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
  $(G_t(a, z) \rightarrow \bar{a}_t)$

• **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. 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

- 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) $b$

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

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

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

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

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

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

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

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

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

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- **Lemma:** *National income accounts*
  \[ w\ell = (1 - \alpha)y, \quad r\kappa = \alpha \frac{\eta - 1}{\eta} y, \quad \Pi = \frac{\alpha}{\eta} y. \]
**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

1 Small open economy: \( r(t) \equiv r^* \)

and \( \kappa(t) \) is perfectly elastically supplied

- Lemma:

\[
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\]

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

2 Closed economy:

\( \kappa(t) = b(t) + x(t) \)

and \( r(t) \) equilibrates capital market

- Lemma:

\[
y = y(x, \kappa, \ell) = \Theta_c \left( x\kappa^{\eta-1} \right)^{\alpha/\eta} \ell^{1-\alpha}
\]

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:
     \[
     R(z) = r \left( 1 + \lambda \left[ \frac{z}{x} - 1 \right]^+ \right) \geq r
     \]
     \[
     \mathbb{E}R(z) = r + \frac{\alpha y}{\eta x} > r
     \]

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
     - $s \leq \varsigma_x x \leq S$
  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:
  \[
  \frac{\dot{u}_c}{u_c} = \rho - r^* \Rightarrow \tau_b = 0
  \]

- **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:

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

Equilibrium Planner

Years

Years
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*, 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

\[
c + b = (1 - \alpha)y(x, \ell) + r^*b - s_x x, \\
\dot{x} = \frac{\alpha}{\eta} y(x, \ell) + (r^* + s_x - \delta)x, \\
s \leq s_x(t) x(t) \leq S
\]

• 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.   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
   - joint use of all available instruments: $$s_k, s_w \propto \gamma(\nu - 1)$$

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 \( \varsigma_\pi \), 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:

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

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

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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   - No distortions \((\tau_b = \tau_\ell = 0)\) and \(x : \frac{\alpha}{\eta} \frac{y}{x} = \delta\)

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   - 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
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- 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

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