Optimal Development Policies with Financial Frictions

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Questions

1. **Normative**:
   - Is there a role for governments to accelerate economic development by intervening in product and factor markets?
   - Taxes? Subsidies? If so, which ones?
2. **Positive**:
   - Most emerging economies pursue active development and industrial policies
   - Under which circumstances may such policies be justified?

Historical accounts of development policies

	Rough period	Suppressed wages	Subsidized credit	Subsidized intermediates	Subsidies to export sector
Japan	1950–1970		✓	✓	✓
Taiwan	1950–1980	✓	✓	✓	
Korea	1960–1980	✓	✓	✓	✓
Malaysia	1960–1990	✓	✓	✓	✓
Singapore	1960–1990	✓			✓
Thailand	1960–1990	✓	✓	✓	✓
China	1980–present		✓		

- Example of wage suppression: South Korea
  - official upper limit on real wage growth: nominal wage growth $< 80\%$ (inflation $+$ productivity growth)
  - Park Chung Hee: 1965 "year to work", 1966 "year of *harder* work"
- Another popular policy: exchange rate devaluation
- All these policies are "crazy" from neoclassical perspective

This paper

- Optimal Ramsey policy in a standard growth model with financial frictions

  1. one-sector economy
  2. multi-sector economy (industrial and exchange rate policies)

- Environment similar to a wide class of development models
  - financial frictions $\Rightarrow$ capital misallocation $\Rightarrow$ low productivity

- but more tractable $\Rightarrow$ Ramsey problem feasible: $\mathcal{G}_t(a, z) \rightarrow \bar{a}_t$

- Features:
  - Collateral constraint: firm's scale limited by net worth
  - Financial wealth affects economy-wide labor productivity
  - Pecuniary externality: high wages hurt profits and wealth accumulation

Main Findings

1. Optimal uniform policy in one-sector model

   — *pro-business* (*pro-output*) policies for developing countries, during early transition when entrepreneurs are undercapitalized

   — *pro-labor* policy for developed countries, close to steady state

   — Rationale: dynamic externality akin to learning-by-doing, but operating via misallocation of resources

2. Optimal targeted and exchange rate policies in multi-sector model

   — favor comparative advantage sectors and speed up transition

   — compress wages in tradable sectors if undercapitalized...

   — ... but whether this results in depreciated real exchange rate is instrument-dependent

One-Sector Economy

1. **Workers**: representative household with wealth (bonds) b

$$\max_{\{c(\cdot),\ell(\cdot)\}} \int_0^\infty e^{-\rho t} u\big(c(t), \ell(t)\big) \mathrm{d}t,$$

$$\text{s.t.} \qquad c(t) + \dot{b}(t) \leq w(t)\ell(t) + r(t)b(t)$$

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2. **Entrepreneurs**: heterogeneous in wealth a and productivity z

$$\max_{\{c_e(\cdot)\}} \mathbb{E}_0 \int_0^\infty e^{-\delta t} \log c_e(t)\mathrm{d}t$$

$$\text{s.t.} \quad \dot{a}(t) = \pi_t\big(a(t),z(t)\big) + r(t)a(t) - c_e(t)$$

$$\pi_t(a,z) = \max_{n\geq 0,\ 0\leq k\leq \lambda a} \big\{A(t)(zk)^\alpha n^{1-\alpha} - w(t)n - r(t)k\big\}$$

- Collateral constraint: $k \leq \lambda a, \ \ \lambda \geq 1$
- Idiosyncratic productivity: $z \sim iid\,\mathrm{Pareto}(\eta)$

Policy functions

- Profit maximization:

$$k_t(a,z) = \lambda a \cdot \mathbf{1}_{\{z \geq \underline{z}(t)\}},$$
$$n_t(a,z) = \left(\frac{1-\alpha}{w(t)}A\right)^{1/\alpha} z k_t(a,z),$$
$$\pi_t(a,z) = \left[\frac{z}{\underline{z}(t)} - 1\right] r(t) k_t(a,z),$$

where

$$\alpha A^{1/\alpha}\left(\frac{1-\alpha}{w(t)}\right)^{\frac{1-\alpha}{\alpha}} \underline{z}(t) = r(t)$$

- Wealth accumulation:

$$\dot{a} = \pi_t(a,z) + \big(r(t) - \delta\big) a$$

Aggregation

- Output:

$$y = A\left(\frac{\eta}{\eta-1}\underline{z}\right)^{\alpha}\cdot\kappa^{\alpha}\ell^{1-\alpha}$$

- Capital demand:

$$\kappa = \lambda x \underline{z}^{-\eta},$$

where aggregate wealth $x(t) \equiv \int a \,\mathrm{d}G_t(a,z)$ evolves:

$$\dot{x} = \Pi + \left(r-\delta\right)x,$$

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- **Lemma**: *National income accounts*

$$w\ell = (1-\alpha)y, \qquad r\kappa = \alpha\frac{\eta-1}{\eta}y, \qquad \Pi = \frac{\alpha}{\eta}y.$$

General equilibrium

1. **Small open economy**: $r(t) \equiv r^*$
   and $\kappa(t)$ is perfectly elastically supplied

- Lemma:

$$y = y(x, \ell) = \Theta x^{\gamma} \ell^{1-\gamma}, \qquad \gamma = \frac{\alpha/\eta}{(1-\alpha) + \alpha/\eta}$$

and $\underline{z}^{\eta} \propto (x/\ell)^{1-\gamma}$

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and $\underline{z}^{\eta} \propto (x/\ell)^{1-\gamma}$

2. **Closed economy**: $\kappa(t) = b(t) + x(t)$
   and $r(t)$ equilibrates capital market

- Lemma:

$$y = y(x, \kappa, \ell) = \Theta_c \left(x \kappa^{\eta-1}\right)^{\alpha/\eta} \ell^{1-\alpha}$$

and $\underline{z}^{\eta} = \lambda x / \kappa$

Excess Return of Entrepreneurs

- Key to understanding all policy interventions: entrepreneurs earn higher return than workers
  - not only individually

$$R(z) = r\left(1 + \lambda\left[\frac{z}{\underline{z}} - 1\right]^{+}\right) \geq r$$

  - but also on average

$$\mathbb{E}R(z) = r + \frac{\alpha}{\eta}\frac{y}{x} > r$$

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- Could generate Pareto improvement with
  - transfer from workers to all entrepreneurs at $t = 0$ + reverse transfer at later date
  - essentially allows planner to sidestep friction
  - perhaps not feasible, e.g. for political economy reasons
- Next: explore alternative policies

Optimal Ramsey Policies
in a Small Open Economy

- Start with three policy instruments:
  1. $\tau_\ell(t)$: labor supply tax
  2. $\tau_b(t)$: worker savings tax
  3. $T(t)$: lump-sum tax on workers; GBC: $\tau_\ell w\ell + \tau_b b = T$

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Lemma (Primal Approach)

Any aggregate allocation $\{c, \ell, b, x\}_{t \geq 0}$ *satisfying*

$$c + \dot{b} = (1-\alpha) y(x, \ell) + r^* b$$
$$\dot{x} = \frac{\alpha}{\eta} y(x, \ell) + (r^* - \delta) x$$

can be supported as a competitive equilibrium under appropriately chosen policies $\{\tau_\ell, \tau_b\}_{t \geq 0}$.

Optimal Ramsey Policies

- Benchmark: zero weight on entrepreneurs
- Planner's problem:

$$\max_{\{c,\ell,b,x\}_{t\geq 0}} \int_0^\infty e^{-\rho t} u(c,\ell)\mathrm{d}t$$

$$\text{subject to} \qquad c + \dot{b} = (1-\alpha)y(x,\ell) + r^* b,$$

$$\dot{x} = \frac{\alpha}{\eta} y(x,\ell) + (r^* - \delta)x,$$

and denote by ν the co-state for x (shadow value of wealth)

- Isomorphic to learning-by-doing externality

- **Inter**-temporal margin undistorted:

$$\frac{\dot{u}_c}{u_c} = \rho - r^* \qquad \Rightarrow \qquad \tau_b = 0$$

- **Intra**-temporal margin distorted:

$$-\frac{u_\ell}{u_c} = \left[1 + \gamma(\nu - 1)\right](1-\alpha)\frac{y}{\ell} \quad \Rightarrow \quad \tau_\ell = \gamma - \gamma \cdot \nu$$

- Two confronting objectives:
  1. Monopoly effect: increase wages by limiting labor supply
  2. Dynamic productivity externality: accumulate x by subsidizing labor supply to increase future labor productivity
- Which effect dominates and when?

- ODE system in (x, ν) with a side-equation:

$$
\begin{aligned}
\dot{x} &= \tfrac{\alpha}{\eta} y(x,\ell) + (r^* - \delta)x, \\
\dot{\nu} &= \delta\nu - (1-\gamma+\gamma\nu)\tfrac{\alpha}{\eta}\tfrac{y(x,\ell)}{x}, \\
-u_\ell/u_c &= (1-\gamma+\gamma\nu)(1-\alpha)\tfrac{y(x,\ell)}{\ell}, \\
\tau_\ell &= \gamma - \gamma \cdot \nu
\end{aligned}
$$

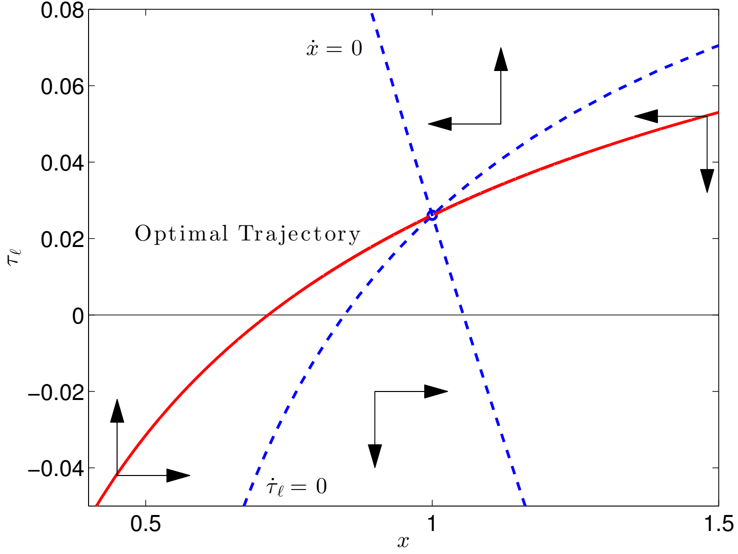
- ODE system in (x, τ_ℓ) with a side-equation:

$$\dot{x} = \tfrac{\alpha}{\eta} y(x,\ell) + (r^* - \delta)x,$$
$$\dot{\tau}_\ell = \delta(\tau_\ell - \gamma) + \gamma(1-\tau_\ell)\tfrac{\alpha}{\eta}\tfrac{y(x,\ell)}{x},$$
$$\ell = \ell(x, \tau_\ell; \bar{\mu})$$

- Proposition: Assume $\delta > \rho = r^*$. Then:
  1. unique steady state $(\bar{x}, \bar{\tau}_\ell)$, globally saddle-path stable
  2. starting from $x_0 \leq \bar{x}$, x and τ_ℓ increase to $(\bar{x}, \bar{\tau}_\ell)$
  3. labor supply subsidized $(\tau_\ell < 0)$ when x is low enough and taxed in steady state: $\bar{\tau}_\ell = \frac{\gamma}{\gamma + (1-\gamma)\delta/\rho} > 0$
  4. intertemporal margin not distorted, $\tau_b \equiv 0$

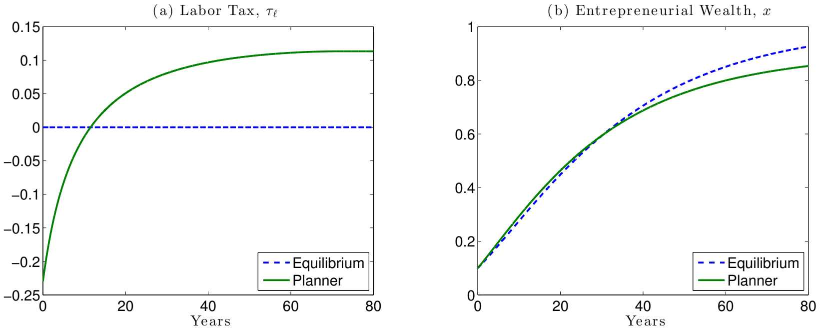
Optimal Ramsey Policies

Phase diagram

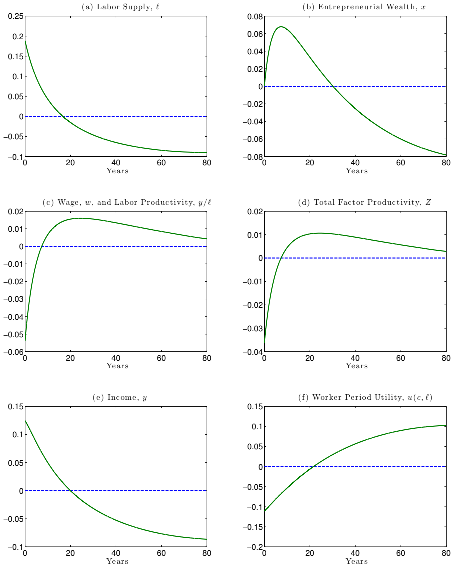


Optimal Ramsey Policies

Time path



Deviations from laissez-faire



Optimal Ramsey Policies

Discussion

- Many alternative implementations
- common feature: make workers work hard even though firms pay low wages
  1. Subsidy to labor supply or demand
  2. Non-market implementation: e.g., forced labor
  3. Non-tax market regulation: e.g., via bargaining power of labor
- Interpretation:
  - — *Pro-business* (or *wage suppression*, or *pro-output*) policies
  - — Policy reversal to *pro-labor* for developed countries
- Intuition: pecuniary externality
  - — High wage reduces profits and slows down wealth accumulation

Optimal Policy with Transfers

- Generalized planner's problem:

$$\max_{\{c,\ell,b,x,\varsigma_x\}_{t\geq 0}} \int_0^\infty e^{-\rho t} u(c,\ell)\mathrm{d}t$$

$$\text{subject to} \qquad c + \dot{b} = (1-\alpha)y(x,\ell) + r^* b - \varsigma_x x,$$

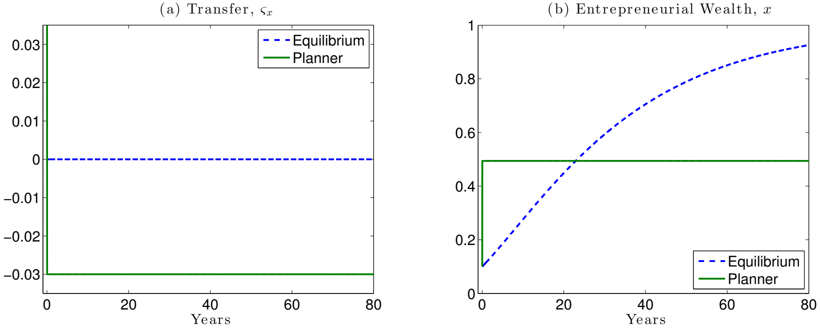
$$\dot{x} = \frac{\alpha}{\eta} y(x,\ell) + (r^* + \varsigma_x - \delta)x,$$

$$s \leq \varsigma_x(t)\, x(t) \leq S$$

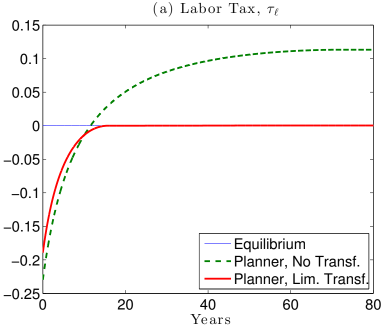
- Three cases:
  1. $s = S = 0$: just studied
  2. $S = -s = +\infty$ (unlimited transfers)
  3. $0 < S, -s < \infty$ (bounded transfers)

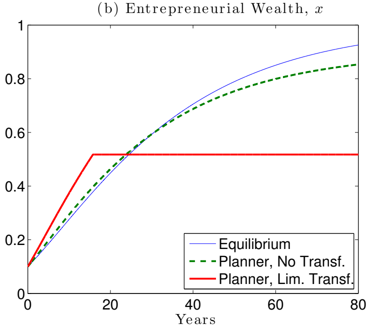
- Why bounded transfers?

Unlimited Transfers



Bounded Transfers





Additional Tax Instruments

- Additional policy instruments, all affecting entrepreneurs and financed by a lump-sum tax on workers
  1. $\varsigma_\pi(t)$: profit subsidy
  2. $\varsigma_y(t)$: revenue subsidy
  3. $\varsigma_w(t)$: wage bill subsidy
  4. $\varsigma_k(t)$: capital (credit) subsidy

- Budget set of entrepreneurs:

$$\dot{a} = (1 + \varsigma_\pi)\pi(a, z) + (r^* + \varsigma_x)a - c_e,$$

$$\pi(a, z) = \max_{\substack{n \geq 0, \\ 0 \leq k \leq \lambda a}} \left\{ (1 + \varsigma_y)A(zk)^\alpha n^{1-\alpha} - (1 - \varsigma_w)w\ell - (1 - \varsigma_k)r^* k \right\}$$

Additional Tax Instruments

- Generalize output function

$$y(x, \ell) = \left(\frac{1 + \varsigma_y}{1 - \varsigma_k} \right)^{\gamma(\eta - 1)} \Theta x^{\gamma} \ell^{1-\gamma}$$

- Proposition:
  (i) Profit subsidy ς_π, as well as $\varsigma_y = -\varsigma_k = -\varsigma_w$, has the same effect as a transfer from workers to entrepreneurs, and dominates other tax instruments.
  (ii) When a transfer cannot be engineered, all available policy instruments are used to speed up the accumulation of entrepreneurial wealth.

- E.g.: $\varsigma_k, \varsigma_w \propto \gamma(\nu - 1)$
- Pro-business policy bias during early transition

OLG and Hand-to-Mouth

- Blanchard (1985) and Yaari (1965) perpetual youth model:

$$U(\tau) = \int_{\tau}^{\infty} e^{-(\rho+q)(t-\tau)} u(t|\tau)\mathrm{d}t$$

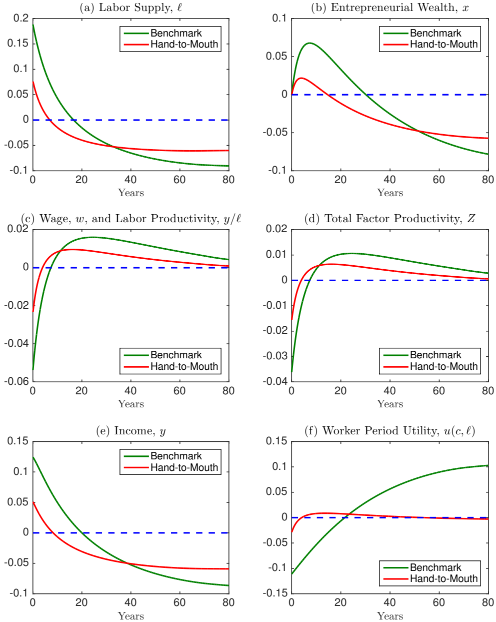
- Calvo and Obstfeld (1988) social welfare function:

$$W_0 = \int_0^{\infty} e^{-\varrho t} V(t)\mathrm{d}t, \quad V(t) = \int_0^{\infty} q e^{-qs} e^{-(\rho-\varrho)s} u(t,s)\mathrm{d}s$$

- If households are not financially constrained, then optimal policy does *not* depend on q, and only depends on $\varrho \neq \rho$

- If households are financially constrained (hand-to-mouth), the optimal path of the labor tax becomes flatter around zero

OLG and Hand-to-Mouth



MULTI-SECTOR ECONOMY

- Want framework for thinking about policies targeted to particular sectors
  - — arguably most prevalent type of development policy
- Generalize framework to multiple sectors
  - — both tradable and non-tradable sectors
- In addition to sectoral policies, also explore implications for real exchange rate
- Another application:
  - — cohort of entrepreneurs and 'infant' industry protection

Multi-Sector Economy: Households

- Households have preferences

$$\int_0^\infty e^{-\rho t} u(c_0, c_1, ..., c_N) dt$$

  - goods $0, ..., k$: tradable
  - goods $k+1, ..., N$: not tradable
  - good 0 is numeraire $\Rightarrow p_0 = 1$

Multi-Sector Economy: Households

- Households have preferences
$$\int_0^\infty e^{-\rho t} u(c_0, c_1, ..., c_N) dt$$
  - goods $0, ..., k$: tradable
  - goods $k+1, ..., N$: not tradable
  - good 0 is numeraire $\Rightarrow p_0 = 1$
- inelastically supply L units of labor, split across sectors
$$\sum_{i=0}^{N} \ell_i = L$$
- Budget constraint
$$\sum_{i=0}^{N} (1+\tau_i^c) p_i c_i + \dot{b} \leq (r - \tau^b) b + \sum_{i=0}^{N} (1-\tau_i^\ell) w_i \ell_i + T$$
- As before, can extend to additional tax instruments

Production

- Within each sector, everything as before
- Output in sector i:

$$y_i(x_i, \ell_i; p_i) = \Theta_i p_i^{\gamma_i(\eta_i - 1)} x_i^{\gamma_i} \ell_i^{1-\gamma_i}, \qquad \text{where}$$

$$\gamma_i = \frac{\alpha_i/\eta_i}{1 - \alpha_i + \alpha_i/\eta_i} \quad \text{and} \quad \Theta_i = \frac{r}{\alpha_i} \left[\frac{\eta_i \lambda_i}{\eta_i - 1} \left(\frac{\alpha_i A_i}{r} \right)^{\eta_i/\alpha_i} \right]^{\gamma_i}$$

- Wealth accumulation

$$\dot{x}_i = \frac{\alpha_i}{\eta_i} p_i y_i(x_i, \ell_i; p_i) + (r - \delta) x_i$$

Optimal Sectoral Policies

- Planner's Problem:

$$\max_{\{x_i,\ell_i\}_{i=0}^{N},\{p_i\}_{i=k+1}^{N}} \int_0^\infty e^{-\rho t} u(c_0, ..., c_N) dt \quad \text{s.t.}$$

$$\dot{b} = rb + \sum_{i=0}^{N} (1-\alpha_i) p_i y_i(x_i, \ell_i, p_i) - \sum_{i=0}^{N} p_i c_i$$

$$\dot{x}_i = \frac{\alpha_i}{\eta_i} p_i y_i(x_i, \ell_i, p_i) + (r-\delta) x_i, \qquad i = 0, \ldots, N$$

$$c_i = y_i(x_i, \ell_i, p_i), \qquad i = k+1, \ldots, N$$

$$L = \textstyle\sum_{i=0}^{N} \ell_i$$

Optimal Targeted Ramsey Policies

- Optimal taxes:

$$\tau^b = 0,$$

$$\tau_i^c = \begin{cases} 0, & i \in T, \\ \frac{1}{\eta_i - 1}(1 - \nu_i), & i \in N, \end{cases}$$

$$\tau_i^\ell = \begin{cases} \gamma_i(1 - \nu_i), & i \in T, \\ -\tau_i^c, & i \in N \end{cases}$$

- Explore two special cases:

1. all sectors are tradable: implications of comparative advantage
2. one tradable, one non-tradable sector: implications for RER

All Sectors are Tradable

Comparative advantage and industrial policies

- International prices $\{p_i^*\}$
- sectoral revenues: $p_i^* y_i = \Theta_i^* x_i^{\gamma_i} \ell_i^{1-\gamma_i}$, $\Theta_i^* = (p_i^*)^{1+\gamma_i(\eta_i - 1)} \Theta_i$
- Comparative advantage:
  - Long run (*latent*): Θ_i^*
  - Short run (*actual*): $\Theta_i^* x_i^{\gamma}$

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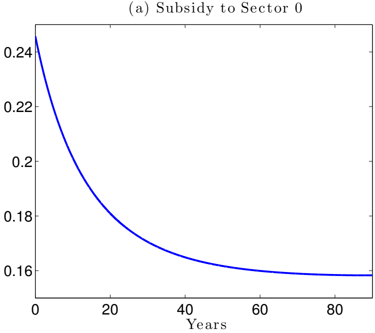
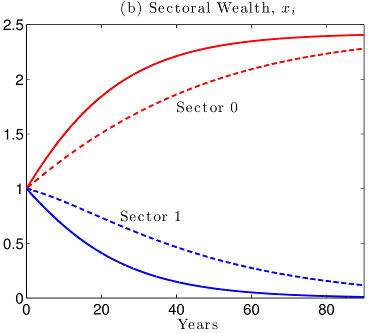
- Comparative advantage:
  - Long run (*latent*): Θ_i^*
  - Short run (*actual*): $\Theta_i^* x_i^{\gamma}$
- Optimal policy: favors the (latent) comparative advantage sector and speeds up the transition

All Sectors are Tradable

Comparative advantage and industrial policies





- Sector one has (latent) comparative advantage: $\Theta_1^* > \Theta_2^*$
- Optimal policy speeds up the transition
- Potentially measurable sufficient statistic: $\gamma_i \cdot \nu_i$, where

$$\dot{\nu}_i - \delta \nu_i = -\left(1 - \alpha_i + \frac{\alpha_i}{\eta_i}\nu_i\right) p_i \frac{\partial y_i}{\partial x_i}$$

Non-tradables and the RER

- Consider economy with two sectors
  - sector 0 produces tradable good, $p_0 = 1$
  - sector 1 produces non-tradable good, $RER = p_1$
- Intuition: if want to subsidize tradables $\Rightarrow$ compress economy-wide $w \propto p_1 \Rightarrow$ RER depreciates
  — see e.g. Rodrik (2008)

Non-tradables and the RER

- Consider economy with two sectors
  - sector 0 produces tradable good, $p_0 = 1$
  - sector 1 produces non-tradable good, $RER = p_1$
- Intuition: if want to subsidize tradables $\Rightarrow$ compress economy-wide $w \propto p_1 \Rightarrow$ RER depreciates
  - — see e.g. Rodrik (2008)
- We find: **robust** policy recommendation = compress **wages** in **tradable** sector if that sector is undercapitalized
- instead implications for RER are **instrument-dependent**
  - if can differentially tax T and NT labor, RER **appreciates**
  - if instead cannot differentially subsidize T $\Rightarrow$ RER depreciates

Other Extensions

1. Positive Pareto weight on entrepreneurs

$$\tau_\ell = \gamma\left[1 - \nu - \omega/x\right]$$

2. Persistent productivity shocks

$$\tau_\ell = \gamma(1 - \bar{\nu})$$

3. Closed economy

- Planner's problem:

$$\max_{\{c,\ell,\kappa,b,x,\varsigma_x\}_{t\geq 0}} \int_0^\infty e^{-\rho t} u(c,\ell)\mathrm{d}t$$

subject to

$$\dot{b} = \left[(1-\alpha) + \alpha\frac{\eta-1}{\eta}\frac{b}{\kappa}\right] y(x,\kappa,\ell) - c - \varsigma_x x,$$

$$\dot{x} = \left[\frac{\alpha}{\eta} + \alpha\frac{\eta-1}{\eta}\frac{x}{\kappa}\right] y(x,\kappa,\ell) + (\varsigma_x - \delta)x,$$

$$\kappa = x + b$$

Closed Economy

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$$\text{subject to} \qquad \dot{\kappa} = y(x,\kappa,\ell) - c - \delta x,$$

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- We study three cases:
  1. Unlimited transfers and $x, \kappa \geq 0$ only
  2. Unlimited transfers and $x \leq \kappa$
  3. Bounded transfers (limiting case $s = S = 0$)

Closed Economy

- Planner's problem:

$$\max_{\{c,\ell,\kappa,b,x,\varsigma_x\}_{t\geq 0}} \int_0^\infty e^{-\rho t} u(c,\ell)\mathrm{d}t$$

$$\text{subject to} \qquad \dot{\kappa} = y(x,\kappa,\ell) - c - \delta x,$$

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- We study three cases:
  1. Unlimited transfers and $x, \kappa \geq 0$ only
     — No distortions ($\tau_b = \tau_\ell = 0$) and $x : \frac{\alpha}{\eta}\frac{y}{x} = \delta$
  2. Unlimited transfers and $x \leq \kappa$
     — No labor supply distortion ($\tau_\ell = 0$); subsidized savings: $\tau_b \geq 0$
  3. Bounded transfers (limiting case $s = S = 0$)
     — Both labor supply and savings are distorted: $\tau_\ell, \tau_b \propto (1-\nu)$

Conclusion

- Optimal Ramsey policy in standard growth model with financial frictions
- Main Lesson from one-sector model: *pro-business* policies accelerate economic development and are welfare-improving
  - — during initial transitions, and not in steady states
  - — when business sector is undercapitalized
- Main Lesson from multi-sector model:
  - — favor comparative advantage sectors and speed up transition
  - — implications for RER are instrument-dependent
- Although stylized, model points towards a measurable sufficient statistic: $\gamma_i \cdot \nu_i$, where

$$\dot{\nu}_i - \delta\nu_i = -\left(1 - \alpha_i + \frac{\alpha_i}{\eta_i}\nu_i\right) p_i \frac{\partial y_i}{\partial x_i}$$