1 – Outline

1. Motivation

2. The Model

3. Calibration

4. Numerical results

5. Conclusion
1 – Motivation

• Population ageing poses challenges to economic growth and fiscal sustainability.
• The dynamic stochastic model with overlapping generations (OLG) has been pre-eminent in analysing the impacts of demographic changes.
• Studies have tried to find the best policy response on the criteria of welfare efficiency (e.g., De Nardi, 1999, Huggett, 1999, Altig, 2001, Vogel, 2017, Nishiyama (2015) and Kitao (2015)), and optimal fiscal scheme (e.g., Imrohoroglu, 1995, Gottardi, 2015).
• Conventional assessment omits at least two important aspects: age-dependent risk aversion and changes in future uncertainties.
• For most people, the welfare improves not only with consumption and leisure but also with how well they can follow through their life plan with certainty.
• People’ welfare will be affected by any changes in policy-induced uncertainties.
1 – What this paper does?

• Revisits the welfare efficiency of fiscal policy alternatives.

• Three self-financing policy alternatives are evaluated under the SSA’s median population projection: (i) increasing the payroll tax rate (ii) cutting social security benefits (iii) extending the retirement age.

• Evaluates demographic change impacts on distributions of life-cycle variables, transition dynamics of per-capita variables, and the welfare of each generation over time.

• **Key findings**
  • When these factors are incorporated, this study shows different welfare ranking of fiscal policy alternatives.
  • Reducing social security benefits and extending the retirement age may not be strongly preferred over increasing the payroll tax rate because the former result in higher uncertainties.
2 – Outline

1. Motivation

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5. Conclusion
2 – Overview

- Heterogeneous-agent OLG model with idiosyncratic wage and mortality shocks and a production side
- Endogenous saving and labour supply
- Risk-sensitive preferences with two risk aversion assumptions, one that is constant and another that is increasing with age.
- Realistic demographic structure and social security system
2 – Households: Preferences

• With an assumption of unit elasticity of substitution, we can convert EZW preferences into risk-sensitive preferences by following the approach of Tallarini (2000).

\[ V^j_t = \left[ (c^j_t)^\nu (1 - l^j_t)^{1-\nu} \right]^{1-\beta} \left[ \mathbb{E}_t (V^j_{t+1}^{1-\gamma^j} \mid \eta^j)^{\frac{1}{1-\gamma^j}} \right]^\beta. \] \( (1) \)

• Taking logs, transform, and rearrange give

\[ \tilde{V}^j_t = \left( \nu \ln c^j_t + (1 - \nu) \ln (1 - l^j_t) \right) - \frac{\beta}{\psi^j} \ln \mathbb{E}_t (e^{-\psi^j \tilde{V}^j_{t+1}} \mid \eta^j) \] \( (2) \)

• The functional form of the certainty equivalent of the risk-sensitive preferences in (2) can also be called the entropic risk measure

\[ \rho_{ent}(V^j_{t+1}) = \frac{1}{\psi^j} \ln(\mathbb{E}(e^{-\psi^j V^j_{t+1}})) \xrightarrow{\text{Taylor expansions}} \mathbb{E}(V^j_{t+1}) - \frac{\psi^j}{2} \text{Var}(V^j_{t+1}) \] \( (3) \)

• See Bommier (2017) for further discussion.
3 – Outline

1. Motivation

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5. Conclusion
## Summary

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source/comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour augmenting prod. growth</td>
<td>$\mu$</td>
<td>1.5% Average growth rate of per-capita real GDP</td>
</tr>
<tr>
<td><strong>Preference</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discount factor</td>
<td>$\beta$</td>
<td>0.9875 Target: capital-output ratio of 3.0</td>
</tr>
<tr>
<td>Taste parameter of consumption</td>
<td>$\nu$</td>
<td>0.375 Target: actual working time (OECD)</td>
</tr>
<tr>
<td><strong>Labour productivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age earning profile</td>
<td>$e^j$</td>
<td>see text Follows Hansen, 1993</td>
</tr>
<tr>
<td>Intrinsic productivity (education)</td>
<td>$\theta$</td>
<td>see text U.S. Bureau of Labour Statistics (BLS)</td>
</tr>
<tr>
<td>stochastic productivity</td>
<td>$\eta^j$</td>
<td></td>
</tr>
<tr>
<td>- autocorrelation</td>
<td>$\rho$</td>
<td>0.93 Target: the variance of log labour earning</td>
</tr>
<tr>
<td>- variance</td>
<td>$\sigma^2_\epsilon$</td>
<td>0.027 Target: the variance of log labour earning</td>
</tr>
<tr>
<td><strong>Production and technology</strong></td>
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<td></td>
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<tr>
<td>Income share</td>
<td>$\alpha$</td>
<td>0.41 U.S. Bureau of Labour Statistics (BLS)</td>
</tr>
<tr>
<td>Total factor productivity</td>
<td>$\Omega$</td>
<td>0.875 Target: wage = 1.0 in 2018</td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>$\delta$</td>
<td>9.7% Target: interest rate = 5.0% in 2018</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum taxable income</td>
<td>$y^s$</td>
<td>$128,400$ Social Security Administration</td>
</tr>
<tr>
<td>Social security benefit</td>
<td>$\chi$</td>
<td>see text Social Security Administration</td>
</tr>
<tr>
<td>Government spending</td>
<td>$G$</td>
<td>20% of GDP Average rate 1975-2018</td>
</tr>
<tr>
<td>Government debt</td>
<td>$D$</td>
<td>60% of GDP</td>
</tr>
<tr>
<td>Consumption tax rate</td>
<td>$\tau^c$</td>
<td>5.54% Nation average of retail sales taxes</td>
</tr>
<tr>
<td>Capital tax rate</td>
<td>$\tau^k$</td>
<td>15% Capital gains tax rate (median bracket)</td>
</tr>
</tbody>
</table>
4 – Outline

1. Motivation

2. The Model

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5. Conclusion
4 – Overview

• Only one population projection is considered in which the aggregate population gradually ages.
• All individuals follow the same historical economic and policy path from 1975 to 2018, after which the policy shock comes as a surprise and takes effect in the year 2019.
• Three alternative fiscal policies are studied to finance the fiscal gap:
  1. Proportionally increase payroll tax rate
  2. Scale down the social security benefits
  3. Extend the retirement age
• This section consists of 4 parts:
  1. Life-cycle decisions in the 2018 benchmark economy
  2. Life-cycle decisions in the year 2100
  3. Transition dynamics of per-capita variables
  4. The welfare impacts
• The results under constant risk aversion and age-dependent increasing risk aversion are compared.
4 – Benchmark Economy

Figure 1: Life-cycle profile: Benchmark Economy

(a) Labour supply

(b) Assets

(c) Income

(d) Consumption
4 – Long-run effect

(a) Labour supply

(b) Assets

(c) Income

(d) Consumption
4 – Transition dynamics (I)

(a) Capital stock per capita

(b) Labour supply per capita

(c) GDP per capita

(d) Consumption per capita
4 – Transition dynamics (II)

(a) Rate of return

(b) Wage rate

(c) Social security tax rate

(d) Labour income tax rate

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4 – Welfare Analysis: Increasing payroll tax rate

(a) Welfare determinants

1. Δ lifetime consumption
2. Δ lifetime leisure
3. Δ lifetime uncertainties

Δ asset distribution:
- Higher asset = more certain income = lower uncertainty

Δ price variables:
- Higher risk-free r → lower uncertainty
- Higher wage → higher uncertainty

(b) Welfare of future cohorts: Option 1

![Graph showing welfare changes over time for constant and age-dependent tax rates.](image-url)
Figure 7: Welfare impacts across different policy options

(a) Welfare of current cohorts

(b) Welfare of future cohorts
4 – Sensitivity analysis

Takeaways from sensitivity analysis:

- The welfare differences between constant and age-dependent risk aversion widen when
  - Older cohorts are more risk averse compared to the younger cohorts
  - Stochastic labour productivity increases
  - Individuals favour consumption to leisure
- Introducing social security benefits distribution causes welfare under option 3 to improve.
5 – Outline

1. Motivation

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5. Conclusion
5 – Conclusion

• An overlapping generation model with risk-sensitive preferences and age-dependent increasing risk aversion is developed in this paper to incorporate the aspect of policy-induced uncertainties into the evaluation of welfare impacts of population ageing.

• Reducing social security benefits and extending the retirement age results in higher future volatility, and makes their retirement planning more difficult compared to the case of payroll tax increase.

• Compared to the benefit reduction, extending the retirement age outperforms both in term of economic growth and future welfare.

• This present study serves as an initial step to incorporate the aspect of policy-induced uncertainties when evaluating welfare implications and provides policymakers with an alternative framework to evaluate the appropriateness of fiscal reforms.