Optimal Development Policies with Financial Frictions

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Question

- Is there a role for governments to accelerate economic development by intervening in product and factor markets?
- Taxes? Subsidies? If so, which ones?

What We Do

- Optimal Ramsey policy in 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 ($\mathcal{G}_t(a, z) \to \bar{a}_t$)
- 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. 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

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

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

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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:

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

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

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

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

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

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

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*

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

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:

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

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

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

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

- Isomorphic to learning-by-doing externality

Optimal Policies without Transfers

Characterization

- **Inter**-temporal margin undistorted:

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

- **Intra**-temporal margin distorted:

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

- 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, ν) with a side-equation:

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

Optimal Policies without Transfers

Characterization

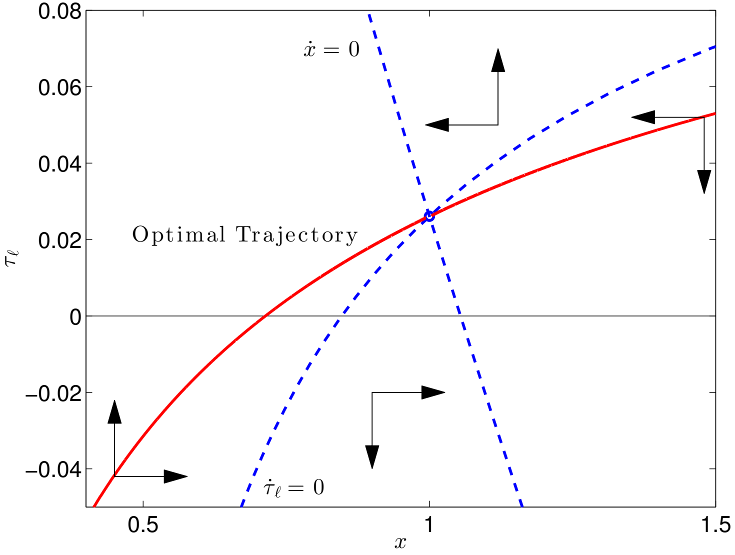
- ODE system in (x, τ_ℓ) with a side-equation:

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

- 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, $\tau_b \equiv 0$

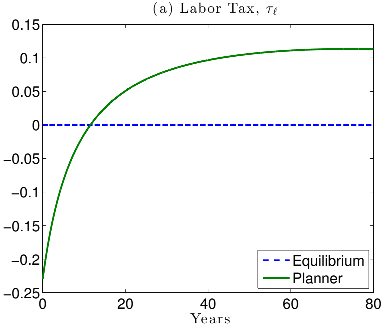
Optimal Policies without Transfers

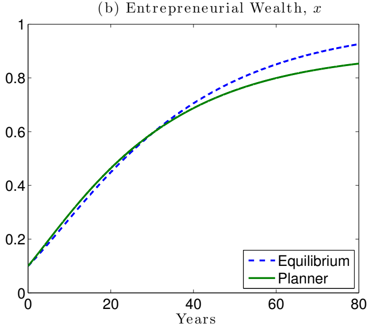
Phase diagram



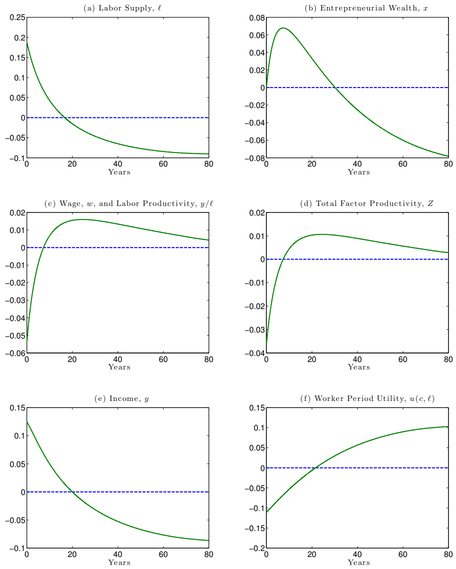
Optimal Policies without Transfers

Time path





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:

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

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

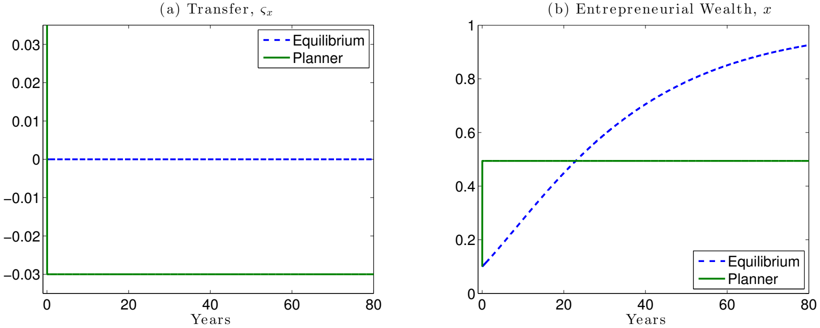
$$\dot{x} = \frac{\alpha}{\eta} y(x,\ell) + (r^* + \varsigma_x - \delta)x,$$

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

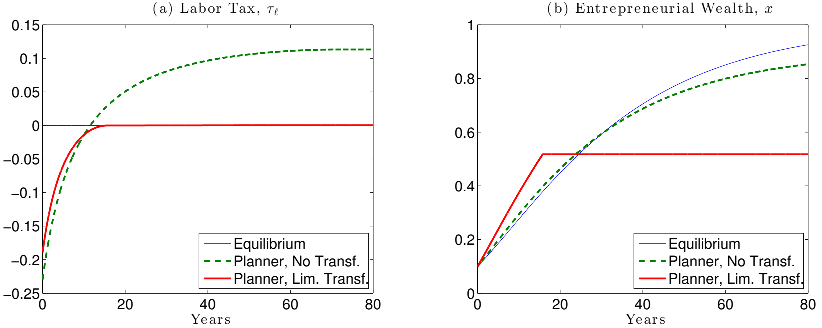
- Three cases:
  1. $s = S = 0$: just studied
  2. $S = -s = +\infty$ (unlimited transfers)
  3. $0 < S, -s < \infty$ (bounded transfers)

- Why bounded transfers?

Unlimited Transfers



Bounded Transfers



Extensions

1. Positive Pareto weight on entrepreneurs

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

2. Additional tax instruments
   - including capital (credit) subsidy
   - joint use of all available instruments: $\varsigma_k, \varsigma_w \propto \gamma(\nu - 1)$

3. Closed economy

4. Economy with a non-tradable sector
   - *real exchange rate* implications

5. 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:

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

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

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

Closed Economy

- Planner's problem:

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

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

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

$$\kappa = x + b$$

Closed Economy

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- 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

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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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  - 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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- Optimal policy: favors the (latent) comparative advantage sector and speeds up the transition

Multisector economy

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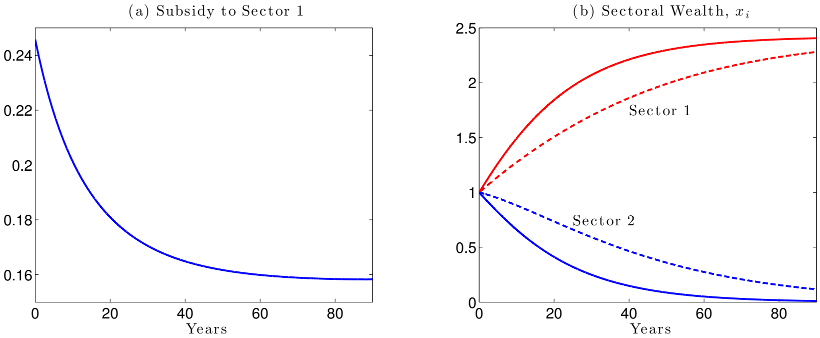

- Sector one has (latent) comparative advantage: $p_1^* \Theta_1 > p_2^* \Theta_2$
- Optimal policy speeds up the transition

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

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