

Optimal Development Policies with Financial Frictions

OLEG ITSKHOKI
Princeton

BENJAMIN MOLL
Princeton

National Bank of Ukraine
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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

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

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

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

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

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

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

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

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:

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

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** $x(t) \equiv \int a dG_t(a, z)$ evolves:

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

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

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

General equilibrium

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

- Lemma:

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

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

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

- Lemma:

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

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

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

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

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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

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

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:**

$$\begin{aligned} & \max_{\{c, \ell, b, x\}_{t \geq 0}} \int_0^{\infty} e^{-\rho t} u(c, \ell) dt \\ & \text{subject to} \quad c + \dot{b} = (1 - \alpha)y(x, \ell) + r^*b, \\ & \quad \quad \quad \dot{x} = \frac{\alpha}{\eta}y(x, \ell) + (r^* - \delta)x, \end{aligned}$$

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

- Isomorphic to **learning-by-doing** externality

Optimal Ramsey Policies

Characterization

- **Inter-temporal** margin undistorted:

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

- **Intra-temporal** margin distorted:

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

- 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?

Optimal Ramsey Policies

Characterization

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

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

$$\dot{\nu} = \delta\nu - (1 - \gamma + \gamma\nu) \frac{\alpha}{\eta} \frac{y(x, \ell)}{x},$$

$$- u_\ell / u_c = (1 - \gamma + \gamma\nu)(1 - \alpha) \frac{y(x, \ell)}{\ell},$$

$$\tau_\ell = \gamma - \gamma \cdot \nu$$

Optimal Ramsey Policies

Characterization

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

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

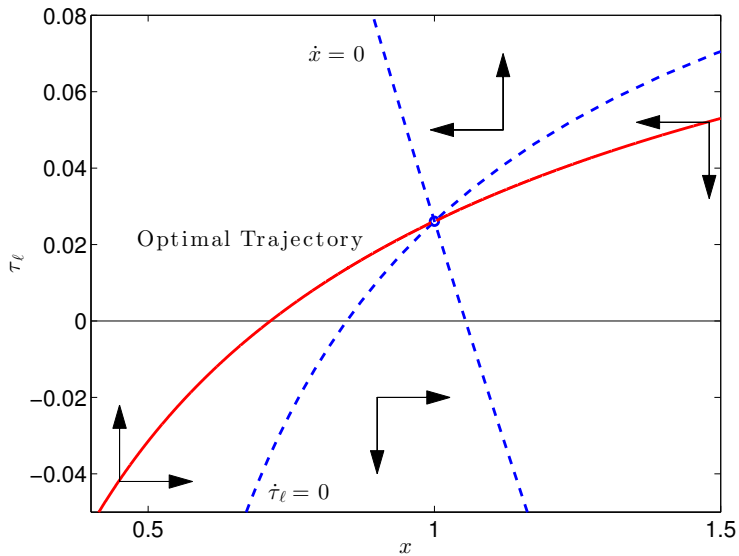
$$\dot{\tau}_\ell = \delta(\tau_\ell - \gamma) + \gamma(1 - \tau_\ell) \frac{\alpha}{\eta} \frac{y(x, \ell)}{x},$$

$$\ell = \ell(x, \tau_\ell; \bar{\mu})$$

- **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

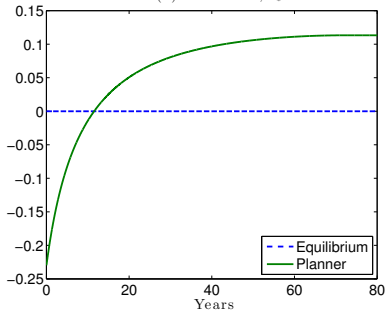
Phase diagram



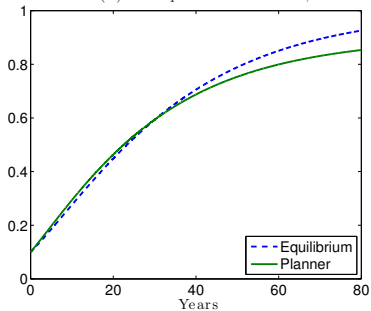
Optimal Ramsey Policies

Time path

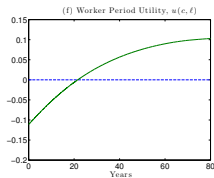
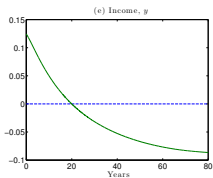
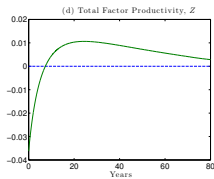
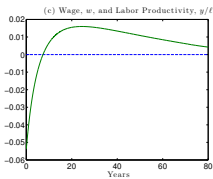
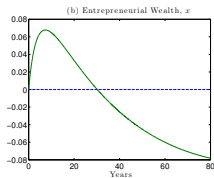
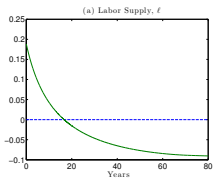
(a) Labor Tax, τ_ℓ



(b) Entrepreneurial Wealth, x



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

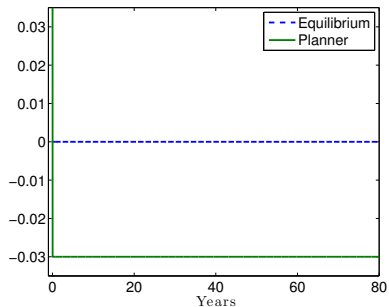
- Generalized planner's problem:

$$\begin{aligned} & \max_{\{c, \ell, b, x, s_x\}_{t \geq 0}} \int_0^{\infty} e^{-\rho t} u(c, \ell) dt \\ & \text{subject to} \quad c + \dot{b} = (1 - \alpha)y(x, \ell) + r^*b - s_x x, \\ & \quad \quad \quad \dot{x} = \frac{\alpha}{\eta} y(x, \ell) + (r^* + s_x - \delta)x, \\ & \quad \quad \quad s \leq s_x(t) x(t) \leq S \end{aligned}$$

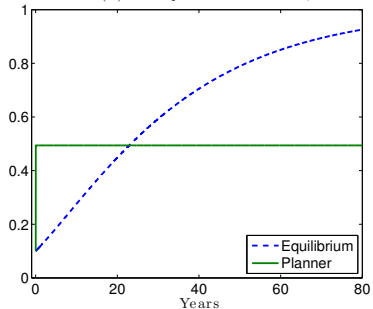
- Three cases:
 - 1 $s = S = 0$: just studied
 - 2 $S = -s = +\infty$ (unlimited transfers)
 - 3 $0 < S, -s < \infty$ (bounded transfers)
- Why bounded transfers?

Unlimited Transfers

(a) Transfer, ζ_x

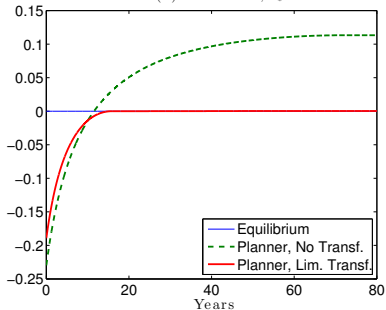


(b) Entrepreneurial Wealth, x

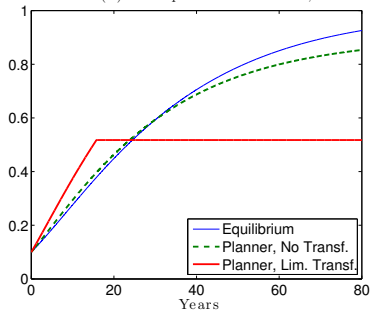


Bounded Transfers

(a) Labor Tax, τ_ℓ



(b) Entrepreneurial Wealth, x



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:

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

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

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:

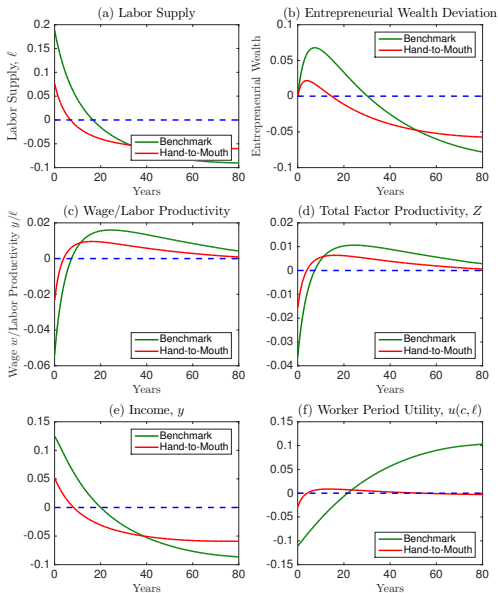
$$U(\tau) = \int_{\tau}^{\infty} e^{-(\rho+q)(t-\tau)} u(t|\tau) dt$$

- Calvo and Obstfeld (1988) social welfare function:

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

- 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

Multi-Sector Economy

Targeted Policies

- 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

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

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

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- goods $0, \dots, k$: tradable
 - goods $k + 1, \dots, N$: 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

$$\sum_{i=0}^N (1 + \tau_i^c) p_i c_i + \dot{b} \leq (r - \tau^b) b + \sum_{i=0}^N (1 - \tau_i^l) w_i \ell_i + T$$

- As before, can extend to additional tax instruments

Production

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

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

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

- 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:

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

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

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

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

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

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*): $\Theta_i^* x_i^\gamma$

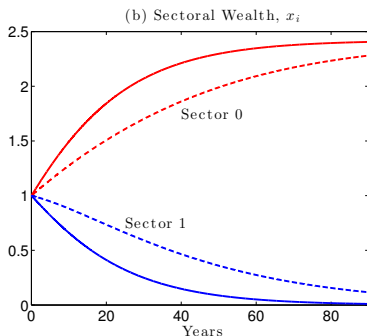
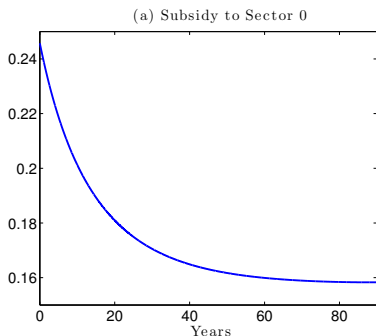
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- Comparative advantage:
 - Long run (*latent*): Θ_i^*
 - Short run (*actual*): $\Theta_i^* x_i^{\gamma_i}$
- Optimal policy: favors the (latent) comparative advantage sector and speeds up the transition

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)

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- 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

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

- 2 Persistent productivity shocks

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

- 3 Closed economy

Closed Economy

- Planner's problem:

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

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

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

$$\kappa = x + b$$

Closed Economy

- Planner's problem:

$$\begin{aligned} & \max_{\{c, \ell, \kappa, b, x, s_x\}_{t \geq 0}} \int_0^{\infty} e^{-\rho t} u(c, \ell) dt \\ \text{subject to} \quad & \dot{\kappa} = y(x, \kappa, \ell) - c - \delta x, \\ & \dot{x} = \left[\frac{\alpha}{\eta} + \alpha \frac{\eta - 1}{\eta} \frac{x}{\kappa} \right] y(x, \kappa, \ell) + (s_x - \delta)x \end{aligned}$$

- 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:

$$\begin{aligned} & \max_{\{c, \ell, \kappa, b, x, s_x\}_{t \geq 0}} \int_0^{\infty} e^{-\rho t} u(c, \ell) dt \\ \text{subject to} \quad & \dot{\kappa} = y(x, \kappa, \ell) - c - \delta x, \\ & \dot{x} = \left[\frac{\alpha}{\eta} + \alpha \frac{\eta - 1}{\eta} \frac{x}{\kappa} \right] y(x, \kappa, \ell) + (s_x - \delta)x \end{aligned}$$

- 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

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