Welfare effects of fiscal policy in reforming the pension system

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Motivation

Longevity ↑

- Pay-As-You-Go Defined Benefits (PAYG DB) ⇒ fiscally unstable if not reformed (Feldstein: deficit +1.4 pp of GDP share)
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- (Partial) funding fosters accumulation of capital
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Reform : PAYG DB ⇔ (partially) funded DC
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Reform: PAYG DB ⟷ (partially) funded DC

shift of contributions to funded pillar ⇒ short run financing?
Motivation

- In deterministic setting: horse-race between:
  - Efficiency
  - Fiscal cost for cohorts paying for the reform
- Efficiency prevails - reform welfare improving

Nishiyama & Smetters (2007, QJE) and subsequent papers:
Negative welfare effects of the reform

But:
Fiscal policy counteracts / reinforces redistribution affecting also economic efficiency (scope of distortions)

Is Nishiyama & Smetters (2007) result universal?

Compare variants of fiscal closures (accompanying the reform)
Introduce new fiscal closures
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- introduce **new** fiscal closures
## Motivation Model Calibration Results

Literature differs in terms of fiscal closures

Table A1: Modeling options taken in the earlier literature

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<th>Fiscal closures</th>
<th>Implicit tax</th>
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<tr>
<td>Belan and Pestieau (1999)</td>
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<td>?</td>
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<td>Bruce and Turnovsky (2013)</td>
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</table>
Literature differs in terms of fiscal closures

- Pension system parameters
  - contribution rates (20 papers)
    e.g. Kumru & Thanopoulos (2011, JPE), Bruce & Turnovsky (2013, JPE)
  - replacement rate (8 papers)
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- Fiscal closure
  - labor tax (3 papers)
    e.g. Bouzahzah et al. (2002, JEDC)
  - consumption tax (10 papers)
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⇒ Studies do not compare across fiscal closures (except for within pension system)
What we do

- **Challenge the view** that in stochastic framework pension system privatization is welfare deteriorating
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- Provide a **systematic overview** of the interaction between the pension system reform and fiscal closure
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- Provide a **systematic overview** of the interaction between the pension system reform and fiscal closure
- Consider **new ways of financing** the pensions system reform
  - tax on capital income
  - labor tax progression
  - public spending
Nishiyama & Smetters (2007) result is NOT universal ⇔ fiscal closure matters

Depending on the fiscal closure in stochastic framework:
- welfare effect of the same reform can be positive or negative
- with political support or not
Preview of the results

- Nishiyama & Smetters (2007) result is **NOT** universal ⇔ fiscal closure matters

- Depending on the fiscal closure in stochastic framework:
  - welfare effect of the same reform can be positive or negative
  - with political support or not

- Welfare gains and political support only sometimes overlap
  - there are many combinations of fiscal policy that make pension system reform welfare improving
  - public debt often “buys” political support for the reform (both improving and deteriorating)
Contents

1 Motivation

2 Model

3 Calibration

4 Results
Consumers

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Competitive producers

- Cobb-Douglas production function
- Capital depreciation rate $d$
Pension system

Baseline scenario PAYG DB

- equal benefit for whole cohort *(provides insurance)*

\[ b_{\bar{t},t} = \rho \cdot w_{avg,t} \]
Pension system

Baseline scenario PAYG DB

- equal benefit for whole cohort (provides insurance)
  \[ b_{J,t} = \rho \cdot w_{avg,t} \]
- indexed with payroll growth rate (GE labor ↑ ⇒ benefits ↑)

Reform scenario partially funded DC

Reform generates a deficit in the pension system ⇒ need for fiscal closure.
Pension system

Baseline scenario PAYG DB

- equal benefit for whole cohort *(provides insurance)*
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- indexed with payroll growth rate *(GE labor ↑ ⇒ benefits ↑)*

- longevity ↑ creates *deficit* *(no balancing mechanism in a system)*
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Reform scenario partially funded DC

- contributions go into PAYG and funded pillar: \( \tau_t = \tau^I_t + \tau^{II}_t \)
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\[ b_{\bar{J},t} = \frac{\text{accrued ‘savings’}}{\text{life expectancy}_t} + \frac{\text{accrued savings}}{\text{life expectancy}_t} \]
Pension system

Baseline scenario PAYG DB

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  \[ b_{\bar{J},t} = \rho \cdot w_{avg,t} \]
- indexed with payroll growth rate (GE labor $\uparrow \Rightarrow$ benefits $\uparrow$)
- longevity $\uparrow$ creates deficit (no balancing mechanism in a system)

Reform scenario partially funded DC

- contributions go into PAYG and funded pillar: \[ \tau_t = \tau_{t}^I + \tau_{t}^{II} \]
- pension accounts indexed with payroll growth rate $\Rightarrow$ no insurance
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- Reform generates a deficit in the pension system $\Rightarrow$ need for fiscal closure.
Government

- Collects taxes

\[ T_t = \tau_{l,t}(1 - \tau_t)w_tL_t + \tau_{k,t}r_tA_t + \tau_{c,t}C_t + \gamma_t \sum_{j=1}^{J} N_{j,t} \]

- Finances government spending \( G_t = gz_t \sum_{j=1}^{J} N_{j,t} \),
- Balances pension system subsidy\( _t \)
- Services debt \( \Delta D_t = D_t - D_{t-1} \)

\[ G_t + \text{subsidy}_t + r_tD_t = T_t + \Delta D_t \]
Fiscal closures

- **Three new closures**
  - progressive labor tax $\Rightarrow$ working cohorts with favorable shocks $\Rightarrow$ labor supply
  - capital tax (+ debt) $\Rightarrow$ cohorts with more wealth $\Rightarrow$ savings & investment

- **Two closures within pension system**
  - contributions $\Rightarrow$ working cohorts $\Rightarrow$ labor supply
  - pensions $\Rightarrow$ on retirees $\Rightarrow$ consumption
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  - labor tax (+ debt) ⇒ working cohorts ⇒ labor supply
Fiscal closures

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- Four closures outside pension system
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- In total: 9 closures (and a 81 possible combinations of fiscal policy in baseline and reform)
Model solving

- Gauss-Seidel iterative algorithm
  - Guess an initial value for $k = \frac{K}{zL}$ and compute prices
  - Solve individual problem and aggregate it to find new $K'$ and $L'$, thus $k'$
  - Iterate until convergence
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- Consumer problem (backward policy function iterations)
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  - Implicit tax to reduce state space, Butler (2002)
  - Policy function iterations with piecewise linear interpolation
  - Within period problem solved with Newton-Raphson
  - Given initial distribution at age $j = 1$, transition matrix for idiosyncratic productivity and the policy functions compute the distribution in any successive age $j$
  - Aggregation done with Gaussian quadrature
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- Transition path, goes between the initial and final steady state
## Contents

1. Motivation
2. Model
3. Calibration
4. Results
Calibration to replicate 2015 US economy

Preferences

- Preference for leisure $\phi$ matches average hours 33%
- Discounting rate $\delta$ matches interest rate 4%
Calibration to replicate 2015 US economy

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Idiosyncratic productivity shock based on Kruger and Ludwig (2013):

- Persistence \( \rho_\eta = 0.95 \)
- Variance \( \sigma_\eta = 0.375 \)
Calibration to replicate 2015 US economy

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Pension system

- **Replacement rate** \( \rho \) matches benefits as % of GDP 5.2%
- **Contribution rate** balances pension system in the initial steady state
- **Retirement age** equal 65 (\( \bar{j} = 9 \))
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- Contribution rate balances pension system in the initial steady state
- Retirement age equal 65 ($\bar{j} = 9$)

Taxes $\{\tau_c, \tau_l, \tau_k\}$ match revenue as % of GDP $\{9.2\%, 3.8\%, 3.6\%\}$
Depreciation rate $d$ matches investment rate of 25%
Calibration to replicate 2015 US economy

Demography is based on the projection by The United Nations.

**Number of 20-year-olds**

**Mortality rates**
Reform: gradually replace PAYG DB ...

... with a partially funded define contribution (DC)

- Cohorts in DB
- Cohorts with initial capital
- Cohorts in DC

1960
1995
2015

Date of birth
Reform date
Contents

1 Motivation

2 Model

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4 Results
Baseline: PAYG DB with aging and thus **deficit**

**Adjustment in pension parameters**
- contribution rate \( \uparrow \) from 7.8% to 9%
- tax on pensions \( \downarrow \) from 0.0% to 17.3%

**Adjustment in fiscal parameters**
- pension system deficit \( \uparrow \) by 1pp of GDP
Pension system deficit temporary ↑ from 0% to 2% of GDP
Major effects of the reform

Links pensions to contributions

1. Efficiency gain
2. Loss of insurance

Necessitates fiscal adjustment

1. Affects degree of efficiency gain
2. Affects degree of insurance loss
What happens within each experiment?

1. Run no policy reform scenario ⇒ baseline
2. Run policy reform scenario ⇒ reform
3. For each cohort compare utility, compensate the losers from the winners
4. If net effect positive ⇒ reform efficient
Compare two different tax closures, $\tau_c$ and $\tau_k$

$\tau_k$ has larger gain than $\tau_c$ towards the end,

$\rightarrow$ positive overall welfare effect
## Welfare effect - transition

<table>
<thead>
<tr>
<th>Fiscal closure</th>
<th>$\tau_k$</th>
<th>$d\tau_k$</th>
<th>prog.</th>
<th>Baseline</th>
<th>$\tau$</th>
<th>$\tau_b$</th>
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% of consumption in the reform scenario which you are willing to give up to ensure that the reform take place

$\tau_k$ is always a good idea but there is little effect of debt on welfare. prog. (almost) always better than $\tau_l$ in the reform.
## Welfare effect - transition

<table>
<thead>
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<th>Fiscal closure</th>
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% of consumption in the reform scenario which you are willing to give up to ensure that the reform take place

- $\tau_k$ is always a good idea
- little effect of debt on welfare
- prog. (almost) always better then $\tau_l$ in the reform
### Welfare effect - final steady state

<table>
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<th>prog.</th>
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## Welfare effect - final steady state

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- $\tau_k$ brings large welfare improvement
- no long run effect of debt
- prog. always better that $\tau_l$
Welfare effects: why public debt can help gaining political support?

- It helps pensioners (who gain anyway)
- Young always lose (→ are against the reform)
- With debt we sway some working who remain in the old system → majority
Welfare effect – $\tau_k$

Why debt can help gain political support

![Graph showing welfare effect over time](image-url)
Welfare effect - transition - $\tau_k$ & debt + $\tau_k$

Why debt can help gain political support
Why debt can help gain political support
## Political support

*green area* denotes welfare gain, *green font* denotes political support

<table>
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<th>$d\tau_k$</th>
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Nishiyama & Smetters, 2007: stochastic vs deterministic?

Compare the effects of pension system reform in a stochastic and deterministic framework.
Nishiyama & Smetters, 2007: stochastic vs deterministic?

Compare the effects of pension system reform in a stochastic and deterministic framework

- large role for the insurance motive *per se*
- but there are closures with positive outcomes despite stochastic setup
 Decomposition

- **Capital tax**: the highest welfare gain due to efficiency
- **Progression**: the smallest welfare loss due to insurance
Decomposition

- capital tax: the highest welfare gain due to efficiency
- progression: the smallest welfare loss due to insurance
Nishiyama & Smetters, 2007: stochastic vs deterministic?
Nishiyama & Smetters, 2007: stochastic vs deterministic?

\[ \tau_c \]

\[ \tau_k \]
Conclusions

- **Social security reform requires fiscal adjustment**
- **Fiscal closures redistribute and affect efficiency**, therefore matter a lot (unnoticed in earlier literature)
- **Loss of Insurance important but not necessarily decisive** for evaluation of (partial) privatization
- **Preferred policy options**
  - Debt closures: allow to smooth the transition burden on more cohorts
  - Tax on capital income
- **Good but never favored policy options**
  - Adjustment in pensions
  - Labor tax progression (puzzling)
Questions or suggestions?
Thank you!

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 e: kmakarski@grape.org.pl
New fiscal closures

- capital tax tax, \( \tau_{k,t} \)

\[
T_t = \tau_{l,t}(1 - \tau_t)w_tL_t + \tau_{k,t}r_tA_t + \tau_{c,t}C_t + \gamma_t \sum_{j=1}^{J} N_{j,t}
\]

\[
G_t + \text{subsidy}_t + r_tD_t = T_t + \Delta D_t
\]

- smoothing tax adjustments with public debt
- part of the costs of the reform shifted to the future generations
- fiscal rule

\[
\tau_{k,t} = (1 - \varphi)\tau_{k,\text{final}} + \varphi\tau_{k,t-1} + \varphi D \left( \left( \frac{D_t}{Y_t} \right) - \left( \frac{D}{Y} \right)_{\text{final}} \right)
\]

- debt in the final steady state the same as in the initial steady state
Fiscal new closures

- $tr_1$ the lowest income threshold
- $tr_n$ is the highest income threshold
- $n$ is the number of income brackets
- $m$ is a tax multiplier such that $\tau^i_{l,t} = \tau^0_{l,t} \times m^i$
Fiscal new closures

- $tr_1$ is the lowest income threshold
- $tr_n$ is the highest income threshold
- $n$ is the number of income brackets
- $m$ is a tax multiplier such that $\tau^i_{l,t} = \tau^0_{l,t} \times m^i$
- Income threshold is multiple of average labor income, $(1 - \tau_t)w_t \bar{l}_t$.
- In the initial steady state $m = 1$
- In the transition path $m = 1.15$ and $n = 4$
Fiscal closures new in the literature

Total gross labor income \((1 - \tau_t)w_tL_t\) is a sum of \(n + 1\) components: earnings taxed by one of \(n + 1\) tax rate.

\[
L^0_t = \sum_{j=1}^{\tilde{J}} N_{j,t} \int_\Omega \min(\omega_{j,t}(s_{j,t})l_{j,t}(s_{j,t}), tr_1) d\Pi_{j,t}
\]

\[
L^i_t = \sum_{j=1}^{\tilde{J}} N_{j,t} \int_\Omega \max(\min(\omega_{j,t}(s_{j,t})l_{j,t}(s_{j,t} - tr_1), tr_i - tr_{i-1}), 0) d\Pi_{j,t} \forall i = 1, ..., n
\]

\[
\tau^0_{l,t} = \frac{G_t + \text{subsidy}_t + \Delta D_t - \Upsilon_1 \sum_{j=1}^{J} N_{j,t} - \tau_{c,1} C_t - \tau_{k,1} r_t A_t - \sum_{i=0}^{n} L^i_t \tau^i_l}{\sum_{i=0}^{n} L^i_t}
\]

\[
\tau^i_l = m^i \cdot \tau^0_{l,1}
\]
Fiscal closures within pension system

To keep pension system balanced government may adjust:

- contribution rate $\tau$
- benefits $b_j$ (as a tax on benefits)

$$\sum_{j=\tilde{J}_t}^{J} N_{j,t}(1 - \tau_{b,t})b_{j,t} = \tau_t \bar{w}_t L_t \quad \text{and} \quad \text{subsidy}_t = 0$$
Fiscal closures outside pension system, $\text{subsidy}_t \neq 0$

- consumption tax, $\tau_{c,t}$
- labor tax, $\tau_{l,t}$

\[ T_t = \tau_{l,t}(1 - \tau_t)w_tL_t + \tau_{k,t}r_tA_t + \tau_{c,t}C_t + \gamma_t \sum_{j=1}^{J} N_{j,t} \]

\[ G_t + \text{subsidy}_t + r_tD_t = T_t + \Delta D_t \]

- smoothing tax adjustments with public debt
- part of the costs of the reform shifted to the future generations
- fiscal rule $\forall \text{tax} \in \{l, c\}$

\[ \tau_{\text{tax},t} = (1 - \varrho)\tau_{\text{tax}}^{\text{final}} + \varrho \tau_{\text{tax},t-1} + \varrho D \left( \left( \frac{D}{Y} \right)_t - \left( \frac{D}{Y} \right)^{\text{final}} \right) \]

- debt in the final steady state the same as in the initial steady state
Profile of average consumption for $\tau_k$: closure

in line with Gourinchas & Parker (2002, Econometrica)
Profile of average labor for $\tau_k$ closure

![Graph showing the profile of average labor for $\tau_k$ closure. The graph plots age on the x-axis and labor on the y-axis. The lines represent different states: initial steady state, baseline final steady state, and reform final steady state.]
Profile of average savings for $\tau_k$ closure

- initial steady state
- baseline final steady state
- reform final steady state
\[ \tau_k \]
\[ \text{debt} + \tau_k \]
\[ \text{progression} \]
\[ \tau_l \]
\[ \text{debt} + \tau_l \]
\[ \tau_b \]
\[ \tau_c \]
\[ \text{debt} + \tau_c \]
$\tau_k$  
$\tau l$  
$\tau b$  
$\tau c$  
$\text{debt } + \tau_k$  
$\text{debt } + \tau l$  
$\text{debt } + \tau c$  
$\text{progression}$
Capital

Years since 2015

Ratio to baseline

- \( \tau \)
- \( \tau_b \)
- \( \tau_c \)
- \( \tau_l \)
- progresive
- debt and \( \tau_c \)
- debt and \( \tau_l \)
- debt and \( \tau_k \)
Labor

The graph illustrates the ratio to baseline over years since 2015. The x-axis represents the years since 2015, ranging from 2000 to 2150. The y-axis shows the ratio to baseline, ranging from 1 to 1.1. Several lines represent different scenarios, each labeled with a specific symbol or abbreviation. The scenarios include:
- \( \tau \)
- \( \tau_b \)
- \( \tau_c \)
- \( \tau_l \)
- progresive
- debt and \( \tau_c \)
- debt and \( \tau_l \)
- debt and \( \tau_k \)
$\tau_k$, debt + $\tau_k$, progression

$\tau$, $\tau_l$, debt + $\tau_l$

$\tau_b$, $\tau_c$, debt + $\tau_c$