SOURCES OF CHINA'S HIGH-SUSTAINABLE GROWTH, PART I

The Advantage of Backwardness &
The Surplus Labor Reallocation

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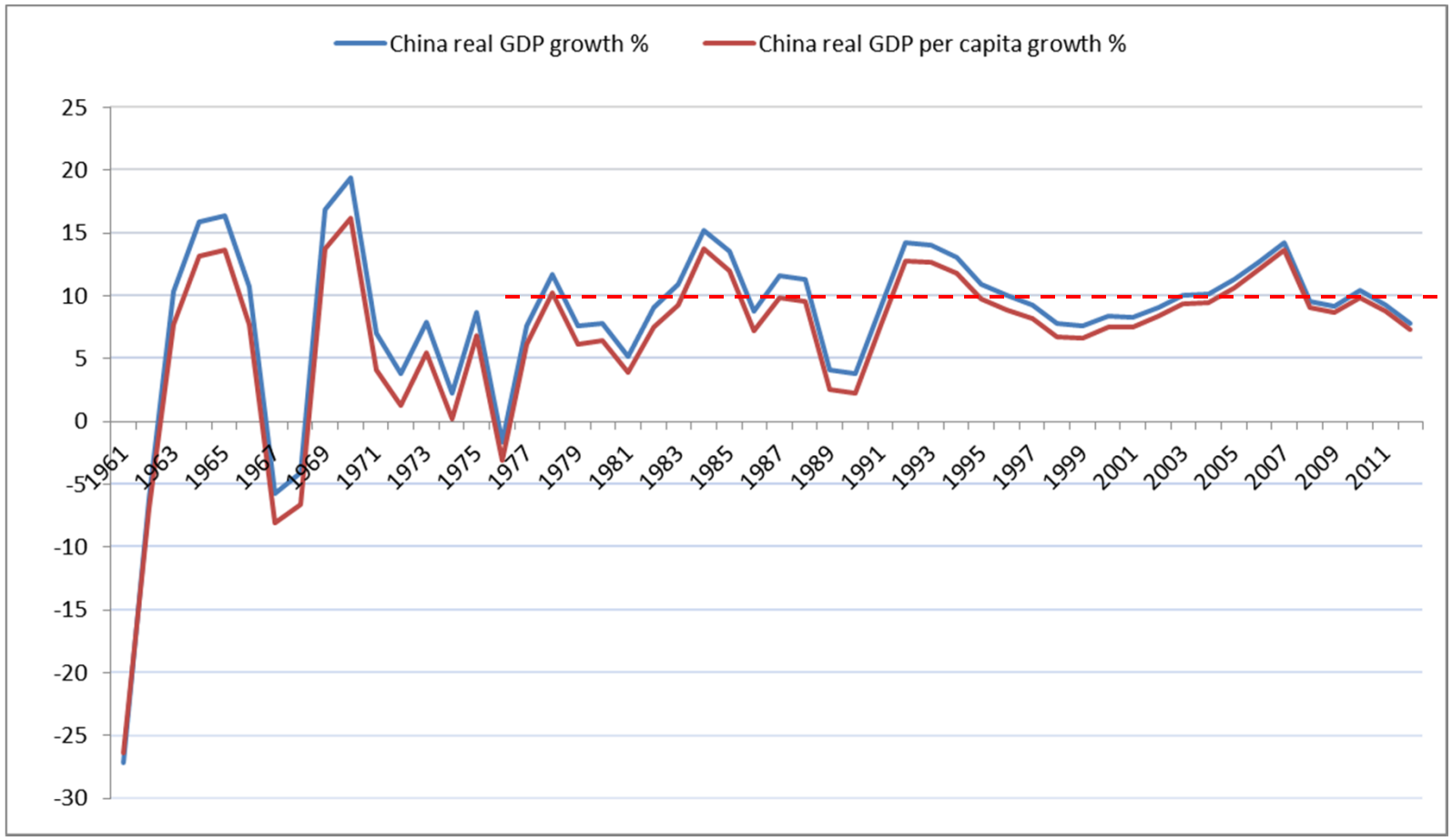
Sept. 17, 2013

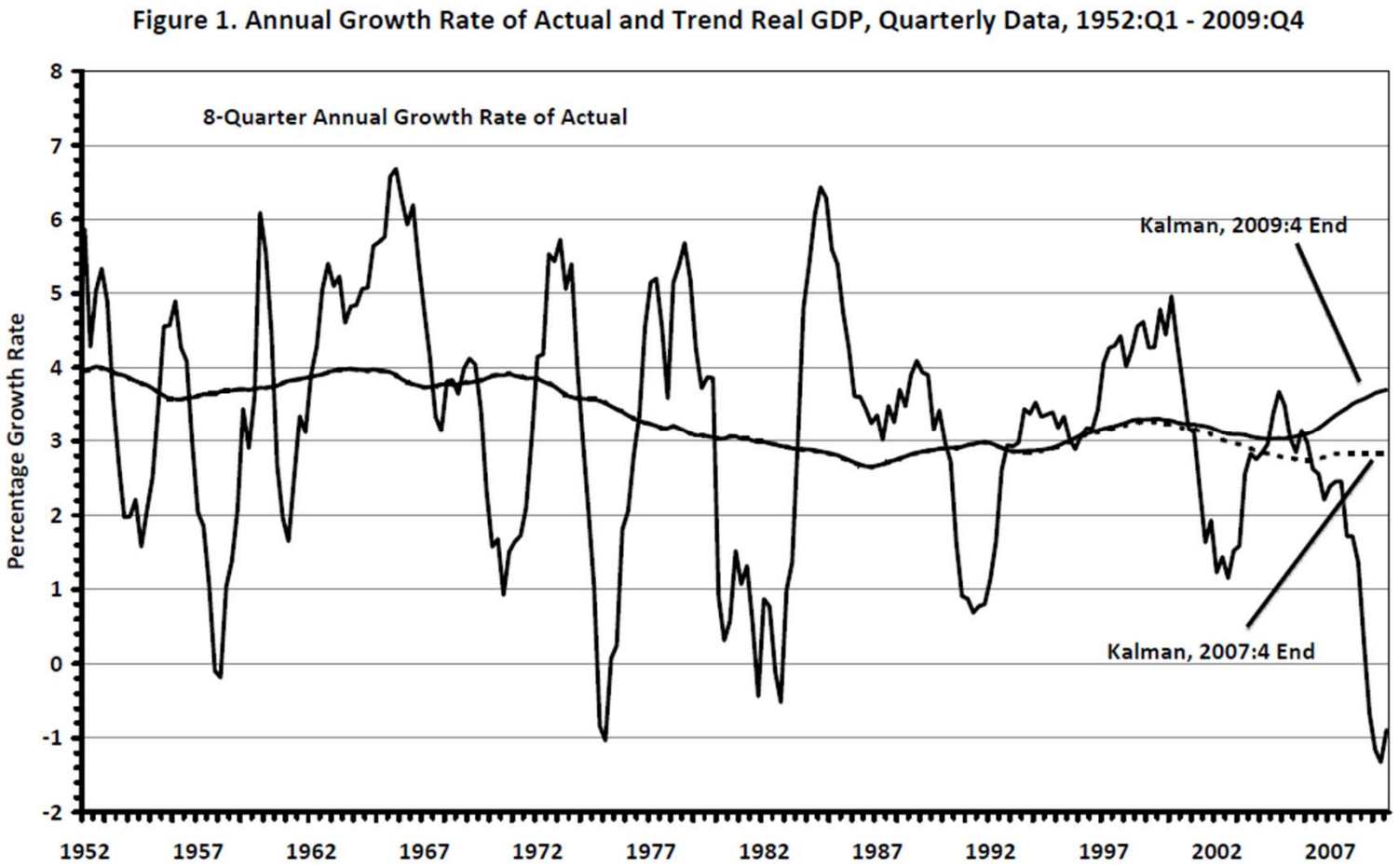
Motivation

China's GDP has grown around 10% per year since 1978



Source: WDI and author's own calculation

The real growth rate of the US GDP in the past 50 years was averaged between 3-3.5%



Source: Bob Gordon

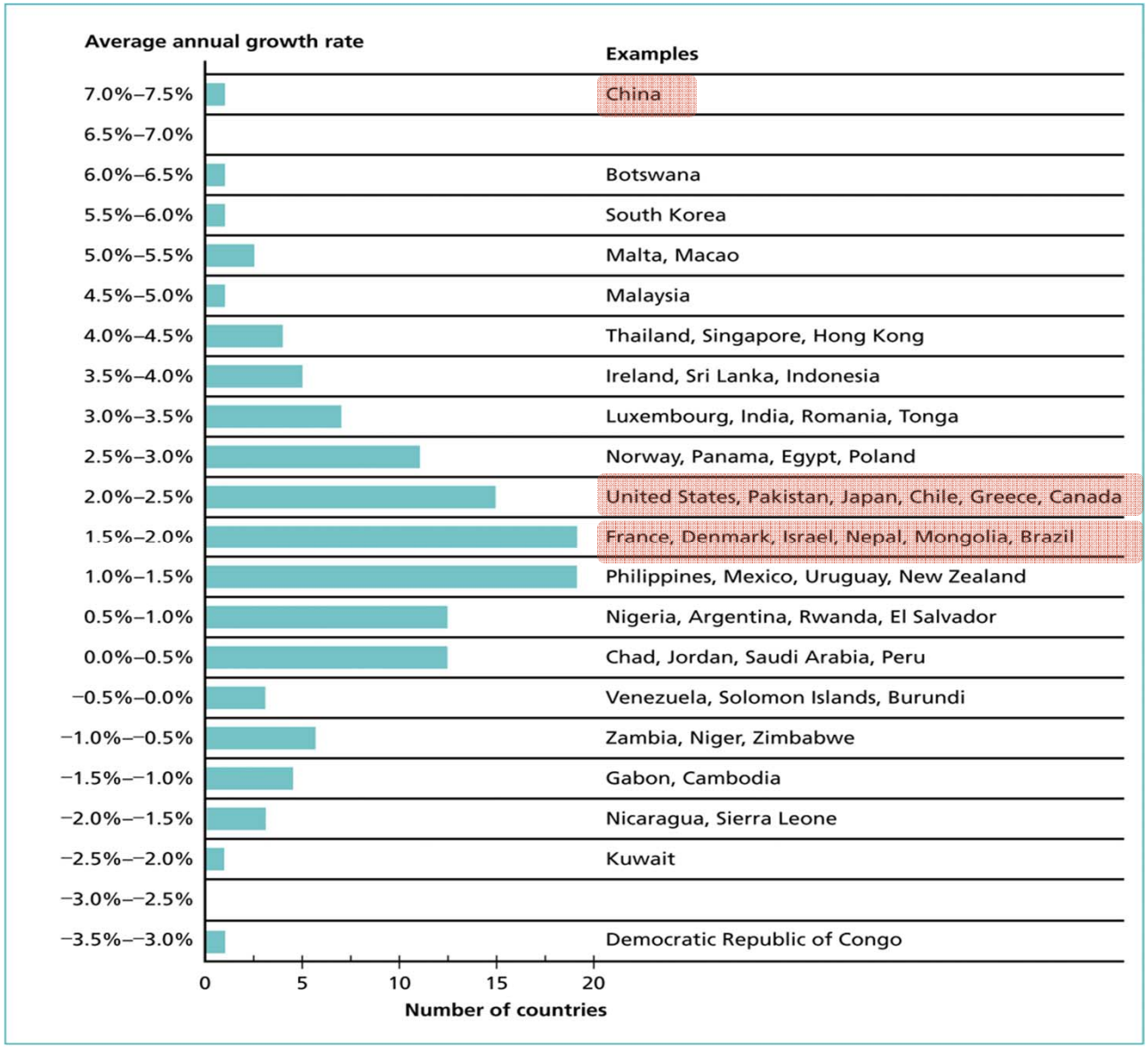
What does this imply?

- **"Rule of 69"**: To calculate how many years it takes one country to double its living standards (or GDP per capita), one could simply divide 69 by the rate of growth of GDP per capita

- China's average GDP growth rate is 10%, population growth at roughly 1% per year, so its GDP per capita growth rate is **9%;** The US average growth is 3.3%, population growth is 1.5%, so US' GDP per capita growth rate is **1.8%.**

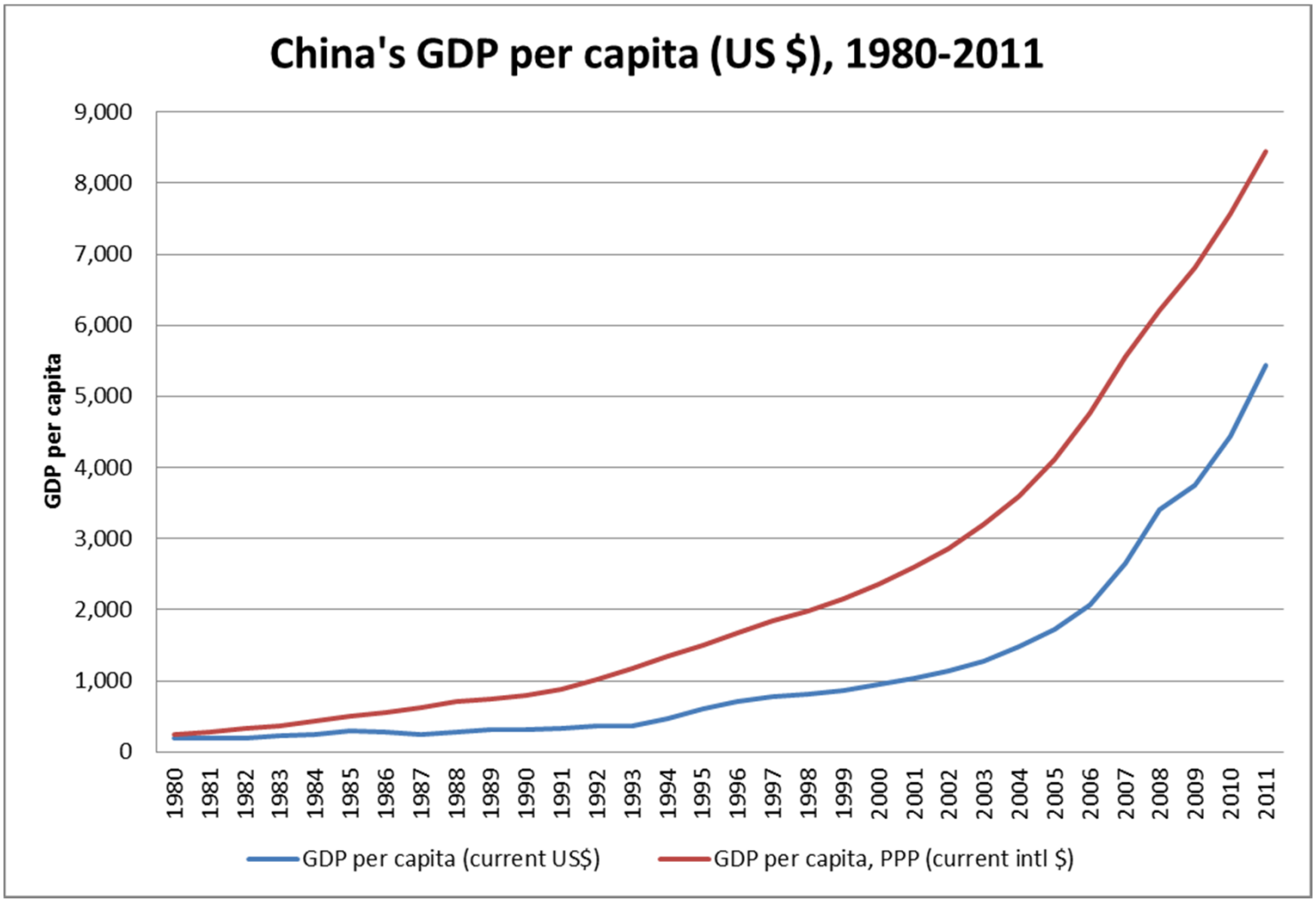
- According to "rule of 69":
  - It will take China around **7.5** (≈69/9) years to double its living standards;
  - While, it will take **38** (≈ 69/1.8) years for the US to double its living standards

The Distribution of Growth Rates of the World, 1970–2005



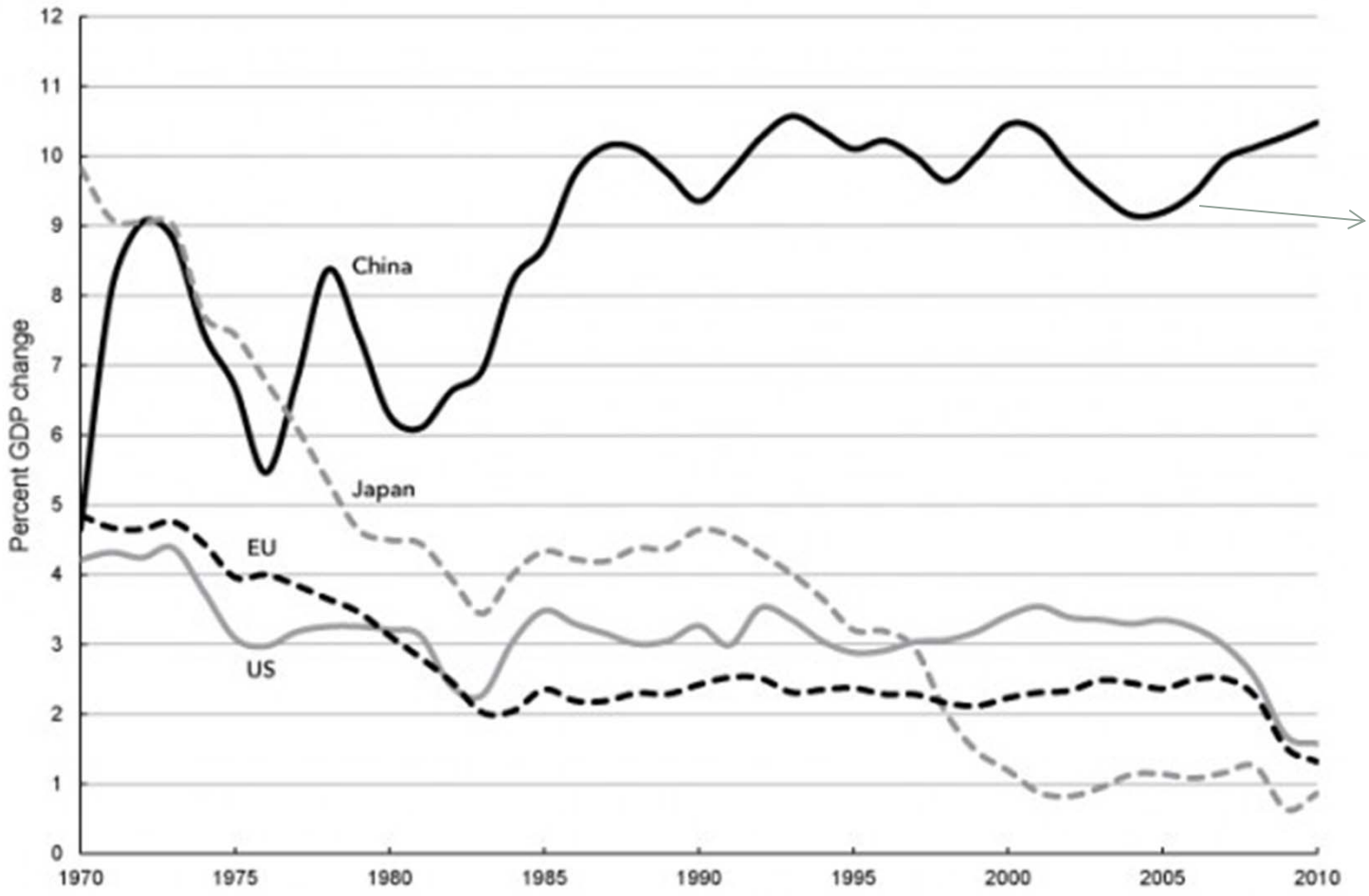
Sources: Heston, Summers, and Aten (2006), World Bank (2007a).

Thirty years of fast growth transformed China from a dirt-poor country to a upper middle-income country



Source: WDI and author's own calculation

But past experiences show fast growth is unlikely to continue forever --- slowdown is inevitable



This fast growth will continue for many years to come, but it surely will slow down at some point.

Preview of Today's Session

- We aim to understand why there has been such a divergent growth pattern in recent decades: China grew at 10%, while the developed world only 2% on average

- More importantly, we want to figure out how China suddenly reversed its fortune after 1978 (focus of the next session)

- We borrow two theoretical frameworks to help us understand the issue:
  1. Solow growth model
  2. Lewis two-sector migration model

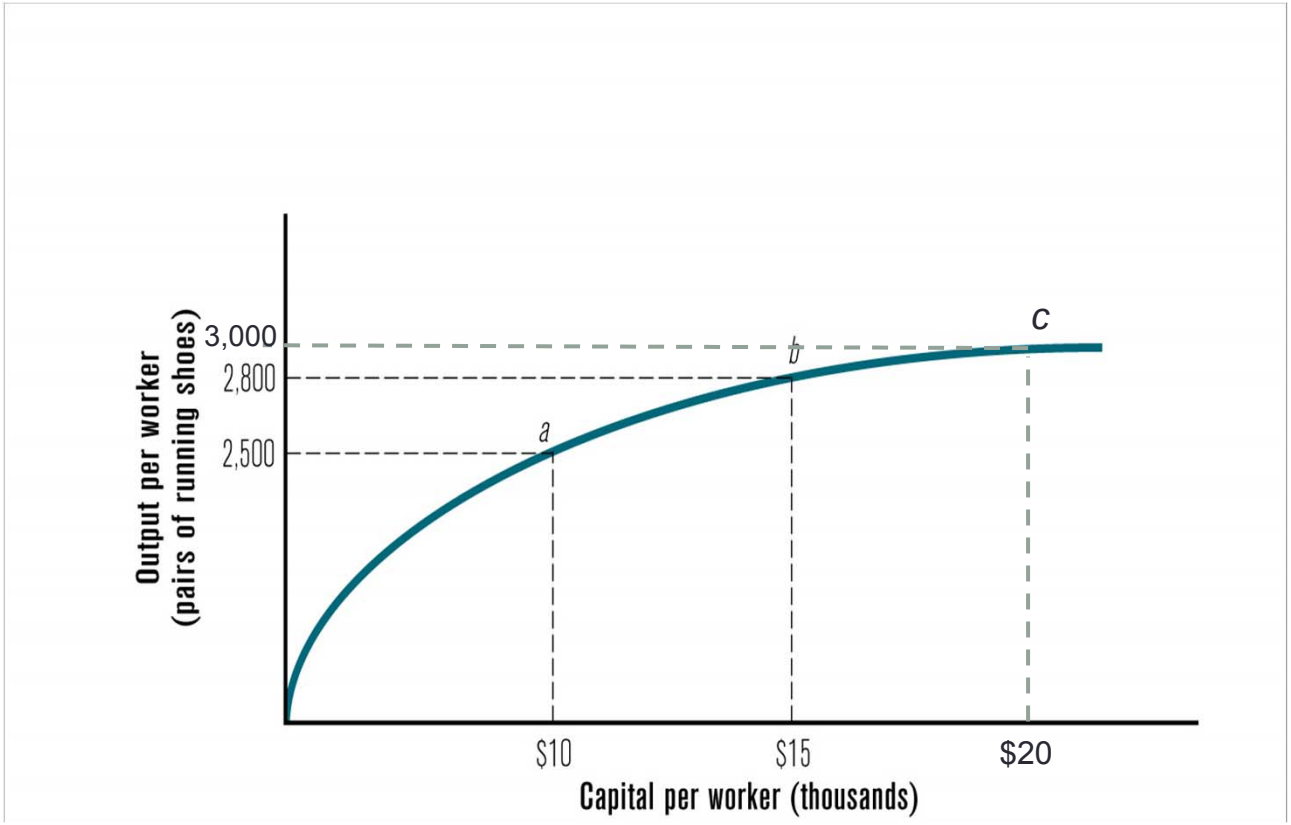
Introducing *Solow Growth Model*

The Concept of Diminishing Return

The pancake story

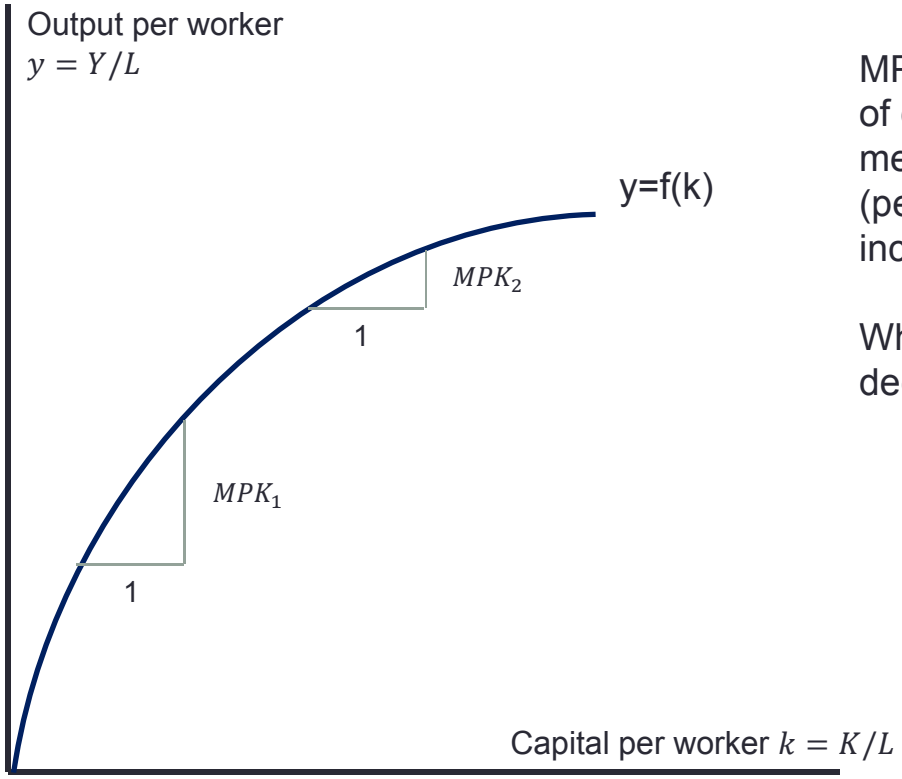
- Pancake recipe calls for 1 cup of milk and 2 cups of flour, with the milk-flour ratio being 1:2 (or 0.5:1)
- Out of flour, pancake maker chooses to add in more and more milk to accommodate a surging demand. So the ratio between milk to four increases from 0.5:1 to 1:1 then to 2:1, 3:1 and so on…but this resulted in thinner and thinner pancakes, and the 'cheating' received an outright rejection from consumers
- As the milk-to-flour ratio increases, the *marginal* product (of pancake) decreases
- Now replace milk-flour relation with capital-labor

The Diminishing Return to Capital



Production Function with Diminishing Return of Capital

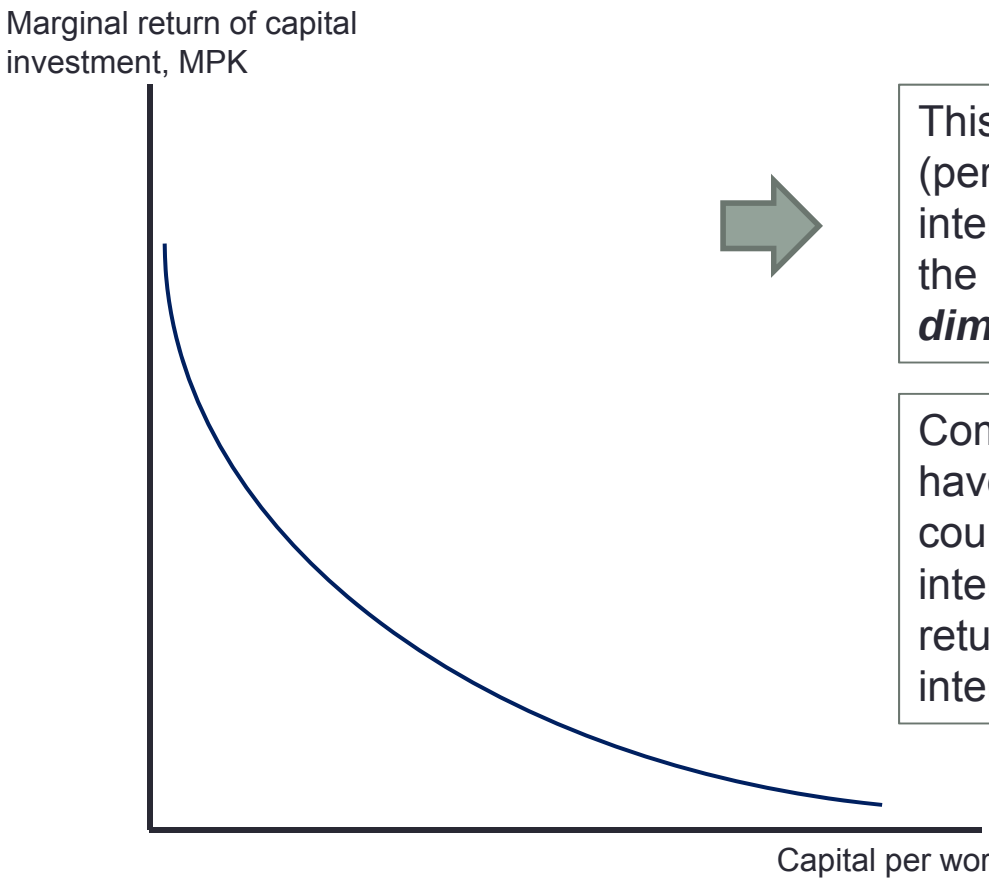
$$Y=F(K,L) \Rightarrow Y/L=F(K/L) \Rightarrow y=f(k),\ (y=Y/L,\ k=K/L)$$



MPK stands for marginal product of capital. In this graph, MPK measures the additional output (per capita) being produced when increasing k (or K/L) by one unit.

When k increases, MPK decrease, e.g., $MPK_2 < MPK_1$.

Marginal Return on Capital



This ***marginal return*** of investment (per capita), MPK, declines as capital intensity increases --- in other words, the return on capital follows ***the law of diminishing return***.

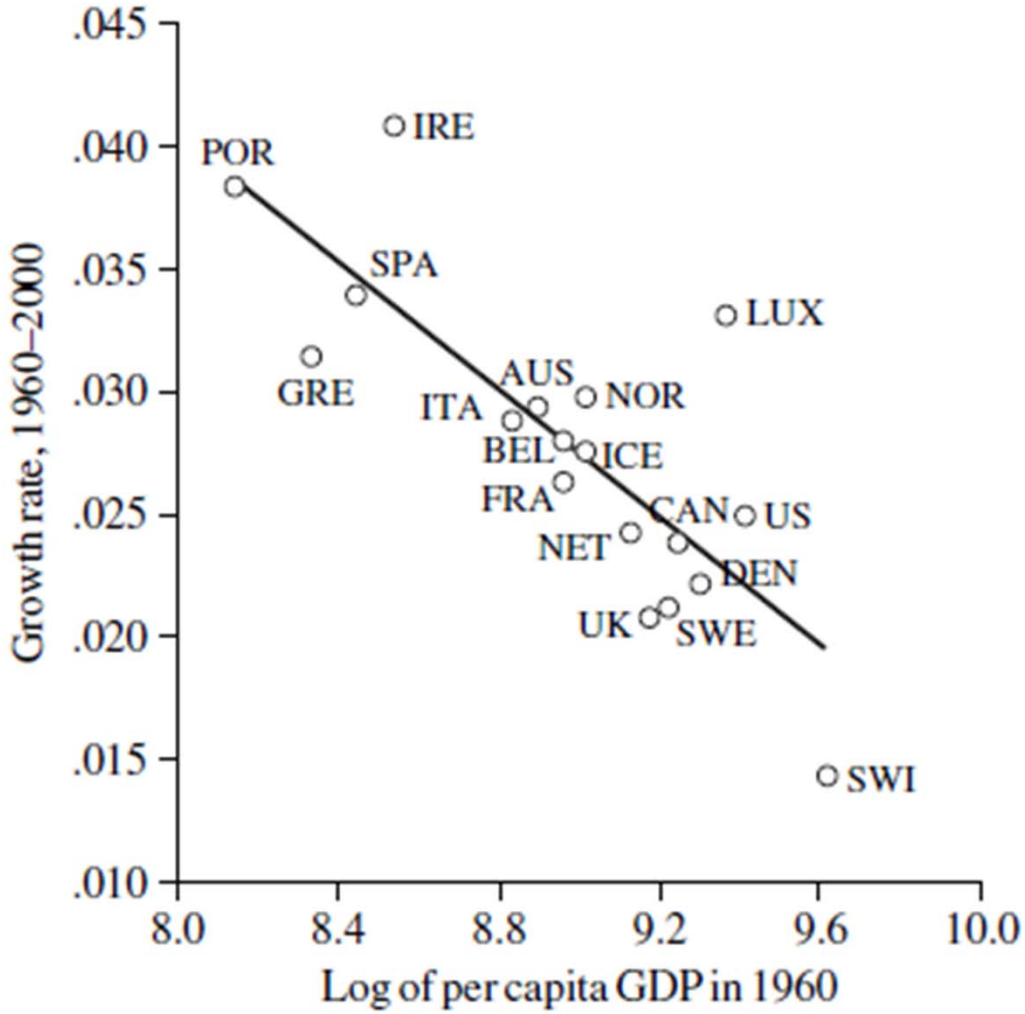
Combining the above, we essentially have the ***following conclusion***: as a country grows richer, its capital intensity rises; with the diminishing return on capital, higher capital intensity leads to slower growth rate.

GDP per worker vs. Capital per worker, 2005

Sources: Calculations based on Heston et al. (2006) and World Bank (2007a).

- Capital per worker (or capital intensity) and GDP per worker are positively correlated
- When a country grows richer, it tends to have higher capital intensity

Yet, rate of growth and GDP per capita tended to be inversely correlated



Solow Model in a Nutshell

Q: What is the economic interpretation of the line: $(n + d)k$?

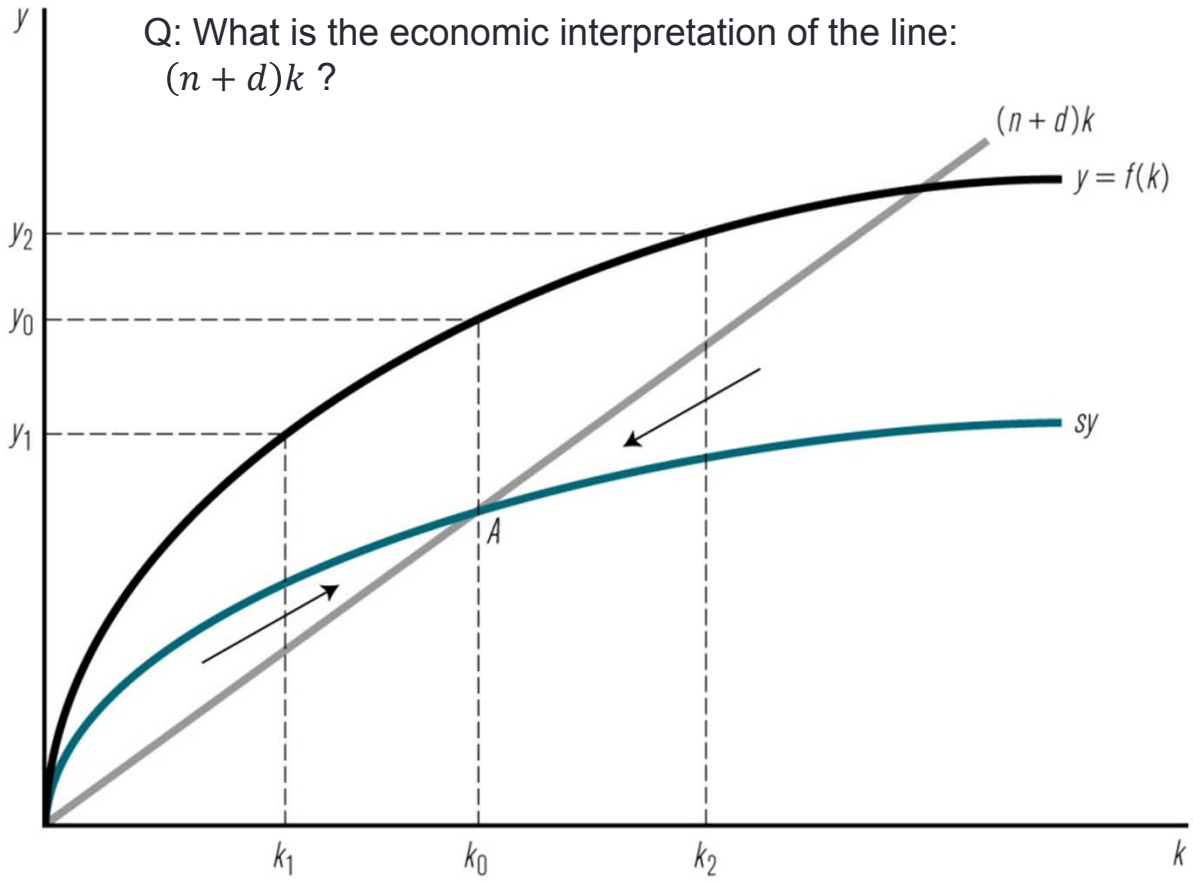


FIGURE 4.4 The Basic Solow Growth Model Diagram

How savings rate affects growth

1. When savings rate, *s*, increases:

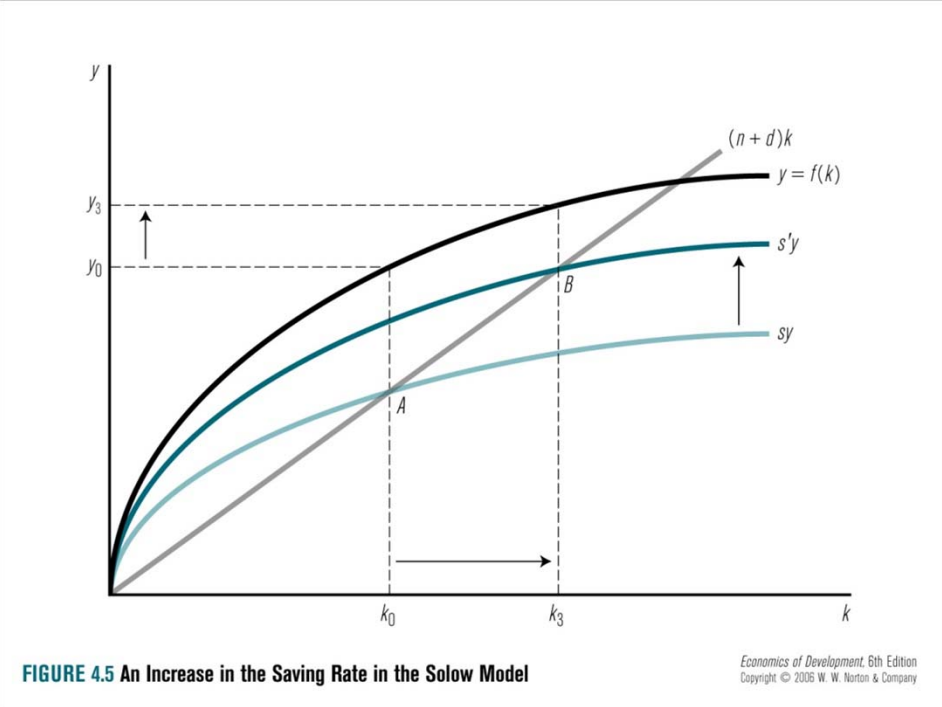
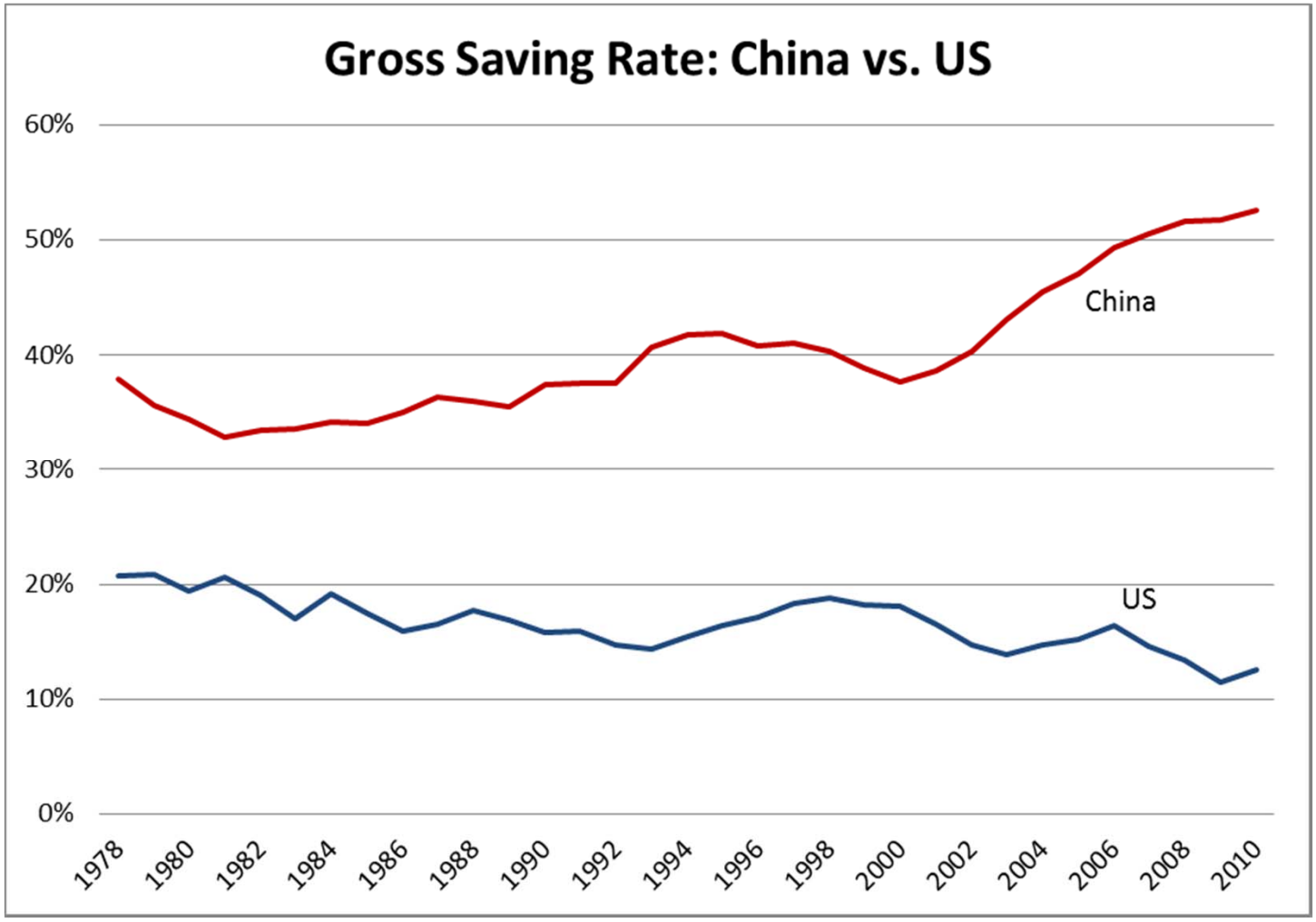


FIGURE 4.5 An Increase in the Saving Rate in the Solow Model

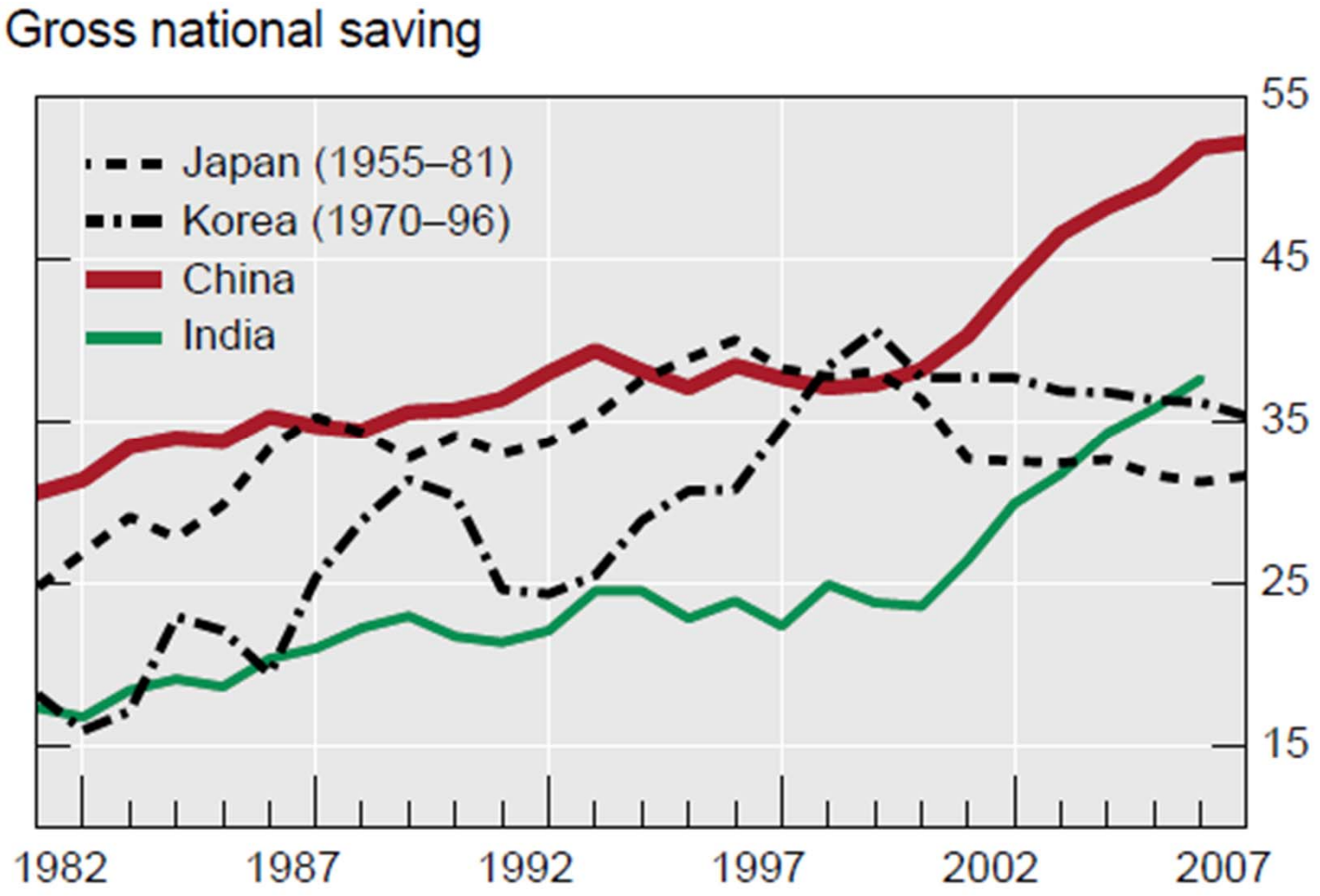
- When savings rate, s →s' (s'>s), curve *sy* shifts upward to *s'y*.
- Equilibrium point shifts from A to B
- Compared the two equilibrium points (B vs. A), we have a higher investment per worker (k=K/L) and a higher output per worker, y=Y/L.

Saving Rates Compared…



Source: Global Insight and author's own calculation

Saving Rates Compared…



Source: Ma and Yi (2010)

How population growth affects growth

2. When population growth rate (n) changes:

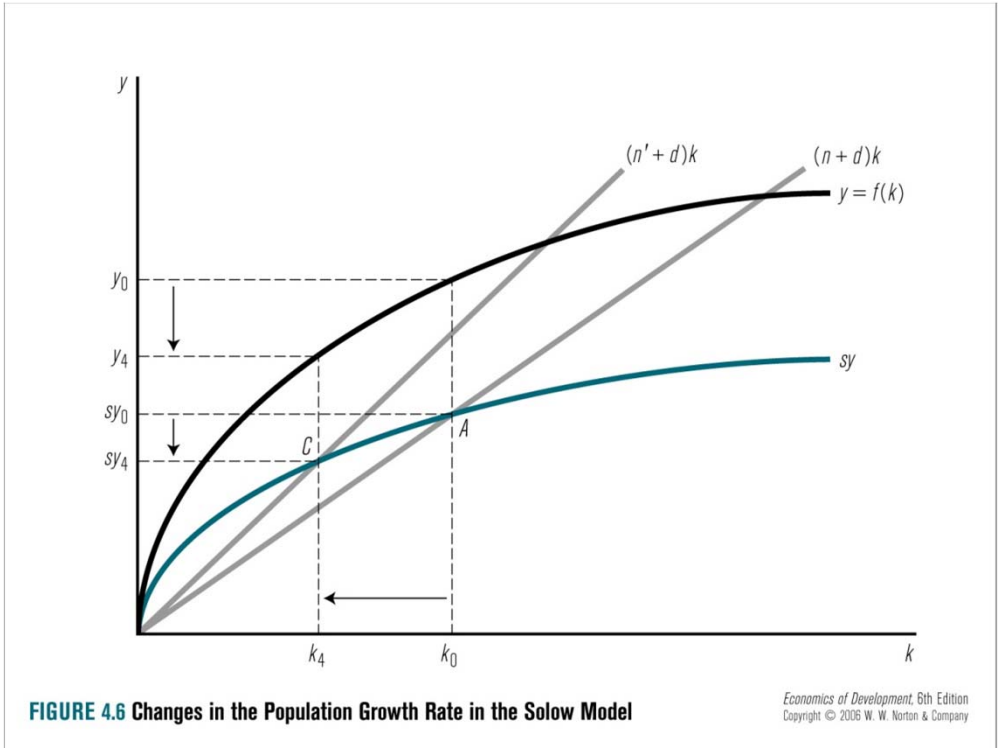


FIGURE 4.6 Changes in the Population Growth Rate in the Solow Model

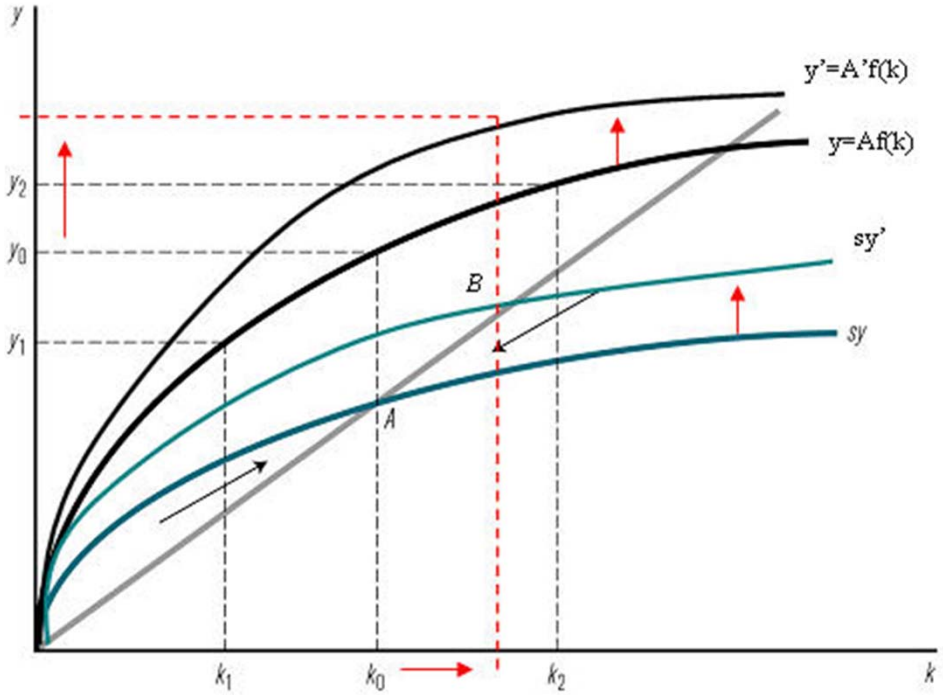
- In the situation we have a higher population growth (n < n'), line (n+d)k shifts upward to (n'+d)k
- The equilibrium point A shifts down to point C.
- At point C, we have a lower capital per worker, and lower output per worker

Solow Model with Technological Change

3. Now let's modify production function to incorporate technology:

$y = A \cdot f(k)$ A is called "*Solow Residual*".

when the economy experiences a technological innovation:



- When a technological breakthrough (innovation) comes about, A→A' (A<A'), both production function curve (*y=Af(k)*) and savings curve (*sy*) shift upward.
- At new equilibrium point B (vs. A), we have both a higher capital per worker and GDP per capita.

Growth in the long run…

- Increasing capital investment (more machines and equipment) was not the ultimate source of sustainable growth in the long run because of diminishing return on capital

- So how to explain the fact that many industrial economies have sustained an average growth rate of 2% in more than a century --- How could this be possible?

- **It's the technology, Stupid**
  - In Solow's calculation, technological change accounted for **7/8 of the US growth per worker over the first half of the 20th century.**

Taking Stock

- So far, we have learned capital tends to suffer diminishing return, which explains why when a country grows richer, its growth tends to slow down
- We have also learned that technology is one of the key drivers of economic growth in the long run
- Now, a puzzle immediately emerges: Why can China, during the past thirty years, maintain almost a constant rate of growth at 10% per year?
- Technology works in the long run. Although there has been some technology improvement, China remains largely technology-backward. So technology may help solve this puzzle a little bit, but it can't be the main story.
- **So what is a coherent story?**

Introducing *Lewis Model*

Arthur Lewis (1915-1991)

In modern era, as countries grow richer, fewer people work in agriculture

country	labor force (in millions)	agricultural % GDP	GDP, nominal (in billions)	agricultural employment share
Somalia	3.7	65%	2.5	71%
India	516	18%	1090	60%
China	803	12%	3249	43%
Mexico	45	4%	886	18%
US	153	1%	13790	0.6%

Note: data is for 2002

In developing countries, the rural sector (agriculture) tends to suffer *the problem of surplus labor*

At point *g* and onwards, *MPL=0*. The additional labor after point *g* is called surplus labor: they don't contribute to the output, and make labor productivity very low on average.

In other words, after point *g*, everyone is not working at their full potential, and some of them will probably shade or shirk.

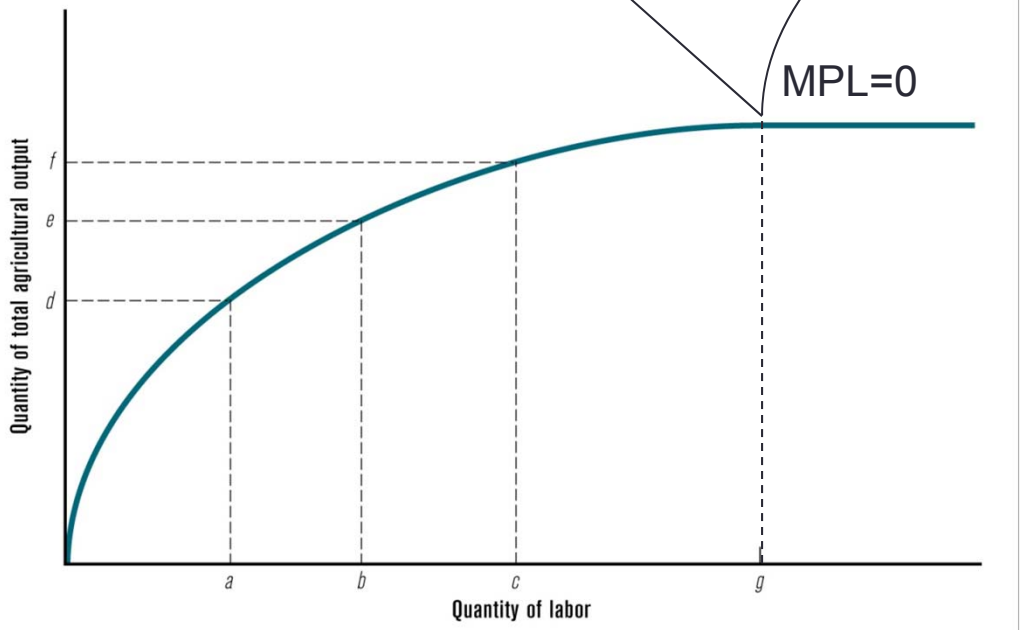


FIGURE 4.8 The Agriculture Production Function

Labor Supply in Rural Sector

Transforming the previous graph into marginal term, we obtain the supply curve of rural labor:

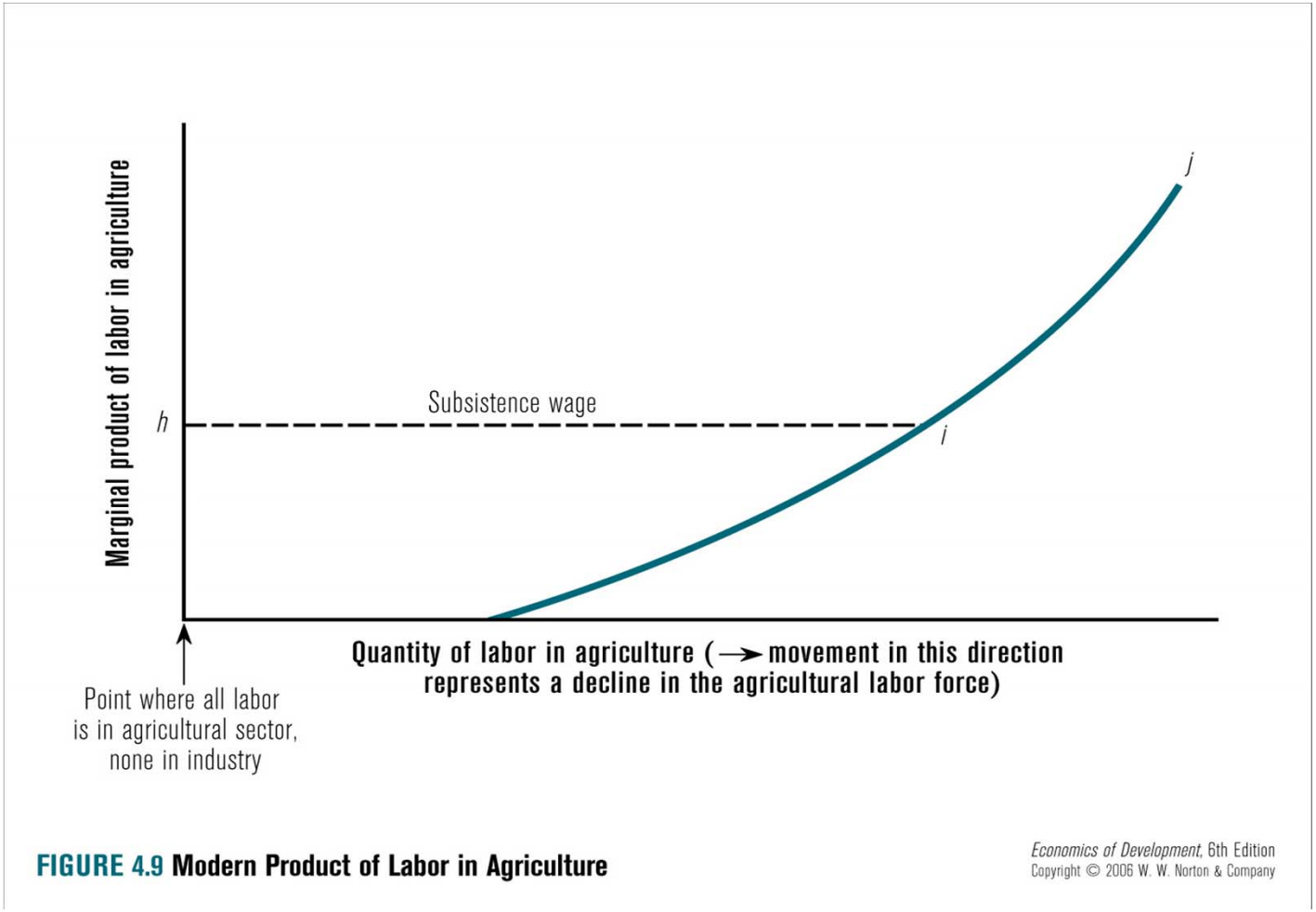


FIGURE 4.9 Modern Product of Labor in Agriculture

When supply meets demand…

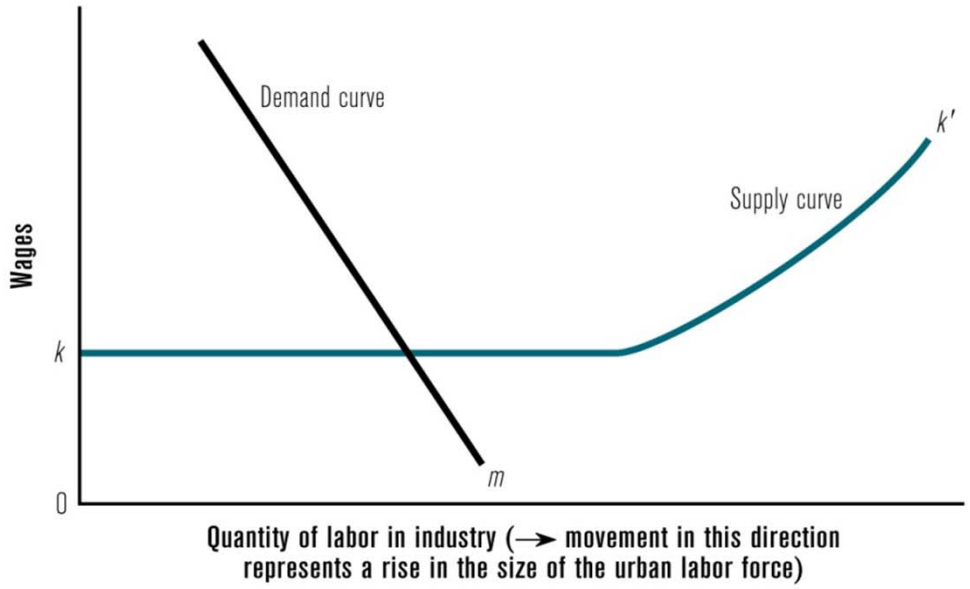


FIGURE 4.10 The Supply and Demand for Industrial Labor

- Now we add in industrial sector, which could potentially use rural labor in industrial sector.
- The demand curve is downward sloping, which says as wage rises, the demand for rural labor decreases.

Supply & Demand of Labor in Industrial Sector

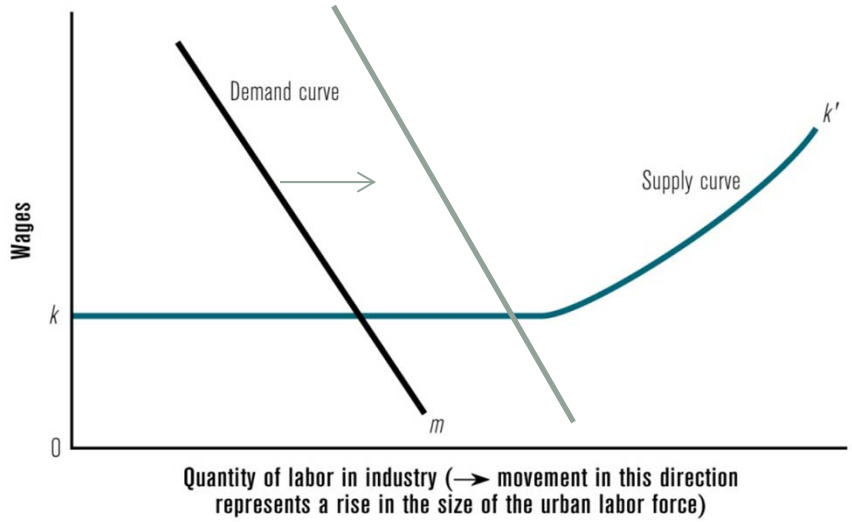
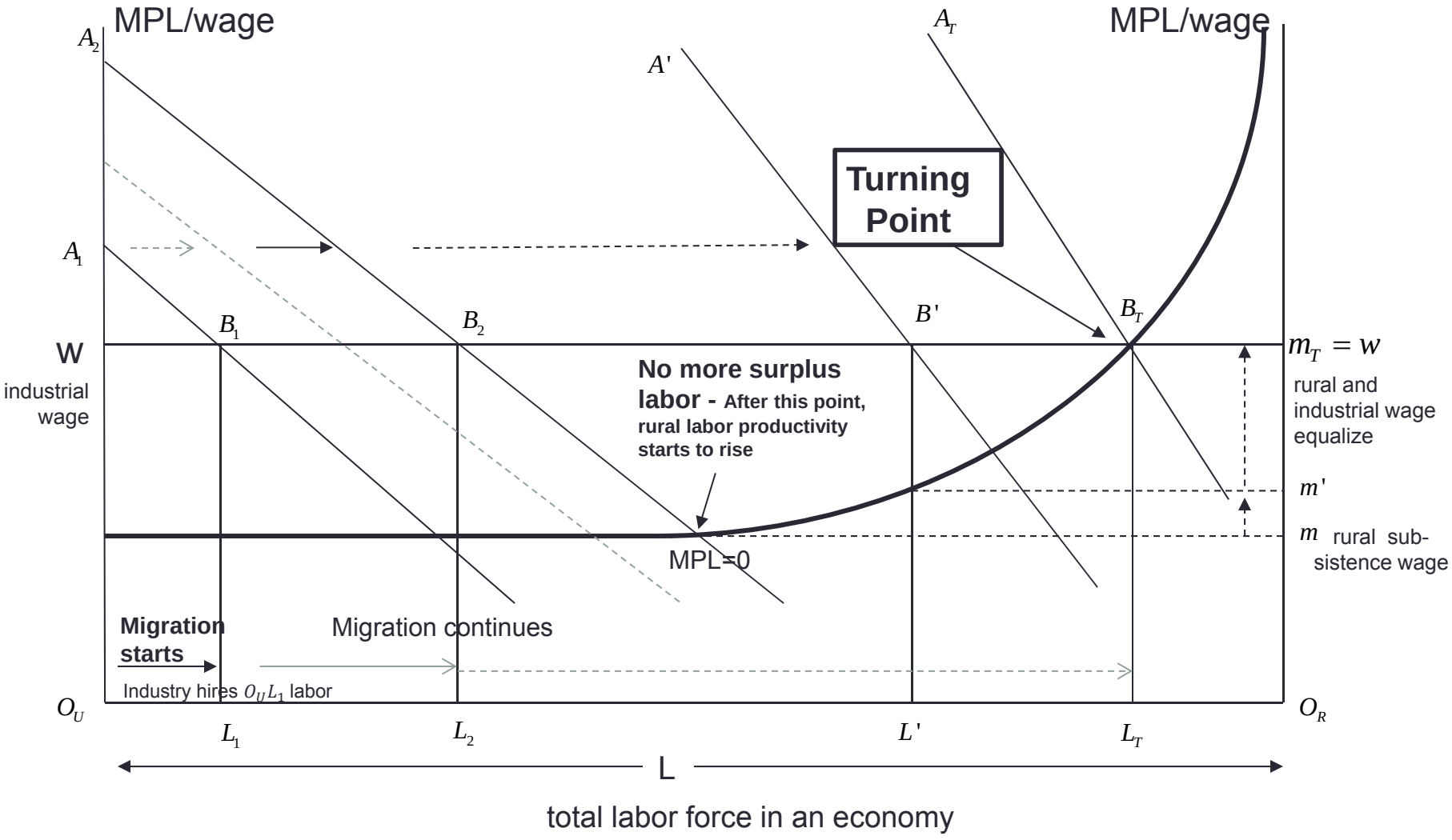


FIGURE 4.10 The Supply and Demand for Industrial Labor

- When industrial sector offers a wage that is higher than the rural wage, it provides incentives for farmers to move out of agricultural sector.
- As industrial sector continues to expands the demand curve keeps shifting outward, which keeps demand for rural labor rising and results in continuous migration of rural labor into industrial sector.
- At one point (at the kinky point on the labor supply curve), surplus labor runs out and marginal product of labor, MPL, starts to rise.

Lewis Two-Sector Migration Model: Dynamics



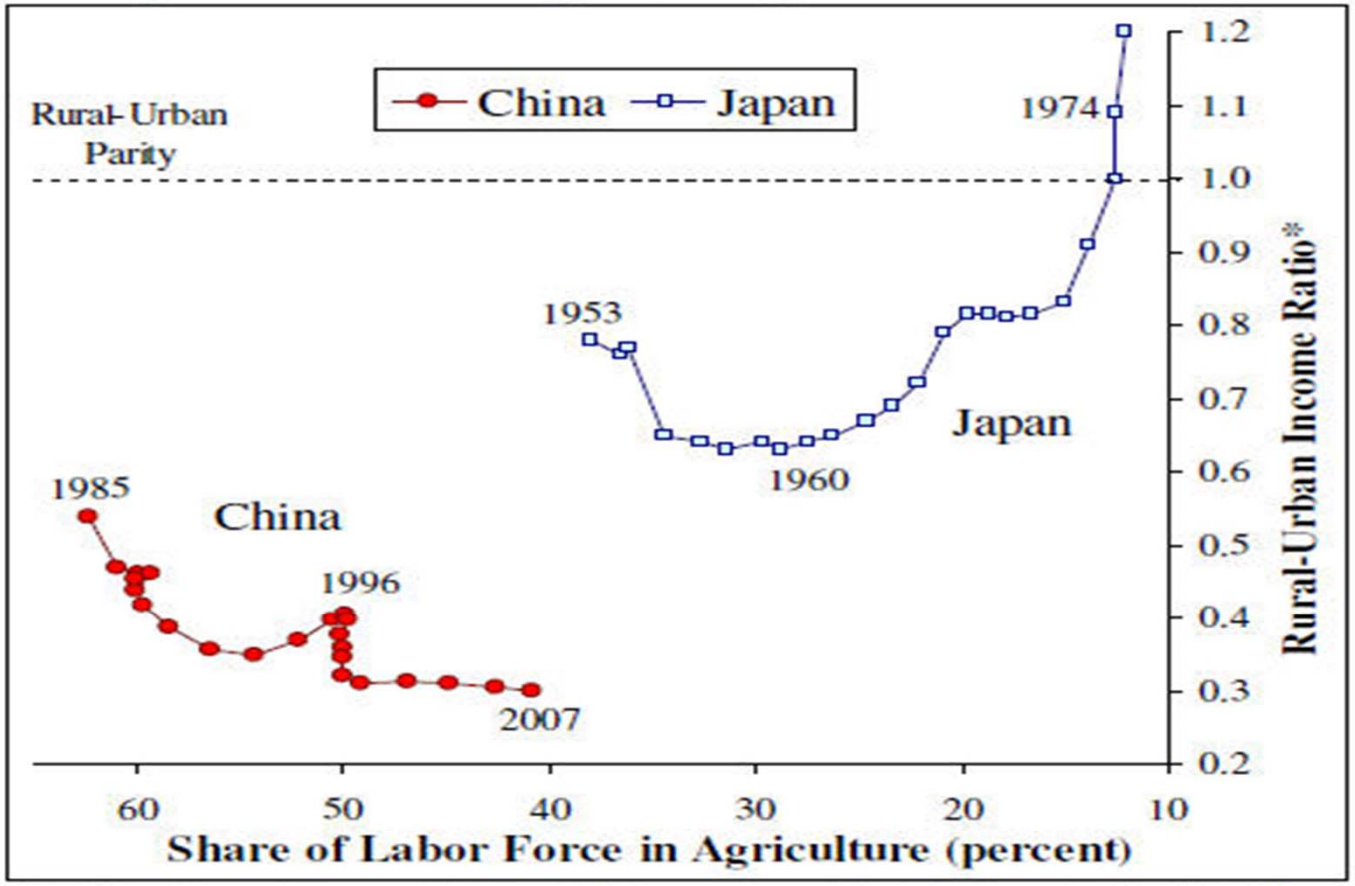
At Turning Point…

- Wages in rural and industrial sectors get equalized
- Further migration is still possible, but slows down dramatically, and it must be due to considerations other than the wage gap
- After reaching the turning point, migration stops, labor supply in industrial sector stops rising; as the demand in industrial sector continues to expand, wage in industrial sector is set to rise
- **Has China reached the turning point?**

China's urban-rural income gap will last for a long while…

Figure 8. Agricultural Labor Force Decline and Rural-Urban Income* Gaps

China's agricultural labor force, at 40 percent, has not yet declined to Japan's level in the middle 1950s; Japan's rural-urban income disparities only began improving after 1960, when its agricultural labor force dropped below 30 percent of the total labor force.

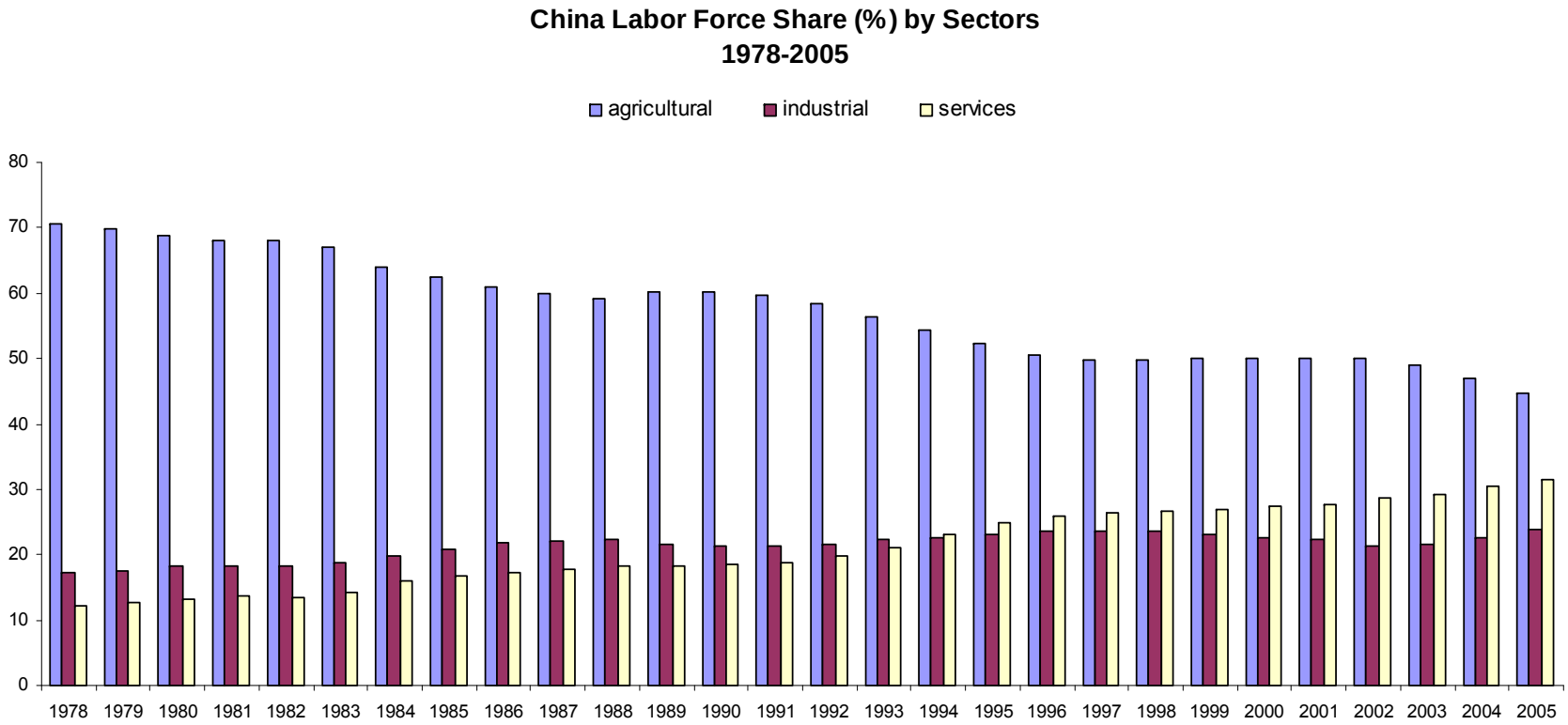


* Note: Chinese income data are rural-urban, while Japanese are agricultural and non-agricultural definitions.

Sources: Mizoguchi and Takayama, *Equity and Poverty Under Rapid Economic Growth* (1984), www.stat.go.jp, and China National Bureau of Statistics, *Statistical Abstract 2008*

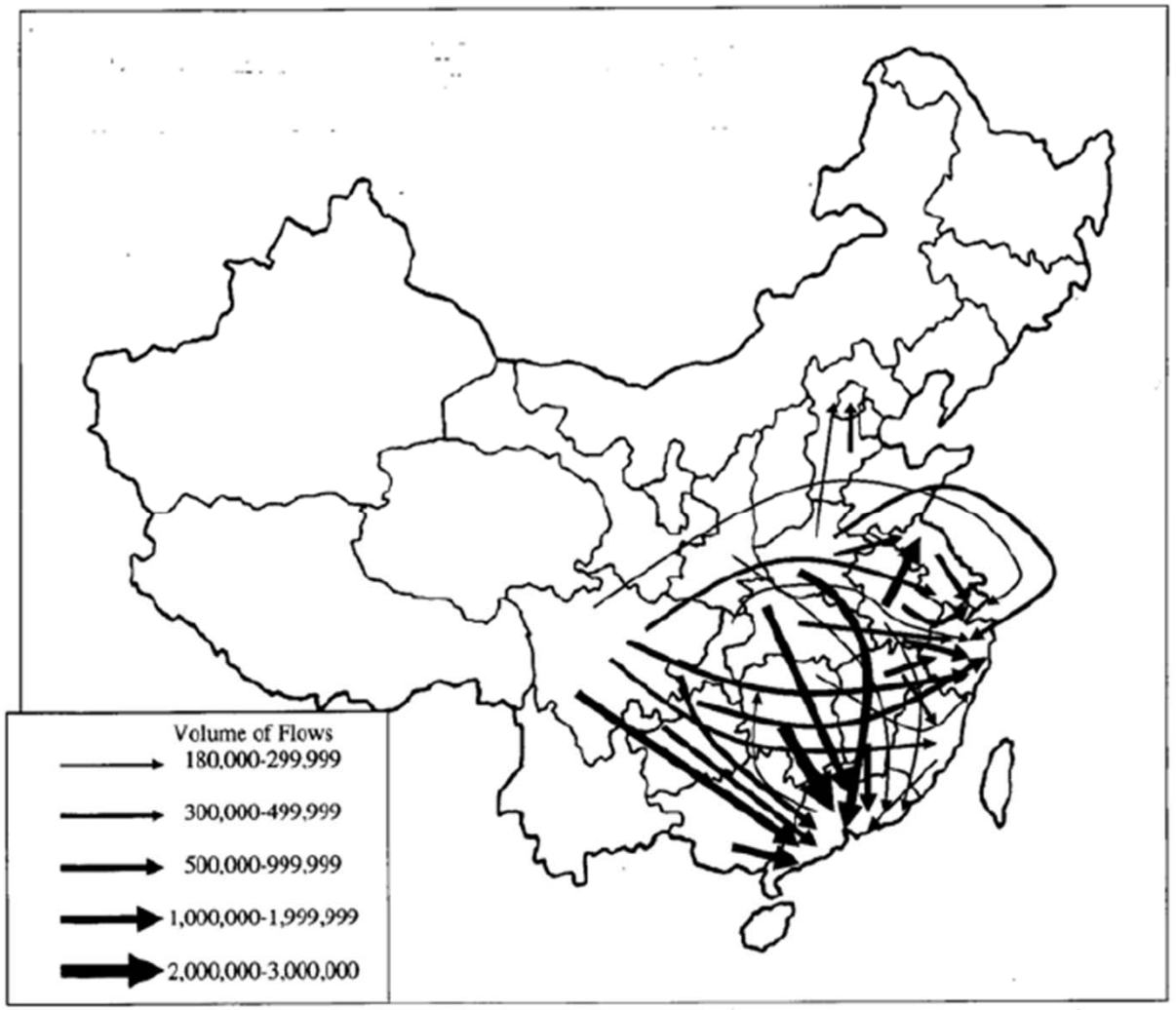
Source: Albert Kiedel (Carnegie Endowment, 2008)

Re-allocating China's Surplus Labor



Source: NBS and author's own calculation

Internal Migration Flows in China, 2000-2005



Source: State Council and National Bureau of Statistics (2007)

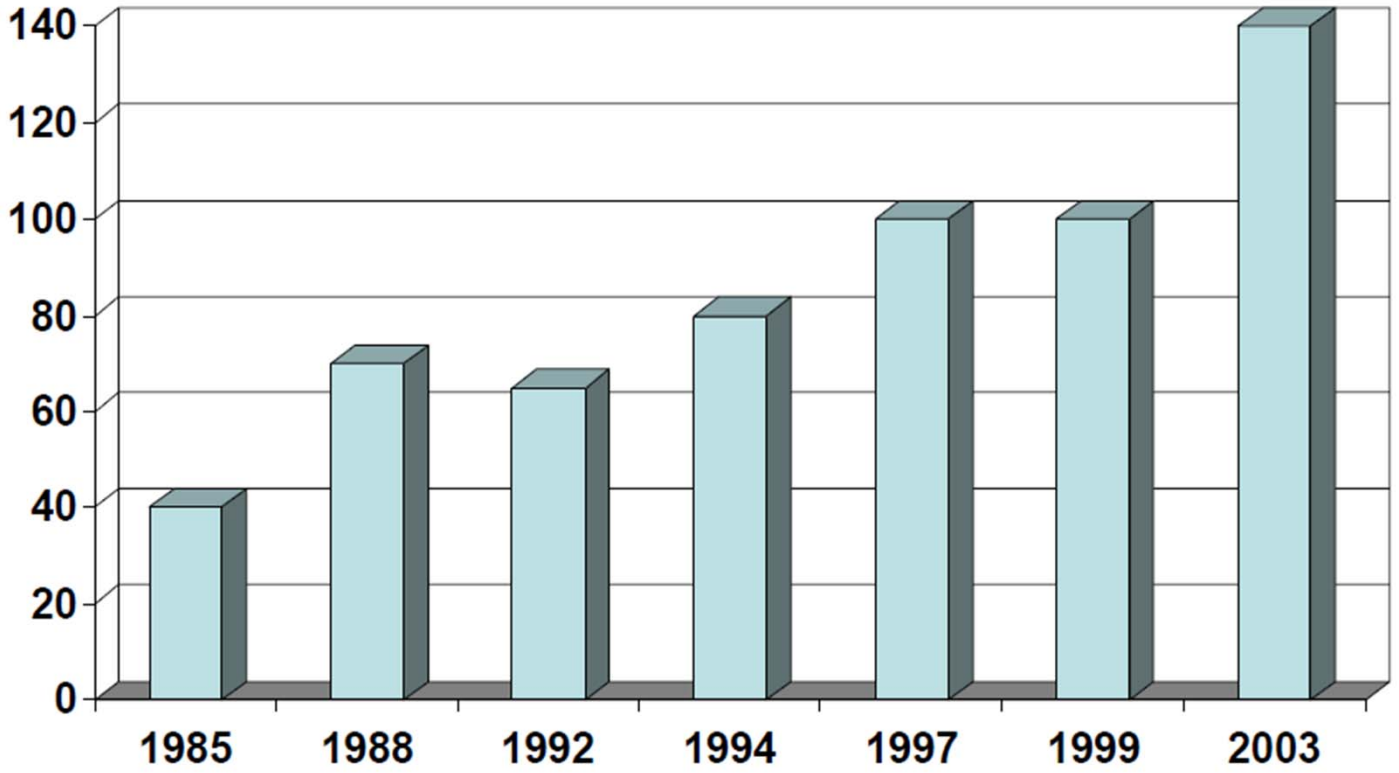
Composition of Rural Migrant Labor

Region	Total Rural labor	Out-migration rate	No. of Migrants		Geographic Distribution (%)				
	Size (in millions)	%	Size (in millions)	%	Within Counties	Within Provinces	Toward Urban Centers		
1993/94									
East	154.5	8.5	13.1	25.6	28.4	66.3	82.0		
Central	143.3	15.9	22.8	44.4	40.6	70.4	83.3		
West	113.8	13.5	15.3	30.0	37.0	76.4	66.5		
TOTAL	411.6	12.5	51.2	100	36.4	71.1	77.9		
2004									
East	198.7	19.8	39.3	33.3	Province-level Cities and Provincial Capitals	Prefecture-level Cities	County-level Cities	Designated Towns	Others
Central	173.8	27.2	47.3	40.0					
West	124.4	25.4	31.6	26.7					
TOTAL	496.8	23.8	118.2	100	28.1	34.3	20.5	11.4	5.7

Source: K.W. Chan, 2008

Migration Trends: Floating Population, 1982-2003

(Estimates in Millions)



Source: K.W. Chan, 2008

Sectoral Evolution of Chinese Economy

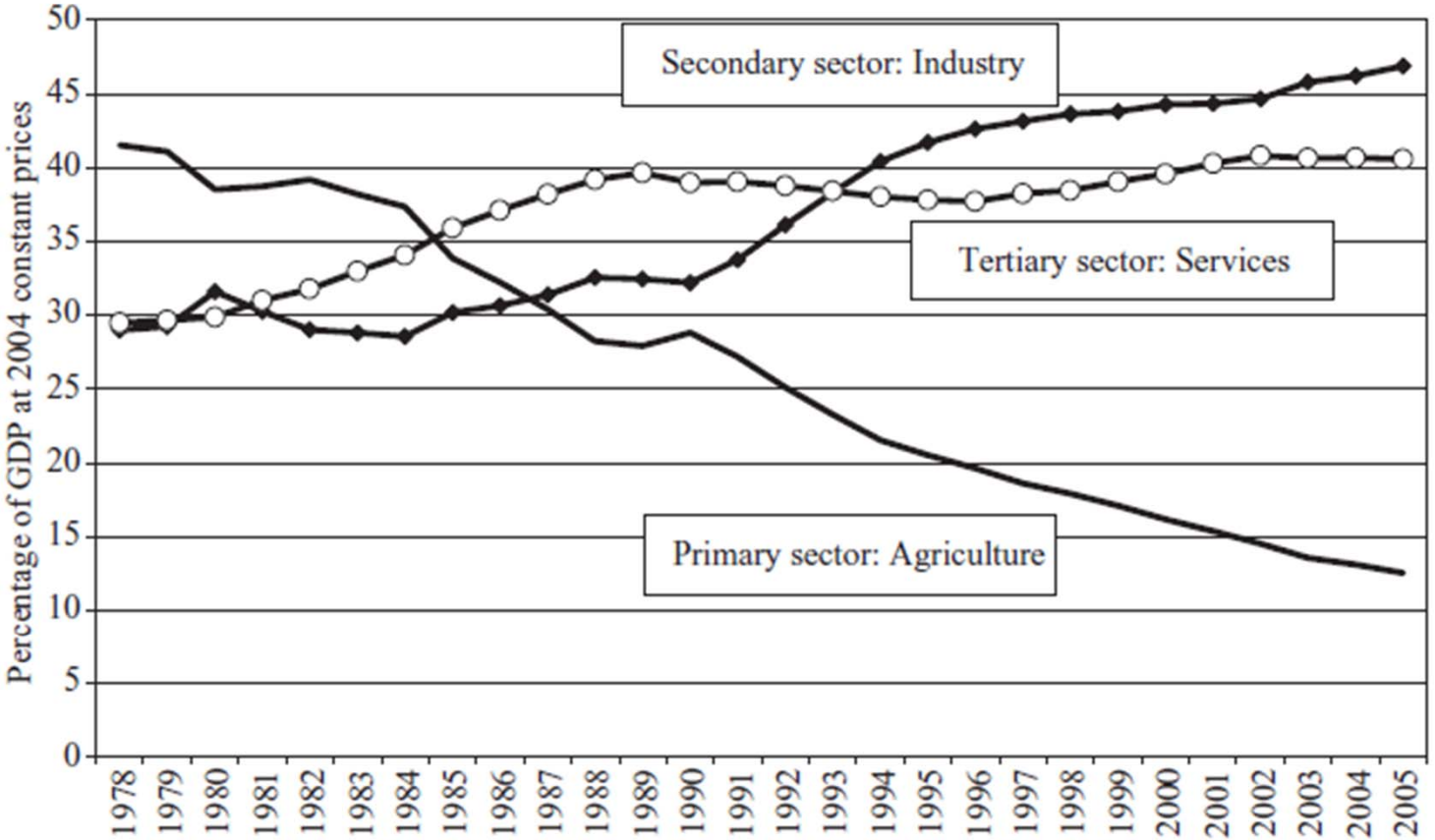


Figure 6.4
Composition of GDP

Two Simultaneous Processes

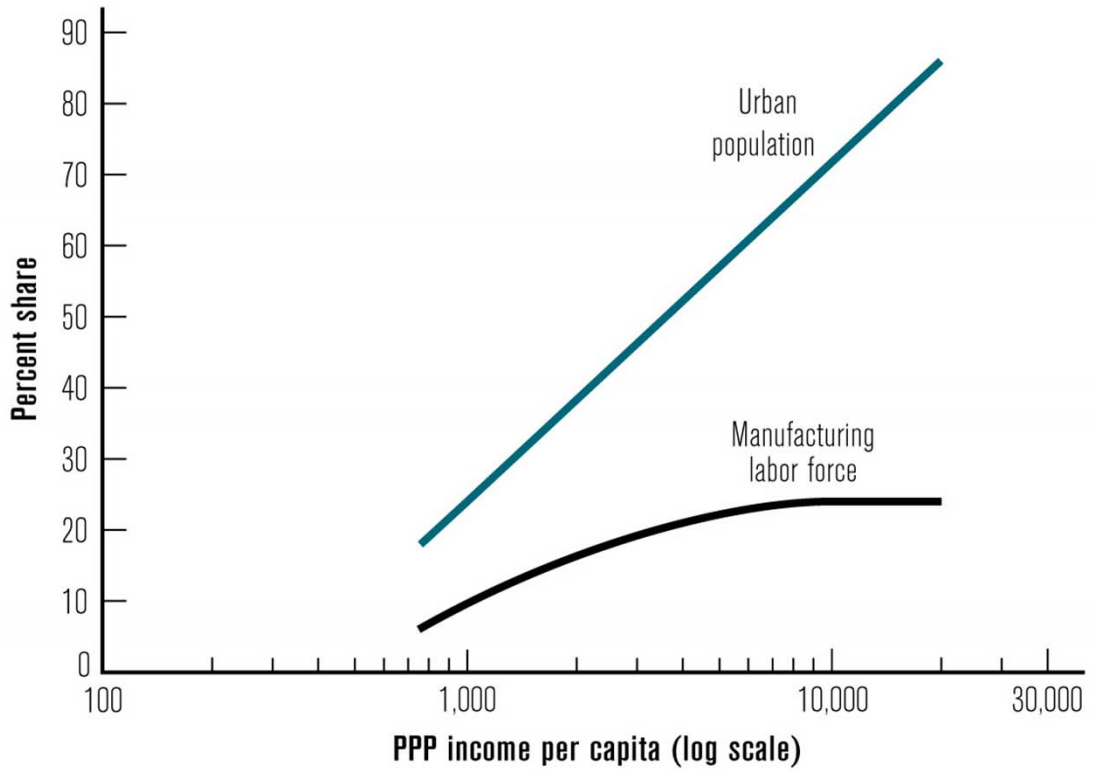
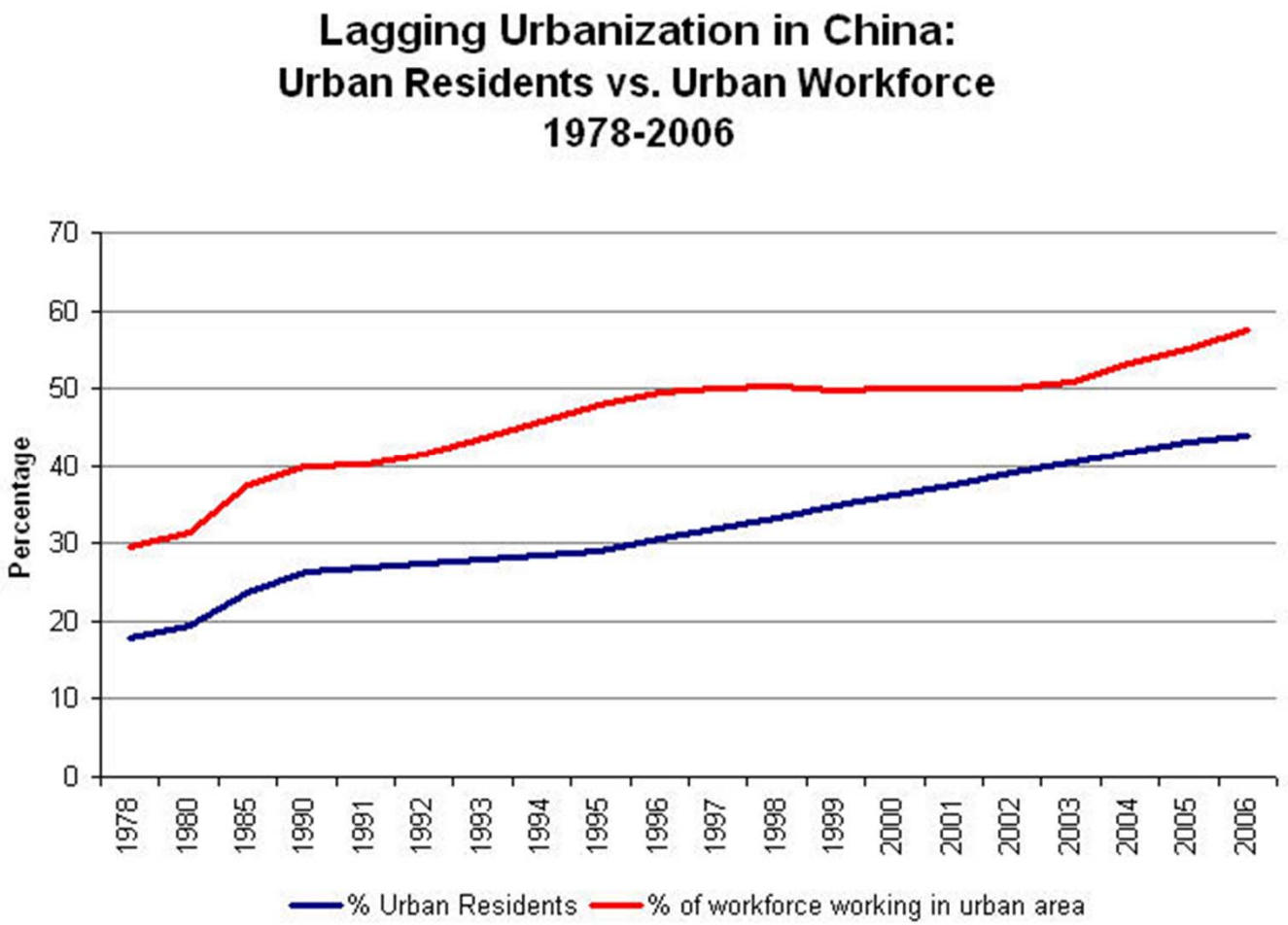


FIGURE 18.2 Industrialization and Urbanization

Lagging Urbanization in China



Source: Deng (2006)

The uniqueness of China's transition process

China's transition can be thought as three simultaneous processes, instead of two:

1. Industrialization
2. Urbanization
3. Socialist transition: from socialist economy to some sort of market economy
   - The exact direction is unknown
   - But there are signs that China economic system starts to resemble what we call "state capitalism" – CCP will never admit it, of course

So, what is the coherent story?

- China's ability to maintain 10% annual growth in the past 30 years despite its fast rising income level signals that China has yet to suffer the diminishing return to capital, or at least not very dramatically

- One reason to untangle this puzzle is to look at the increase of labor supply, which resulted from the continuous migration from rural area

- Capital intensity (*K/L*) in China's industrial sector must have not increased dramatically, due to the fact that *K* and *L* have been increasing at the same time

- Since K and L were both increasing, this keeps the force of diminishing return in check, but **the "dark" force will eventually bite,** as L (labor supply) dwindles

Summary

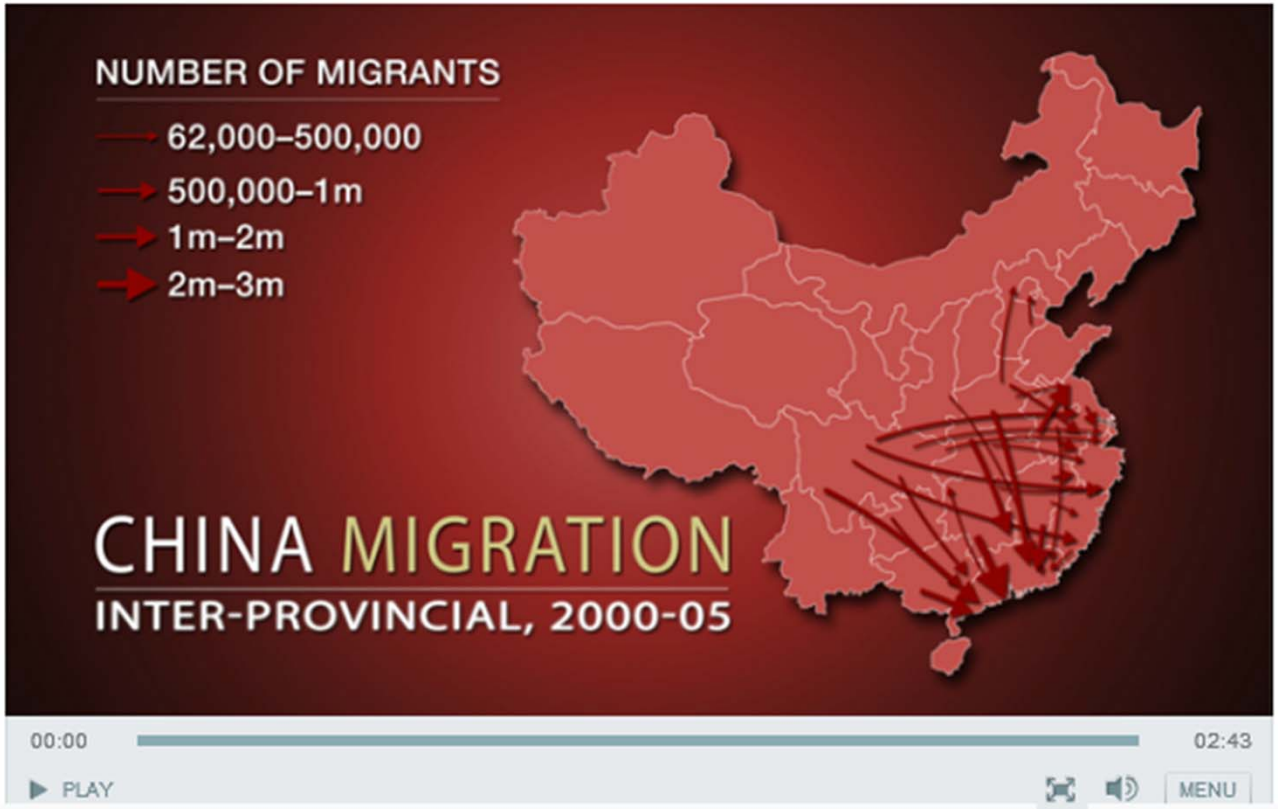
- China tends to grow faster than developed countries because it's relatively poor --- the so-called ***"the advantage of backwardness"***
- China's internal labor migration is the largest in human history. The continuous increase of industrial labor supply has kept Chinese wage at very low level
- The large flow of migrant labor helped China delay the effect of decreasing return on capital. But the law of diminishing return will kick in eventually.
- However, what really mattered (to be discussed in later lectures) was the unleashing of individual's incentives – people work harder because they know they will be rightly rewarded – this was best exemplified by the experiments in rural farming and SOE restructuring

Next Time…

We will discuss China's rural reform and I will provide insights into the restructuring in China's state-owned enterprises (SOEs)

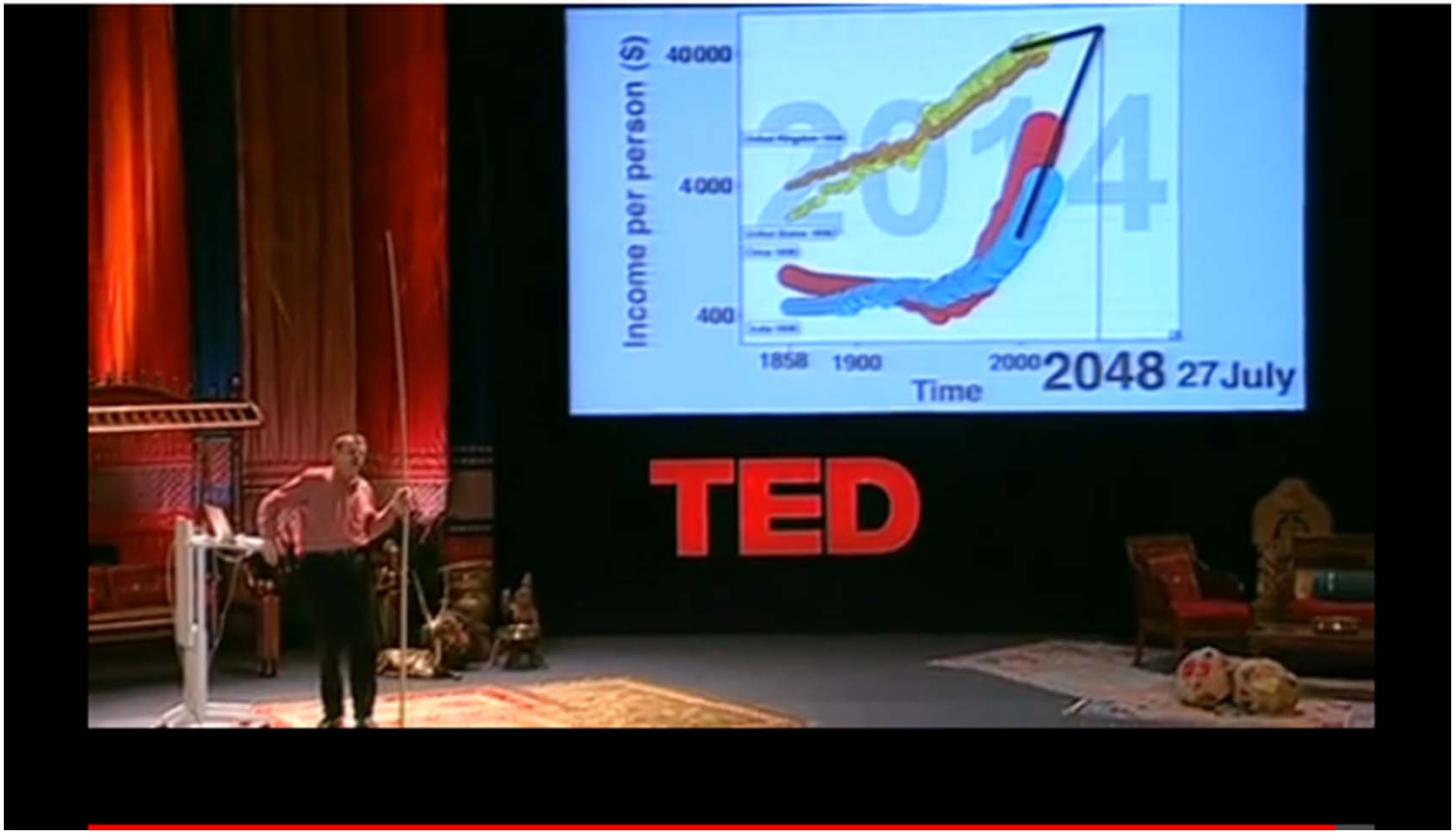
Recommended

Watch this video, "**The Largest Migration in Human History**" from *Economist Magazine*.



Link: http://economistonline.muogao.com/2012/03/the-largest-migration-in-history.html

Recommended: When the real catch-up will take place?



Click the graph to view the video or use the link below:
http://www.ted.com/talks/hans_rosling_asia_s_rise_how_and_when.html

Optional Material

Derivation of Solow Model

By definition, net change of capital input (ΔK) equals investment (I) minus capital depreciation $d \cdot K$ (d: deprecation rate), thus we have

$$\Delta K = I - d \cdot K \quad ①$$

Since all savings eventually finds its way to investment, we have $S = I$, and assume savings is a fixed proportion of income, we have $S = s \cdot Y$ (s is saving rate, or saving propensity).

Plug these two equations into equation ①, we get:

$$\Delta K = I - d \cdot K = s \cdot Y - d \cdot K \quad ②$$

Now is the more difficult part:

$k = K / L$, after total differentiation we have:

$$\Delta k = \Delta K / L - \Delta L \cdot K / L^2 = \frac{\Delta K}{L} - \frac{K}{L} \cdot \frac{\Delta L}{L} = \frac{\Delta K}{L} - k \cdot n \quad ③$$

(n: is the population growth rate, assume it equals labor growth rate)

Plug ② into ③, we have:

$$\Delta k = \frac{s \cdot Y - d \cdot K}{L} - k \cdot n = s \cdot y - d \cdot k - n \cdot k = sy - (n + d)k$$