

# 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 such policies may be justified?

## What We Do

- Optimal Ramsey policy in a standard growth model with financial frictions
- 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 (bad idea to equalize MPL when MPK are not)

# Main Findings

- ① *Robust* optimal policy intervention:
  - *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
- ② Rationale: dynamic externality akin to **learning-by-doing**, but operating via **misallocation** of resources
- ③ Extension with nontradables and real exchange rate:
  - policies may induce **real devaluation**, joint with capital outflows and FDI inflows
- ④ Multisector extension with comparative advantage:
  - optimal industrial policies favor the **comparative advantage** sectors and speed up the transition

## Empirical Relevance

- Input price suppression policies in developing Asia  
(Lin, 2012, 2013; Kim and Leipziger, 1997)
- Industrial revolution in the 19th century Britain  
(Ventura and Voth, 2013)
- Real exchange rate devaluation policy, financial repression  
(Rodrik, 2008)
- Support to comparative advantage industries, export promotion and import substitution  
(Harrison and Rodriguez-Clare, 2010; Lin, 2012)

## Model Setup

- 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:

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

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:

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

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

# Decentralized Equilibrium

- **Proposition:** Decentralized equilibrium is **inefficient**
- *Simple deviations* from decentralized equilibrium result in strict **Pareto improvement**

① Wealth transfer from workers to all entrepreneurs:

— Higher return for entrepreneurs:

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

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

② Coordinated labor supply adjustment by workers

# 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  $\varsigma_x(t)$ : asset subsidy to entrepreneurs
    - an effective transfer between workers and entrepreneurs
    - $s \leq \varsigma_x x \leq S$
  - ④  $T$ : lump-sum tax on workers; GBC:  $\tau_\ell w\ell + \tau_b b = \varsigma_x x + T$

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## Lemma (Primal Approach)

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

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

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

## Optimal Policies without Transfers

- **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  $\nu$  the co-state for  $x$  (shadow value of wealth)

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



# Optimal Policies without Transfers

## Characterization

- **Inter-temporal** margin undistorted:

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

- **Intra-temporal** margin distorted:

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

- 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 Policies without Transfers

## Characterization

- ODE system in  $(x, \nu)$  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 Policies without Transfers

## Characterization

- ODE system in  $(x, \tau_\ell)$  with a side-equation:

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

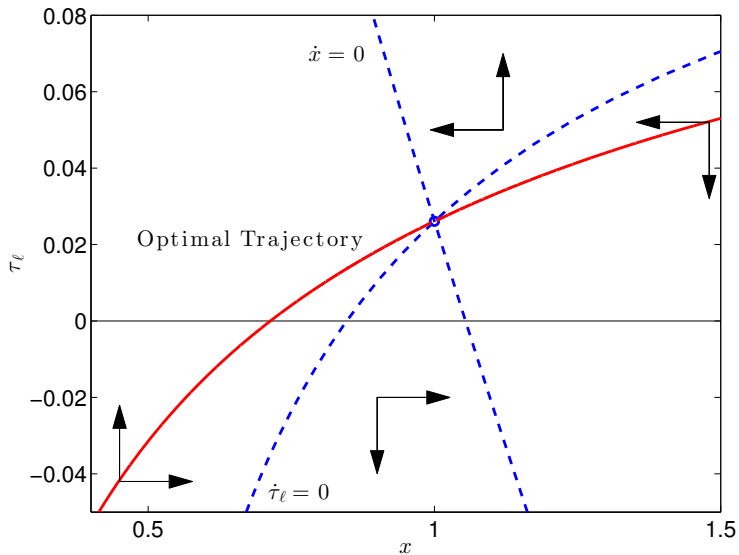
$$\dot{\tau}_\ell = \delta(\tau_\ell - \gamma) + \gamma(1 - \tau_\ell) \frac{\alpha}{\eta} \frac{y(x, \ell)}{x},$$

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

- **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  $\tau_\ell$  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 Policies without Transfers

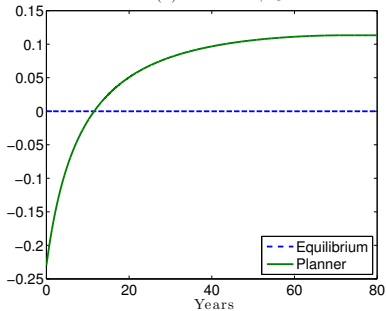
Phase diagram



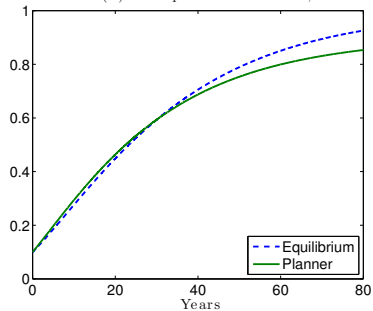
# Optimal Policies without Transfers

Time path

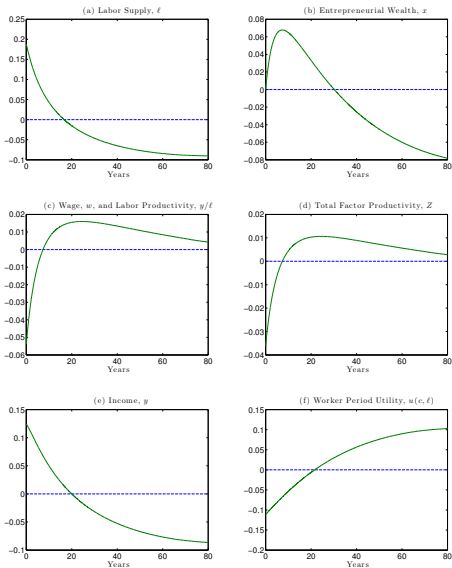
(a) Labor Tax,  $\tau_\ell$



(b) Entrepreneurial Wealth,  $x$



# Deviations from laissez-faire



# Optimal Policies without Transfers

## Discussion

- **Implementation:**
  - 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
  - Reinterpretation of New Deal policies (*cf.* Cole and Ohanian)
- **Intuition:** *pecuniary externality*
  - High wage reduces profits and slows down wealth accumulation
  - How general?

## Optimal Policy with Transfers

- Generalized planner's problem:

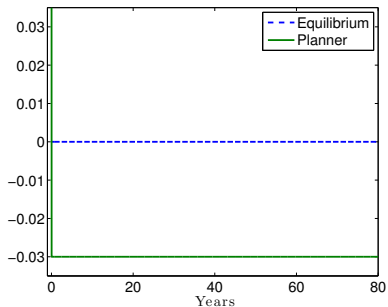
$$\begin{aligned} & \max_{\{c, \ell, b, x, s_x\}_{t \geq 0}} \int_0^{\infty} e^{-\rho t} u(c, \ell) dt \\ & \text{subject to} \quad c + \dot{b} = (1 - \alpha)y(x, \ell) + r^* b - s_x x, \\ & \quad \quad \quad \dot{x} = \frac{\alpha}{\eta} y(x, \ell) + (r^* + s_x - \delta)x, \\ & \quad \quad \quad s \leq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

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

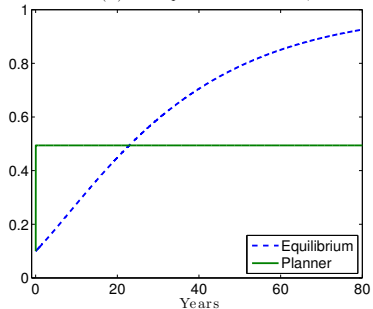


# Unlimited Transfers

(a) Transfer,  $\zeta_x$

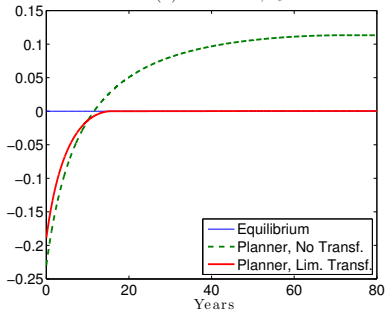


(b) Entrepreneurial Wealth,  $x$

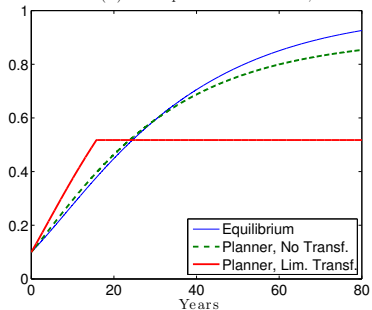


## Bounded Transfers

(a) Labor Tax,  $\tau_\ell$



(b) Entrepreneurial Wealth,  $x$



## Extensions

- 1 Positive Pareto weight on entrepreneurs

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

- 2 Additional tax instruments

- including capital (credit) subsidy
- joint use of all available instruments:  $s_k, s_w \propto \gamma(\nu - 1)$

- 3 Closed economy

- 4 Persistent productivity shocks

- 5 Economy with a non-tradable sector

- *real exchange rate* implications

- 6 Multisector economy with comparative advantage

- optimal sectoral *industrial policies*

## 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  $\varsigma_\pi$ , 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

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

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

$$\kappa = x + b$$

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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  $s = S = 0$ )

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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:  $\tau_\ell, \tau_b \propto (1 - \nu)$



## Non-tradables and RER

- Modified setup:
  - flow utility  $U(c, c_N)$ , inelastic labor supply
  - frictionless non-tradable production:  $y_N = \ell_N = 1 - \ell$
- Same setup subject to reinterpretation:  $U_N/U_c = (1 + \tau_N)w$ 
  - Tax on non-tradables instead of labor subsidy
  - Early transition: tax non-tradables  $\Rightarrow$  appreciated RER

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- Same setup subject to reinterpretation:  $U_N/U_c = (1 + \tau_N)w$ 
  - Tax on non-tradables instead of labor subsidy
  - Early transition: tax non-tradables  $\Rightarrow$  appreciated RER
- If no such instrument, then distort intertemporal margin
  - Early transition: subsidize savings ( $\tau_b < 0$ )
  - Increases labor supply and reduces demand for non-tradables
  - Real devaluation...
  - Implementation: forced savings via reserve accumulation under capital controls (China)

# Multisector economy

## Comparative advantage and industrial policies

- $N$  sectors:  $y_i = \Theta_i x_i^\gamma \ell_i^{1-\gamma}$
- Allocation of labor:  $L = \sum_{i=1}^N \ell_i$
- International prices  $\{p_i^*\}$
- Comparative advantage:
  - Long run (*latent*):  $p_i^* \Theta_i$
  - Short run (*actual*):  $p_i^* \Theta_i x_i^\gamma$

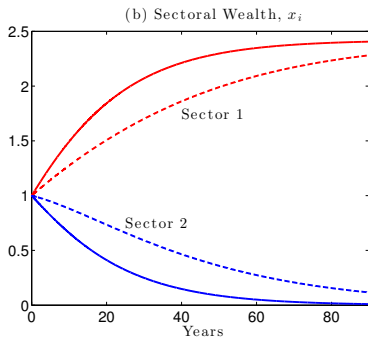
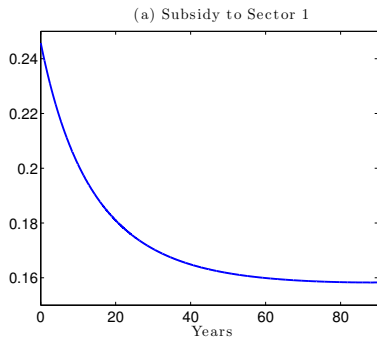
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- Comparative advantage:
  - Long run (*latent*):  $p_i^* \Theta_i$
  - Short run (*actual*):  $p_i^* \Theta_i x_i^\gamma$
- Optimal policy: favors the (latent) comparative advantage sector and speeds up the transition

# Multisector economy

## Comparative advantage and industrial policies



- Sector one has (latent) comparative advantage:  $p_1^* \Theta_1 > p_2^* \Theta_2$
- Optimal policy speeds up the transition

## Conclusion

- Optimal Ramsey policy in standard growth model with financial frictions
- Main Lesson: *pro-business* policies accelerate economic development and are welfare-improving
  - during initial transitions, and not in steady states
  - when business sector is undercapitalized
- The model is tractable and can be extended to think about exchange rate and industrial policies
- Although stylized, the model points towards a measurable sufficient statistic:  $\gamma \cdot \nu$ , where

$$\dot{\nu} - \delta\nu = - \left( 1 - \alpha + \frac{\alpha}{\eta} \nu \right) \frac{\partial y}{\partial x}$$