Markovian Social Security in Unequal Societies

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Figure 1: The Correlation between Earnings Inequality and The Size of Social Security Across OECD Countries
Question

- How is the social security system sustained over time?

- Can policy decisions be reconciled with the observed puzzling correlation between inequality and the size of social security?
  
  – An answer to the second question serves as a natural check of the empirical relevance of our proposed theory toward the first.
In this paper

- We develop a dynamic politico-economic theory of social security, in which self-interested forward-looking citizens vote repeatedly for a social security tax.
  
  – temporal separation of contribution from benefit; a lack of commitment over future policies.

  – focus exclusively on Markov perfect equilibria, in which policy decisions are based on politico-economic fundamentals.

- Our theoretical predictions are consistent with the observed negative correlation between inequality and the social security size.
1. The Economy

Environment

- 3-period OLG. Each individual works in the first two periods of life and retires in the last.

- Population grows at a rate \( n \). Labor supply at both periods is inelastic and normalized to unity.

- The young can make human-capital investment before working to increase labor productivity at both working ages.
Within-Cohort Heterogeneity

- Each individual is born with either high or low ability, receiving either a high wage rate ($w^s$) or low wage rate ($w^u$) per unit of human capital.

- The proportion of the low-ability agent (“the poor”) is a constant $\lambda$ within each cohort. We assume $\lambda \geq 1/2$ so that the poor are the majority of the population.

- Normalize $\lambda (w^u)^2 + (1 - \lambda) (w^s)^2$ to unity so that wage inequality has no first-order effect on the tax base.
Social Security System

- Pay-as-you-go
  - Benefit per retiree is $p_t = \tau_t y_t$. $y_t$ is tax base per retiree at period $t$.

- Non-actuarially fair
  - Social security benefit is uniform across different types of the old.

- Timing of decision: $\tau_t$ is chosen $\implies$ the young at period $t$ make human capital investment
The Investment Problem of the Type–j Young

- The type–j young have linear-quadratic preference over life-time wealth and cost of human capital investment

\[
\max_{h_t^j} A_t^j - \frac{1}{2} (h_t^j)^2
\]

where the life-time wealth \( A_t^j \) follows

\[
A_t^j = (1 - \tau_t) w^j h_t^j + \frac{(1 - \tau_{t+1}) w^j h_t^j}{R} + \frac{p_{t+2}}{R^2},
\]
Optimal Investment Choice

\[ h^j_t = \left( 1 - \tau_t + \frac{1 - \tau_{t+1}}{R} \right) w^j. \]  \hspace{1cm} (1)

- A high-ability agent invests more in human capital and earns a higher wage income.

- For each type \( j \), human-capital investment decreases in tax rates of both working periods.

- The higher is the wage rate, the more elastic is human capital investment to tax.
1.1 Ramsey Solution (Benevolent, Full Commitment)

No Social Security at Steady State under $\beta = n/R$

- Intuition: at the steady state, the $MRS$ between consumption of two consecutive generations, $\beta R$, is equal to the corresponding $MRT$, $1 + n \implies$ no further room for inter-generational redistribution.

- The linearity of preference over consumption $\implies$ no need for intra-generational redistribution.

- Given the presence of tax distortion, it is optimal not to impose a positive social security tax in the long run.
No Impact of Wage Inequality on Social Security Size

- Intuition: under linear utility in consumption, the benevolent planner has no incentive to redistribute resource within each cohort.

- Remark: these two results indicate that both the sustainability of social security and its correlation with wage inequality stem from conflicts of interests across different groups and a lack of commitment over future policies in political equilibria.
2 Political Equilibrium

- Each period, the middle and the old vote for payroll tax $\tau$ under majority voting.

- Since $h_{s-1}^s / h_{u-1}^{u} = w^s / w^u$, each period the only payoff-relevant state variable is $h_{u-1}^{u}$

$$\tau = T(h_{u-1}^{u})$$

- Given perceived future tax policy as $\tau' = T(h^{u})$, optimal human capital investment of the young poor follows decision rule $h^{u} = H(\tau)$. 
The Middle Poor’s Political Decision in Recursive Form

- Rewrite \( \tau' = T \circ H(\tau) \equiv B(\tau) \)

  - \( B(\tau) \) represents an intertemporal tax linkage, which is jointly decided by the Markovian tax policy and private investment rule.

- The middle poor’s problem

  \[
  \max_\tau (1 - \tau) w^u h^u_{-1} + \frac{1}{R} B(\tau) Y(\tau).
  \]

  - The middle poor realize that their current policy choice affects private investment of the young and, hence, future tax policy \( \tau' \) (and, therefore, their own future social security benefits).
• FOC implies

\[ B(\tau) = \frac{1}{-Y'(\tau)/R} \left( \frac{B'(\tau)Y(\tau)}{R - \bar{w}\bar{h}_{-1}} + \bar{w}\bar{h}_{-1} - w_u h_u^{u-1} \right) \]  

(2)

• at this stage, take \( B'(\cdot) \), the magnitude of intertemporal tax linkage, as exogenously given (i.e., assume future generations commit to following a given policy rule \( B'(\cdot) \)).

• Later on, we explore the determination of \( B(\cdot) \) in a Markov perfect equilibrium.
Prerequisite for Political Sustainability of Social Security \( (B'(\tau) > 0) \)

- \( B'(\tau) > 0 \) allows the current median voter to indirectly influence future political decisions.

- Rationally perceiving a positive tax linkage, the current median voter understands that the more taxes she pays today, the larger social security benefit she will receive tomorrow.

- As a result, she may vote for a positive tax to trade off her current tax burden against her future redistributive benefit.
Determinants of the Size of $\tau$

- $\tau$ is positively related to the degree of intertemporal tax linkage, $B'(\cdot)$ and future tax base, $Y(\cdot)$.
  - A higher $B'(\cdot)$ or $Y(\cdot)$ implies larger inter-generational redistributive benefit.

- Given $B'(\cdot)$, $\tau$ is positively related to wage inequality (i.e., negatively to $w^u$ and $h^u_{-1}$).
  - A larger wage inequality implies a larger intra-generational redistributive benefit.

- $\tau$ is negatively affected by the degree of the tax distortion, $Y'(\cdot)$. 
Equilibrium Policy Rules

- Confine to linear solutions, analytically solved for by the method of undetermined coefficients.

- There exists a unique linear nontrivial Markov perfect equilibrium

\[ T(h_{-1}^u) = \phi_0 + \phi_1 h_{-1}^u \]  
\[ H(\tau) = h_0 + h_1 \tau \]  

which implies

\[ B(\tau) = b_0 + b_1 \tau \]  

where \( \phi_1 < 0, \ h_1 < 0 \) and \( b_1 > 0 \)
Intuition for a positive intertemporal tax linkage \((b_1 > 0)\)

- The current payroll tax rate distorts the young’s human capital investment \(h^u, H' (\tau) < 0\).

- A lower human capital stock \(h^u\) of the next-period middle poor’s implies higher future redistributive benefits and induces them to choose a higher tax rate, \(T' (h^u) < 0\).

- As a result, current decisive voters can indirectly influence future political decision via private investment, and, thus, the pay-off-relevant state variable of future policy makers \((B' (\tau) = H' (\tau) T' (h^u) > 0)\)!
3 Effects of Wage Inequality

Two channels for wage inequality to affect the equilibrium tax rate

- the redistributive effect: via affecting human capital investment, given tax policy rule.
  - a lower $w^u$ yields a lower human-capital investment for the poor, which leads to more redistributive benefit and, therefore, a higher preferred tax rate by tomorrow’s decisive voters.

- the strategic effect: via changing the equilibrium tax policy rule (i.e., $\phi_0$ and $\phi_1$).
Intuition for the Strategic effect

- In a society with larger wage inequality, the relatively lower wage rate for the poor dampens the impact of the current tax on human-capital investment of the young poor \((w^u \downarrow \implies H'(\tau) \downarrow)\).

- Since human capital stocks of future decisive voters are less elastic to current tax, the future tax becomes less responsive to the current one \((w^u \downarrow \implies B'(\tau) \downarrow)\).

- The weakened intertemporal tax linkage implies less inter-generational redistributive benefit for the current median voter.

- Anticipating this, the current middle poor will choose a lower tax.
Permanent Shock to Wage Inequality

- Suppose that the economy is at the steady state in period 0.

- At the beginning of period 1, there is an unexpected increase in wage inequality.

- It is followed by political decision on $\tau_1$.

- Since the human-capital stock of the middle poor is predetermined, only the strategic effect plays a role upon impact.
Figure 2: Impulse Response Function for an Unanticipated Permanent Shock to Wage Inequality
Inequality and Steady-State $\tau$
Figure 3: The Correlation between Wage Inequality and Steady-State Payroll Tax Rate
4 Conclusion

- A dynamic politico-economic model of social security, which features *temporal separation* of contribution and benefit for policy makers and a *lack of commitment* over future policies.

- Under Markov strategy, the impact of a current tax on future decisive voters’ redistributive benefit shapes a *positive intertemporal tax linkage*, which
  
  - serves as the key element in the political sustainability of social security;

  - allows *intra-generational* inequality to *negatively* affects *inter-generational* redistributive benefit and, thus, the size of social security.
• Our theoretical predictions are consistent with the observed negative correlation between inequality and the social security size.

• The mechanism here has the potential to explain other social programs characterized by temporal separation of contribution and benefit (e.g., health insurance program, government debt).