Staged Development

Ping Wang
Department of Economics
Washington University in St. Louis

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A. Basic Idea

Lewis (1955), Rostow (1960) and Tsiang (1964) emphasized staged growth and development for a country to be transformed from a *traditional* agricultural economy to a *modern* industrialized economy.

- During such a transformation process, it is necessary to shift labor as well as other resources from the tradition to the modern sector.
- A successful process will lead an economy from agricultural to manufacturing and eventually to service (FIRE) activities.
- At the later stage of economic development, it features *mass consumption*, which is crucial for enhancing the welfare of well beings.

Although big push theory suggests coordinated investment (by firms or by workers and entrepreneurs jointly) is the basis of industrialization, it is silent about the underlying process of creating a modern industry. To facilitate better understanding of such a process is the primary purpose of this note. We will focus on addressing two issues:

- to explore the channels through which a modern industry is activated,
- to explain the speed of transition from agricultural to modern economy.
B. Stylized Facts

- Sustained growth is only a recent phenomenon:
  - prior to 1780: output/consumption per capita and wage rate were roughly constant over time
  - after 1780: all these aggregates were growing over time
  - measuring output (Y) by real farm land rent and wage (W) by real farm wage in UK, Hansen-Prescott (2002) find that while population increased only 5 times from 11 to 57 millions from 1780 to 1989, Y per hour increased 22 times:

\[ 1265 = 100 \]
• The speed of transition to modern growth is increasing over time
  o it took Netherlands/UK/US/Canada (early development) 65/55/45/35 years to grow from $2,000 to $4,000 (in 1990 US$)
  o it took Korea and Taiwan (taking off in mid-1960s) only 15/10 years to accomplish such a transition
• The industrialization processes are highly diversified:
  o East Asian newly industrialized countries (NICs) have experienced rapid growth and industrial transformation
  o many African, South American and South Asian countries are still in low-growth trap with primarily traditional industries

• Sharply different development stories abound:
  o Korea and Taiwan took off successfully in mid-1960, joining with Hong Kong and Singapore to become Asian Tigers (Balassa 1972, Kuo 1983, Amsden 1989 and Thorbecke and Wan 1999)
  o While Argentina was ahead of most countries in 1900 except 10 or so world leaders and Philippines was ahead of most Asian countries except Japan right in the 1950s, they fell behind afterward
  o The emperor's new clothes were not made in Colombia (Morawetz 1981)
  o Morogoro Shoe Factory in Tanzania was shut down not too long after opening
  o Both foreign-assisted Akosombo Dam in Ghana and $2 billion US Aid in Zambia were failed (Easterly 2001)

The key issue to be addressed is to explore the important channels through which a modern industry is activated. The key features considered are:

- production in the modern industry requires high-skilled labor in addition to new technologies
- the modern sector needs industrial coordination to overcome the scale barrier concerned by big push theory
- the modern goods are not necessary for survival

1. The Organizing Framework

- Two sectors (i=1,2):
  - sector 1: traditional industry
    - requiring unskilled labor and capital
    - producing an agricultural product necessary for survival
  - sector 2: modern industry
    - requiring skilled labor ($L_2$) and capital, facing a scale barrier
    - producing a modern industrial good unnecessary for survival
• Production technologies:
  o traditional industry: \[ Y_1 = A_1 K_1^{\alpha_1} L_1^{1-\alpha_1} \]
  o modern industry: \[ Y_2 = A_2 K_2^{\alpha_2} L_2^{1-\alpha_2} K_2^{-1-\alpha_2} \]
  o key features:
    ▪ \( L_1 \) can be either unskilled or skilled, whereas \( L_2 \) must be skilled
    ▪ \( A_2 > A_1 \): modern sector is more technologically advanced
    ▪ \( \alpha_2 > \alpha_1 \): modern sector is more capital intensive
      (manufacturing vs. agriculture)
    ▪ there is an uncompensated positive knowledge spillovers in the production of the modern goods represented by \( K_2 \) as in Romer (1986), where \( K_2 = K_2 \) in equilibrium
    ▪ as a result of the presence of uncompensated positive knowledge spillovers, there is a scale barrier in the sense that the modern sector’s production is not as effective when its size is too small – that is, the coordination issues in big push theory can be captured
    ▪ the modern sector is not operative if either \( K_2 = 0 \) (insufficient funding to be allocated to modern production) or \( L_2 = 0 \) (unattractive wage for skilled labor to work in modern sector)
Factor allocation (FA) constraints:
  o capital: \( K_1 + qK_2 \leq F \)
    ▪ total available funds \( F \) depends on domestic savings as well as foreign aid/FDI
    ▪ \( q > 1 \) captures capital allocation barriers: it is more costly to invest in modern industry – \( q \) is lower with
      ➢ lower uncertainty or technological/institutional barriers to modern sector investment
      ➢ higher modern-industry investment subsidies or investment tax credit/rebate
  o skilled labor:
    ▪ supply: \( N_2 \) (fixed)
    ▪ constraint: \( L_2 \leq N_2 \), i.e., modern production requires skills
  o unskilled labor:
    ▪ supply: \( N_1 \) (fixed)
    ▪ constraint: \( L_1 + L_2 \leq N_1 + N_2 \), i.e., the skilled can downgrade themselves to work as unskilled

Aggregate output:
  o numeraire = the traditional product
  o real GNP=\( Y_1 + pY_2 \)
• Preferences: \( U = \ln(C_1) + \ln(C_2 + \theta) \)
  - \( \theta > 0 \) indicates that \( C_2 \) is not necessary for survival
• Goods market equilibrium (GE) conditions:
  - sector 1: \( C_1 = Y_1 \)
  - sector 2: \( C_2 = Y_2 \)
• Optimization: to attain highest utility given the 3 (FA) constraints, the two production technologies and the 2 (GE) conditions.

2. Competitive Equilibrium:

• Equalization of the relative price and the marginal rate of substitution (MRS): \( p = \text{MRS} = \frac{A_1 K_1^{\alpha_1} L_1^{1-\alpha_1}}{A_2 K_2^{1-\alpha_2} L_2^{1-\alpha_2} + \theta} \), which depends negatively on the preference bias (the luxury nature of the modern good)
• Should the modern industry be operative,
  - the values of MPK must be equalized between the two sectors: \( \text{MPK}_1 = r = (p/q) \text{MRK}_2 \)
  - the values of MPL of the unskilled must be less than that of the skilled: \( \text{MPL}_1 = W_1 < W_2 = p \cdot \text{MRL}_2 \) (segmented labor market)
• Remark: Expanded Edgeworth Box with \( q = 1 \)
3. Conditions for Activating a Modern Industry

- Industry 2 can become operative only if it is sufficiently productive to attract funding:

  - In Case I, the modern sector is operative and the allocation of capital is allocated based on the equilibrium point $E$
  - In Case II, the modern sector is not productive enough to attract funds that are subject to investment barriers

  - In Case I, the modern sector is operative and the allocation of capital is allocated based on the equilibrium point $E$
  - In Case II, the modern sector is not productive enough to attract funds that are subject to investment barriers
• the modern sector remains inactive with
  ▪ insufficient funding or skilled labor (low F or N2)
  ▪ imperfect adoption of advanced technology (low A2)
  ▪ strong preference bias (high θ)
  ▪ large modern capital investment barriers (high q)

• This above condition is necessary but not sufficient, because it considers only capital but not labor allocation, which is driven by the relative wage of modern to traditional industry (Ω=W2/W1)
  o in order for the modern sector to attract skilled labor, Ω must exceed 1 – that is, the skilled can earn higher wages in the modern sector than working as unskilled in the traditional sector
  o this condition is more likely to hold true with
    ▪ better modern technology A2
    ▪ weaker preference bias θ
  o when this condition is met, the labor markets are segmented:
    ▪ all the unskilled work in the traditional sector (L1 = N1), earning W1
    ▪ all the skilled work in the modern sector (L2 = N2), earning W2>W1
• In summary, we have:
  o I: $\Omega \leq 0$, funding is insufficient and industry 2 is unprofitable
  o II: $0 < \Omega \leq 1$, the relative wage is too low for skilled workers to participate in industry 2
  o III: $\Omega > 1$, the modern industry is activated, which requires:
    ▪ sufficient resources of capital funds
    ▪ sufficient resources of skilled labor
    ▪ good access to new technologies
    ▪ sufficiently low capital barrier
    ▪ sufficiently low preference bias
4. Development Policy

The theoretical analysis above leads to policy prescriptions both in the short and in the long run.

- **Short-term policy prescriptions:**
  - receiving external assistance to raise $F$ (European Investment Bank loans/U.S. Aid)
  - obtaining technological transfer from developed countries to advance $A_2$
  - attracting immigrants of high skill to increase $N_2$

- **Long-term policy prescriptions:**
  - greater saving incentives
  - more R&D investments
  - better education
D. Transition from Agricultural to Industrialized Economy: Gollin, Parente and Rogerson (2003, 2007)

To study the transition speed from agricultural to industrialized economy, we consider the following key features:

- production in agricultural sector requires only labor but production in the modern industry requires both labor and capital
- both agricultural and modern technologies grow over time
- there is a subsistence consumption level of agricultural goods

1. The Organizing Framework

- Two sectors (i=a,m):
  - sector 1: agricultural, requiring only labor
  - sector 2: manufacturing, requiring both labor and capital
- Production technologies:
  - agricultural: \( Y_a = A_a \cdot e^{\gamma a t} \cdot N_a \)
    - the initial level of the agricultural technology is at \( A_a \)
    - agricultural technology grows at rate \( \gamma_a \)
o manufacturing: \( Y_m = A_m \left[ K^\alpha \left( e^{\gamma_m t} \cdot N_m \right)^{1-\alpha} + \phi N_m \right] \)
  - the initial level of the manufacturing technology is at \( A_m \)
  - manufacturing technology grows at rate \( \gamma_m > \gamma_a \) and is Harrod-neutral
  - with \( \phi > 0 \), capital is not necessary for production

- Capital accumulation: \( \dot{K} = I - \delta K \)
- Labor allocation: \( N_a + N_m = 1 \)
- Goods market equilibrium conditions:
  - agricultural: \( a = Y_a \)
  - manufacturing: \( c + I = Y_m \)
- Preference: lifetime utility = \( \int_0^\infty U(c,a)e^{-\rho t}dt \)
  - \( U = a \) if \( a \leq \bar{a} \) (below subsistence, consuming only \( a \))
  - \( U = \ln(c) + \bar{a} \) if \( a \geq \bar{a} \) (above subsistence, consuming both \( a \) and \( c \))
- Optimization: maximize lifetime utility subject to:
  - the two technologies
  - the two market equilibrium conditions
  - the labor allocation equation
  - the capital accumulation equation
2. Equilibrium

- Before reaching the subsistence level $\bar{a}$, all labor must be used to produce $a$ and no capital would be accumulated
- After reaching the subsistence level $\bar{a}$, we have $Y_a = \bar{a}$, which can be used to solve $N_a$ immediately
- These imply the following equilibrium allocation of labor:

$$
N_a = \min \left\{ \frac{\bar{a}}{A_a e^{\gamma_a t}}, 1 \right\}, \quad N_m = 1 - \min \left\{ \frac{\bar{a}}{A_a e^{\gamma_a t}}, 1 \right\}
$$

- Thus, more labor can be shifted to the manufacturing sector if
  - the subsistence level $\bar{a}$ is low
  - the agricultural productivity level $A_a$ or growth $\gamma_a$ is high


- Set $\gamma_m = 1.013$, $\delta = 0.065$ and $\rho = 0.05$ to fit the observations
- Select $\alpha = 0.5$ and $\phi = 0.0001$ and then choose $(\bar{a}, \gamma_a)$ such that:
  $N_a(1800) = 35\%$ and $N_a(1950) = 5\%$ (cf. Kuznets 1966)
• Results:
  o staged development of countries (flying geese)
  o long/slow process of early development, with late comers growing faster
  o $A_a = 1, 0.19$ and $0.05$ yielding transitions to modern growth started in 1750, 1850 and 1950, respectively (depicting relative outputs their long-run BGP values):
  o at a given year (say, 1975), early developed countries grow at slower rates than the late comers.
E. Post-WWII World Development

As the Second World War ended and the Cold War started, there have been several crucial developments around the globe.

- With a few exceptions, the colonial empires that monopolized the resources of the New World came to an end. The end of colonization:
  - allowed emerging economies to grow
  - helped removing the disadvantage of resource-poor countries, such as Japan and the 4 Asian Tigers

- Technologies continued to advance rapidly. Many technologies benefited from defense inventions during the war and throughout the Cold War, including several micro-electronics that can serve as general purpose technology (GPT):
  - audio technology (radio, media & telecommunication)
  - video technology (camera, type recorder, CD player)
  - computing technology (calculator/TI, computer)
  - machine tools
  - commercialization of satellite and the rise of internet
• The basic infrastructure continued to improve rapidly:
  o highway
  o railroad
  o shipping
  o air transportation
  o water supply and sewer

• The basic education continued to improve:
  o in most emerging economies, elementary schooling became mandatory
  o in some fast growing countries:
    • mandatory education has been up to 9 or even 12 years
    • adultery education and skill training have been offered

• The laws and institutions continued to set up globally:
  o private property ownership
  o IPR protection
  o international business law
  o GATT
  o WTO
• With rising domestic wages and reduced trade costs (transport costs and tariffs), leading advanced economies, particularly the U.S., have exercised not global trade but product fragmentation:
  o global trade created world demand for goods produced in emerging economies, learning by exporting (Bond-Jones-Wang 2005)
  o product fragmentation enabled emerging economies to participate in the world production chain, learning by producing (Lucas 1993)
  o some fast growing countries eventually moved up along the world production chain, chaining roles from subsidiaries/subcontractors to MNEs/outsourcers

• As a strategic consequence of the Cold War, many Asian countries gained geographic advantage as part of the alliance, receiving USAid as well as other institutional and infrastructural assistance:
  o East Asia: Korea, Japan, Taiwan, Hong Kong
  o Southeast Asia: Philippines, Indonesia, Thailand, Malaysia, Singapore
  o South Asia: Bangladesh, India, Pakistan
• A tale of two continents: Asia vs. Africa (Easterly 2001, own notes in red)
• Widened productivity gap (Duarte-Rustuccia 2006):
  o Ratio of output per worker – richest five to poorest five countries over 1960-96:
o Relative output per worker:

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Mobility of countries over 1960-1996:
Mobility of countries by quintile (20 years over 1960-1996 window):

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Relative output per worker by regions:

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Output per worker growth (1960-1996):
Global growth (Buiter 2011):
  - World GDP and population
    - 2010: 73
    - 2030: 180
    - 2050: 376

Average world per capita GDP growth:
Growth of advanced economies:

Growth of emerging economies (CEE=Central & Eastern Europe; CIS=Commonwealth of Independent States):
Relative per capita real GDP growth to the U.S.:
Per capita real GDP projection in 2050:
Key to future growth:

- investment and savings (% of GDP):

- the power of consumption (consumption spending and number of households with income exceeding US$10,000):
- the rise of world trade and the increasing exports to China:
- new emerging economies (2010-15 vs. 2010-50 by growth %):

- the future giants (by real GDP in trillion 2010 PPP US$):

<table>
<thead>
<tr>
<th>Rank Country</th>
<th>2010</th>
<th>Rank Country</th>
<th>2015</th>
<th>Rank Country</th>
<th>2050</th>
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<td>2 China</td>
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<td>10 Italy</td>
<td>1.84</td>
<td>10 Egypt</td>
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### the future richest (by per capita real GDP in 2010 PPP US$):

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### Remark:

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* World Bank PPP