Japan and the World Economy
in the 20th Century

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• Consider this topic as student of economic growth, not as Japanese expert

• Unique character of Japanese economic history makes a good case study
  – first non-European country to industrialize
  – total GDP third largest in world
  – post-WW II growth fastest sustained growth ever by large economy
  – model (?) for Korea, Taiwan, other east Asian “miracles”
  – potential model for others?
• Modern history of Japan begins in 1868 — “Meiji restoration”

• Overthrow of Tokugawa regime that had kept country closed to foreigners

• Forced “opening” by Americans in 1850 had exposed military weakness, relative to west

• New rulers centralized government, with emperor at “head”

• Began program of westernization, industrialization
• At time of Meiji restoration, per capita GDP in Japan was $740
  
  (1990 U.S. dollars, Maddison, OECD)

• Population was 34 million

• Largely feudal, agricultural economy—typical of Asia

• 2001 numbers: $21,000 ( = 28 \times 740)
  
  ....and 127 million ( = (3.7) \times 34)
• Two questions:
  – How did they do it?
  – What took them so long?

• Begin with the post-war miracle Japan: a simple model explains a lot

• Then ask why this simple model fails to fit the 60 years between the Meiji restoration and World War II
A Model of Catch-up Growth

- Let $H$ be GDP per person in leading economy (e.g. U.S.)

- ...and let $h < H$ be GDP per person in developing economy (e.g. Japan)

- Assume

$$\frac{1}{H} \frac{dH}{dt} = \mu$$

$$\frac{1}{h} \frac{dh}{dt} = \mu \left( \frac{H}{h} \right)^\theta$$
• Idea is that $H, h$ proportional to technology levels in two countries

• ...and that knowledge spills over from advanced economy to relatively backward economy

• How fast? Depends on spillover parameter $\theta$

• Use 1960-2000 data from 112 countries to estimate $\theta$

• Fit curve to open economies (as defined by Sachs and Warner (1995))

• (See, Lucas, “Trade and the Diffusion of the Industrial Revolution,” NBER WP # 13286)
INCOME LEVELS AND GROWTH RATES, 112 COUNTRIES
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Annual Growth Rate, 1960-2000 vs. 1960 Per Capita Income (1990 $)
Parameter Values

\[ \theta = 0.67 \]
\[ \mu = 0.02 \]
INCOME LEVELS AND GROWTH RATES, 39 OPEN ECONOMIES

Parameter Values

\[ \theta = .5, .67, .83 \]

\[ \mu = .02 \]
POSTWAR JAPAN: GROWTH RATES

PER CAPITA GDP, ANNUAL GROWTH RATES

θ = .9

POSTWAR JAPAN: INCOME RELATIVE TO UNITED STATES

RATIO OF PER CAPITA GDPS
• The model

\[ \frac{1}{H} \frac{dH}{dt} = \mu \]

\[ \frac{1}{h} \frac{dh}{dt} = \mu \left( \frac{H}{h} \right)^\theta \]

just does not make sense for very poor economies

• Diffusion of technology involves interchanges among educated people

• Large, illiterate sector cannot participate

• Model needs to incorporate this
A Dual Economy Model

• Postulate a two sector economy:

• Fraction $x$ of each unit of labor allocated to farm sector, producing

$$y_f = Ah^\xi x^\alpha$$

• Fraction $1 - x$ allocated to a city sector, producing

$$y_c = h(1 - x).$$

• Here knowledge level in city, $h$, has spillover effect $h^\xi$ on agriculture
• Equilibrium and optimal allocation given by $x$ value that solves

$$y(h) = \max_x \left[ Ah^\xi x^\alpha + h(1 - x) \right].$$

• The FOC is

$$\alpha Ah^\xi x^{\alpha-1} \geq h \quad \text{w/eq if } x < 1$$

• When equality holds,

$$x(h) = \left( \frac{\alpha A}{h^{1-\xi}} \right)^{1/(1-\alpha)}$$

• As $h \to \infty$, $x(h) \to 0$
The two functions, \( x(h) \) and \( y(h) \) defined by this model have implications for the way the employment share in agriculture should vary with GDP per capita.

Evidence on this relation can provide information on parameter \( \xi \).

Use cross section for 1980, based on World Bank data on agricultural share of employment and Maddison income data.

Use Kuznets’s 1971 study for historical time series.
EMPLOYMENT SHARES IN AGRICULTURE: FOUR COUNTRIES

U.K.  
U.S.  
Japan  
India
AGRICULTURAL EMPLOYMENT SHARES, 112 COUNTRIES, 1980

Parameter Values:

\[ \alpha = 0.6 \]

\[ \xi = 0.75 \]
Agricultural Employment Shares, Four Countries

Parameter Values:

\[ \alpha = 0.6 \]

\[ \xi = 0.75 \]
• Now re-introduce dynamics,

\[
\frac{dh}{dt} = \mu H(t)^\theta h(t)^{1-\theta}
\]

where \(h(t)\) reflects knowledge level in city only

• Let rate of absorption of incoming ideas be increasing in fraction of people in cities

\[
\frac{dh}{dt} = \mu H(t)^\theta h(t)^{1-\theta} [1 - x(h(t))] \zeta.
\]

• Why not the *number* in cities? Want to avoid scale economy
• More compactly,

\[ x(h) = \min \left[ 1, (\alpha A)^{1/(1-\alpha)} h^{-(1-\xi)/(1-\alpha)} \right] \]

\[ y(h) = Ah^{\xi} [x(h)]^{\alpha} + h(1 - x(h)) \]

• Choose \( A \) and \( h(0) \) to be consistent with observed \( x(0) \) and \( y(0) \)

• Compute solution path

\[ \frac{dh}{dt} = \mu H(t)^{\theta} h(t)^{1-\theta} [1 - x(h(t))]^{\zeta} \]
POSTWAR JAPAN: GROWTH RATES

PER CAPITA GDP, ANNUAL GROWTH RATES

\[ \theta = 0.9 \]
\[ x(0) = 0.25 \]

POSTWAR JAPAN: INCOME RELATIVE TO UNITED STATES

RATIO OF PER CAPITA GDPS
• For Asian miracle economies, dual economy modifications not very important (South Korea an exception).

• For Japan, $x(1950) \sim .25$

• Next slide simulates hypothetical Japan with different $x(0)$ values, all with $y(0) = 1920$ (1990 U.S. $)$

• (20% of U.S. income level – compare to 1870: 30%)
GROWTH EFFECTS OF FARM SECTOR

Initial Fractions in Farm Sector = 0, 0.4, 0.8

RELATIVE INCOME EFFECTS OF FARM SECTOR

Initial Fractions in Farm Sector = 0, 0.4, 0.8
• Can see that with 80% of labor force in agriculture growth is much slower

• Fits growth experience of postwar Thailand, Indonesia, Malaysia too

• Even so theory predicts that in 50 years relative income doubles: 20% to 40%

• 1870-1940 data do not show this

• Why not?
• Fumio Hayashi and Edward Prescott, “The Depressing Effect of Agricultural Institutions on the Prewar Japanese Economy” (forthcoming, *JPE*)

• Argue that “the prewar patriarchy...forced the son designated as heir to stay in agriculture”

• Careful simulations show this could retard catch-up growth

• If so, helps to explain postwar miracle too: a release of talent

• But decline in Japanese agriculture share similar to other countries
EMPLOYMENT SHARES IN AGRICULTURE: FOUR COUNTRIES

LOG PER CAPITA GDP

EMPLOYMENT SHARE, PERCENT

India
U.S.
Japan
U.K.
• Another—complementary—factor is removal of trade barriers in Europe, North America, Japan after WW II

• Surely the case that trade flows stimulate idea flows

• Model as change in spillover parameter $\theta$
GROWTH EFFECTS OF OPENNESS

PER CAPITA GDP, ANNUAL GROWTH RATES

RELATIVE INCOME EFFECTS OF OPENNESS

RATIO OF PER CAPITA GDPS

\[ \theta = 0.3, 0.6, 0.9 \]
• Model may help to account for striking postwar income “convergence” in other countries
MEAN AND STD. DEV., LOG INCOME, EIGHT COUNTRIES

MEAN LOG GDP, RESCALED
Conclusions

• Economic growth a complex process, involving all aspects of economic life

• But small list of forces common to capitalist economies account for most of what we observe
  
  – diffusion of ideas from some countries to others

  – migration of labor force out of traditional agriculture, into educated sectors

  – concentration of economic activity in cities
• Have used economic history of Japan to illustrate interaction of these forces

• No two societies are alike, and much of this history distinctively Japanese

• But the main story of postwar economic growth is common to many countries

• After WW II, Europe and North America adopted a free trade regime for themselves and toward the rest of the world
• A vast market was opened to the rest of the world, offering high returns to producers who could meet (or surpass!) the technical standards of the advanced economies.

• Countries—like Japan—that responded to this challenge prospered.

• Countries that hid behind tariff walls and central planning failed.