# Inter vs. Intragenerational Equity: Allowing disruptions under the Pareto criterion

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# Motivation

- Economic disruptions happen routinely and most have significant labor market implications creating winners and losers, i.e., real wage and welfare gains/losses.
  - technology adoption, robots, trade liberalization, immigration reform package, environmental regulation, social distancing, mask/vaccine mandate, privatization of social security.
- Certain disruptions are controlled by governments and long-lived once allowed entry.
- Economic disruptions can flourish future generations. However, the inaugural winners, on impact, may not fully compensate the same-cohort losers who pre-determined their skills when young, even with individualized lump-sum taxes.

# Motivation

- To allow entry, the government needs to involve future cohorts to compensate the inaugural cohort for intergenerational equity using public debts.
- Future cohorts can adjust skills (sector) unlike their parent generation, and make an optimal decision for a new regime, which can generate an additional aggregate gain.
- However, taxing future cohorts based on their skill (sector) status, because of asymmetric information, can be distortionary as in Mirrlees (1971).

# Goals

- This paper provides a compensation scheme that offsets the welfare losses of the cross-cohort losers by redistributing the gains of the cross-cohort winners under labor market disruptions (**LMD**).
- It considers the presence of private information and endogenous responses of future cohorts on an extensive margin (skill choice) in designing the distortionary policy and computing the government budget.
- This paper characterizes the nature (e.g. scale, asymmetry) of LMD that allows the existence of Kaldor-Hicks **Pareto**-neutral fiscal policies across generations.

# Results

- Double budget effects from a mass of “switchers” can help the government to compensate the inaugural generation by taxing the future generations.

- For a country with a high initial skill premium, more LMD are likely to be compensable, i.e., budget-feasible.

- We show that under public information, **incremental-scale** LMD can be allowed entry under the Pareto criterion. Not so, under private information: the scale has to be **sufficiently big**.
    - Loosely, constrained to tax the skilled at the marginal skilled person (the lowest rate), the government has to raise the scale to bring in more tax revenue to increase the tax rate and base (the new skilled group).

- Notably, while the government can ensure intergenerational (pre- and post-LMD) equity, it must accept higher intragenerational inequity.
    - Skilled people with net incomes higher than the marginal skilled person pay the same tax as her, which means they enjoy positive and untaxed surpluses even under the Pareto criterion.

# Model

# Primitives

- Time is discrete.
- A small open economy where an infinitely-lived government borrows/saves under $R > 1$.
- A two-period-lived OLG model consisting of skill-acquiring young and working middle-aged.
  - A new-born is indexed by $i \in \mathcal{I} = [0, 1]$, which denotes an innate ability for skill acquisition.
  - An agent $i$ faces the cost of getting a skill $\eta(i)$ (measured in numeraire goods) satisfies $\eta(i) \geq 0$ and $\eta'(i) < 0$, $\forall i$.
  - The innate ability $i$ is drawn from a continuous distribution function $H(i)$.

# Primitives

- An young agent
  - chooses a skill acquisition on an extensive margin: skilled ($s$) or unskilled ($n$) when they work in middle-aged.
  - borrows $\eta(i)/R$ if she decides to obtain a skill given a perfect capital market.

- A middle-aged agent
  - supplies one unit of labor time inelastically either in the skilled or non-unskilled sector based on their prior skill decision.
    - ★ gets a sector-specific wage: skilled wage $w^s$ and unskilled wage $w^n$ *irrespective* of $i$.
  - repays the loan during middle age, $\eta(i)$.
  - faces a lump sum tax/transfer, $T$.
  - consumes, in the middle-aged only, *a net income* in sector $j \in \{s, n\}$: $w^j - \mathbb{I}(j = s)\, \eta(i)$.

# Skill Decision

- **Skill premium** given by $\phi \equiv w^s - w^n$.
- An agent $i$ chooses to get a skill if $w^s - \eta(i) \geq w^n$ or $\phi \geq \eta(i)$.
- Define $\tilde{\imath}$ as the cut-off $i$ s.t. $w^s - \eta(\tilde{\imath}) \equiv w^n$ or $\phi \equiv \eta(\tilde{\imath})$.
- The mass of skilled $S = \int_{\tilde{\imath}}^{1} dH\,(i) = 1 - H\,(\tilde{\imath})$, which is strictly increasing in $\phi$.
  - A rising skill premium draws more low-ability agents (those with a high education cost, $\eta\,(i)$) into the skilled group.

# Labor Market Disruption (LMD)

- The government at $t-1$ *contemplates* allowing a labor market disruption (LMD) to enter the economy at the start of $t$, after the young born in $t$ makes a skill decision.
- Specifically, an LMD is an unanticipated, permanent shock that forever ($t+k$ for $k \geq 0$) strictly increases (decreases) the skilled (unskilled) wage.
- Define **status quo (SQ)** as the business-as-usual world before any disruption happens where the government is inactive.
  - skilled wage $w^{s,SQ}$ , unskilled wage $w^{n,SQ}$, and skill premium $\phi^{SQ} = w^{s,SQ} - w^{n,SQ}$.

# Labor Market Disruption (LMD)

- The **post-LMD** world reaches a steady state right away at date $t$ with
  - skilled wage $w^s$ and unskilled wage $w^n$,
  - skill premium $\phi = \phi^{SQ} + \Delta_s + \Delta_n$ where $\Delta_s \equiv w^s - w^{s,SQ} > 0$ and $\Delta_n \equiv -\left(w^n - w^{n,SQ}\right) > 0$.
- Define $\tilde{\imath}^{SQ}$ and $\tilde{\imath}$ as cut-off ability values for status quo and post-LMD worlds, respectively.
- Since $\phi > \phi^{SQ}$, $\tilde{\imath} < \tilde{\imath}^{SQ}$ and $S = \int_{\tilde{\imath}}^{1} dH(i) > S^{SQ} = \int_{\tilde{\imath}^{SQ}}^{1} dH(i)$.

# Labor Market Disruption (LMD)

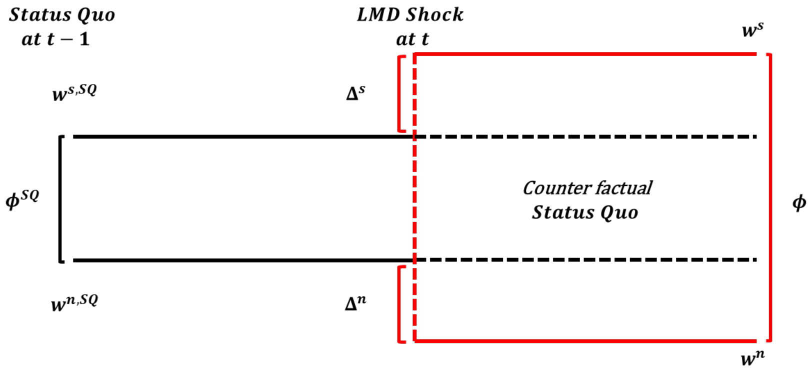



**Figure 1:** LMD Timeline

# Winners and Losers: Laissez Faire (LF)

- In this case, the government permits an LMD shock to enter but is inactive otherwise.

- Impact on the inaugural middle-aged cohort at $t$ (born at $t-1$)
  - If the LMD shock is allowed to enter, it creates winners and losers on impact.
  - Their education choices are predetermined at the status quo, which turns out to be incorrect decisions post-LMD.
  - The middle-aged who had erstwhile chosen to get (not get) skills will gain $\Delta_s$ (lose $\Delta_n$).

- Future winners and losers born at $t$ onward
  - The shock also generates winners and losers among the future middle-aged.
  - However, their education choices are optimal by expecting correct wages under the LMD shock.
  - Thus, there are switcher groups who endogenously minimize (maximize) losses (gains) by being skilled.

# Winners and Losers: Laissez Faire (LF)

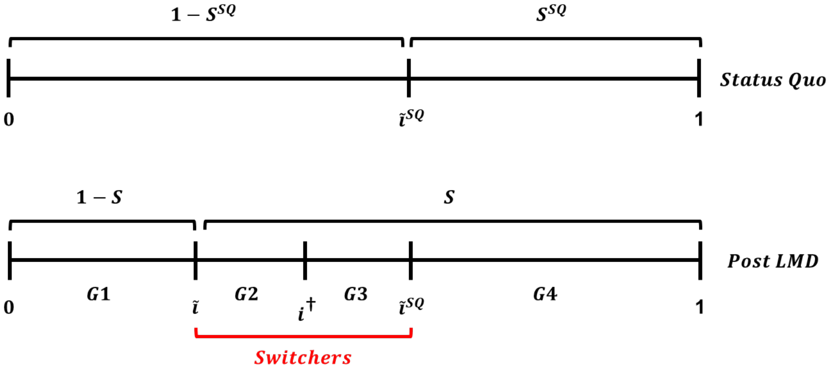



**Figure 2:** Winners and losers across generations

# Winners and Losers: Laissez Faire (LF)

- **G1**: $[\mathbf{0}, \tilde{\imath})$ is unskilled in both SQ and post-LMD worlds and worse off post-LMD.
- **G2**: $\left[\tilde{\imath}, i^{\dagger}\right)$ is skilled in post-LMD world (unskilled in SQ world) and worse off post-LMD.
  - Here, $i^{\dagger}$ is the ability level of the agent who gets the same utility as skilled post-LMD as unskilled pre-LMD, i.e., $w^{s} - \eta(i^{\dagger}) \equiv w^{n,SQ}$.
- **G3**: $\left[i^{\dagger}, \tilde{\imath}^{SQ}\right)$ is skilled in post-LMD world (unskilled in SQ world) and better off post-LMD.
- **G4**: $\left[\tilde{\imath}^{SQ}, \mathbf{1}\right]$ is skilled in both SQ and post-LMD and better off post-LMD.

# Winners and Losers: Laissez Faire (LF)

- Given a uniform distribution $H$,

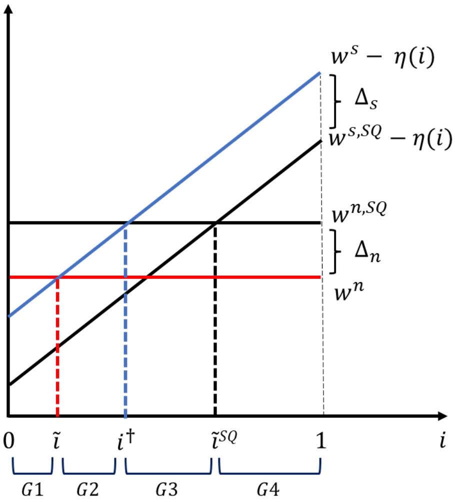



**Figure 3:** Skill distributions in SQ and LF post-LMD

# Winners and Losers: Laissez Faire (LF)

- Group **G2** is of special interest because its members would have been *better off unskilled* in the counterfactual status quo but choose to get skills under LMD to avoid a lower unskilled wage.
- This is an important insight missing in models without an extensive margin choice. In such models, it would appear at first glance, that any agent choosing to get skills post-LMD would have to be better off because of the higher wage – for sure, they would not need any compensation.
- Here, *even* some people who get skills post-LMD *will* need compensation. This is important: if the government is to design compensation schemes that ensure **G2** is not hurt by the LMD shock, they must receive at least an income, $w^{n,SQ}$.

# Public Information

# Government Policy

- This section studies the case where $i$ is **publicly observed** by the government.
- Thus, the government can choose person-specific Pareto-neutral lump-sum taxes (**PNLT**), which generate no distortionary effects on the skill choices of future cohorts.
- The government should permit the LMD shock iff everyone ex-post is at least *as well off* as in the counterfactual status quo by a compensation reform.

# Compensation Scheme

- PNLT for inaugural middle-aged cohorts (born in $t-1$)

$$T^i = \begin{cases} w^n - w^{n,SQ} = -\Delta^n < 0 & \text{if } i \in \mathbb{N}, \\ w^s - w^{s,SQ} = \Delta^s > 0 & \text{if } i \in \mathbb{S}. \end{cases}$$

- PNLT for future middle-aged cohorts (born in $t$ onward)

$$T^{*,i} = \begin{cases} w^n - w^{n,SQ} = -\Delta^n < 0 & \text{if } i \in \mathbb{G}1, \\ w^s - \eta(i) - w^{n,SQ} < 0 & \text{if } i \in \mathbb{G}2, \\ w^s - \eta(i) - w^{n,SQ} \geq 0 & \text{if } i \in \mathbb{G}3, \\ w^s - \eta(i) - \left(w^{s,SQ} - \eta(i)\right) = \Delta^s > 0 & \text{if } i \in \mathbb{G}4. \end{cases}$$

# Budget Surplus

- Pareto-neutral-fiscal-surplus (PNFS) under PNLT for inaugural middle-aged cohorts

$$\mathcal{P} = S^{SQ} T^{i\in\mathbb{S}} + \left(1 - S^{SQ}\right) T^{i\in\mathbb{N}}. \tag{1}$$

- PNFS under PNLT for future middle-aged cohorts

$$\begin{aligned} \mathcal{P}^* = \; & \int_0^{\tilde{\imath}} T^{*,i\in\mathbb{G}1} dH(i) + \int_{\tilde{\imath}}^{i^\dagger} T^{*,i\in\mathbb{G}2} dH(i) \\ & + \int_{i^\dagger}^{\tilde{\imath}^{SQ}} T^{*,i\in\mathbb{G}3} dH(i) + \int_{\tilde{\imath}^{SQ}}^{1} T^{*,i\in\mathbb{G}4} dH(i) . \end{aligned} \tag{2}$$

# Properties of PNFS

$$\mathcal{P} < 0 \iff \frac{S^{SQ}}{1 - S^{SQ}} < \frac{\Delta_n}{\Delta_s}. \tag{3}$$

$$\begin{aligned} \mathcal{P}^* = \; & \mathcal{P} + \underbrace{\int_{\tilde{\imath}}^{i^\dagger} \left( T^{i.*\in\mathbb{G}2} - T^{i\in\mathbb{N}} \right) dH(i)}_{>0,\text{ Double budget effect from }\mathbf{G2}} \\ & + \underbrace{\int_{i^\dagger}^{\tilde{\imath}^{SQ}} \left( T^{i.*\in\mathbb{G}3} - T^{i\in\mathbb{N}} \right) dH(i)}_{>0,\text{ Double budget effect from }\mathbf{G3}}. \end{aligned} \tag{4}$$

- The budget gains in $\mathcal{P}^*$ relative to $\mathcal{P}$ from the switchers in **G2** and **G3**. This means even when $\mathcal{P} < 0$, it is possible that $\mathcal{P}^* > 0$.

# Properties of PNFS

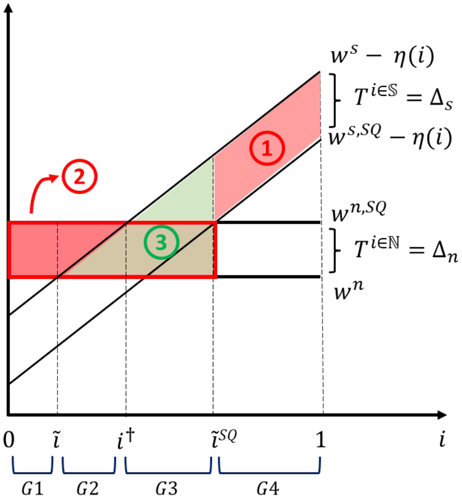



**Figure 4:** Decomposition of $\mathcal{P}$ and $\mathcal{P}^*$

(1): $S^{SQ}T^{i\in\mathbb{S}}$, (2): $\left(1 - S^{SQ}\right) T^{i\in\mathbb{N}}$, (3): Double budget effects.

# Properties of PNFS

**Lemma 1**

*For* $\phi > \phi^{SQ}$,

$$\frac{\partial \mathcal{P}^*}{\partial \Delta_s} > \frac{\partial \mathcal{P}}{\partial \Delta_s} > 0, \ \frac{\partial \mathcal{P}}{\partial \Delta_n} < \frac{\partial \mathcal{P}^*}{\partial \Delta_n} < 0. \tag{5}$$

# Debt Dynamics

- The government can make up the transfer shortfall at $t$ by borrowing an amount $B_t = -\mathcal{P}$ on the international financial markets.
- We assume full commitment to repay, so no default is possible.
- It services the debt by taxing the *next* generation: $\mathcal{P}^* + B_{t+1} \geq RB_t$.
- Iterating forward, $\mathcal{D} \equiv \mathcal{P} + \mathcal{P}^* \sum_{k=1}^{\infty} \frac{1}{R^k}$ is the present value of PNFS.
- $\mathcal{D} \geq 0$ implies the **feasibility** of the PNLT.

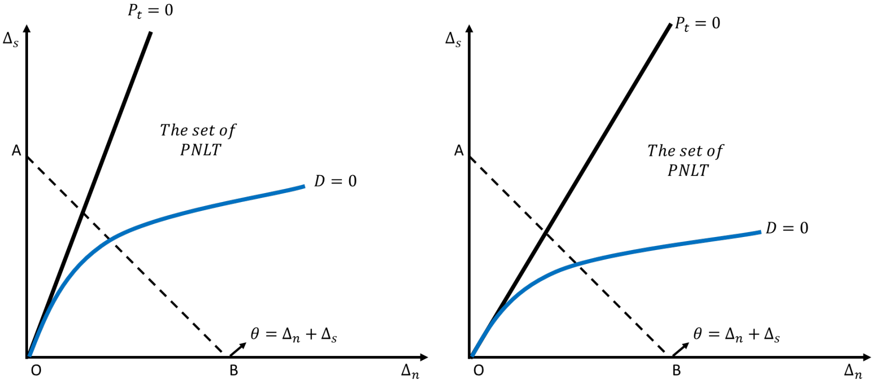
# Government Problem

- We focus on the situation, $\mathcal{P} < 0 < \mathcal{P}^*$, thereby requiring the government to involve future winners and losers in its budget calculus.
  - This is where our overlapping-generations structure becomes *salient* because in its absence, the Pareto criterion when $\mathcal{P} < 0$ would reject the entry of LMD outright because the unskilled in the inaugural generation cannot be compensated by taxing the skilled.
  - But if dynamic, cross-cohort schemes are available, LMD entry under the Pareto criterion may yet be allowed which, in turn, could lift welfare for *all* generations above their status-quo levels.
  - Of course, $\mathcal{P}^* > 0$ does not gaurantee $\mathcal{D} \geq 0$.
- Our main goal is to characterize the set of primitives $\left\{\phi^{SQ}, \Delta_n, \Delta_s\right\}$ that satisfy $\mathcal{P} < 0$ and $\mathcal{D} \geq 0$.

# Results: *PNLT set*

**Lemma 2**

*For an arbitrary $\Delta_n > 0$, there exists a $\Delta_s > 0$ that satisfies $\mathcal{D} = 0$.*




**(a)** Low $\phi^{SQ}$ **(b)** High $\phi^{SQ}$

**Figure 5:** The set of PNLT under public information

# Results: *PNLT set*

1. If $(\Delta_n, \Delta_s) = (0,0), \mathcal{P} = \mathcal{D} = 0$.
2. For all $\Delta_n > 0$, the $\mathcal{D} = 0$ curve lies strictly below the $\mathcal{P} = 0$ line ($\Delta_s = \frac{1-S^{SQ}}{S^{SQ}} \Delta_n$).
3. The $\mathcal{D}\left(\Delta_n, \Delta_s; \phi^{SQ}\right) = 0$ locus is strictly increasing and concave in $\Delta_n$.

# Results: *Initial Skill Premium*

- The $\mathcal{D} = 0$ locus rotates clockwise when $\phi^{SQ}$ rises.
- The area of $\mathcal{D} < 0$ is larger in a country with a low initial skill premium (LSP country) than in one with a high initial skill premium (HSP country) because of a smaller size of **G4**.
- Given the same $(\Delta_n, \Delta_s)$, $\mathcal{D}$ is higher in the HSP country than in the LSP country.

# Results: *Scale* and *Asymmetry*

- *Scale* $\theta = \Delta_n + \Delta_s = \phi - \phi^{SQ}$:
  - Notice, even for very small $\Delta_n$, there exists a corresponding $\Delta_s$ inside the PNLT set. This means **marginal** LMD shocks can be supported under the Pareto criterion. As we will show below, this will *no longer* be the case under private information on $i$.
- *Asymmetry*:
  - The government allows LMD shocks to enter under the Pareto criterion for a LSP country if a rise in the skilled wage is much higher than a decline in the unskilled wage. However, a HSP country permits a rise in the skilled wage is moderate for the same decline in the unskilled wage.
  - As $\phi^{SQ}$ rises, the PNLT set expands, meaning the likelihood of being inside the PNLT set post-LMD is higher for a HSP country.

# Results: Inequality

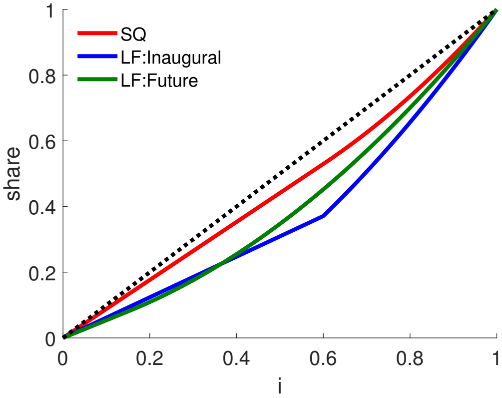



**Figure 6:** Lorenz curves for net income under public information

# Private Information

# Government Policy

- This section studies the case where $i$ is **private information**, but skill status is *publicly observable* to the government.
- Private information does not change anything for the inaugural cohort since education choices are pre-determined from $t-1$. Thus, PNLT for inaugural middle-aged cohorts is identical to the public information case.
- The composition of skilled and unskilled in the status quo is unchanged, and the initial fiscal surplus is the same as $\mathcal{P}$ in Eq. (1).

# Government Policy

- For future cohorts, the government can no longer levy person-spescific PNLT.
- Instead, they must rely on PNLT conditioned on skilled status, i.e., $\{T^n, T^s\}$. Since skill choice is endogenous, such PNLT policies distort the education decision.
- The PNLT $\{T^n, T^s\}$ for future cohorts should be computed by maximizing the fiscal surplus under the Pareto criterion and considering their response.

# Government Policy

- Given a $\{T^n, T^s\}$, define $\tilde{\imath}^v$ as the ability threshold for future cohorts to be indifferent between getting skilled or not, i.e.,

$$w^s - T^s - \eta(\tilde{\imath}^v) \equiv w^n - T^n. \tag{6}$$

- An agent $i \in [0, \tilde{\imath}^v)$ would choose no skills, and $i \in [\tilde{\imath}^v, 1]$ would choose to get skills. The PNFS for future middle-aged cohorts is given by

$$\mathcal{P}^{*v} \equiv S^v T^s + (1 - S^v)\, T^n. \tag{7}$$

where $S^v = \int_{\tilde{\imath}^v}^{1} dH\,(i) = 1 - H(\tilde{\imath}^v)$.

# Government Policy

- Taxes on the skilled become constrained to the marginal (lowest) skilled person under the Pareto criterion.
- Thus, an optimal $\tilde{\imath}^v$ should be targeted within **G3** $\cup\, \tilde{\imath}^{SQ}$, i.e., $\left[i^{\dagger}, \tilde{\imath}^{SQ}\right]$.

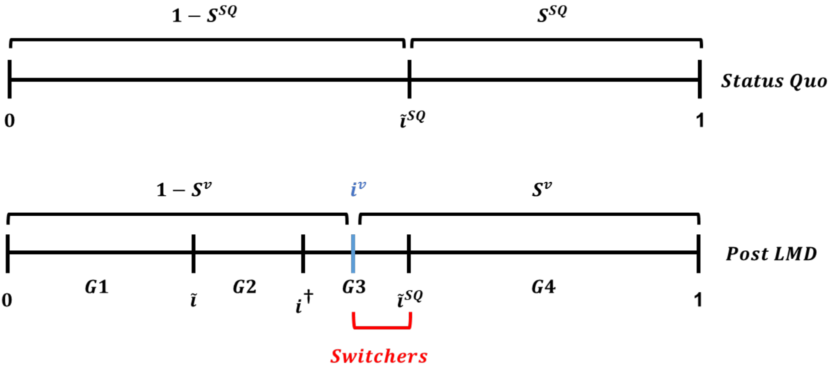



**Figure 7:** Winners and losers across generations

# Government Policy

- The government problem is given as

$$\max_{\tilde{i}^v \in [i^\dagger, \tilde{\imath}^{SQ}]} \mathcal{P}^{*v} = S^v T^s + (1 - S^v) T^n \tag{8}$$

subject to

$$\begin{aligned} T^s &= w^s - \eta\left(\tilde{i}^v\right) - w^{n,SQ} \\ T^n &= -\Delta_n \\ S^v &= \int_{\tilde{i}^v}^{1} dH(i). \end{aligned} \tag{9}$$

- There is a trade-off: lowering $\tilde{i}^v$ reduces the tax size on the skilled $T^s$ but expands the tax base (the mass of the skilled) *and* reduces the mass of unskilled workers needing compensation, i.e., double budget effect.

# Properties of PNFS

$$\mathcal{P}^{*v} = \mathcal{P} + \underbrace{\left(T^{s} - T^{n}\right)}_{\text{Double budget effect}} \underbrace{\left(S^{v} - S^{SQ}\right)}_{\text{for Switchers}} + S^{SQ} \underbrace{\left(T^{s} - T^{i \in \mathbb{S}}\right)}_{\text{Tax fall}} . \quad (10)$$

- The budget gains in $\mathcal{P}^{*v}$ relative to $\mathcal{P}$ from the switchers in $\mathbf{G3} \cup \tilde{\imath}^{SQ}$, but budget losses from tax fall. This means $\mathcal{P}^{*v}$ is not always strictly larger than $\mathcal{P}$.

# Properties of PNFS

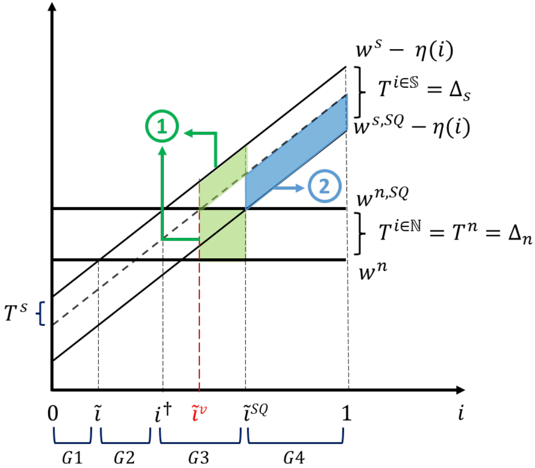



**Figure 8:** Budget gains and losses in $\mathcal{P}^{*v}$

(1): $(T^s - T^n)\left(S^v - S^{SQ}\right)$, (2): $S^{SQ}\left(T^s - T^{i\in\mathbb{S}}\right)$.

# Results: *PNLT set*

**Lemma 3**

*There is a unique corner solution at* $\tilde{i}^v = \tilde{\imath}^{SQ}$ *if*

$$\theta = \Delta_n + \Delta_s \leq \bar{\theta} = -\frac{\left(1 - H\left(\tilde{i}^{SQ}\right)\right)\eta'\left(\tilde{i}^{SQ}\right)}{h\left(\tilde{i}^{SQ}\right)} = \frac{\phi^{SQ}}{\varepsilon_{S,\phi}^{SQ}} \tag{11}$$

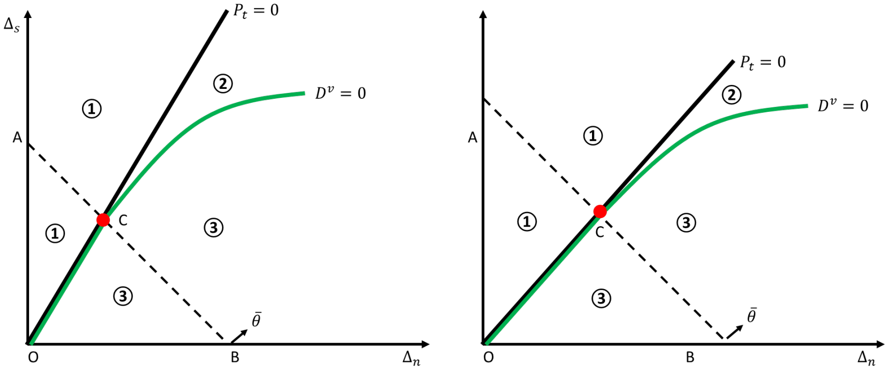
*where* $h(\cdot)$ *is a density function and* $\varepsilon_{S,\phi}^{SQ}$ *is the elasticity of the mass of the skilled with respect to the skill premium at the status quo.*

- Given a small size of shock (depending on the initial skill premium), the optimal skill size is $S^{SQ}$ because the effect of tax fall dominates the double budget effect from switchers on the fiscal surplus.

# Results: *PNLT set*

**Lemma 4**

*For an arbitrary $\Delta_n > 0$, there exists a $\Delta_s > 0$ that satisfies $\mathcal{D}^v = 0$.*




**(a)** low $\phi^{SQ}$ **(b)** high $\phi^{SQ}$

**Figure 9:** The set of PNLT under private information

# Results: *PNLT set*

1. If $\theta \leq \bar{\theta}$ including $(\Delta_n, \Delta_s) = (0,0)$, $\mathcal{P} = \mathcal{D}^v = 0$ because the government treat the inaugural and future generations with the same fiscal policy and generate the same net tax revenue across different generations.
2. For all $\Delta_n > \overline{\Delta}_n$, the $\mathcal{D}^v = 0$ curve lies strictly below the $\mathcal{P} = 0$ line ($\Delta_s = \frac{1-S^{SQ}}{S^{SQ}}\Delta_n$) and is strictly increasing and concave in $\Delta_n$.

# Results: *Initial Skill Premium*

- The $\mathcal{D}^v = 0$ locus rotates clockwise when $\phi^{SQ}$ rises.
- The area of $\mathcal{D}^v < 0$ is larger in a country with a LSP country than in one with a HSP country.
- Given the same $(\Delta_n, \Delta_s)$, $\mathcal{D}^v$ is higher in the HSP country than in the LSP country.

# Results: *Scale* and *Asymmetry*

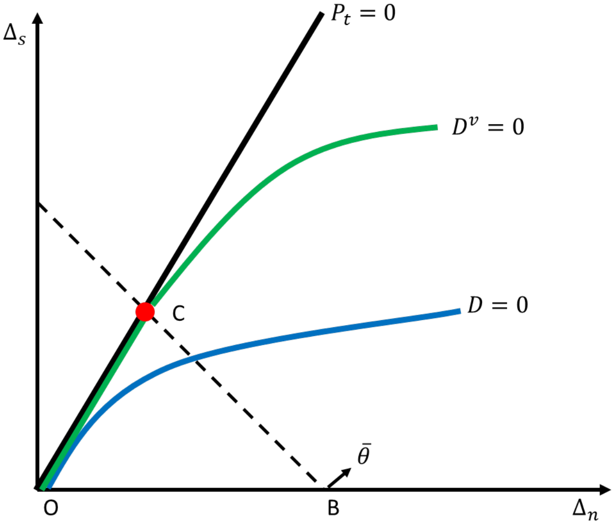



**Figure 10:** The set of PNLT in both cases

# Results: *Scale* and *Asymmetry*

- *Scale*
  - For a small shock, we don't see any interesting cases like the inaugural generations hurt but the future generations get better off for intergenerational transfer. Given the interesting case, we need large shocks under private information for Pareto improvement.
- *Asymmetry*
  - $\mathcal{D}^v = 0$ is *uniformly higher and steeper* than $\mathcal{D} = 0$, or the LMD shock should be skewed toward $\Delta_s$ given the same sacle.
    - ⋆ An average tax rate is lower in the private information case compared to the public information case as the average tax rate is uniformly set at the marginally skilled person among switchers.
    - ⋆ Thus, for the same $\Delta_n$, $\Delta_s$ should be higher to increase both average tax rates and the mass of the skilled under information friction.

# Results: Inequality

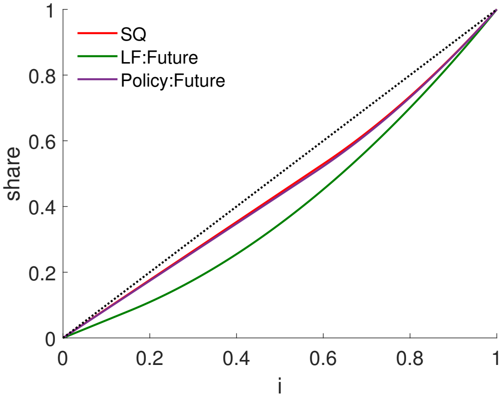



**Figure 11:** Lorenz curves for future cohorts under private information