Accounting for China's Growth in 1952-2008
- China's Growth Performance Debate Revisited

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Agenda

- The debate and motivation of the paper
- Methodology
- Re-construction of the employment data
- Re-construction of the output data
- Estimation of the aggregate capital stock
- China's TFP performance revisited
- Implications of the new findings

The Debate on China's Post-Reform Growth Performance

- All studies have agreed that the post-reform period outperformed the pre-reform era, but have disagreed on …
  - Largely productivity- or input-driven?
  - Productivity growth mainly relied on input in new technology or also made full use of the existing technology (i.e. efficiency improvement as well)?
  - Productivity rising, declining or one-time gain along with the reform?
  - However, disagreement on productivity performance can also be due to differences in estimation techniques, measurement issues, or data deficiencies …

The Debate…

- However, people in the "optimistic camp" (Maddison, 1998; Hu and Khan, 1997; Borensztein and Ostry, 1996; Chow and Li, 2002) outnumbered people in the "pessimistic camp" (Summers and Heston, 1994; Sachs and Woo, 1997; Young, 2003)
- Even so, most studies seem to have confirmed that the growth of productivity in China has slowed down since the 1990s or the late 1990s (Jefferson, et. al, 2000; Zheng and Hu, 2006; Cao et al, 2009)
- Some studies focusing on Chinese industries, however, have found accelerated productivity growth since the 1990s (Ozyurt, 2008) or since the 2000s (Wu, 2007)
- While the world needs a better understanding of China, the debate remains inconclusive and there is no easy way out as we can see in this study

A "Data Fundamentalist" Approach

- This study takes a "data fundamentalist" approach towards the debate (Maddison, 1998; Wu, 2002; Young, 2003; Maddison and Wu, 2008) by emphasizing that…
  - Adjustment of input and output data should be made systematic and coherent in a SNA framework
  - Adjustment for aggregate and broad sector requires its "micro foundation" (check industry-level information for justification)
  - Work that is only for part of the economy should be reconciled with national totals through the SNA framework
  - Alternative, and (relatively) independent, indicators should be searched for and used to compare with available official indicators
  - Assumptions should be proposed with alternatives, especially for sensitive coefficients, and different results should be compared with sensitivity tests
  - All data handling and measurement work should be made transparent and available for repeating similar exercises

Critiques on Studies by Some "Data Fundamentalists"…

- Maddison and Wu (2008) bypasses the serious inconsistency between the population census/survey-based employment estimates and annual labor statistics (Yue, 2006)
- Maddison (1998 and 2007)'s assumption of zero labor productivity growth in so-called "non-material services" is unrealistic (Holz, 2006)
- Wu (1997, 2002)'s physical output-based real quantity index assumes constant input-output technology and hence contains bias (Wu and Yue, 2000)
- Wu (2002)'s physical output-based industrial index only captured quantity but ignored quality change in industrial output and hence underestimated China's industrial growth (Holz, 2006; Rawski, 2007)
- Most studies (Chow, 1993; Maddison, 1998) on the reconstruction of aggregate capital stock have to use strong assumptions or rough guesstimate for initial K and "delta"

Methodology

- Following Solow we begin with an assumption of a linearly homogeneous Cobb-Douglas aggregate production function with a Hick's neutral shift parameter:

$$Y = A(t)K^{\alpha}L^{1-\alpha}$$

- *Y*, *K*, and *L* denote output, capital, and labour, respectively, α gives the output elasticity of capital, and the Hicksian *A*, which is assumed to be a function of time *t*, measures the shift in the production function at the given levels of capital and labour. With total (logarithmic) differentiation and then a little mathematical rearrangement, we could get the famous Solow residual:

$$\frac{\dot{A}_t}{A_t} = \frac{\dot{Y}_t}{Y_t} - \frac{\partial Y}{\partial K}\frac{K_t}{Y_t}\frac{\dot{K}_t}{K_t} - \frac{\partial Y}{\partial L}\frac{L_t}{Y_t}\frac{\dot{L}_t}{L_t}$$

- Here comes the key link between the unobserved output elasticities and the observable income shares of capital and labour, which hinges on Solow's assumption that each input is paid its marginal product

Data Work on Employment

- Our work on employment for aggregate and major sectors of the economy
- It has two objectives:
  - To adjust the serious break in 1990 (17% or 94.2 ml. jump in the middle of 1989-90 downturn) in the employment statistics following the 1990 pop census, from then on creating a continuous gap between the census and annual employment statistics
  - To reconstruct employment data for "non-material services" that will be used to improve the estimates by Maddison (1998; 2007), also in Maddison-Wu (2008)

Data Work on Employment…

- Three approaches may be used to adjust the 1990 break:
  - I. A simple smoothing by taking a midpoint between 1989 (1.8%) and 1991 (1.1%) that lifts up the level back to the early 1950s, which may be justified by the quality of the 1990 census – i.e. all the pre-1990 census employment had been undercounted (so far, only this exercise has been done)
  - II. Assuming the "gap" should have appeared in the early 1970s when the policy on rural enterprises was relaxed, then a "trend-deviation" approach can be used to lift up the data series since 1972 onwards
  - III. While I and II allocate the "newly increased" employment into existing sectors, the third approach will not (implicitly) assume that the census-discovered employment is full-time workers and their industrial structure is the same as others, rather, it adjusts them by (part-time) hours and allocate these hours into the most labor-intensive manufacturing industries and services based on the existing industrial structure

Data Work on Employment…

- Our work for the employment in "non-material" services is mainly to adjust military personnel to make the component in employment consistent
- Instead of adding fixed 3 ml. to each year's "non-material" service employment as in Maddison (1998; 2007) and Maddison-Wu (2008), a careful information gathering (well documented in this study) has helped improve the estimates and the results have added variations to the series, with significant impact on the early 1950s and after 1990 (when the military personnel began to be included in the official estimates)
- The results provide a new base for exercising Maddison's "zero-labor productivity change" assumption for the "non-material" sector, as well as for exercising its alternatives in this study (see the work on output below)

Data Work on Output

- My data work on output follows the upward bias hypothesis about Chinese industrial output statistics (Maddison, 1998; Wu, 1997 and 2002; Ren, 1997; Woo, 1996; Keidel, 1992; Perkins, 1988; Rawski, 1980, 1993)
- It takes the value added (production-side) approach
- The production accounts are divided into five broad sectors: agriculture (I), industry (I-I), construction (I-C), material services (III-M) and non-material services (III-N)
- The data work focuses on 3 out of the 5 sectors: I, II-I, III-N, assuming that II-C and III-M have no upward bias (still fairly strong assumption)

Data Work on Output…

- Agricultural output: Maddison (1998)'s quantity output-based estimation has shown that the official statistics are fairly reliable. Here we based on Maddison and use NBS data for updating the 1952-2003 series in Maddison-Wu (2008)
- For the output of "non-material services" (III-N) (typically considered "measurement resistance"), based on the new employment estimates for this sector, we provide 3 sets of results:
  - GDP (A) based on Maddison's "zero-labor productivity change" assumption, comparing with NBS 1.9% in pre-reform and 6.2% in post-reform
  - GDP (B) on an assumption of 1% p.a. labor productivity increase since 1978, but zero before, and
  - GDP (C) on an assumption of 1% rise p.a. since 1978 and 2% since 1993

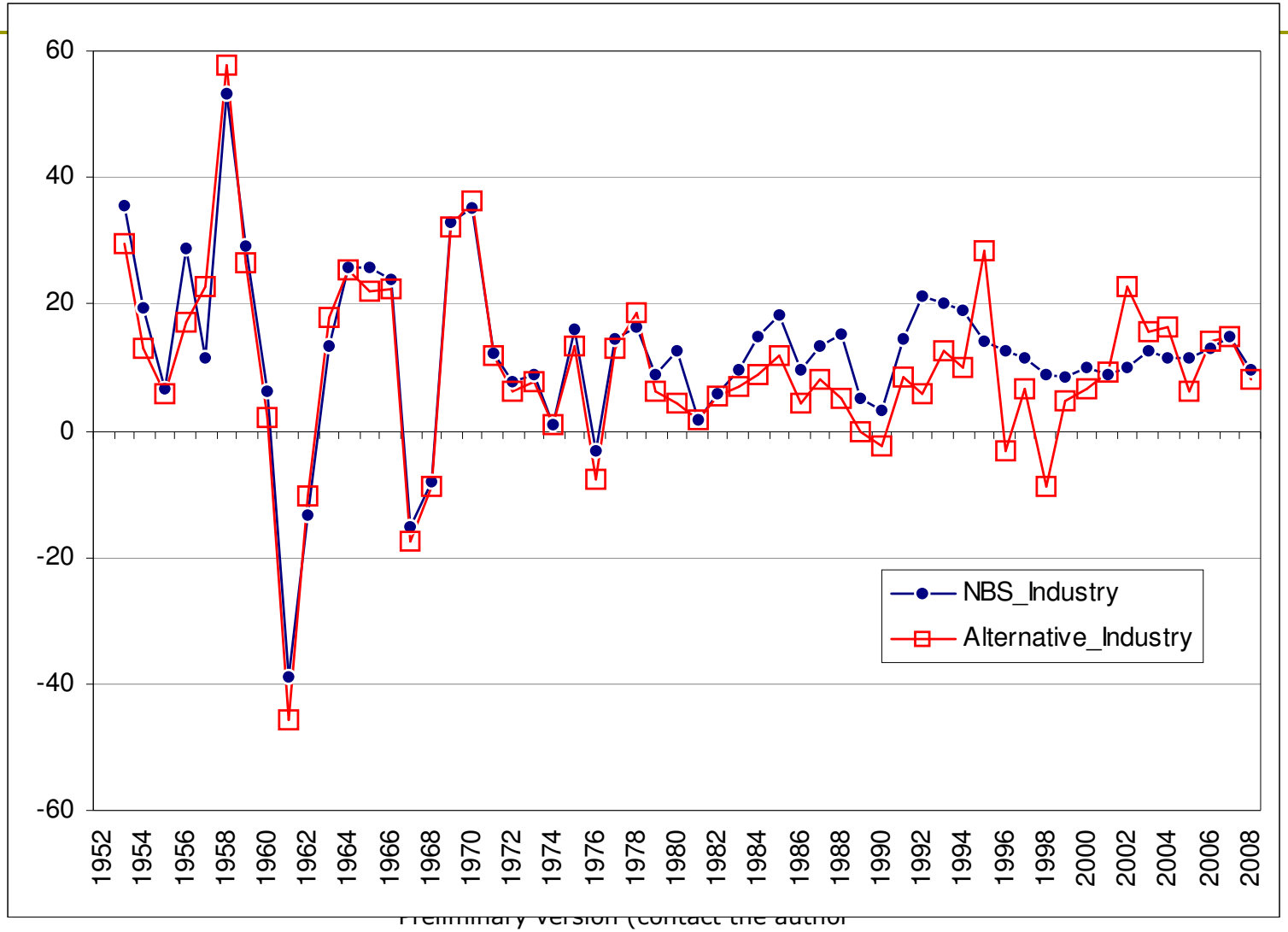
Data Work on Output…

- The new work here on quantity-based industrial output in line with three full IO tables ("micro foundations") has significantly improved my earlier work (Wu, 2002 and 2007; Maddison-Wu, 2008) in the following areas:
  - It has replaced the fixed 1987 input-output table weights by 1987, 1992 and 1997 IO weights and chained, which shows a clear substitution bias with 1987 weights (the Gerschenkron effect), resulting in an even slower industrial GVO growth!
  - It has dropped fixed GVA ratio (GVA/GVO) assumption and introduced variant GVA ratios over time based on IO tables
  - It has further investigated and hence adjusted most the spikes in the previous results using alternative sources including high frequent product data from the CEIC database

Data Work on Output…

- The new exercise on Chinese industrial output has further confirmed the previous findings:
  - Slower but more volatile industrial GVA growth than the estimates by NBS (Chart 1)
  - The growth was negative at the time of Asian Financial Crisis in 1998, which made the aggregate GDP negative (Chart 2)
- Furthermore, one may take the difference between the two series and easily conclude that there is simply no credit to the quality problem critique (Holz, 2006; Rawski, 2007), i.e. no systematic pattern can be shown from the derived gap
- The results can serve as an (more reliable) alternative to check the official industrial GDP estimates (by bypassing the tricky price issue – Chart 3)

Chart 1: Industrial GVA Growth – Alternative vs NBS



Preliminary version (contact the author for the complete version)

Chart 2: Aggregate GVA Growth – Alternative vs NBS

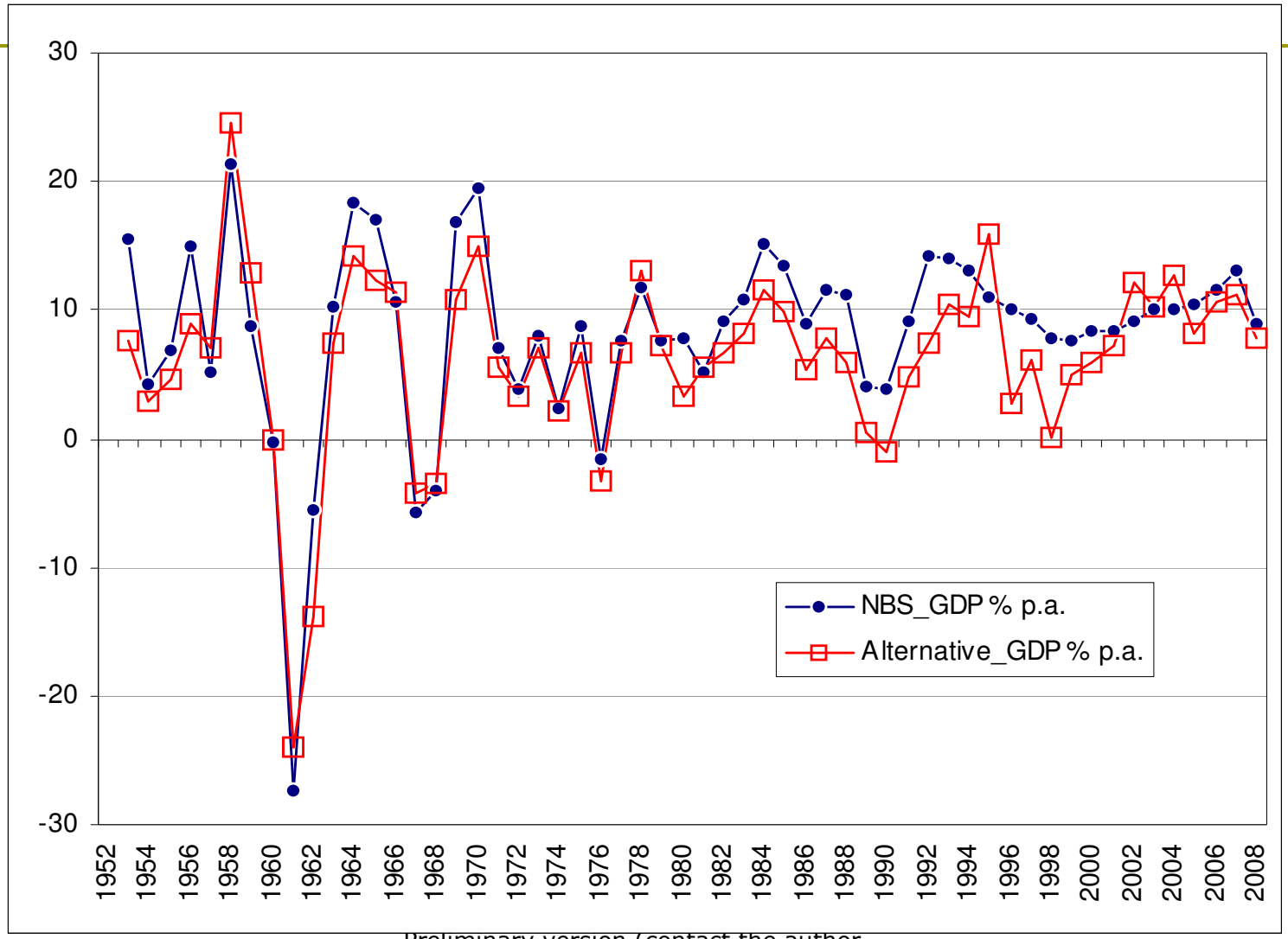
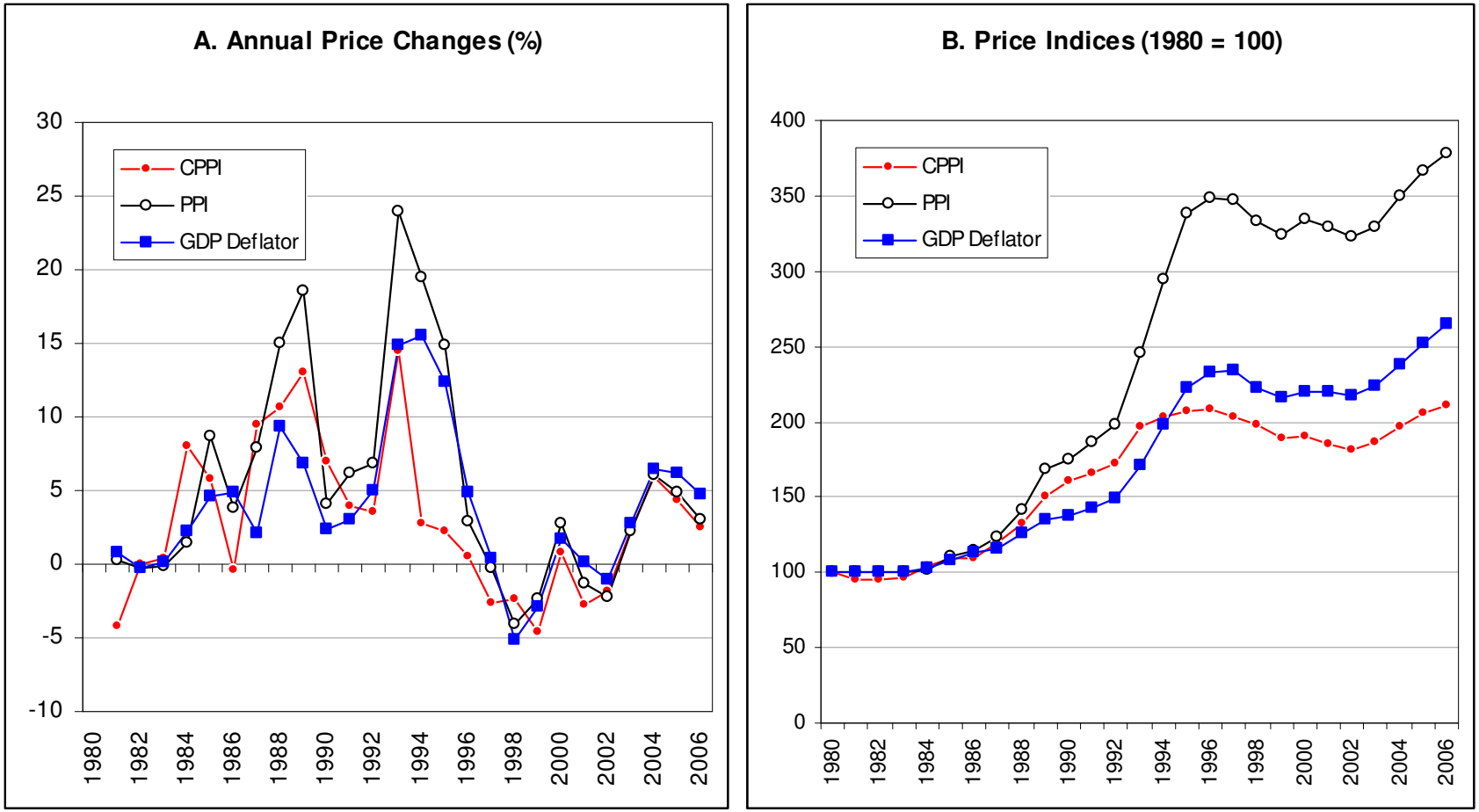


Chart 3: Available Deflators for the Industrial Sector – Which Can You Use?



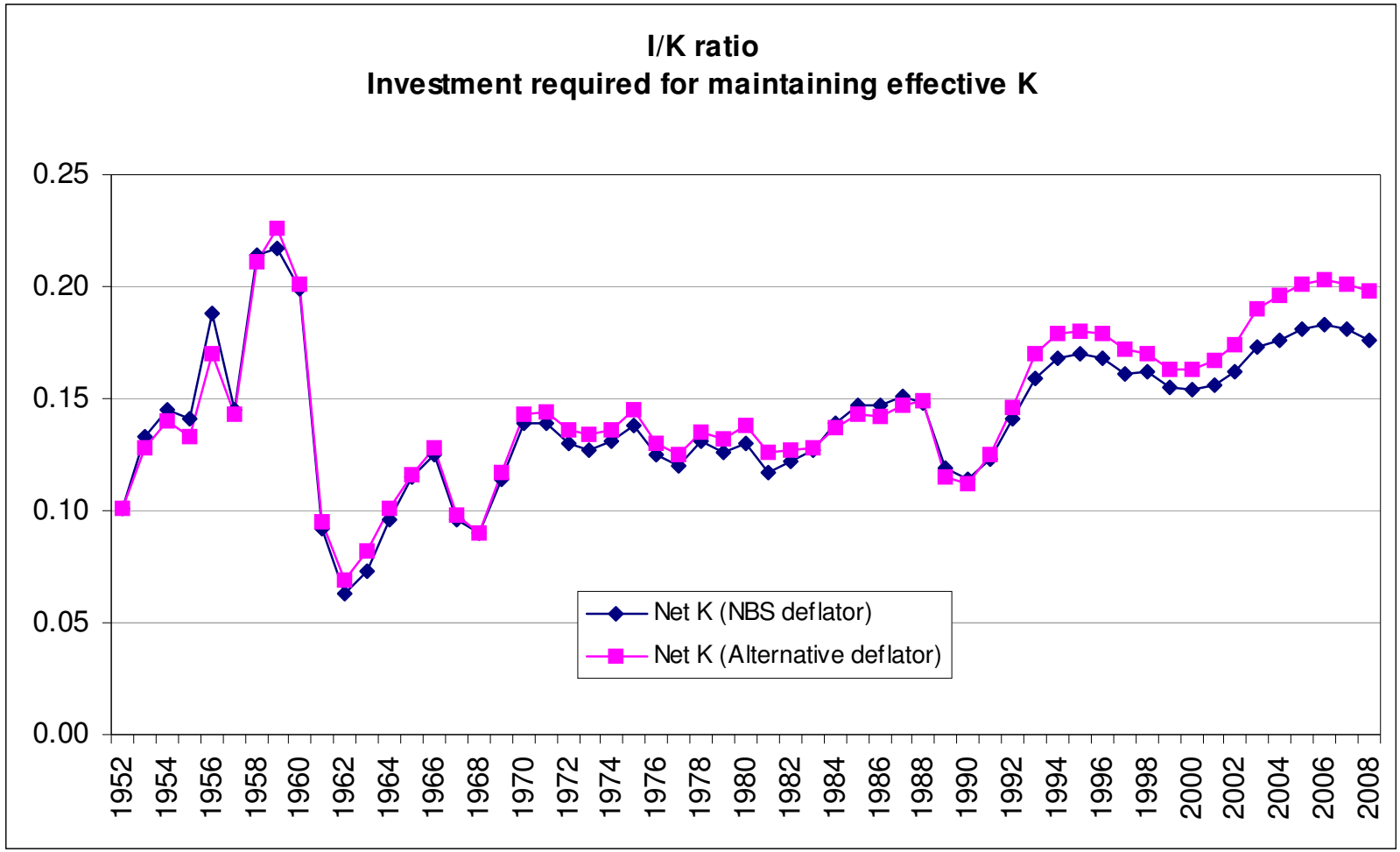
Data Work on Capital

- The estimation of net capital stock here for the aggregate economy is based on my industry-level estimation ("micro foundation") that provides
  - An initial capital stock for the industrial sector based on the 1950-51 national asset census (systematic data have been lost but various reports are available in the national achieves)
  - A careful re-estimation of depreciation rate for individual industries based on official asset lives (T) and the BEA used declining balance rates (R) of fixed assets following the relationship below $\delta = R/T$ (Hulten and Wykoff, 1981)
  - An industry-specific assets-weighted deflator for the industry as a whole which is used as an alternative to the official implicit deflator for FCF

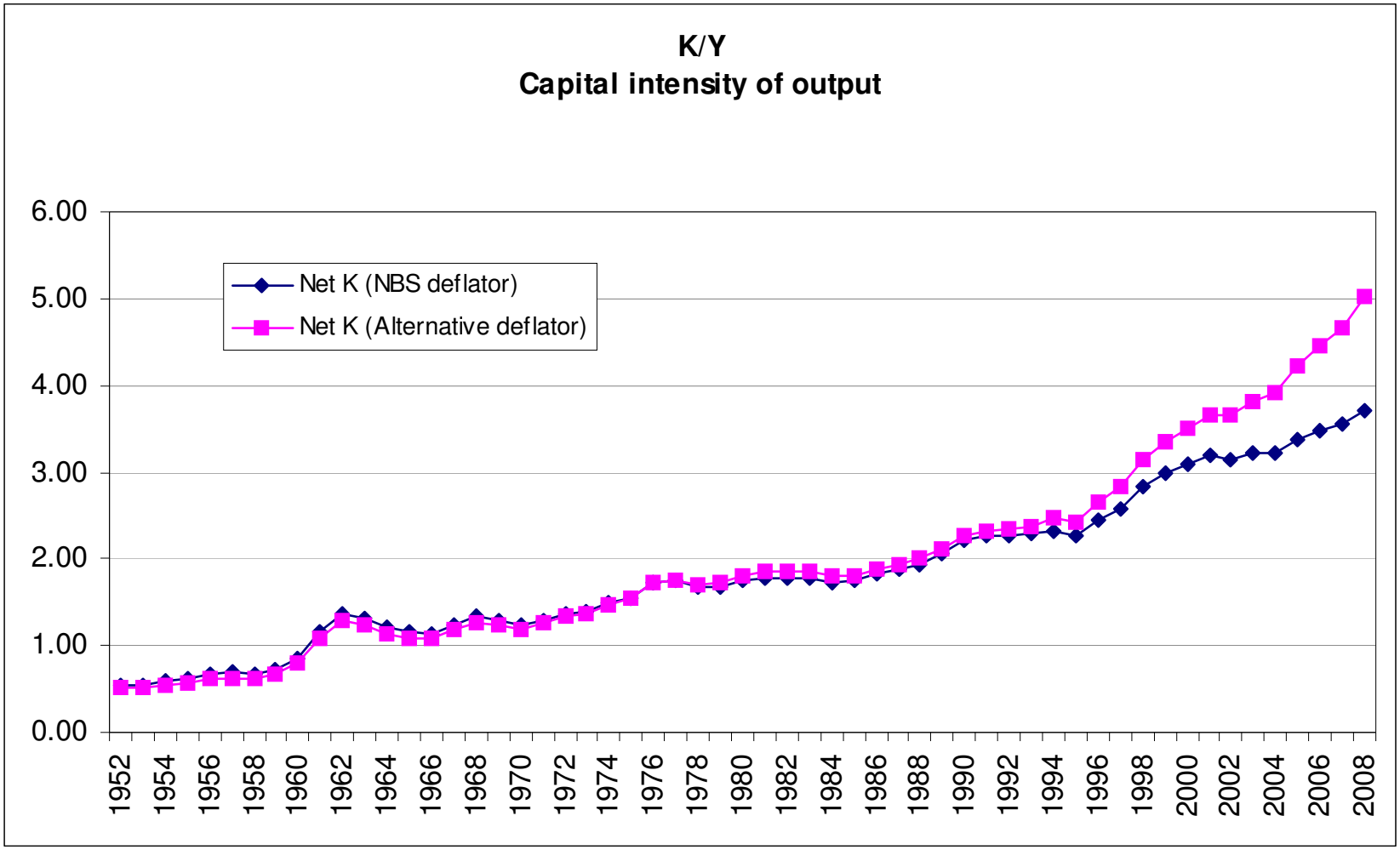
Data Work on Capital…

- Step 1 – the NBS fixed capital formation (FCF) (excluding inventory) is deflated by two deflators in parallel: NBS and alternative
- Step 2 – the initial stock for 1952 is estimated using the same approach as in Young (2003), i.e. $K(0)=I/(\delta+g)$, where g is the average GDP growth rate of 1952-55 using both NBS and Wu alternatives; as δ is found to be from 5.7 to 6.6% over time for industry, we provide alternative estimates based on 5, 6 and 7% as well as on multiple rates assuming accelerated depreciation along with the reform
- Step 3 – following the PIM model to estimate annual net capital stock for the Chinese economy as a whole
- Step 4 – the results are crosschecked and reconciled with my independent estimates for Chinese industry at 2-digit level as mentioned earlier

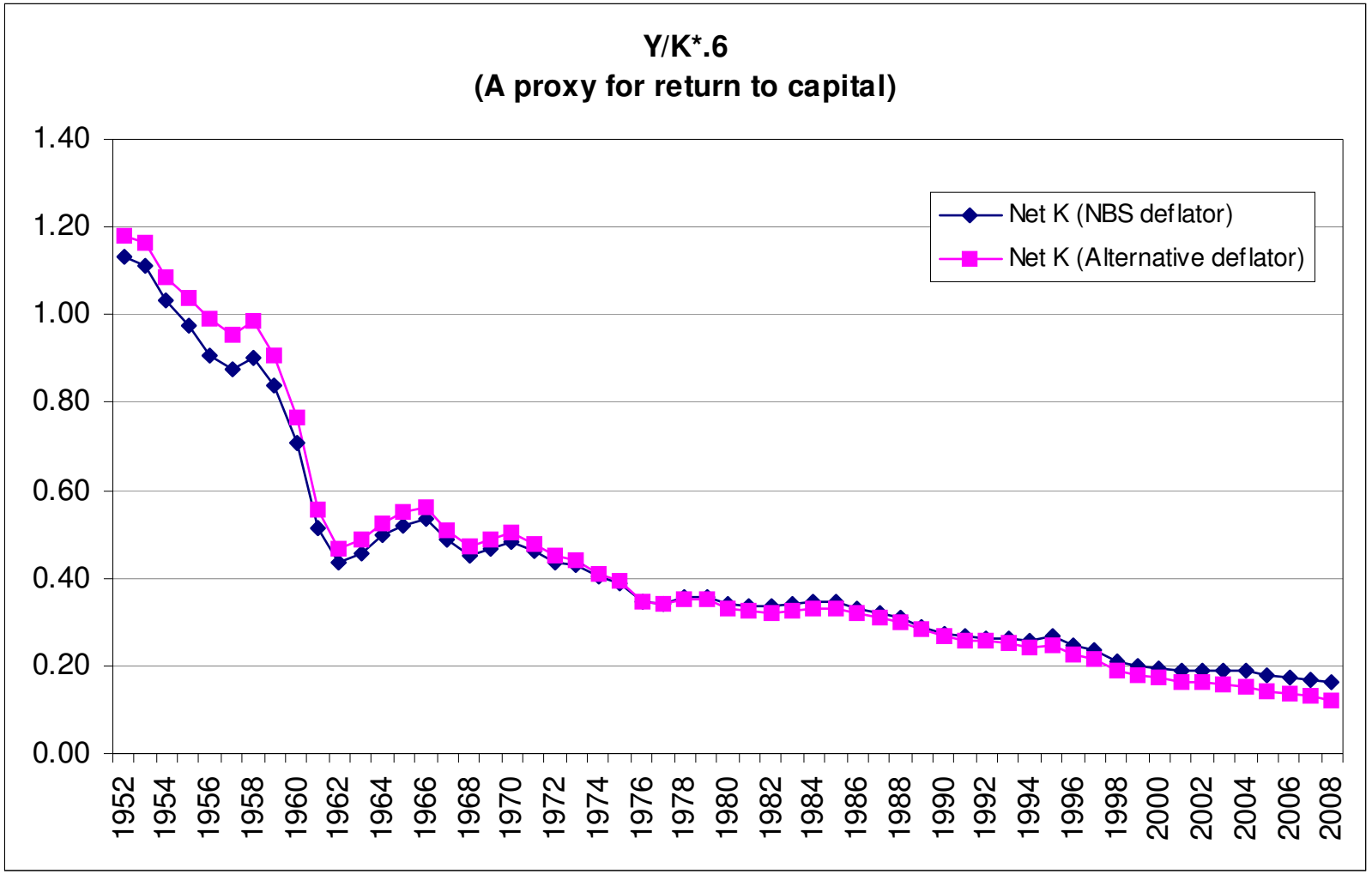
Results on Capital Stock: Chart 4



Results on Capital Stock: Chart 5: Rising Capital Intensity



Results on Capital Stock: Chart 6: Declining Return to Capital



Results:
GDP and Labor Productivity Growth

(GDP(A)="Zero labor productivity for III(N), (B)=1% since 1978, (C)=(B) and 2% since 1993. Employment uses Approach I)

	GDP (NBS)	GDP (A)	GDP (B)	GDP (C)
		Maddison-Wu (2008)		
1952-57	6.75	6.26	6.26	6.26
1957-65	2.42	3.03	3.03	3.03
1965-78	5.06	5.22	5.23	5.23
1952-78	**4.56**	**4.74**	**4.75**	**4.75**
1978-93	9.30	6.02	6.20	6.21
1993-01	9.39	6.08	6.24	6.43
2001-08	10.60	10.30	10.29	10.40
1978-08	**9.63**	**7.02**	**7.15**	**7.23**
	Y/L (NBS)	**Y/L (A)**	**Y/L (B)**	**Y/L (C)**
1952-57	3.88	3.41	3.41	3.41
1957-65	0.05	0.65	0.65	0.65
1965-78	2.32	2.47	2.49	2.49
1952-78	**1.92**	**2.09**	**2.09**	**2.09**
1978-93	6.71	3.51	3.68	3.69
1993-01	8.34	5.07	5.22	5.41
2001-08	9.26	8.96	8.95	9.06
1978-08	**7.74**	**5.18**	**5.30**	**5.38**

Results:
Annual Changes of Capital Stock

	NET K(.05)	NET K(.06)	NET K(.07)	NET K(mltp)
		By NBS implicit deflator		
1952-57	11.87	12.36	12.83	11.87
1957-65	9.95	9.94	9.89	9.95
1965-78	8.38	8.40	8.42	8.30
1952-78	**9.53**	**9.62**	**9.71**	**9.49**
1978-93	8.92	8.93	8.94	8.41
1993-01	11.36	11.45	11.53	10.95
2001-08	12.85	12.95	13.04	12.88
1978-08	**10.47**	**10.53**	**10.57**	**10.12**
		By Wu-Adjusted deflator		
1952-57	10.84	11.27	11.68	10.84
1957-65	10.43	10.47	10.47	10.43
1965-78	8.92	8.95	8.99	8.84
1952-78	**9.75**	**9.86**	**9.96**	**9.71**
1978-93	9.14	9.14	9.14	8.64
1993-01	12.62	12.75	12.86	12.27
2001-08	15.36	15.51	15.65	15.50
1978-08	**11.49**	**11.56**	**11.62**	**11.17**
(Data in the parentheses refer to the delta)				

Results:
K/L - Capital Deepening

	K/L(.05)	K/L(.06)	K/L(.07)	K/L(mltp)
		By NBS implicit deflator		
1952-57	8.87	9.35	9.81	8.87
1957-65	7.41	7.40	7.35	7.41
1965-78	5.55	5.57	5.59	5.48
1952-78	**6.75**	**6.85**	**6.93**	**6.72**
1978-93	6.34	6.35	6.36	5.85
1993-01	10.30	10.38	10.46	9.89
2001-08	11.48	11.58	11.67	11.51
1978-08	**8.57**	**8.62**	**8.67**	**8.22**
		By Wu-Adjusted deflator		
1952-57	7.87	8.29	8.68	7.87
1957-65	7.88	7.92	7.92	7.88
1965-78	6.08	6.11	6.15	6.00
1952-78	**6.97**	**7.08**	**7.17**	**6.94**
1978-93	6.55	6.56	6.56	6.07
1993-01	11.55	11.67	11.78	11.20
2001-08	13.97	14.11	14.25	14.10
1978-08	**9.57**	**9.64**	**9.70**	**9.26**
(Data in the parentheses refer to the delta)				

Results:
TFP using IO Table Weights (variant)

	TFP (GDP/NBS)	TFP (GDP/A)	TFP (GDP/B)	TFP (GDP/C)
		K/L by NBS implicit deflator		
1952-57	0.27	-0.19	-0.19	-0.19
1957-65	-3.09	-2.51	-2.51	-2.51
1965-78	-0.48	-0.33	-0.32	-0.32
1952-78	**-1.15**	**-0.98**	**-0.97**	**-0.97**
1978-93	3.46	0.36	0.52	0.53
1993-01	3.25	0.13	0.27	0.45
2001-08	2.78	2.51	2.49	2.60
1978-08	**3.24**	**0.79**	**0.91**	**0.99**
		K/L by Wu-Adjusted deflator		
1952-57	0.65	0.19	0.19	0.19
1957-65	-3.28	-2.71	-2.71	-2.71
1965-78	-0.74	-0.59	-0.58	-0.58
1952-78	**-1.26**	**-1.10**	**-1.09**	**-1.09**
1978-93	3.34	0.24	0.41	0.42
1993-01	2.62	-0.47	-0.33	-0.15
2001-08	1.47	1.19	1.18	1.28
1978-08	**2.71**	**0.27**	**0.39**	**0.47**

Results:
TFP using "Young Weights" (.6 for L)

	TFP (GDP/NBS)	TFP (GDP/A)	TFP (GDP/B)	TFP (GDP/C)
		K/L by NBS implicit deflator		
1952-57	0.41	-0.04	-0.04	-0.04
1957-65	-2.77	-2.19	-2.19	-2.19
1965-78	0.16	0.31	0.32	0.32
1952-78	**-0.70**	**-0.53**	**-0.53**	**-0.53**
1978-93	4.32	1.19	1.35	1.36
1993-01	4.33	1.18	1.33	1.51
2001-08	4.60	4.32	4.30	4.41
1978-08	**4.39**	**1.91**	**2.03**	**2.11**
		K/L by Wu-Adjusted deflator		
1952-57	0.78	0.32	0.32	0.32
1957-65	-2.94	-2.36	-2.36	-2.36
1965-78	-0.04	0.11	0.13	0.13
1952-78	**-0.78**	**-0.61**	**-0.61**	**-0.61**
1978-93	4.23	1.10	1.27	1.28
1993-01	3.84	0.70	0.85	1.03
2001-08	3.64	3.37	3.35	3.45
1978-08	**3.99**	**1.52**	**1.64**	**1.72**

Results:
TFP using "Chow Weights" (.4 for L)

	TFP (GDP/NBS)	TFP (GDP/A)	TFP (GDP/B)	TFP (GDP/C)
		K/L by NBS implicit deflator		
1952-57	-1.28	-1.73	-1.73	-1.73
1957-65	-4.15	-3.58	-3.58	-3.58
1965-78	-0.90	-0.75	-0.74	-0.74
1952-78	**-1.98**	**-1.82**	**-1.81**	**-1.81**
1978-93	3.14	0.04	0.21	0.22
1993-01	2.38	-0.71	-0.57	-0.39
2001-08	2.34	2.07	2.05	2.16
1978-08	**2.75**	**0.31**	**0.43**	**0.50**
		K/L by Wu-Adjusted deflator		
1952-57	-0.73	-1.18	-1.18	-1.18
1957-65	-4.40	-3.83	-3.83	-3.83
1965-78	-1.19	-1.05	-1.04	-1.04
1952-78	**-2.10**	**-1.94**	**-1.93**	**-1.93**
1978-93	3.01	-0.08	0.08	0.09
1993-01	1.66	-1.41	-1.27	-1.09
2001-08	0.95	0.67	0.66	0.76
1978-08	**2.16**	**-0.26**	**-0.15**	**-0.07**

Concluding Remarks…

- What have we learned from work on basic data?
  - If we shift from official output estimates to alternatives the annual GDP growth rate will be reduced by 2-2.5% for the reform period, but little influence on the planning era; upward bias mainly exists in the reform period
  - Changing assumption from zero to 1 to 2% increase in labor productivity of non-material services does not alter the results significantly
  - If we shift from official investment deflator to alternative ones it will raise annual growth of K by 1% for the reform period, but little influence on the planning period; also true for K/L
  - These suggest that most data problems are related to the reform period and they are sensitive to any adjustment
- Capital estimation
  - Choice of depreciation rate between 5, 6 and 7% will only change/increase K growth marginally; also true for K/L

Concluding Remarks…

- TFP estimation
  - Using alternative K deflator will lower TFP by about 0.5% for the reform period since it results in faster growth of K
  - Shift from official to alternative GDP will change TFP of the 2nd period of reform into negative value
  - TFP results are very sensitive to the choice of factor income shares/coefficients – increasing labor share can substantially raise TFP estimates
  - Following Young's assumption of 60% allocated to labor, we have arrived at the highest TFP estimates based on all the data work.
  - However, shift to Chow's assumption of 60% allocated to capital, we have negative TFP
  - Using both the IO and Chow's income weights, the 2nd period of reform indeed turned into negative TFP, but not in the case of Young's income weights.

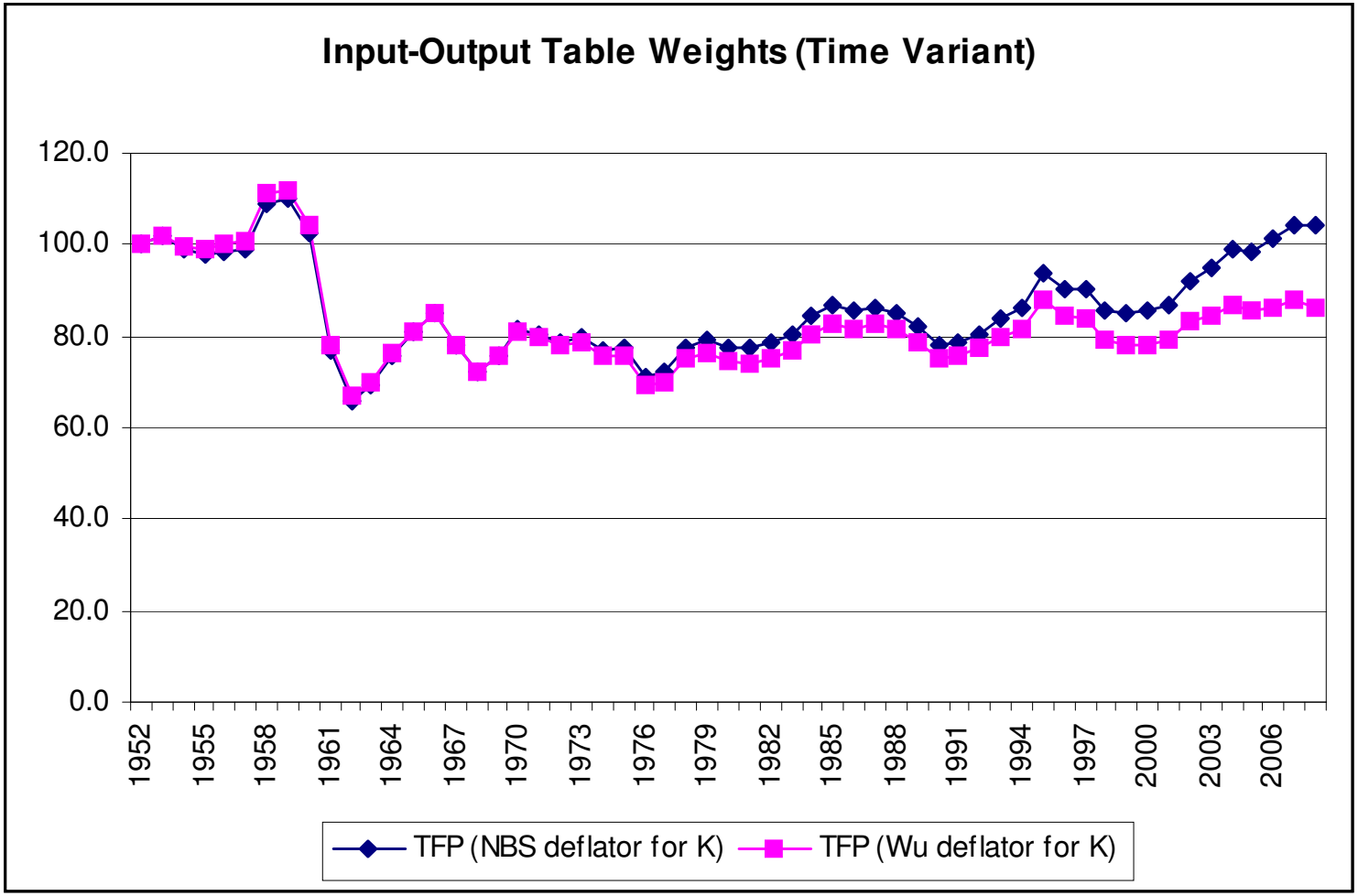
Concluding Remarks…

- Data tell the truth and also hide the truth.
- The conclusion for the Chinese growth and productivity performance should be made by the reader.
- What is essential is transparency and the next is your knowledge about the economy and the institutions (and their deficiencies!) and mechanism through which the data are produced by state agencies for the economy.
- Last but not least, how to interpret TFP for a country like China is a challenge because it does not well fit the neoclassic institutional and behavioral assumptions.
- Tasks yet to be done
  - Further adjustment of the 1990 break of the employment statistics – Approach II and III
  - Fine-tuning input-output table based income shares
  - Capital breakdown into major sectors
  - Estimation of labor and capital quality
  - Work on construction and material services (trade, transport, catering, etc.) should also be considered

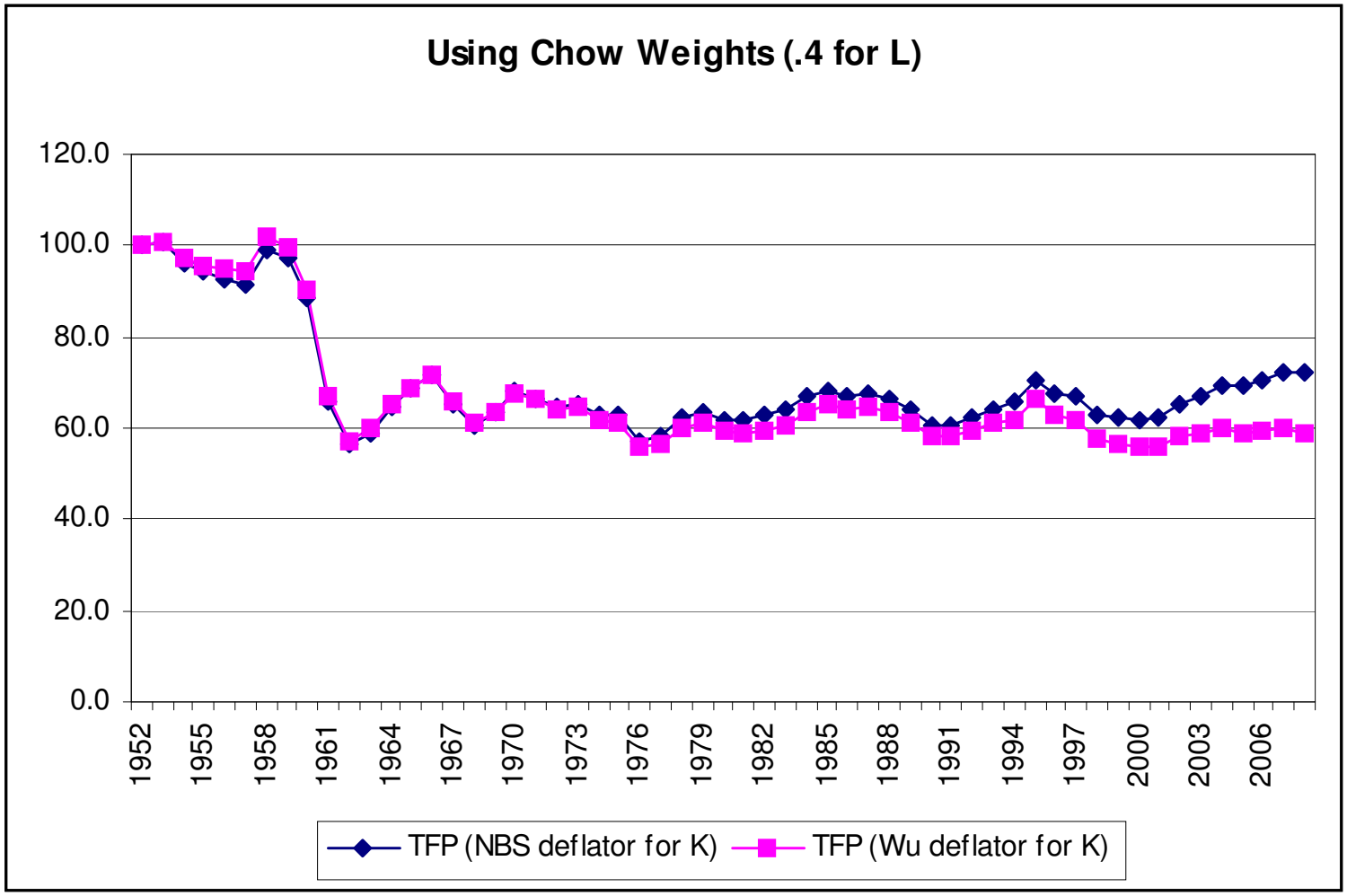
Some Long-Run Pictures

Based on the results

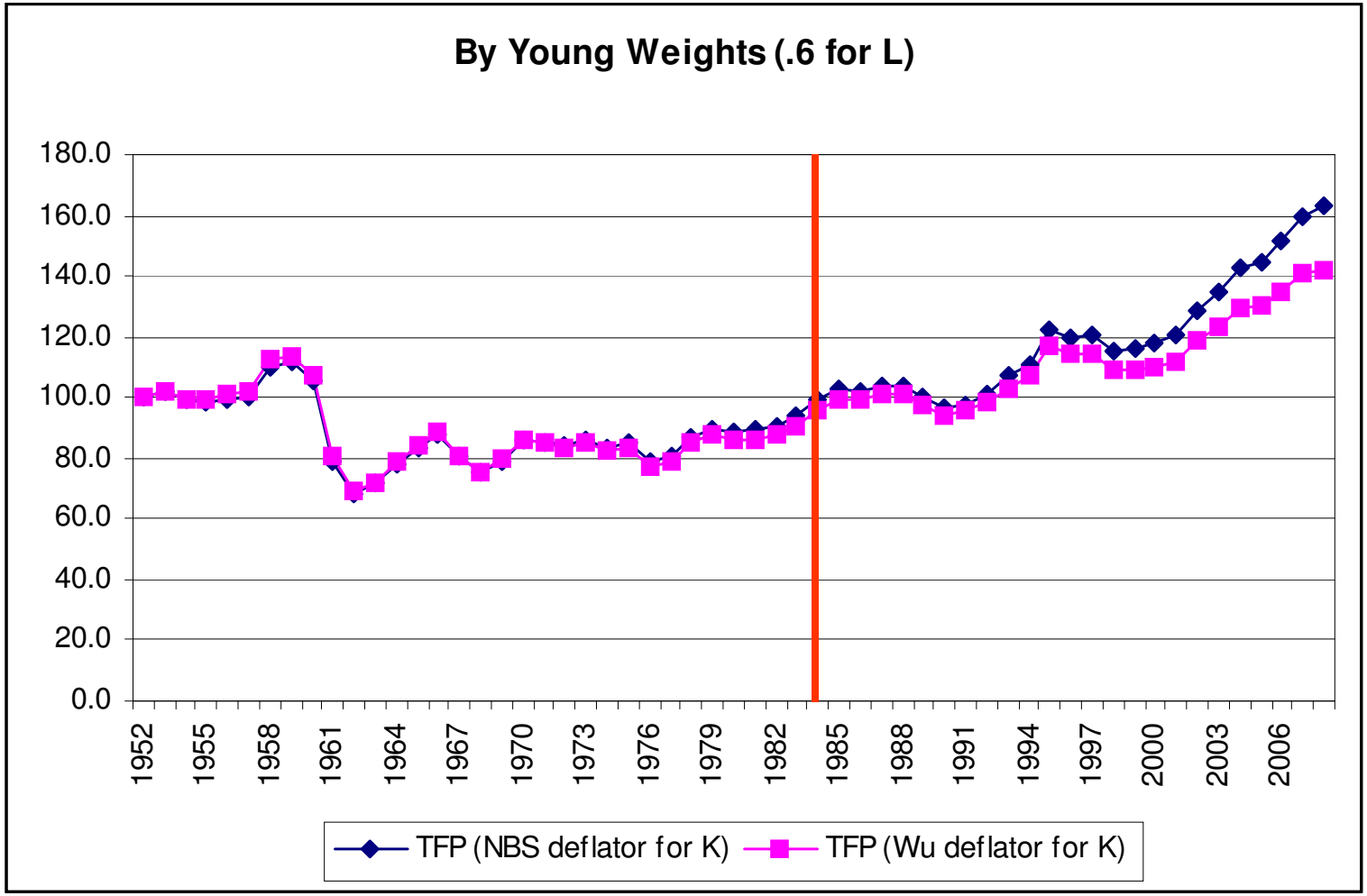
TFP Level Index 1 (1952=100)
Struggling to Return to the Original Level…



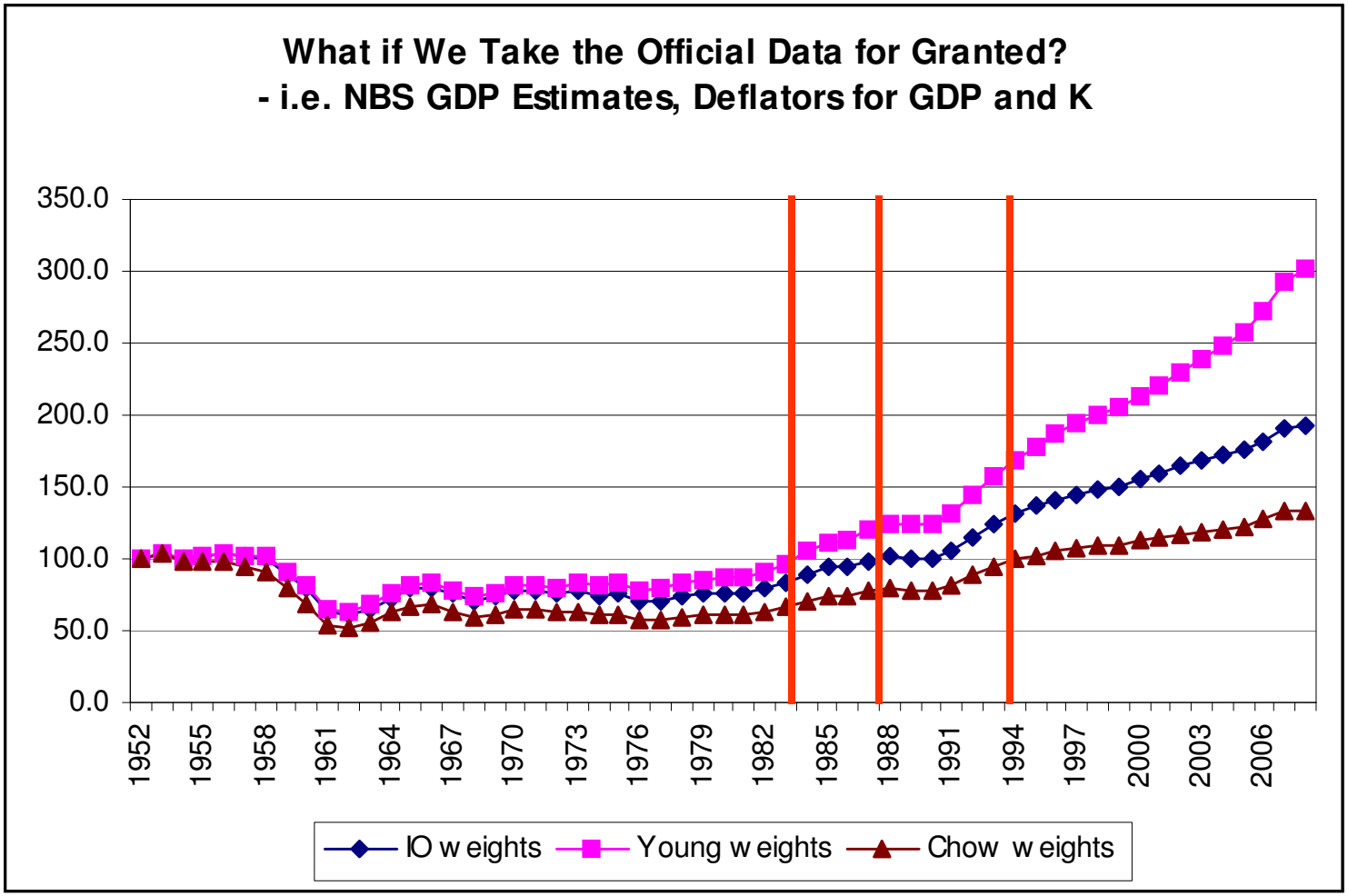
TFP Level Index 2 (1952=100)
No Direction or A Long Way to Go…



TFP Level Index 3 (1952=100) Hooray to the Party's Policy!



What if We Take the Official Data for Granted? – Reform is Indeed Productivity Rewarding



Thank You!