

GDP: Data and Problems

- The Official data
 - Average annual growth (1979-2004): 9.6%
 - 2003: 10.0%
 - 2004: 10.1%
 - 2005: 10.2%
 - 2006: 10.7% (preliminary)
- Questions
 - Is the official data reliable?
 - Is the growth rate overstated?
- Alternative method of estimation
 - Using electricity consumption growth rate, if elasticity of electricity consumption is constant

GDP: Data and Problems

- Possible problem (1)
 - Miscalculation of the GDP deflator
 - Growth rates could be overstated by 1-2%
 - If so, growth is around 8% and growth per capita is around 7%
- Possible problem (2)
 - Reporting incentives by local officials
 - Overstating at trough and understating during boom
 - Overstating in poor areas and understating in rich areas
- Possible problem (3)
 - Missing data (small-scale, private firms)

Growth is Real

- Growth is still very impressive even under possible downward revision
 - Comparable growth to fastest growing economies
 - Population almost three times of 8 high performing economies: Japan, South Korea, Taiwan, Hong Kong, Singapore, Malaysia, Thailand, and Indonesia
- Growth measurement in physical terms (not in value)
 - Production in steel, automobile, housing, highway etc.
 - Consumption per capita

2004 Economic Census and GDP Revision

- GDP revision based on the first economic census in 2004
- Announcement on December 20, 2005
 - Upward revision of 2004 GDP by 16.8% (2.3 trillion yuan or \$285 billion) to 16 trillion yuan
 - 2.13 trillion yuan was added to service sector
 - 19 provinces were up, 12 provinces down
- Main reasons
 - To collect data in a more inclusive way

2004 Economic Census and GDP Revision

- Growth rates adjustment from 1993 to 2004
 - 2000: from 8.0% to 8.4%
 - 2001: from 7.5% to 8.3%
 - 2002: from 8.3% to 9.1%
 - 2003: from 9.5% to 10.0%
 - 2004: from 9.5% to 10.1%
- As a result adjustment for average growth rate in 1979-2004: from 9.4% to 9.6%

2004 Economic Census and GDP Revision

- Is this revision reliable?
 - Not a surprise to international investment banks
 - Not a surprise to economists
- Independent evidence
 - Tax revenue (more reliable data)
 - Export (more reliable data)
 - Service sector (data very unreliable)

Service/GDP: China vs. India

	China	India	Difference
Total service	34.3	50.7	-16.4
Retail, restaurants	8.1	14.8	-6.7
Real estate	2.0	6.7	-4.7
Transportation	3.5	6.1	-2.6
Government	2.7	6.2	-3.5
Financial service	5.7	7	-1.4
Telecomm	2.6	1.6	1

Compound Growth Math

$$GDP_{t+n} = GDP_t (1+g)^n$$

- Rule of 70: number of years to double = 70/growth rate
- g = 9%: double every 8 years
- g = 7%: double every 10 years
- g = 6%: double every 12 years
- g = 5%: double every 15 years
- g = 4%: double every 18 years

China's Economy in 2020

- Which exchange rate should be used?
 - current exchange rate: US\$1 = RMB7.78 yuan
 - purchasing power parity (PPP) in terms of "Big Mac Index:"
US\$1 = 3.9 Yuan
(Big Mac prices: US\$ 2.54 in US and 9.9 yuan in China)
 - purchasing power parity (PPP) in World Bank studies:
US\$1 = 2 Yuan

China's Economy in 2020

- GDP sizes of China and US in 2000 under alternative exchange rates
 - At current exchange rate: China US\$ 1 trillion; US US\$ 10 trillion
 - At purchasing power parity (US\$1 = 2 Yuan): US per capita GDP US\$ 35,000; China per capita GDP: US\$ 3,500
 - At purchasing power parity (US\$1 = 2 Yuan): China US\$ 4.5 trillion (China's population is about 4.5 times of US)

China's Economy in 2020

Per capita GDP (World Bank, 1998-99)

	at exchange rate	at PPP
Malaysia	4,680	10,920
Mexico	3,680	8,120
Thailand	2,800	6,590
Brazil	4,720	6,240
Philippines	1,220	3,670
China	860	3,570
Indonesia	1,110	3,450
Egypt	1,180	2,940
India	390	1,650
Pakistan	490	1,590
Bangladesh	270	1,050

China's Economy in 2020

- Assuming China's economy in 2000 is 0.5 of US
 - If the growth rate difference between China and US is 5% (China 8% and US 3%), then China will overtake US in total GDP in 2015
 - If the growth rate difference between China and US is 4% (China 7% and US 3%), then China will overtake US in total GDP in 2018
- Assuming China's economy in 2000 is 0.4 of US
 - If the growth rate difference between China and US is 5% (China 8% and US 3%), then China will overtake US in total GDP in 2020
 - If the growth rate difference between China and US is 4% (China 7% and US 3%), then China will overtake US in total GDP in 2024

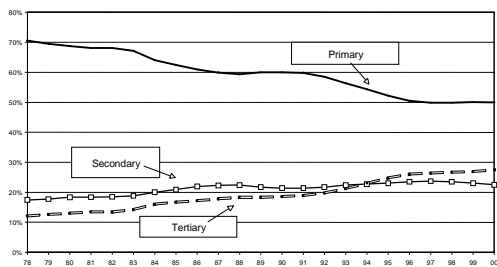
Structural Change: Labor

- Three sectors
 - Primary sector: agriculture
 - Secondary sector: manufacturing, mining, utilities, construction
 - Tertiary (service) sector: restaurants, transportation, communication, trade, education, health care, etc.
- Labor force
 - Those in population: 16-59 for male, 16-54 for female
 - High labor force participation: > 80%
 - Mainly because of high female labor force participation

Structural Change: Labor

- Patterns of structural change
 - Labor moving from the agricultural sector to the non-agricultural sector (development story)
 - Correcting the initial distortion by expanding the service sector (distortion correction story)
 - Labor moving from the domestically oriented sector to the export oriented manufacturing sector (globalization and the world's factory story)

Structural Change: Labor



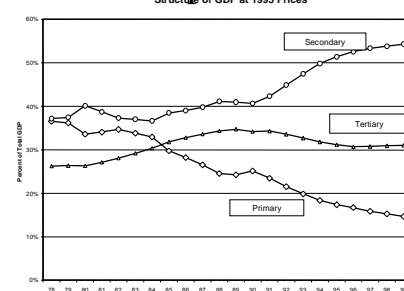
Structural Change: GDP Components

- Distortions in measuring structure change (relative importance of agriculture and industry) using distorted prices
 - Low agricultural prices underestimate the share of primary sector
 - High industrial prices overestimate the share of secondary sector

Structural Change: GDP Components

- 1978 GDP components at 1978 prices
 - Primary sector: 28%
 - Secondary sector: 48%
 - Tertiary sector: 24%
- 1978 GDP components at 1993 prices
 - Primary sector: 37%
 - Secondary sector: 37%
 - Tertiary sector: 26%

Structural Change: GDP Components



Structural Problems in China

2004 data	Before revision	After revision
Service/GDP	32.01%	40.07%
Capital formation/GDP	44.20%	37.84%
Savings/GDP	46.03%	39.41%
Export/GDP	35.95%	30.78%
Energy consumption/GDP (ton of standard coal/10k yuan)	1.44	1.23

Structural Problems in China

- Is China's service sector too small (or is China's industrial sector too large)?
- Is China's investment rate too high (or is China's investment inefficient)?
- Is China's saving rate too high (or is China's consumption too low)?
- Does China rely too much on export (or does China rely less on domestic consumption)?
- Does China consume too much energy?

The Return to Capital in China

$$r(t) = i(t) - \dot{P}_k(t) = \frac{\alpha(t)}{P_k(t)K(t)/P_y(t)Y(t)} + (\dot{P}_k(t) - \dot{P}_y(t)) - \delta(t).$$

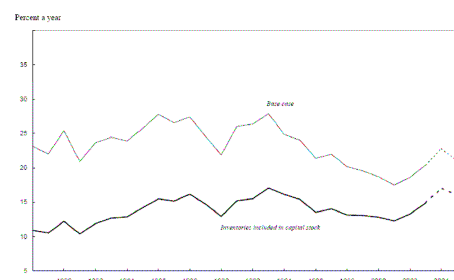
Return to Capital: Base Line



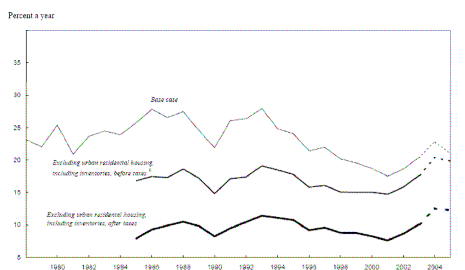
Return to Capital: After Taxes



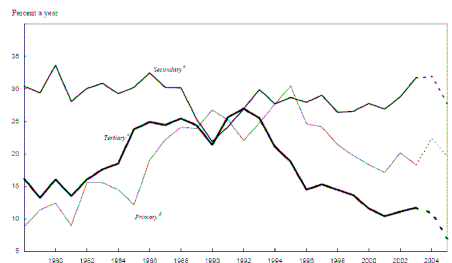
Return to Capital: Inclusive of Inventories



Return to Capital: Excluding Residential Housing, Taxes, Including Inventories



Return to Capital: By Sector



Productivity

- Labor productivity
 - Rough measure: Output per worker (Y/L)
 - Precise measure: Output per working hour (Y/H)
- Labor productivity depends on many factors
 - Physical capital
 - Human capital (skills)
 - Technology
 - Labor participation rate
 - Number of working hours

Productivity

- Different sector has different labor productivity
 - Labor productivity in both secondary and tertiary sectors is about 4 times as high as that in agriculture sector in 1978 (at 1993 prices)
- Sector reallocation
 - Movement of labor from low labor productivity sector to high labor productivity sector
 - The process of industrialization
- Total factor productivity: see below

Sources of Growth

- The neoclassical growth model (Solow model)

$$Y_t = A e^{\alpha t} K_t^\beta L_t^\gamma$$

- Explanations
 - Y: output
 - K: capital
 - L: labor
 - t: time
 - β : elasticity of capital
 - γ : elasticity of labor
 - If $\beta + \gamma = 1$, constant return to scale (Cobb-Douglas production function)

Sources of Growth

- Why are economists interested in estimating this equation?

$$\ln Y_t = \ln A + \alpha t + \beta \ln K_t + \gamma \ln L_t$$

$$\begin{aligned} \ln Y_{t+1} &= \ln A + \alpha(t+1) + \beta \ln K_{t+1} + \gamma \ln L_{t+1} \\ \ln Y_{t+1} - \ln Y_t &= \alpha + \beta(\ln K_{t+1} - \ln K_t) + \gamma(\ln L_{t+1} - \ln L_t) \\ \ln(Y_{t+1}/Y_t) &= \alpha + \beta(\ln(K_{t+1}/K_t)) + \gamma(\ln(L_{t+1}/L_t)) \\ \ln(1+\Delta Y_t/Y_t) &= \alpha + \beta(\ln(1+\Delta K_t/K_t)) + \gamma(\ln(1+\Delta L_t/L_t)) \end{aligned}$$

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t)$$

Sources of Growth

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t)$$

- Explanations
 - $\Delta Y_t/Y_t$: GDP growth rate
 - $\Delta K_t/K_t$: capital growth rate
 - $\Delta L_t/L_t$: labor growth rate
 - α : “Solow Residuals” or “technical progress” or “Total Factor Productivity” (TFP)

Sources of Growth

- Estimation equations

$$\ln Y_t = \ln A + \alpha t + \beta \ln K_t + \gamma \ln L_t + \varepsilon_t$$

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t) + u_t$$
- Difficulties
 - Measurement of capital stock K_t

$$K_t = (1-d)K_{t-1} + I_t$$
 - Measurement of labor L_t
 - Deflators used for Y_t and K_t

Growth Accounting of the U.S. Economy

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t)$$

- 1990-95:

$$2.5\% = 0.6\% + (1/3)(3.7\%) + (2/3)(1\%)$$

$$= 0.6\% + 1.2\% + 0.7\%$$
- 1995-98:

$$3.5\% = 1.4\% + (1/3)(4.3\%) + (2/3)(1\%)$$

$$= 1.4\% + 1.4\% + 0.7\%$$

Growth Accounting of China's Economy

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t)$$

- Before reform (1952-78)

$$5.5\% = 0\% + (3/4)(6.1\%) + (1/4)(3.6\%)$$

$$= 0\% + 4.6\% + 0.9\%$$
- After reform (1978-98)

$$9.3\% = 2.7\% + (3/4)(7.6\%) + (1/4)(3.6\%)$$

$$= 2.7\% + 5.7\% + 0.9\%$$

Growth Accounting of China's Economy

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t)$$

- What do we learn
 - Capital accumulation has been the most important factor for growth, contributing about 62% of growth
 - Labor reallocation from agriculture to industry contributes to about 10% of growth
 - TFP growth contributes to about 28% of growth

Growth Accounting of China's Economy

$$\Delta Y_t/Y_t = \alpha + \beta(\Delta K_t/K_t) + \gamma(\Delta L_t/L_t)$$

- Growth prospect: sources
 - Capital accumulation will still be very high
 - Labor reallocation from rural to urban areas will continue for some time, but not forever
 - TFP growth rate α may still be moderate
 - Capital elasticity β (very high now) may start to decline (not yet)
 - Labor elasticity γ (very low now) may start to increase (not yet)