Intergenerational Policy and the Measurement of the Tax Incidence of Unfunded Liabilities

Juan Carlos Conesa, Universitat Autònoma de Barcelona
Carlos Garriga, Federal Reserve Bank of St. Louis

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Motivation

- Ageing population threats large fiscal imbalances for future generations i.e. Social Security, Medicare, etc...

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- Ageing population threats large fiscal imbalances for future generations i.e. Social Security, Medicare, etc...
- Before deciding the magnitude of the fiscal adjustment (**intergenerational policy**), it is important to measure the tax incidence
    1. Identify the individuals who are currently bearing the cost of the tax bill
    2. Changes in the tax burden implied by alternative tax regimes.

The Measurement of Tax Incidence

The complexity of tax policy makes the use of simple metrics based on accounting identities a "good" proxy (Auerbach, Gokhale and Kotlikoff (1991))

Consider total taxes paid by a given individual

$$(1+\tau^c)c + s = (1-\tau^l)wl + (1+r(1-\tau^k))s + m$$

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Consider total taxes paid by a given individual

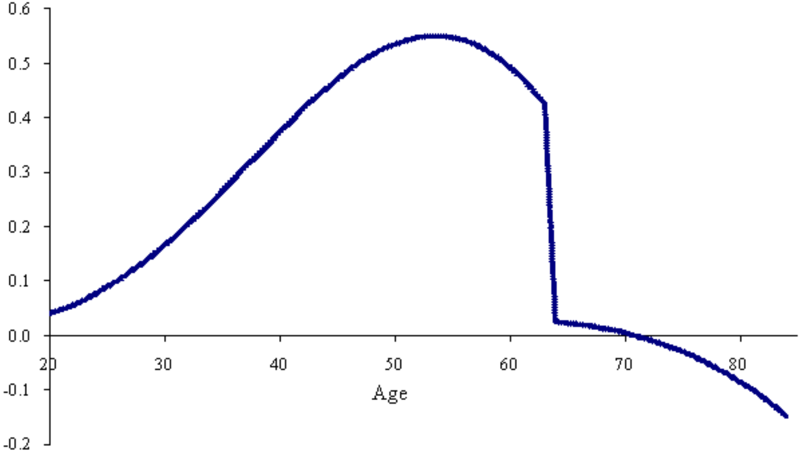
$$(1+\tau^c)c + s = (1-\tau^l)wl + (1+r(1-\tau^k))s + m$$

Then, empirical data is used to back out net tax incidence

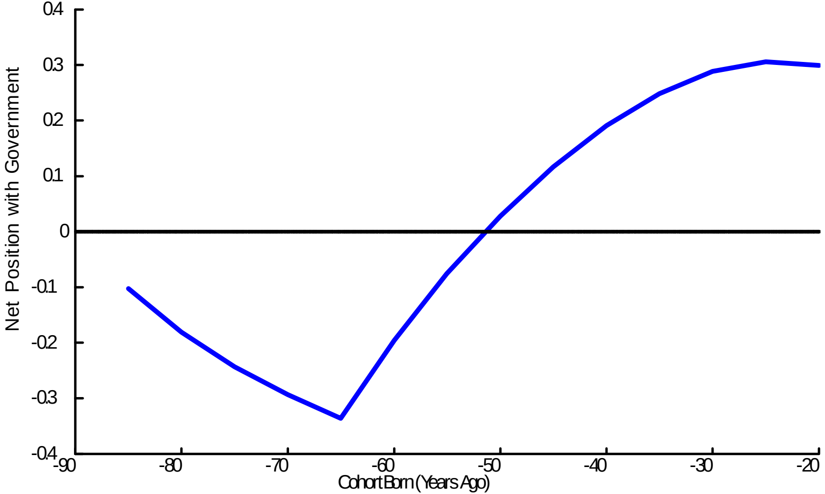
$$c + s' = wl + (1+r)s + b$$

where $b = m - (\tau^c c + \tau^l wl + r\tau^k s)$

Tax Incidence of the Life Cycle



Tax Incidence Across Population



Intergenerational Policy

The individual metrics are aggregated using the GBC

$$\sum_{s=0}^{d} \mu_{t,t-s} b_{t,t-s} + \sum_{s=1}^{\infty} \frac{\mu_{t,t-s}}{R^s} b_{t,t+s} = B_t + \sum_{s=1}^{\infty} \frac{G_{t+s}}{R^s}$$

Fix $b_{t,t+s} = \overline{b}(1+g)^s$ and the expression becomes

$$\sum_{s=0}^{d} \mu_{t,t-s} b_{t,t-s} + \sum_{s=1}^{\infty} \frac{\mu_{t,t+s}\overline{b}(1+g)^s}{R^{s-t}} = D_t + \sum_{s=t}^{\infty} \frac{G_s}{R^{s-t}}.$$

If $b_{t,s} \neq \overline{b}$the account is **not** balanced.
Intergenerational imbalances can be solved by changes in

- Government purchases
- Taxes and transfers

Intergenerational Policy and Policy Selection

Widespread use for policy analysis in practice (Board of Governors, CBO, Department of Treasure, World Bank,. . .) and academia

- Altig, Kotlikoff, Smetters, and Walliser (AER, 2001) a swift from income to consumption taxation
- Gokhale, Page, Potter and Sturrock (AER, 2000), burden of future demographics
- Kotlikoff, Smetters, and Walliser (2001) effects social security privatization
- Gokhale, Page, Potter and Sturrock (2000) assume $R = 4\%$ and $g = 2.2\%$ and find $\triangle \overline{b} = 41.6$ and propose
  - A 31% permanent increase in federal and personal corporate income taxes.
  - 12% raise of all federal, state, and local taxes.
  - 21.9% reduction all transfers programs (SS, Medicare, Medicaid, food stamps, UI, housing support, etc...)
  - Reduce all government expenditures by 21%, or federal expenditure by 66.3%.

In This Paper

- Construct a quantitative general equilibrium model as a **laboratory** to evaluate the performance of different metrics of tax incidence (Fehr and Kotlikoff (1996))

$$b = m - (\tau^c c + \tau^l wl + r\tau^k s)$$

- Using the data from the experiments provides economic decisions, general equilibrium effects, and welfare
- Simulate policy reforms that deal with large unfunded liabilities of government programs (i.e. social security).
  - **Policy 1**: Constructed to eliminate effects on quantities and prices
  - **Policy 2:** Constructed to have all effects
- Our ultimate goal is to evaluate the performance of the metrics and not the policies.

Summary Main Findings

- **Reform 1: Policies with no real effects**
  For small errors in the choice of the discount rate, the metrics can be easily biased by 15 percent.

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$\Rightarrow$ Unfortunately, we are not going to provide an alternative metric that can solve these issues

Outline

- Baseline Model
- Metrics of Tax Incidence
- Construct Intergenerational Policy Reforms
- Calibration
- Findings
- Conclusions

I) Baseline Model

Preferences and Endowments

Generations live for I periods, $\mu_{i,t}$ is the measure of generation i in period t

$$\mu_i = \frac{1}{1+n}\pi_i \mu_{i-1},$$

Preferences

$$U(c^t, l^t) = \sum_{i=1}^{I} s_i \beta^{i-1} U(c_{i,t+i-1}, l_{i,t+i-1})$$

Endowments: efficiency units of labor

$$\varepsilon = \{\varepsilon_1, ..., \varepsilon_I\}$$

Technology

Production possibility frontier

$$Y_t = F(K_t, L_t)$$

with $L_t = \sum_{i=1}^{I} \mu_i \varepsilon_i l_{i,t}$

Constant depreciation rate δ

Resource constraint

$$\sum_{i=1}^{I} \mu_{i,t} c_{i,t} + (1+x)(1+n)K_{t+1} - (1-\delta)K_t + G_t = F(K_t, N_t)$$

Government

Stationary economy with a PAYG social security system

Payroll taxes finance transfers to the retired (exogenously specified mandatory retirement)

Linear consumption, capital and labor income taxes used to finance exogenous government consumption, G

Government debt balances the period-by-period government budget constraint

$$\tau_t^c C_t + \tau_t^l w_t L_t + \tau_t^k r_t \sum_{i=1}^{I} \mu_{i,t} a_{i,t} + B_{t+1} = R_t B_t + G_t + \sum_{i=1}^{I} \mu_{i,t} m_{i,t},$$

Competitive Equilibrium

Given a government policy $\widehat{\Pi} = \{\widehat{\tau}^c_t, \widehat{\tau}^l_t, \widehat{\tau}^k_t, \widehat{B}_t, \{\widehat{m}_{i,t}\}^I_{i=1}\}^\infty_{t=0}$, a market equilibrium in the economy is a sequence of allocations $\widehat{x} = \{\{\widehat{c}_{i,t}, \widehat{l}_{i,t}\}^I_{i=1}, \widehat{K}_{t+1}\}^\infty_{t=0}$ and prices $\widehat{p} = \{\widehat{r}_t, \widehat{w}_t, \widehat{R}_t\}^\infty_{t=0}$, such that

1. consumers maximize utility subject to their budget constraints,
2. firms maximize profits,
3. the government budget constraint is balanced, and
4. markets clear.

A tax policy $\widehat{\Pi}$ and the equilibrium allocation $\widehat{x}$ implies a sequence of utilities $\widehat{U} = \{\widehat{U}_s\}^\infty_{s=I-1}$ for all cohorts.

II) Metrics of Tax Incidence

Metrics of Tax Incidence (I): Statutory Taxation

Social discount rate, $R_t = 1 + r_t$ and the sequential budget constraint, where

$$q_t = 1,$$

and

$$q_{t+i-1} = \frac{q_{t+i-2}}{1 + r_{t+i-1}}$$

and the metric is

$$ga_t^{SOC} = \frac{\sum_{i=1}^{I} q_{t+i-1} \left[\begin{array}{c} \tau^c_{t+i-1} c_{i,t+i-1} + \tau^l_{t+i-1} w_{t+i-1} \epsilon_i l_{i,t+i-1} \\ -\tau^k_{t+i-1} r_{t+i-1} a_{i,t+i-1} - m_{i,t+i-1} \end{array} \right]}{\sum_{i=1}^{I} q_{t+i-1} w_{t+i-1} \epsilon_i l_{i,t+i-1}}.$$

Metrics of Tax Incidence (II): Effective Taxation

Use private discount rate $R_t = 1 + r_t(1 - \tau_t^k)$ with the notion of intertemporal budget constraint.

$$\widetilde{q}_t = 1$$

and

$$\widetilde{q}_{t+i-1} = \frac{\widetilde{q}_{t+i-2}}{1 + r_{t+i-1}(1 - \tau_{t+i-1}^k)}$$

and the metric is

$$ga_t^{PRI} = \frac{\sum_{i=1}^{I} \widetilde{q}_{t+i-1} \left[\begin{array}{c} \tau_{t+i-1}^c c_{i,t+i-1} + \\ \tau_{t+i-1}^l w_{t+i-1} \epsilon_i l_{i,t+i-1} - m_{i,t+i-1} \end{array} \right]}{\sum_{i=1}^{I} \widetilde{q}_{t+i-1} w_{t+i-1} \epsilon_i l_{i,t+i-1}}.$$

III) Construct Policy Reforms

PAYG vs FF Social Security Systems

- Defining pay-as-you-go (PAYG) vs. fully-funded (FF)
- Equivalence between both systems
- Recognition of implicit liabilities (welfare neutral reforms)
- Partial/Full elimination of implicit liabilities

PAYG vs FF Social Security Systems

Pay-as-you-go

$\max U(c_1, l, c_2)$

$s.t. \quad c_1 + \frac{c_2}{R} = wl - T(l, \tau, P)$

FOC

$-\frac{U_l}{U_{c1}} = (1 - \tau)w$

$c_1 + \frac{c_2}{R} = (1 - \widetilde{\tau})wl$

where $\widetilde{\tau} < \tau$

Fully-Funded

$\max U(c_1, l, c_2)$

$s.t. \quad c_1 + \frac{c_2}{R} = wl,$

FOC

$-\frac{U_l}{U_{c1}} = w$

$c_1 + \frac{c_2}{R} = wl$

Complete Default Implicit Liabilities

	t=0	(Reform) t=1	t=2	...
Old	$P_0 = R_0$	$P_1 = 0$	$P_2 = 0$	...
Young	$R_0 = (1+n)\tau_0 w_0 L_0$	$\tau_1 = 0$	$\tau_2 = 0$	...

Cut benefits or increase tax burden of some cohorts $\Longrightarrow$ Welfare losses

Equivalent PAYG and FF Social Security System

Pay-as-you-go

$\max U(c_1, l, c_2)$

s.t.

$c_1 + \frac{c_2}{R} = wl - T(l, \tau, P)$

Fully-Funded

$\max U(c_1, l, c_2)$

s.t.

$c_1 + \frac{c_2}{R} = wl - \widetilde{T}(l, \tau, a^{PUB}),$

FOC

$-\frac{U_l}{U_{c1}} = (1 - \tau)w$

$c_1 + \frac{c_2}{R} = (1 - \widetilde{\tau})wl$

$a^{PUB} = t = \tau wl / R \Longrightarrow$

Subsidy used to buy D

Neutral Social Security Privatization

	t=0	(Reform) t=1	t=2	...
Old	$P_0 = R_0$	$R_1 = P_1$	$D_1(1+r)$	...
Young	$R_0 = (1+n)\tau_0 w_0 L_0$	$R_1 = T_1 + D_1$	$R_2 = T_1 + D_2$	...

Government issues debt, and implements a FF system with the same level of distortions $\Longrightarrow$ No welfare gains

Implicit debt is made explicit $\Longrightarrow D_1 = D_2 = ... = D$

Tax revenues T are used to finance constant level of debt D

Partial/Complete Elimination Unfunded Liabilities

	t=0	(Reform) t=1	t=2	...
Old	$P_0 = R_0$	$R_1 = P_1^*$	$D_1 R$	...
Young	$R_0 = (1+n)\tau_0 w_0 L_0$	$R_1 = T_1^* + D_1^*$	$R_2 = T_1^* + D_2^*$	...

Government issues debt, and implements a FF system with the **"optimal"** level of distortions $\Longrightarrow$ Welfare improvements

IV) Calibration

Functional Forms

Utility

$$u(c, l) = \frac{(c^{\gamma}(1-l)^{1-\gamma})^{1-\sigma}}{1-\sigma},$$

Technology

$$F(K, L) = K^{\alpha} L^{1-\alpha}$$

Efficiency units from Current Population Survey data

Parameters and Targets

Parameterization of the Economy

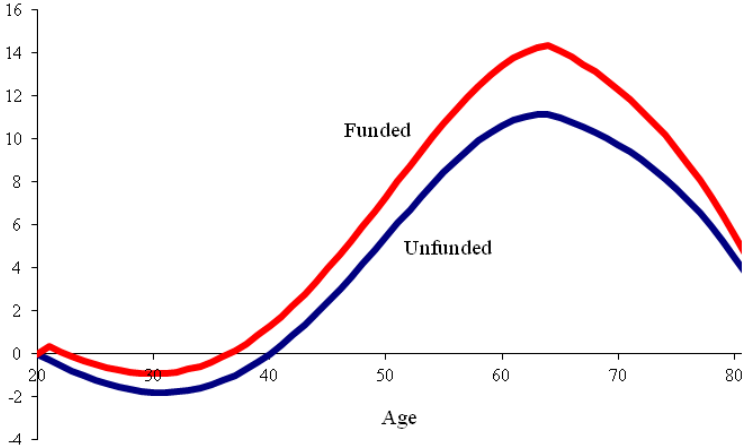
Statistic	Target	Result
Wealth to GDP ratio	3.00	3.00
Investment to GDP	0.16	0.16
Average Hours Worked	0.33	0.33
Debt to GDP	0.50	0.50
Government Expenditure to GDP	0.20	0.20

Variable	Parameter	Value
Discount factor	β	0.984
Consumption share	γ	0.460
Depreciation rate	δ	0.041
Labor income tax	τ^l	0.169

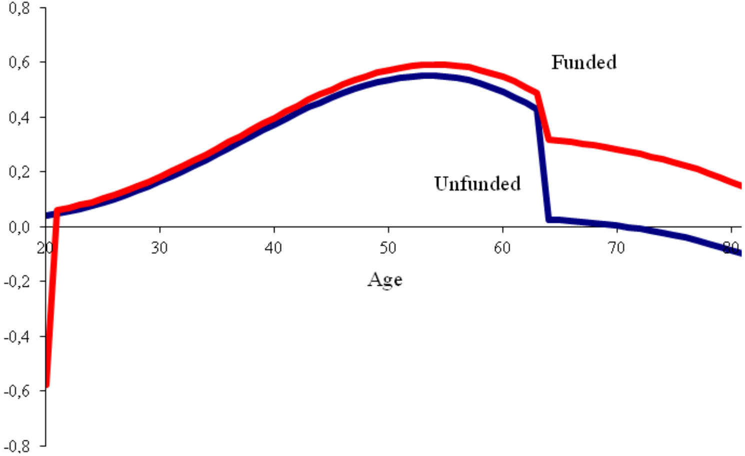
V) Policy Reforms

1) Welfare Neutral Reforms

Asset Distributions (relative to yearly income)



Net Taxes Paid (relative to yearly income)



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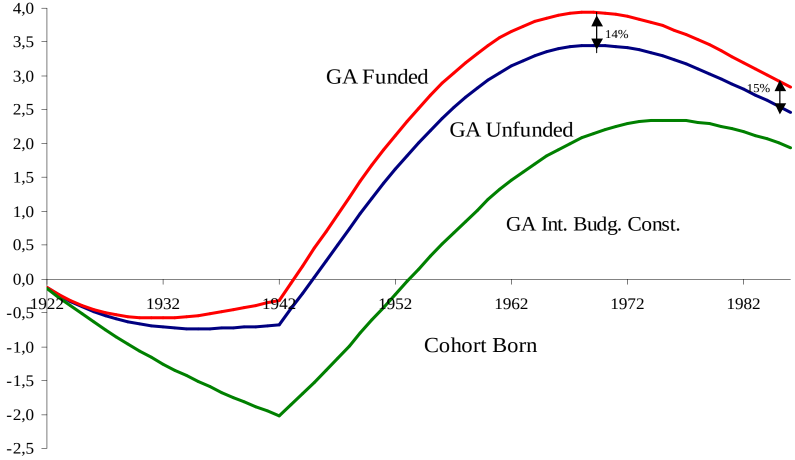

2) Welfare Improving Reforms

- Define the implicit liabilities in terms of utility for the existing generations alive

$$\widehat{U}(c^{t-j}, l^{t-j}) = \kappa \sum_{i=j}^{I} \frac{s_i}{s_j} \beta^{i-j} U(\widehat{c}_i, \widehat{l}_i)$$

where the term $\kappa^{t-j} \in (0, 1]$ captures the size of additional gains for the initial generations alive.

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- The government objective is a utilitarian welfare function of **all future cohorts**

$$\sum_{t=1}^{\infty} \lambda^{t-1} U(c^t, l^t)$$

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  where $\lambda \in (0, 1)$ is the relative weight

- The set of welfare improving policies is necessary to maximize the welfare of future generations over the set of implementable allocations together with the status quo constraints.

2) Welfare Neutral Reforms: Optimization Problem

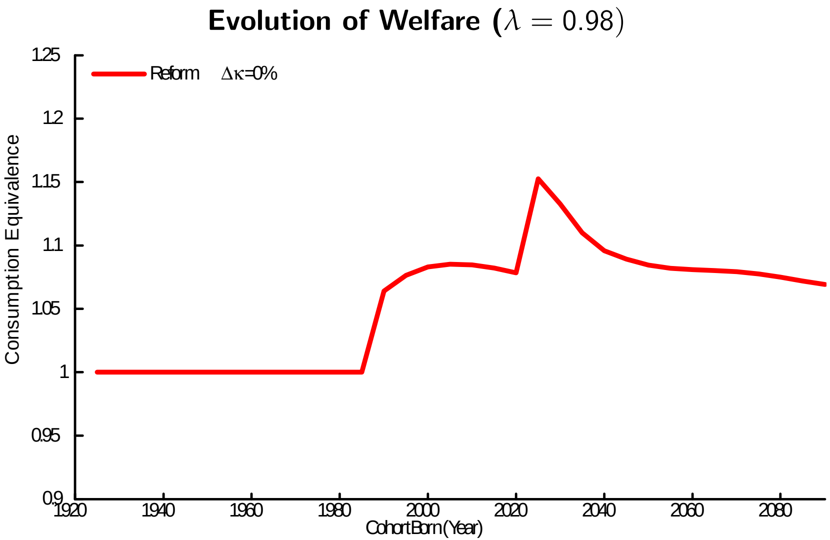
$$\max \sum_{t=1}^{\infty} \lambda^{t-1} U(c^t, l^t),$$

$$\sum_{i=1}^{I} \mu_{i,t} c_{i,t} + (1+x)(1+n)K_{t+1} - (1-\delta)K_t + G_t = F(K_t, L_t), \quad \forall t,$$

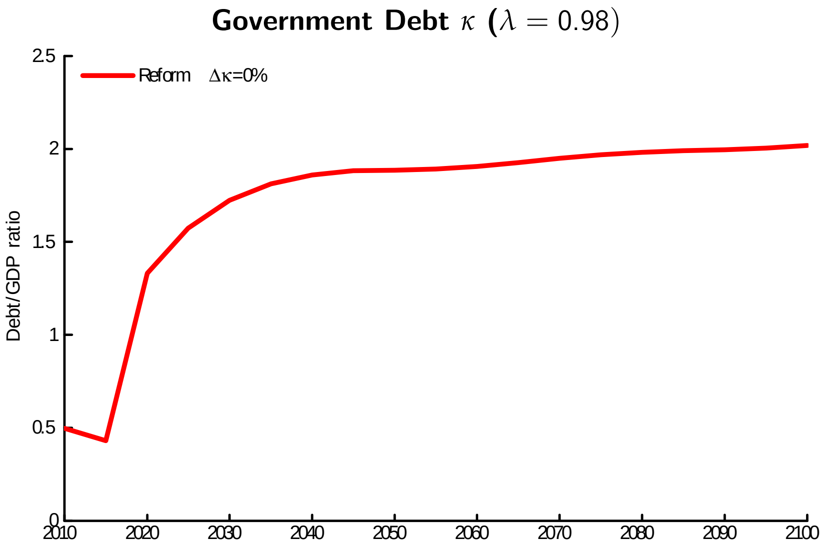
$$\sum_{i=1}^{I} s_i \beta^{i-1} \left[c_{i,t+i-1} U_{c_{i,t+i-1}} + l_{i,t+i-1} U_{l_{i,t+i-1}} \right] = 0, \qquad t \geq 1,$$

$$\sum_{i=j}^{I} \frac{s_i}{s_j} \beta^{i-j} \left[c_{i,i-j+1} U_{c_{i,i-j+1}} + l_{i,i-j+1} U_{l_{i,i-j+1}} \right] = \frac{U_{c_{j,1}}}{1+\tau_0^c} [R(\tau_0^k)\widehat{a}_{j,1} + \widetilde{m}_{i,1}],$$

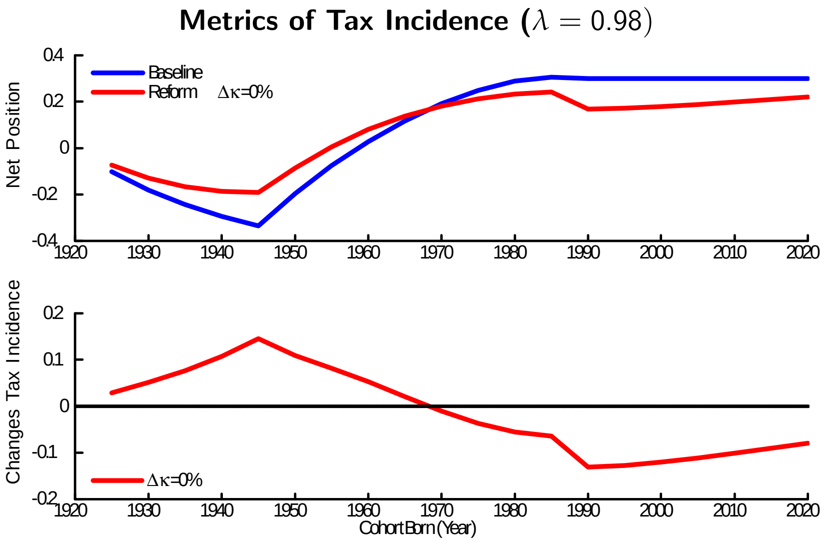
$$\sum_{i=j}^{I} \frac{s_i}{s_j} \beta^{i-j} U(\widehat{c}_i, \widehat{l}_i) \geq \frac{\widehat{U}(c^{t-j}, l^{t-j})}{\kappa},$$



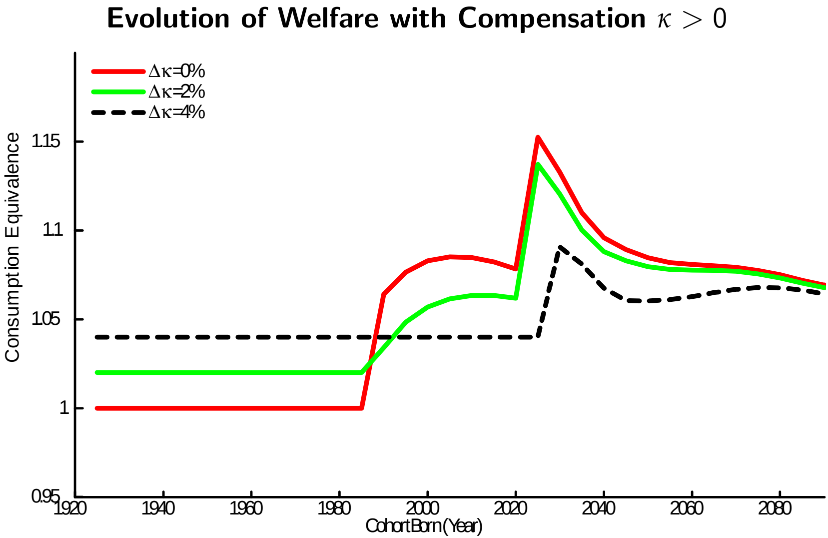
Evolution of Welfare ($\lambda = 0.98$)
Reform Δκ=0%
Consumption Equivalence
Cohort Born (Year)
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
1920
1940
1960
1980
2000
2020
2040
2060
2080



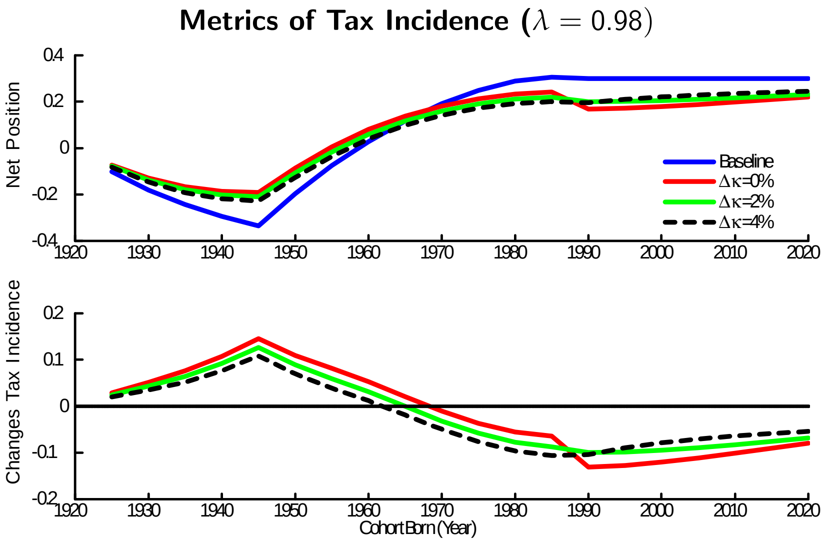
Government Debt κ ($\lambda = 0.98$)
Reform Δκ=0%
Debt/GDP ratio
2.5
2
1.5
1
0.5
0
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100



Metrics of Tax Incidence ($\lambda = 0.98$)
Net Position
Baseline
Reform Δκ=0%
0.4
0.2
0
-0.2
-0.4
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Changes Tax Incidence
0.2
0.1
0
-0.1
-0.2
Δκ=0%
Cohort Born (Year)

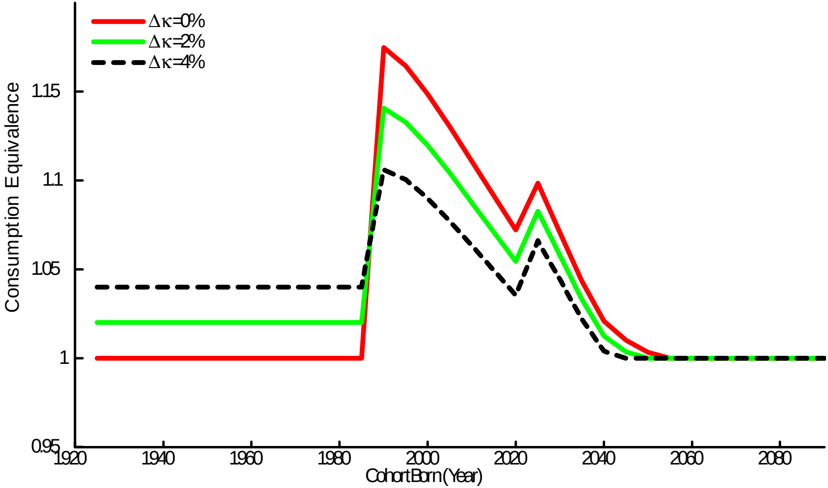


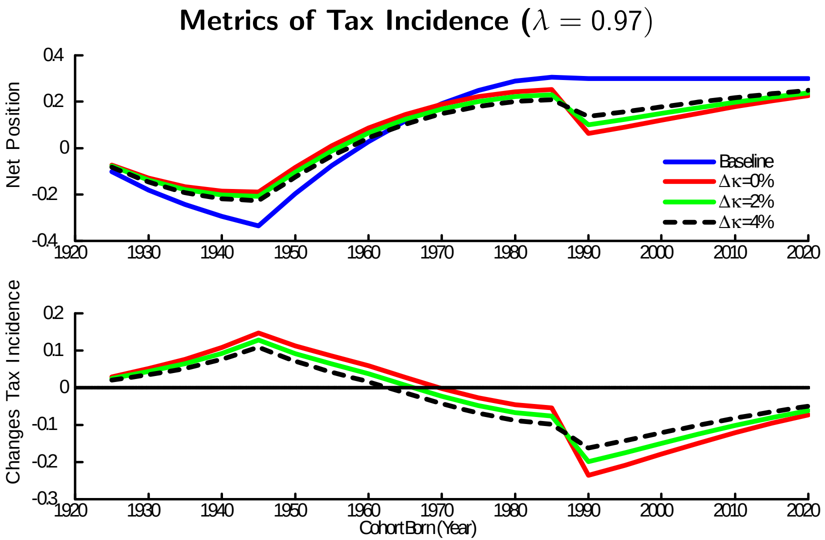
Evolution of Welfare with Compensation $\kappa > 0$
Δκ=0%
Δκ=2%
Δκ=4%
Consumption Equivalence
1.15
1.1
1.05
1
0.95
1920
1940
1960
1980
2000
2020
2040
2060
2080
Cohort Born (Year)



Metrics of Tax Incidence ($\lambda = 0.98$)
Net Position
0.4
0.2
0
-0.2
-0.4
Baseline
Δκ=0%
Δκ=2%
Δκ=4%
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Changes Tax Incidence
0.2
0.1
0
-0.1
-0.2
Cohort Born (Year)

Evolution of Welfare for Different κ ($\lambda = 0.97$)




Metrics of Tax Incidence ($\lambda = 0.97$)
Net Position
0.4
0.2
0
-0.2
-0.4
Baseline
Δκ=0%
Δκ=2%
Δκ=4%
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Changes Tax Incidence
0.2
0.1
0
-0.1
-0.2
-0.3
Cohort Born (Year)

Conclusions

Accounting-based tax incidence metrics are easy to compute (no assumptions about preferences, technology)

Unfortunately, the quantitative bias when measuring tax incidence is potentially large

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Accounting-based tax incidence metrics are easy to compute (no assumptions about preferences, technology)

Unfortunately, the quantitative bias when measuring tax incidence is potentially large

- **Policies with no real effects:** The incorrect choice of discouting can make policies with no real effect to have real effects (easy to obtain biases of 15 percent)
- **Policies with real effects:** Even with the correct discouting, the metrics fail to capture the identity of the generations that bear the cost of the reform

Future Research

- Introduce demographics projections and deal with all unfunded liabilities.
- What is the status-quo utility (entitlements) in this scenario?
- Missing dimensions that can mitigate the cost of the reforms:
  - Investment in human capital
  - Investment in health