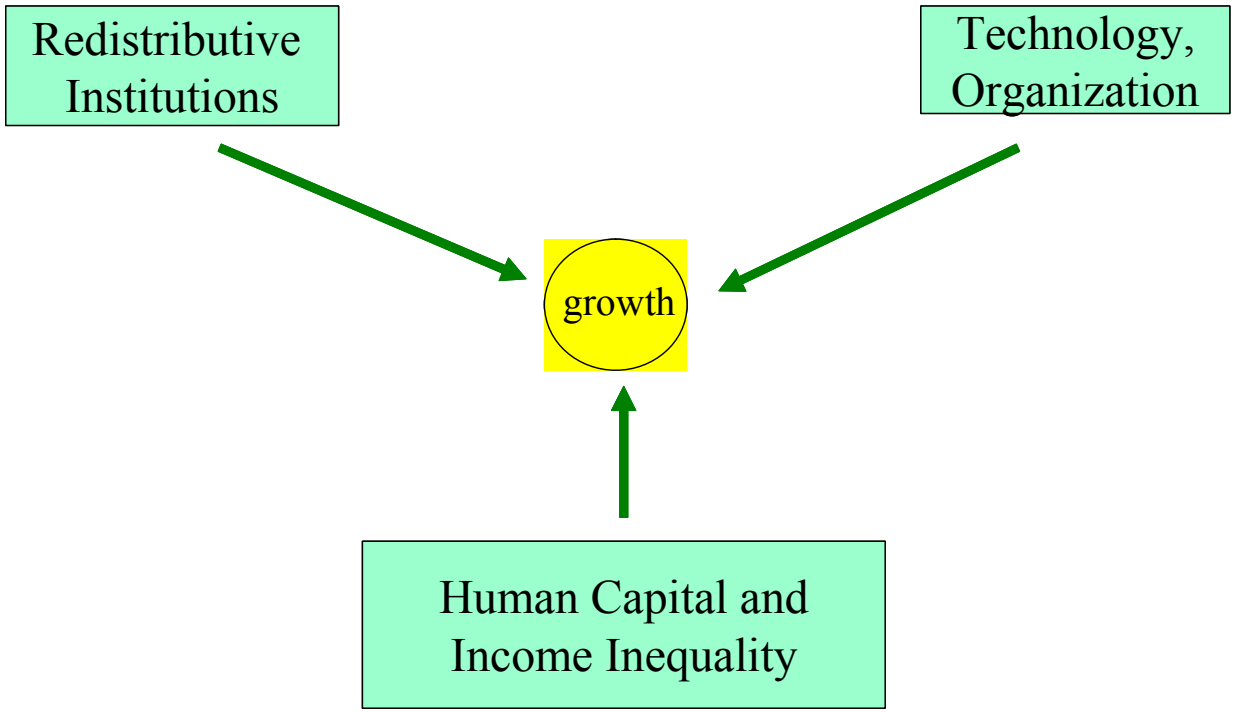
Inequality, Technology, and the Social Contract

Roland Bénabou
Princeton University

Handbook of Economic Growth (2006)

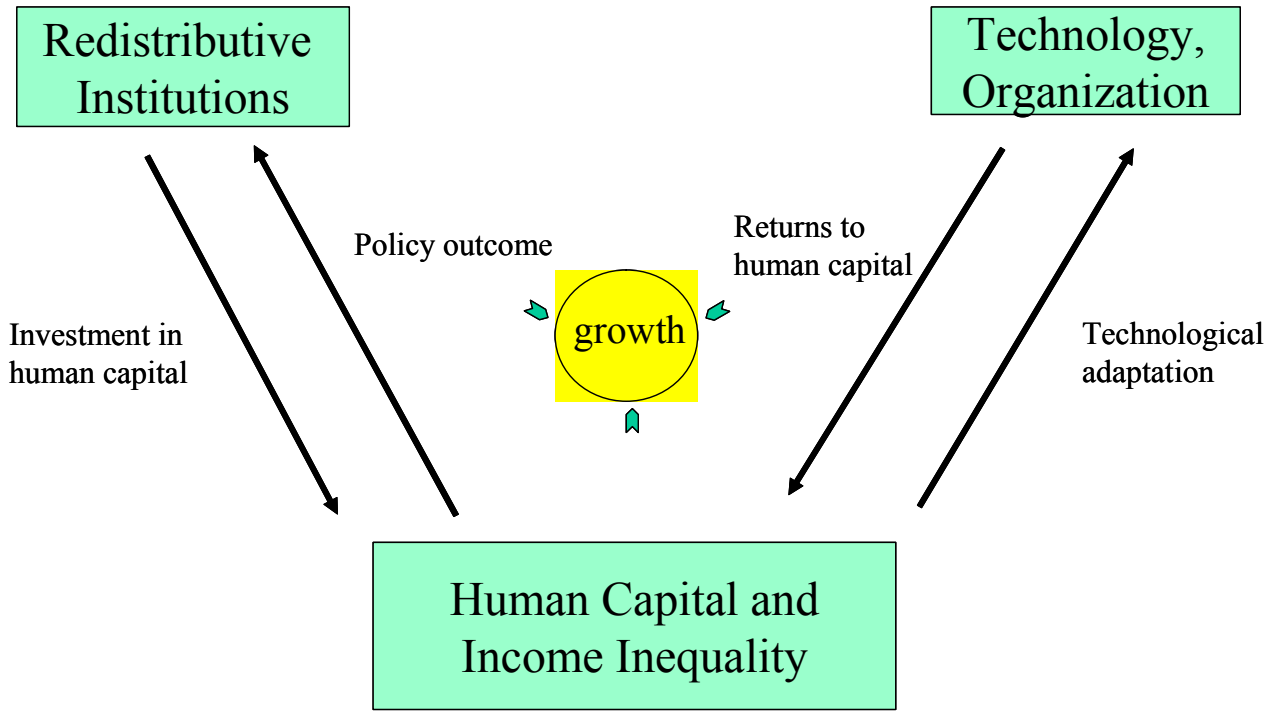
INTRODUCTION

• Main theme: distribution of human capital / income = key state variable in the growth process.



• Potentially matters both directly and through its effects on the "standard" determinants of growth: policy / institutions, technology.

- Conversely, its dynamics over time are shaped by these same factors



- Evolution of inequality, institutions, policy also of independent interest.

$\Rightarrow$ Will develop a unified model of all these interactions.

QUESTIONS

1) Inequality and Redistributive Institutions

• Why is the social contract (taxes and transfers, social insurance, labor market regulation, education finance) so different across otherwise similar countries? Europe vs. US; Scandinavian vs. others, etc. Also: more unequal countries often redistribute *less.*

• Growth Implications?

• What makes the Welfare State sustainable? What shocks may cause it to unravel?

2) Technology, and Inequality

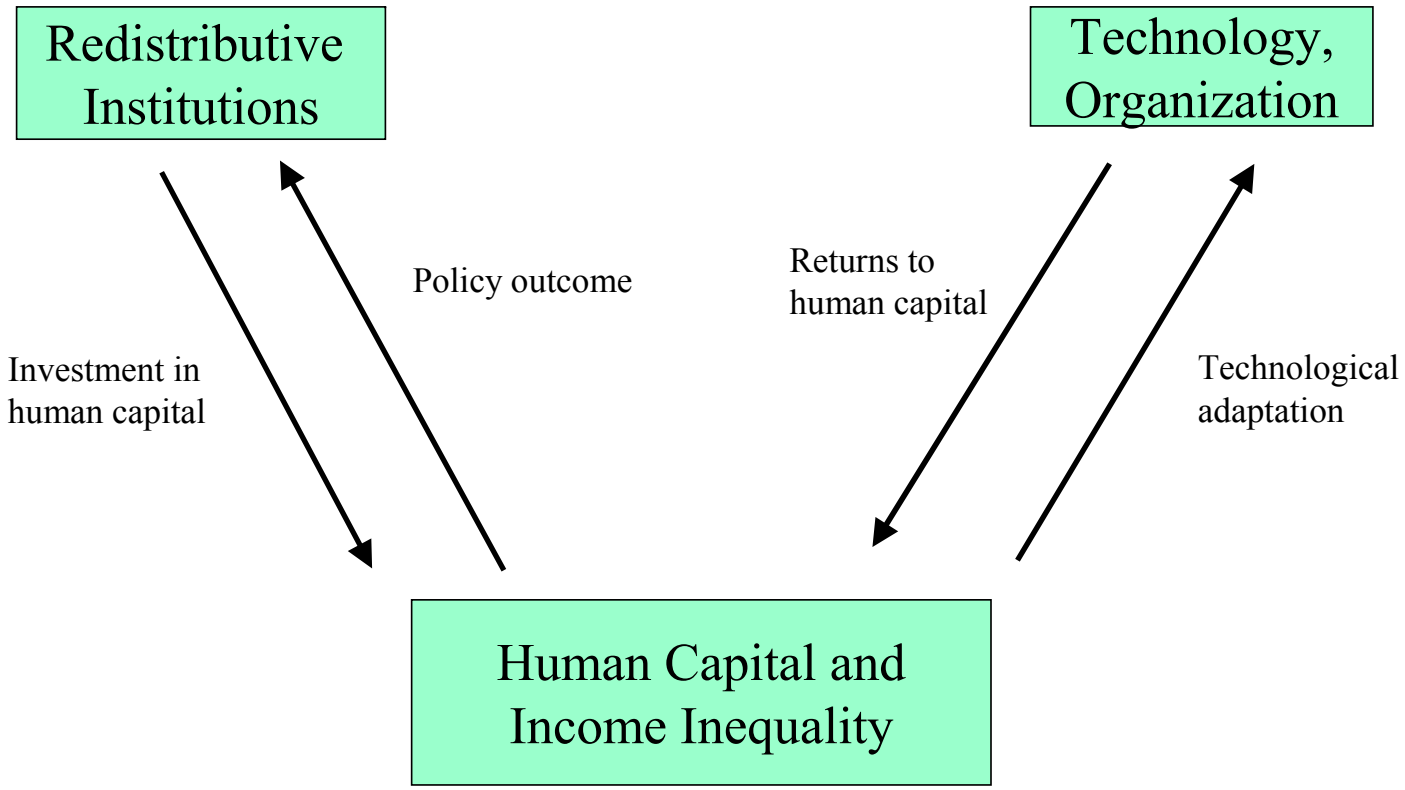
• How does skill-biased technical change, through its distributional impact, alter the set of sustainable policies?

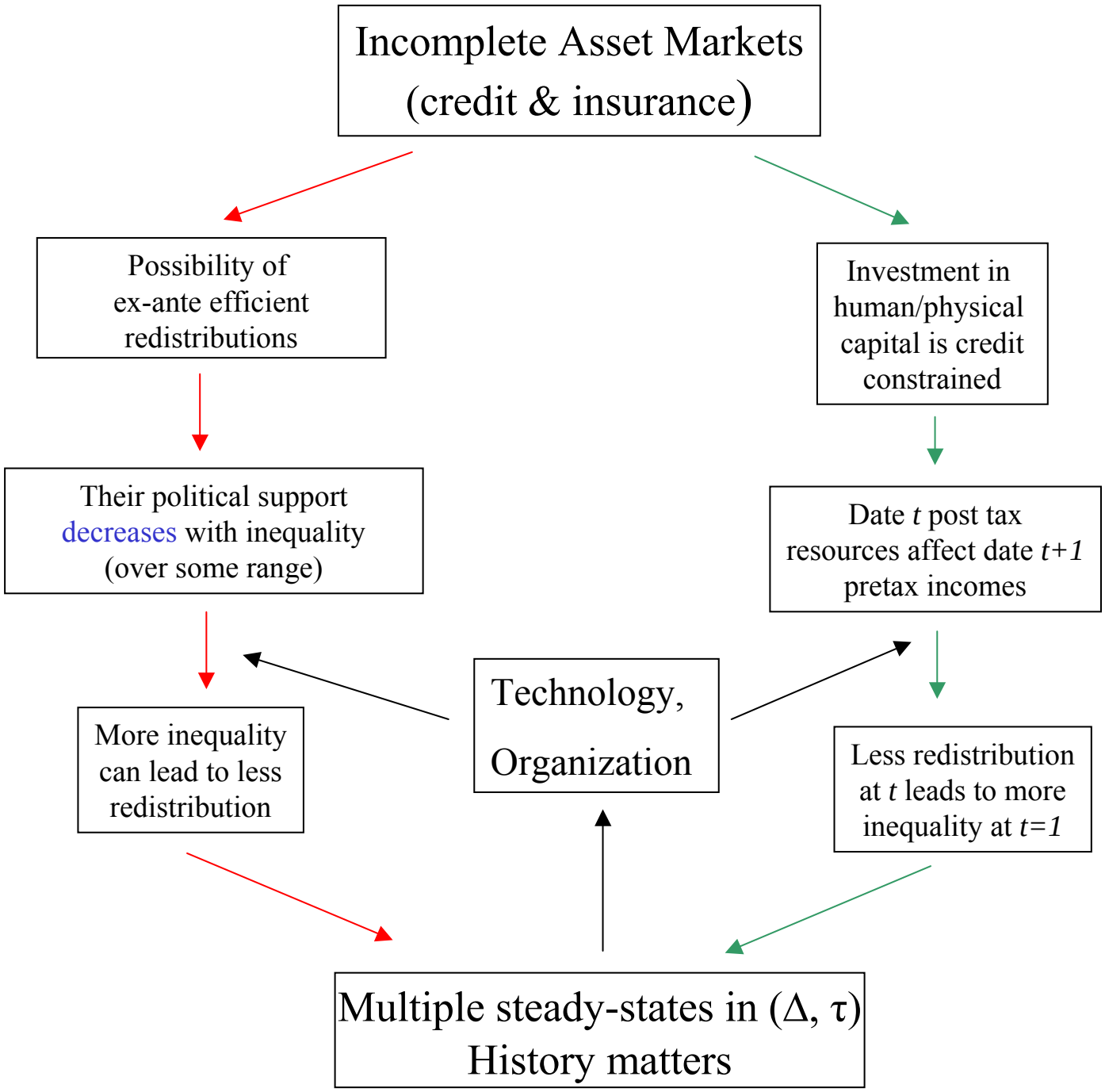
• Feedback from inequality onto the nature of technical / organizational change. Here, firms' choice of *flexibility.*

• Human capital distribution & production system shape each other. Possibility of high-inequality + high skill-bias *traps?*

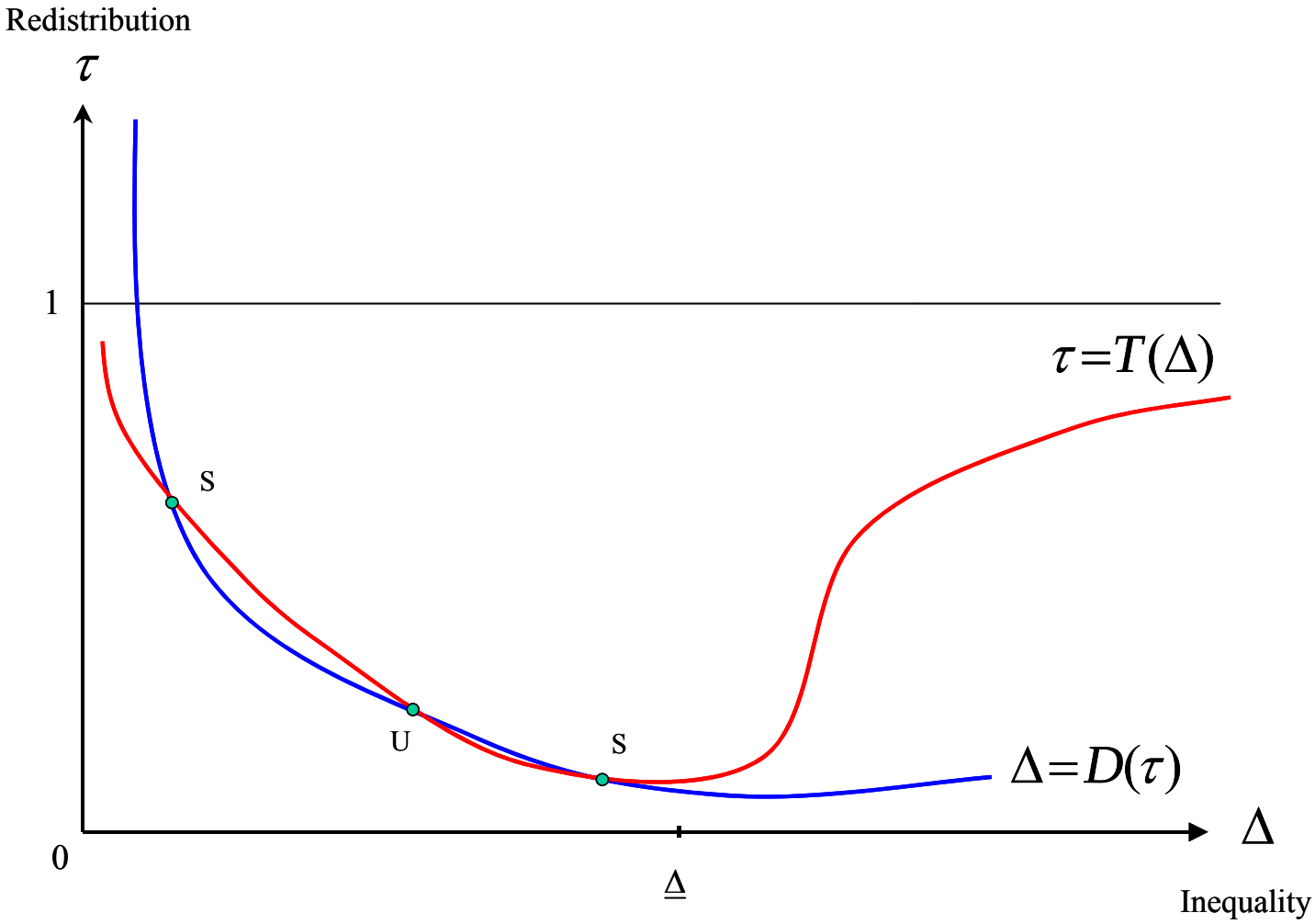
3) Joint Determination of Inequality, Technology, and the Social Contract

- Which countries will be the first to develop / adopt skill-biased production processes?
- Will a single societal "model" ultimately prevail?
- "Exporting Inequality": international spillovers between institutions.




Incomplete Asset Markets
(credit & insurance)
Possibility of
ex-ante efficient
redistributions
Investment in
human/physical
capital is credit
constrained
Their political support
decreases with inequality
(over some range)
Date t post tax
resources affect date t+1
pretax incomes
Technology,
Organization
More inequality
can lead to less
redistribution
Less redistribution
at t leads to more
inequality at t=1
Multiple steady-states in (Δ, τ)
History matters

Two Key Relationships Linking Inequality and Redistribution



Inequality: Δ^2 = inequality in human capital (variance of log-normal).

Redistribution: $\tau \leq 1$ = degree of progressivity / equalization in fiscal (taxes + transfers), or educational (school finance), or labor market (minimum wage, unions) policy.

Some Related Literature

• *Dynamic politico-economic models with multiple steady-states:*

Bénabou (AER 2000), Saint Paul (RED 2001), Hassler, Rodriguez-Mora, Storesletten, Zillibotti (AER 2002), Vindigini (2002).

• *Effects of skill-biased technological change on earnings inequality:* huge empirical and theoretical literature.

• *Effects of the skill distribution on technological choice:*

Kremer and Maskin (1996), Acemoglu (QJE 1998), Lloyd-Ellis (AER 1999), Kiley (EJ 1999), Grossman and Maggi (AER 2000).

I - THE ECONOMY

Overlapping–generations families $i \in [0, 1]$.

• *Production:* Human capital k_t^i + labor l_t^i + iid productivity shock ln $z_t^i \sim \mathcal{N}(-v^2/2, v^2)$; Later on, add worker interactions + technology choice.

$$y_t^i = z_t^i \left(k_t^i\right)^\gamma \left(l_t^i\right)^\delta.$$

• *Accumulation:* iid ability $\xi_{t+1}^i \sim \mathcal{N}(-w^2/2, w^2)$ + at home transmission of k_t^i + human capital investment e_t^i.

$$k_{t+1}^i = \kappa\, \xi_{t+1}^i \left(k_t^i\right)^\alpha \left(e_t^i\right)^\beta$$

• *Incomplete markets:* no loan market $\Rightarrow$ must finance both consumption c_t^i and investment e_t^i out of disposable income $\hat{y}_t^i$:

$$c_t^i + e_t^i = \hat{y}_t^i$$

No insurance market for the productivity + child's ability risks z_t^i.

• *Policy:* disposable $\hat{y}_t^i$ obtained from y_t^i via progressive redistribution at rate $\tau_t \leq 1$: *taxes and transfers*, or *education finance* equalization, or *wage compression* (minimum wage, union-friendly labor market regulation).

• *Policy:* disposable $\hat{y}_t^i$ linked to market y_t^i via *progressive* redistribution rate $\tau_t \leq 1$.

$$\hat{y}_t^i \equiv (y_t^i)^{1-\tau_t} (\tilde{y}_t)^{\tau_t}.$$

Break–even level $\tilde{y}_t$ determined by the balanced-budget constraint:

$$\int_0^1 (y_t^i)^{1-\tau_t} (\tilde{y}_t)^{\tau_t} \, di = y_t \,,$$

where $y_t \equiv$ per capita income. The elasticity τ_t measures the degree of *progressivity* (or regressivity) of in fiscal policy / taxes and transfers.

Alternative interpretations:

– *wage compression*: through labor market institutions favorable to workers with relatively low skills: minimum wage laws, union-friendly or right-to-strike regulations, public sector pay and employment, etc.

– *education finance equalization:* redistribute only e_t^i instead of y_t^i : $\tau = 0$ private / local, $\tau = 1$ national / uniform;

• *Preferences:* once he has learned productivity shock z_t^i, the adult chooses labor, consumption and savings to maximize:

$$\ln V_t^i = \max_{l_t^i,\, c_t^i} \left\{ (1-\rho)[\ln c_t^i - (l_t^i)^\eta] + \rho \ln E_t[k_{t+1}^i] \right\}.$$

Disutility of labor / elasticity of labor supply parametrized by $1/\eta$.

• When voting over τ_t, the agent knows his endowment k_t^ibut has not yet learned z_t^i, and therefore not the lifetime utility V_t^i that he will achieve. His relative risk-aversion is $a \geq 0$:

$$U_t^i = \left(E_t[(V_t^i)^{1-a}] \right)^{1/(1-a)}.$$

• *Costs and benefits of redistribution:*

– cost will rise with labor elasticity $1/\eta$, as labor supply $l(\tau)$ is distorted.

– benefits will rise with risk-aversion a (insurance) and with concavity of accumulation technology ($\backsim \beta$), via relaxation of credit constraints.

In fact, benefits will involve composite parameter

$$B \equiv a + \rho(1-\beta)(1-a) \geq 0,$$

appearing in individual + average welfare. Could add inequality-aversion.

• *Political system:* imperfectly democratic. Agents' political influence (probability of voting, campaign contributions, etc..) rises with their income or education $\Rightarrow$ aggregate votes with different weights ω^i. Summary statistic : given single peaked preferences, the

$$\underline{\text{pivotal agent}} \text{ is located at the } p^* \geq 50\,\text{th percentile,}$$

e.g., 70^{th}, 75^{th}, etc. Equivalently, can parametrize the degree of *wealth-bias* in the political system by λ, where

$$p^* = \Phi(\lambda)$$

and Φ is the cdf of a standard normal ($\lambda = 0$: ideal democracy).

– Slight variant of the model: ω^i's such that bias increases with inequality: $\lambda \rightarrow \lambda\Delta$. Only strengthens the results.

- *Distributional and Aggregate Dynamics*

Proposition 1 *Given a redistribution rate τ_t, agents in generation t choose a common labor supply and savings rate: $l_t = \chi\,(1-\tau_t)^{1/\eta}$ and $e_t^i = s\,\hat{y}_t^i$, where χ is constant and $s \equiv \rho\beta/(1-\rho+\rho\beta)$.*

The resulting law of motion for human wealth is loglinear:

$$\begin{aligned}\ln k_{t+1}^i &= \ln \xi_{t+1}^i + \beta(1-\tau_t)\ln z_t^i + \ln\kappa + \beta \ln s \\ &\quad +(\alpha+\beta\gamma(1-\tau_t))\ln k_t^i + \beta\delta(1-\tau_t)\ln l_t + \beta\tau_t \ln \tilde{y}_t.\end{aligned}$$

Thus, human capital and income remain log-normally distributed:

$$\begin{aligned}\ln k_t^i &\sim \mathcal{N}(m_t, \Delta_t^2), \\ \ln y_t^i &\sim \mathcal{N}(\gamma m_t + \delta \ln l_t - v^2/2, \gamma^2\Delta_t^2 + v^2),\end{aligned}$$

and the evolution of the whole economy is governed by two simple linear difference equations in (Δ_t^2, m_t), or equivalently in $(\Delta_t^2, \ln y_t)$, given below.

• *Voter Preferences*

Each generation chooses, before the individual productivity shocks z_t^i are realized, the rate of progressivity τ_t to which it will be subject. Voter i's ideal policy = maximize his intertemporal welfare $U_t^i = \mathcal{U}(\tau_t, k_t^i \,|\, m_t, \Delta_t)$. The first order condition is:

$$\frac{\partial U_t^i}{\partial \tau} = (1-\rho+\rho\beta)\left[\gamma(m_t - \ln k_t^i) - \frac{\delta}{\eta}\left(\frac{\tau}{1-\tau}\right) + (1-\tau)(\gamma^2\Delta_t^2 + Bv^2)\right] = 0,$$

where $B \equiv a + \rho(1-\beta)(1-a)$ was explained earlier.

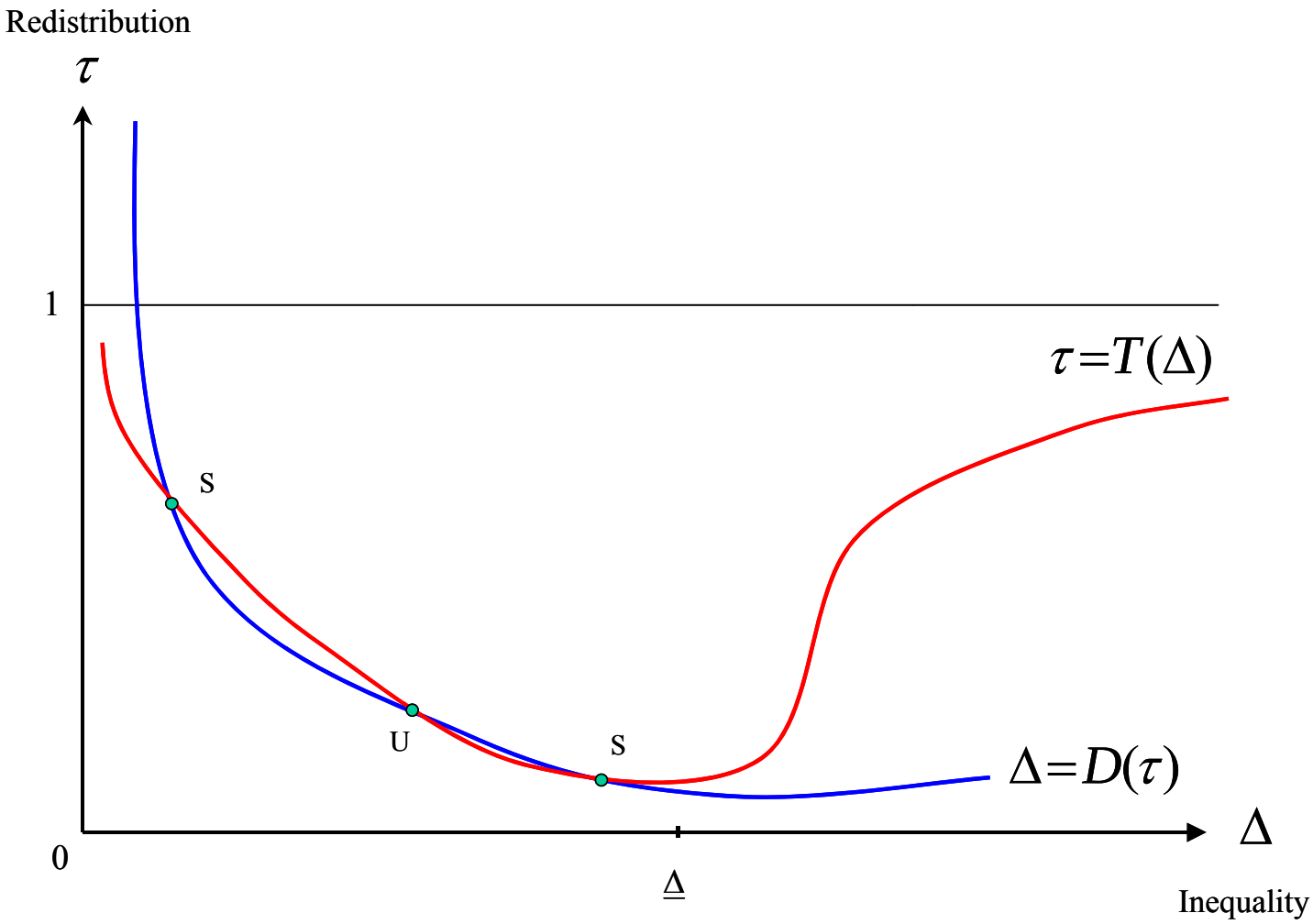
– First term: *redistributive* effects of a marginal increase in τ (zero-sum);

– Second term, which is minimized for $\tau = 0$: *aggregate welfare cost* of a marginal increase in τ_t (deadweight loss);

– Third term, which is maximized for $\tau = 1$, embodies: a) the marginal *efficiency gains* arising from better insurance and the redistribution of resources towards more severely credit-constrained investments; b) skewness.

• *Pivotal agent: located at* $p^* = \Phi((\ln k_t^i - m_t)/\Delta_t)$, or $\ln k_t^i = m_t + \lambda\Delta_t$.

Two Key Relationships Linking Inequality and Redistribution



Inequality: Δ^2 = inequality in human capital (variance of log-normal).

Redistribution: $\tau \leq 1$ = degree of progressivity / equalization in fiscal (taxes + transfers), or educational (school finance), or labor market (minimum wage, unions) policy.

• *Locus $\Delta = D(\tau)$: in steady-state, inequality declines with redistribution:*

$$\Delta^2 = \frac{w^2 + \beta^2(1-\tau)^2 v^2}{1 - (\alpha + \beta\gamma(1-\tau))^2} \equiv D(\tau;\gamma)$$

Reflects the (loglinear) intergenerational transmission of inequality under missing loan market, partially offset by redistribution:

$$\Delta_{t+1}^2 = \underbrace{(\alpha + \beta\gamma(1-\tau_t))^2 \cdot \Delta_t^2}_{\text{parental human capital inequality}} + \underbrace{\beta^2(1-\tau_t)^2 v^2}_{\text{parental income shocks}} + \underbrace{w^2}_{\text{new ability shocks}}$$

• *Locus $\tau = T(\Delta)$: in each period, the equilibrium rate of redistribution is U-shaped with respect to inequality.* Simplest with fixed labor supply:

$$\frac{1}{1-\tau_t} = \underbrace{\frac{1}{\lambda}}_{\text{political power of wealth}} \left(\underbrace{\gamma\Delta_t}_{\text{skewness \& initial L.C.'s}} + \underbrace{\frac{Bv^2}{\gamma\Delta_t}}_{\text{ex-ante welfare gain / distributional conflict}} \right),$$

minimized at $\gamma^2\underline{\Delta}^2 = Bv^2$. True more generally, with $|\tau_t|$ also $\searrow$ in $1/\eta$.

Proposition 2 *The rate of redistribution $\tau_t = T(\Delta_t)$ chosen in generation t has the following features:*

1) τ_t increases with the ex–ante efficiency gain from redistribution (gross of distortions) Bv^2, and decreases with the political influence of wealth, λ.

2) $|\tau_t|$ decreases with the elasticity of labor supply $1/\eta$.

3) τ_t is U-shaped with respect to inequality Δ_t. It starts at ex–ante efficient $T(0) > 0$, declines to a minimum at some $\underline{\Delta}(B) > 0$, then rises back towards $T(\infty) = 1$.

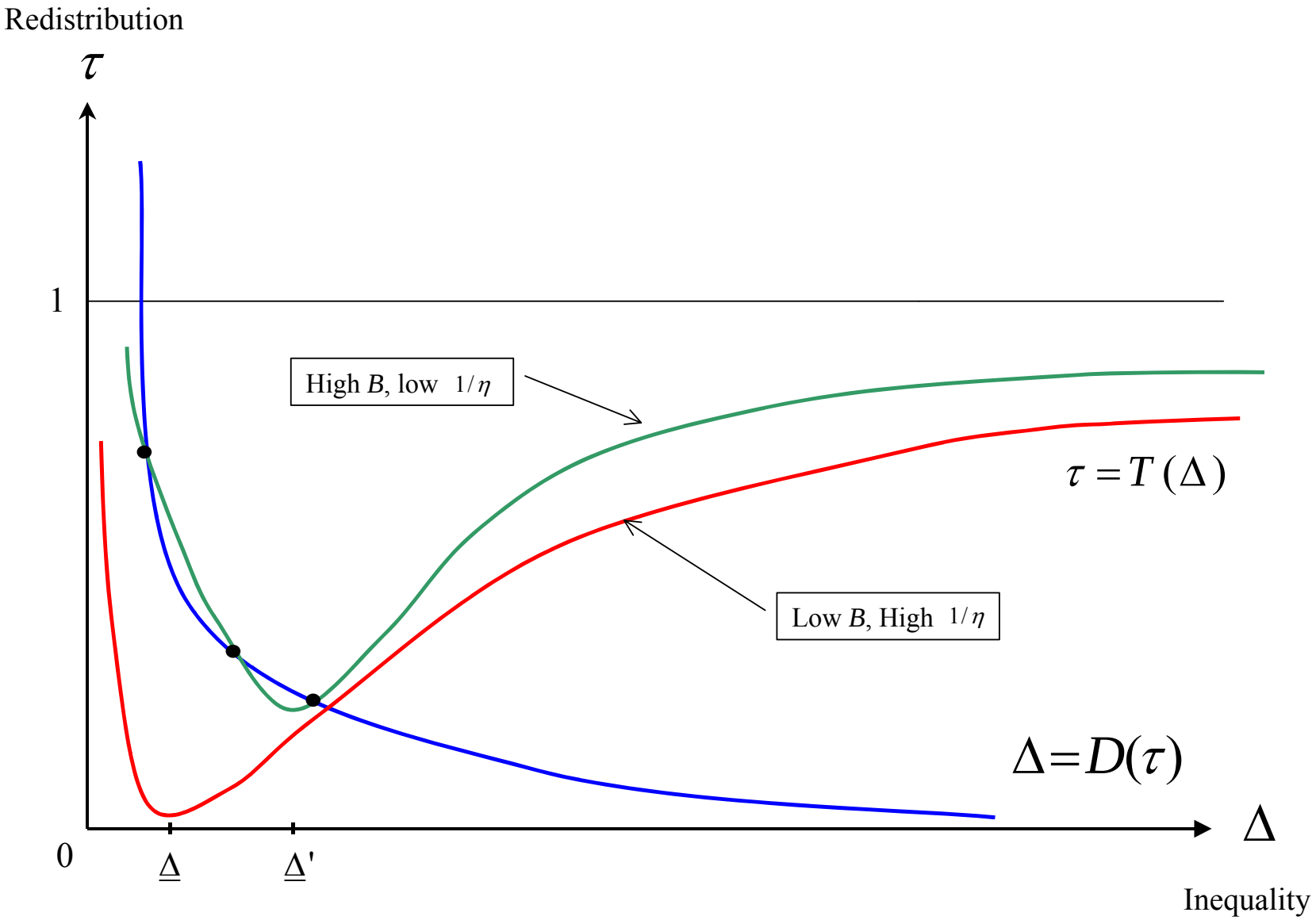
4) The larger is Bv^2, the wider the range $[0, \underline{\Delta}(B)]$ over which inequality declines with redistribution.

• *Intuition* (all "at the margin") :

a) Distributional conflict small enough relative to net efficiency gains $\Rightarrow$ high level of support for redistributive policy.

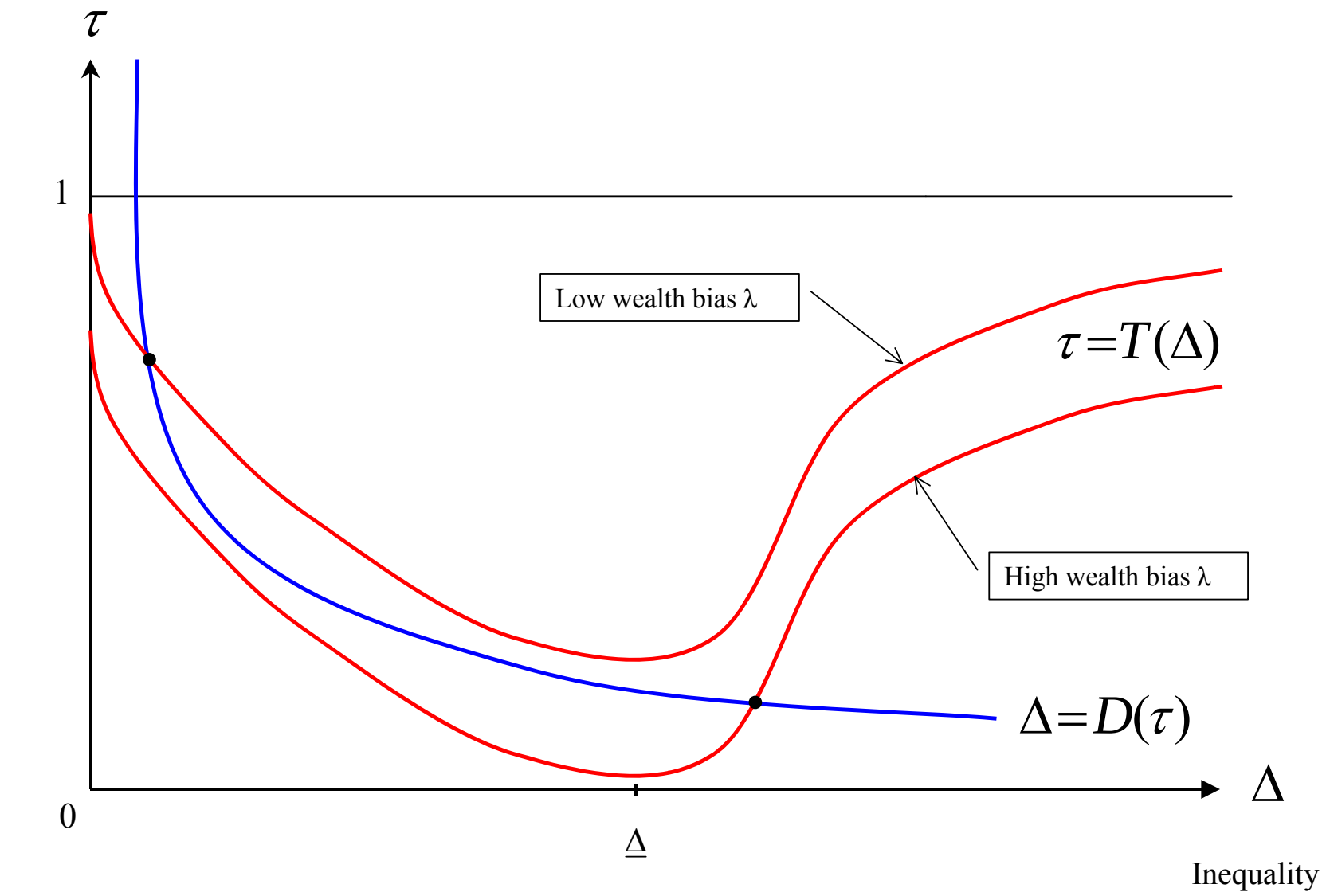
b) As inequality rises, so does the proportion of those rich enough to be net losers from the policy eases; will *block* efficient redistribution

c) At high enough levels of inequality, standard skewness effect dominates: so many poor that *impose* high redistribution, even when inefficient.



B (a,β,ρ): parametrizes the efficiency benefits of redistribution (insurance, relaxing credit constraints).

$1/\eta$: elasticity of labor supply; parametrizes the efficiency costs of redistribution



The pivotal voter is located at the $p^*=\Phi(\lambda)$ -th percentile in the income (and wealth) distribution.

II - HISTORY-DEPENDENT SOCIAL CONTRACTS

Politico-economic steady-states: intersections of $\tau = T(\Delta)$ and $\Delta = D(\tau)$.

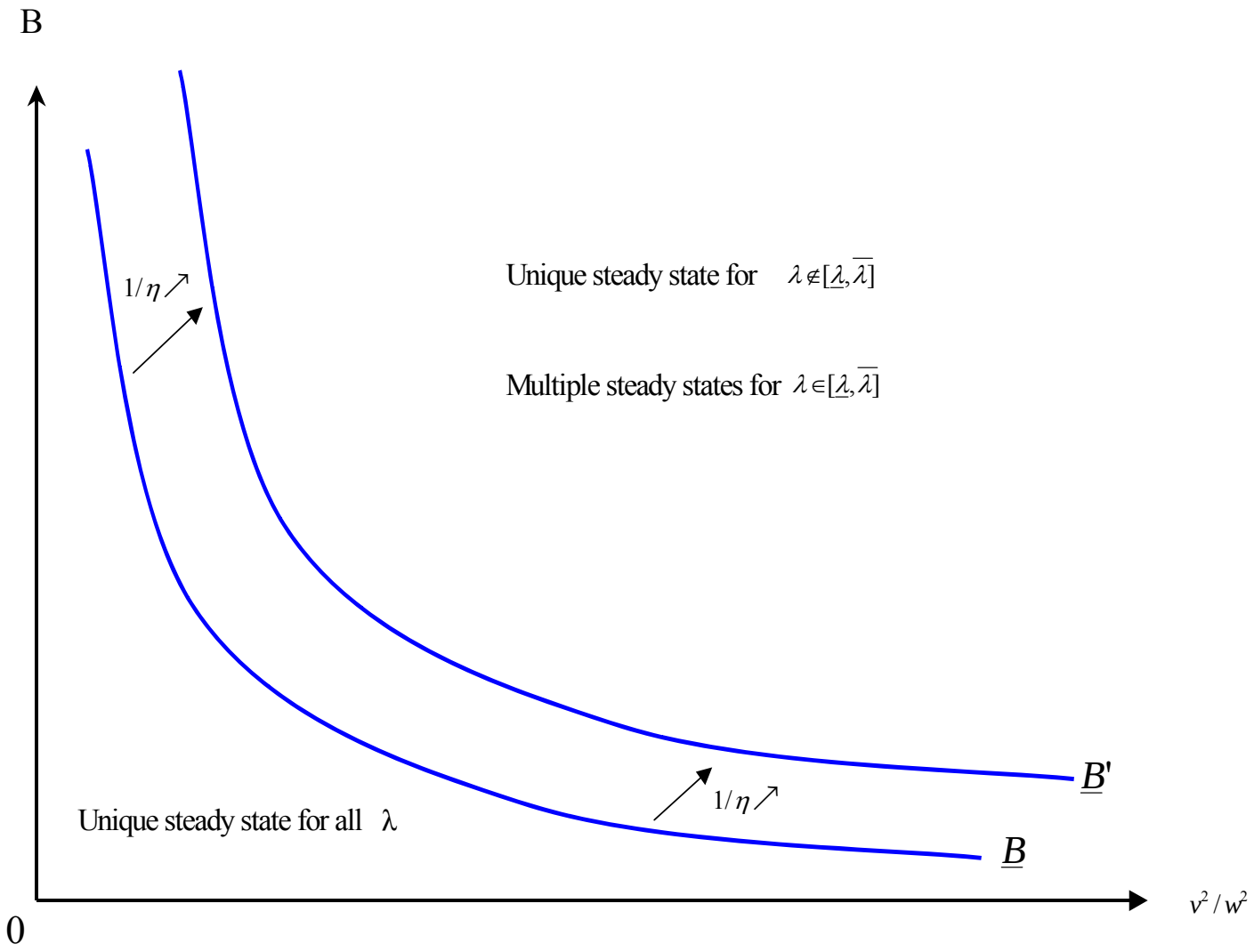
Proposition 3 *There exists threshold value $\underline{B}$ for the efficiency gains coefficient $B = a + \rho(1-\beta)(1-a)$ (e.g., for risk aversion), such that:*

1) For $B \leq \underline{B}$, there is a unique, stable, steady–state

2) For $B > \underline{B}$, there exists $0 < \underline{\lambda} < \bar{\lambda}$ such that:

- *If $\lambda < \underline{\lambda}$ or $\lambda > \bar{\lambda}$ there is a unique, stable, steady–state.*
- *If $\lambda \in [\underline{\lambda}, \bar{\lambda}]$, there are (at least) two stable steady-states.*

The efficiency threshold for multiplicity $\underline{B}$ decreases with income uncertainty v^2 and increases with endowment variability w^2. It also rises with the labor supply elasticity $1/\eta$, i.e. with the distortions from redistribution.



Multiplicity of steady states: the role of economic and political factors

B parametrizes the benefits of redistribution; $1/\eta$ parametrizes the costs of redistribution (labor distortions), and λ parametrizes the political influence of influence of wealth; v^2/w^2: relative variance of shocks received after/before voting.

Main Implications

• Same economic & political fundamentals allow two different "societies" (institutions and income distributions) to persist.

⇒ *Continental European "Welfare State" versus more "Laissez Faire" US social contract.*

• These two societies cannot be Pareto ranked.

• Similar results for *school finance* (centralized/egalitarian vs. local/quasi-private systems), and for *labor market regulation* (societies with vs. without significant wage compression via minimum wage, unions).

• *History-dependence:* temporary shocks to the distribution of wealth (immigration, educational discrimination, demand shifts) or political system (slavery, voting rights restrictions) can have long–lasting effects on the inequality, growth, and institutions.

⇒ Provides model for Engerman-Sokoloff (1998) thesis about origins of *South vs. North America's* very different development paths: in the former, much higher initial inequality Δ_0 and concentrated power structure λ_0.

• Alternative sources of inequality have different effects on policy. Will study role of *technology* in determining the set of feasible social contracts.

Growth

- Distribution $\ln k_t^i \sim \mathcal{N}(m_t, \Delta_t)$. Dynamics of inequality Δ_t seen earlier.

- Per capita income:

$$\ln(y_{t+1}/y_t) = \ln\tilde{\kappa} - \underbrace{(1-\alpha-\beta\gamma)\ln y_t + \delta(\ln l(\tau_{t+1}) - \alpha \ln l(\tau_t))}_{\text{representative-agent terms}}$$

$$- \underbrace{\mathfrak{L}_v(\tau_t)v^2/2 - \mathfrak{L}_\Delta(\tau_t)\gamma^2\Delta_t^2/2}_{\text{inequality + credit constraints}}$$

where:

$$\begin{aligned} \mathfrak{L}_v(\tau) &\equiv \beta\gamma(1-\beta\gamma)(1-\tau)^2 \geq 0, \\ \mathfrak{L}_\Delta(\tau) &\equiv \alpha + \beta\gamma(1-\tau)^2 - (\alpha + \beta\gamma(1-\tau))^2 \geq 0. \end{aligned}$$

- $\tau \Rightarrow$ tradeoff between labor supply distortions and relaxation of credit constraints.

Growth Implications

Proposition 4 *Compared to its more laissez-faire counterpart* $(\underline{\tau}, D(\underline{\tau}))$, *the egalitarian steady state* $(\bar{\tau}, D(\bar{\tau}))$:

1) has higher growth when tax distortions are small $(1/\eta \approx 0)$ *relative to those induced by credit constraints on the accumulation of human capital* $(\beta\gamma < 1)$.

2) has lower growth when tax distortions are high $(1/\eta > 0)$ *and the credit–constraint effect is weak* $(\beta\gamma \approx 1)$.

Scenario 1: "Growth–enhancing redistributions": seems most relevant for human capital + health expenditures in LDC's; e.g., East Asia vs. Latin America.

Scenario 2: "Eurosclerosis and the welfare state": Europeans choosing more *social insurance* than Americans, at the cost of higher unemployment and slower growth –even though they are not necessarily more risk-averse.

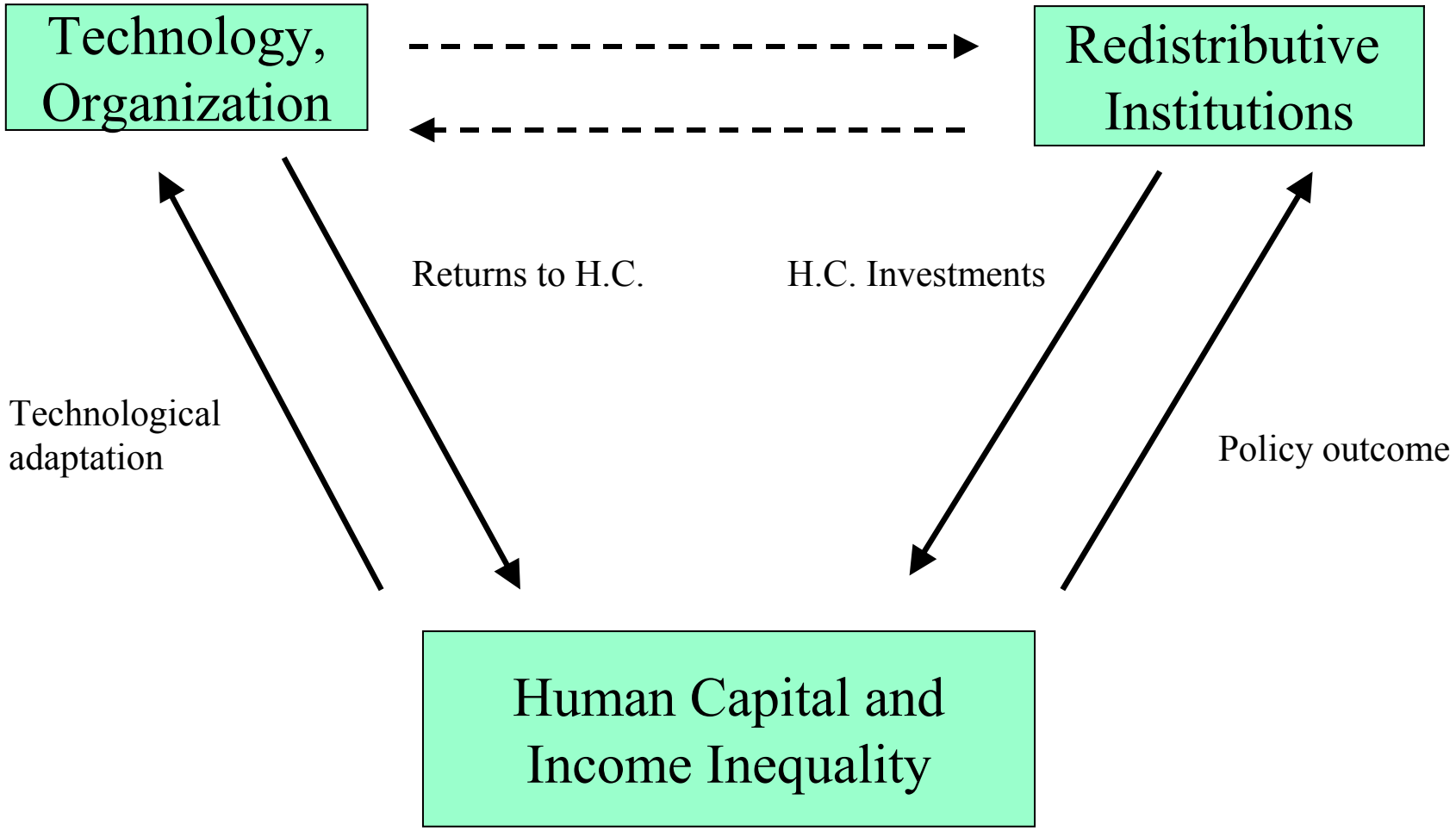
III - TECHNOLOGY AND THE SOCIAL CONTRACT

• Major trend in most industrialized countries over the last 20 years: rise in wage inequality, and in particular in the skill premium. Note: especially in the US, GB = the more "laissez faire" countries. Why?

• Usually attributed in large part to: *1) skill-biased* technological / organizational change. But also: 2) international trade; *3) institutional change:* erosion of minimum wage, decline of unions. The latter are policy outcomes –part of the social contract. And indeed, these variables evolved very differently in Continental Europe or Canada (e.g., Freeman (1995), Acemoglu, Aghion and Violante (CR 2002)).

• Has also been argued that (exogenous) changes in the distribution of skills, especially in the US, have themselves prompted firms to implement skill-biased technical / organizational change. Kremer and Maskin (1996), Acemoglu (QJE 1998), Kiley (EJ 1999), Lloyd-Ellis (AER 1999). Also Grossman and Maggi (AER 2000) for int'l specialization.

TECHNOLOGY AND THE SOCIAL CONTRACT



Here, want to:

• Examine how technological change will affect the politico-economic equilibrium. *Sustainability of the welfare state?*

• Show how inequality itself *feeds back* onto the nature of technical / organizational change. Emphasize here firms' choice of *flexibility.*

Furthermore, education & productive systems shape each other through technological choice by firms & human capital investments by labor force. Possibility of high-inequality + high skill-bias *traps,* and vice-versa?

• *Politico-economic equilibrium* with *endogenous technology.* Can no longer think of "technological" and "institutional" factors as distinct, competing factors in explaining rising inequality. Rather, they are interdependent. View of "the welfare state as a system" (Freeman (AER1995)).

• *"Exporting Inequality"*: implications for the social contract in initially low-inequality countries of technological innovations developed in other countries in response to their own higher inequality. More generally, international spillovers between institutions.

A. Technical Change and the Viability of the Welfare State

As γ, the return to human capital, increases (exogenously for now):

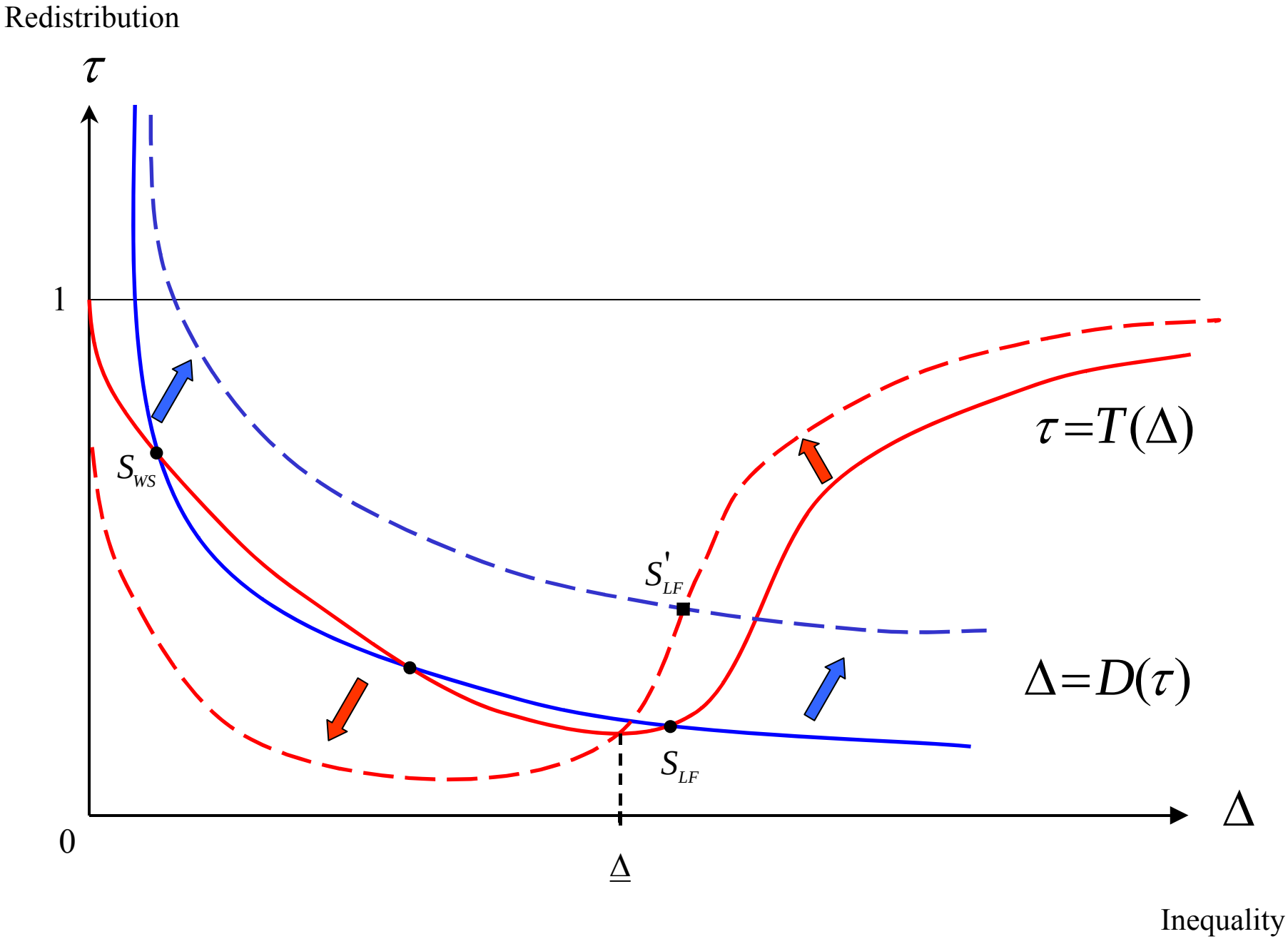
– For any given τ, more income inequality gets transmitted intergenerationally, hence more of it in the long run $\Rightarrow$ *the* $D(\tau;\gamma)$ *curve shifts up.*

– For a given human capital distribution Δ, there is more income inequality $\gamma\Delta$. Recall: at low and moderate levels, inequality reduces redistribution, so τ decreases with γ; reverse occurs at high levels $\Rightarrow$ *the* $T(\Delta;\gamma)$ *curve twists around* Δ, as shown

Figure suggests that:

$*$ Starting from situation with multiple steady-states, $\gamma \nearrow$ tends to undermine the "Welfare State" equilibrium

$*$ Starting from situation with a single Welfare-state equilibrium, $\gamma \nearrow$ tends to make the "Laissez-Faire" equilibrium appear.



The effects of a skill-biased technical change: an increase in γ.

Global analysis is quite complicated. Make simplifying assumptions. First, restrict attention to a choice between two policies:

- *"Welfare State"* social contract: relatively high rate of redistribution $\bar{\tau}$, with $0 < \bar{\tau} \leq 1$;

- *"Laissez Faire"* social contract: relatively low rate of redistribution $\underline{\tau}$, with $0 < \underline{\tau} < \bar{\tau} \leq 1$;

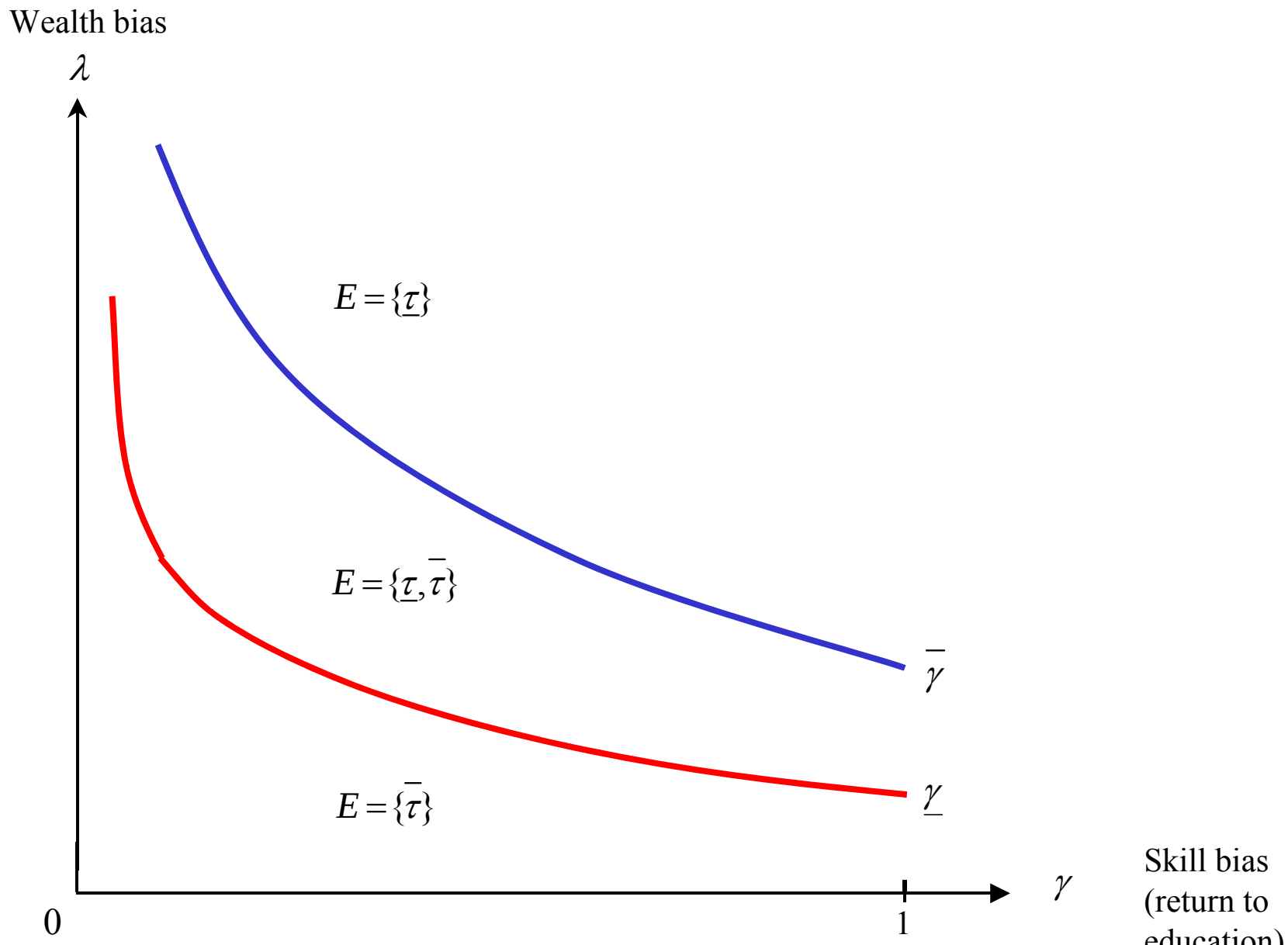
Also abstract from labor supply distortions ($1/\eta > 0$), and assume that B is large enough.

Proposition 5 *There exist two skill-bias thresholds* $\underline{\gamma}(\lambda; B) < \bar{\gamma}(\lambda; B)$, *both decreasing in* γ *and increasing in* B, *such that:*

i) for $\gamma < \underline{\gamma}$, *the unique steady-state is the Welfare State* $(\bar{\tau}, D(\bar{\tau}, \gamma))$;

ii) for $\gamma \in \left[\underline{\gamma}, \bar{\gamma}\right]$, *both* $(\bar{\tau}, D(\bar{\tau}, \gamma))$ *and* $(\underline{\tau}, D(\underline{\tau}, \gamma))$ *are stable steady-states;*

iii) for $\gamma > \bar{\gamma}$, *the unique steady-state is Laissez Faire* $(\underline{\tau}, D(\underline{\tau}, \gamma))$.



Technology, Political Influence, and the Social Contract

$\bar{\tau}$: "Welfare State"; $\underline{\tau}$: "Laissez Faire"

B. Skills, Technology, and Income Inequality

Consider here the reverse mechanism, namely how inequality itself *feeds back* onto the nature of technical change: endogenize γ.

• Final output is now produced by competitive firms using differentiated inputs or specialized labor:

$$y_t = A_t \cdot \left(\int_0^\infty z_t(s) \cdot x_t(s)^{\frac{\sigma-1}{\sigma}} \, d\, s \right)^{\frac{\sigma}{\sigma-1}}, \ \sigma \geq 1$$

where $x_t(s) =$ quantity of input s, and $z_t(s) =$ iid productivity shock.

• *Workers* specialize in a single input. Face downward-sloping demand curves $\Rightarrow$ each chooses a different task, $s(i) = i$, producing $x_t^i = k_t^i \cdot l_t^i$ units. Hourly wages are $\omega_t^i = p_t^i \, k_t^i$, and the resulting incomes

$$y_t^i = \omega_t^i \, l_t = z_t^i \cdot \left(k_t^i \, l_t^i \right)^{\frac{\sigma-1}{\sigma}} \times \tilde{A}_t.$$

Exactly as before, with $\gamma = \delta = \frac{\sigma-1}{\sigma}$ and productivity $\tilde{A}_t \equiv A_t^{\frac{\sigma-1}{\sigma}} (y_t)^{\frac{1}{\sigma}}$, which individuals take as given.

$\Rightarrow$ *Distributional dynamics and politico-economic are unchanged:* same $D(\tau; \gamma)$ and $T(\tau; \gamma)$ curves.

• *Firms:* since $l_t^i = l_t$ and $\ln k_t^i \sim \mathcal{N}(m, \Delta_t^2)$, equilibrium output is:

$$y_t = A_t \cdot l_t \cdot \left(\int_0^1 \left(k_t^i\right)^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} = A_t \cdot l_t \cdot e^{-\Delta_t^2/2\sigma} \cdot \left(\int_0^1 k_t^i \, di \right),$$

• Loss $e^{-\Delta_t^2/2\sigma}$ captures the *productivity costs* due to (excessive) *heterogeneity of the labor force:* poorly educated, insufficiently skilled production or clerical workers will drag down the productivity of engineers, managers, scientists, etc.

• A *more flexible* production process –with *greater substitutability* between workers / inputs– *reduces the costs* of labor force heterogeneity (Bénabou (AER 1996), Grossman and Maggi (AER 2000)).

• Can also think of a higher σ as a more discriminating matching / search technology, resulting in stronger assortative matching between workers. $\Rightarrow$ more *segregated* organizational structure (Kremer and Maskin (1995)).

• For workers, lower complementarity results in *greater income inequality.* Indeed it has the effect of *uncoupling* the marginal products, and therefore the wages, of workers with different skills.

$$\text{Var}\left[\ln y_t^i\right] = \left(\frac{\sigma_t - 1}{\sigma_t}\right)^2 \Delta_t^2 = \gamma_t^2 \Delta_t^2.$$

C. Technological Choice: Endogenous Flexibility

Simple model of the tradeoff facing firms (could / should add R&D).

• Firms choose from a menu of available technologies, with different *degrees of flexibility / elasticities of substitution* $\sigma \in [1, +\infty)$ and TFP's

$$A(\sigma) = e^{-c(\sigma)}, \;\; c' > 0, \; c'' > 0.$$

Given $\ln k_t^i \sim \mathcal{N}(m, \Delta_t^2)$, if a firm chooses $\hat{\sigma}$ when all others use σ_t, its marginal cost given market p_t^i's is:

$$mc(\hat{\sigma}|\sigma_t) \propto \exp\left[c(\hat{\sigma}) - c(\sigma_t) + \frac{\Delta_t^2}{2}\left(\frac{\sigma_t - \hat{\sigma}}{\sigma_t^2}\right)\right].$$

Benefit of flexibility rises with the variability of skills in the labor force, but decreases with the degree to which other firms choose technologies that allow them to better substitute toward better workers, as in doing so they drive up the skill premium.

Proposition 6 *There is a unique symmetric equilibrium in technological choice* $\sigma^*(\Delta_t)$*, given by the solution to* $\sigma_t^2 \cdot c'(\sigma_t) = \Delta_t^2/2$*. The more heterogenous the workforce, the more skill-biased / flexible the technology used by firms:* $0 < \partial \ln \sigma^* / \partial \ln \Delta < 1$.

Main Implications

• 1. The return to human capital $\partial \ln y / \partial \ln k = (\sigma^* - 1)/\sigma^* = \gamma^*$ is higher where the labor force is more heterogenous. This represents a positive feedback that *magnifies* the effects of educational disparities. Testable.

• 2. Combined with credit-constrained human capital accumulation $\Delta = D(\tau, \gamma)$, this may lead to multiple equilibria, even for given τ (and no IRS): *Immiserizing* technological choices: high skill $\Delta \Rightarrow$ highly biased $\sigma \Rightarrow$ high inequality of wages, hence of investments $\Rightarrow$ *trap*. Most likely with low or regressive τ (or with endogenous choice of τ).

• 3. Dynamic externality: firms' equilibrium choice of σ tends to be *too flexible* (wage-disequalizing). For instance, let $\alpha = 0$, $\beta = 1$, and $1/\eta = 0$. Fixing τ, the long-run growth rate is:

$$g_\infty = \text{constant} - c(\sigma_\infty) - \frac{D(\tau; \gamma_\infty)^2}{2\sigma_\infty}.$$

where σ_∞ and γ_∞ are the equilibrium values. A marginal reduction in σ, permanently implemented by all firms, would increase steady-state growth:

$$\left.\frac{\partial g_\infty}{\partial \sigma}\right|_{\sigma=\sigma_\infty} = - - \frac{\gamma'(\sigma_\infty)}{2\sigma_\infty} \cdot \frac{\partial D(\tau, \gamma_\infty)}{\partial \gamma} < 0.$$

IV - ENDOGENOUS INSTITUTIONS AND ENDOGENOUS TECHNOLOGY

• Combine the two mechanisms. Let $\Gamma(\Delta) \equiv (\sigma^*(\Delta) - 1)/\sigma^*(\Delta)$. The inequality-redistribution-technology dynamical system remains recursive:

$$\begin{cases} \gamma_t &= \Gamma(\Delta_t) \\ \tau_t &= T(\gamma_t\ \Delta_t) \\ \Delta_{t+1} &= \mathcal{D}(\Delta_t, \tau_t; \gamma_t). \end{cases}$$

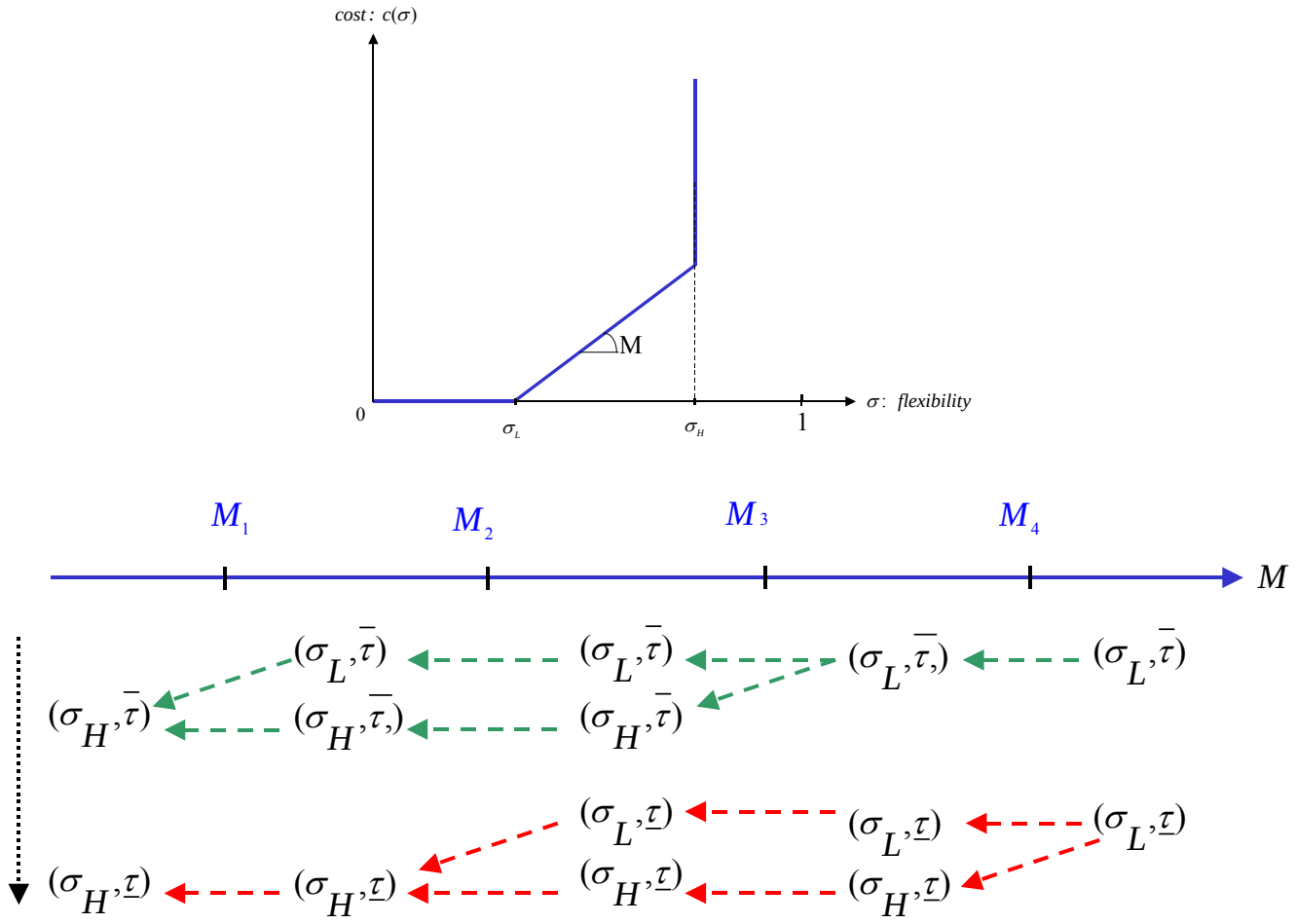
Growth: $\ln(y_{t+1}/y_t) = g(\tau_t, \Delta_t, \gamma_t)$. Steady-states are given by:

$$\Delta = \mathcal{D}(\Delta, T(\Delta; \Gamma(\Delta)), \Gamma(\Delta)).$$

• *Multiplier effects:* shocks affecting inequality (e.g., higher variance of abilities w^2), or the political system (e.g. a higher λ) are amplified through the reactions of technology + policy choice + intergenerational transmission. May have very large long-term effects.

• Outcome will depend in particular on the steepness of the *"technology frontier"* $c(\cdot)$ faced by firms. Take simple linear case.

• Use to ask: which countries will be "early adopters" or first developers of flexible technologies and organizational forms?

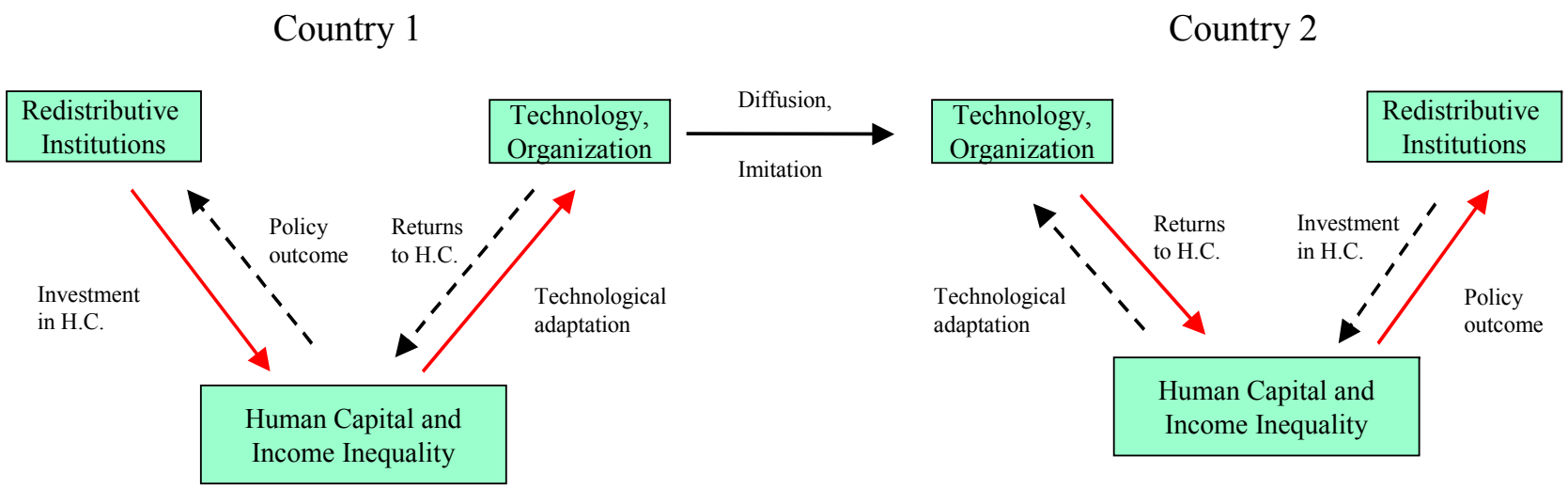


• Society with more unequal social contract $\underline{\tau} \Rightarrow$ innovates / adopts first when $M \searrow$. Thus, *US, England* leading *Continental Europe.*

• Critical interaction of *technology response* and *policy response:* feasible new technologies are not implemented unless institutions are (or become) sufficiently inegalitarian; conversely, the occurrence of technological change alters the institutions.

Exporting Inequality: International Spillovers Between Social Contracts

• Study spillovers between *institutions*, via technological and organizational adaptation / diffusion.



• Scenario 1: shift in the technological frontier in C_1 : how it affects C_1, and whether it is transmitted to C_2 and undermines its redistributive institutions, depend on C_1's initial social contract.

• Scenario 2: Shift in the political system in C_1 (e.g., campaign finance): will eventually affect both C_1 and C_2's social contracts.

Assumptions

• As before, marginal cost of *developing* a technology with higher flexibility σ is M.

• But, if already exists in another country, can be *imitated / adapted / copied* at a lower cost $m < M$ (e.g., imperfectly enforced property rights, as in Acemoglu (1998)).

• *Assumption A1:* set of restrictions on the parameters characterizing the economy (B), the political system, (λ), the available technologies (σ_L, σ_H) and the costs of implementing them, whether on one's own (M or $M' < M$), or through imitation (m).

• *Assumption A2:* different set of restrictions on the economy and technology ($\sigma_L, \sigma_H; M, m; B$), and on the political system (λ or $\lambda' > \lambda$).

A Shift in One Country's Technological Frontier

Proposition 7 *Consider two countries, C_1 and C_2, that both start in steady-state, with the same technology σ_L. Suppose now that the cost of flexibility in country C_1 declines from M to $M' < M$. Under A1:*

1) If both C_1 and C_2 were initially in the more egalitarian of the two regimes compatible with σ_L, nothing happens, in the sense that this $(\bar{\tau}, \sigma_L, D(\bar{\tau}, \gamma_L))$ remains a steady-state for both countries.

2) If C_1 was initially in the more inegalitarian regime $(\underline{\tau}, \sigma_L, D(\underline{\tau}, \gamma_L))$, the unique long run outcome is for both countries to switch to the technology σ_H, and for country C_2 to also adopt the more unequal social contract $\underline{\tau}$: thus both countries end up at the steady-state $(\underline{\tau}, \gamma_H, D(\underline{\tau}, \gamma_H))$.

• Note: technological change (shift in frontier) has significant effects only when mediated through specific institutions (which social contract C_1 had adopted). Conversely, its then impacts institutions in C_2.

A Shift in One Country's Political Institutions

• Initial shock in C_1 could be purely political, e.g. an increase in λ in C_1 : rising importance of *campaign contributions* and *lobbying;* decline in *unionization*, or in electoral *turnout* by the poor.

Proposition 8 *Consider two countries, C_1 and C_2, that both start in the egalitarian steady-state, $(\bar{\tau}, \sigma_L, D(\bar{\tau}, \gamma_L))$, with the same technology σ_L. Suppose now that the political influence of wealth in country C_1 rises from λ to λ'.*

Under A2, the unique long run outcome is for <u>both</u> countries to switch to the technology σ_H <u>and</u> the more unequal social contract $\underline{\tau}$, thus ending up at the steady-state $(\underline{\tau}, \sigma_H, D(\underline{\tau}, \gamma_H))$.

• C_1 : shift in political power $\lambda_1 \Rightarrow$ redistribution τ_1 declines $\Rightarrow$ h.c. inequality Δ_1 increases $\Rightarrow$ technology σ_1 becomes more disequalizing $\Rightarrow$ In C_2 : technology diffuses $\Rightarrow \sigma_2$ increases $\Rightarrow$ inequality Δ_2 rises $\Rightarrow$ redistribution τ_2 declines.

• Effects of institutional shift (in political power) are amplified by technological change in C_1, which is then transmitted to C_2, and ultimately affects that country's institutions.

CONCLUDING COMMENTS

• Model identifies / analyzes important politico-economic mechanisms that allow alternative *"societal models"* to perpetuate themselves, as well as some powerful forces that push towards *uniformization.*

• Among the latter is skill-biased technical change, which can potentially lead (for better or for worse) to the unravelling of the Welfare State.

• When technological or organizational form is endogenous, firms respond to greater human capital heterogeneity with more flexible technologies, further exacerbating income inequality. May lead to traps.

• Stressed the interdependence of political / institutional factors and technology, which are linked through the dynamics of the distribution of human capital. In the long run, all three are *jointly determined.*

• The possibility for firms in different countries to chose technologies adapted to their labor force may make it easier to sustain multiple societal models, but...

• The international diffusion of technology implies that more flexible and skill-biased technologies developed in countries with more unequal social contracts may be imitated by firms in other countries, generating a *"chain reaction"* that pushes the whole system towards a more inegalitarian outcome –technologically, economically, and politically speaking.

• Such international spillovers between social contracts seem to be important concerns in the debate over globalization.