

# Age-Dependent Risk Aversion: Re-evaluating Fiscal Policy Impacts of Population Ageing

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#### 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.

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# 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).

$$V_t^j = \left[ (c_t^j)^{\nu} (1 - l_t^j)^{1-\nu} \right]^{1-\beta} \left[ \mathbb{E}_t (V_{t+1}^{j+1})^{(1-\gamma^j)} | \eta^j)^{\frac{1}{1-\gamma^j}} \right]^{\beta}.$$
 (1)

• Taking logs, transform, and rearrange give

$$\tilde{V}_{t}^{j} = \left(\nu \ln c_{t}^{j} + (1-\nu) \ln(1-l_{t}^{j})\right) - \frac{\beta}{\psi^{j}} \ln \mathbb{E}_{t}(e^{-\psi^{j}\tilde{V}_{t+1}^{j+1}} | \eta^{j})$$
(2)

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

$$\rho^{ent}(V_{t+1}^{j+1}) = \frac{1}{\psi^j} \ln(\mathbb{E}(e^{-\psi^j V_{t+1}^{j+1}})) \xrightarrow{\text{Taylor expansions}} \mathbb{E}(V_{t+1}^{j+1}) - \frac{\psi^j}{2} Var(V_{t+1}^{j+1})$$
(3)

• See Bommier (2017) for further discussion.

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# 3 – Summary

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



#### 4 – Long-run effect



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# 4 – Transition dynamics (I)



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# 4 – Transition dynamics (II)



#### 4 – Welfare Analysis: Increasing payroll tax rate

#### (a) Welfare determinants

(b) Welfare of future cohorts: Option 1



#### 4 – Welfare Analysis: Cross comparison



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# 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.

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- 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.