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 ⇒ capital misallocation ⇒ low productivity

• but more **tractable** ⇒ Ramsey problem feasible: \( G_t(a, z) \rightarrow \bar{a}_t \)

• **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

• 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

Workers: representative household with wealth (bonds) $b$

$$\max \{c(\cdot), \ell(\cdot)\} \quad \int_{0}^{\infty} e^{-\rho t} u(c(t), \ell(t)) \, dt,$$

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

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

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\]

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

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. \(\dot{a}(t) = \pi_t(a(t), z(t)) + r(t)a(t) - c_{e}(t)\)

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

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

- Profit maximization:

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

  where

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

- Wealth accumulation:

  \[ \dot{a} = \pi_t(a, z) + (r(t) - \delta) a \]
Output:

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

Capital demand:

\[ \kappa = \lambda x z^{-\eta}, \]

where aggregate wealth \( x(t) \equiv \int a \, dG_t(a, z) \) evolves:

\[ \dot{x} = \Pi + (r - \delta) x, \]
• Output:
\[ y = A \left( \frac{\eta}{\eta - 1} z \right)^{\alpha} \cdot \kappa^{\alpha \ell^{1-\alpha}} \]

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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

**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 \( z^n \propto (x/\ell)^{1-\gamma} \)
General equilibrium

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

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

   - **Lemma**:
     \[
     y = y(x, \kappa, \ell) = \Theta_c (x\kappa^{\eta-1})^{\alpha/\eta} \ell^{1-\alpha}
     \]
     and \( z^\eta = \lambda x/\kappa \)
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:
     \[ R(z) = r \left(1 + \lambda \left[ \frac{z}{z} - 1 \right]^+ \right) \geq r \]
     \[ \mathbb{E}R(z) = r + \frac{\alpha y}{\eta x} > r \]

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
     - $s \leq \varsigma_x \leq S$
  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:**

\[
\max_{\{c, \ell, b, x\}_{t \geq 0}} \int_{0}^{\infty} e^{-\rho t} u(c, \ell) dt
\]

subject to

\[
c + \dot{b} = (1 - \alpha)y(x, \ell) + r^*b,
\]

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

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:

\[
\begin{align*}
\dot{x} & = \frac{\alpha}{\eta} y(x, \ell) + (r^* - \delta)x, \\
\dot{\nu} & = \delta \nu - (1 - \gamma + \gamma \nu) \frac{\alpha}{\eta} \frac{y(x, \ell)}{x}, \\
- \frac{u_\ell}{u_c} & = (1 - \gamma + \gamma \nu)(1 - \alpha) \frac{y(x, \ell)}{\ell}, \\
\tau_\ell & = \gamma - \gamma \cdot \nu
\end{align*}
\]
Optimal Policies without Transfers

Characterization

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

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

• 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 Trajectory

\[ \dot{x} = 0 \]

\[ \dot{\tau}_\ell = 0 \]
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:

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

subject to

\[
c + \dot{b} = (1 - \alpha) y(x, \ell) + r^* b - s_x x,
\]

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

\[
s \leq s_x(t) x(t) \leq S
\]

- 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

(a) Transfer, $\varsigma_x$

(b) Entrepreneurial Wealth, $x$
Bounded Transfers

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

(b) Entrepreneurial Wealth, $x$

Equilibrium Planner, No Transf.
Equilibrium Planner, Lim. Transf.

[Graphs showing the changes in labor tax and entrepreneurial wealth over years for different scenarios.]
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:

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

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

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

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

$$\kappa = x + b$$

We study three cases:

1. Unlimited transfers and $x, \kappa \geq 0$ only — No distortions ($\tau_b = \tau_\ell = 0$) and $x$: $\alpha \eta y_x = \delta$

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

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\max_{\{c, \ell, \kappa, b, x, \varsigma x\}} \int_{0}^{\infty} e^{-\rho t} u(c, \ell) dt
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subject to

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

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  1. Unlimited transfers and \( x, \kappa \geq 0 \) only

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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
Non-tradables and 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): $p_i^* \Theta_i x_i^\gamma$
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):  \( p_i^* \Theta_i x_i^\gamma \)

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

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