

# The Dynamic Effect of Openness on Income Distribution and Long-Run Equilibrium

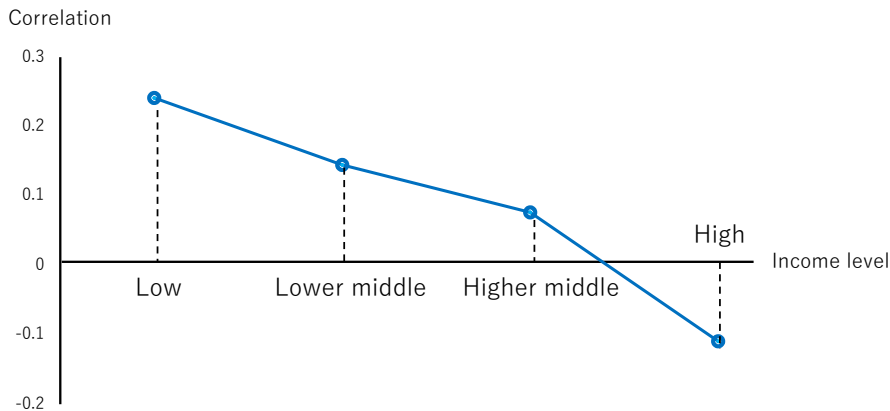
Tatsuya ASAMI

Graduate School of Economics, Kobe University (D1)  
azutotatsu@gmail.com

The Japan Society of International Economics Kansai  
July 21, 2018

# Trade and Inequality in Different Income Level

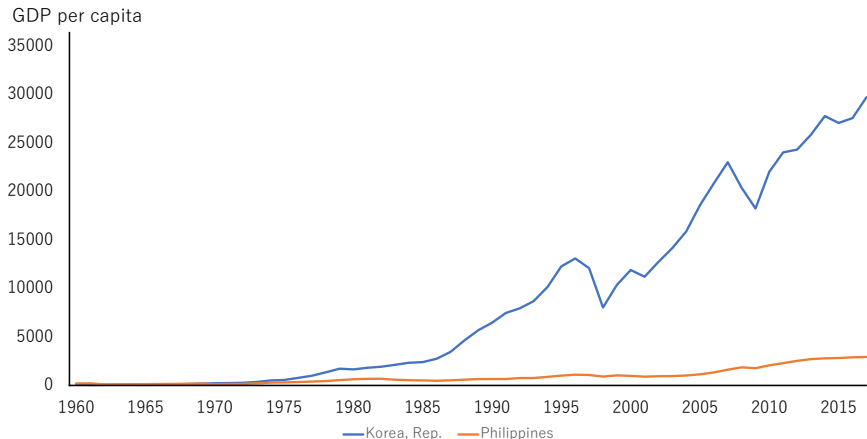
Figure 1 : Trade (% GDP) and Gini Index in 2010



Source: World Bank (2018) <https://data.worldbank.org/>

# Long-Run Difference

Figure 2 : Two countries are open at 1960



Source: World Bank (2018) <https://data.worldbank.org/>

# Literature

## Empirical analysis:

- Feenstra and Hanson (1996, A.E.R.)  
Outsourcing  $\Rightarrow$  inequality  $\uparrow$  in U.S.
- Meschi and Vivarelli (2009, World Dev.)  
Trade  $\Rightarrow$  inequality  $\uparrow$  in developing countries

## Theoretical analysis:

- Galor and Zeira (1993, R.E. Stud.)  
Initial wealth distribution  $\Rightarrow$  Long-run distribution
- Falvey et al. (2010, J.I.E.)  
Delay of trade liberalization  $\Rightarrow$  Benefit from trade  $\uparrow$
- Aghion and Bolton (1997, R.E. Stud.)  
Development process  $\Rightarrow$  Inequality
- Galor and Moav (2004, R.E. Stud.)  
Inequality  $\Rightarrow$  Development process

# Position in the Literature

	steady state	transition	closed	opening
Galor and Zeira (1993)	○			○
Falvey et al. (2010)		○		○
Aghion and Bolton (1997)	○	○	○	
Galor and Moav (2004)		○	○	
This paper	○	○	○	○

# Main Results

## — Inequality

- open regimes  $>$  closed economy (less developed)
- closed economy  $>$  open regimes (developing)

## — What determines long-run equilibrium?

- Galor and Zeira (1993): Initial wealth distribution (exogenous)
- This paper: Wealth distribution at market opening (endogenous)

# Setup

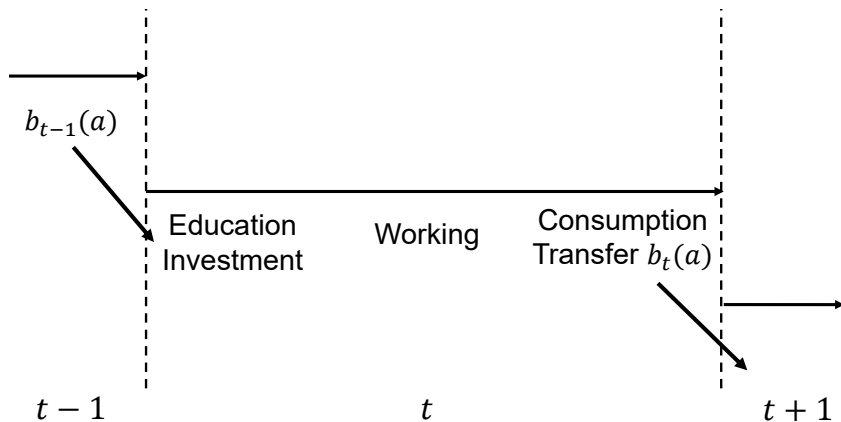
## Households

- Lifetime: one period
- Continuum heterogeneous Individuals in terms of ability ( $a \in [0, 1]$ ): efficiency as **skilled labor**
- Intergeneration: transfer
- Initial transfer: independent of ability

## Productions

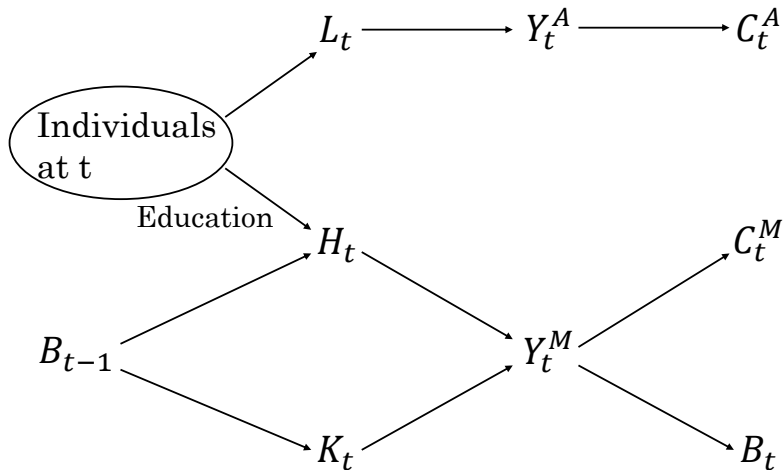
- Three factors;  $K$ ,  $L$  and  $H$
- Two final goods:  $Y^A(L)$  and  $Y^M(K, H)$
- Perfectly competitive markets

# Overview (Household $a$ )





# Overview (Productions)



# Productions and Factor Prices

$$Y^A(L) = AL,$$

$$Y^M(K, H) = M [\alpha K^{(\sigma-1)/\sigma} + (1 - \alpha)H^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)}. \quad (1)$$

$$w^L = Ap, \quad w^H = w^H(k), \quad r = r(k),$$

- $p$ : price of  $Y^A$  in units of  $Y^M$
- $k = K/H$

## Problem of Individual $a$

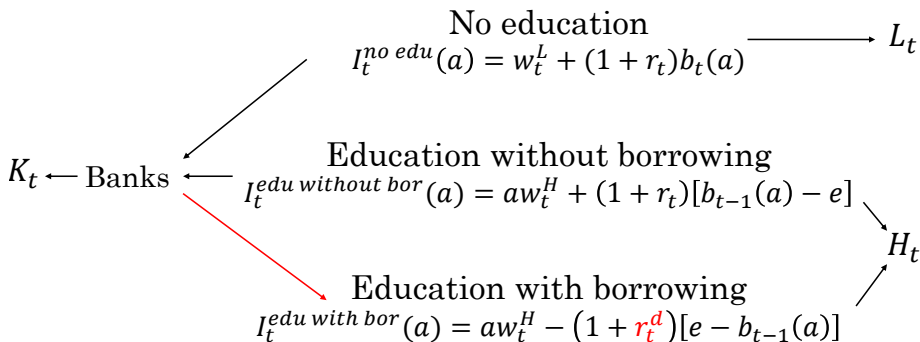
$$\max (1 - \beta) [\gamma \ln c_t^A + (1 - \gamma) \ln c_t^M] + \beta \ln b_t, \quad (2)$$

$$\text{s.t. } p_t c_t^A + c_t^M + b_t = I_t(a). \quad (3)$$

For given income  $I_t(a)$ , FOCs are,

$$\begin{aligned} c_t^A(a) &= [(1 - \beta)\gamma/p_t] I_t(a), \\ c_t^M(a) &= (1 - \beta)(1 - \gamma) I_t(a), \\ b_t(a) &= \beta I_t(a). \end{aligned} \quad (4)$$

# Working, Education and Income



$$r_t^d = r_t + z. \quad (5)$$

# Borrowing and Education Choice

Income of individuals depends

- education
- borrowing for education cost  $e$

$$I_t(a) = \begin{cases} \max\{I_t^{no\ edu}(a), I_t^{edu\ without\ bor}(a)\}, & \text{if } b_{t-1}(a) \geq e. \\ \max\{I_t^{no\ edu}(a), I_t^{edu\ with\ bor}(a)\}, & \text{if } b_{t-1}(a) < e. \end{cases} \quad (6)$$

$$\text{cutoff ability } a_t^e \Leftarrow \begin{cases} I_t^{no\ edu}(a) = I_t^{edu\ without\ bor}(a) \\ \text{or} \\ I_t^{no\ edu}(a) = I_t^{edu\ with\ bor}(a) \end{cases}$$

# Aggregate Supplies

— Factor supplies at  $t$ :

$$\begin{aligned}
 K(a^e(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}), B_{t-1}) &= B_{t-1} - [1 - G(a^e(\cdot))]e, \\
 H(a^e(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]})) &= \int_{a^e(\cdot)}^1 a \, dG(a), \\
 L(a^e(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]})) &= G(a^e(\cdot)),
 \end{aligned} \tag{7}$$

where  $B_{t-1} = \int_0^1 b_{t-1}(a) \, dG(a)$ .

— Goods supplies at  $t$ :  $Y^A(L(\cdot))$  and  $Y^M(K(\cdot), H(\cdot))$ .

Aggregate supplies are functions of  $p_t$ ,  $k_t$  and  $\{b_{t-1}(a)\}_{a \in [0,1]}$ .

# Aggregate Demands

— Aggregate demands of goods at  $t$ :

$$C^A(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}) = \frac{(1 - \beta)\gamma}{p_t} \int_0^1 I(r_t, w_t^L, w_t^H, b_{t-1}(a); a) dG(a). \quad (8)$$

$$C^M(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}) = (1 - \beta)(1 - \gamma) \int_0^1 I(r_t, w_t^L, w_t^H, b_{t-1}(a); a) dG(a).$$

— Transfer of agents at  $t$

$$b_t(a) = \beta I(r_t, w_t^L, w_t^H, b_{t-1}(a); a), \quad \text{for all } a \in [0, 1]. \quad (9)$$

Aggregate demands are functions of  $p_t$ ,  $k_t$  and  $\{b_{t-1}(a)\}_{a \in [0,1]}$ .

# Dynamic Equilibrium

## Definition 1

For all  $t = 1, 2, \dots, \infty$  and for given  $b_0$ ,  $(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]})$  satisfies

- *factors market equilibrium condition*

$$k_t = \frac{K(a^e(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}), B_{t-1})}{H(a^e(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}))}.$$

- *goods market equilibrium condition*

$$Y^A[L(a^e(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}))] \\ = C^A(p_t, k_t, \{b_{t-1}(a)\}_{a \in [0,1]}).$$

- *Transition of transfer*

$$b_t(a) = \beta I(r(k_t), w^L(p_t), w^H(k_t), b_{t-1}(a); a) \text{ for all } a \in [0, 1].$$



# Steady States

## Definition 2

We call dynamic equilibrium as steady state if

$$b_{t-1}(a) = b_t(a) \quad \text{for all } a \in [0, 1].$$

## Proposition 3 (Existence)

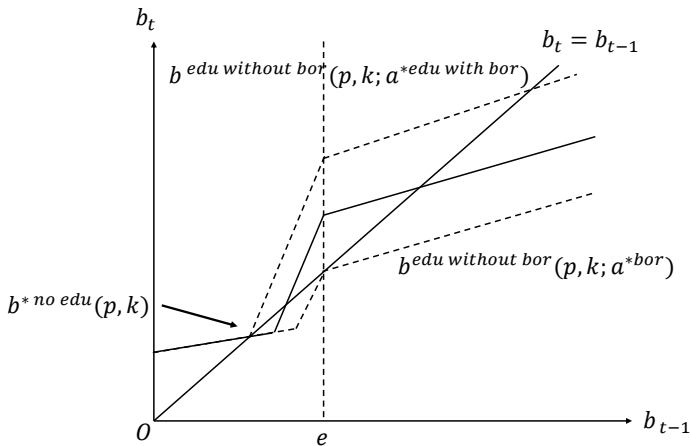
There exist steady state(s) if

- $\lim_{k \rightarrow \infty} \frac{\beta}{1-\gamma+\beta\gamma} [1 + r(k)] \leq 1$
- $\exists b_0 > 0$  s.t.  $b_1(0) > b_0$

With incomplete credit market  $r^d > r$ ,  
there may exist **multiple** steady states.

# Possibility of Multiple Steady States

$$b^*(p, k; a) = \begin{cases} b^{*no\ edu}(p, k) & \text{if } a < a^{*e}, \\ b^{*edu\ without\ bor}(p, k; a) & \text{if } a \geq a^{*e}, \end{cases} \quad (10)$$



# Transfer and Cutoff Abilities

$b^{*no\ edu}(p, k)$ ,  $b^{*edu\ with\ bor}(p, k; a)$ ,  $b^{*edu\ without\ bor}(p, k; a)$ :  
transfer at steady states ( $b_t(a) = b_{t-1}(a)$ ).

Three cutoff abilities:

— borrowing

$$a^{*bor}(p, k) \Leftarrow b^{*edu\ without\ bor}(p, k; a) = e,$$

— education

$$a^{*edu\ with\ bor}(p, k) \Leftarrow b^{*no\ edu}(p, k) = b^{*edu\ with\ bor}(p, k; a),$$

$$a^{*edu\ without\ bor}(p, k) \Leftarrow b^{*no\ edu}(p, k) = b^{*edu\ without\ bor}(p, k; a).$$

# Transition of Endogenous Variables (1)

— Early stage:  $b_t(a) > b_{t-1}(a)$  for all  $a$ ,

- Supply side (education and working)

- education  $\uparrow$  ( $a^e \downarrow$ )

- $L \downarrow$

- $Y^A \downarrow$

- Demand side

- Aggregate income  $\uparrow$

- $C^A \uparrow$

$\Rightarrow p (= p^A/p^M) \uparrow$  (Proposition 6)

$k \uparrow$  ( $K \uparrow$ ) unless  $r^d \gg r$

$w^L(p) \uparrow$ ,  $w^H(k) \uparrow$  and  $r(k) \downarrow$

## Transition of Endogenous Variables (2)

— Late stage:  $B_t > B_{t-1}$ ,  $b_t(a) < b_{t-1}(a)$  for some  $a$ ,

- Supply side (education and working)

- $I(a^e) \uparrow$  ( $a^e \downarrow$ )

- $L \downarrow$

- $Y^A \downarrow$

- Demand side

- Aggregate income  $\uparrow$

- $C^A \uparrow$

$$\Rightarrow p (= p^A/p^M) \uparrow$$

$$k \uparrow (K \uparrow) \text{ unless } r^d \gg r$$

$$w^L(p) \uparrow, w^H(k) \uparrow \text{ and } r(k) \downarrow$$

# Market Opening on Prices

- home country: during transition
- world economy: steady state
- parameter is common

$$\Rightarrow p^w > p, k^w > k$$

Table 1 : Market opening and prices

	$p$	$w^L$	$w^H$	$r$
Free trade (goods only)	↑	↑	depending on $k$	depending on $k$
+ Capital movement	↑	↑	↑	↓

# Numerical Examples

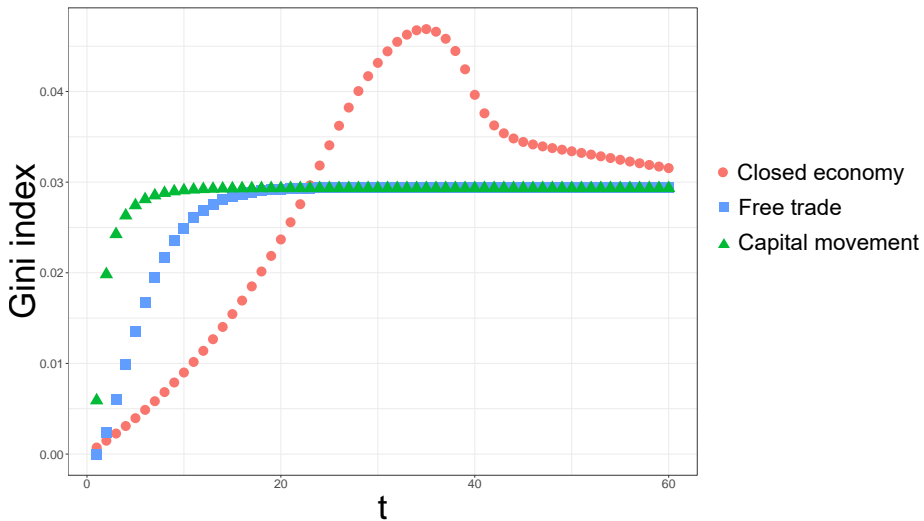
Parameters we use are cited from Harris and Robertson (2013, J.I.E.) and Lim and McNelis (2016, Econ. Modelling).

Table 2 : Parameters

$A$	$M$	$\alpha$	$\beta$	$\gamma$	$\sigma$	$\delta$	$e$	$z$
3	3	0.5	0.5	0.5	1.2	0.04,	2,	0.5

The initial condition:  $b_0(a) = 0.2$  for all  $a$ .

# Transition of Inequality





# Inequality and Market Opening

The key factors of inequality:

- difference in ability (skill premium).
- difference in received transfer (rental rate).

— In the early stage of development,

- Transfer is less accumulated  $\Rightarrow$  ability is main factor
- Inequality: open regimes  $>$  closed economy

— During development,

- Transfer is accumulated enough  
 $\Rightarrow$  received transfer is main factor
- Inequality: closed economy  $>$  open regimes

# Timing of Opening and Long-Run Outcome

Suppose a small country;  $r^d - r$  is large

— Earlier free trade leads to

- more accumulation of  $b$  due to increase in aggregate income
- $r$  and revenue from capital  $\downarrow$
- $H \downarrow$  and  $w^H \uparrow$

— Earlier capital movement leads to

- more capital accumulation due to inflow of capital
- $r$  and revenue from capital  $\downarrow$
- $H \downarrow$

## Concluding Remark

In closed and developing countries,

— Inequality

- In the least developed economy,  
open regimes  $>$  closed economy;  $\Leftarrow$  higher skill premium.
- In developing economy,  
closed economy  $>$  open regimes;  $\Leftarrow$  higher rental rate.

— Long-run outcome

- Earlier market opening may leads to poor steady state
  - smaller rental rate (free trade)
  - outflow of rental revenue (capital movement)

# References

Aghion, P. and Bolton, P. (1997). A theory of trickle-down growth and development. *Review of Economic Studies*, 64(2):151-172.

Falvey, R., Greenaway, D., and Silva, J. (2010). Trade liberalisation and human capital adjustment. *Journal of International Economics*, 81(2):230-239.

Feenstra, R. C. and Hanson, G. H. (1996). Globalization, outsourcing, and wage inequality. *American Economic Review*, 86(2):240-245.

Galor, O. and Moav, O. (2004). From physical to human capital accumulation: Inequality and the process of development. *Review of Economic Studies*, 71(4):1001-1026.

Galor, O. and Zeira, J. (1993). Income distribution and macroeconomics. *Review of Economic Studies*, 60(1):35-52.

Harris, R. G. and Robertson, P. E. (2013). Trade, wages and skill accumulation in the emerging giants. *Journal of International Economics*, 89(2):407-421.

Lim, G. C. and McNelis, P. D. (2016). Income growth and inequality: The threshold effects of trade and financial openness. *Economic Modelling*, 58:403-412.

Meschi, E. and Vivarelli, M. (2009). Trade and income inequality in developing countries. *World Development*, 37(2):287-302.