Tax Incidence and Optimal Taxation with General Equilibrium and Transition

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Question

- What is the role of **GE effects** and **transition** on the tax reform incidence and optimal redistributive tax schedule?
  - Standard trickle-down effects:
    Stiglitz (1982), Rothschild & Scheuer (2013), Sachs et al. (2020)
  - Key: **complementarity** b/w different labor types
  - conventional implication: less progressive tax
- We analyze this in an **Aiyagari** — GE self-insurance model.
  - GE effects: complementarity b/w K and L
  - transition: sluggish adjustment of savings $\Rightarrow$ interacting with GE
- Key Questions

  Q1. Do the GE effects **favor** more/less **progressive** reform?

  Q2. What factors determine the **direction** & **size** of the GE effects?

  Q3. What are the implications of the local/global transition?

What I do...

- Derive nonlinear-**formulas** for the **tax-incidence** & **optimal tax**
  - variational (perturbation) approach
  - under restrictive tax system (time invariant, history independent)
- Find the **summary stat** for the **GE effects** & (local) **transition**.
- Identify the factors for the direction & the size of the **GE effects**.
  - tax schedule to which the reform is applied
  - capital income tax

  Under which conditions, does the **GE favor** *more* progressive/redistributive reform?
- Investigate the effects of the **local/global transition**:
  - local transition: due to a small tax reform (perturbation)
  - global transition: current US → optimal steady state
  - Is it always desirable to account for the global transition?

Preview of Results

- Tax incidence (optimal) formula: $dW\ (\frac{T'}{1-T'}) = R1 + R2 + R3 + R4$
  - R1: (standard) redistribution vs behavioral
  - R2: welfare effects of the borrowing constrained HH
  - R3: Pecuniary Externalities
  - R4: Fiscal Externalities

  R3 and R4 $\Rightarrow$ **GE effects**; R2, R3 and R4: interaction w/ pirv MKT

- R3+R4 = $\boldsymbol{\overline{dr_t} K \times (\Delta_p - \Delta_f)}$
  - $\Delta_p - \Delta_f < 0$:
    - negative externality per unit price change $r \uparrow (w \downarrow)$
  - Which tax reform leads to $\overline{dr_t} < 0$?
    - Depends on the relative response of K & L and transition.
    - Consider $T'(z^*) \uparrow$: redistributive reform

      $L \downarrow \Rightarrow dr_t < 0$ (short-run) Vs. $K \downarrow \Rightarrow dr_t > 0$ (long-run)
    - (e.g.) Stronger dL relative to $dK \Rightarrow$ GE favors more redistribution

Preview of Results (Findings)

1. Level & progressivity of the initial tax matter for the GE effects.
   - With modest amount of existing redistribution (e.g. T'_{US}), the GE effects support *less* redistributive reform.

     (dK dominates dL)
   - With enough redistribution (e.g. T'_{opt}), the GE effects can support *more* redistributive tax reform.
2. τ_K tends to amplify the GE effects (w/o changing its direction).
3. Local transition makes GE-effects favor more progressive reform.
   - The short-run labor response ($L \downarrow \Rightarrow r \downarrow$) has positive incidences.
4. Considering global transition, $T'_{opt-global}$ is more progressive than T'_{opt}.
5. Global transition to T'_{opt} has a huge short-run welfare gain at the cost of long-run welfare loss.

Model : Preferences & Productivity

- Continuum of workers with measure 1.

  $(1-\beta)\sum_{t=0}^{\infty}\beta^t E_0[U(c_t, l_t)]$

- Focus on preferences without income effects in labor:

  $u(c - v(l))$.

- Productivity x_t
  - Follows a Markov process: $f(x_{t+1}|x_t)$
  - History of realizations: $x^t = (x_0, x_1, \cdots, x_t)$ with prob $f(x^t|x_0)$.
  - Invariant stationary distribution $F(x)$ w/ density $f(x)$.

    $x_0 \sim F$.

- Labor supply: $l_t(x_t) \quad \Rightarrow$ Earnings: $z_t(x_t) = w_t x_t l_t(x_t)$.
  - Stationary earning distribution $F_z(z)$ with density $f_z(z)$.

Tax-Transfer and Priv Insurance

[Public Insurance]

- nonlinear tax-transfer schedule: $T(z)$.
- **Restriction on** $T(z)$
  - Time-invariant
  - On current labor income only (no history dependence)
  - No capital income tax $\Rightarrow$ relaxed later
- Budget balance of the government: $\int T(z) f_z(z) dz = E$

[Self Insurance & Incomplete Market] ▸ Why Aiyagari?

- Two market frictions (Aiyagari) :
  - trade state noncontingent bond only
  - exogenous borrowing limit : $\underline{a}$
- Consumer's problem: given a_0, x_0, max *lifetime utility* s.t.

$$c_t(a_0, x^t) + a_{t+1}(a_0, x^t) = w_t x_t l(x_t) - T(w_t x_t l(x_t)) + (1 + r_t) a_t(a_0, x^{t-1}),$$

$$a_{t+1}(a_0, x^t) \geq \underline{a}$$

Production and MKT Clearing

- Production : $F(K_t, L_t)$
  - Constant Return to Scale, $F_L, F_L, F_{KL} > 0$, $F_{KK}, F_{LL} < 0$
- Firm's problem:

$$r_t = F_K(K_t, L_t) - \delta, \quad w_t = F_L(K_t, L_t)$$

- Aggregate state of the economy: $\Phi(a_t, x_t)$
  - Transition: $\Phi_{t+1}(B) = \int_S Q(\Phi_t, a, x, B; h^A) d\Phi_t$
  - Steady state: $\Phi' = \Phi$
- Market clear:

$$K_t = \int a_t d\Phi(a_t, x_t)$$

$$L_t = \int x_t l(x_t) f(x_t) dx_t$$

$$\int c(a_t, x_t) d\Phi(a_t, x_t) + K_{t+1} = F(K_t, L_t) + (1 - \delta) K_t$$

Social Welfare

- individual utility:

  $V(a_0, x_0) = (1-\beta)\sum_t \beta^t f(x^t|x_0)u(x_t, a_t(a_0, x^t))$

- social welfare: $W = \iint V(a_0, x_0) d\Phi(a_0, x_0)$

  $\Rightarrow$ Utilitarian SWF

- **With Vs without global transition**

  - considered tax schedule $T(z)$ before a small reform

  - Benchmark: without global transition

    $\Phi_0 = \Phi_{ss}(a, x; T)$ and $\Phi_t = \Phi_0 = \Phi, \forall t.$

  - with global transition:

    $\Phi_0 = \Phi_{ss}(a, x; T^{US})$ and $\Phi_t(a, x; T)$ changes over time.

Tax Reform

- Derive Formulas using "variational" approach.
  - Assume that the economy is in a steady state, given $T(.)$.

    $\Rightarrow$ do not consider the global transition
  - Consider a (revenue-neutral) tax reform of $T'(z)$.

    – Perturbed tax schedule: $T(\cdot) + \mu\tau(\cdot)$

    – Elementary tax reform : $\tau(z) = \frac{1}{1-F_z(z^*)} 1_{\{z \geq z^*\}}$
  - Account for the local transition associated with this perturbation
- First-order effects of reform: (Gateaux derivative in direction τ)

Tax Incidence Formula

$$dW = R1 + R2 + R3 + R4$$

$$where$$

$$R1 = \lambda \left[\iint_{x^*}^{\infty} \left(1 - \frac{u'(a,x)}{\lambda}\right) \frac{\phi(a,x)}{1-F(x^*)} dx da - \frac{T'(z(x^*))}{1-T'(z(x^*))} \epsilon^l_{1-T'}(x^*) \frac{z(x^*)}{z'(x^*)} \frac{f(x^*)}{1-F(x^*)} \right]$$

$$R2 = -(1-\beta) \sum_{t=0}^{\infty} \beta^t \iint \Big[u'(a,x) - \beta(1+r) E[u'(a',x')|x] \Big] dh^A_{t+1}(a, y(x)) d\Phi(a,x)$$

$$R3 = (1-\beta) \sum_{t=0}^{\infty} \beta^t \iint u'(a,x) \Big[dr_t \cdot a + dw_t \cdot x l(x)(1 - T'(z(x))) \Big] d\Phi(a,x)$$

$$R4 = \lambda(1-\beta) \sum_{t=0}^{\infty} \beta^t \cdot dw_t \int (1 + \epsilon^l_w(x)) x l(x) T'(z(x)) f(x) dx$$

- $R1$= standard equity-efficiency trade-off
- $R2$= borrowing constraints effects
- $R3$= **pecuniary externalities**: welfare effects of dw & dr
- $R4$= **fiscal externalities**: revenue effects of dw & dr

GE Effects - Summary Stat

- CRS production: $F(K,L) = (r+\delta)\cdot K + w \cdot L$
- By differentiating: $L \cdot dw_t + K \cdot dr_t = 0$

$$\Rightarrow \quad \mathbf{R3} = \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t \int \frac{u'(a,x)}{\lambda}\left[dr_t \cdot a + dw_t \cdot xl(x)(1-T'(z(x)))\right] d\Phi$$

$$= \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t \cdot K \int \frac{u'(a,x)}{\lambda}\left[\frac{a}{K} - \frac{xl(x)(1-T'(z(x)))}{L}\right] d\Phi$$

$$= \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t \cdot K \underbrace{\left\{\int \frac{u'(a,x)}{\lambda}\left[\frac{a}{K}-1\right] d\Phi - \int \frac{u'(a,x)}{\lambda}\left[\frac{xl(1-T')}{L}-1\right] d\Phi\right\}}_{\equiv \Delta_p\text{: welfare effects of increasing } r}$$

$$\Rightarrow \quad \mathbf{R4} = \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t dw_t \cdot L \underbrace{\int (1+\epsilon_w^l(x))\frac{xl(x)}{L} T'(z(x)) f(x) dx}_{\equiv \Delta_f\text{: revenue effects of increasing } w}$$

$$\Rightarrow \mathbf{R3} + \mathbf{R4} = \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t \cdot K \cdot \Delta_p + \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t dw_t \cdot L \cdot \Delta_f$$

$$= \lambda(1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t \cdot K \times (\Delta_p - \Delta_f)$$

$\therefore \; \frac{1}{\lambda}(R_3 + R_4) = \overline{dr_t} K \times (\Delta_p - \Delta_f)$: summary stat of the GE effects

GE EFFECTS: $\overline{dr_t}(z^*)K \times (\Delta_p - \Delta_f)$

(1) **Sign of $\Delta_p - \Delta_f < 0$**

- $\Delta_p < 0$: $r \uparrow \Rightarrow$ negative redistribution over asset inequality
- $-\Delta_f < 0$: $w \downarrow \Rightarrow wxl \downarrow \Rightarrow T(wxl) \downarrow$

$\Rightarrow$ **Gov't prefers the tax reform which decreases r ($\overline{dr_t} < 0$).**

(2) **Key Q: Which tax reform does imply $\overline{dr_t} < 0$?**

- Consider a redistributive reform:

$$\begin{cases} T'(z^*) \uparrow \quad \Rightarrow \quad L \downarrow \quad \Rightarrow \quad r \downarrow \\ T'(z^*) \uparrow \quad \Rightarrow \quad K \downarrow \quad \Rightarrow \quad r \uparrow \end{cases}$$

- $\begin{cases} \textbf{Short-run: } L \downarrow \text{ tends to dominate} \Rightarrow dr_t < 0, \quad dw_t > 0 \\ \textbf{Long-run: } K \downarrow \text{ tends to dominate} \Rightarrow dr_t > 0, \quad dw_t < 0 \end{cases}$

$\Rightarrow$ $\overline{dr_t} \lesseqgtr \mathbf{0}$ depends on the relative response of L & K.

GE effects in Optimal Tax Formula

$$\frac{T'(z^*)}{1-T'(z^*)} = \frac{1+e(x^*)}{e(x^*)}\frac{1-F(x^*)}{x^*f(x^*)} \times [R1(x^*) + R2(x^*) + R3(x^*) + R4(x^*)]$$

where

$$R1(x^*) = \int\int_{x^*}^{\infty}\left(1-\frac{u'(a,x)}{\lambda}\right)\frac{\phi(a,x)}{1-F(x^*)}dxda$$

$$R2(x^*) = -\frac{1-\beta}{\lambda}\sum_{t=0}^{\infty}\beta^t\int[u'(a,x)-\beta(1+r)E[u'(a',x')|x]]dh_{t+1}^{A}(a,y(x))d\Phi(a,x)$$

$$R3(x^*) = (1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t K\int\frac{u'(a,x)}{\lambda}\left[\frac{a}{K}-\frac{xl(x)(1-T'(z(x)))}{L}\right]d\Phi(a,x)$$

$$R4(x^*) = (1-\beta)\sum_{t=0}^{\infty}\beta^t dw_t\int(1+\epsilon_w^l(x))xl(x)T'(z(x))f(x)dx.$$

- Optimal tax formula does not consider the global transition.
- GE has (1) direct price effects (R3,R4) & (2) indirect distribution effects (Φ).

▸ SCPE ▸ dec

Rest of the presentation....

Quantitative analysis on

(1) Determinants of the Direction & Size of GE effects

1. Initial tax schedule
2. Capital income tax

(2) Role of the Local and Global Transition

1. Local transition associated with a tax perturbation
2. Global transition from the current US to the optimal steady state

Calibration for Quantitative Analysis

[Preferences]

- $u(c - v(l)) = \frac{1}{1-\gamma}\left(c - \frac{l^{1+\frac{1}{e}}}{1+\frac{1}{e}}\right)^{1-\gamma}$, $\gamma = 1.5$, $e = 0.5$
- Borrowing Constraint : fraction of negative asset HH 13%

[Productivity]

- $\ln x' = (1-\rho)\mu + \rho \ln x + \epsilon$, $\quad \rho = 0.92$, $E(\ln x) = 2.75$ & $SD(\ln x) = 0.56$
- Pareto Tail: adjust hazard rate at top 5% = 1.6

[Technology]

- baseline: $Y = K^{\alpha} L^{1-\alpha}$, $\alpha = 0.33$, $\delta = 0.1$

[Government]

- $T(z)$: piece-wise linear approximation
- Government purchase $\bar{E} = 0.189 \cdot Y(T^{US})$

Role of the initial tax schedule

- The initial tax schedule to which the reform is applied is crucial for **the relative responses of K and L.**
- Consider a HSV $T(z) = z - \lambda z^{1-\tau}$.
- Role of the Level (λ) and Progressivity (τ)
  - With **Higher level or progressivity** (existing insurance/redist $\uparrow$), a redistributive reform $T' \uparrow$ leads to
    - Stronger labor response ($L \downarrow \Rightarrow r \downarrow \Rightarrow R3 + R4 > 0$)
    - Weaker savings response ($K \downarrow$)
  - Effects of the GE depends on the **existing redistribution**.
    - modest redistribution $\Rightarrow$ favor less redistributive reform
    - enough redistribution $\Rightarrow$ favor more redistributive reform

Role of initial tax level & progressivity

Figure: (normalized dW) $R3 + R4$

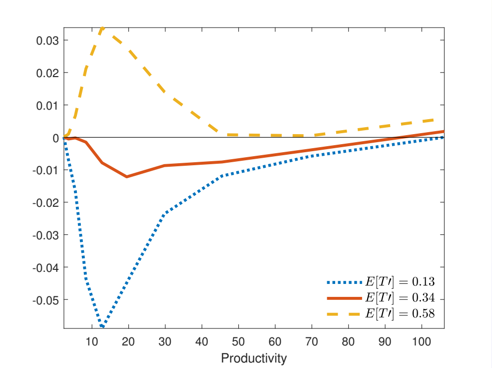
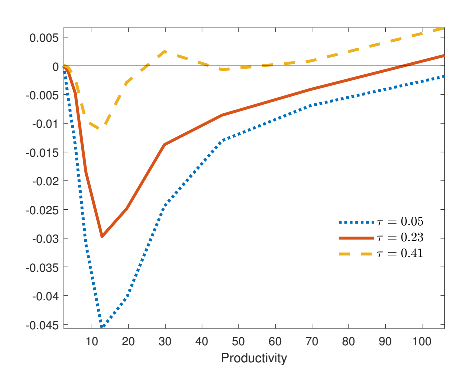


Figure: (normalized dW) $R3 + R4$



- $\Delta_p - \Delta_f < 0$ for all λ and τ we consider. ▸ $\Delta_p - \Delta_f$
- With high $E[T']$, redistributive reforms lead to $\overline{dr_t} < 0 \Rightarrow$ +welfare
- With high τ, a reform of $T' \uparrow$ at the top leads to $\overline{dr_t} < 0$. ▸ $\overline{dr}K$

GE effects: US vs Optimal

Figure: Marginal Tax Rates

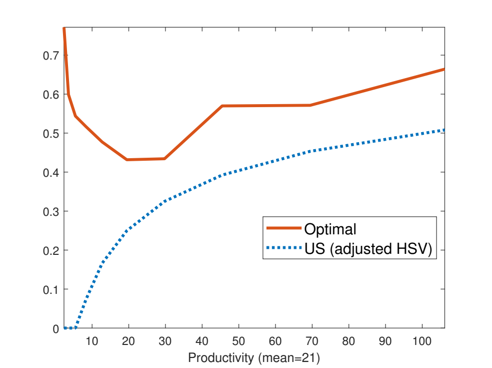
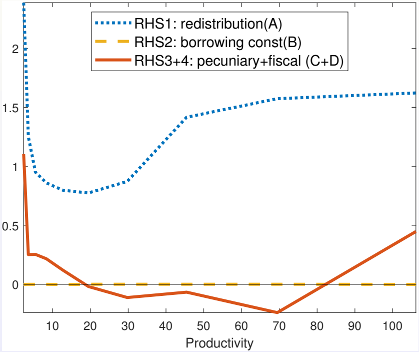


Figure: Decomposition: optimal $\frac{T'}{1-T'}$



[Key difference in the tax schedule]

- Optimal: higher tax rates & higher transfer
- Local progressivity over z: regresive $\Rightarrow$ progressive
- They are driven by $R1$.

GE effects: US Vs Optimal

Figure: dW through the GE effects

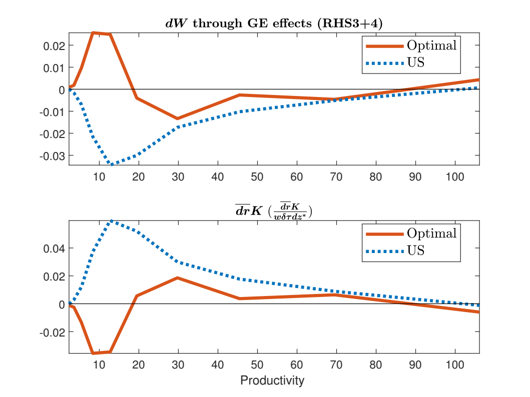


Table: $\Delta_p - \Delta_f$: US vs Opt

	US	optimal
$\Delta_p - \Delta_f$	-0.58	-0.72
Δ_p	-0.10	0.03
$-\Delta_f$	-0.48	-0.75
L-Gini	0.51	0.52
K-Gini	0.73	0.76
$corr(\frac{a}{K}, \frac{xl}{L})$	0.55	0.48

- Under the optimal: GE effects favor $T' \uparrow$ at the low & high income.
- $T'(z_{low}) \uparrow$: redistribution$\uparrow$ the most $\Rightarrow$ more sensitive response of K
- Higher progressivity at the top $\Rightarrow$ more sensitive response of L

Allowing Capital Income Taxes

- Tax-Formula result (Diamond-Mirrlees) requires the ability to tax trades of different goods at different rates.
  - It does not apply as long as history-dependent tax is not allowed.
- With linear capital income tax rate $\tau_k > 0$,

$$
\begin{aligned}
R3 + R4 &= (1-\beta)\sum_t \beta^t dr_t K \times \left[\Delta_p - \Delta_{fL} + \Delta_{fK,t}\right] \\
&= \overline{dr_t} K \times (\underbrace{\Delta_p - \Delta_{fL}}_{<0} + \overline{\Delta_{fK}}),
\end{aligned}
$$

where $\Delta_{fK,t} = \tau_k \int (1 + \epsilon^a_{r,t}(a,x)) \frac{a}{K} d\Phi > 0$: additional fiscal externality

- Quantitatively, the **GE effects tend to be amplified!**
  - $\Delta_p - \Delta_{fL} + \overline{\Delta_{fK}} < 0$ with some mitigation $\overline{\Delta_{fK}}$
  - However, the response of $\overline{dr_t}$ is amplified!

    (steeper asset supply curve $\Rightarrow$ sensitive $r \uparrow\downarrow$ for the shift of supply)

Role of the capital income tax

Figure: US: dW—GE effects

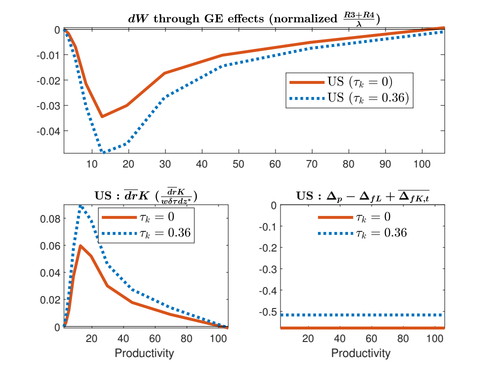
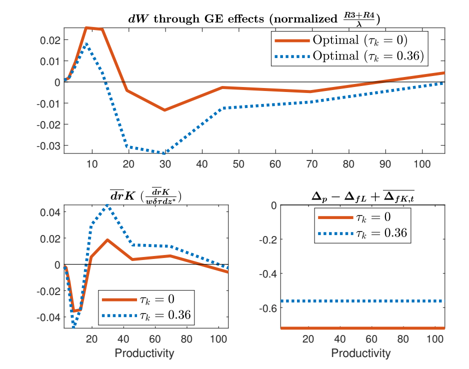


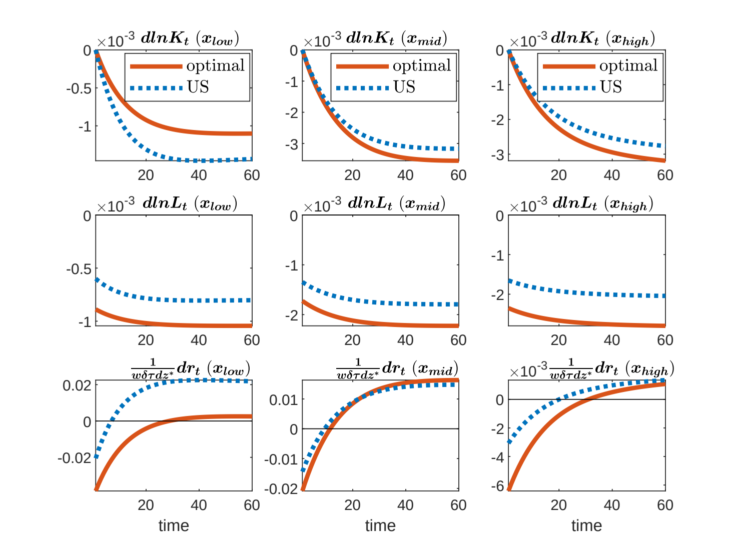
Figure: Optimal: dW—GE effects



▸ JointOpt ▸ Other Factors

Role of the Local Transition

- Local transition path associated with small tax reforms:



Role of the Local Transition

- Accounting for the local transition: GE favors more progressive reforms

  - Short-run benefit of a more progressive reform ($dr_t < 0$) is considered.

▸ β-effect

Figure: US: dW—GE Effects

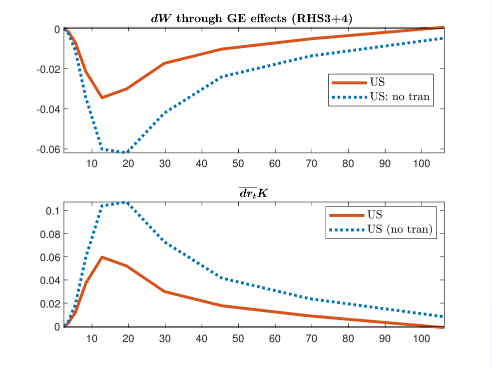
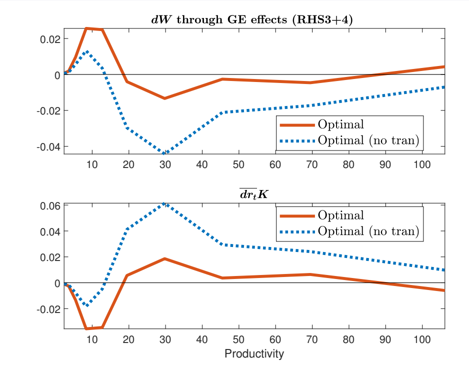


Figure: Optimal: dW—GE effects

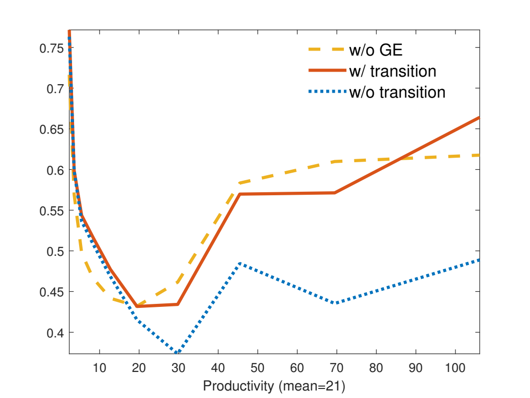


Role of the Local Transition

- **W/ local transition**, optimal tax becomes **more progressive**.

▸ β-effect

Figure: Optimal Marginal Tax Rates



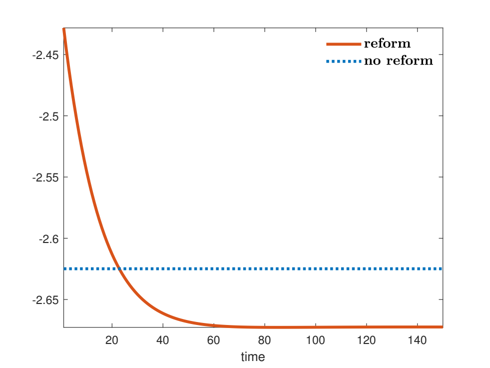
Global Transition to Optimal Reform

- Typical concern of T'_{opt} not accounting for the global transition would be the welfare loss during the transition.
- But a global reform from T'_{US} to T'_{opt} has positive average welfare gain.

  - huge short-run welfare gain at the cost of long-run welfare loss

▸ detail

Figure: Average Welfare over Time



$T\prime_{opt-global}$ and GE effects

- $T\prime_{opt-global}$ is more progressive than $T\prime_{opt}$. ▸ decomp
- $T\prime_{opt-global}$ exploits sluggish adjustment of savings (and distribution).

$\Rightarrow$ Even more asymmetric welfare incidence in the short run & long run

Figure: Optimal Marginal Tax Rates

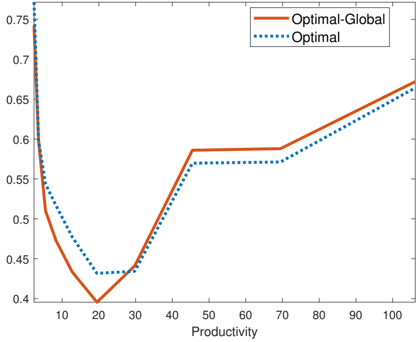
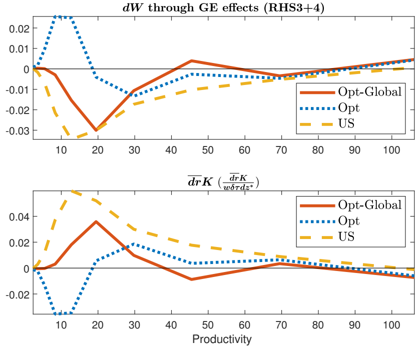


Figure: Optimal: dW—GE effects



Conclusion

- In an Aiyagari economy, considering GE effects can favor either more or less redistributive/progressive tax reform.
- The direction of the GE effects depends on the relative response of K & L.
  - Enough existing redistribution before reform implies that the GE effects favor even more redistributive reform.
  - Capital income tax tends to amplify the GE effects without changing its directoin.
- Both local and global transition make the optimal tax schedule more progressive.
  - This is because we can exploit the sluggish adjustment of savings.
- Global tax reform to the optimal tax has huge short-run welfare gain at the cost of long-run welfare loss.

Appendix

Review of Chang and Park (2021)

- **Why do we need to assume market structure?**
  - Formula with general representation of private insurance.
  - Main difficulty: Need to know whether the response of private insurance to the tax reform has welfare effects.

    ⇒ **Elasticities are not sufficient!**
  - (e.g.) No/ Partial/ Full Envelope theorem.
    - No envelope theorem: Chetty and Saez (2010)
    - Full envelope theorem: Findeisen-Sachs (2018)
    - Partial envelope theorem: Huggett (1993), Aiyagari (1994), Alvarez-Jermann (2000)

  ⇒ **Optimal formula depends on the market structure.**

◂ go back

SCPE-GE

- **Self-Confirming Policy Eq tax**: optimal tax of a government which assumes that the prices are independent of the tax system.
- In a SCPE, the optimality of the tax system is confirmed when a newly chosen tax by a gov'tt given prices generated by the existing tax coincides with the existing one.

$$\frac{T'_{SCPE}(z^*)}{1-T'_{SCPE}(z^*)} = \frac{1}{\epsilon^l_{1-T'}(z^*)}\frac{1-F_z(z^*)}{z^* f_z(z^*)} \times \left[\begin{array}{l} \iint_{z^*}^{\infty}\left(1-\frac{u'(a,z)}{\lambda_{SCPE}}\right)\frac{\phi_{SCPE}(a,z)}{1-F_z(z^*)}dzda \\ -\frac{1}{\lambda_{SCPE}}\int[u'(a,z)-\beta(1+r)E[u'(a',z')|z]]dh^A_{SCPE}(a,y(z))d\Phi_{SCPE} \end{array}\right]$$

go back

Optimal Tax Formula Decomposition

[Decomposition — Price & distribution effect]

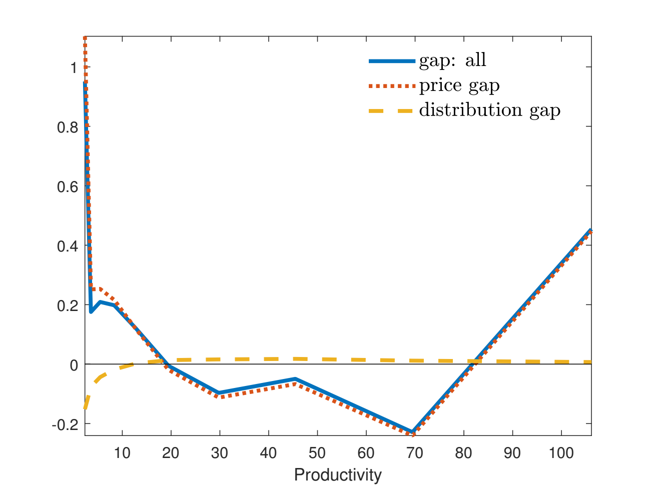
$$
\begin{aligned}
\frac{T'(z^*)}{1-T'(z^*)} - \frac{T'_{SCPE}(z^*)}{1-T'_{SCPE}(z^*)} &= \frac{1+e(x^*)}{e(x^*)} \frac{1-F(x^*)}{x^* f(x^*)} \times [\Omega_{price}(x^*) + \Omega_{dist}(x^*)] \\
where \quad \Omega_{price}(x^*) &= R3 + R4 \\
\Omega_{dist}(x^*) &= (R1(x^*) - R1_{SCPE}(x^*)) + (R2(x^*) - R2_{SCPE}(x^*))
\end{aligned}
$$

- Numerically: $\boldsymbol{\Omega_{price}}$ **strongly dominates** Ω_{dist}

go back

Decomposition of $\frac{T'_{opt}}{1-T'_{opt}} - \frac{T'_{SCPE}}{1-T'_{SCPE}}$

Figure: Decomposition



go back

Role of Initial Tax: $\Delta_p - \Delta_f$

Figure: Externality per unit $\Delta_p - \Delta_f$

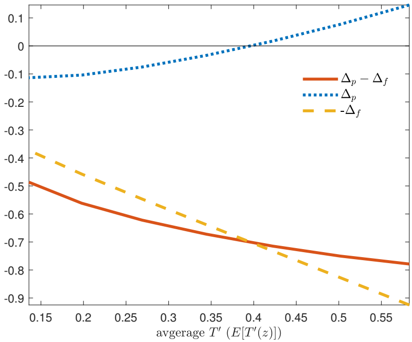
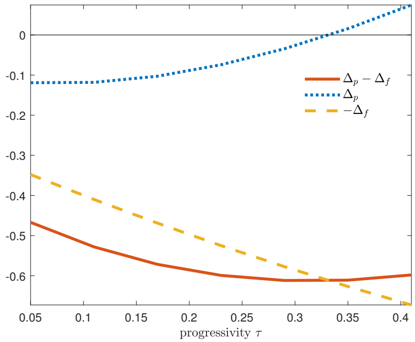


Figure: Externality per unit $\Delta_p - \Delta_f$



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Role of initial tax level & progressivity

Figure: (normalized) $\overline{dr}K$

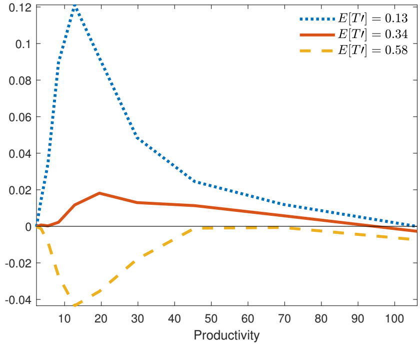
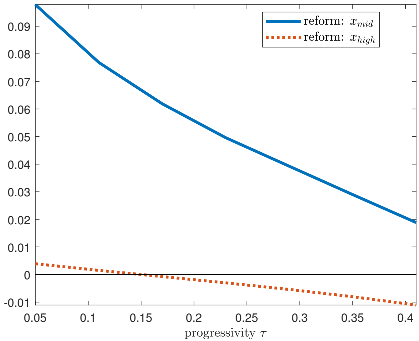


Figure: (normalized) $\overline{dr}K$



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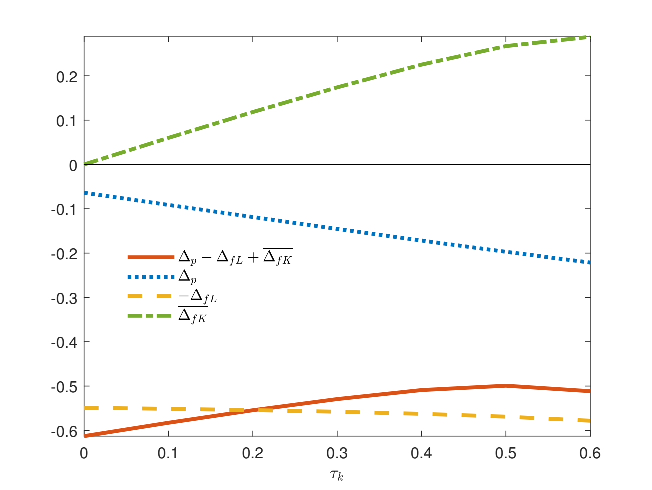
Role of the capital income tax

Figure: Externalitly per unit price change



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Joint Optimal Tax System

- optimal $\tau_k^* = 0.67$ (much higher than $\tau_k^{US} = 0.36$)

Figure: Optimal: dW—GE effects

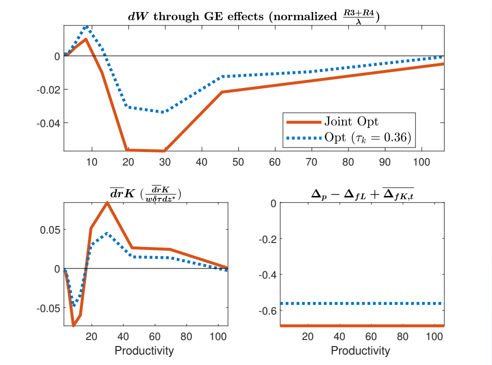
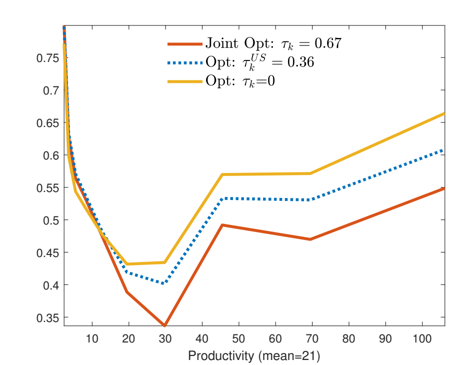


Figure: Optimal Marginal Tax Rates



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Other determinants of K & L response

- Relative response of K and L to the tax reform is crucial!
- Other factors of this relative response:
  - risk aversion ▸ CRRA
  - elasticity of substitution ▸ ES
  - Additional sources of Inequality ▸ capitalist
- Lesson:
  - The role of these factors on the GE effects depends on the interaction with the initial tax schedule!

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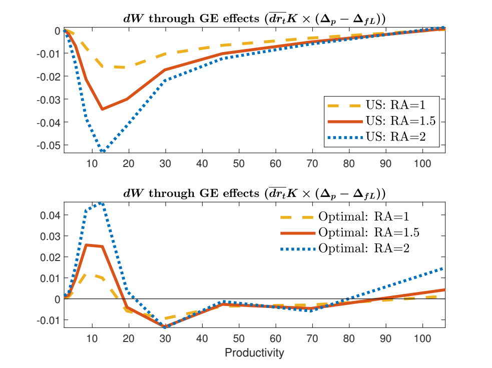
Role of relative risk aversion

Figure: Role of RA for the GE-effects



- under T'_{US}: higher RA implies
  - stronger response of savings
  - more increase in r
  - more negative GE-effects of a redistributive reform

$\Rightarrow$ favor less redistributive reform

- under T'_{opt}: higher RA implies
  - higher T'_{opt}
  - stronger response of $L \Rightarrow r \downarrow$
  - more positive GE-effects

$\Rightarrow$ favor more redistributive reform

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Role of RA for the GE-effects

Figure: Optimal Marginal Tax Rates

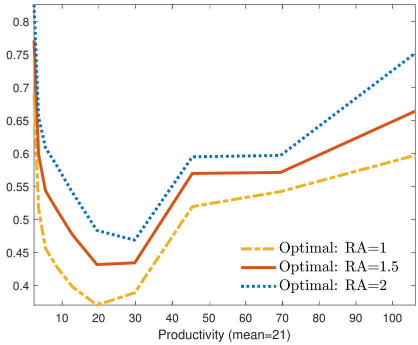
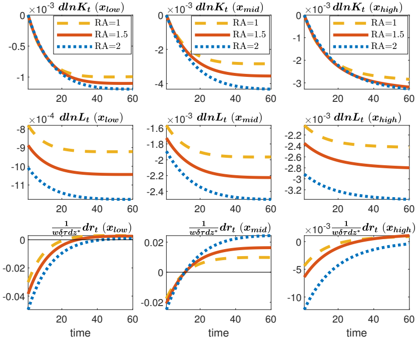


Figure: Transition Path: under T'_{opt}



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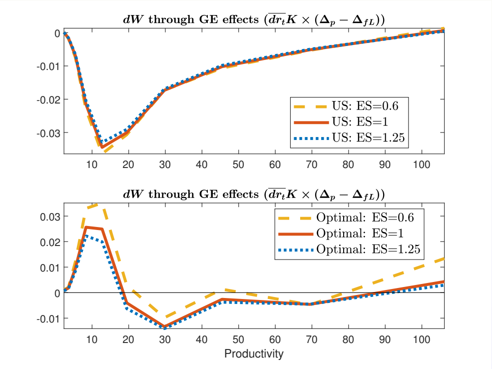
Role of elasticity of substitution

FIGURE: Role of ES for the GE-effects



- under T'_{US}: with lower ES,
  - both $dr_t < 0$ (short-run) & $dr_t > 0$ (long-run) stronger

  $\Rightarrow$ little impact on the GE-effect.
- under T'_{opt}: $\sigma_{es} < 1$ implies
  - small $\frac{K_{opt}}{Y_{opt}}$ leads to $\alpha = \frac{rK}{Y} \uparrow$
  - amplification of the short-run price incidence

  $\Rightarrow$ favor more redistributive reform

- Consider CES production with constant ES (σ_{es})
- $dr_t \cdot K = -\frac{(1-\alpha)\alpha}{\sigma_{es}} Y \left(\frac{dK_t}{K} - \frac{dL_t}{L} \right)$, where $1 - \alpha = \frac{wL}{Y}$

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ROLE OF ES FOR THE GE-EFFECTS

FIGURE: Transition Path: under T'_{US}

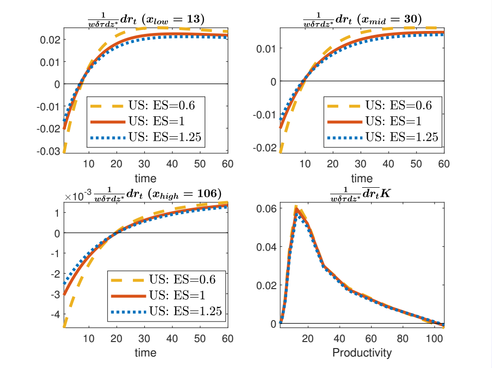
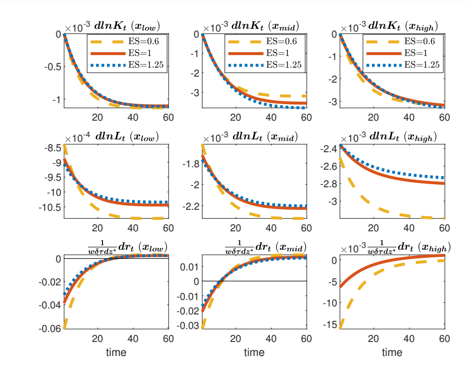


FIGURE: Transition Path: under T'_{opt}



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Role of additional sources of inequality

- capitalist spirit: $u(c - v(l)) + U\left(\frac{a}{K}\right)$
- mitigation of the GE effects

Figure: Decomposition of dW

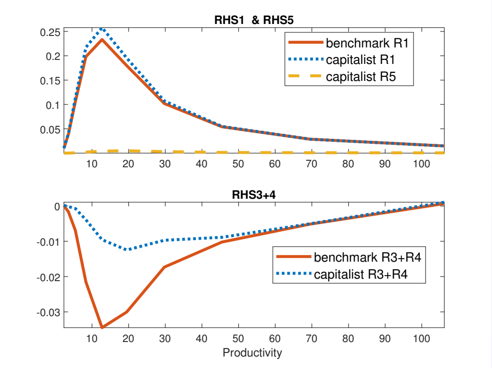
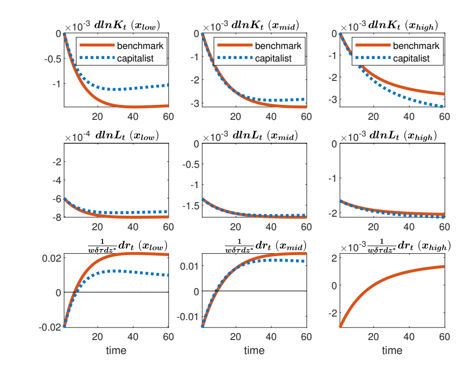


Figure: Transition under the US



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Role of Transition: β-effects

Figure: Optimal: dW—GE effects

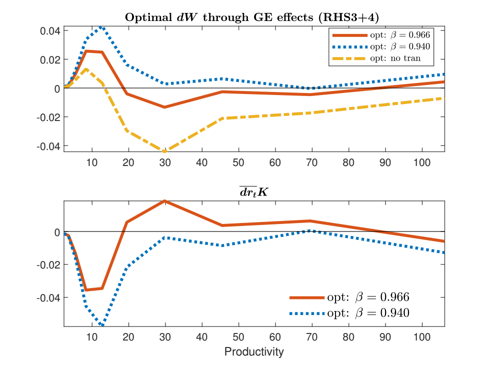
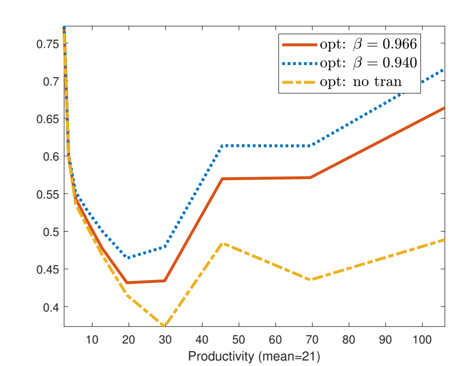


Figure: Optimal Marginal Tax Rates



◂ dW ◂ opt tax

Global Transition to Optimal Reform

- The average welfare gain Δ of the tax reform is measured by consumption equivalent variation (CEV).

$$\int u((1+\Delta)c^{SQ}(a,x), l^{SQ}(a,x))d\Phi(a,x) = \int E_0 \left[(1-\beta) \sum_{t=0}^{\infty} \beta^t u(c_t^R, l_t^R) \right] d\Phi(a_0, x_0)$$

Table: Average Welfare Gain (CEV)

β	high β ($r^{US} = 0.015$)			low β ($r^{US} = 0.04$)		
reform to	optimal w/ $\tau_k = 0$	optimal w/ τ_k^{US}	joint optimal	optimal w/ $\tau_k = 0$	optimal w/ τ_k^{US}	joint optimal
Δ	0.019	0.004	0.013	0.028	0.012	0.023

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Global Reform

Figure: Global Transition: Aggregates

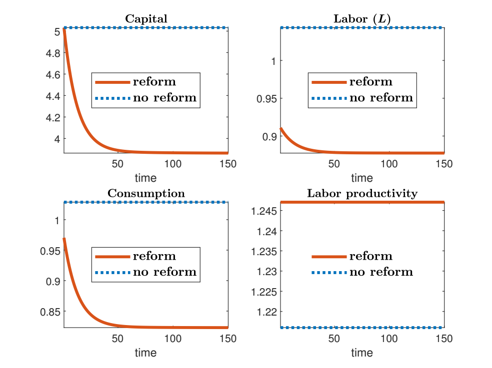
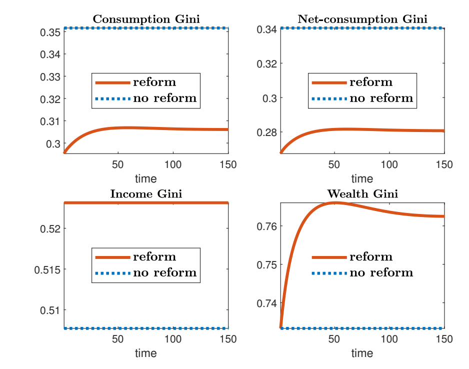


Figure: Global Transition: Distributio



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Optimal Formula w/ Global Tran

- optimal formula:

$$\frac{T'(z^*)}{1-T'(z^*)} = \frac{1+e}{e} \times \frac{1}{(1-\beta)\sum_{t=0}^{\infty}\beta^t \cdot \frac{x_t^* f(x_t^*)}{1-F(x^*)} \cdot \lambda_t} \times$$

$$\left[\begin{array}{l}(1-\beta)\sum_{t=0}^{\infty}\beta^t \cdot \lambda_t \cdot \frac{1-F(x_t^*)}{1-F(x^*)} \iint_{x_t^*}^{\infty}\left(1-\frac{u'(\tilde{c}_t(a,x))}{\lambda_t}\right)\frac{\phi_t(a,x)}{1-F(x_t^*)}dxda \\ -(1-\beta)\sum_{t=0}^{\infty}\beta^t \iint \left[u'(\tilde{c}_t(a,x))-\beta(1+r_{t+1})E[u'(\tilde{c}_t(a',x'))|x]\right] dh_{t+1}^A(a,y_t(x))d\Phi_t \\ +(1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t K_t \iint u'(\tilde{c}_t(a,x))\left[\frac{a}{K_t}-\frac{xl(x)(1-T'(z(x)))}{L_t}\right]d\Phi_t(a,x) \\ +(1-\beta)\sum_{t=0}^{\infty}\beta^t \cdot \lambda_t \cdot dw_t L_t \int (1+\epsilon_{w,t}^l(x))\frac{xl_t(x)}{L_t}T'(z_t(x))f(x)dx\end{array}\right]$$

- incidence on welfare through the GE effects:

$$(1-\beta)\sum_{t=0}^{\infty}\beta^t dr_t K_t \times (\Delta_{p,t}-\Delta_{f,t}), \quad \text{where}$$

$$\Delta_{p,t} = \frac{\iint u'(\tilde{c}_t(a,x))\left[\frac{a}{K_t}-\frac{xl(x)(1-T'(z(x)))}{L_t}\right]d\Phi_t(a,x)}{(1-\beta)\sum_{s=0}^{\infty}\beta^s\lambda_s}$$

$$\Delta_{f,t} = \frac{\lambda_t \int (1+\epsilon_{w,t}^l(x))\frac{xl_t(x)}{L_t}T'(z_t(x))f(x)dx}{(1-\beta)\sum_{s=0}^{\infty}\beta^s\lambda_s}$$

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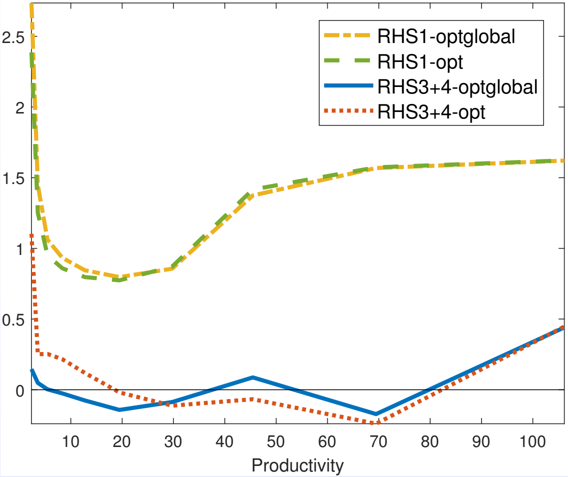
$\frac{T\prime}{1-T\prime}$ DECOMPOSITION W/ GLOBAL TRAN

Figure: $\frac{T'}{1-T'}$ decomposition



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