simulation model of individuals, firms and government. Distinguishing among age, genders, employment types, pension types, etc.
  - A significant debt accumulation occurs without any reform. Net debt used to absorb a fiscal imbalance would reach 1000% of GDP by 2100 without any reform.
  - Factors that affect the size of debt -- growth, pension reforms, female labor force participation.

# Frameworks of analysis

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- So what do we do in “the” model?
  - Let an agent (an individual) face a sequence of an “economic environment” such as
    - Fiscal variables (taxes, public pension, health insurance, etc)
    - Demographic factors (longevity, population distribution)
    - Expected income and expenditures
    - Macroeconomic factors (interest rate, wage rate, unemployment rate, etc)
    - Various sources of uncertainty
  - and let them make optimal life-cycle decisions (consumption, saving, labor supply).
  - Do the same for firms.
  - Compute aggregates. (As necessary, update the “environment” factors and repeat. )

# Recent papers : equilibrium models

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- Imrohoroglu and Sudo (2010), Hansen and Imrohoroglu (2015, RED)
  - A representative-agent neoclassical growth model
  - 30-40% increase in consumption taxes is needed to stabilize the debt
- Braun and Joines (2015, JEDC)
  - An OLG model with medical expenditures and health insurance program.
  - Predict a fiscal crisis (partial default) by 2039 with no major reform, when consumption tax needs be raised to over 50%.
  - Present ways to avoid the crisis : raising health insurance copays, raise consumption taxes sooner, etc.

# Recent papers : equilibrium models

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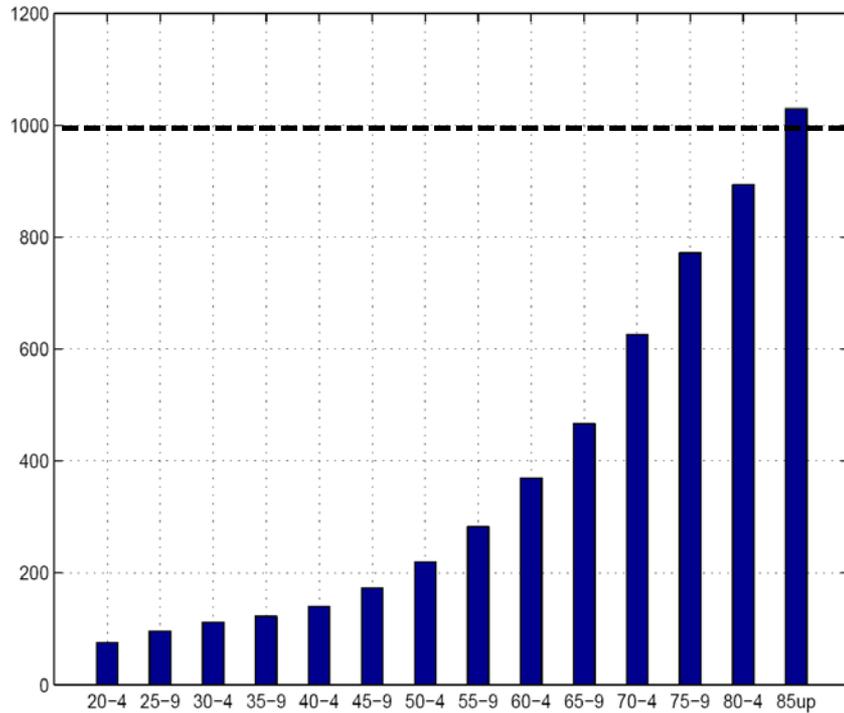
- Many others including Ihori, Kato, Kawade and Bessho (2005, 2011), Ueda, Yoneta and Ota (2014), Arai and Ueda (2013), Miyazawa and Yamada (2015), Yamada (2012), Kashiwase, Nozaki and Tokuyoka (2012), Kitao (2015a, 2015b), Okamoto (2013), etc.
- Kitao (2015a, JEDC)
  - An OLG model of heterogeneous agents with endogenous retirement decisions and details of the health insurance systems (healthcare and long-term care).
  - Consumption tax to reach 48% in 2080s without any reform.

# Kitao (2015a)

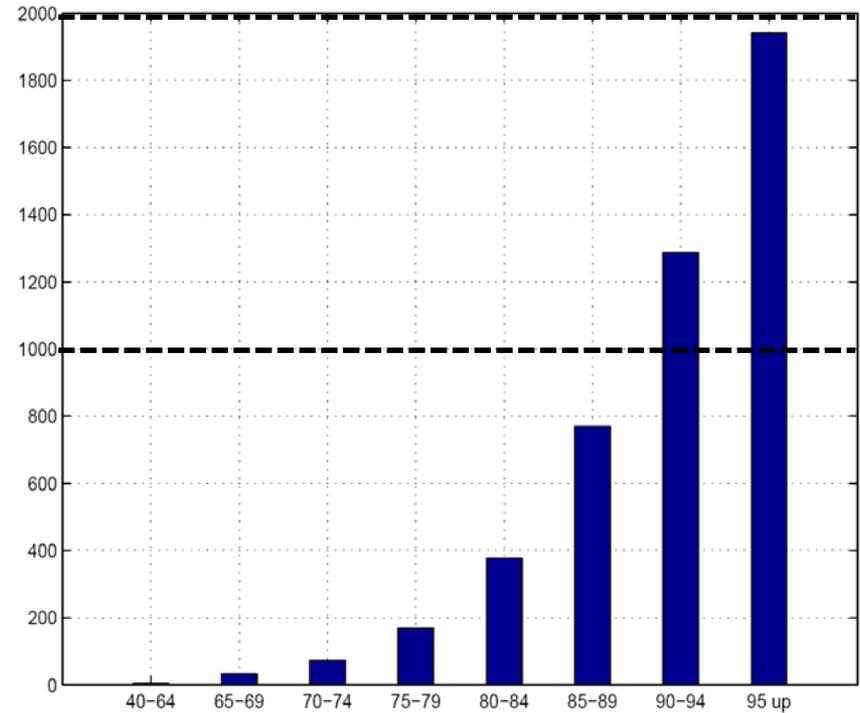
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- An example to give a glance over a standard modeling method and some outcomes. A use of micro-founded stochastic dynamic general equilibrium model of heterogeneous agents.
- Questions
  - What is the fiscal cost of demographic transition?
    - In the short-run and long-run
    - Evaluated in terms of consumption taxes
    - Breakdown of the cost : public pension vs medical expenditures (health care and long-term care)
  - What are the policy options ?
    - Effects of alternative policies – changes in consumption, labor supply and saving of individuals. Factor prices (wage rate, interest rate). Aggregate output, capital and labor supply.
    - Welfare effects. Which reform options do people like – by age and cohort?

# Medical expenditures (average annual spending in JPY 1,000)



(a) Health care expenditures



(b) Long-term care expenditures

Source: Ministry of Health, Labour and Welfare (MHLW, 2010)

# Kitao (2015a)

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- What to assume about demographics?
  - Use projections of fertility rates and survival rates by IPSS up to 2060.
  - Assume that the total fertility rate converges to 2.0 (zero population growth) gradually by 2150 and survival rates stay constant after 2060. → Assume that the population will be constant in the long-run.

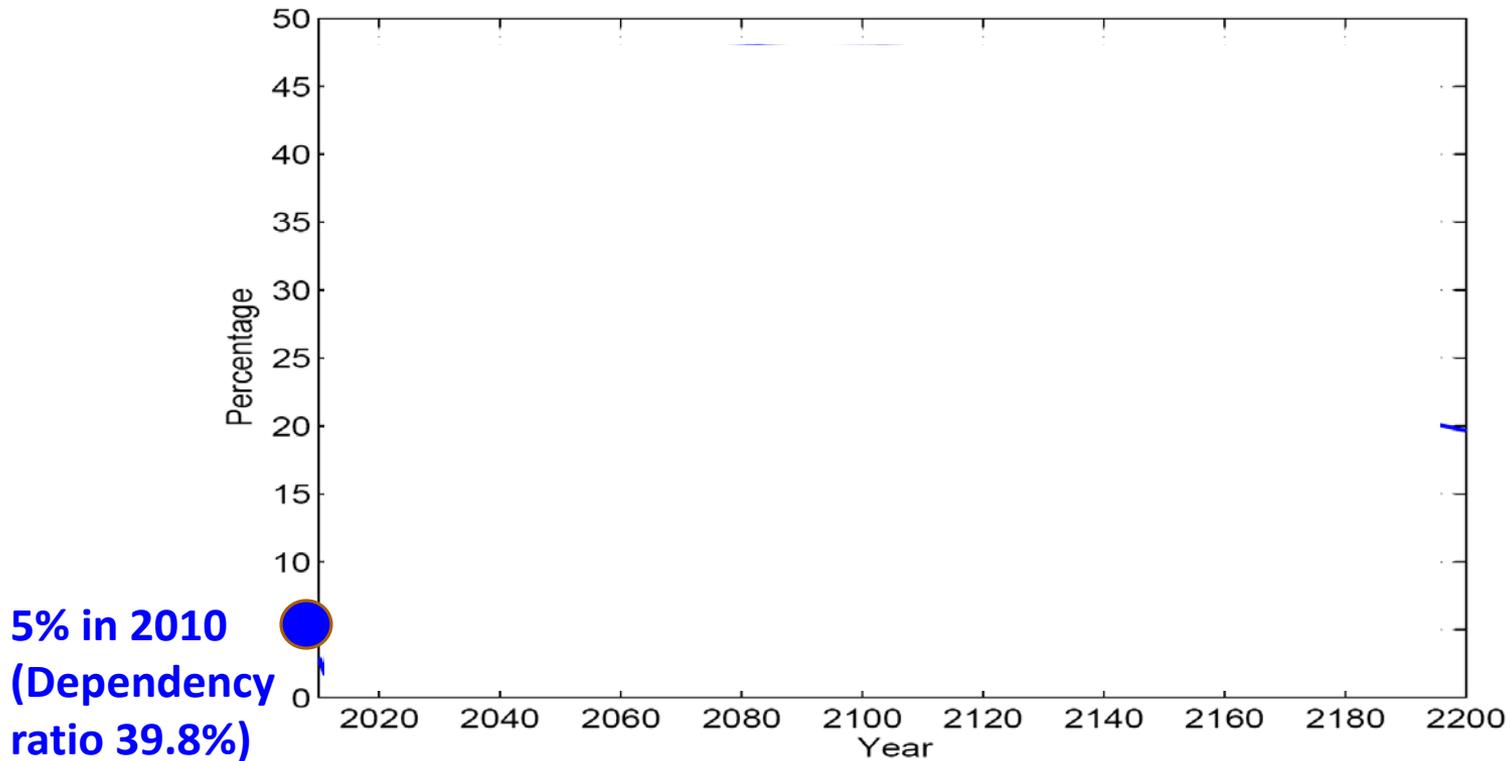
# Kitao (2015a)

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- In the baseline scenario, assume no change in policies (public pension, health insurance, income tax, debt-GDP ratio, etc) --- except for consumption tax rates.
  - Note: ignore any reform already embedded in the system, e.g. macroeconomic slide.
- Start the simulation in 2010 and continue through 2200 (and beyond for computational purposes).
- Then consider alternative policies and assess how they affect the path of consumption taxes and other variables.

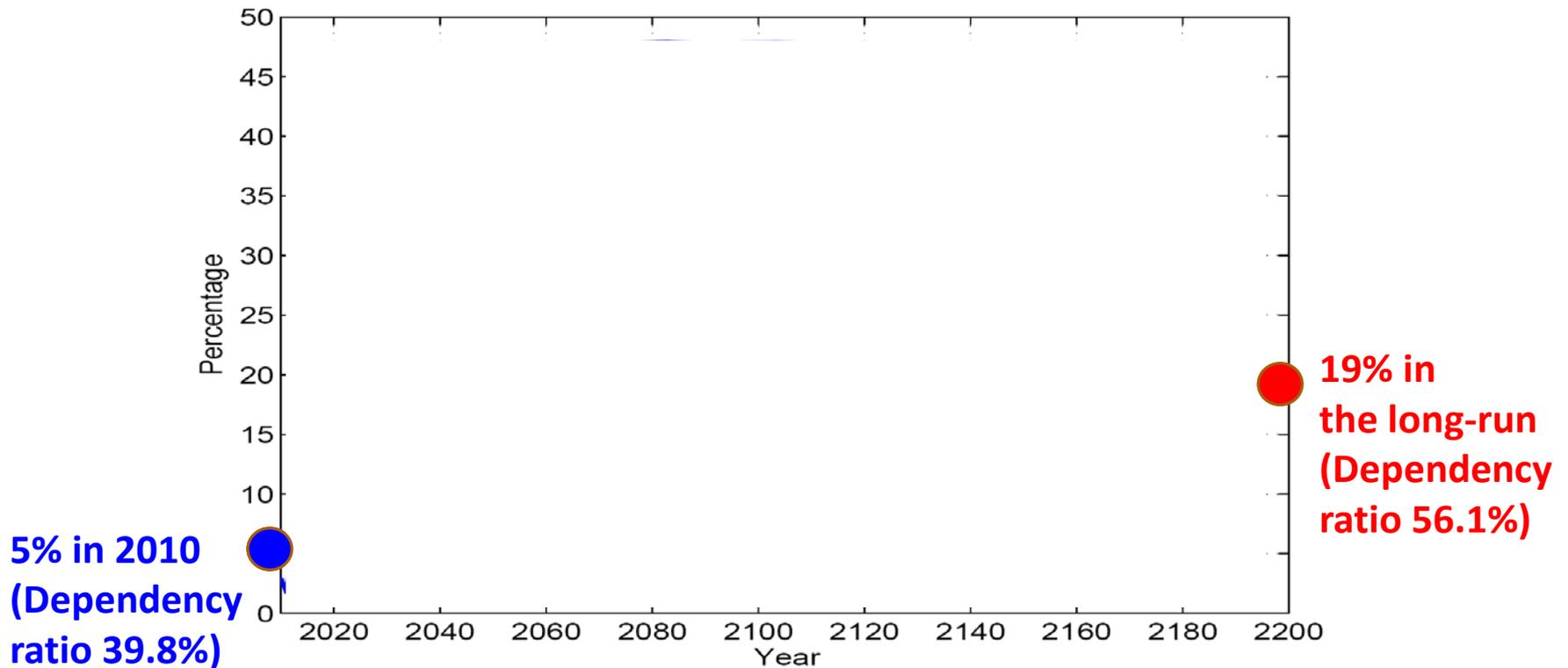
# Consumption tax rates 2010-2200

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# Consumption tax rates 2010-2200

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## Long-run effects of demographic shift

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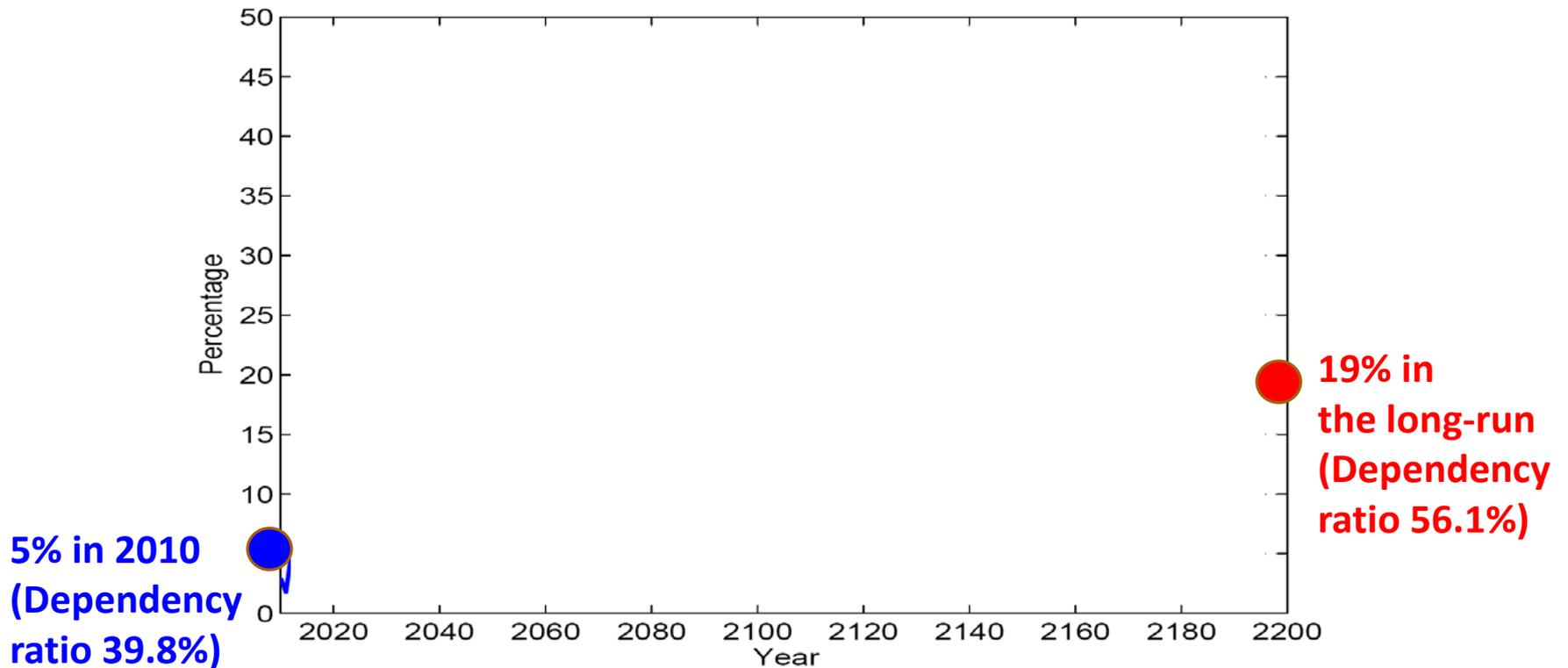
	2010 economy	Long-run
<b>Dep. ratio &gt;65/20-64</b>	<b>39.8%</b>	<b>56.1%</b>
<b>Average life expectancy</b>	<b>83.5</b>	<b>88.0</b>
<b>Consumption tax</b>	<b>5.0%</b>	<b>19.3%</b>
Pension / GDP	10.3%	13.1%
Med (paid by govt) / GDP	5.9%	8.2%
Population (age 20 up)	98,600,400	22,678,100
	1 (norm.)	0.230
GDP	1 (norm.)	0.236
Labor supply	1 (norm.)	0.227
Capital	1 (norm.)	0.256

## Long-run effects of demographic shift

	2010 economy	Long-run
<b>Dep. ratio &gt;65/20-64</b>	<b>39.8%</b>	<b>56.1%</b>
<b>Average life expectancy</b>	<b>83.5</b>	<b>88.0</b>
<b>Consumption tax</b>	<b>5.0%</b>	<b>19.3%</b>
Output per capita	-	+3.3%
Capital per capita	-	+11.6%
Labor per capita	-	-1.1%
Participation rates		
- 55-69	79.2%	82.7%
- 70-90	8.9%	11.6%
Avg work years	43.0	44.5
Interest rate	-	-1.0 ppt
Wage rate	-	+4.5%

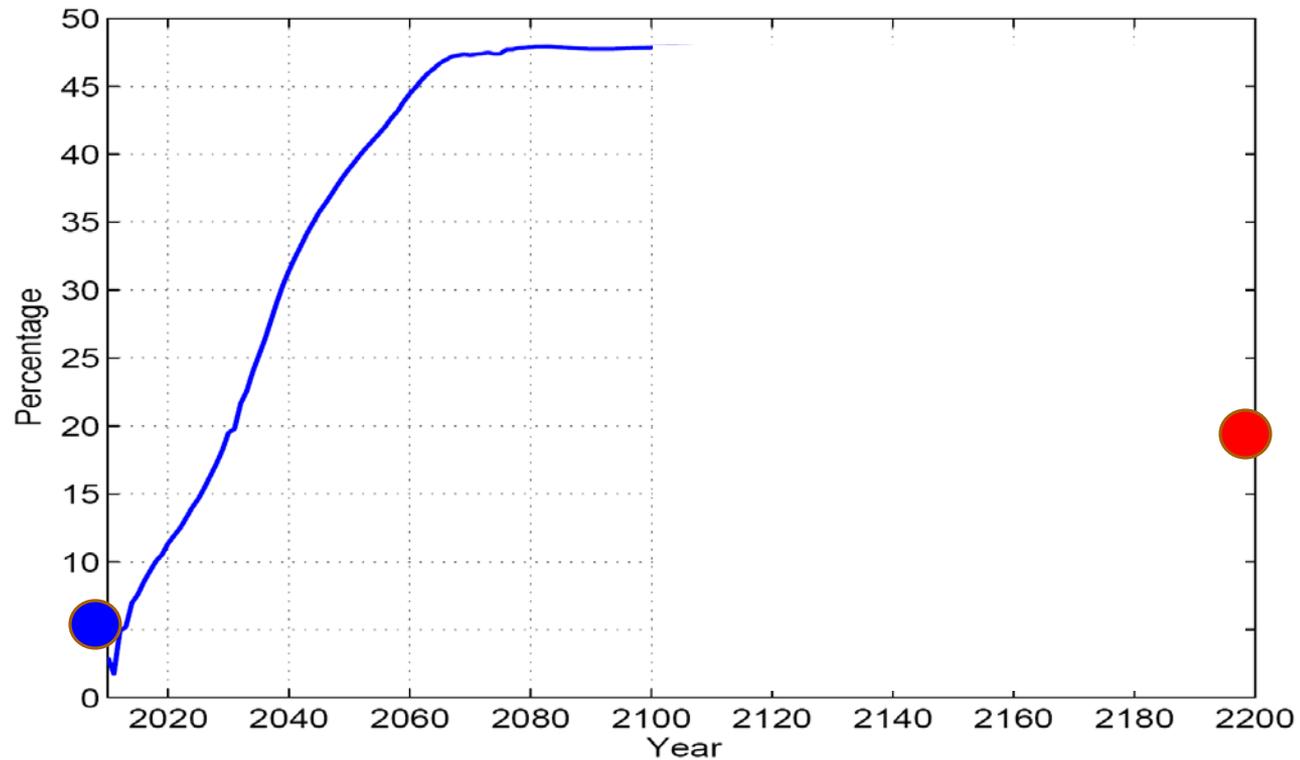
# Consumption tax rate 2010-2200

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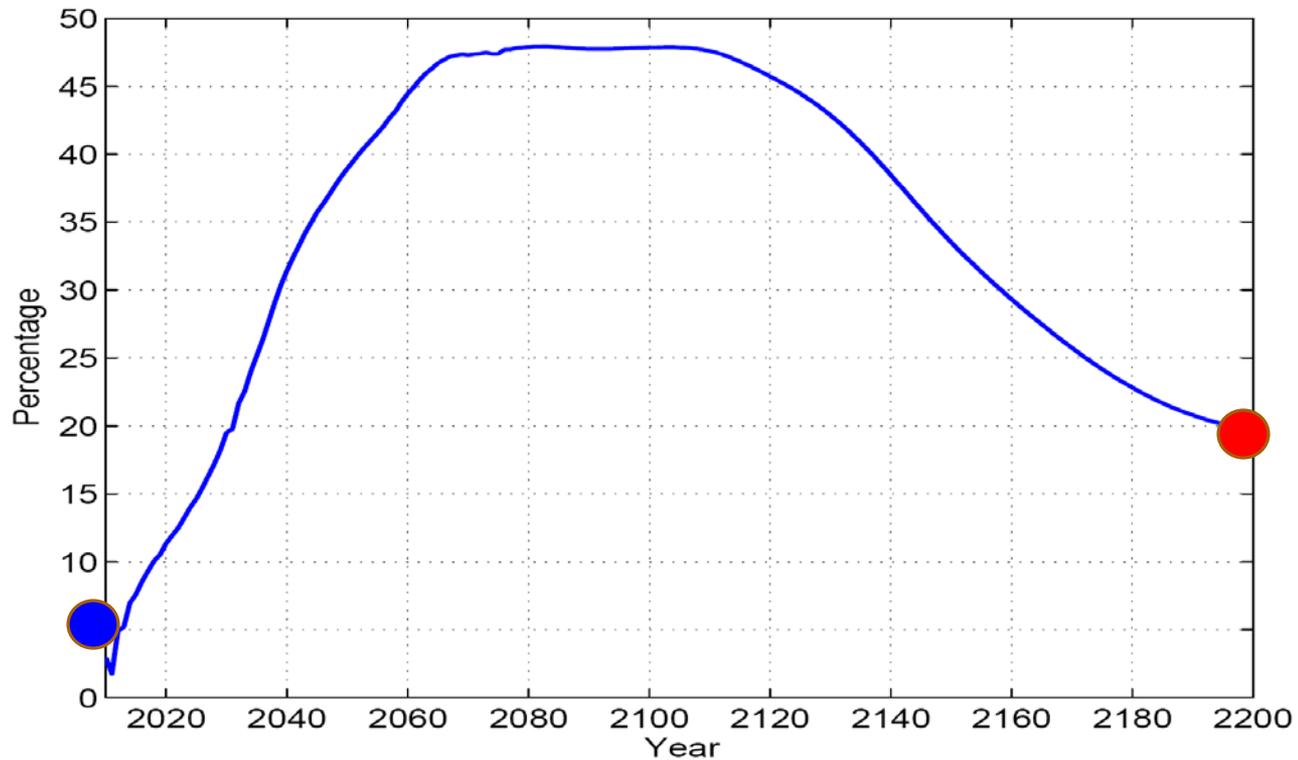
# Consumption tax rate 2010-2200

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# Consumption tax rate 2010-2200

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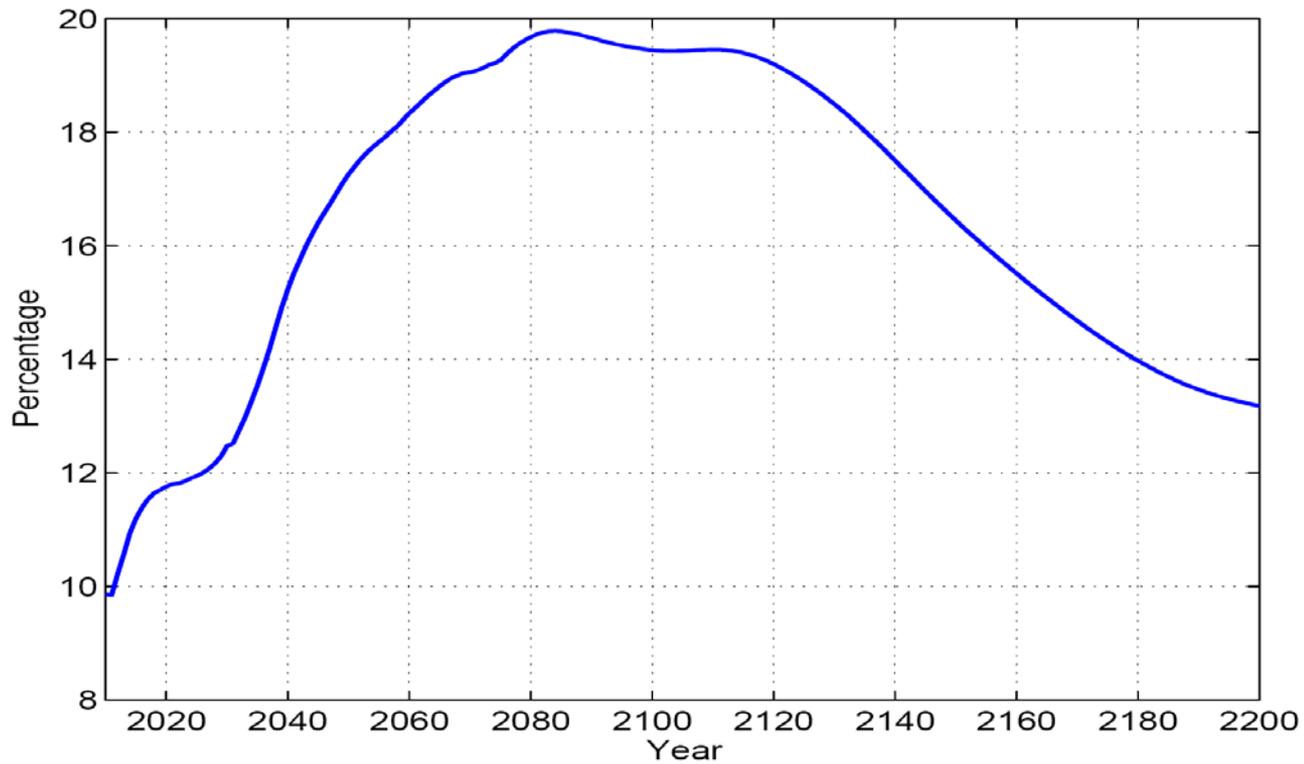
# What explains the rise?

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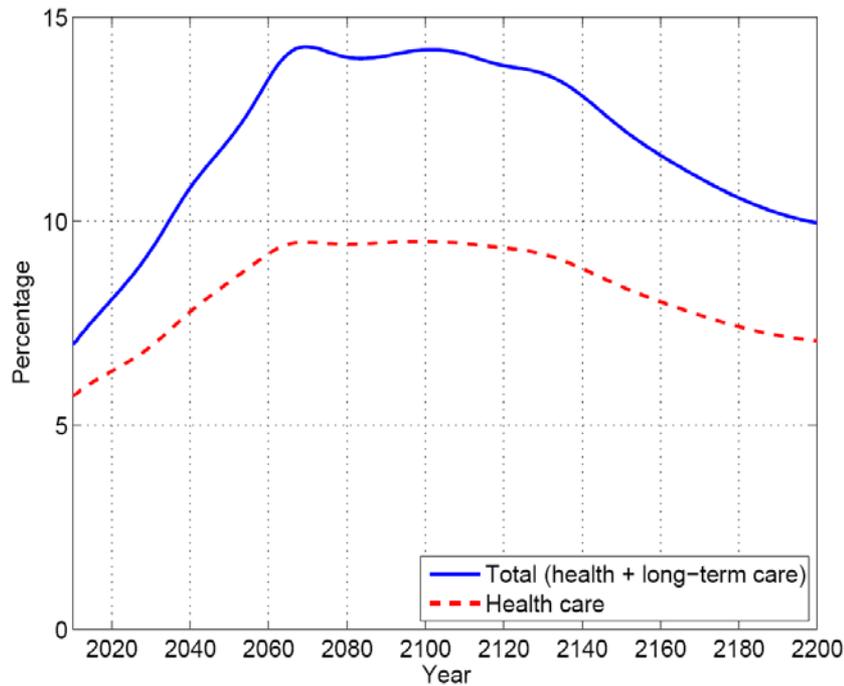
- Identify the sources of rising government expenditures
  - Public pension benefits?
  - Medical expenditures (health care and long-term care insurances)?

# Pension expenditures (% of GDP) 2010-2200

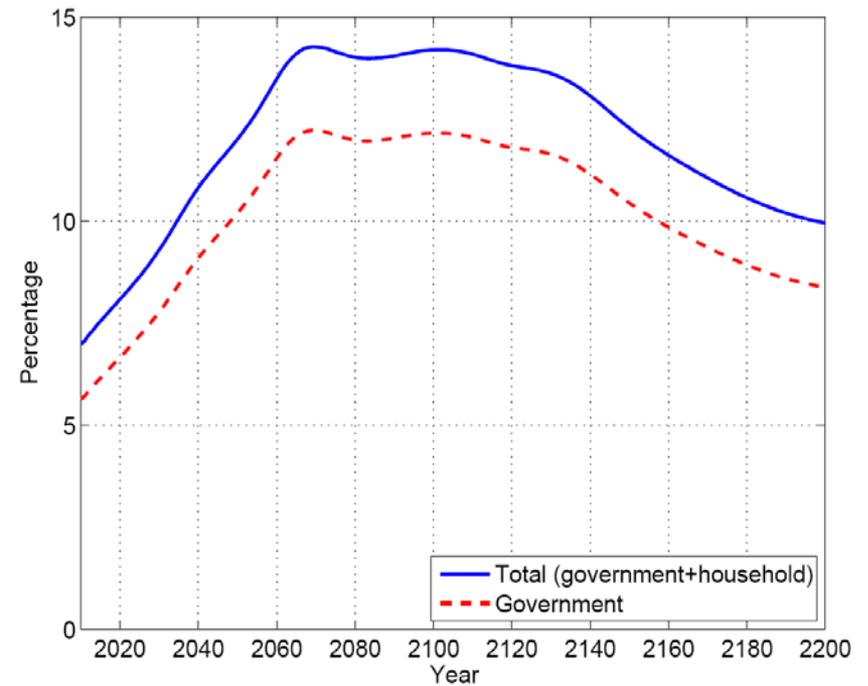
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# Medical expenditures (% of GDP) 2010-2200



(a) Health and long-term care expenditures (% of aggregate output)

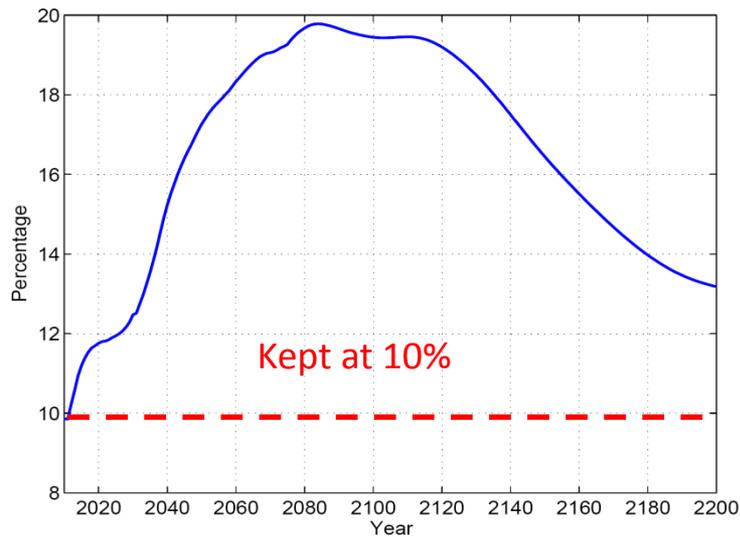


(b) Expenditures paid by government and households (% of aggregate output)

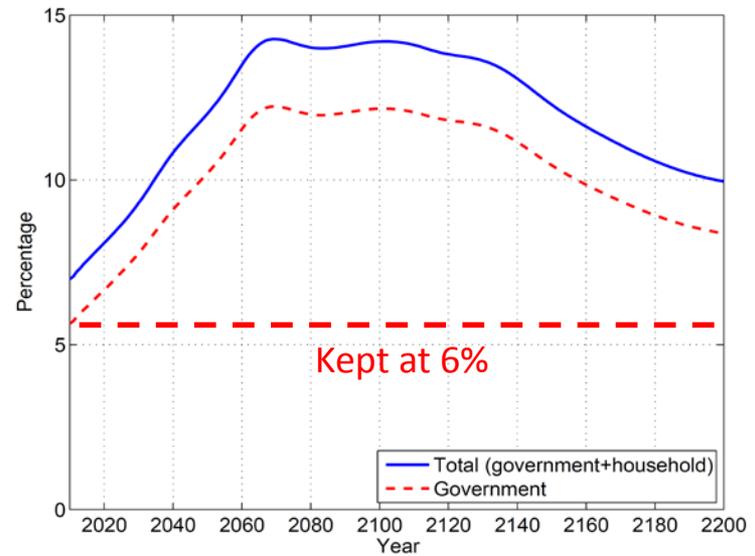
# Pension and health insurance cost

- What if (pension expenditures)/GDP and (health insurance cost)/GDP remain the same?

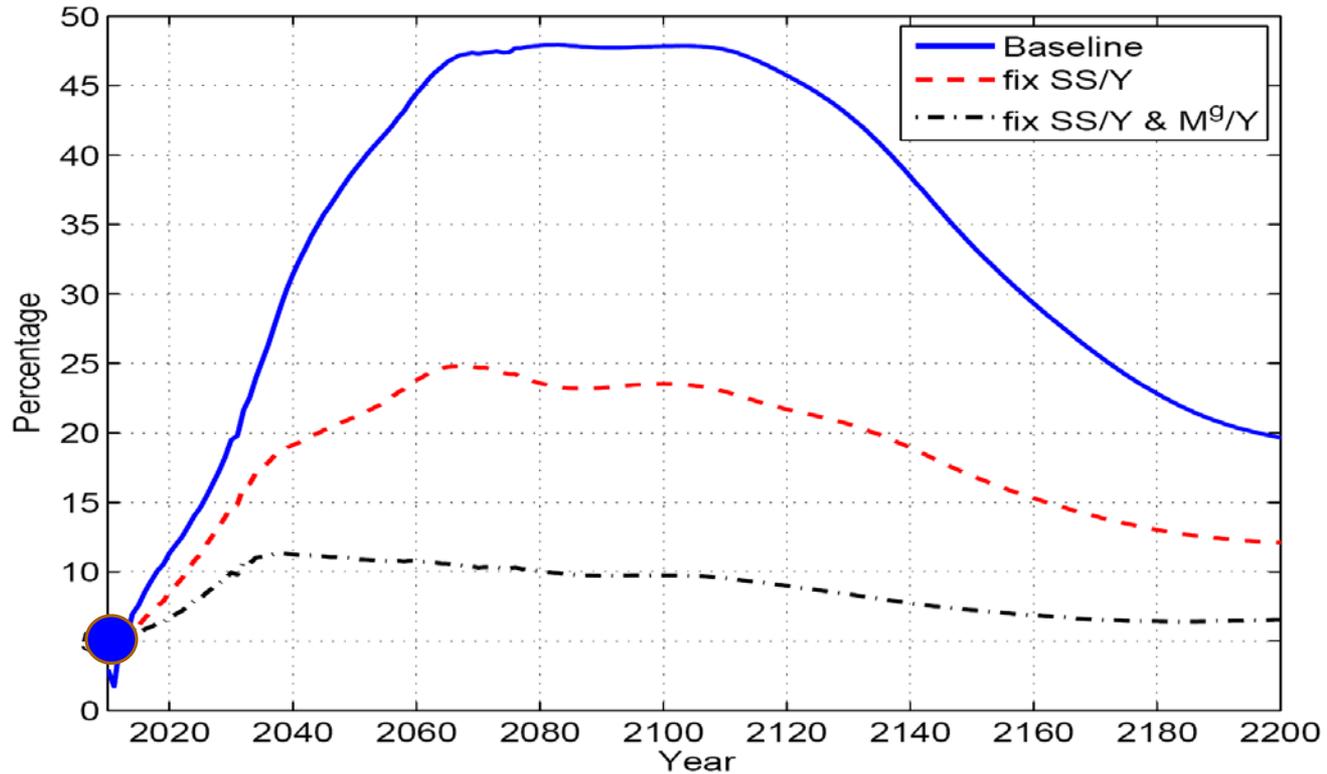
Pension expenditures (% of GDP)



Medical expenditures (% of GDP)



# Consumption tax rate : fixed pension/GDP and med/GDP

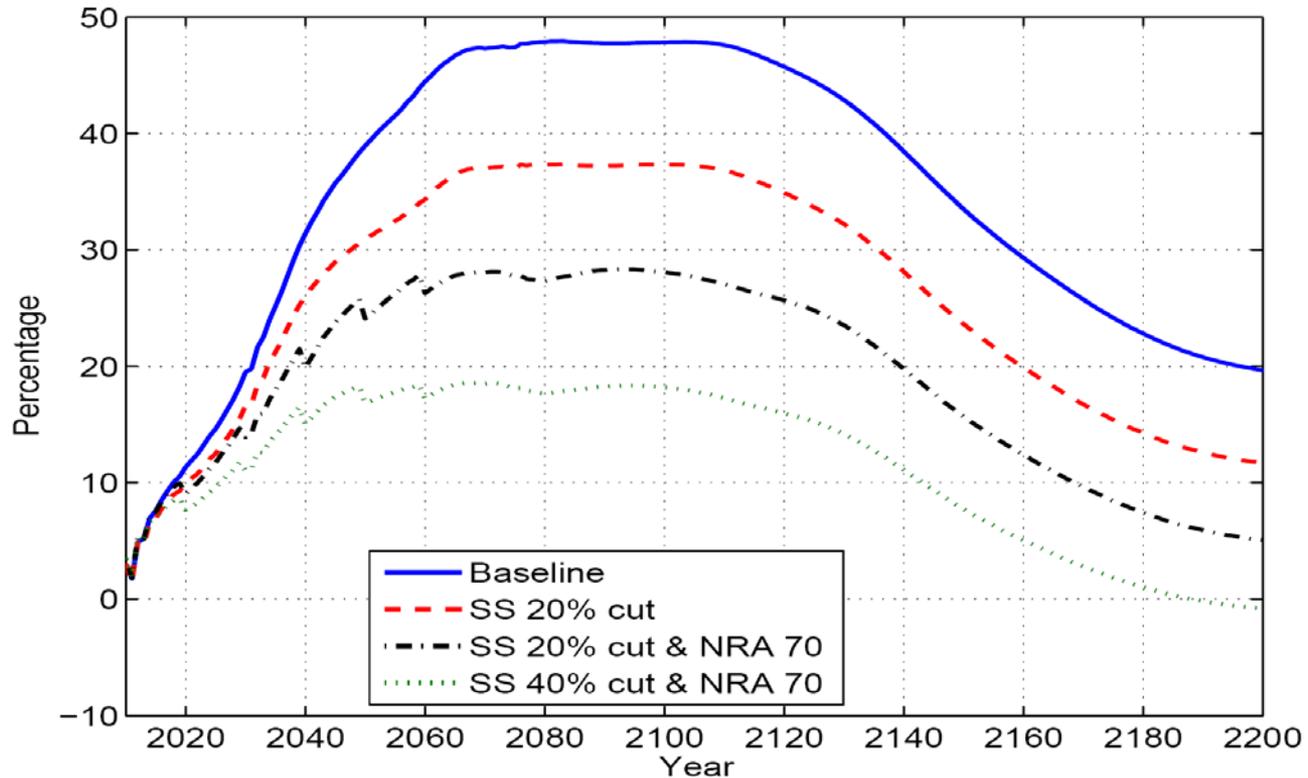


# Pension reforms

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- Simulate pension reforms
  - Benefits reduced by 20% -- as embedded in the 2004-reform
  - Benefits reduced by 20% + retirement age raised from 65 to 70
  - Benefits reduced by 40% + retirement age raised from 65 to 70
- The change will occur gradually over 50-year period.

# Pension reforms



# ... good but are they feasible?

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- Raising consumption taxes by 30-40%?
  - Reducing benefits by additional 20% or raising the retirement age to 70?
- Represent the magnitude of the fiscal issues, which must be realized.
- Political feasibility, however, is another question.

# Other options?

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- Higher TFP and miracle growth?
  - Yes, great, but how?
- An increase in female labor supply, a rise in fertility rates?
  - May help in the short/medium terms but can exacerbate the fiscal imbalance in the long-run without fundamental reform.
- A shift from pay-as-you-go pension system to self-financed system?
  - Kitao (2015b) studies the effects of individual retirement accounts (IRA).
- Foreign workers?
  - Imrohoroglu, Kitao and Yamada (2015) quantify economic effects of introducing various foreign guest worker programs.

# A shift from PAYGO to IRA : Kitao (2015b)

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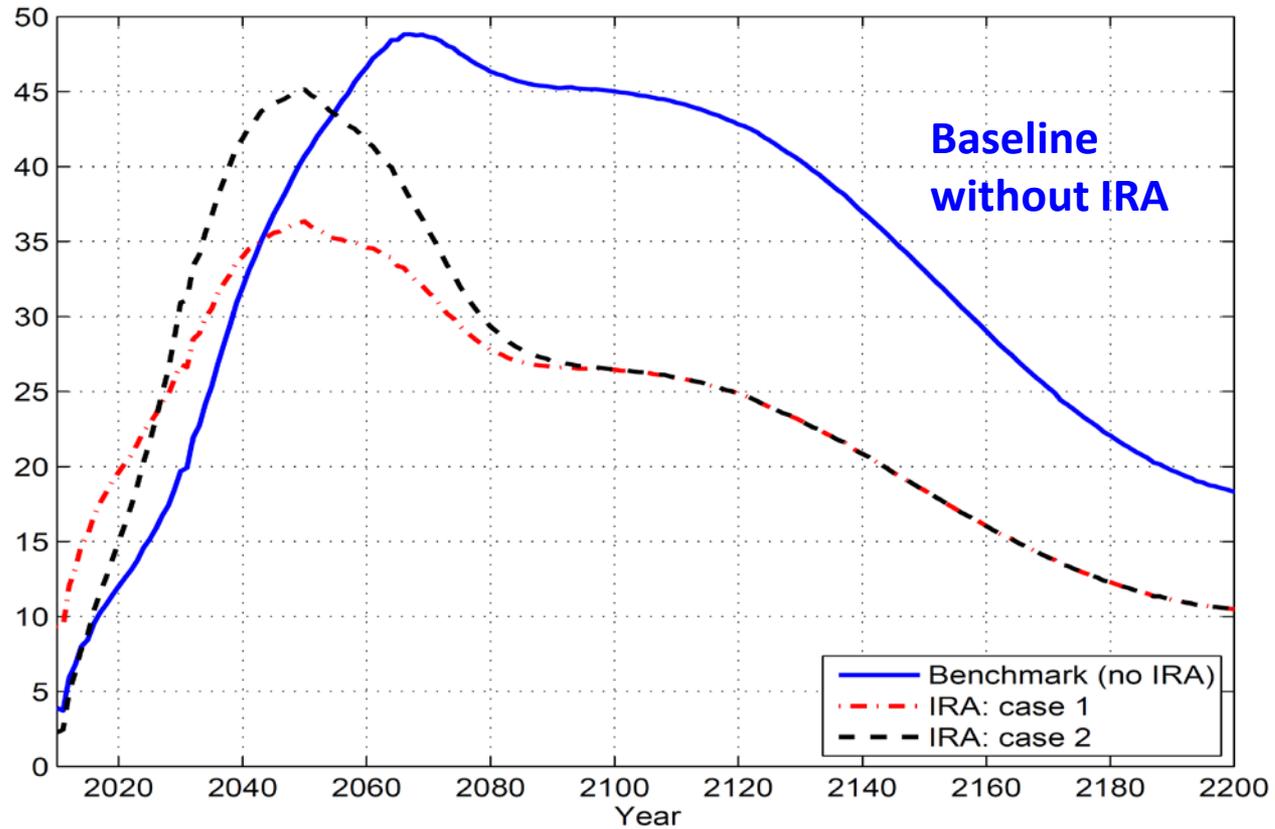
- Study the effects of shifting from the current pay-as-you-go (PAYGO) pension system to a mandatory Individual Retirement Account (IRA) system.
- Use a similar model as Kitao (2015a) though a little simpler to accommodate additional complexities with the IRA.
- Proposed system
  - Gradually eliminate earnings-related part of public pension.
  - Also eliminate workers' contribution (about 9% of earnings) and require them to contribute the same amount to their own IRAs.
  - The balance is paid out to the account owner at the retirement age.
  - Keep the basic pension (*kiso nenkin*) as is.

# A shift from PAYGO to IRA : Kitao (2015b)

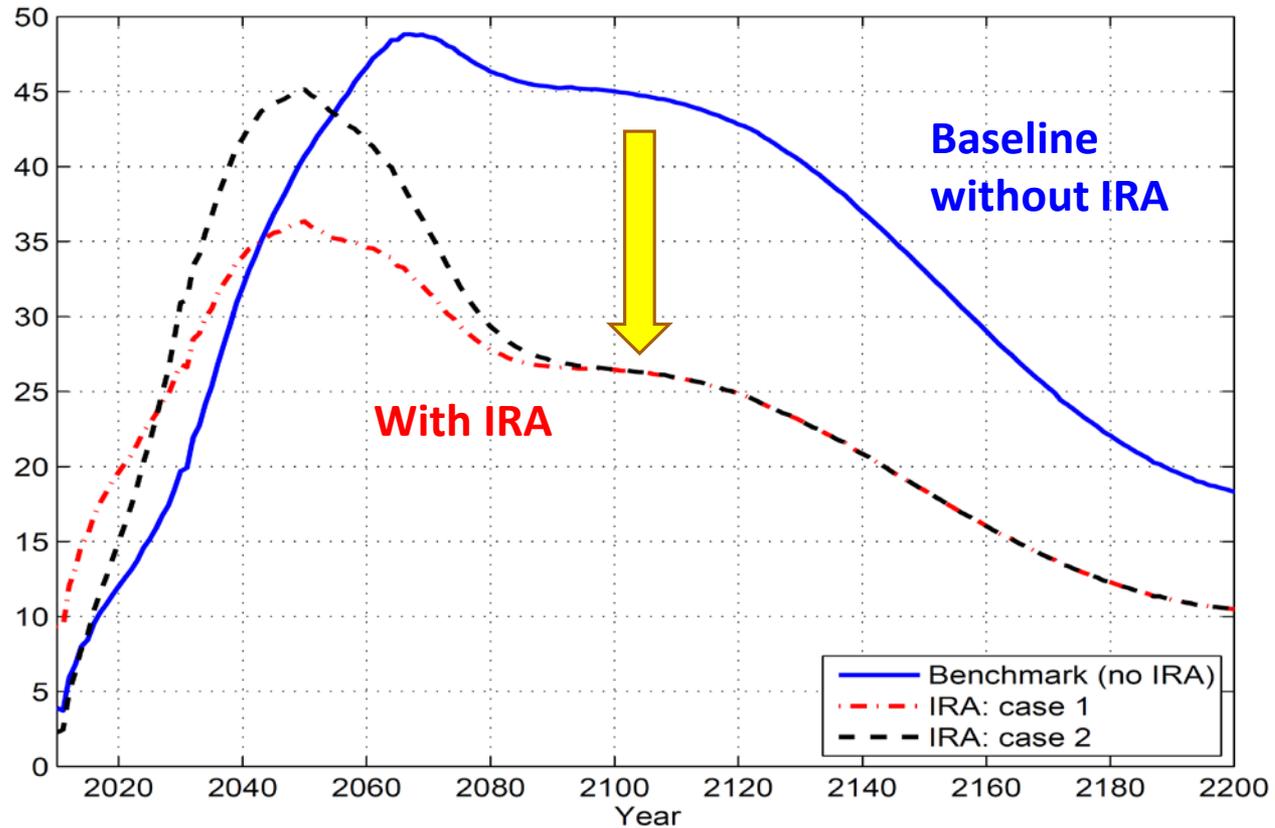
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- Key features
  - The contribution rate (a fraction taken away from the earnings) remains the same as before.
  - Contribution belongs to each contributor, not the government.

# Consumption tax rate 2010-2200



# Consumption tax rate 2010-2200



# Fiscal effects of the IRA – why so large?

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- Direct saving of pension payment
- A major increase in economic activities and tax revenues
  - Contribution paid out of earnings will be saved and invested for decades and contribute to the production. A huge increase in saving and capital will occur.
  - Labor becomes more scarce and wages rise, encouraging labor supply.
  - Tax revenues from other sources will rise and so will the consumption.

# IRA: not a perfect solution in the short-run

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- Though the IRA generates a significant gain in revenues and economic activities in the LONG-RUN, it comes with a large cost in terms of revenues and welfare in the short-run.
  - Individuals must save more (by cutting consumption) during the transition.
  - A loss of linkage between earnings and future pensions generates work disincentives.
  - A gradual decline in contribution (while honoring the benefits of existing retirees) reduce revenues and consumption taxes are higher during the initial decades.
- Can be a very effective policy in the long-run but needs some remedy in the short-run.

# Imrohoroglu, Kitao and Yamada (2015, working paper)

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- Warning: preliminary results
- Study economic and fiscal effects of introducing guest worker programs.
- Consider different policies in terms of the number of guest workers, their skill levels (wages), duration of their stay, etc.
- Example
  - Annual inflows of 200,000 (or 100,000) foreign workers with the same skill as an average Japanese individual (or 50%).
  - Assume that guest workers come at age 35 and stay for 10 years.
  - Assume that they pay income taxes as the Japanese workers but do not pay pension premium nor receive pension benefits.

# Imrohoroglu, Kitao and Yamada (2015, working paper)

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- Some results
  - 200,000 workers each year with the same skills as an average Japanese worker
    - Savings of 3% in consumption taxes in the medium-run (2050) and 5% in the long-run (2100)
  - A more radical policy: as in the U.S., 16% of workers will be foreigners eventually
    - Consumption tax will be 8 to 10% lower in the medium and long-run
- Helps deal with the rising cost of demographics but cannot be a major remedy unless implemented in a significant scale.

# What's next?

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- How to deal with the rising cost of health insurance and medical expenditures?
  - Macro-health is one of the hottest field in economics in the U.S.
  - Model of health stock, investment and endogenous spending decisions.
- Inclusion of detailed family structures in a dynamic equilibrium model
  - Female labor force participation and family bargaining/decision-making
  - Fertility decisions and impacts of childcare policy