Directory

Intermediate Goods and Weak Links: A Theory of Economic Development

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I. Introduction

- Huge income differences across countries — why?
- Old ideas: Leontief (1936) and Hirschman (1958)

  Linkages: Intermediate goods are another produced input $\Rightarrow$ an extra multiplier (like capital).

  Complementarity: Multiple weak links in production make development hard.
- A model to make these ideas precise
  - Linkages, complementarity, and superstar effect amplify small distortions.

Literature Review

- Kremer (1993) O-Rings. Ciccone (2002) input chains.
- Empirical work: Hall-Jones, Klenow-Rodriguez, Acemoglu-Johnson-Robinson.
- Models: Romer (1994), Benabou (1996), Blanchard-Kremer (1997), Parente and Prescott (1999), Manuelli-Seshadri (2005), Klenow-Rodriguez (2005), Acemoglu and coauthors.
- Political economy and insitutions
    - Why are allocations distorted? Political economy.
    - Why do distortions lead to large differences? This paper.

Linkages through Intermediate Goods

- Capital multiplier: more $K \to$ more $Y \to$ more K, etc.
  - Multiplier is $\frac{1}{1-\alpha} = 3/2$ if $\alpha = 1/3$.
  - Broaden capital: Need $\alpha = 2/3 \Rightarrow$ multiplier = 3.
- The Intermediate Goods Multiplier:
  - Telecommunications, electric power, transportation, education, food supply, health care.
  - Production in each of these sectors depends on productivity in the other sectors = linkages
  - Telecom $\leftarrow$ electricity, educated and healthy workers.
  - Electric generation $\leftarrow$ transportation, telecom, health.
  - Health care $\leftarrow$ telecom, transport, food supply.
- Low productivity in one activity reduces output in the others, which in turn reduces output in the original activity.

A Simple Example

$$Y_t = \bar{A}\left(K_t^{\alpha} L_t^{1-\alpha}\right)^{1-\sigma} X_t^{\sigma}$$

$$K_{t+1} = \bar{s} Y_t + (1-\delta) K_t$$

$$X_{t+1} = \bar{x} Y_t$$

- Steady State:

$$Y = \left(\bar{A}\bar{x}^{\sigma}\right)^{\frac{1}{1-\sigma}} K^{\alpha} L^{1-\alpha}$$

$$y \equiv \frac{Y}{L} = \left(\bar{A}\bar{x}^{\sigma}\left(\frac{\bar{s}}{\delta}\right)^{\alpha(1-\sigma)}\right)^{\frac{1}{(1-\alpha)(1-\sigma)}}$$

- Intermediate goods multiplier (with $\sigma = 1/2$):
  $\frac{1}{1-\sigma} \cdot \frac{1}{1-\alpha} = 2 \cdot 3/2 = 3$
- Ciccone (2002)

The Role of Complementarity

- Linkages and Complementarity often go together (Hirschman 1958)
  - Intermediate goods (energy, raw materials)
- Kremer (1993) O-ring story
  - Production requires 10 things to go right.
  - In the poorest countries, 5 or 6 may be broken.
  - Fixing 1 or 2 will then have small effects.
  - Example: Making socks
- Intuitive channel, but lacking in recent literature

Complementarity and Substitution

$$Y = \left(\int_0^1 z_i^\eta di \right)^{1/\eta}$$

- Degree of complementarity is a parameter: η
  - $\eta = 0$ is Cobb-Douglas (geometric mean)
  - $\eta < 0$ puts more weight on weak links.
  - $\eta > 0$ puts more weight on superstars.
- Generalized (power) mean of the z_i

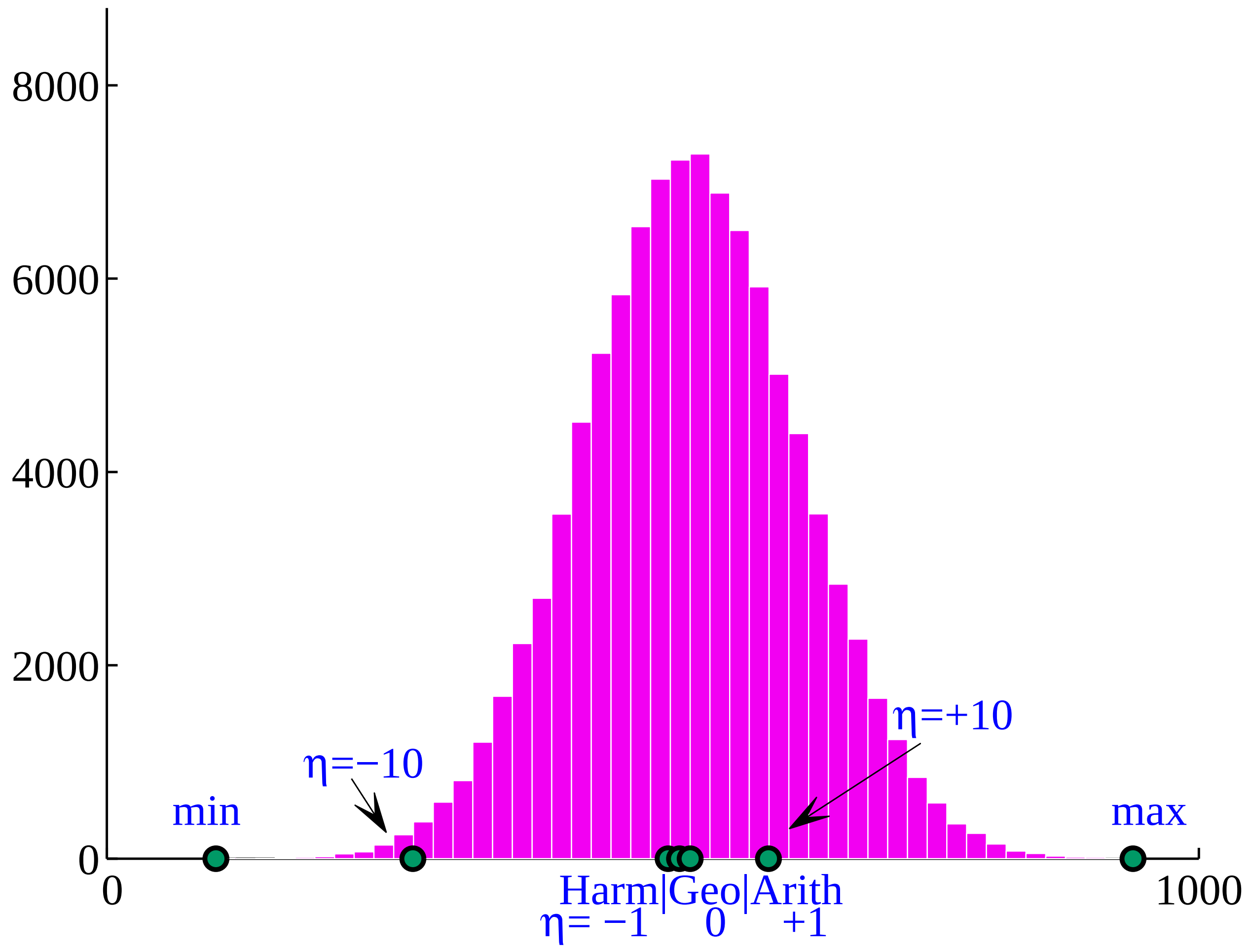
  $\eta = 1$ – Arithmetic mean

  $\eta = -1$ – Harmonic mean

  $\eta \to -\infty$ – Minimum (Leontief)

  $\eta \to +\infty$ – Maximum (Superstars)
- Power mean is an increasing function of η.

Power Means


8000
6000
4000
2000
0
0
1000
min
max
η=−10
η=+10
Harm|Geo|Arith
η= −1 0 +1

II. The Model

The Economic Environment

Production of Variety i: $$Y_i = A_i \left(K_i^{\alpha} H_i^{1-\alpha}\right)^{1-\sigma} X_i^{\sigma}$$

Resource constraint (good i): $$c_i + z_i = Y_i$$

Final uses (substitutes): $$Y = \left(\int_0^1 c_i^{\theta} di\right)^{1/\theta}, \quad 0 < \theta < 1$$

Intermediate uses (complements): $$X = \left(\int_0^1 z_i^{\rho} di\right)^{1/\rho}, \quad \rho < 0$$

Resource constraint (X): $$\int_0^1 X_i \, di \le X$$

A_i = exogenous productivity, σ = Linkages parameter,
θ = substitutability of final, ρ = complementarity of intermediates

Environment – continued

Resource constraint (K): $\int_0^1 K_i di \leq K$

Resource constraint (H): $\int_0^1 H_i di \leq H \equiv \bar{h}\bar{L}$

Capital accumulation: $\dot{K} = I - \delta K$

Resource constraint (GDP): $C + I \leq Y$

Preferences: $U = \int_0^\infty e^{-\lambda t} u(C_t) dt$

Allocating Resources

- Two ways:
  1. Symmetric: A "rule of thumb" allocation, like Solow.
  2. Competitive Equilibrium: With tax wedges / distortions.
- Advantages of starting with symmetric
  - Easy to solve for; delivers some key results.
  - Important benchmark for understanding CE.
- DEFINITION: The *symmetric allocation* has $K_i = K$, $H_i = H$, $X_i = X$, $I = \bar{s}Y$, and $z_i = \bar{z}Y_i$, where $0 < \bar{s}, \bar{z} < 1$.

The Symmetric Allocation

PROPOSITION 1. THE SYMMETRIC ALLOCATION: Given K units of capital, GDP is

$$Y = \phi(\bar{z})(S_\theta^{1-\sigma} S_\rho^\sigma)^{\frac{1}{1-\sigma}} K^\alpha H^{1-\alpha},$$

where

$$S_\rho \equiv \left(\int_0^1 A_i^\rho di \right)^{\frac{1}{\rho}}$$

and

$$\phi(\bar{z}) \equiv ((1-\bar{z})^{1-\sigma} \bar{z}^\sigma)^{\frac{1}{1-\sigma}}$$

and S_θ is defined in a way analogous to S_ρ.

1. Substitution vs. Complementarity

$$S \equiv S_\theta^{1-\sigma} S_\rho^{\sigma}, \quad S_\eta \equiv \left(\int_0^1 A_i^\eta di \right)^{\frac{1}{\eta}}$$

- TFP involves both CES combinations of productivities.
  - S_θ is between geometric and arithmetic means
  - S_ρ is between geometric and minimum

  $\Rightarrow$ Weak links crucial; importance of σ.
- Example: $\theta = 1$, $\rho \to -\infty$, $\sigma = 1/2$
  - TFP $= \bar{A} \times \min\{A_i\}$.
  - Aggregate TFP is determined by the weakest link.
- U.S. and Kenya may not be so different on average but several weak links can drag down output.

2. Linkages deliver a multiplier

$$Y = S^{\frac{1}{1-\sigma}} K^{\alpha} H^{1-\alpha}$$

- TFP is the CES average raised to the power $\frac{1}{1-\sigma}$.
- Example: Suppose $Y_t = aX_t^{\sigma}$ and $X_t = sY_{t-1}$.
  - Output depends on intermediate goods
  - Intermediate goods are yesterday's output.

  Solving these two equations in steady state gives

$$Y^* = a^{1/1-\sigma} s^{\sigma/1-\sigma}.$$

- Analogous to the multiplier from capital accumulation.

The Competitive Equilibrium Allocation

- Standard CE with one key difference:
  - Each variety i producer is subject to a variety-specific tax τ_i
- Motivated by Banerjee-Duflo (2005), CKM (2007), Restuccia-Rogerson (2007), Hsieh-Klenow (2007)
  - Misallocation at micro level $\Rightarrow$ Aggregate TFP.
  - Tax wedges: formal taxes, theft, expropriation, preferential credit, protection from competition, etc.
- Standard neoclassical model $\Rightarrow$ small effects
  - Here, multiplied though intermediate goods and weak links

CE Optimization Problems

- Final Use Problem

$$\max_{\{c_i\}} \left(\int_0^1 c_i^\theta di \right)^{1/\theta} - \int_0^1 p_i c_i \, di$$

- Intermediate Use Problem

$$\max_{\{z_i\}} q \left(\int_0^1 z_i^\rho di \right)^{1/\rho} - \int_0^1 p_i z_i \, di$$

- Variety i's Problem

$$\max_{\{X_i, K_i, H_i\}} (1-\tau_i) p_i A_i \left(K_i^\alpha H_i^{1-\alpha} \right)^{1-\sigma} X_i^\sigma - (r+\delta) K_i - w H_i - q X_i .$$

Definition of Equilibrium

The *competitive equilibrium with tax wedges* consists of quantities and prices $\{p_i\}, q, w, r$ such that

1. Firms and households optimize (previous slide).
2. Prices clear markets.
3. Government's budget balances: $T = \int_0^1 \tau_i p_i Y_i di$
4. Economic environment is respected.

Solving for the CE

PROPOSITION 2. THE COMPETITIVE EQUILIBRIUM, GIVEN CAPITAL: Given K, GDP in the competitive equilibrium is

$$Y = \psi(\tau)\left(Q_\theta^{1-\sigma} Q_\rho^{\sigma}\right)^{\frac{1}{1-\sigma}} K^{\alpha} H^{1-\alpha},$$

where

$$Q_\eta \equiv \left(\int_0^1 (A_i(1-\tau_i))^{\frac{\eta}{1-\eta}} di\right)^{\frac{1-\eta}{\eta}},$$

and

$$\psi(\tau) \equiv \frac{1-\sigma(1-\tau)}{1-\tau} \cdot \sigma^{\frac{\sigma}{1-\sigma}}$$

where $\tau \equiv T/(Y+qX)$ is an average tax rate.

Three Remarks

1. The intermediate goods multiplier plays same role.
2. Tax wedges work through aggregate TFP
   - As in CKM, RR, HK
   - Now they get multiplied by IG multiplier as well.
3. Change in curvature parameter in CES... (next slide)

Strengthen weak links, Favor superstars

$$Q_\eta \equiv \left(\int_0^1 (A_i(1-\tau_i))^{\frac{\eta}{1-\eta}} di \right)^{\frac{1-\eta}{\eta}}$$

- Curvature parameter is $\frac{\eta}{1-\eta}$ rather than η
  - $\rho \in [0, -\infty)$ implies $\frac{\rho}{1-\rho} \in [0, -1)$
  - $\theta \in [0, 1)$ implies $\frac{\theta}{1-\theta} \in [0, \infty)$
  - A *higher* power mean
    $\Rightarrow$ Strengthen weak links, favor superstars.
- Example: $\theta = 1$, $\rho \to -\infty$, $\sigma = 1/2$
  - TFP $= \max\{A_i\} \times \bar{A}$.
  - Aggregate TFP is determined by the superstar.
- Even with Leontief, other margins of substitution:
  - Resources substitute for low A_i.

The Steady State

PROPOSITION 3. THE COMPETITIVE EQUILIBRIUM IN STEADY STATE: Let $y \equiv Y/\bar{L}$. GDP per worker in SS is

$$y^* = \psi(\tau)\left(Q_\theta^{1-\sigma} Q_\rho^\sigma\right)^{\frac{1}{1-\sigma}\frac{1}{1-\alpha}} \left(\frac{\alpha(1-\sigma)}{\lambda+\delta}\right)^{\frac{\alpha}{1-\alpha}} \bar{h}.$$

- The long-run multiplier is $\frac{1}{1-\sigma}\frac{1}{1-\alpha} = \frac{1}{1-\beta}$
- Suppose we compare 2 economies with $Q^{rich} = 2 \times Q^{poor}$
- Income ratios
  - Neoclassical ($\sigma = 0$): $2^{3/2} \approx 2.8$
  - Here ($\sigma = 1/2$): $2^{2\times 3/2} = 2^3 = 8$.

Symmetric Taxes

PROPOSITION 4. SYMMETRIC TAX WEDGES: Suppose $\tau_i = \bar{\tau}$. Let $z \equiv \frac{qX}{Y+qX}$. Then $z^* = \sigma(1-\bar{\tau})$, and

$$Y = (1-z^*)z^{*\frac{\sigma}{1-\sigma}} \left(\tilde{Q}_\theta^{1-\sigma}\tilde{Q}_\rho^{\sigma}\right)^{\frac{1}{1-\sigma}} K^\alpha H^{1-\alpha},$$

Also, in steady state

$$y^* = (1-\sigma(1-\bar{\tau}))\,(1-\bar{\tau})^{\frac{1}{1-\sigma}\frac{1}{1-\alpha}-1} \left(\tilde{Q}_\theta^{1-\sigma}\tilde{Q}_\rho^{\sigma}\right)^{\frac{1}{1-\sigma}\frac{1}{1-\alpha}} \bar{h},$$

- GDP is maximized at $\bar{\tau} = 0$ (i.e. $z^* = \sigma$).
- Why does a symmetric tax distort? Diamond-Mirrlees/Chamley/Judd.
- Monopoly distortions would also be multiplied.

Random Productivity and Taxes

PROPOSITION 5: Let $a_i \equiv log A_i$ and $\omega_i \equiv \log(1-\tau_i)$ be jointly normally distributed so that $a_i \sim N(\mu_a, \nu_a^2)$ and $\omega_i \sim N(\mu_\omega, \nu_\omega^2)$ and $Cov(\omega_i, a_i) = \nu_{a\omega}$. Finally, let $\nu^2 \equiv \nu_a^2 + \nu_\omega^2 + 2\nu_{a\omega}$. Then

$$\log y^* = \underbrace{\log\left(\frac{1-\sigma(1-\tau)}{1-\tau}\right)}_{\text{A}} + \frac{1}{1-\sigma}\frac{1}{1-\alpha}\left(\underbrace{(1-\sigma)\log Q_\theta + \sigma \log Q_\rho}_{\text{B}}\right)$$

where

$$A = \log\left(1 - \sigma \exp\left[\mu_\omega + \frac{1}{2}\cdot\frac{1+\rho}{1-\rho}\nu_\omega^2 + \frac{\rho}{1-\rho}\nu_{a\omega}\right]\right) - \left(\mu_\omega + \frac{1}{2}\cdot\frac{1+\theta}{1-\theta}\nu_\omega^2 + \frac{\theta}{1-\theta}\nu_{a\omega}\right)$$

and

$$B = \mu_a + \mu_\omega + \frac{1}{2}\cdot\left((1-\sigma)\frac{\theta}{1-\theta} + \sigma\frac{\rho}{1-\rho}\right)\nu^2$$

Moreover, $\frac{\partial \log y^*}{\partial \nu_\omega^2} < 0$.

III. Development Accounting

Intermediate Goods Share: σ

- Basu (1995) uses $\sigma = 1/2$ based on Jorgenson, Gollop, and Fraumeni (1987) U.S. average for 1947–1979.
- Chenery, Robinson, and Syrquin (1986) suggest that share rises with development
  - But Korea, Taiwan, and Japan in 1970s are all *higher* than this U.S. number, at 61% to 80%
- OECD I-O database at 1-digit level has

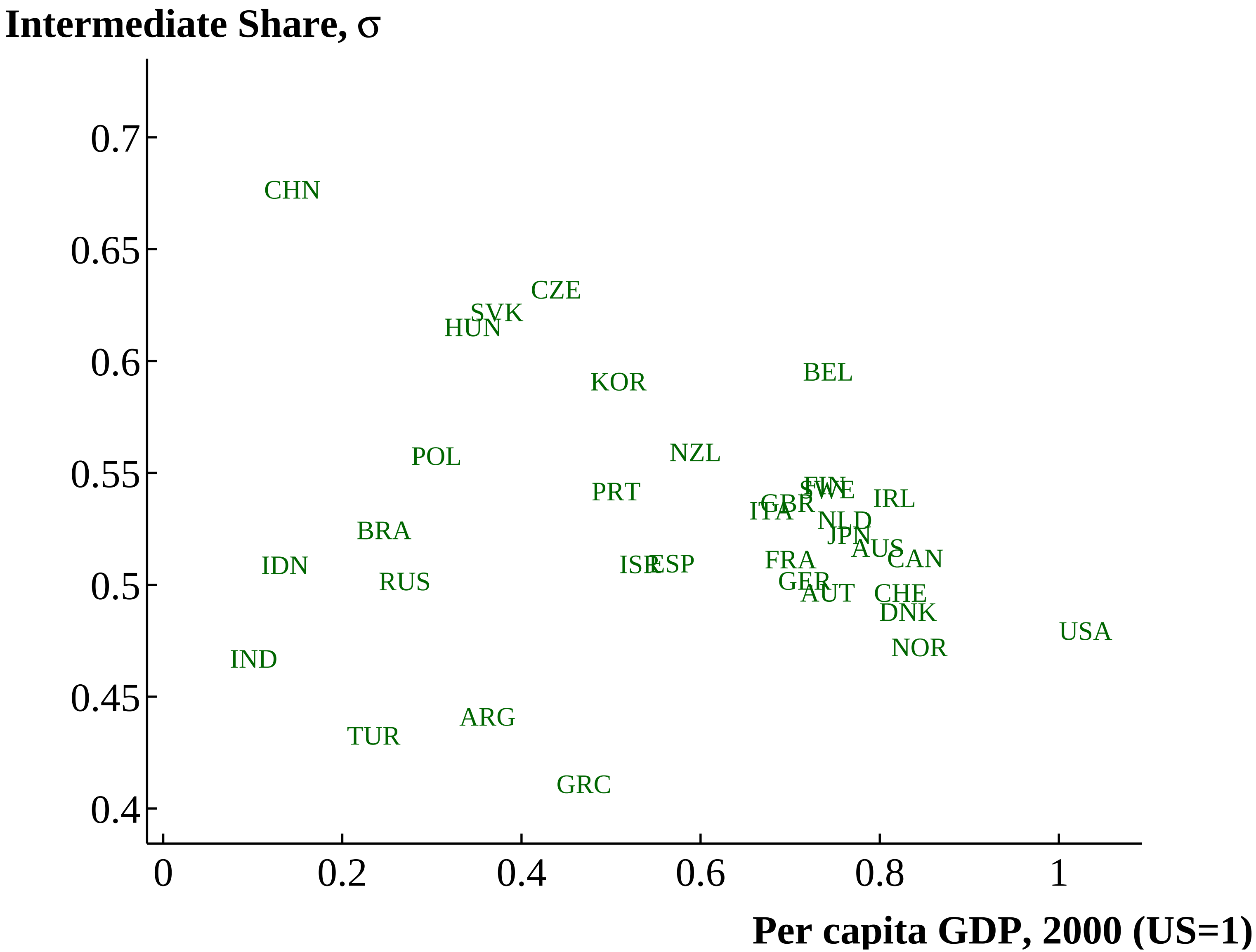
  $\sigma \approx 46\%$ for U.S., Japan, India

  $\sigma = 64\%$ for China

  Across 21 countries: mean = 52.4%, stdev = 6%.

$\Rightarrow \sigma = 1/2$ seems quite reasonable

The Intermediate Goods Share



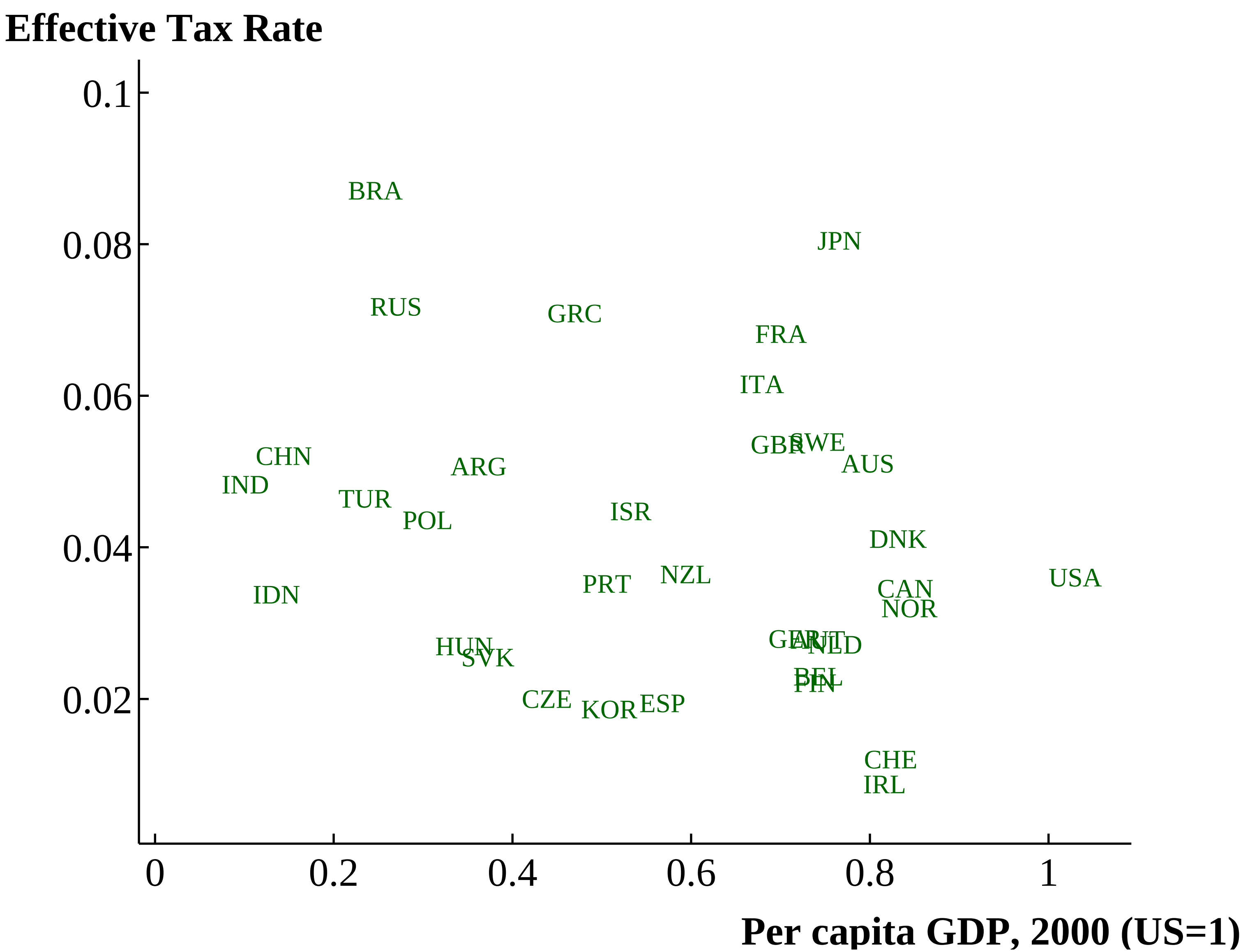
Using Factor Shares to Measure Distortions?

- Following the idea of Hsieh-Klenow (2007), perhaps variation in the Intermediate Share $\Rightarrow$ distortions.
- Example: Sales tax $\rightarrow$ FOC $\rightarrow$ $(1-\tau)\alpha Y/K = r$
- Similarly, for a single intermediate good (and IG taxes as well):

$$\frac{pX}{Y} = \frac{\sigma(1-\tau_Y)}{1+\tau_X}$$

- Problems:
  - Need to know σ_i
  - Aggregation misses firm-level distortions
  - *Measured* taxes are small.
- Conceivable that high sales taxes and large subsidies to IntGoods in China and Hungary coexist.

Effective Tax Rate from IntGoods FOCS



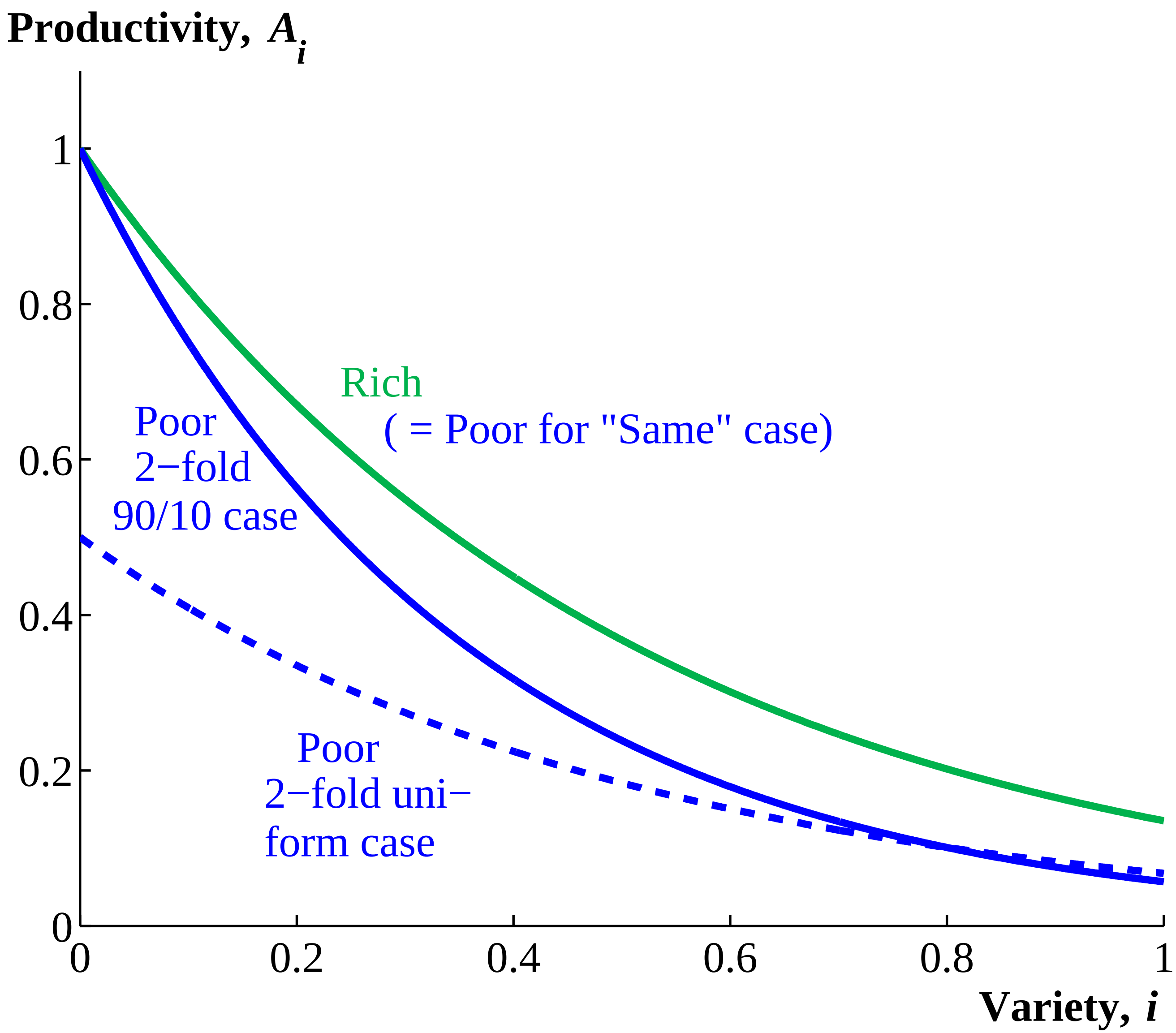
Calibrating TFP, Taxes, and Complementarity

- Least confident in calibrating: TFP, Tax Wedges, Complementarity
  - Approach: Illustrate multipliers with conservative calibration.
- Compare two countries, “rich” vs. “poor”
  1. TFP and taxes are deterministic functions of i
  2. Log-normal example tied closely to Hsieh-Klenow.

Calibrating TFP Differences

- Hsieh-Klenow: 90/10 Ratios of plant-level TFP within 4 digit industries
  - US=9, China=11, India=27
  - Not exactly what we want...
  - Baseline “rich” has a 90/10 ratio of 5
- Three scenarios:
  - “Same”: Rich and poor identical
  - “2-fold 90/10”: Identical at 100th percentile, 90/10 twice as large in poor.
  - “2-fold uniform”: Poor is 1/2 as productive in each variety.

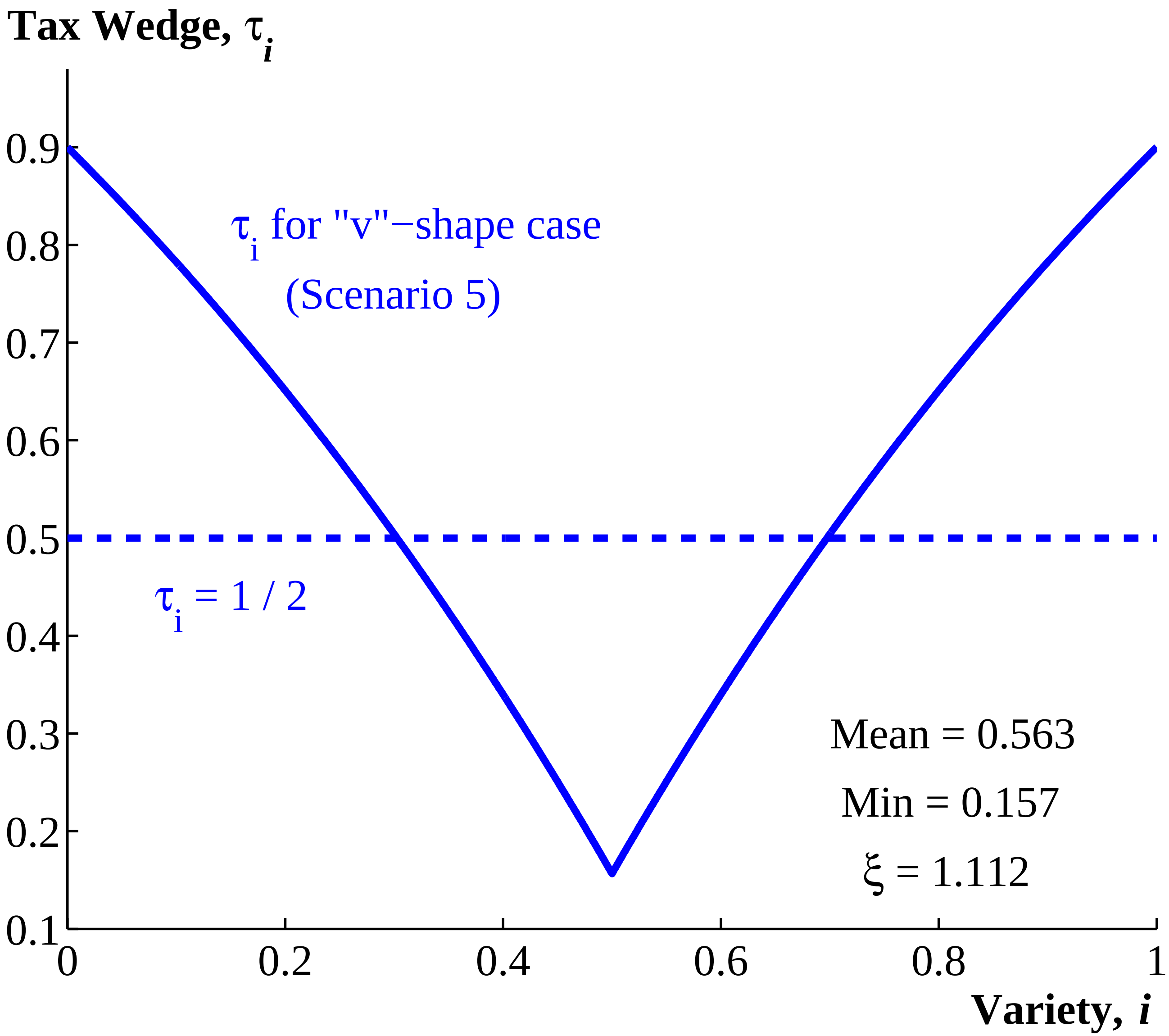
Assumed TFP: Three Scenarios



Tax Wedges

- Initially: Two interesting examples. Later: Hsieh-Klenow.
- Rich country has no distortions: $\tau_i^{rich} = 0$.
- Poor country, Two alternatives:
  - Symmetric case: $\tau_i^{poor} = 1/2$.
  - “v”-shaped wedges: Distorts both weak links and superstars.

Assumed Tax Wedges in Poor: Two Cases



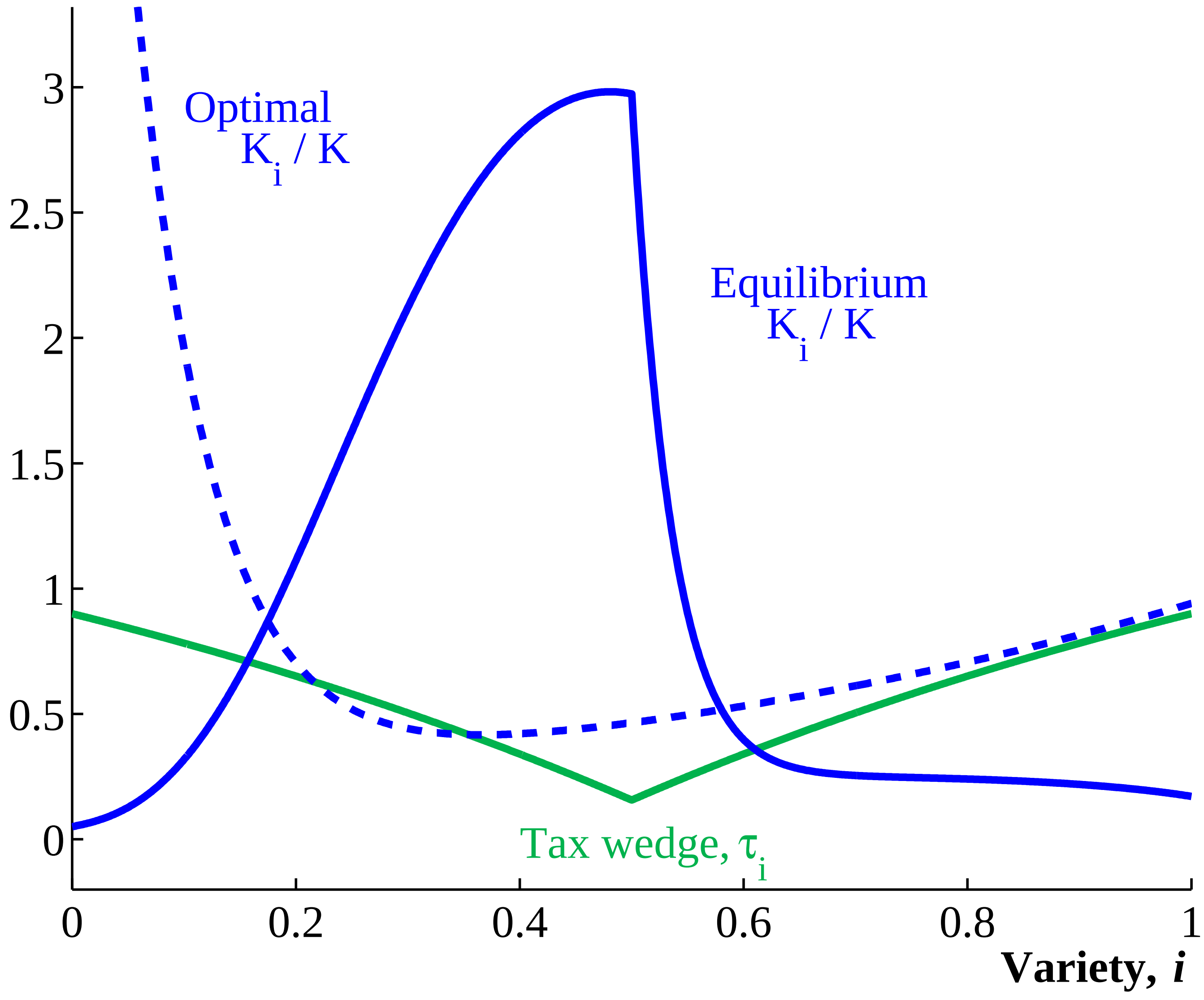
Parameter Choices

Parameter	Value	Comment
α	1/3	Conventional value for capital share
$\bar{h}^r/\bar{h}^p$	2	Standard contribution from education
θ	1/1.2	Consistent with 20% markups
ρ	-1	Elasticity of substitution is 1/2
$\bar{A}^r$	1	Normalization
$\bar{A}^p$	{1,1/2}	Illustrative purposes
γ^r	2	Gives a 90/10 ratio of 4.96
γ^p	{2,2.87}	Doubles the 90/10 ratio
$\bar{\tau}_0$	0.9	Maximum tax rate
ξ	...	To match capital-output ratio factor of 3

Output per Worker Ratios: “Rich” vs. “Poor”

Scenario	TFP Case	Tax Case	No Intermediate Goods $\sigma = 0$	Baseline Case $\sigma = 1/2$	*Multiplicative Factor*
1.	Same	$\tau_i = 1/2$	2.8	5.3	*1.9*
2.	$2\times$ @ 90/10	$\tau_i = 1/2$	3.1	12.9	*4.1*
3.	$2\times$ uniform	$\tau_i = 1/2$	8.0	42.7	*5.3*
4.	Same	“v”-shape	6.3	19.6	*3.1*
5.	$2\times$ @ 90/10	“v”-shape	7.9	53.2	*6.8*
6.	$2\times$ uniform	“v”-shape	17.8	156.5	*8.8*

The Allocation in Scenario 5



Output per Worker Ratios: Robustness

Scenario	No Inter-mediates $\sigma = 0$	Cobb-Douglas	*Robustness Results* $\theta = 0.9$ (EofS=10)	$\theta = 1/2$ (EofS=2)	"Leontief" $\rho = -100$
Ratio of output per worker:					
1.	2.8	5.3	5.3	5.3	5.3
2.	3.1	19.6	12.3	17.5	14.4
3.	8.0	42.7	42.7	42.7	42.7
4.	6.3	8.8	24.2	11.9	22.4
5.	7.9	32.2	62.3	40.7	72.9
6.	17.8	70.2	193.3	95.1	178.9

Output per Worker Ratios: Robustness (Multipliers)

Scenario	No Inter-mediates $\sigma = 0$	Cobb-Douglas	*Robustness Results* $\theta = 0.9$ (EofS=10)	$\theta = 1/2$ (EofS=2)	"Leontief" $\rho = -100$
Multiplicative factor relative to $\sigma = 0$:					
1.	1.0	1.9	1.9	1.9	1.9
2.	1.0	6.2	3.9	5.6	4.6
3.	1.0	5.3	5.3	5.3	5.3
4.	1.0	1.4	3.8	1.9	3.5
5.	1.0	4.1	7.9	5.2	9.2
6.	1.0	3.9	10.8	5.3	10.0

A Calibration based on Hsieh-Klenow (2007)

- Does not map particularly well into this framework
  - Within industry only, not distortions between as well
  - Value-added instead of gross output
  - Distortion measure also includes distortions between factors
- Still, perhaps useful in light of limited measures.
- Focus on China and India
  - China: 8.9 times poorer than U.S.
  - India: 13.4 times pooer than U.S.

Output per Worker Ratios: Hsieh-Klenow

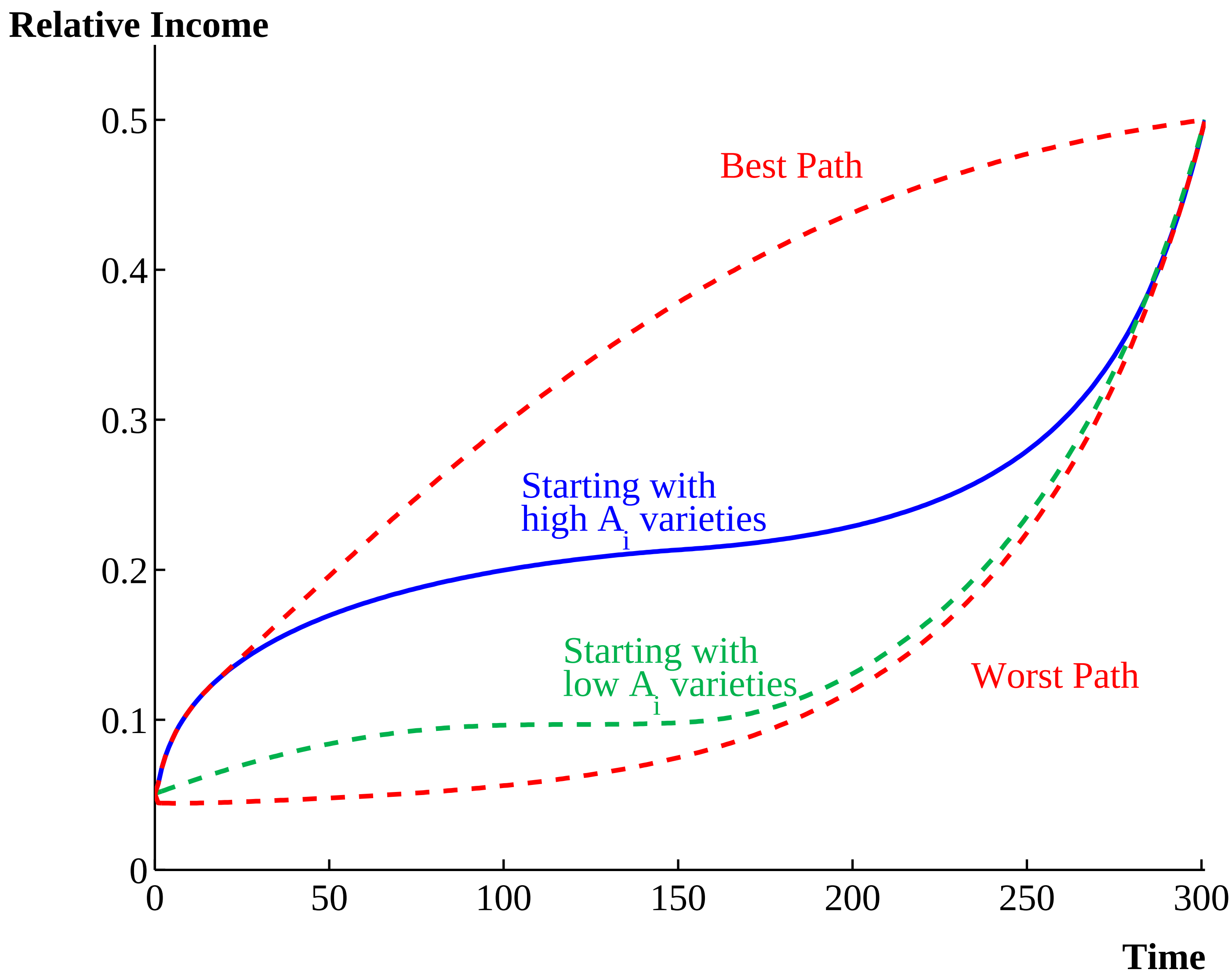
Scenario	Description	"Average" TFP	No Intermediates $\sigma = 0$	Base Case $\sigma = 1/2$	*Multiplicative Factor*
7.	Baseline	0.498	3.9	14.8	*3.8*
8.	Identical TFPs	1.000	3.1	3.4	*1.1*
9.	$\nu_a^{rich} = \nu_a^{poor} = 1.07$	0.750	4.7	8.0	*1.7*
10.	$\nu_a^{rich} = \nu_a^{poor} = .5$	0.750	3.4	6.5	*1.9*
11.	$\nu_a^{rich} = .5$, $\nu_a^{poor} = .75$	0.559	3.7	11.9	*3.2*
12.	11, but $\nu_{aw} = 0$	0.559	3.0	10.5	*3.5*

Baseline has $\theta = 2/3$, $\rho = -1$, $\bar{h} = 1.52$. See Table 4 in paper.

IV. Making Development Hard

- A large multiplier may make the development problem easy to solve.
- However, complementarity can dampen this effect
  - If there are numerous weak links, reforms to one or two can have small effects.
- Example: Consider Scenario 4 above
  - “V”-shaped tax wedges and a 2-fold difference in h
  - Otherwise rich and poor countries are identical
  - Sequence of reforms: eliminate one tax wedge at a time (cumulative, approximate continuum w/ 300 grid points)

Fig 5. Cumulative Effect of Reforms



Multinationals and Trade

- Some reforms may affect many sectors at once
- Trade reforms are an example
  - Import intermediate goods at weak links
  - Special economic zones
- If poorest countries are closed, the income calculations above provide a useful benchmark
  - But reform paths could be very different...
- Domestic weak links can still be crucial
  - Contract enforcement, knowledge, property rights, energy, transportation, distribution, etc.

Conclusions

- Intermediate goods and Complementarity provide multipliers
  - Intermediate goods: large effect, relatively easily calibrated.
  - Complementarity: Hard to calibrate, offset by substitution?
- Directions for further research
  - What about a much richer input-output structure?
  - Redo Hsieh and Klenow (2008) with intermediate goods
  - Measuring weak links and misallocation

N Sector Input-Output Model

$$Y_i = A_i (K_i^{\alpha_i} H_i^{1-\alpha_i})^{1-\sigma_i} x_{i1}^{\sigma_{i1}} x_{i2}^{\sigma_{i2}} \cdot \ldots \cdot x_{iN}^{\sigma_{iN}}, \quad A_i = A\epsilon_i$$

$$C_j + \sum_{i=1}^{N} x_{ij} = Y_j$$

$$\sum_{i=1}^{N} K_i \leq K, \;\; \sum_{i=1}^{N} H_i \leq H$$

$$Y = C_1^{\beta_1} C_2^{\beta_2} \cdot \ldots \cdot C_N^{\beta_N}, \quad \sum_{i=1}^{N} \beta_i = 1$$

Allocating Resources and Results

Definition 1 *The symmetric allocation has* $K_i = \bar{K} \equiv K/N$, $H_i = \bar{H} \equiv H/N$, *and* $x_{ij} = \bar{x}Y_j$.

Proposition 0.1 *Let* $\beta \equiv$ *vector of* β_i *and* $B \equiv$ *matrix of* σ_{ij}. *Under the symmetric allocation,*

$$Y = A^{\phi} \bar{K}^{\tilde{\alpha}} \bar{H}^{1-\tilde{\alpha}} \epsilon \tag{1}$$

where

$\phi \equiv \beta'(I - B)^{-1}\mathbf{1}$,
$\tilde{\alpha} \equiv \sum_i \sum_j \beta_i \ell_{ij}(1 - \sigma_j)\alpha_j$,
$\ell_{ij} \equiv$ *elements of Leontief inverse* $(I - B)^{-1}$.

Some Corollaries

Corollary 1 *Under the symmetric allocation,*

$$\frac{\partial \log Y}{\partial \log A} = \beta'(I - B)^{-1}\mathbf{1}. \tag{2}$$

Corollary 2 *Suppose* $\sum_{j=1}^{N} \sigma_{ij} = \bar{\sigma}$. *Then under the symmetric allocation,*

$$\frac{\partial \log Y}{\partial \log A} = \frac{1}{1 - \bar{\sigma}}. \tag{3}$$

I-O Multipliers for 1-Digit Data

Country	Input-Output Multiplier $\beta'(I-B)^{-1}\mathbf{1}$	"As-if" Intermediate Share	Actual Intermediate Share
United States	1.82	0.449	0.462
Japan	1.71	0.415	0.465
China	2.60	0.615	0.641
India	1.66	0.396	0.467

Source: OECD Input-Output Database.