Advanced Economic Growth: Lecture 23: Structural Transformations and Market Failures in Development (Part 1)

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Introduction I

- Development and structural change come with transformation of economy:
  - major social changes and greater coordination of economic activities.
- Think of relatively developed countries nearer ("notional") frontier of production possibilities set than less-developed.
- Potential reasons (models along both lines):
  1. Reaching frontier requires large amount of capital or specific technological advances.
  2. Severe market failures.

Introduction II

- Structural transformations:
  - Limited by amount of capital or technology.
    - ★ Development accompanied with financial development, enabling more risk sharing and investment in higher productivity activities.
  - Demographic transition and links to investments in human capital.
  - Increase in the population living in urban areas via migration:
    - ★ Development allocating workers to where marginal product is higher
    - ★ Dual economy structure in equilibrium slow down this reallocation.
  - Structure of production. The internal organization of firms:
    - ★ Stage of development captured by distance to the world technology frontier.
    - ★ Distance to frontier affecting whether unsuccessful entrepreneurs will be replaced by or not.

Introduction III

- Market failures and failure to take advantage of new technologies.
- Less-developed economies "stuck" in "development trap:"
    - Different types of market failures:
        - multiple equilibria due to aggregate demand externalities.
        - income inequality and imperfect capital markets.
    - Emphasize difference between multiple equilibria and multiple steady states.

Financial Development I

- Key aspect of structural transformation: change in financial relations, financial deepening.
- Financial development brings about complementary changes:
  1. Better diversification of aggregate risks:
     - leads to better allocation of funds across sectors/projects
  2. Risk sharing and consumption smoothing: better diversification of *idiosyncratic risks*.
     - leads to better allocation of funds across individuals.
  3. Reduce credit constraints on investors:
     - allows transfer of funds to individuals with better investment opportunities.
- 2 and 3 affect distribution of income: individuals might take riskier actions.

Financial Development II

- Overlapping generations economy, each individual lives for two periods.
- Preferences:

$$\mathbb{E}_t U(c(t), c(t+1)) = \log c(t) + \beta \mathbb{E}_t \log c(t+1), \qquad (1)$$

- Preferences ensure constant savings rate.
- No population growth, each generation normalized to 1.
- Each individual born with labor endowment l, distribution function $G(l)$ over support $[\underline{l}, \bar{l}]$.
- Distribution of labor endowments is constant over time with mean $L = 1$
- Labor supplied inelastically by all individuals in period 1 of their lives.
- In period 2 of their lives, can't supply labor and consume capital income.

Financial Development III

- Aggregate production function:

$$Y(t) = K(t)^{\alpha} L(t)^{1-\alpha} = K(t)^{\alpha},$$

- Only risk is in transforming savings into capital.
- Agents can either save using:
  - safe technology with rate of return q (in terms of capital at the next date) or
  - risky technology with return $Q + \varepsilon$, where ε is a mean i.i.d. stochastic shock and

$$Q > q.$$

- Individuals have to choose one of these two technologies rather than dividing their savings between the two.
- Note because ε is i.i.d. *across individuals*, if individuals could pool would get rid of idiosyncratic risk and enjoy return Q.

Financial Development IV

- Assume that this is not possible because of *informational problem*—return of an individual's saving decision not observed by other individuals unless some financial monitoring is undertaken.
- Financial monitoring has cost $\xi > 0$: paying cost ξ, each individual can join the financial market, become part of "financial coalition", and return of his savings are all observed.
- Note joining financial markets is more attractive for richer individuals, since fixed cost is less important for them.
  - plausible and consistent with microdata.
- If the individual does not join the financial markets, no other agent can observe realization of returns on his savings and opportunistic behavior prevents any risk sharing.
- Assume that ε's distribution places positive probability on $\varepsilon = -Q$.
- Hence without some type risk sharing, individuals would always choose safe project.

Financial Development V

- Economy starts with some initial capital stock of $K(0)$.
- Individual with labor endowment l_i will have labor earnings

$$W_i(0) = w(0)\, l_i,$$

where

$$w(t) = (1-\alpha) K(t)^{\alpha} \tag{2}$$

- After labor incomes are realized, individuals first make their savings decisions and then choose which assets to invest in.
- Preferences in (1) imply constant saving fraction

$$\frac{\beta}{1+\beta}$$

- Hence value to not participating in financial markets for individual i at time t is

$$V_i^N(W_i(t), R(t+1)) = \log\left(\frac{W_i(t)}{1+\beta}\right) + \beta \log \frac{\beta R(t+1)\, q W_i(t)}{1+\beta},$$

Financial Development VI

- Taking part in financial markets (presuming enough other individuals take part to provide risk diversification), value will be:

$$\begin{aligned} V_i^F\left(W_i\left(t\right), R\left(t+1\right)\right) &= \log\left(\frac{1}{1+\beta}\left(W_i\left(t\right)-\xi\right)\right) \\ &\quad +\beta\log\left(\frac{\beta R\left(t+1\right)Q}{1+\beta}\left(W_i\left(t\right)-\xi\right)\right), \end{aligned}$$

- Comparison of expressions gives the threshold level:

$$W^* \equiv \frac{\xi}{1-\left(q/Q\right)^{\beta/(1+\beta)}} > 0 \qquad (3)$$

- Note W^* is independent of rate of return on capital in the second period of the lives of the individuals, R (because of log preferences (1)).
- Individual earnings determined by individual labor endowments and the capital stock at time t, which determines $w\left(t\right)$ as given in (2).

Financial Development VII

- The fraction of individuals who will join financial market at time t, $g^F(t)$, is given by fraction who have $I_i \geq W^* / w(t)$.
- Using distribution $G(\cdot)$, the fraction of individuals investing in financial markets is:

$$g^F(t) \equiv 1 - G\left(\frac{W^*}{w(t)}\right) = 1 - G\left(\frac{W^*}{(1-\alpha)K(t)^\alpha}\right). \tag{4}$$

- Thus capital stock at time $t+1$ is

$$K(t+1) = \frac{\beta}{1+\beta}\left[\begin{array}{c} q\left(\int_{\underline{I}}^{\frac{W^*}{(1-\alpha)K(t)^\alpha}} I dG(I)\right)(1-\alpha)K(t)^\alpha \\ +Q\int_{\frac{W^*}{(1-\alpha)K(t)^\alpha}}^{\bar{I}} \left((1-\alpha)K(t)^\alpha I - \xi\right) dG(I) \end{array}\right], \tag{5}$$

- $K(t+1)$ is increasing in $K(t)$: there will be growth in capital stock (and output) provided that $K(t)$ is small enough.

Financial Development: Conclusions I

- Economic and financial development go hand-in-hand: as $K(t)$ increases, (4) implies more individuals join financial market.
  - More capital: more risk taking, better risk sharing, better composition of investment.
  - Economic development leads to endogenously higher productivity by improving allocation of funds.
- Potential causal effect of financial development on growth: if societies differ in their ξs.
- Richer agents will join financial market: *unequalizing* effect.

Financial Development: Conclusions II

- Financial market increases with $K(t)$: as economy grows, at least at early stages, unequalizing effect will become stronger.
- As $K(t)$ increases even further, eventually *equalizing* effect of the financial market:
  - Fraction joining and enjoying greater returns is steadily increasing.
  - If K^* is such that $\underline{I} \geq W^* / (1-\alpha)(K^*)^\alpha$, eventually all individuals join and receive same rate of return.
- Last two observations: consistent with *Kuznets curve*.
- Evidence on Kuznets curve is debated:
  - many European societies seem to have gone through a phase of increasing and then decreasing inequality during 19th century, but evidence for the 20th century is more mixed.
  - theoretical and empirical analysis and examination of mechanisms area of future research

Fertility, Mortality and the Demographic Transition I

- Striking differences in the level of population across countries and over time
- Figure (data from Maddison (2002)) shows levels and evolution of population (in log scale) over the past 2000 years.
  - Starting about 250 years ago: a significant increase in population growth rate in many areas
  - Population growth slows down in Western Europe sometime in 19th century (not so in Western Offshoots because of immigration).
  - But no similar slow down in less-developed parts: in many growth seems to have increased over past 50.
- One of the reasons: spread of antibiotics, basic sanitation and other health-care measures.
- Equally notable: *demographic transition* in Western Europe, i.e., the decline in fertility sometime during the 19th century.

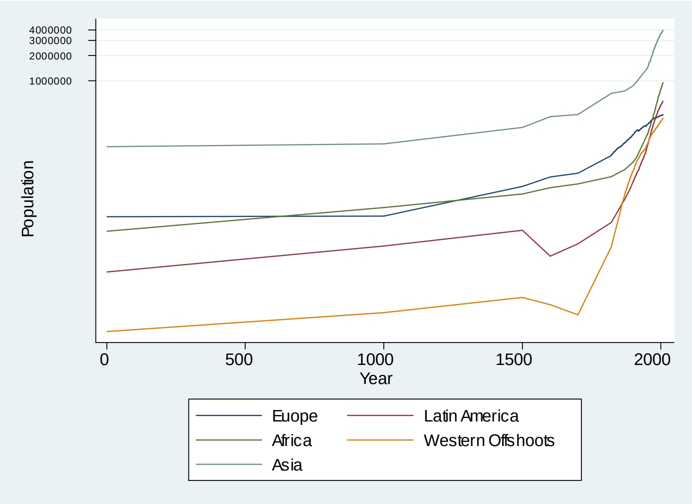


Figure: Total population in different parts of the world over the past 2000 years.

Fertility, Mortality and the Demographic Transition II

- Basic approaches to population dynamics and fertility:
  - Malthusian model and potential causes of the demographic transition:
    - *negative relationship* between population, endogenously determined, and income per capita.
    - dire prediction that population will adjust up or down (by births or deaths) until all individuals are at the subsistence level of consumption ("the dismal science")
  - Extension due to Gary Becker: tradeoff between quantity and quality of children that changes over process of development.

A Simple Malthusian Model I

- Non-overlapping generations model.
- $L(0) > 0$ given.
- Each individual living at time t supplies one unit of labor inelastically.
- Preferences

$$c(t)^{\beta}\left[y(t+1)(n(t+1)-1)-\frac{1}{2}\eta_0 n(t+1)^2\right], \tag{6}$$

  where:

  - $c(t)$=consumption of unique final good by individual himself,
  - $n(t+1)$=number of offsprings the individual has
  - $y(t+1)$=income of each offspring,
  - $\beta > 0$ and $\eta_0 > 0$.
  - Last term in square brackets is child-rearing costs; convex to reflect costs of having more and more children will be higher

A Simple Malthusian Model II

- Preferences introduce simplifying assumptions.
  1. Each individual allowed to have as many offsprings as it likes and not incorporate possible specialization in child-rearing and market work within family.
  2. "Warm glow" type altruism: utility not from the utility of their offspring, but from some characteristic of their offsprings.
  3. Costs of child-rearing are in "utils" rather than forgone income and current consumption multiplies both the benefits and the costs of having additional children.
     - ★ Motivated by balanced growth type reasoning: demand for children will be independent of current income (otherwise, growth will lead to greater demand for children).
- There are no savings.

A Simple Malthusian Model III

- Production function for unique good:

$$Y(t) = Z^{\alpha} L(t)^{1-\alpha}, \tag{7}$$

where Z=total amount of land available for production.

- Land creates diminishing returns to labor, important element of Malthusian model.
- Normalize $Z = 1$.
- Assume land is owned by another set of agents, whose behavior will not be analyzed here: key is those receiving land rents do not supply labor and/or their offsprings do not make an important contribution to overall population growth.
- Population at time $t + 1$:

$$L(t+1) = n(t+1) L(t), \tag{8}$$

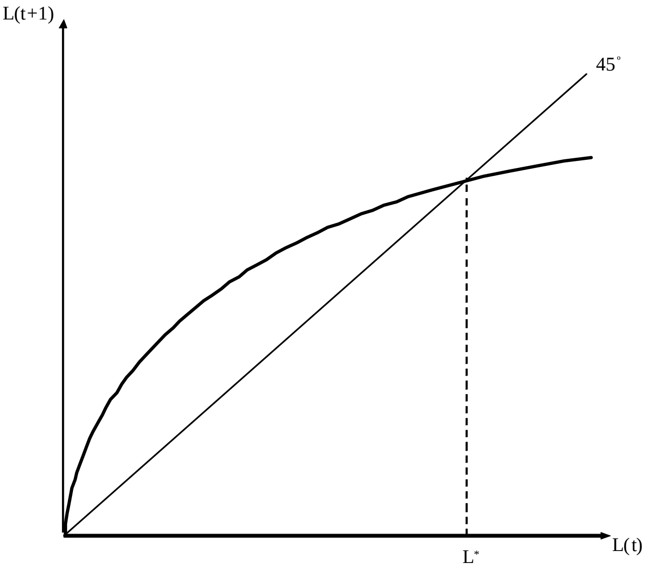


Figure: Population dynamics in this simple Malthusian model.

A Simple Malthusian Model IV

- Labor markets are competitive, so

$$w(t+1) = (1-\alpha) L(t+1)^{-\alpha}. \tag{9}$$

- Since there is no other source of income, also equal to income of each individual at $t+1$, $y(t+1)$.
- Thus individual with income $w(t)$ will maximize (6) subject to $c(t) \leq w(t)$, together with $y(t+1) = (1-\alpha) L(t+1)^{-\alpha}$.
- Implies individual takes population level in next period as given (since he is infinitesimal).
- Focus on symmetric equilibrium, which will require choice of $n(t+1)$ to be consistent with $L(t+1)$ according to equation (8).

A Simple Malthusian Model V

- Maximization problem gives $c(t) = w(t)$ and

$$n(t+1) = (1-\alpha) L(t+1)^{-\alpha} \eta_0^{-1}.$$

- Substituting for (8) and rearranging:

$$L(t+1) = (1-\alpha)^{\frac{1}{1+\alpha}} \eta_0^{-\frac{1}{1+\alpha}} L(t)^{\frac{1}{1+\alpha}}. \tag{10}$$

- Implies that $L(t+1)$ is an increasing concave function of $L(t)$.
- Law of motion for population implied by (10) resembles the dynamics of capital-labor ratio in the Solow growth model (or the overlapping generations model)

A Simple Malthusian Model VI

- Figure shows starting with any $L(0) > 0$, there exists a unique globally stable state state L^*:

$$L^* \equiv (1-\alpha)^{1/\alpha} \eta_0^{-1/\alpha}. \tag{11}$$

- If $L(0) < L^*$: population will adjust towards this steady-state level and (9) shows wages will fall.
- If $L(0) > L^*$: decline in population and rising real wages.

A Simple Malthusian Model VII

- With shocks to population economy will fluctuate around L^* (with an invariant distribution depending on distribution of shocks) and experience Malthusian cycles:
  - periods of increasing population and decreasing wages followed by decreasing population and increasing wages.
- Main difference from crudest version of Malthusian model: no biologically determined subsistence level of consumption.
- level of consumption will tend to a constant, not determined biologically, but by preferences and technology:

$$\begin{aligned} c^* &= (1-\alpha)\left(L^*\right)^{-\alpha} \\ &= \eta_0, \end{aligned}$$

The Demographic Transition I

- Extensions to study demographic transition: quality-quantity tradeoff along Gary Becker and two production technologies for producing the final good.
- Each parent can choose offsprings to be unskilled or skilled.
- Parent has to exert additional effort for child-rearing, $e(t) \in \{0, 1\}$. If he chooses not to, offsprings will be unskilled.
- $U(t)$ and $S(t)$=Population of unskilled and skilled, with

$$L(t) = U(t) + S(t).$$

- Malthusian (traditional) technology given by (7) and any worker can be employed with the Malthusian technology.
- Modern technology:

$$Y^M(t) = X(t) S(t). \tag{12}$$

The Demographic Transition II

- Productivity in modern technology is potentially time varying; only skilled workers.
- Also imposes that all skilled workers will be employed with this technology:
    - not true in general (may be excess supply), but true in equilibrium since parents would exert additional effort to endow offsprings with skills if they would work in traditional sector.
- Preferences modified from (6) to

$$c(t)^{\beta}\left[\begin{array}{c} y(t+1)(n(t+1)-1) \\ -\frac{1}{2}\left(\eta_0(1-e(t))+\eta_1 X(t+1)e(t)\right)n(t+1)^2 \end{array}\right]. \quad (13)$$

- i.e. if the individual decides invests in his offsprings' skills, instead of η_0 has to pay a cost proportional to amount of knowledge $X(t+1)$ that offspring has to absorb to use the modern technology.

The Demographic Transition III

- Assume that $X(0)\eta_1 > \eta_0$: even at initial level of modern technology rearing a skilled child is more costly.
- External learning-by-doing assumption as in Romer (1986):

$$X(t+1) = \delta S(t), \tag{14}$$

- Another important feature of this production function is that it does not use land.
- Output of traditional and modern sector are perfect substitutes—produce the same final good.
- Since all unskilled workers will work in traditional sector and all skilled workers in modern sector:

$$w^U(t) = (1-\alpha) U(t)^{-\alpha}, \tag{15}$$

and

$$w^S(t) = X(t), \tag{16}$$

The Demographic Transition IV

- Each individual will consume all his income and his income level has no effect on his fertility and quality-quantity decisions.
- Thus do not need to distinguish between high-skill and low-skill parents.
- Thus look at the optimal number of offsprings that an individual will have when he chooses $e(t) = 0$:

$$\begin{aligned} n^U(t+1) &= w^U(t+1)\,\eta_0^{-1} \\ &= (1-\alpha)\,U(t+1)^{-\alpha}\,\eta_0^{-1}, \end{aligned} \tag{17}$$

  where the second line uses (15).
- If parent decides $e(t) = 1$:

$$\begin{aligned} n^S(t+1) &= w^S(t+1)\,X(t+1)^{-1}\,\eta_1^{-1} \\ &= \eta_1^{-1}. \end{aligned} \tag{18}$$

The Demographic Transition V

- Comparison of (17) and (18) suggests that unless unskilled wages are very low, an individual who decides to provide additional skills to his offsprings will have fewer offsprings.
- Substituting back into utility function (13), utility (normalized by consumption, which does not affect his decision):

$$V^{U}(t) = \frac{1}{2}(1-\alpha)^{2} U(t+1)^{-2\alpha} \eta_0^{-1}$$

and

$$V^{S}(t) = \frac{1}{2} X(t+1) \eta_1^{-1}.$$

- Can never have an equilibrium in which all offsprings are skilled, since otherwise V^U would become unboundly large.
- Thus in equilibrium

$$V^{U}(t) \geq V^{S}(t). \tag{19}$$

- Two possible configurations: pure Malthusian economy or stylized representation of demographic transition.

Pure Malthusian Economy

- Law of motion of population is identical to previous version and never any investment in skills.
- $X(0)$ can be so low that (19) will hold as a strict inequality.
- All offsprings will be unskilled.
- The condition for this inequality to be strict is

$$X(0)\,\eta_1^{-1} < (1-\alpha)^2\,L(1)^{-2\alpha}\,\eta_0^{-1},$$

which uses that when there are no skilled workers there is no production in modern sector and thus $X(1) = X(0)$.

- No skilled children at date $t = 0$, but as long as $L(1)$ is less than L^* as given in (11), population will grow.
- Hence at some point (19) may hold with equality. For this never to happen:

$$X(0)\,\eta_1^{-1} < (1-\alpha)^2\,(L^*)^{-2\alpha}\,\eta_0^{-1}. \tag{20}$$

Stylized Demographic Transition I

- If last condition not satisfied: at some point individuals will start investing in the skills of their offsprings and the modern sector will have skilled workers to employ.
- From then on (19) must hold as equality.
- In that case, let fraction of parents having unskilled children be $u(t+1)$. Then,

$$\begin{aligned} U(t+1) &= u(t+1)\left(n^U(t+1)-1\right)L(t) \\ &= u(t+1)^{1/(1+\alpha)}(1-\alpha)^{2/(1+\alpha)}\eta_0^{-1/(1+\alpha)}L(t)^{1/(1+\alpha)} \end{aligned} \tag{21}$$

and

$$\begin{aligned} S(t+1) &= (1-u(t+1))\left(n^S(t+1)-1\right)L(t) \\ &= (1-u(t+1))\eta_1^{-1}L(t). \end{aligned} \tag{22}$$

Stylized Demographic Transition II

- To satisfy (19) as equality, need

$$X(t+1)\eta_1^{-1} = u(t+1)^{-2\alpha/(1+\alpha)} \times (1-\alpha)^{2(1-\alpha)/(1+\alpha)} \eta_0^{-(1-\alpha)/(1+\alpha)} L(t)^{-2\alpha/(1+\alpha)}. \quad (23)$$

- Equilibrium dynamics: determined by (21)-(23) together with (16). General picture:
  - if an economy starts with low $X(0)$ and low $L(0)$, but does not satisfy condition (20), economy will start in the Malthusian regime.
  - as population increases wages fall, and parents start finding it beneficial to invest in skills of children and firms start using modern technology.
  - parents that invest in skills of children have fewer children than parents rearing unskilled offsprings.
  - population growth and fertility are high at first, but as modern technology improves and demand for skills increases, larger fraction of parents invest in skills and population growth declines.
  - rate of population growth approaches η_1^{-1}.

The Demographic Transition: Conclusion

- Many ways of introducing quality-quantity tradeoffs.
- What spurs change in tradeoff may be increase in capital intensity of production, changes in wages of workers, or in wages of women affecting the desirability of market and home activities.
- Despite this emphasis on the quality-quantity tradeoff, there is relatively little direct evidence
- No general consensus on the causes of the demographic transition or on the role of the quality-quantity tradeoff.

Migration, Urbanization and The Dual Economy I

- As an economy develops more individuals move to cities and social changes associated with separation from small community and becoming part of larger more anonymous environment.
- Also some regard the replacement of "collective responsibility systems" by "individual responsibility systems" as an important social transformation. Related to
  - changes in living arrangements (villages versus cities, or extended versus nuclear families),
  - whether different types of contracts are enforced by social norms and communityor by legal institutions.
- Shift in importance of the market: more activities mediated via prices
- Illustrate main ideas focusing on migration from rural areas and urbanization.

Migration, Urbanization and The Dual Economy II

- Reallocation of labor from rural to urban related to *the dual economy*:
  - less-developed economies consist of modern sector and traditional sector, but imperfect connection between them.
  - traditional sector viewed as less efficient, thus lack of interaction also way of shielding from its more efficient competitor.
  - process of development: less efficient traditional sector replaced by more efficient modern one, and
  - lack of development: inability to secure such reallocation.
- First model of migration and dual economy building on Arthur Lewis (1954).
  - Useful starting point, but somewhat mechanical.
- Later models of the dual economy with informational problems and inappropriate technologies.

Surplus Labor and the Dual Economy I

- Main emphasis Lewis: *surplus labor*, i.e. less-developed economies have unemployed or underemployed labor often in the villages.
- Dual economy viewed as juxtaposition of modern sector with workers productively employed, and traditional sector where they are underemployed.
- Key feature is barriers to allocation of workers away from traditional sector towards urban areas and modern sector.
- Continuous-time infinite-horizon economy of two sectors or regions, urban and rural.
- Total population normalized to 1.
- At $t = 0$, $L^U(0)$ individuals in urban area and $L^R(0) = 1 - L^U(0)$ in rural.

Surplus Labor and the Dual Economy II

- Rural area: only agriculture and linear production function,

$$Y^A(t) = B^A L^R(0),$$

where $B^A > 0$.

- Urban area: manufacturing, that can only employ workers in urban area,

$$Y^M(t) = F\left(K(t), L^U(t)\right),$$

- F staisfies usual assumptions.
- Assume manufacturing and agricultural goods are perfect substitutes.
- Labor markets competitive in bothe areas.
- No technological change in either sector.

Surplus Labor and the Dual Economy III

- Key assumptions:
  1. Marginal product of labor, thus wage, in manufacturing will be higher than in agriculture.
  2. Barriers to mobility,thus slow migration of workers from rural to urban.
- Capital accumulates only out of savings of individuals in urban area,

$$\dot{K}(t) = sF\left(K(t), L^U(t)\right) - \delta K(t), \tag{24}$$

- Key is that greater output in modern sector leads to further accumulation of capital for modern sector.
- Alternative is size of modern sector directly influences its productivity growth, e.g. learning-by-doing externalities or endogenous technological change.
- Wage rates in the urban and rural:

$$w^U(t) = \frac{\partial F\left(K(t), L^U(t)\right)}{\partial L} \text{ and } w^R(t) = B^A.$$

Surplus Labor and the Dual Economy IV

- Assume

$$\frac{\partial F(K(0), 1)}{\partial L} > B^A, \tag{25}$$

- Migration dynamics:

$$\dot{L}^R(t) \begin{cases} = -\mu L^R(t) & \text{if } w^U(t) > w^R(t) \\ \in [0, -\mu L^R(t)] & \text{if } w^U(t) = w^R(t) \\ = 0 & \text{if } w^U(t) < w^R(t) \end{cases} \tag{26}$$

- Speed of migration independent of wage gap to simplify.
- Think of μ small: barriers to migration.
- (25): at $t = 0$, there will be migration.
- Moreover, assuming $K(0)/L^U(0)$ is below steady-state capital-labor ratio, wage will remain high and I continue to attract workers.

Surplus Labor and the Dual Economy V

- Define

$$k(0) \equiv \frac{K(0)}{L^U(0)}$$

and with per capita production function $f(k(t))$,

$$w^U(t) = f(k(t)) - k(t) f'(k(t)).$$

- Combining (24) and (26), as long as $f(k(t)) - k(t) f'(k(t)) > B^A$:

$$\dot{k}(t) = sf(k(t)) - (\delta + \mu\nu(t)) k(t), \tag{27}$$

- $\nu(t) \equiv L^R(t) / L^U(t)$ =ratio of rural to urban population.
- Notice rate of migration, μ, times ratio $\nu(t)$, plays role of rate of population growth in Solow model.
- When $f(k(t)) - k(t) f'(k(t)) \leq B^A$, no migration and $\dot{k}(t) = sf(k(t)) - \delta k(t)$.
- Focus on case $f(k(t)) - k(t) f'(k(t)) > B^A$.

Surplus Labor and the Dual Economy VI

- Define level of capital-labor ratio $\bar{k}$

$$f(\bar{k}) - \bar{k} f'(\bar{k}) = B^A, \tag{28}$$

- Once $\bar{k}$ is reached, migration stops and $\nu(t)$ remain constant and dynamics given by $\dot{k}(t) = sf(k(t)) - \delta k(t)$.
- Thus steady state always involve:

$$\frac{sf(\hat{k})}{\hat{k}} = \delta. \tag{29}$$

- Transitional dynamics: several cases. Suppose:
    1. $k(0) < \hat{k}$. Also implies $sf(k(0)) - \delta k(0) > 0$.
    2. $k(0) > \bar{k}$, which implies $f(k(0)) - k(0) f'(k(0)) > B^A$, so wages initially higher in urban.
    3. $sf(k(0)) - (\delta + \mu\nu(0)) k(0) < 0$: given distribution of population between urban and rural, initial migration will decline k.

Surplus Labor and the Dual Economy VII

- Economy starts with rural to urban migration.
- Since $\nu(0)$ is high, this reduces k in urban area (which evolves according to (27)).
- Then, two possibilities:
  1. Capital-labor ratio never falls below $\bar{k}$:
     - ★ Migration at maximum rate μ forever.
     - ★ Effect on $k(t)$ reduced as $\nu(t)$ declines with migration.
     - ★ Since $sf(k(0)) - \delta k(0) > 0$, at some point $k(t)$ will start increasing, and converge to $\hat{k}$.
     - ★ Convergence can take a long time and not monotonic: $k(t)$ and $w^U(t)$ first fall, then increase.
  2. Initial surge in migration reduces $k(t)$ to $\bar{k}$ at some point, say at date t'.
     - ★ Wages remain constant at B^A in both sectors and $\dot{L}^R(t)/L^R(t)$ adjusts exactly so that $k(t)$ remains at $\bar{k}$ for a while (when wages are equal, (26) admits migration between zero and μ).
     - ★ Ultimately, $\nu(t)$ will again decline sufficiently that $k(t)$ must start increasing.
     - ★ Then migration takes place at μ and economy again converges to $\hat{k}$.

Surplus Labor and the Dual Economy VIII

- Especially in the first case, economy has the flavor of a *dual economy*:
  - Wages and marginal product of labor higher in urban area
  - If μ is low reallocation of workers will be slow despite the higher wages.
  - Urban migration increases total output, but also slowly: workers allocated to where marginal product is higher.
- But be cautious in referring to this as "market failure": did not specify why migration is slow.
- Drawbacks:
  1. Migration too reduced-form but us at heart of the model and can't tell if optimal or suboptimal.
  2. Flavor of too little migration, but many less-developed economies urban overpopulated.
  3. Assumming manufacturing sector more productive than agriculture is crude; compensating differentials in less productive sector.

Community Enforcement, Migration and Development I

- Inspired by Banerjee and Newman (1998) and Acemoglu and Zilibotti (1999).
- Banerjee and Newman:
  - Traditional sector: low productivity but less affected by informational asymmetries than modern sector.
  - Process of development: reallocation from traditional to modern sector, slowed down by informational advantage of traditional sector.
- Acemoglu and Zilibotti (1999):
  - Development process as one of "information accumulation": enables more sophisticated contracts and more complex production relations.
  - Process is associated with changes in: technology, financial relations and social transformations.
- Simplified version of both of these papers, but similar economic mechanism.

Community Enforcement, Migration and Development II

- Rural areas subject to community enforcement: economic and social relationships not unduly affected by moral hazard.
- Cities: more productive activities, but other enforcement systems necessary to comply to social rules, contracts and norms.
- Enforcement systems have costs.
- Modern sector has learning-by-doing externalities: productivity advantage grows as more individuals migrate.
- Community enforcement advantage of villages slows down this process and may even lead to a development trap.
- Basic structure as previously.
- All labor markets are competitive and population is normalized to 1.

Community Enforcement, Migration and Development III

- 3 differences:

  1. Migration between the rural and urban areas is costless.
  2. Instead of capital accumulation, externality in manufacturing sector:

     $$Y^M(t) = X(t) F\left(L^U(t), Z\right),$$

     where $X(t)$ denotes productivity of modern sector and Z other factor with fixed supply (hence diminishing returns to labor), and F satisfies standard assumptions, and

     $$\dot{X}(t) = \eta L^U(t) X(t)^\zeta,$$

     where $\zeta \in (0, 1)$: externalities less than necessary to sustain endogenous growth.
  3. Rural areas have a comparative advantage in *community enforcement*: individual pays flow cost of $\xi > 0$ due to lack of community enforcement when in urban area.

Community Enforcement, Migration and Development IV

- All individuals maximize their utility, but savings do not matter for the key: don't need to specify utility functions, just realize all individuals would like to maximize the net present discounted value of their lifetime incomes.
- Each individual should work where net wage is higher (moving is costless).
- Interior equilibrium (both sectors active), wage equalization condition:

$$w^M(t) - \xi = w^A(t).$$

- Competitive labor markets imply:

$$w^M(t) = X(t) \frac{\partial F\left(L^U(t), Z\right)}{\partial L} \equiv X(t)\,\tilde{\phi}\left(L^U(t)\right),$$

- Function $\tilde{\phi}$ is strictly decreasing in view of standard assumptions on F.

Community Enforcement, Migration and Development V

- Substituting from the above, labor market clearing implies

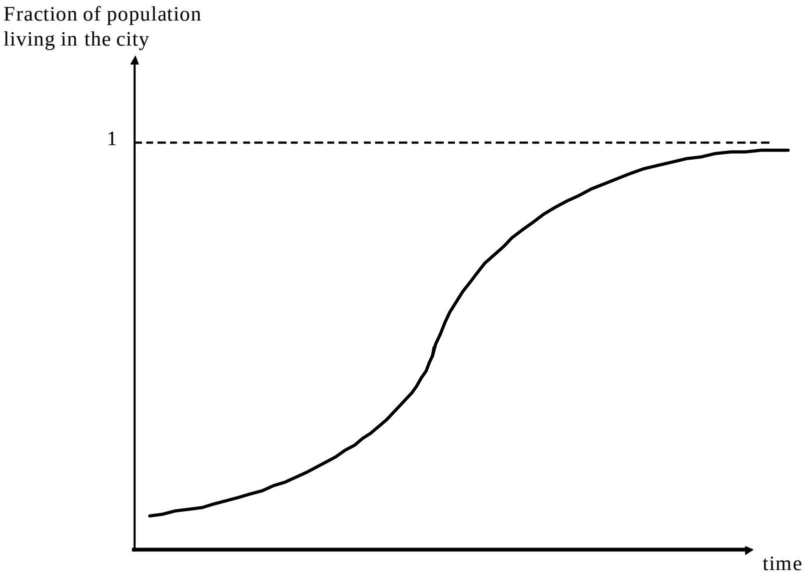
$$X(t)\,\tilde{\phi}\left(L^U(t)\right) = B^A + \xi,$$

or

$$L^U(t) = \tilde{\phi}^{-1}\left(\frac{B^A+\xi}{X(t)}\right) \equiv \phi\left(\frac{X(t)}{B^A+\xi}\right),$$

- Function ϕ is strictly increasing since $\tilde{\phi}$ (and thus $\tilde{\phi}^{-1}$) is strictly decreasing.
- Thus evolution of economy can be represented by the differential equation:

$$\dot{X}(t) = \eta\phi\left(\frac{X(t)}{B^A+\xi}\right)X(t)^{\zeta}.$$



Fraction of population
living in the city
1
time

Community Enforcement, Migration and Development VI

- S-shaped pattern of technological change:
  - When $X(0)$ is low, would expect $\phi\left(X(t) / \left(B^A + \xi\right)\right)$ to be also low during early stages of development and thus manufacturing technology to progress slowly.
  - As $X(t)$ increases, $\phi\left(X(t) / \left(B^A + \xi\right)\right)$ and thus rate of technological change will also increase.
  - But $L^U(t)$ cannot exceed 1, so ultimately $\phi\left(X(t) / \left(B^A + \xi\right)\right)$ will tend to a constant.
- Associated with this migration of workers from rural to urban will also follow S-shaped pattern.
- Process of technological change in manufacturing and migration slowed down by comparative advantage of rural areas in enforcement:
  - Greater is ξ, slower technological change and migration.
  - Slows down economic development (loose positive externalities of urban employment).

Community Enforcement, Migration and Development VII

- Tradeoff. High levels of ξ:
  - Dynamic effect above: reduce growth and welfare in the economy.
  - But, static gains: better community enforcement increase initial level of consumption.
- Formalization of some of dual economy ideas:
  - no mobility barriers, thus same wage in both areas.
  - but functioning of the economy and structure of social relations are different.

Inappropriate Technologies and the Dual Economy I

- Technology is Leontief type: requires a certain number of skilled and unskilled (L) workers.
- Technology A_h will produce $A_h L$ units of final good, but requires a ratio of skilled to unskilled exactly equal to h.
- A_h is increasing in h.
- Less-developed economy has access to all technologies A_h for $h \in [0, \bar{h}]$ for some $\bar{h} < \infty$.
- Population of this economy consists of H skilled L unskilled, such that $H/L < \bar{h}$.
- Hence not all workers can be employed with the most skill-intensive technology.
- All markets are competitive, so allocation of workers to tasks will maximize output.

Inappropriate Technologies and the Dual Economy II

- Thus problem can be written as

$$\max_{[L(h)]_{h\in[0,\bar{h}]}} \int_0^{\bar{h}} A_h L(h)\, dh \tag{30}$$

subject to

$$\begin{aligned} \int_0^{\bar{h}} L(h)\, dh &= L, \text{ and} \\ \int_0^{\bar{h}} hL(h)\, dh &= H, \end{aligned}$$

where $L(h)$=number of unskilled workers assigned to technology A_h.

- First-order conditions:

$$A_h \leq \lambda_L + h\lambda_H \text{ for all } h \in [0, \bar{h}], \tag{31}$$

where λ_L=multiplier of first constraint and λ_H=multiplier of second constraint.

Inappropriate Technologies and the Dual Economy III

- Inequality, since not all technologies $h \in [0, \bar{h}]$ will be used, and those not active might have strict inequality.
- First-order conditions. If $A_{\bar{h}}$ is sufficiently high and if $A_0 > 0$:
  - all skilled workers will be employed at technology $\bar{h}$ with $L(\bar{h}) = H/\bar{h}$ unskilled workers, and
  - the remaining $L - L(\bar{h})$ workers will be employed with the technology $h = 0$.
- Equilibrium feature of a dual economy: two very different technologies, one more advanced (modern) and one least advanced that is feasible.

Inappropriate Technologies and the Dual Economy IV

- Emerges because of a non-convexity:
  - To maximize output, necessary to operate the most advanced technology.
  - But this exhausts skilled workers, so unskilled have to be employed in technologies that do not require skilled inputs.
- Suggests dual economy might be outcome of technology transfer from more advanced, especially if these technologies are inappropriate.
- Can generalize by assuming more advanced technology will be operated in urban areas and with contractual arrangements enforced by modern institutions.

Distance to the Frontier and Changes in the Organization of Production I

- Structure of production changes over process of development, related to changes in internal organization of the firm and to a shift in the "growth strategy" of an economy.
- Consider less-developed economy that is behind the world technology frontier.
- Time is discrete and economy is populated by two-period lived overlapping generations of individuals.
- Total population is normalized to 1.
- Unique final good, also taken as the numeraire.
- Produced competitively according to standard Dixit-Stiglitz (constant elasticity of substitution) aggregator:

$$Y(t) = \int_0^1 A(\nu, t)^{1-\alpha} x(\nu, t)^{\alpha} \, d\nu, \tag{32}$$

Distance to the Frontier and Changes in the Organization of Production II

- Each intermediate produced by a monopolist $\nu \in [0, 1]$ at a unit marginal cost in terms of unique final good.
- Monopolist faces competitive fringe that can copy technology and also produce identical intermediate good with productivity $A(\nu, t)$.
- Competitive fringe can produce each intermediate at the cost of $\chi > 1$ units of final good.
- Competitive fringe forces the monopolist to charge a *limit price*:

$$p(\nu, t) = \chi > 1. \tag{33}$$

- Will be an equilibrium when χ is not so high that the monopolist prefers lower unconstrained monopoly price.
- Condition for this is (impose throughout):

$$\chi \leq 1/\alpha,$$

Distance to the Frontier and Changes in the Organization of Production III

- χ capturing technological factors and government regulations regarding competitive policy.
- Given demand implied by (32) and the equilibrium limit price in (33), monopoly profits are:

$$\pi(\nu, t) = \delta A(\nu, t), \tag{34}$$

where

$$\delta \equiv (\chi - 1) \chi^{-1/(1-\alpha)} \alpha^{1/(1-\alpha)}$$

is a measure of the extent of monopoly power.

- In particular δ is increasing in χ for all $\chi \leq 1/\alpha$.
- Economic development here not by capital accumulation but by technological progress: increases in $A(\nu, t)$.

Distance to the Frontier and Changes in the Organization of Production IV

- Each monopolist $\nu \in [0, 1]$ can increase $A(\nu, t)$ by two complementary processes:
  1. imitation (adoption of existing technologies); and
  2. innovation (discovery of new technologies).
- Key economic tradeoffs: different economic arrangements (organization of firms, growth strategy) will lead to different amounts of imitation and innovation.
- Define average productivity of the economy:

$$A(t) \equiv \int_0^1 A(\nu, t)\, d\nu.$$

- $\bar{A}(t)$=productivity at the world technology frontier,

$$A(t) \leq \bar{A}(t)$$

Distance to the Frontier and Changes in the Organization of Production V

- World technology frontier progresses according to:

$$\bar{A}(t) = (1+g)\,\bar{A}(t-1)\,, \tag{35}$$

- Growth rate of the world technology frontier ($\underline{\eta}$ and $\bar{\gamma}$ will be defined below):

$$g \equiv \underline{\eta} + \bar{\gamma} - 1, \tag{36}$$

- Process of imitation and innovation leads to:

$$A(\nu, t) = \eta \bar{A}(t-1) + \gamma A(t-1) + \varepsilon(\nu, t)\,, \tag{37}$$

where $\eta > 0$ and $\gamma > 0$.

- $\varepsilon(\nu, t)$ is a random variable with zero mean, capturing differences in innovation performance across firms and sectors.

Distance to the Frontier and Changes in the Organization of Production V

- In equation (37): $\eta \bar{A}(t-1)$ stands for advances from *adoption*, $\gamma A(t-1)$ coming from innovation.
- Let us also define
$$a(t) \equiv \frac{A(t)}{\bar{A}(t)}$$
as the (inverse) measure of the country's *distance to the technological frontier* at date t.
- Integrate (37) over $\nu \in [0,1]$, use the fact that $\varepsilon(\nu, t)$ has mean zero, divide both sides by $\bar{A}(t)$ and use (35) to obtain:
$$a(t) = \frac{1}{1+g}(\eta + \gamma a(t-1)). \tag{38}$$
- Dual process of imitation and innovation may lead to a process of convergence.
    - As long as $\gamma > 1+g$, (38) implies that $a(t)$ will eventually converge to 1.

Distance to the Frontier and Changes in the Organization of Production VI

- Also shows that relative importances of imitation and innovation will depend on the distance to the frontier:
  - $a(t)$ is large γ—thus innovation—matters more for growth.
  - $a(t)$ is small η—thus imitation—relatively more important.
- Endogenize η and γ using a reduced-form approach.
- Acemoglu, Aghion and Zilibotti (2006): η and γ as functions of investments by entrepreneurs and contractual arrangement between firms and entrepreneurs.
- Two types of entrepreneurs: high-skill and low-skill.
- When entrepreneur starts a business, skill level is unknown, revealed over time through subsequent performance.

Distance to the Frontier and Changes in the Organization of Production VII

- Two types of "growth strategies"
  - $R = 0$: *selection*: replace any entrepreneur that is revealed to be low skill.
    - high degree of turning (creative destruction) and large number of young entrepreneurs
  - $R = 1$: maintain experienced entrepreneurs
    - organization of firms relying on "longer-term relationships", emphasis on experience and cumulative earnings, less creative destruction.
- Several potential reasons why an experienced low-skill entrepreneur might be preferred to new young entrepreneur.
- Here, in presence of credit market imperfections, retained earnings of an old entrepreneur may provide him with an advantage in the credit market.

Distance to the Frontier and Changes in the Organization of Production VIII

- Key assumption:
  - Experienced entrepreneurs better at increasing productivity of their company when this involves imitation.
  - High-skill entrepreneurs more innovative and generate higher growth due to innovation.
  - Thus tradeoff between $R = 1$ and $R = 0$ and between organizational forms is tradeoff between imitation vs. innovation (thus *imitation-based growth strategy* vs. *innovation-based growth strategy*).
- Assume law of motion of the distance to frontier, (38), takes the form

$$a(t) = \begin{cases} \frac{1}{1+g}\left(\bar{\eta} + \underline{\gamma} a(t-1)\right) & \text{if} \quad R(t) = 1 \\ \frac{1}{1+g}\left(\underline{\eta} + \bar{\gamma} a(t-1)\right) & \text{if} \quad R(t) = 0 \end{cases} \tag{39}$$

- We assume that

$$\bar{\gamma} > \underline{\gamma} < 1 + g \text{ and } \bar{\eta} > \underline{\eta}. \tag{40}$$

Distance to the Frontier and Changes in the Organization of Production IX

- First part of assumption: high-skill entrepreneurs are better at innovation
- Second part, $\bar{\gamma} > \underline{\gamma}$: experienced entrepreneurs are better at imitation.
- Final part, $\underline{\gamma} < 1 + g$: imitation-based growth will not lead to faster growth than the world technology frontier.
- In terms of (39), we can interpret assumption (36) as stating that world technology frontier advances due to innovation-based growth strategy.

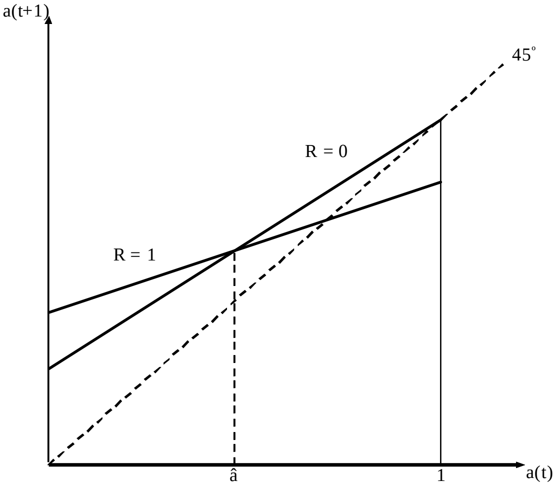


Figure: The growth-maximizing threshold and the dynamics of the distance to frontier in the growth-maximizing equilibrium.

Distance to the Frontier and Changes in the Organization of Production X

- Economy with long-term contracts $(R = 1)$ achieves greater growth (higher level of $a(t)$ for given $a(t-1)$) through imitation channel, but lower growth through the innovation channel.
- Which regime maximizes growth rate of the economy depends on $a(t-1)$.
- In particular, (39) is sufficient to establish there exists a threshold

$$\hat{a} \equiv \frac{\bar{\eta} - \underline{\eta}}{\bar{\gamma} - \underline{\gamma}} \in (0, 1) \tag{41}$$

  such that when $a(t-1) < \hat{a}$, the imitation-based strategy, $R = 1$ leads to greater growth, and when $a(t-1) > \hat{a}$, the innovation-based strategy, $R = 0$, achieves higher growth.
- Growth-maximizing sequence of strategies: start with $R = 1$ and then switch to $R = 0$.

Distance to the Frontier and Changes in the Organization of Production XI

- In imitation-based regime: incumbent entrepreneurs are sheltered from the competition of younger entrepreneurs.
- In innovation-based regime: organizational form relying on greater selection and greater emphasis on maximizing innovation at expense of experience, imitation and investment.
- Have not specified what the equilibrium sequence of $\{R(t)\}_{t=0}^{\infty}$ is.
- Equilibrium behavior involves selection of entrepreneurs as well as functioning of credit markets.
- Four configurations which may arise under different institutional settings.

Distance to the Frontier and Changes in the Organization of Production XII

- *Growth-maximizing equilibrium*:

$$R(t) = \begin{cases} 1 & \text{if} \quad a(t-1) < \hat{a} \\ 0 & \text{if} \quad a(t-1) \geq \hat{a} \end{cases}$$

  - Economy achieves upper envelope of the two lines in Figure
  - No possibility of outside intervention to increase growth rate.
  - Economy starting with $a(0) < 1$ always achieves a growth rate greater than g, and ultimately $a(t) \to 1$.
  - Economy first starts with a particular set of organizations/institutions, corresponding to $R = 1$.
  - Then, consistent with Kuznets' vision, change in organizational form and growth strategy, and switches to $R = 0$.
  - Here structural transformation implies long-term relationships disappearing and replaced by shorter-term relationships, greater competition, and better selection.

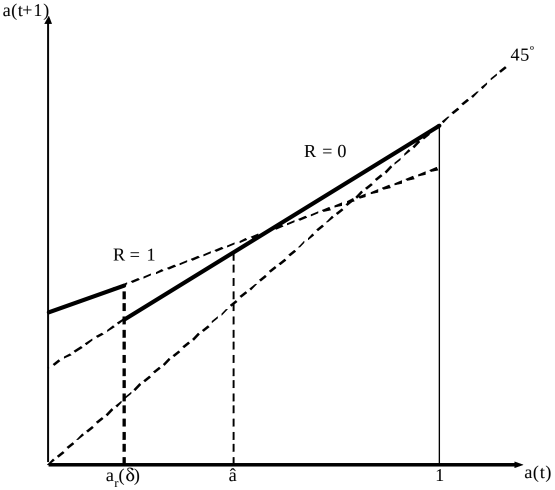


Figure: Dynamics of the distance to frontier in the underinvestment equilibrium.

Distance to the Frontier and Changes in the Organization of Production XIII

- *Underinvestment equilibrium*:

$$R(t) = \begin{cases} 1 & \text{if} \quad a(t-1) < a_r(\delta) \\ 0 & \text{if} \quad a(t-1) \geq a_r(\delta) \end{cases}$$

  where $a_r(\delta) < \hat{a}$.
- See Figure, thick black lines corresponding to equilibrium law of motion of the distance to the frontier, a.
- Determination of $a_r(\delta)$:
  - Retained earnings of old entrepreneurs enable them to undertake greater investments.
  - But monopolistic competition implies *appropriability effect*: entrepreneur does not capture all the surplus of investment, some accrues to consumers.
- "Underinvestment": in $a \in (a_r(\delta), \hat{a})$, could reach higher growth with $R(t) = 1$.

Distance to the Frontier and Changes in the Organization of Production XIV

- Equilibrium is different, but again follows sequence of $R = 1$ followed by $R = 0$: structural transformation.
- Also still $a(t) = 1$ is reached as $t \to \infty$, just that transformation from $R = 1$ to $R = 0$ happens too soon at $a(t-1) = a_r(\delta)$ rather than at $\hat{a}$.
- Hence *temporary* government intervention may increase growth rate of the economy (while $a \in (a_r(\delta), \hat{a})$).
- Subsidies to investment would be one possibility:
- Competition in product market has an indirect effect on the equilibrium, $a_r(\delta)$.
- Higher level of δ, lower competition in product market (i.e., higher χ), increase $a_r(\delta)$: close the gap between $a_r(\delta)$ and $\hat{a}$.
- But reducing competition will create static distortions (because of higher markups), and can have much more detrimental effects on growth.

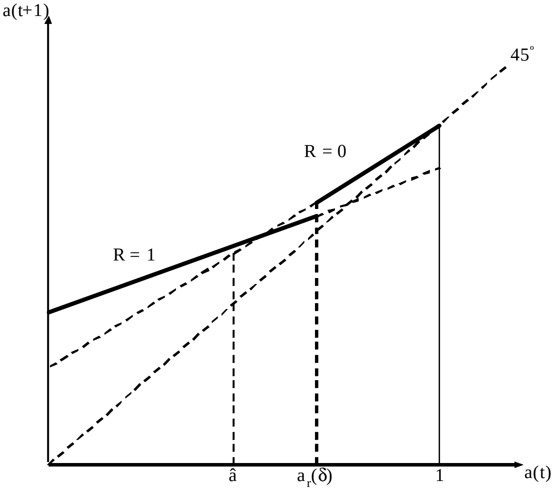


Figure: Dynamics of the distance to frontier in the sclerotic equilibrium.

Distance to the Frontier and Changes in the Organization of Production XV

- *Sclerotic equilibrium*: $a_r(\delta) > \hat{a}$, so that incumbent low-skill, low-productivity firms survive even when potentially damaging to economic growth.
    - Can also arise in equilibrium because retained earnings of incumbent entrepreneurs act as a *shield* against creative destruction.
    - In general, advantages of experienced entrepreneurs have (social) benefits and costs.
    - When benefits dominate, equilibrium may feature too rapid a switch to innovation-based strategy; opposite when costs dominate.
    - Economy fails to achieve maximum growth rate for a range $a \in (\hat{a}, a_r(\delta))$: innovation-based regime would be growth-maximizing, but economy is stuck with imitation-based.
    - Also pattern in line with Kuznets's vision and also convergence to $a = 1$.

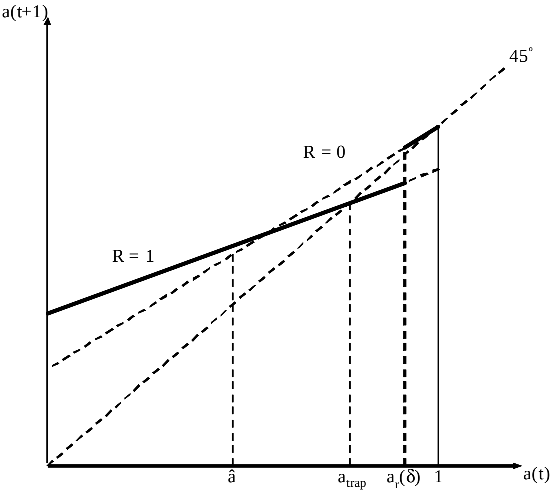


Figure: Dynamics of the distance to frontier in a non-convergence trap. If the economy starts with $a(0) < a_{trap}$, it fails to converge to the world technology frontier and instead converges to a_{trap}.

Distance to the Frontier and Changes in the Organization of Production XVI

- *Non-convergence trap equilibrium:* again $a_r(\delta) > \hat{a}$ but gap between $a_r(\delta)$ and $\hat{a}$ is even larger, and includes the level of a, a_{trap}, such that

$$a_{trap} \equiv \frac{\bar{\eta}}{1 + g - \underline{\gamma}}.$$

  - (39): if $a(t-1) = a_{trap}$ and $R(t) = 1$, the economy will remain at a_{trap}.
  - Experience of incumbent firms afford them so much protection that the economy never transitions to $R = 0$.
  - Only equilibrium pattern in which the economy fails to converge to the frontier.
  - With $R = 1$, economy does not grow beyond a_{trap}, and at this distance to frontier, equilibrium keeps choosing $R = 1$.
  - Encouraging imitation-based growth, may appear as a good policy but condemns economy to non-convergence.
  - NO Kuznetsian structural transformation: the resulting economy is underdeveloped.

Distance to the Frontier and Changes in the Organization of Production: Conclusion

- In sum, no presumption that the efficient or the growth-maximizing sequence of growth strategies will be pursued.
- Government intervention might be useful, but also can have fairly negative unintended consequences.
- Intervention will improve growth during a limited period of time (when $a \in (a_r(\delta), \hat{a})$), but can create non-convergence trap.
- Unless there is precise information and a way of reversing policies protecting incumbents, government interventions might backfire.