Optimal Development Policies with Financial Frictions

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• 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
What We Do

• Optimal Ramsey policy in 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

• 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 policy intervention:
   - *pro-business* policies for developing countries, i.e. during early transition when entrepreneurs are undercapitalized
   - *pro-labor* policy for developed countries, close to steady state
   - policies reminiscent of developing Asia

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


- Industrial revolution in Britain (Ventura and Voth, 2013)

- Real exchange rate devaluation (Rodrik, 2008)

- Support to comparative advantage industries (Harrison and Rodriguez-Clare, 2010; Lin, 2012)
Model Setup

1. Worker: representative household with wealth (bonds) \( b \)

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

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

\[ k_t(a, z) = \lambda a \cdot 1_{\{z \geq z(t)\}}, \]

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

\[ \pi_t(a, z) = \left[ \frac{z}{z(t)} - 1 \right] r(t) k_t(a, z), \]

where

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

• Wealth accumulation:

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

• 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 \( x(t) \equiv \int adG_t(a, z) \) evolves:

\[ \dot{x} = \Pi + (r - \delta)x, \]
Aggregation

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

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

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 \( z^n = \lambda x/\kappa \)
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 \( \{c, \ell, b, x\}_{t\geq0} \) satisfying

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

can be supported as a competitive equilibrium under appropriately chosen policies \( \{\tau_{\ell}, \tau_{b}, \varsigma_{x}\}_{t\geq0} \).
Optimal Policies without Transfers

- **Benchmark:** zero weight on entrepreneurs

- **Planner’s problem:**

\[
\max \left\{ c, \ell, b, x \right\}_{t \geq 0} \int_{0}^{\infty} e^{-\rho t} u(c, \ell) dt \\
\text{subject to} \quad c + \dot{b} = (1 - \alpha) y(x, \ell) + r^* b, \\
\dot{x} = \frac{\alpha}{\eta} y(x, \ell) + (r^* - \delta) x,
\]

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:

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

• **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:

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

• 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

\[ \dot{x} = 0 \]

\[ \dot{\tau}_L = 0 \]
Optimal Policies without Transfers

Time path

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

(b) Entrepreneurial Wealth, $x$
Deviations from laissez-faire

(a) Labor Supply, $\ell$

(b) Entrepreneurial Wealth, $x$

(c) Wage, $w$, and Labor Productivity, $y/\ell$

(d) Total Factor Productivity, $Z$

(e) Income, $y$

(f) Worker Period Utility, $u(c, \ell)$
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*), 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

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

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

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

• 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

(a) Transfer, $\varsigma_x$

(b) Entrepreneurial Wealth, $x$

Equilibrium Planner

Graphs showing the transfer and entrepreneurial wealth over years.
Bounded Transfers

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

(b) Entrepreneurial Wealth, $x$

Equilibrium Planner, No Transf. vs. Planner, Lim. Transf.
Extensions

1. Positive Pareto weight on entrepreneurs

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

2. Additional tax instruments
   — including capital (credit) subsidy

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. $s_\pi(t)$: profit subsidy
2. $s_y(t)$: revenue subsidy
3. $s_w(t)$: wage bill subsidy
4. $s_k(t)$: capital (credit) subsidy

- Budget set of entrepreneurs:

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

\[ \pi(a, z) = \max_{n \geq 0, 0 \leq k \leq \lambda a} \left\{ (1 + s_y)A(zk)^\alpha n^{1-\alpha} - (1 - s_w)w\ell - (1 - s_k)r^*k \right\} \]
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.: \( \varsigma_k, \varsigma_w \propto (\nu - 1) \)

- Pro-business policy bias during early transition
Closed Economy

- Planner’s problem:

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

subject to

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

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

$$\kappa = x + b$$

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: $\tau \ell, \tau b \propto (1 - \nu)^{24 / 27}$
Closed Economy

- Planner’s problem:
  \[
  \max_{\{c, \ell, \kappa, b, x, \varsigma_x\}} \int_0^\infty e^{-\rho t} u(c, \ell) dt \\
  \text{subject to } \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) + (\varsigma_x - \delta)x
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  2. Unlimited transfers and $x \leq \kappa$
  3. Bounded transfers (limiting case $s = S = 0$)
Closed Economy

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   — 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: $y_i = \Theta_i x_i \delta_i^{1-\gamma}$
- 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
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

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