Energy Intensity in China
Past and Future Trends

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China's GDP Elasticity of Energy Demand: Three *Research* Questions

- **Rapid reduction in $\Delta E / \Delta$ GDP from 1979-2000.**

  Was this reduction real?

- **Rapid rise in $\Delta E / \Delta$ GDP after 2001.**

  What caused this apparent change?

- **GDP and energy data have been revised and remain controversial.**

  What does this imply for modelers?

GDP Elasticity of Energy Demand,

Selected Countries, 1980-2001

Country	Δ E/ Δ GDP
China	0.38
India	0.83
Indonesia	1.01
Brazil	1.41
Pakistan	1.03
Bangladesh	1.44
Philippines	2.06
Egypt	1.31
Turkey	1.32

Source: Calculated by Kong Bo, using World Bank, "World Development Indicators Database," 2005. Data were given in Purchasing Power Parity, Year 2000 US$ values.

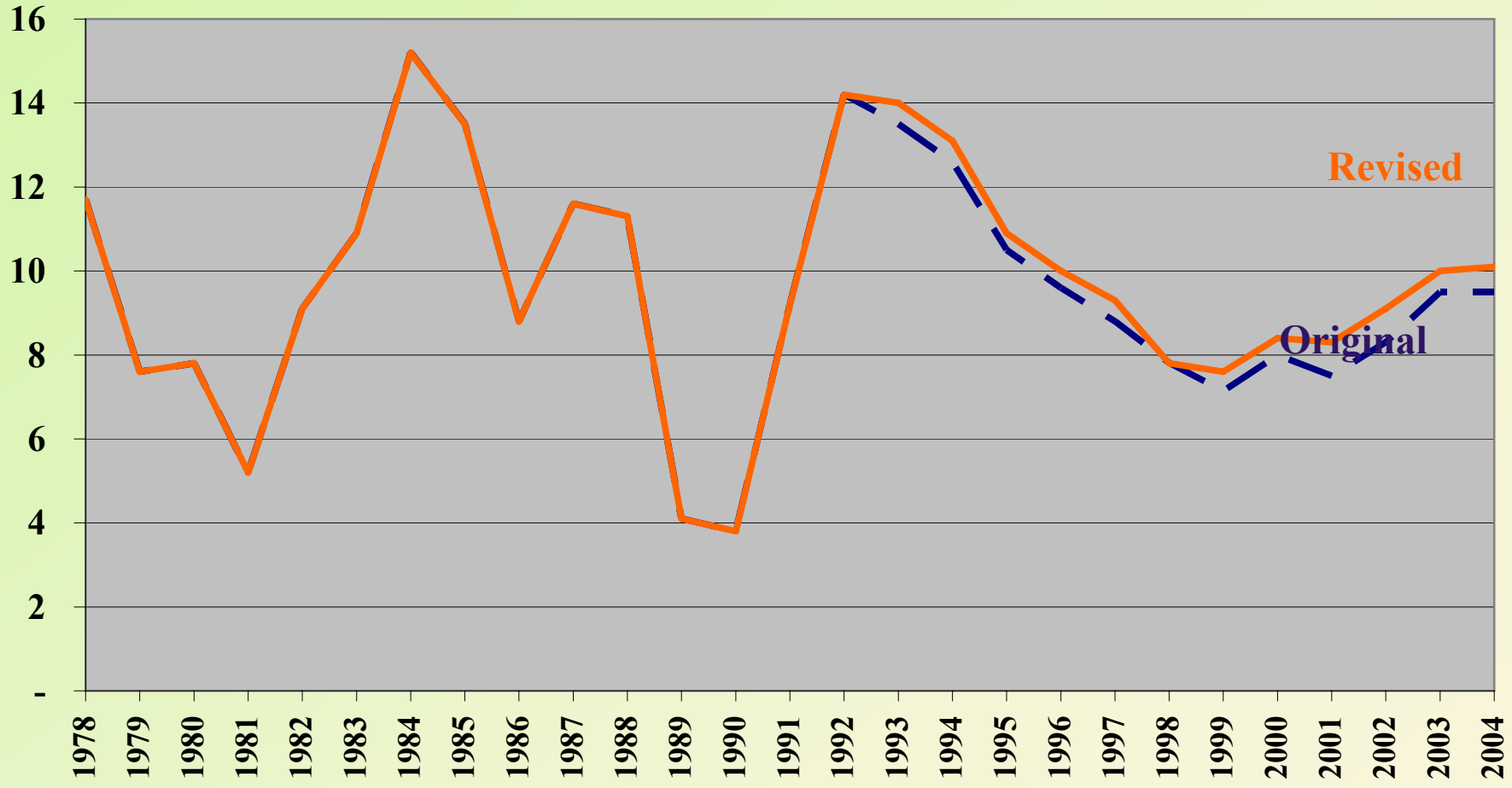
China E/GDP Without "Smoothed" Coal Data

	Original GDP	*Revised* GDP
1990	0.48	0.48
1991	0.56	0.56
1992	0.37	0.37
1993	0.46	0.45
1994	0.46	0.44
1995	0.65	0.63
1996	0.62	0.59
1997	-0.09	-0.09
1998	-0.52	-0.52
1999	-0.22	-0.21
2000	0.02	0.02
2001	0.47	0.43
2002	1.19	1.08
2003	1.61	1.53
2004	1.60	1.51

Source: China National Statistical Bureau, 2005 and 2006.

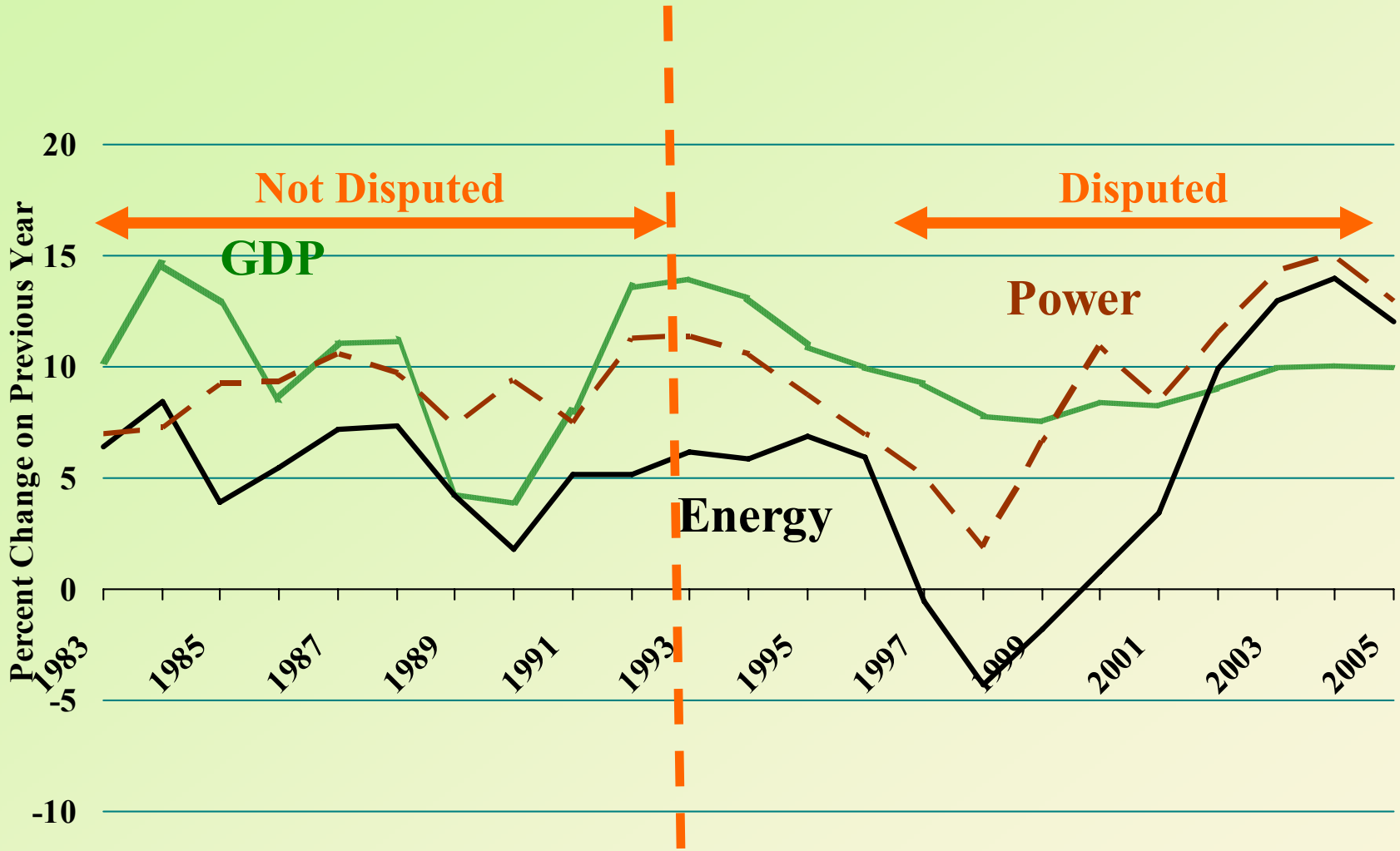
Very odd result

China's Revised GDP Growth Estimates, 1993-2004



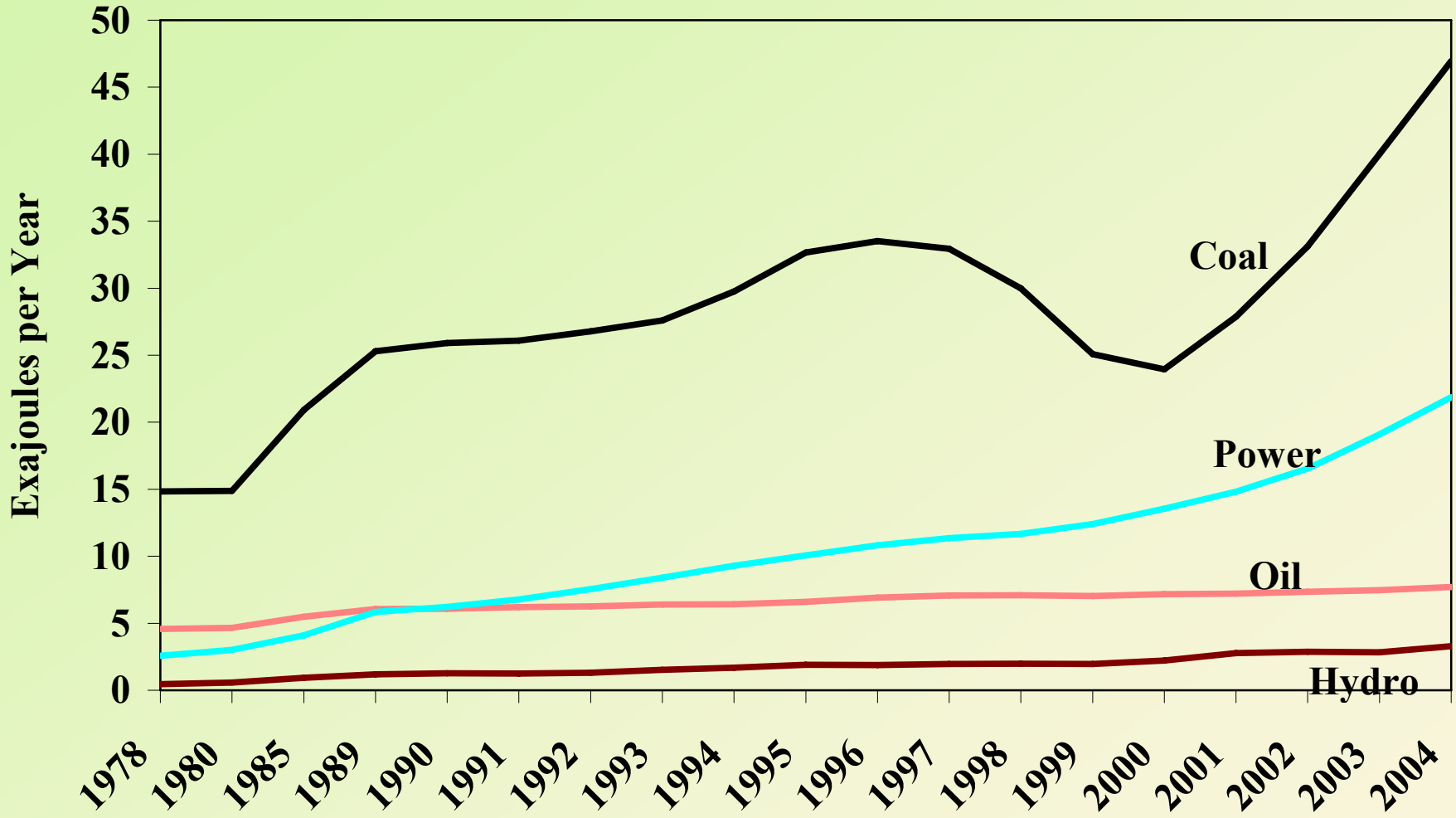
Source: China Statistical Yearbook, 2005

China's Unprecedented Energy Intensity Reduction

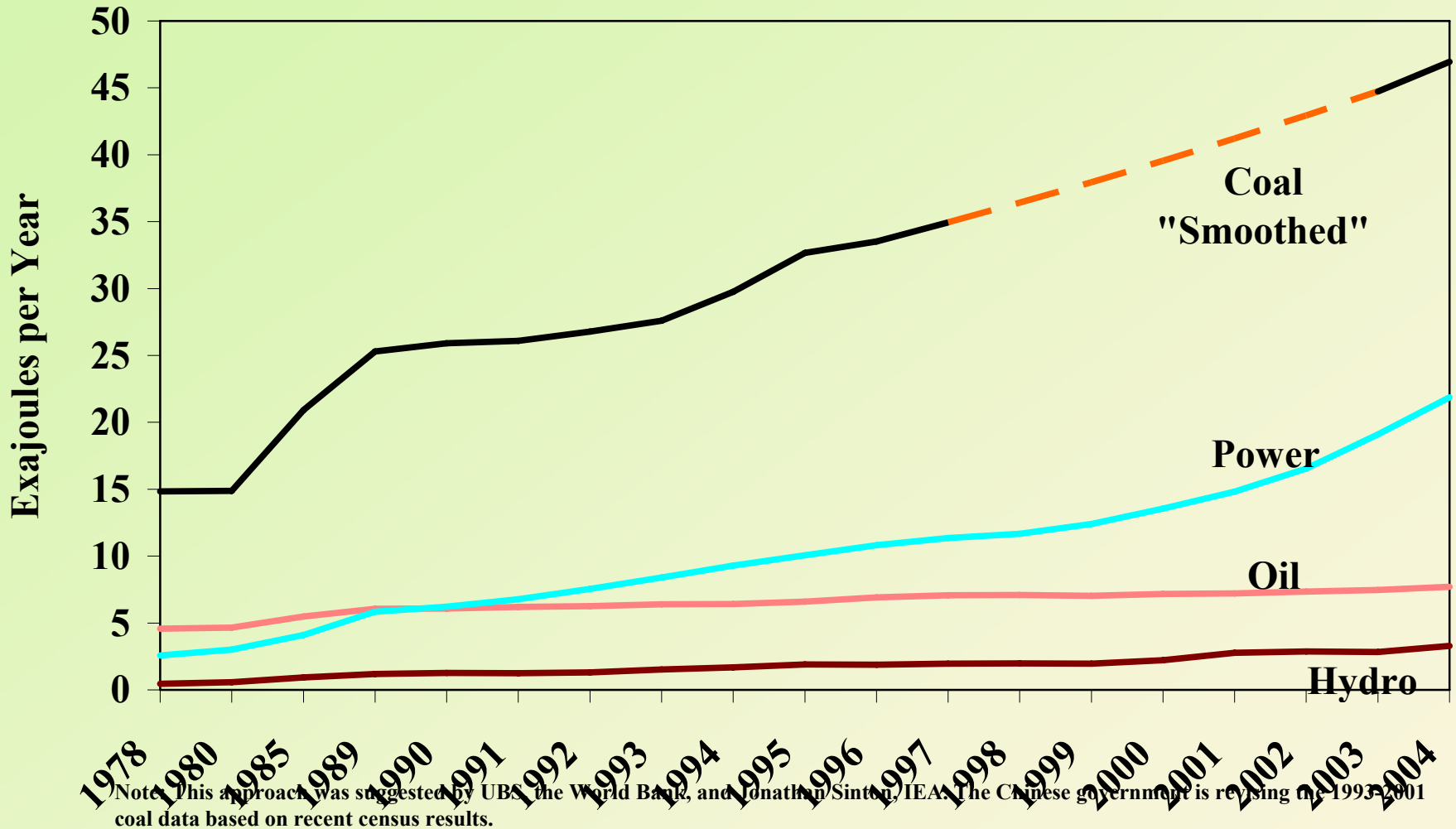


Source: Jeffrey Logan, International Energy Agency, private communication, 2005. Jonathan Sinton, International Energy Agency, private communication, 2006.

Energy Carriers in China



Energy Carriers in China



Note: This approach was suggested by UBS, the World Bank, and Jonathan Sinton, IEA. The Chinese government is revising the 1993-2001 coal data based on recent census results.

China E/GDP With "Smoothed" Coal Data Through *2001*

	Previous GDP	Revised GDP
1990	0.48	0.48
1995	0.65	0.63
2000	0.19	0.18
2001	0.20	0.18
2002	-0.13	-0.12
2003	1.61	1.53
2004	1.60	1.51

Odd result remains

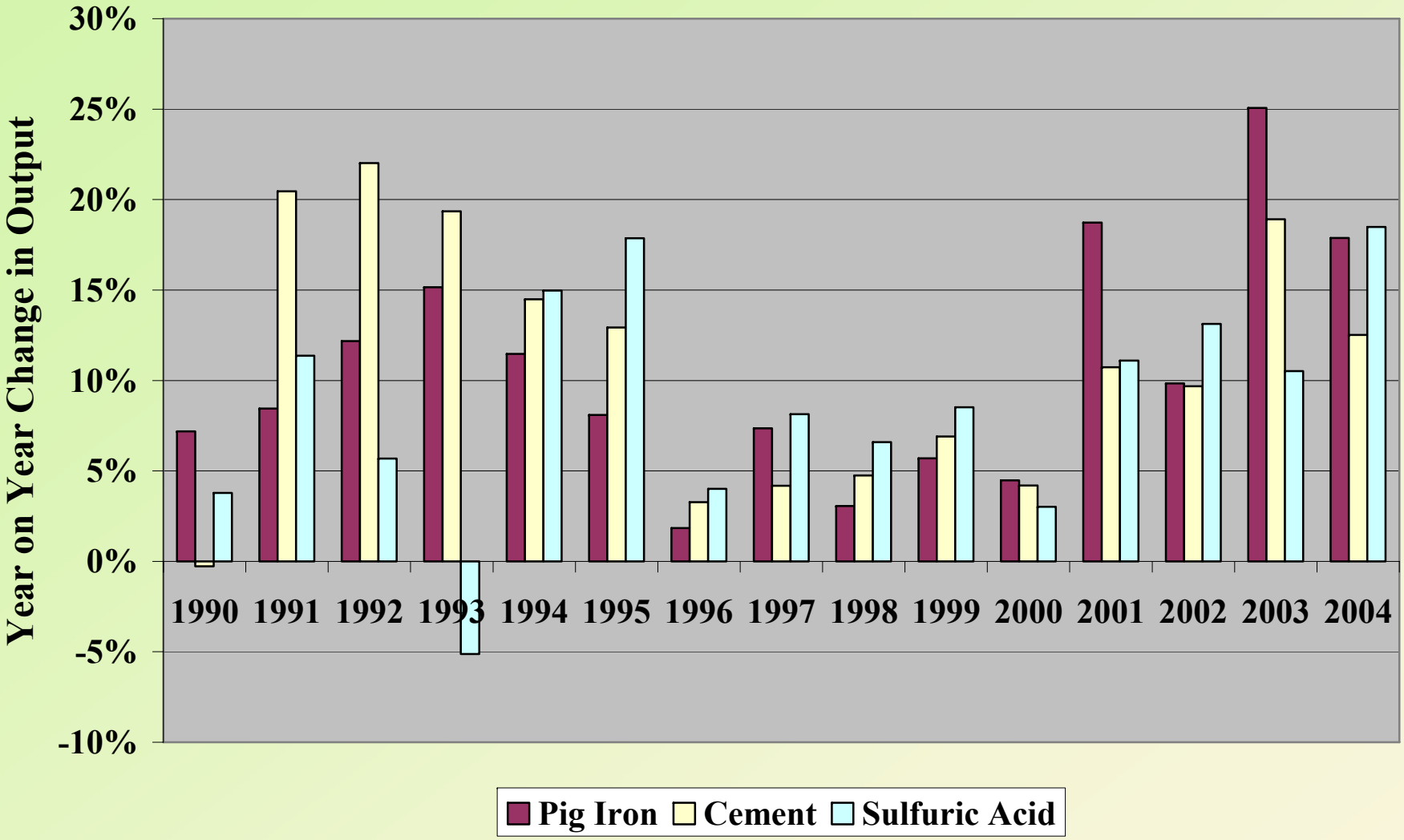
China E/GDP With "Smoothed" Coal Data Through *2002*

	Previous GDP	Revised GDP
1990	0.48	0.48
1995	0.65	0.63
2000	0.41	0.39
2001	0.44	0.40
2002	0.40	0.36
2003	0.13	0.12
2004	1.60	1.51

Source: China Statistical Yearbook, 2005; W. Chandler, 2006

Result depends on both base year, adjustment period

Chinese Energy Intensive Materials Production



Cement Use per Capita, Selected Countries, 2003

	Tons/Person
China	0.63
Germany	0.36
India	0.10
Indonesia	0.16
Italy	0.65
Japan	0.58
Russia	0.29
USA	0.32

Source: US Geological Survey, 2005; Population Reference Bureau, 2005

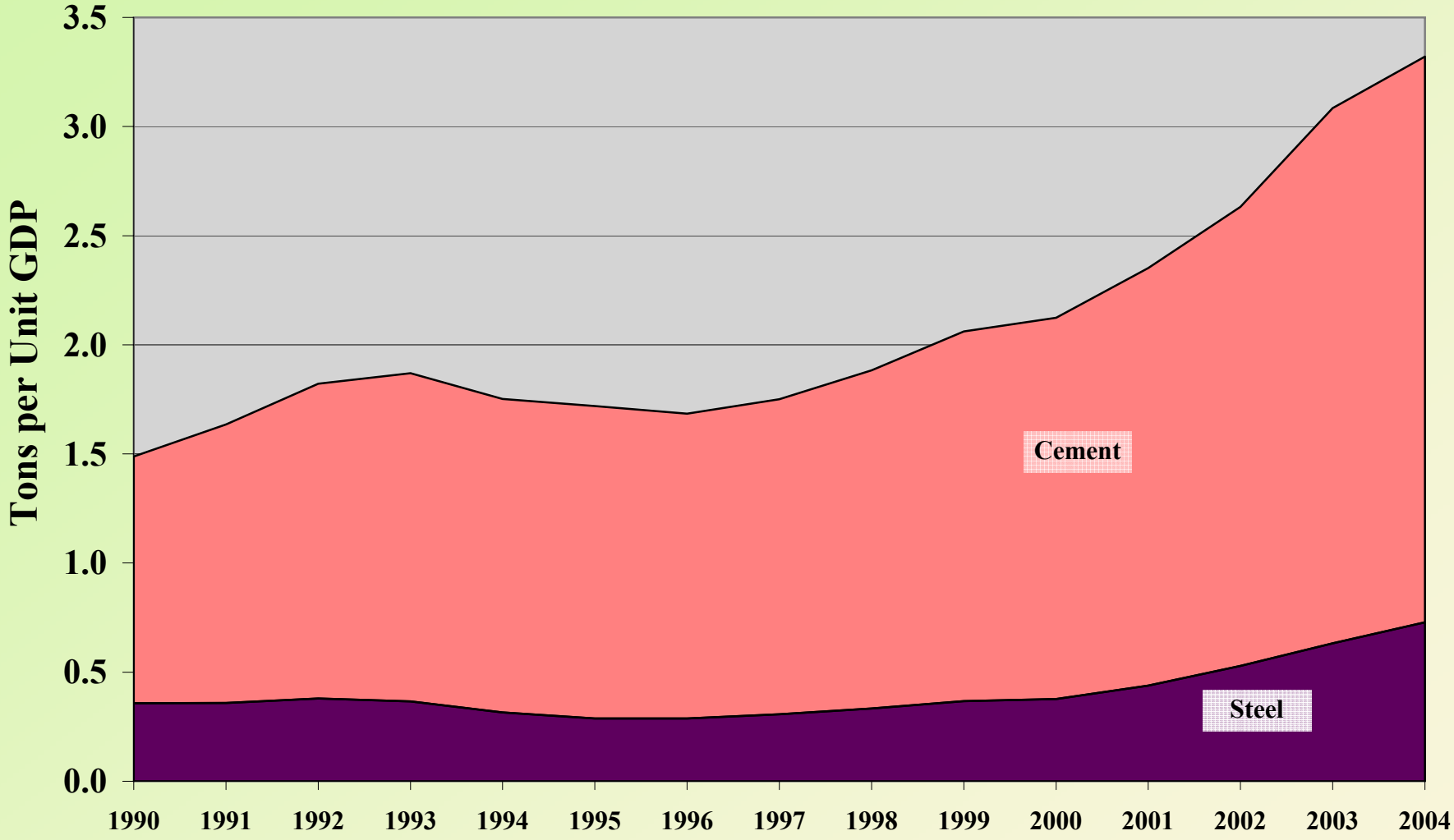
Cement In Place

(Total Cement Manufactured 1986-2003/ Population 2004)

	Tons/Person
China	5.6
Germany	7.6
India	1.1
Japan	11.4
Korea	15.9
USA	4.6

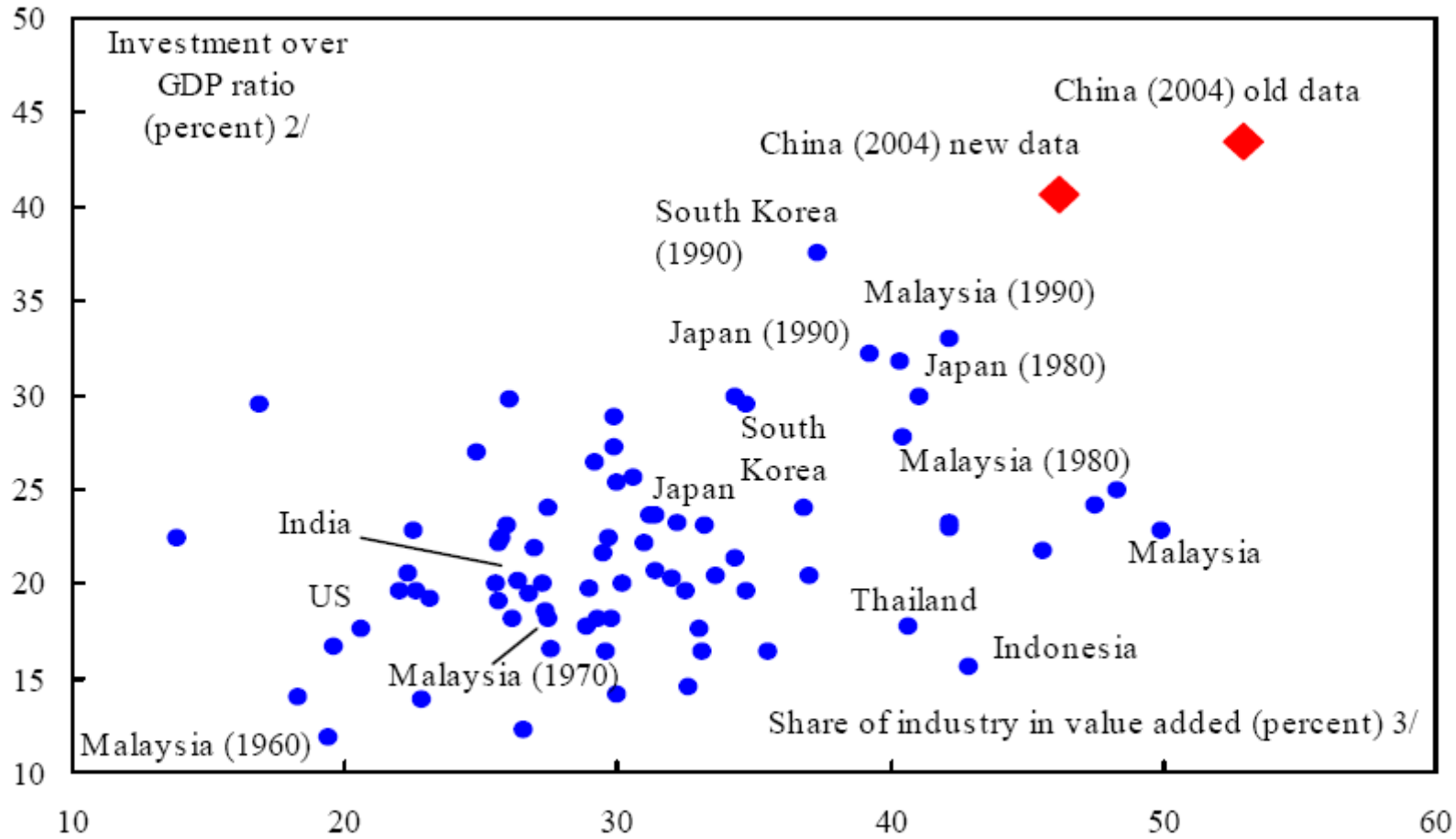
Source: US Geological Survey, 2005; Population Reference Bureau, 2005

Steel and Cement Intensity of the Chinese Economy



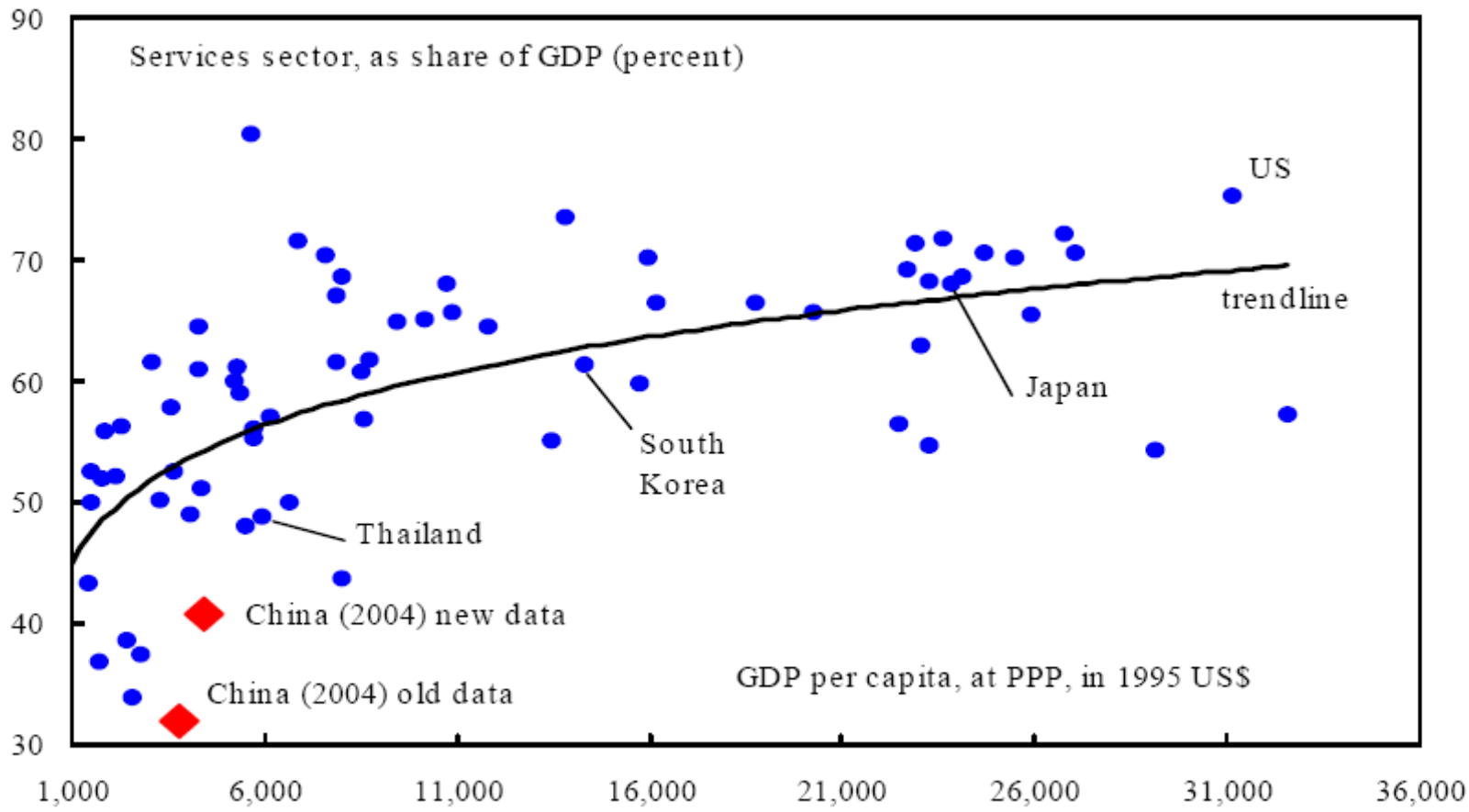
Source: China Statistical Yearbook, 2005

Share of Industry in China's GDP Remains High



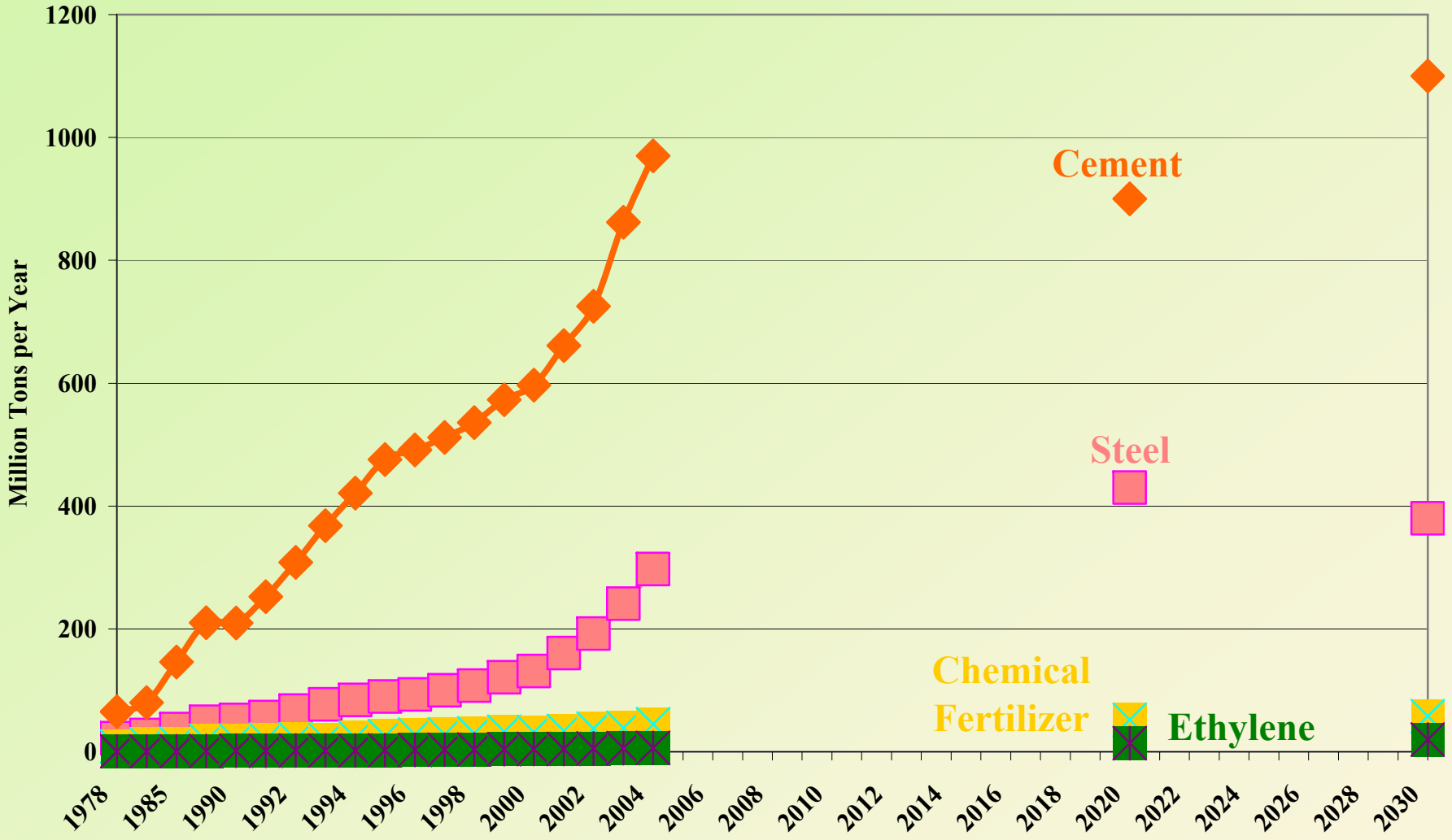
Sources: World Development Indicators, NBS (for China), and staff estimates.

Share of Services in China's GDP Remains Low

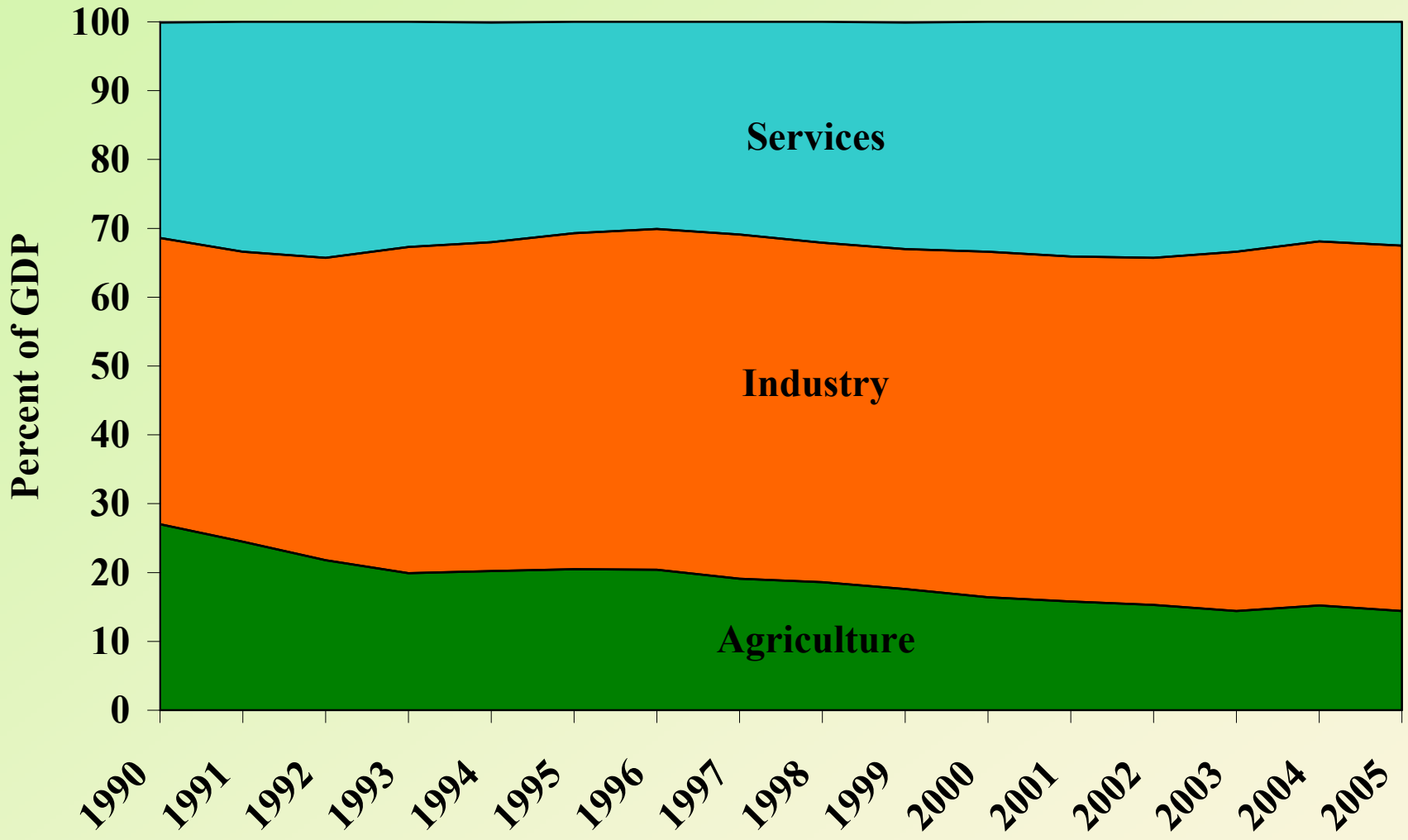


Sources: World Development Indicators and NBS (for China).

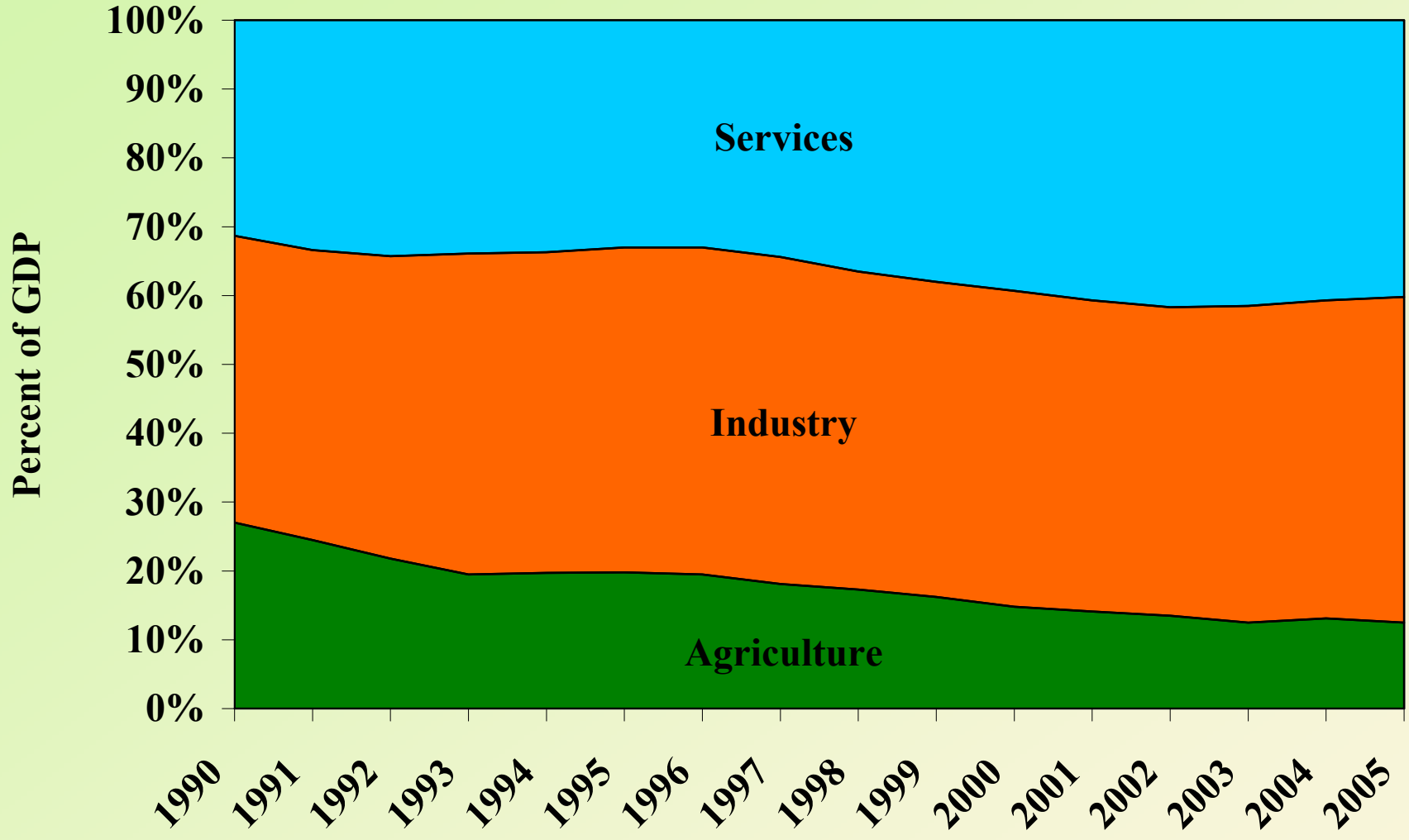
Energy-Intensive Materials Output in China



Structure of the Chinese Economy: *Before GDP Revision*



Structure of the Chinese Economy: *After* GDP Revision



Structure of Chinese Economy Before and After GDP Revision

Percent of GDP in 2005		
	Before	After
Industry	53.1	47.3
Services	32.5	40.2

Source: World Bank, 2006

China's GDP Elasticity of Energy Demand: Conclusions and *Policy* Questions:

- **Under-reported coal consumption caused much of change in $\Delta E / \Delta GDP$ in China this decade.**
  This undermines belief that GDP elasticity of energy demand in China has fundamentally changed.

- **Chinese energy intensity has probably increased due to an increase in materials intensity.**
  Heavy materials output has recently increased unsustainably.

- **Economic models need to incorporate recent trends.**
  Modelers underestimate importance of these issues.

Annual Change in E/GDP in Various Models

Scenario/Period	2030/2000	2030/2000
Scenario	**A1**	**B1**
AIM	**-4.1%**	**-2.8%**
ASF	**-1.9%**	**-2.2%**
IMAGE	**-2.5%**	**-3.2%**
MESSAGE	**-4.3%**	**-3.1%**
MINICAM	**-2.2%**	**-3.3%**
MARIA	**-4.2%**	**-3.2%**

Source: Nakicenovic, Nebojsa and Swart, Rob (eds.), *Special Report on Emissions Scenarios*, Intergovernmental Panel on Climate Change (Cambridge: Cambridge University Press, 2000).

Note: These rates apply to the "Asia" region; China was not disaggregated in the published data.

Implications for Modelers:

IPCC SRES scenario exercise seriously flawed?

SRES asserted:

"...due to methodology...it is not possible to disaggregate energy intensity improvements [in various models] into various components."

"Over the short-term, the impacts of economic structural change and technology diffusion are necessarily low."

"Prices assume a paramount importance in driving alternative energy demand patterns in short-term."

These assertions are undermined by the Chinese empirical evidence.

General Conclusions for China

- **Coal and GDP data remain problematic.**
- **China's low $\Delta E/\Delta GDP$ achievement in 1980-96 appears real.**
- **Materials intensity has increased since 2001.**
- **$\Delta E/\Delta GDP$ appears to be increasing, but is difficult to prove, and probably unsustainable.**