

ESTIMATING THE ICT CAPITAL STOCK OF CHINA

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Outline of presentation

I. ICT investment in China

II. Estimation of ICT capital stock

**III. ICT and economic growth in
China**

IV. Conclusion



Definition of ICT/IT investment

- **Shinjo & Zhang(2003)** - computer hardware, software and communications equipment.
- **Miyagawa et al(2004)** - include a range of communications and electronic equipment in their definition of 'IT capital goods', such as telecommunications systems, radio, consumer electronic equipment as well as electrical and optical instruments.
- **Timmer & van Ark(2005)** - 'ICT investment' to include computers, communications equipment (which comprises radio, TV, telecommunications and photocopiers) and software.

For this paper

- **Data** – Investments in capital construction & investments in innovation for the telecom & computer industries.
- **Sources**
 - *Yearbook of China's Electronics Industry* (1984 - 1995).
 - *China Statistical Yearbook of High Technology Industry*(1996 - 2003).

Figure 1. Investment in telecommunications and computer industries in China, 1984-2003

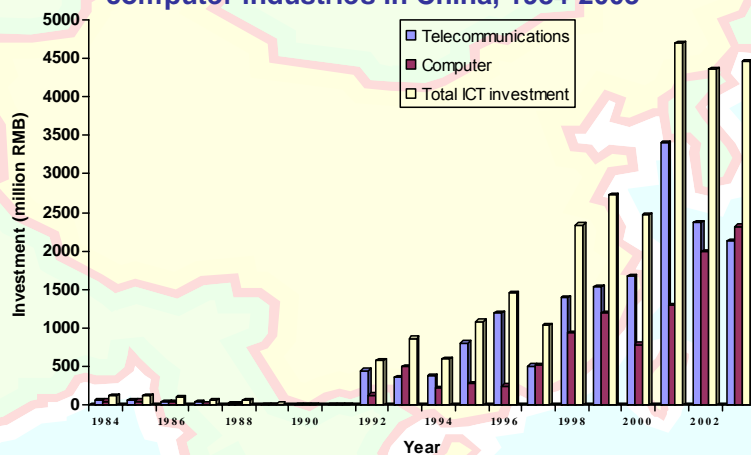


Figure 2. Ratio of ICT to total fixed assets investment in China, 1984-2003

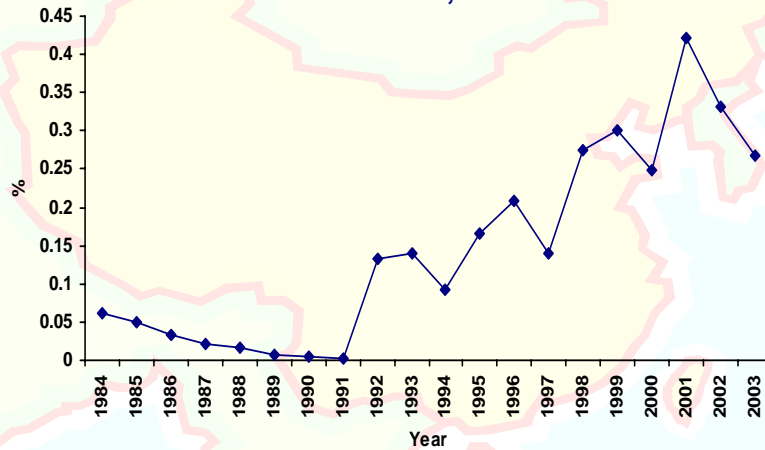

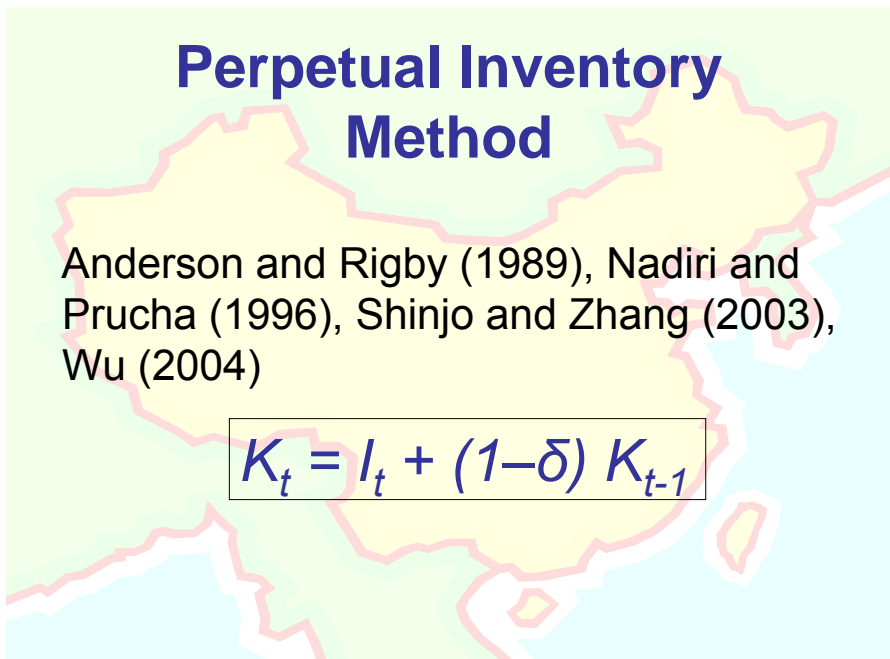


Table 2. Growth indicators of the Chinese economy during the Five-year Plan (FYP) periods

Five-year Plan Period	Average growth rate of ICT investment (%)	Average growth rate of non-ICT investment (%)	Average growth rate of total investment (%)	Average growth rate of GDP (%)
7 th FYP (1986-90)	-36.7	13.3	13.3	4.7
8 th FYP (1991-95)	89.9	20.3	20.4	11.5
9 th FYP (1996-2000)	16.8	9.1	9.2	7.0
10 th FYP (2001-03)	19.2	18.1	18.1	9.0



Part II
**Estimation of ICT
capital stock**



**Perpetual Inventory
Method**

Anderson and Rigby (1989), Nadiri and Prucha (1996), Shinjo and Zhang (2003), Wu (2004)

$$K_t = I_t + (1-\delta) K_{t-1}$$

Depreciation rate

Fraumeni (1997)

- Geometric pattern: $\delta_G = \frac{R}{T}$
- Straight-line pattern: $\delta_{i,SL} = \frac{1}{n - (i - 1)}$

Table 1. Depreciation rate of IT/ICT equipment

Author(s)	Category of equipment	Depreciation rate
Jorgenson (1989)	-Office, computing and accounting machinery – 1977	0.2729
	-Communications equipment - 1977	0.1179
Nadiri and Prucha (1996)	R&D capital stock	0.12
Fraumeni (1997)	Office, computing and accounting machinery	
	-Before 1978	0.2729
	-1978 and later	0.3119
	Communications equipment	
- Business services	0.1500	
-Other industries	0.1100	
Kim (2002)	IT capital (Korea)	
	- 1970-77	0.131
	-1977-00	0.142
Miyagawa, Ito and Harada (2004)	IT capital (Japan)	
	Office, computing and accounting machinery	
	- Before 1978	0.2729
	-1978 and later	0.3119
	Communications equipment	
	- Business services	0.1500
- Other industries	0.1100	

Assumptions about the depreciation rate of ICT capital of China

- In the mid-80s, China was still “ten to fifteen years behind the world leaders in almost all aspects of the computer spectrum except for the area of Chinese I/O” (Witzell and Smith, 1989)
- ICT equipment used in the 1980s is similar to those of the US and Japan in the 1970s
- $\delta = 0.10$ (before 1979)
- $\delta = 0.15$ (1979 and after)

Estimating the initial value of ICT capital stock:

Three approaches

Initial value approach

- Nadiri and Prucha (1996), Shinjo and Zhang (2003), Miyagawa et al (2004) and Reinsdorf and Cover (2005) are applied.

$$K_{83} = \frac{I_{84}}{g + \delta}$$

Initial value of ICT capital stock in 1983 is estimated to be 698 million RMB.

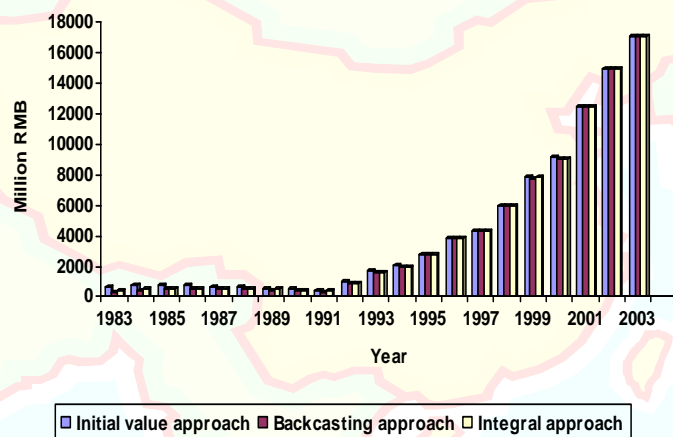
Backcasting approach

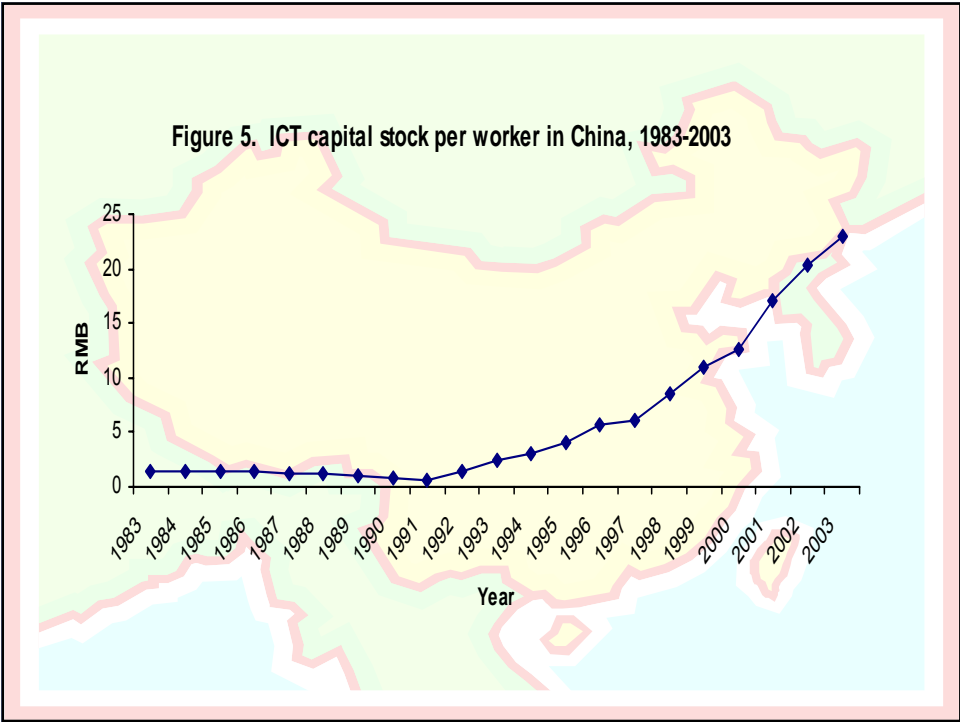
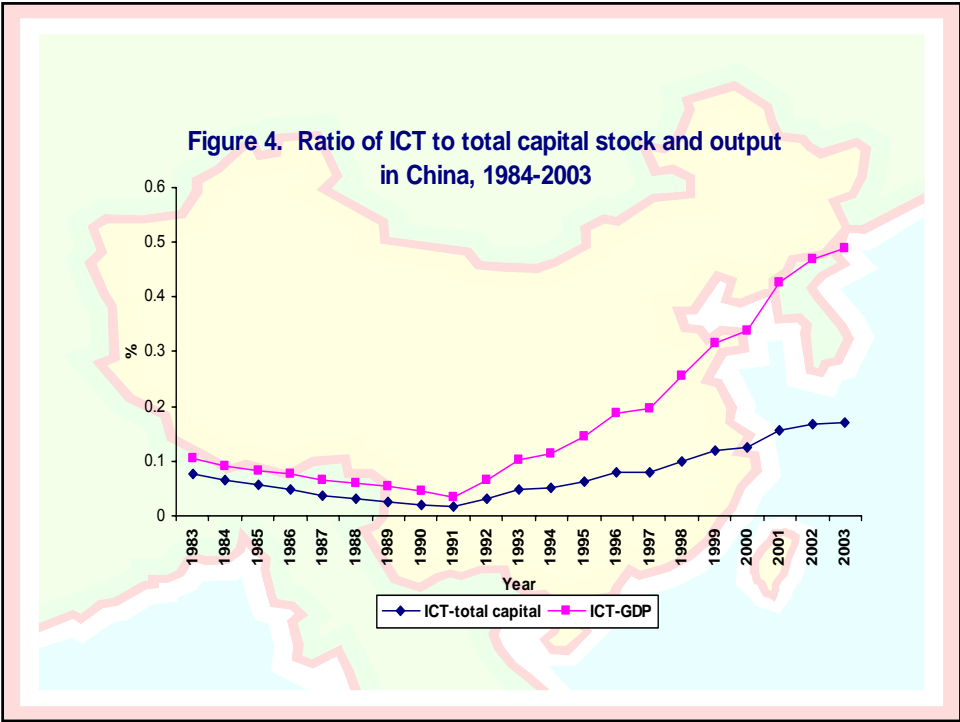
- Estimate the data series for incremental value of capital stock by backcasting to a much earlier period, 1950, assuming ICT investment increases at a constant rate.
- *Initial value of capital is estimated to be 0.6 million RMB in 1950, and 344 million RMB in 1983.*

Integral approach

- Assumes capital stock in the first period to be the sum of all past investments.
- *Initial value of ICT capital stock at 462 million RMB in 1983.*

Figure 3. ICT capital stock in China, 1983-2003

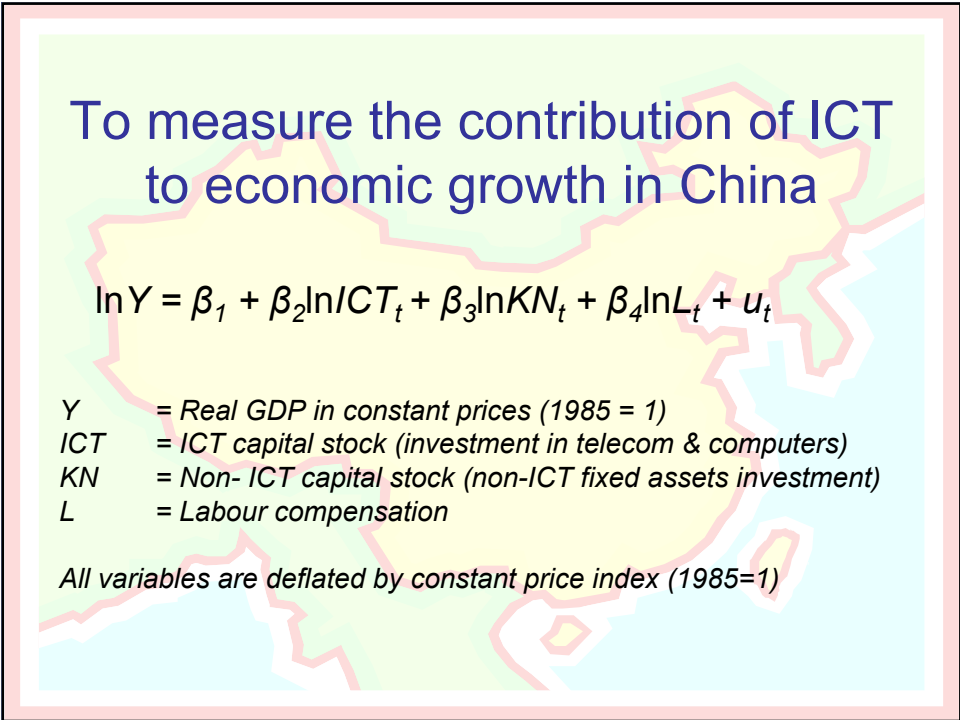




A stylized map of China is shown in the background, colored in shades of yellow and green. The text is overlaid on the map.

Part III

ICT and economic growth in China

A stylized map of China is shown in the background, colored in shades of yellow and green. The text is overlaid on the map.

To measure the contribution of ICT to economic growth in China

$$\ln Y = \beta_1 + \beta_2 \ln ICT_t + \beta_3 \ln KN_t + \beta_4 \ln L_t + u_t$$

Y = Real GDP in constant prices (1985 = 1)
ICT = ICT capital stock (investment in telecom & computers)
KN = Non-ICT capital stock (non-ICT fixed assets investment)
L = Labour compensation

All variables are deflated by constant price index (1985=1)

Table 3. Sources of economic growth in China, 1983-2003

Explanatory variables	Model specification		
	Initial value	Backcasting	Integral
Intercept	2.9654 (7.088)	3.4118 (6.740)	3.2096 (6.888)
<i>ln</i> CT	0.0414 (3.142)	0.0487 (3.355)	0.0453 (3.264)
<i>ln</i> KN	0.3376 (4.498)	0.3414 (4.661)	0.3396 (4.589)
<i>ln</i> L	0.4307 (4.132)	0.3905 (3.697)	0.4089 (3.900)
R ²	0.9971	0.9972	0.9972
Adjusted R ²	0.9966	0.9968	0.9967
Standard Error	0.0288	0.0281	0.0284
Observations	21	21	21
Durbin-Watson statistic	1.1593	1.1821	1.1736

Note: Figures in italic parenthesis () are the *t*-ratios.

Table 4. Contributions to Output Growth in China, 1983-2003 (unit: %)

Output growth rate	Period			
	1983-03	1983-91	1992-00	2000-03
	8.32 (100.0)	8.07 (100.0)	8.43 (100.0)	8.69 (100.0)
ICT Capital	0.66 (8.0)	-0.25 (-3.1)	1.40 (16.7)	0.87 (10.1)
Other Capital	3.75 (45.1)	3.96 (49.1)	3.59 (42.6)	3.70 (42.6)
Labour	3.80 (45.7)	3.57 (44.3)	3.86 (45.8)	4.23 (48.7)
TFP	0.10 (1.3)	0.78 (9.7)	-0.42 (-5.0)	-0.11 (-1.3)

Note: Figures in parenthesis () are the weights of each factor growth.

Table 5. Empirical studies of the contribution of ICT to China's economic and labour productivity growth

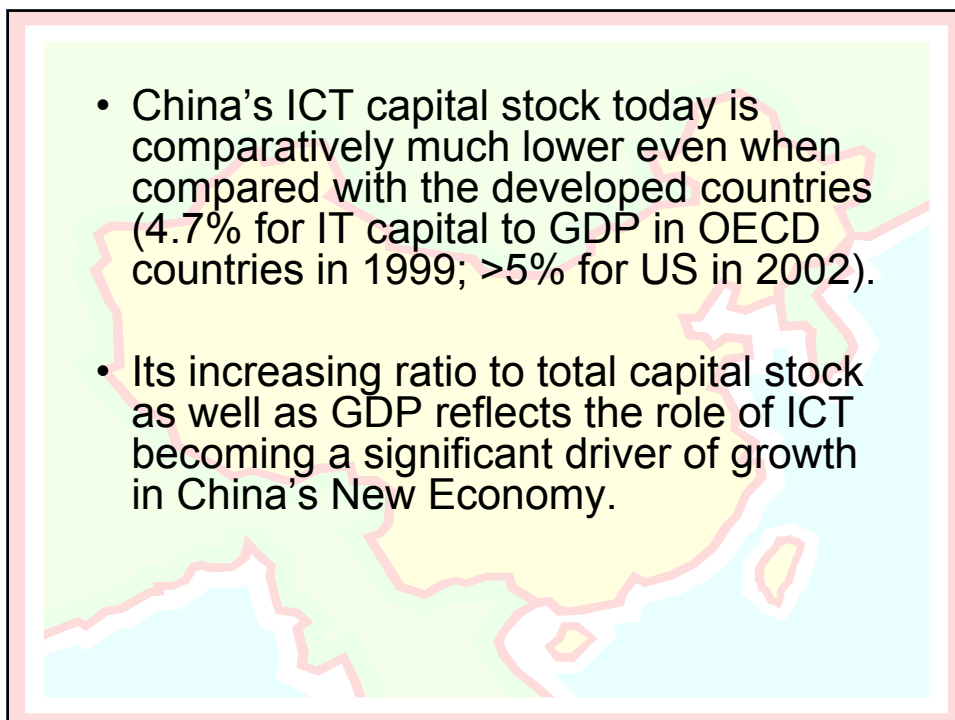
Author	Period	GDP	Contribution to growth			
			ICT	Non-ICT	Labour	TFP
Lee and Khatri (2003)	1990-94	10.63	0.14 (1.3)	3.23 (30.4)	3.78 (35.6)	3.49 (32.8)
	1995-99	8.76	0.27 (3.1)	3.39 (38.7)	1.34 (15.3)	3.76 (42.9)
	Period	ALP	ICT	Non-ICT	Labour	TFP
	1990-94	6.63	0.10 (1.5)	2.16 (32.6)	1.10 (16.6)	3.27 (49.3)
	1995-99	7.41	0.21 (2.8)	2.92 (39.4)	0.65 (8.8)	3.63 (49.0)
Jorgenson and Vu (2005)	Period	GDP	ICT	Non-ICT	Labour	TFP
	1989-95	9.94	0.17 (1.7)	2.12 (21.3)	1.32 (13.3)	6.33 (63.7)
	1995-03	7.13	0.63 (8.8)	3.17 (44.5)	0.84 (11.8)	2.49 (34.9)

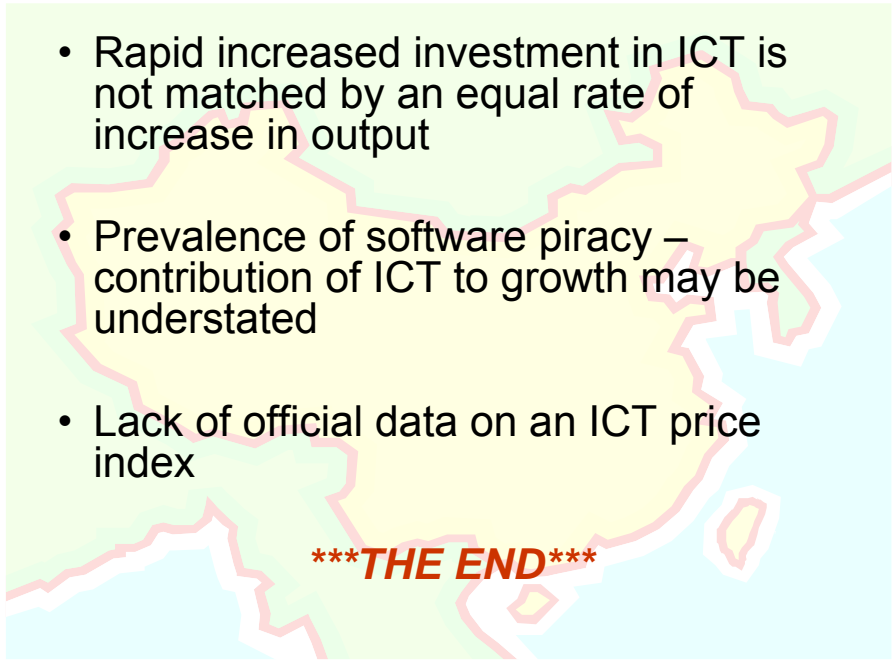
Note: Figures in parenthesis () are the weights of each factor growth.

Table 6. Sensitivity Analysis

Depreciation rate of ICT capital (%)	Contribution to output growth (%)			
	ICT	KN	L	TFP
10	0.69 (8.3)	3.75 (45.1)	3.80 (45.7)	0.08 (0.9)
15	0.66 (8.0)	3.75 (45.1)	3.80 (45.7)	0.10 (1.3)
20	0.64 (7.6)	3.75 (45.1)	3.80 (45.7)	0.13 (1.6)
25	0.61 (7.4)	3.75 (45.1)	3.80 (45.7)	0.16 (1.9)
30	0.59 (7.1)	3.75 (45.1)	3.80 (45.7)	0.18 (2.2)

Note: Figures in parenthesis () are the weights of each factor growth.



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- Rapid increased investment in ICT is not matched by an equal rate of increase in output
 - Prevalence of software piracy – contribution of ICT to growth may be understated
 - Lack of official data on an ICT price index

*****THE END*****