

Chinese Economic Growth and Atmospheric Pollution: An Overview

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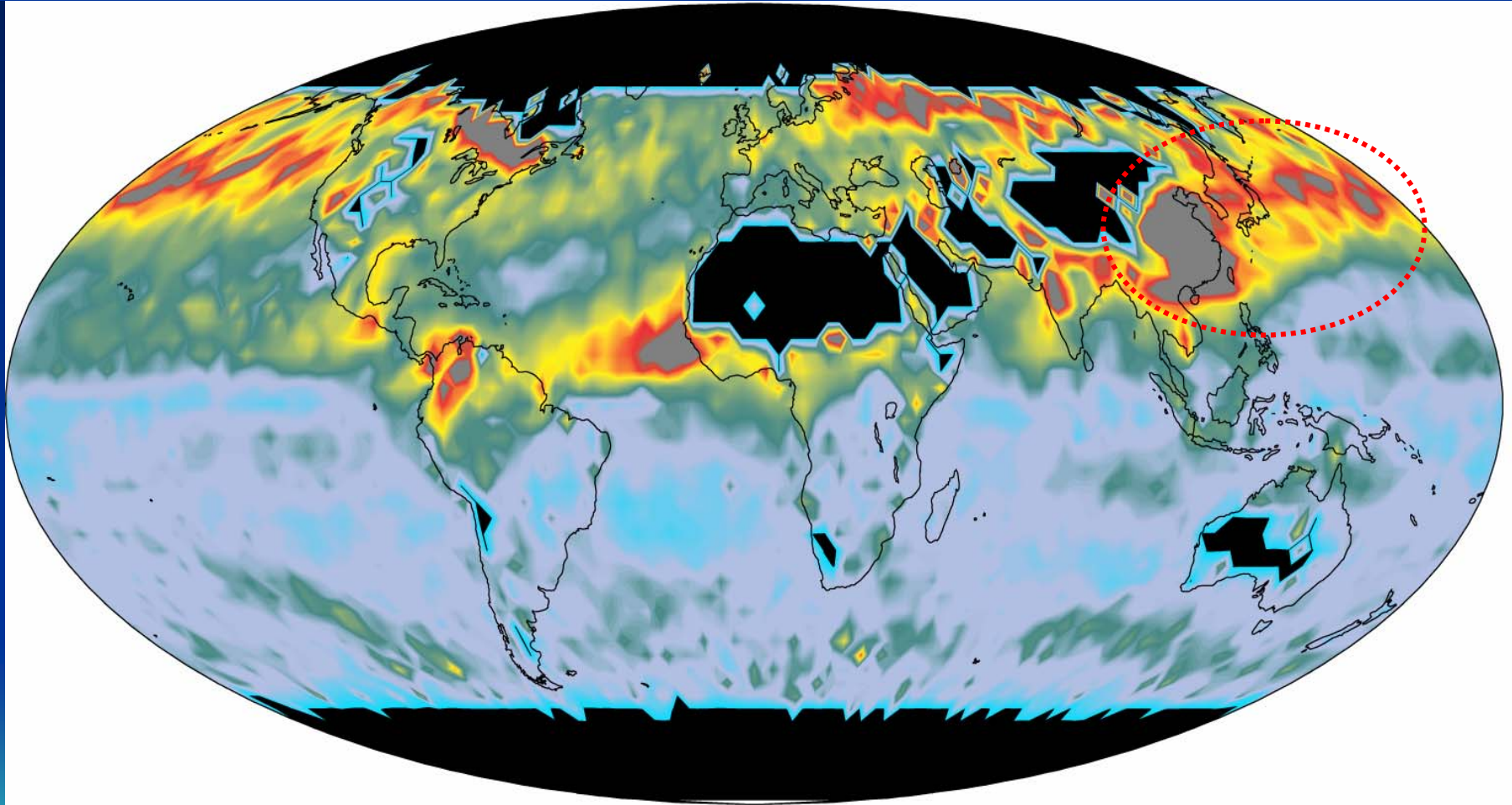
Motivation

Why we should care about this:

1. Chinese GHG emissions are already a significant regional externality and could be decisive on a global basis.
2. China's energy demand is "rocking the tanker."
3. Because of its status as a populous DC, what happens in China in terms of sustainable living is of special significance.

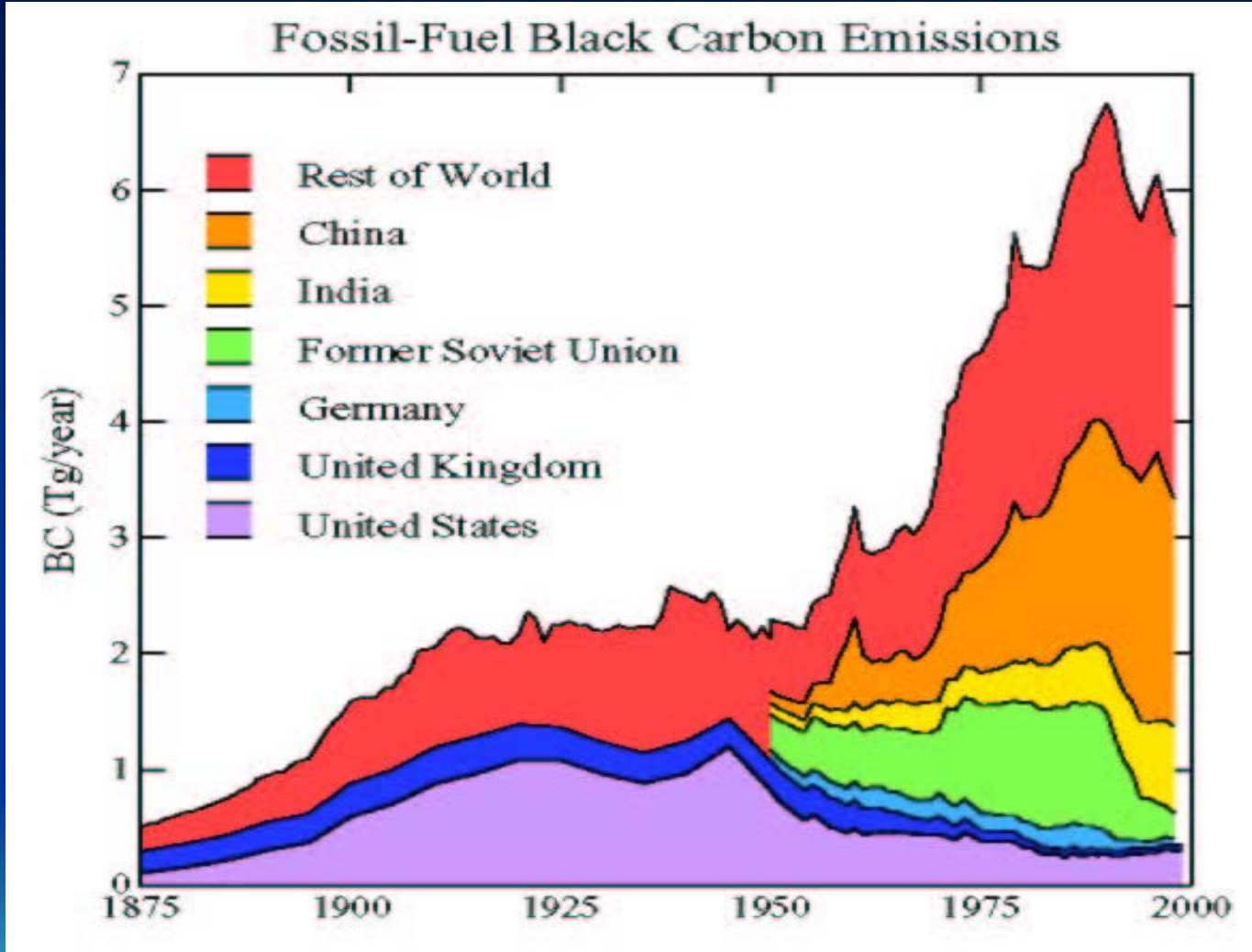
Aerosol Optical Depth : April 2001

NASA-TERRA Satellite; MODIS Inst



Source: Y. Kaufman: 2001, NASA-GSFC





Source: Novakov, Ramanathan, Hansen, .. Sathaye, GRL, 2002

Three Focal Points

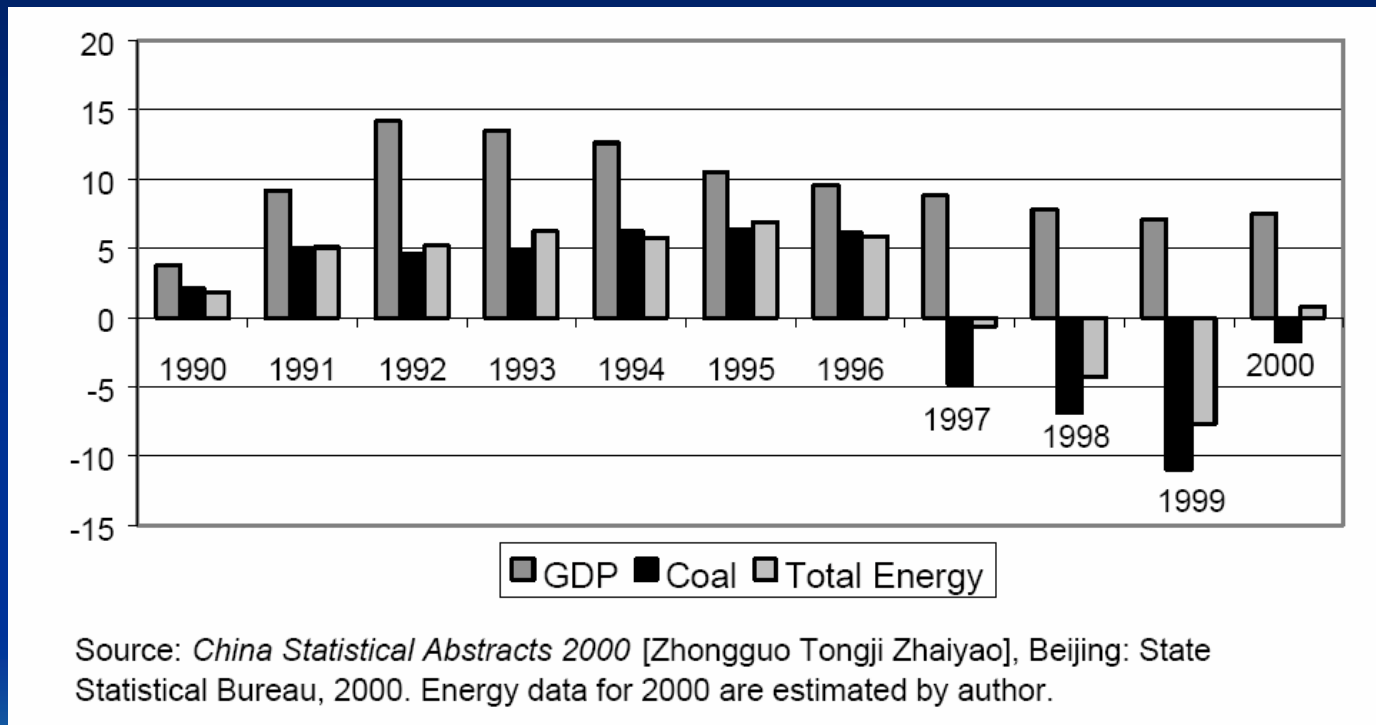
1. Where is China along the path of energy dependence?
2. How might energy prices and policies influence its course?
3. How can we decompose the ensuing environmental effects?

Energy and GHG Trends in China

Two contending perspectives:

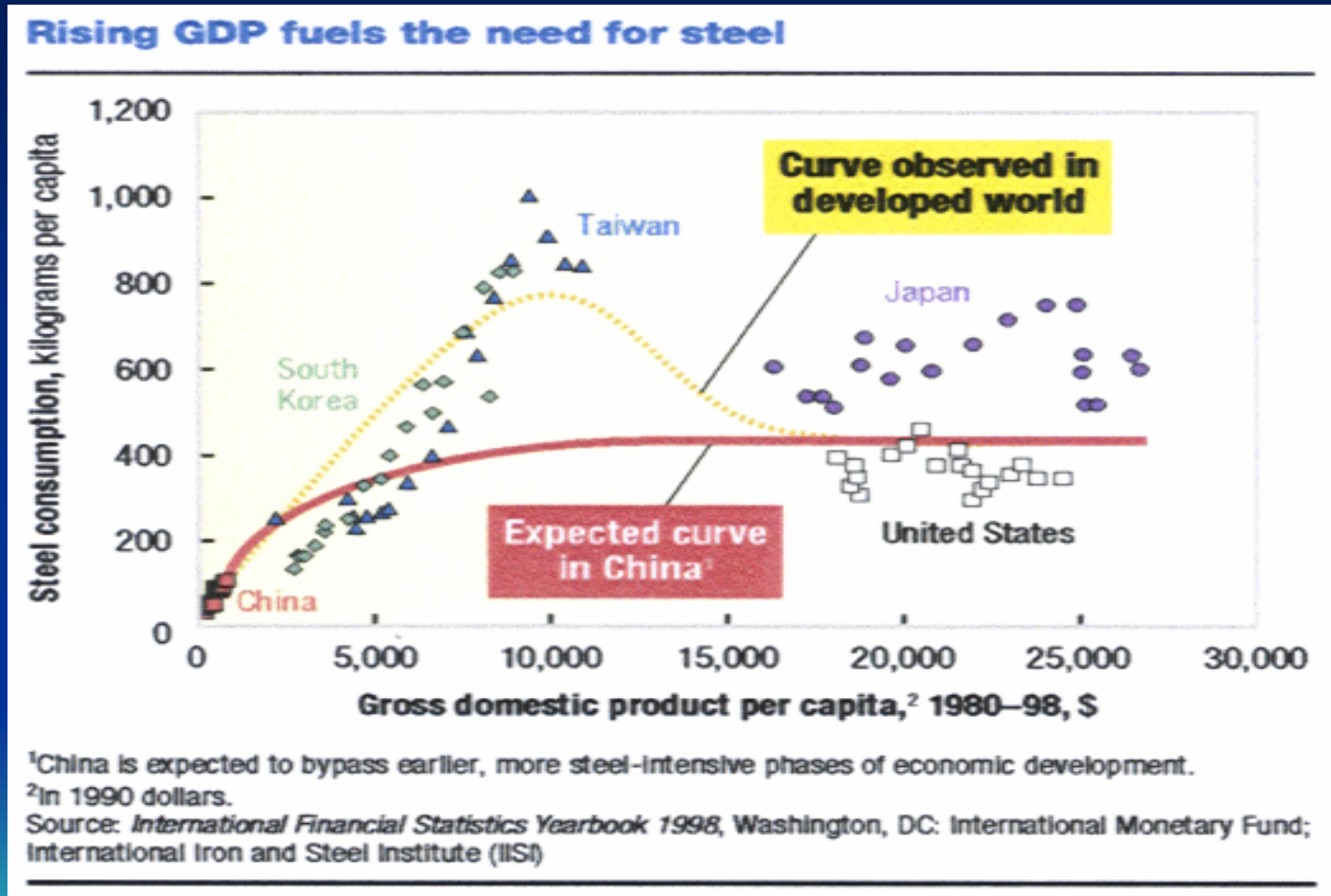
1. Optimists point to falling coal intensity in the late 1990s and massive technology infusion across the economy.
2. Others see resurgence of coal and overwhelming demand shifts in recent years, driven mainly by final consumption and completion of the process of modernization.

Reported Growth Rates of GDP and Commercial Energy Use in China



Source: Logan:2001

Chinese Steel: An Optimistic View



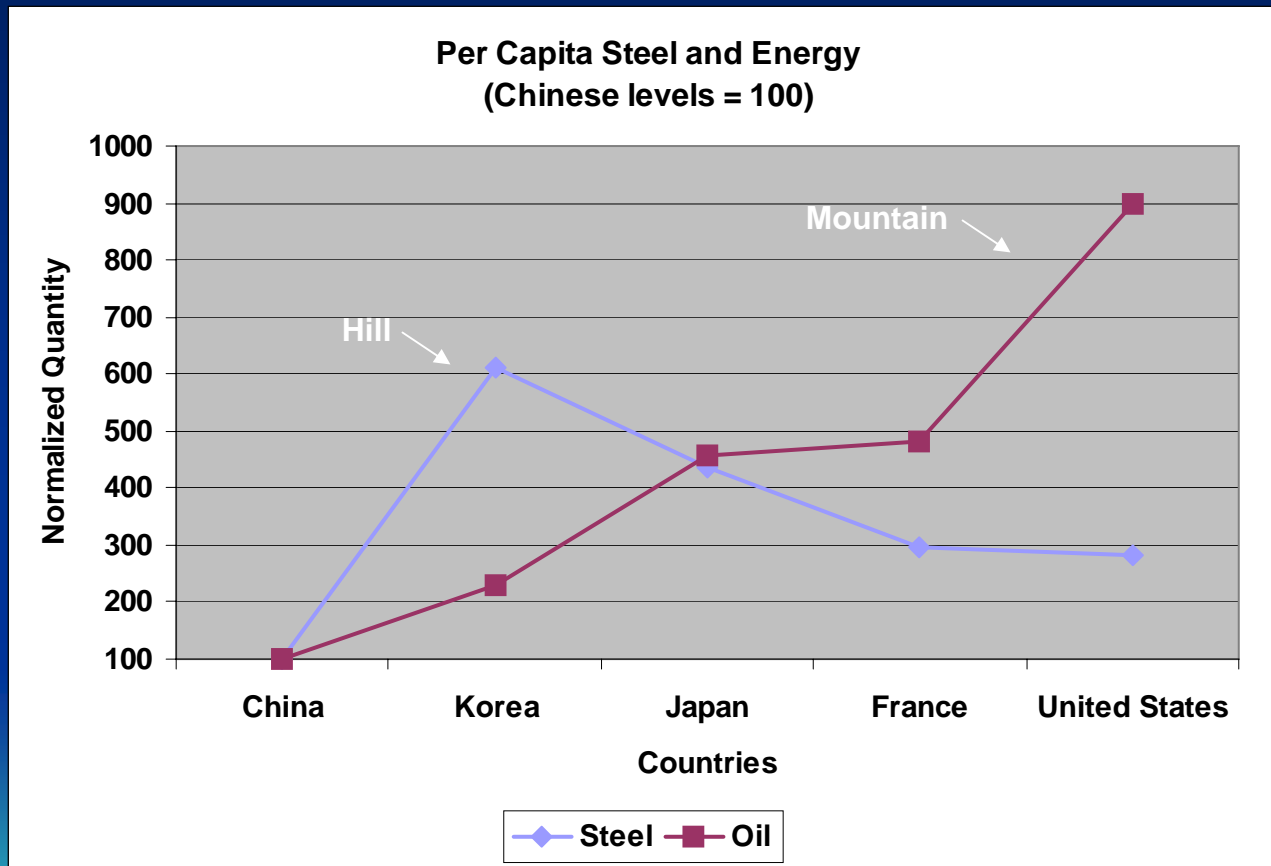
Chinese Steel: Reality – Now below average, growing fast, and headed much higher

- Per capita consumption up 2.5 times in last decade
- Likely to more than double again in coming decade
- Even 15% annual growth would still be less than Korea in 1992

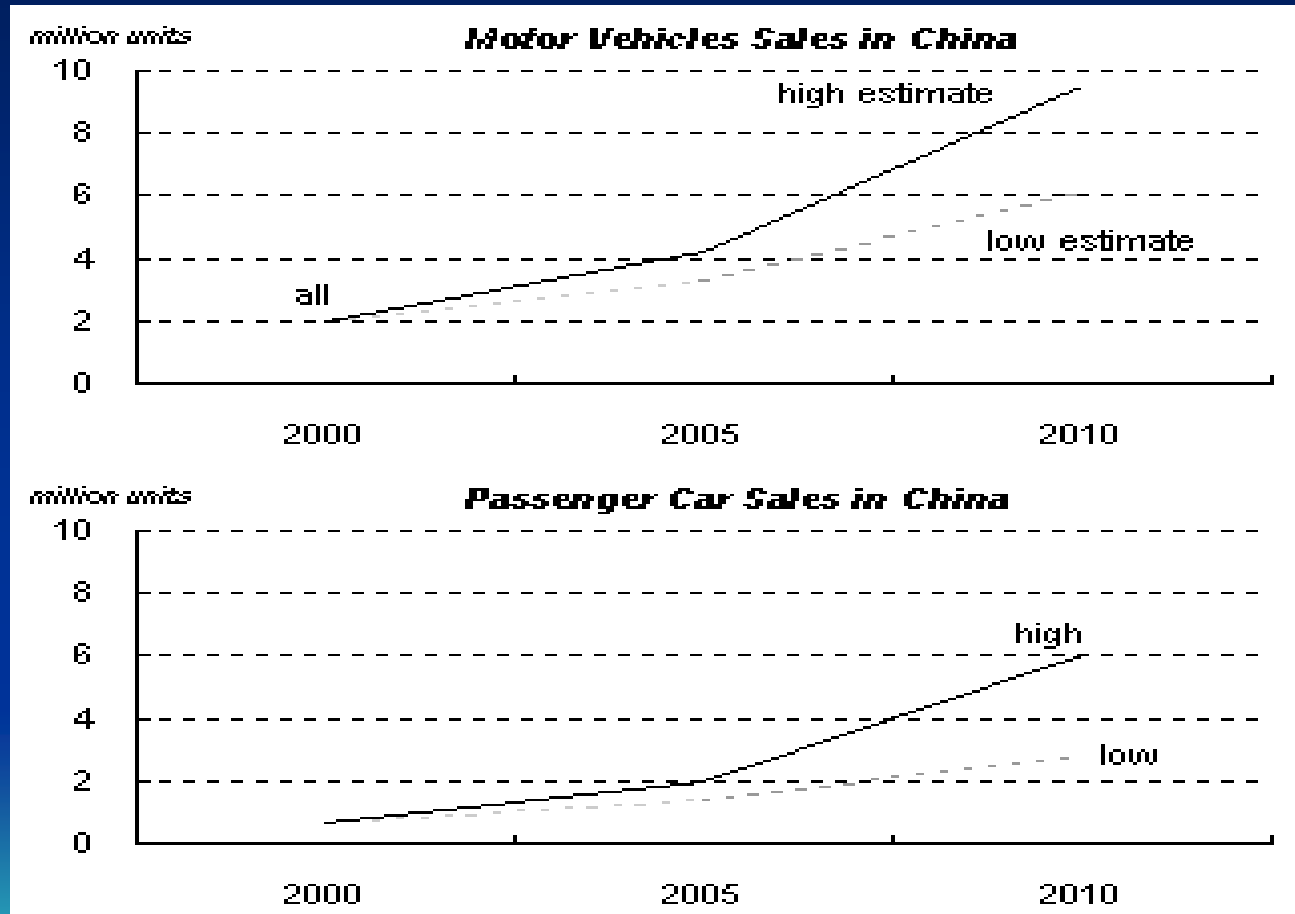
Annual Kilograms Per Capita

Country	Steel Production		Oil Consumption
	1992	2001	2000
China	59	132	905
Korea	499	809	2071
Japan	635	575	4136
France	382	390	4366
United States	330	373	8141

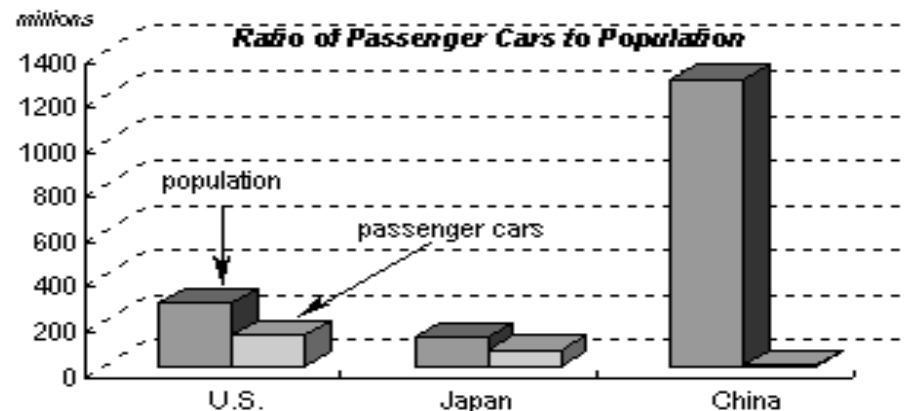
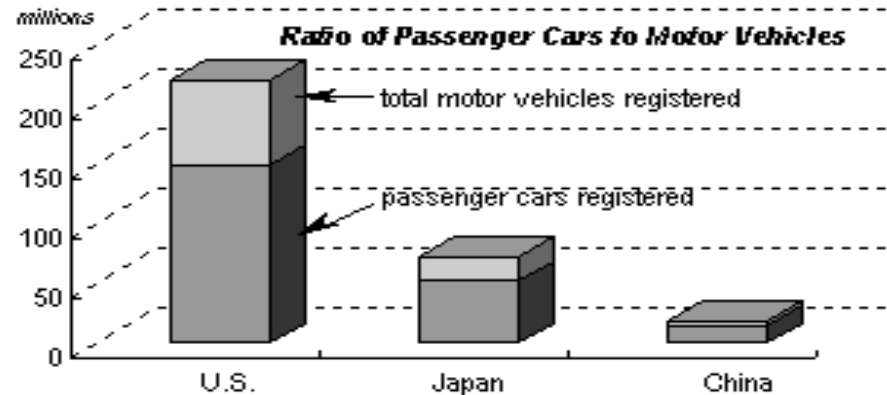
Industrialization may be energy-intensive, but affluence is much more so.



China: The World's 3rd Largest Car Market by 2010



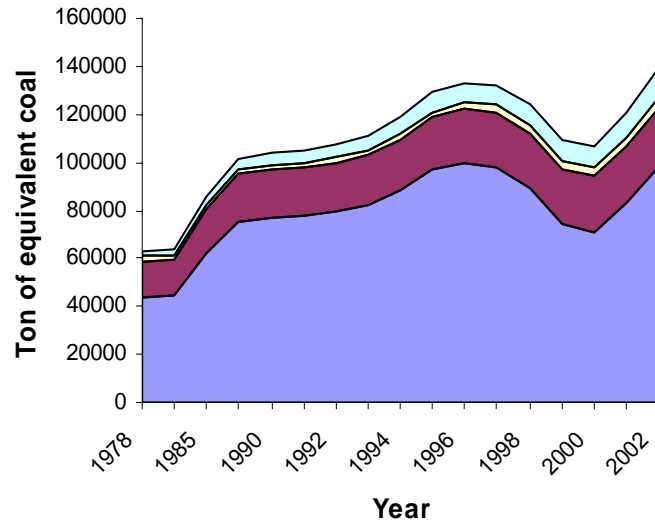
Demographics of Vehicle Demand



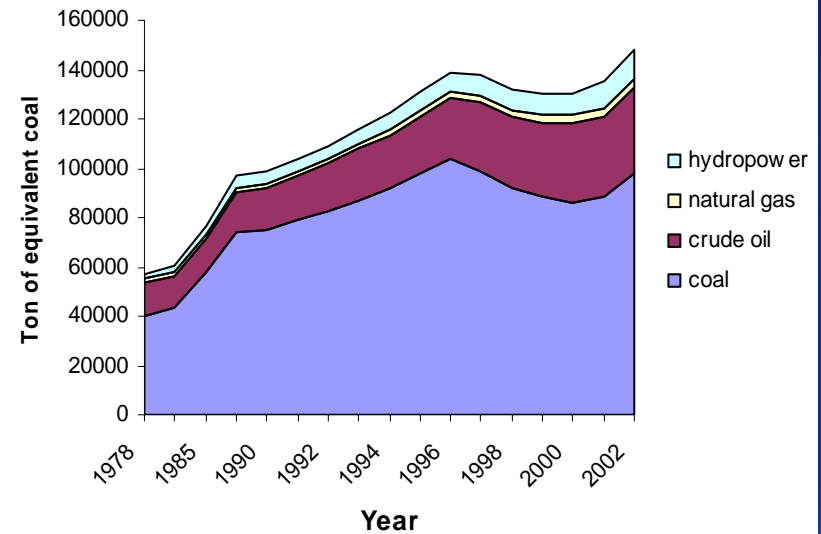
Sources: U.S. Census Bureau, Japan Association of Automobile Manufacturers, World Markets Research Centre

Coal at the Foundaton, Oil at the Margin: Energy Composition by Type

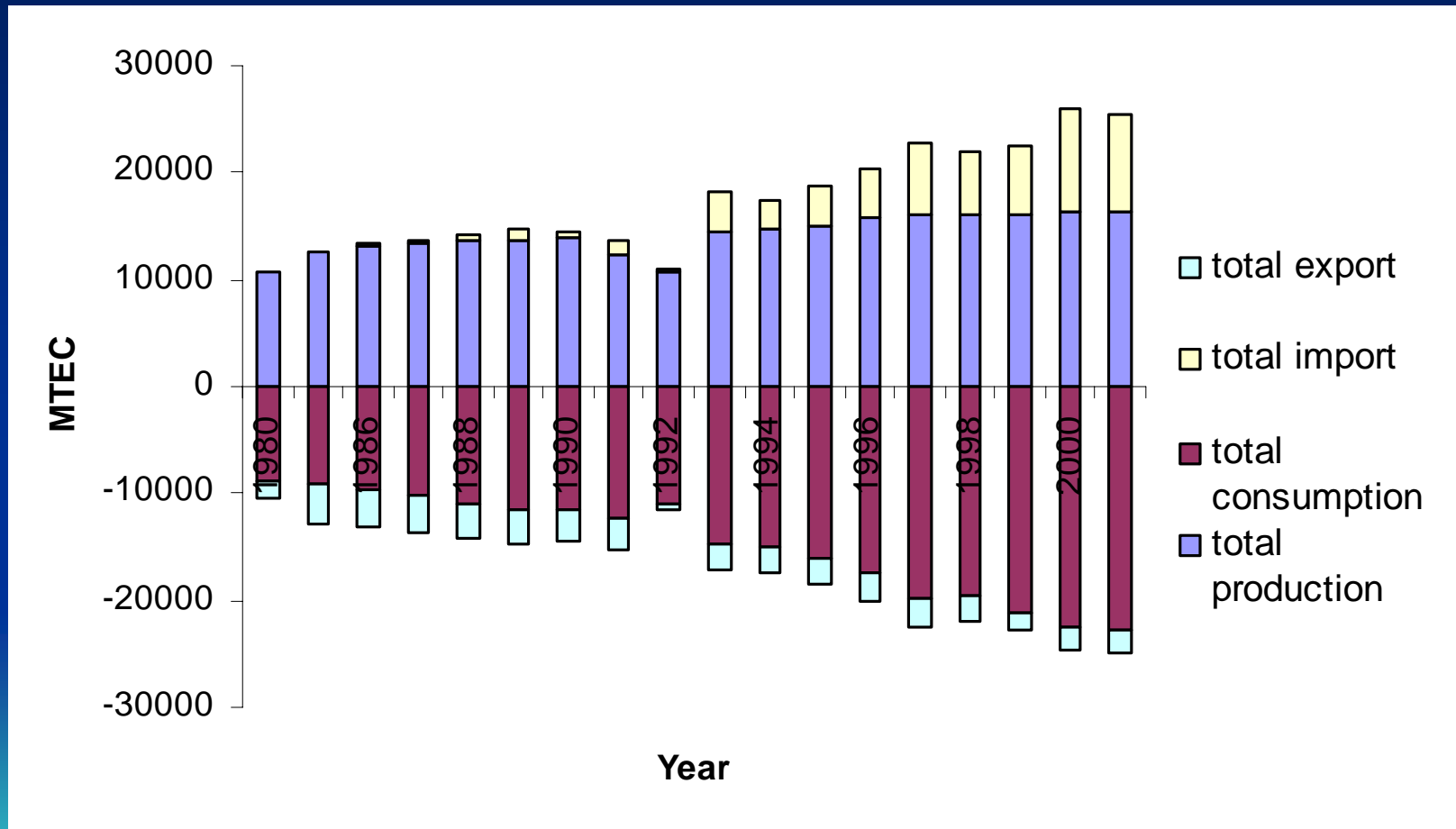
A. Energy production structure



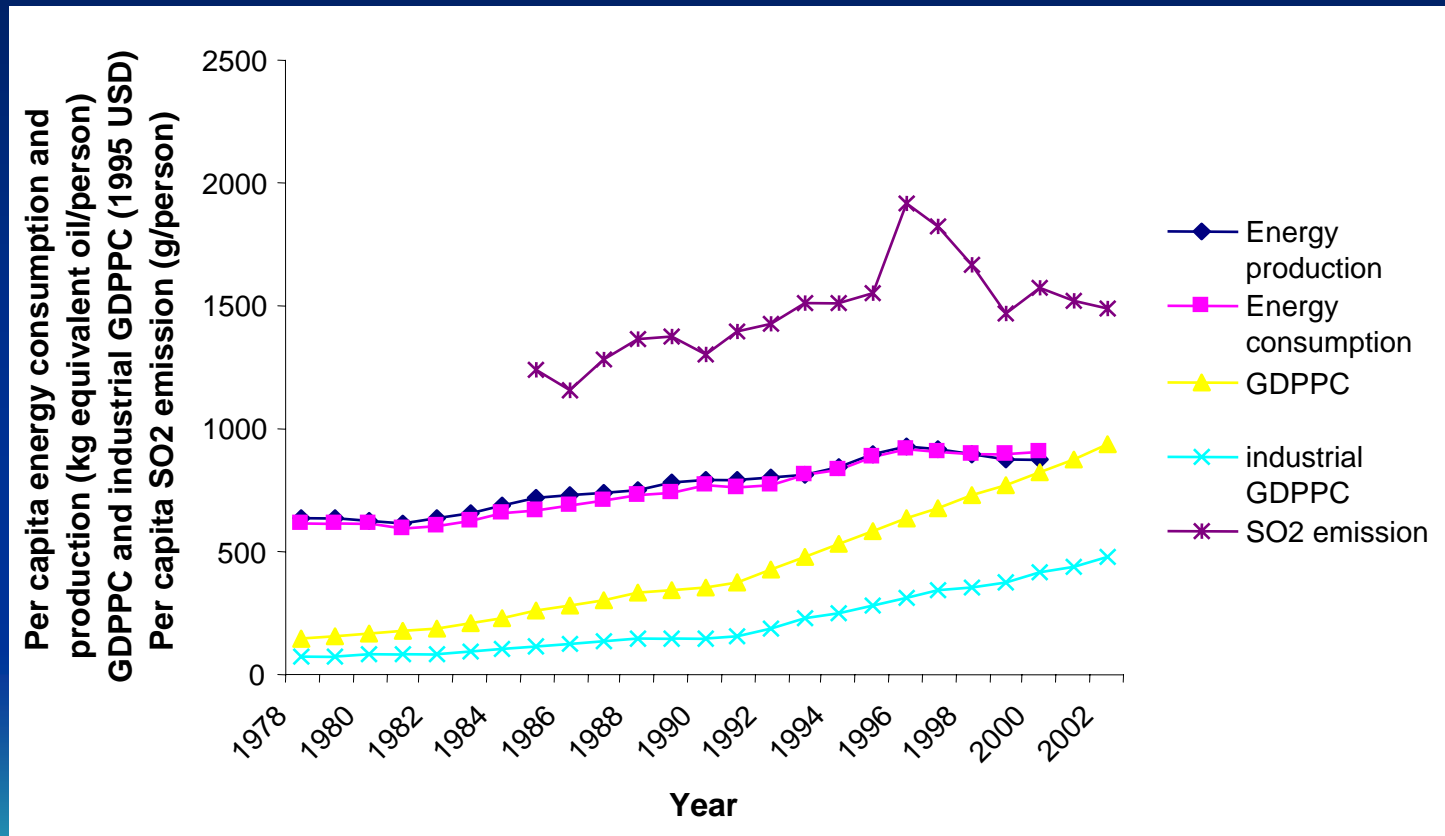
B. Total energy consumption



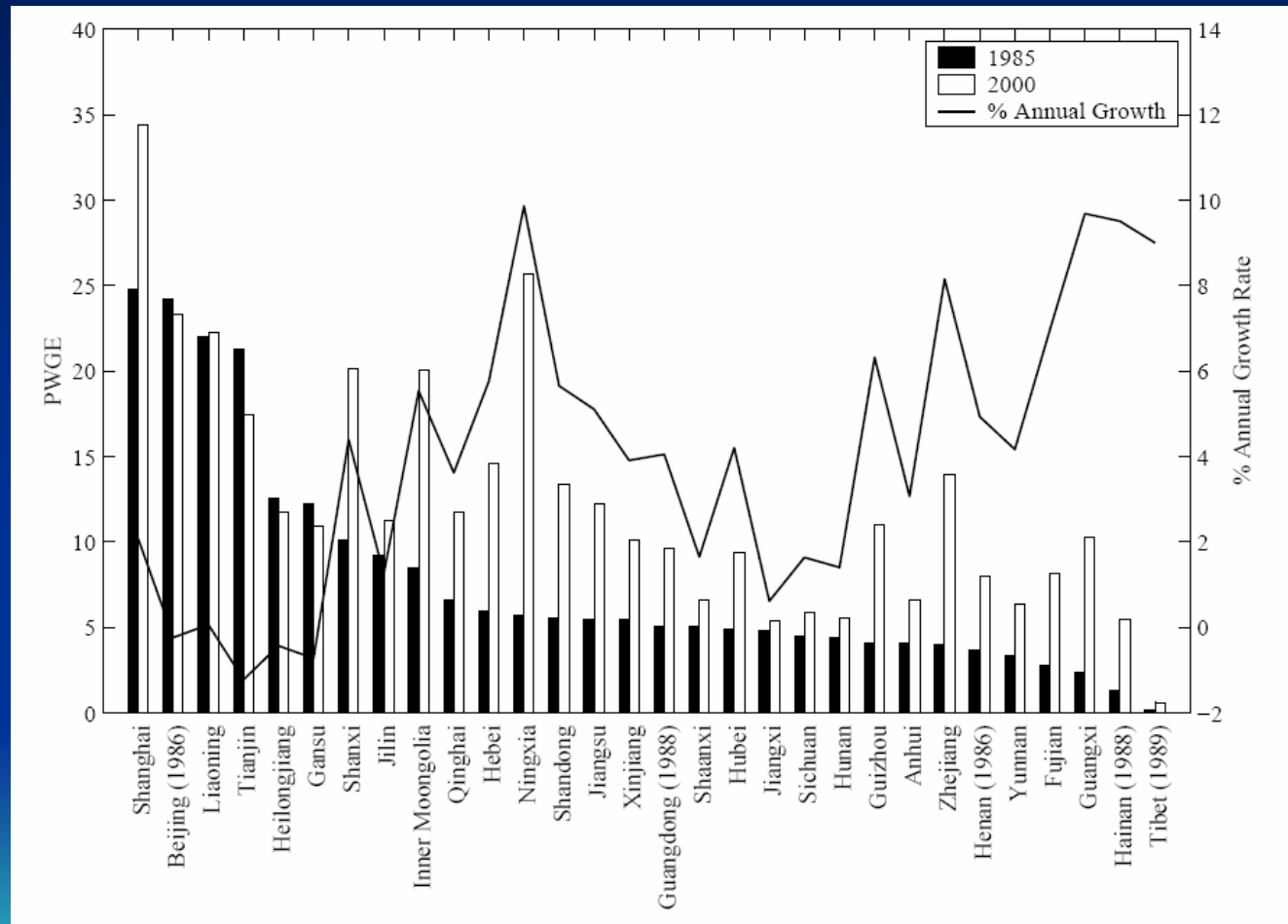
Tipping the Trade Balance: Energy Demand and Supply Composition



Macro Efficiency Determinants



China: Per Capita Waste Gas Emissions (1,000 cubic meters)

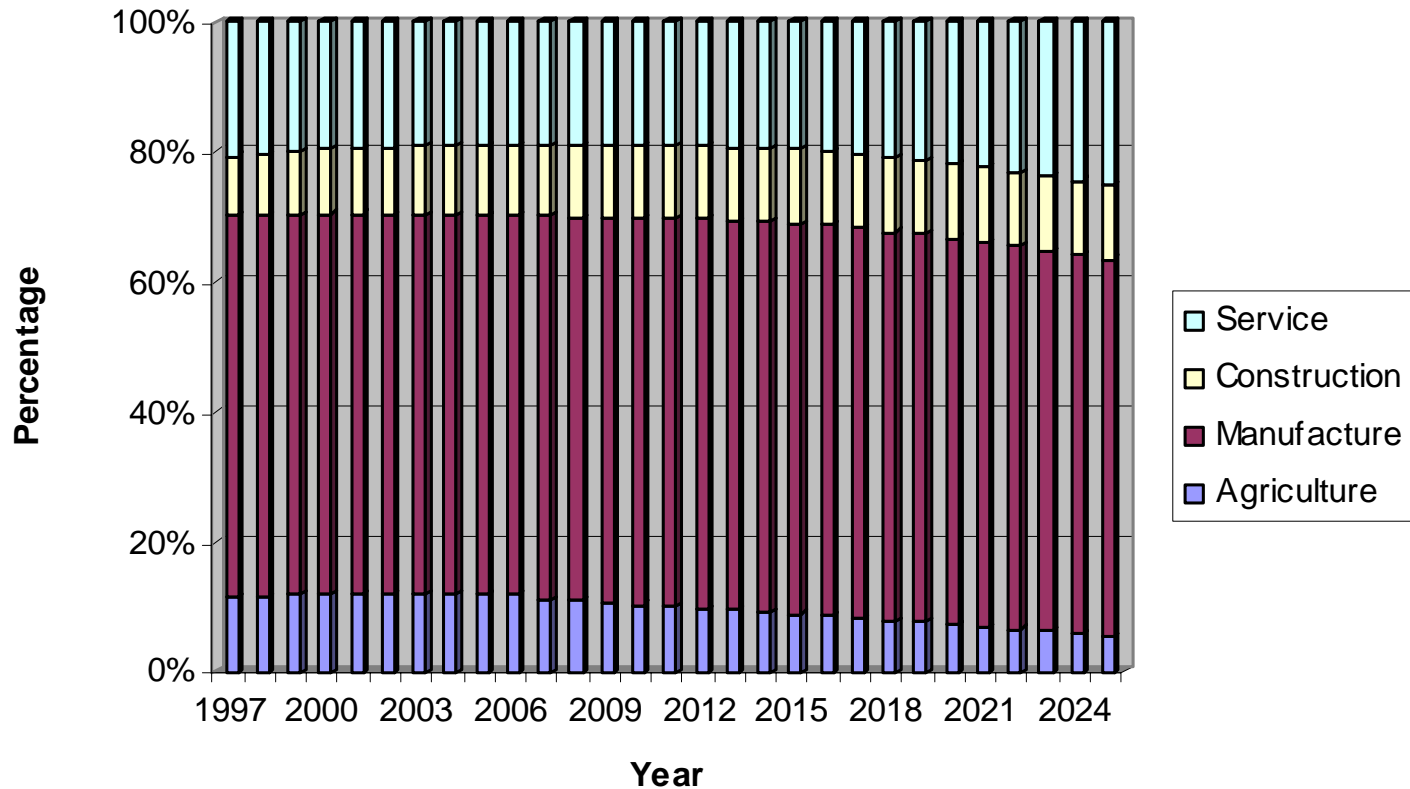


Source: Aufhammer et al: 2003

Projections to 2025

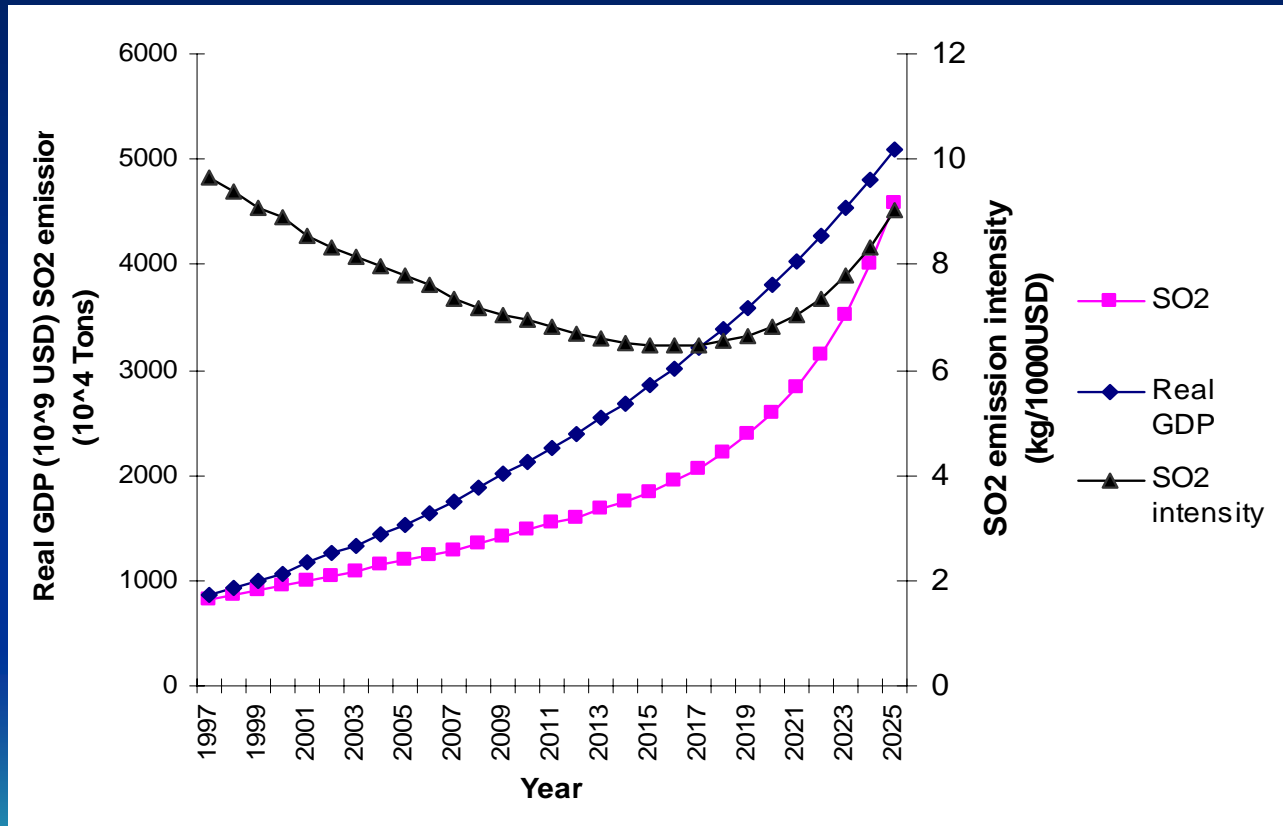
- We use a recursive dynamic CGE model to forecast trends for China over the next two decades.
- Around a calibrated baseline of consensus GDP growth, we evaluate the effects of rising oil prices.

Sectoral Output Composition

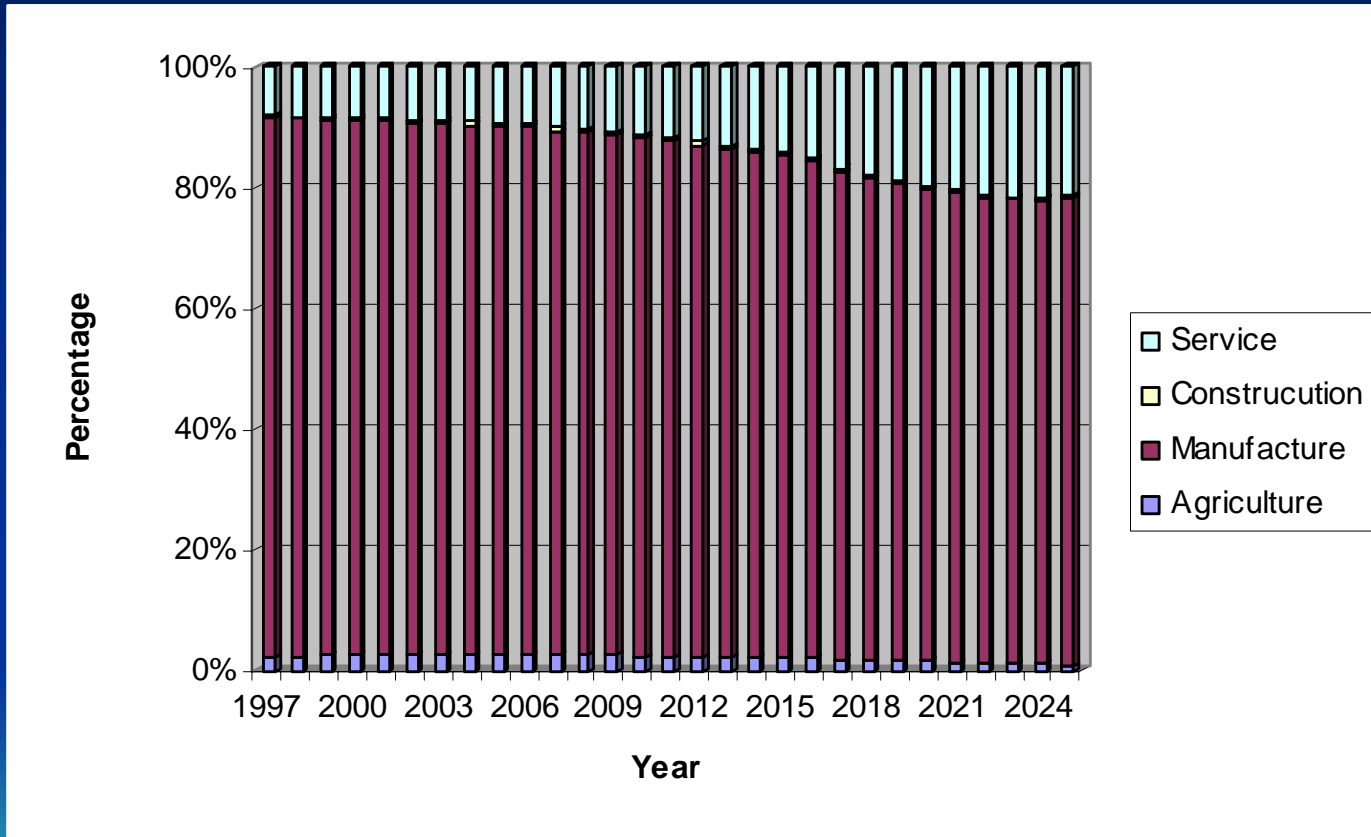


Inverted Kuznets Curve?

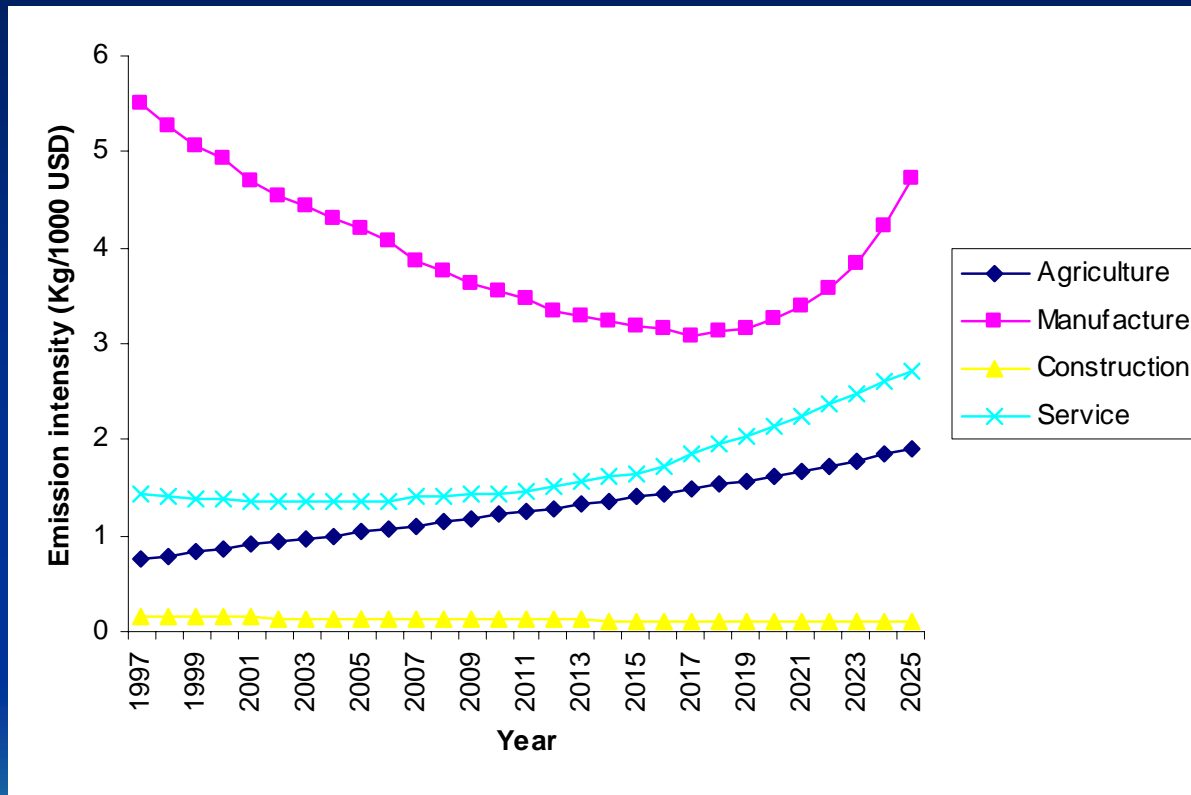
Real GDP and SO2 Emission Trends



CO2 as the Hidden Dragon: Final Consumption Trends

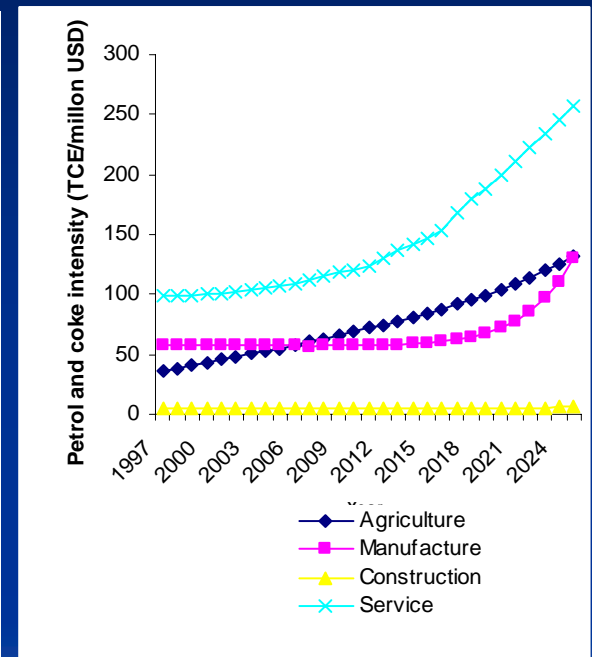
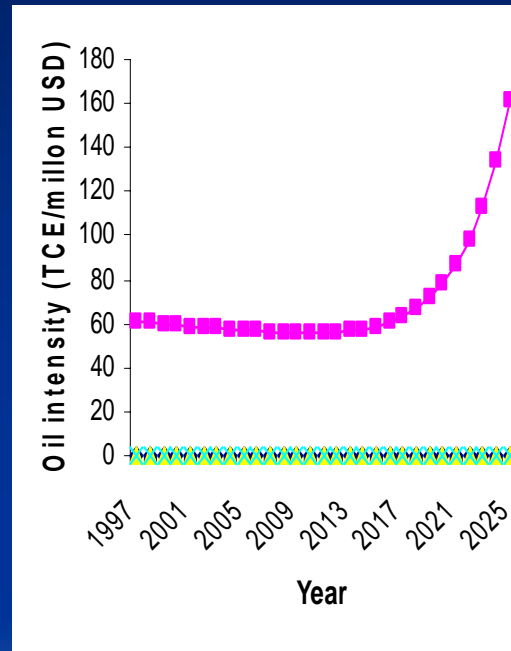
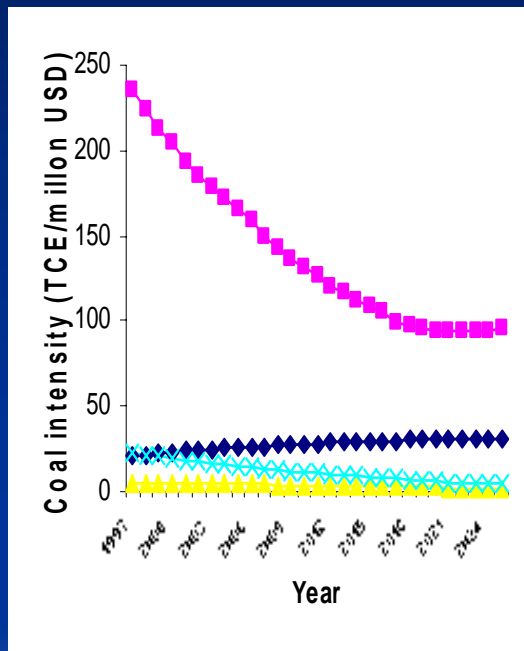


Ills of Affluence



Mfg reverses course because of electricity production.
Services are about transportation.

Real Sources Of Emission Intensity



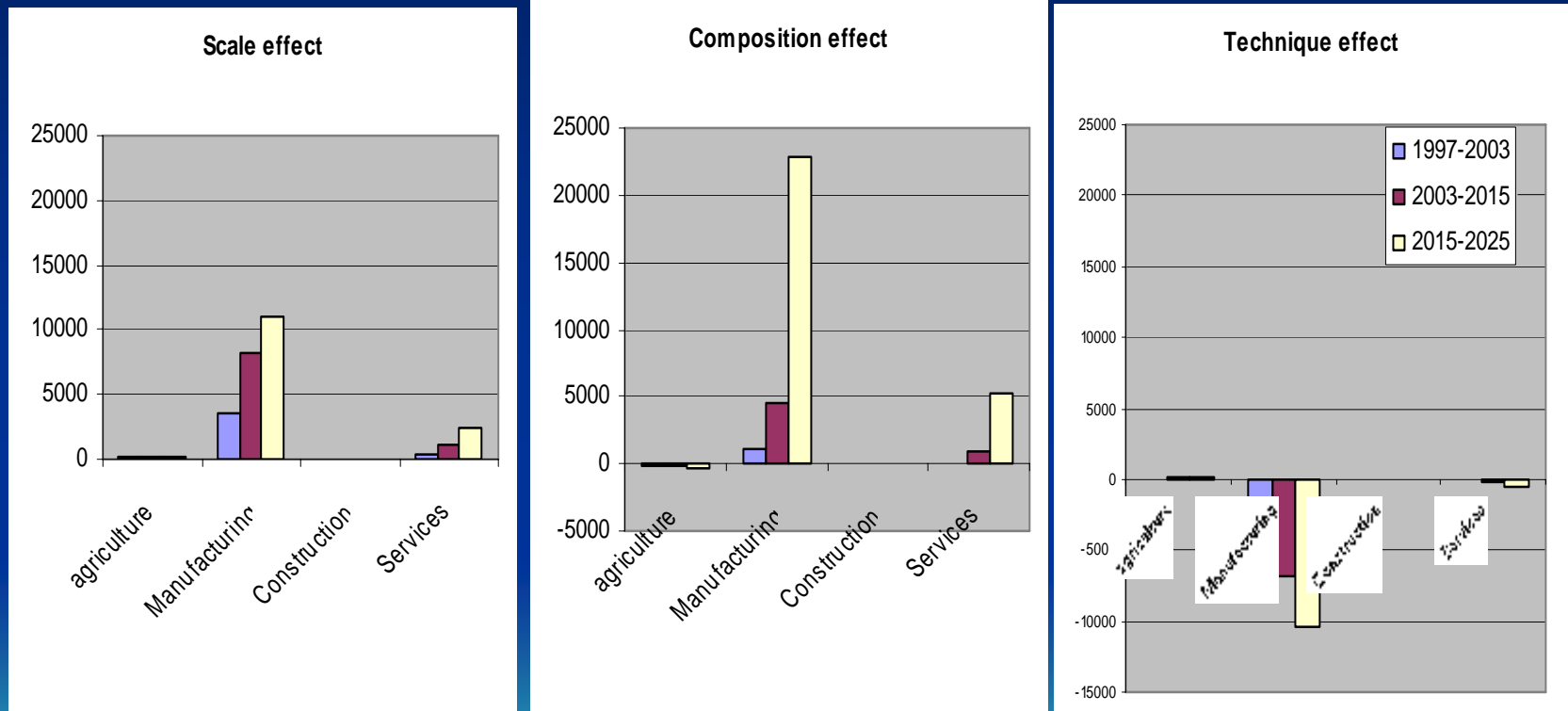
Composition of Environmental Incidence: Primary Drivers and the Pollution Troika

Economic sources of pollution can be decomposed into three parts:

1. Growth effects – expanding the envelope of economic activity. China's successes here are now legendary, and becoming almost surreal.
2. Composition effects – shifting patterns of supply and demand around the surface of the envelope. Things will get much worse before they get better.
3. Technological change – efficiency gains, bending the envelope. Here is the only unequivocally good news, driven mainly by coal use/distribution constraints and technology transfer.

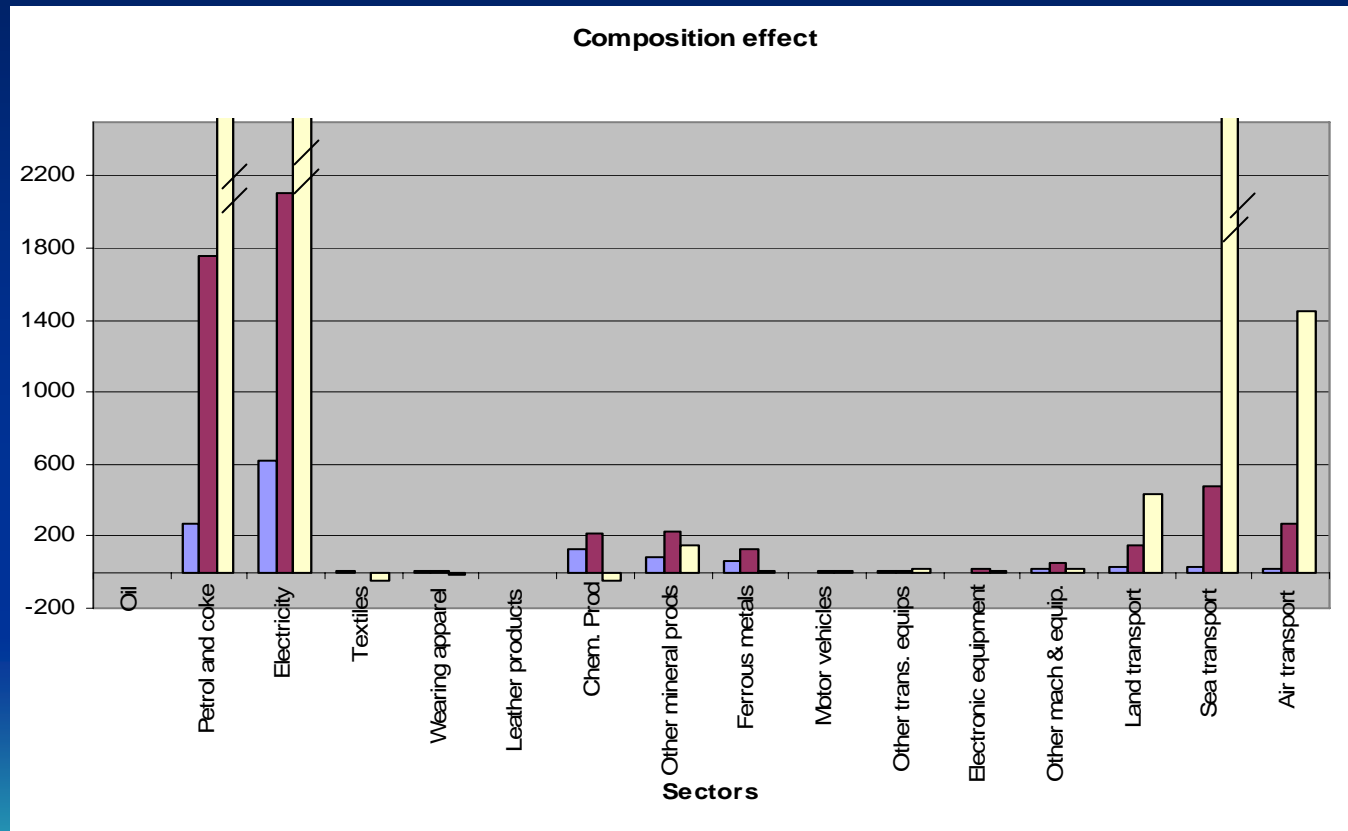
Divisia Decomposition Results

- SO2 emission variation during 1997-2025.

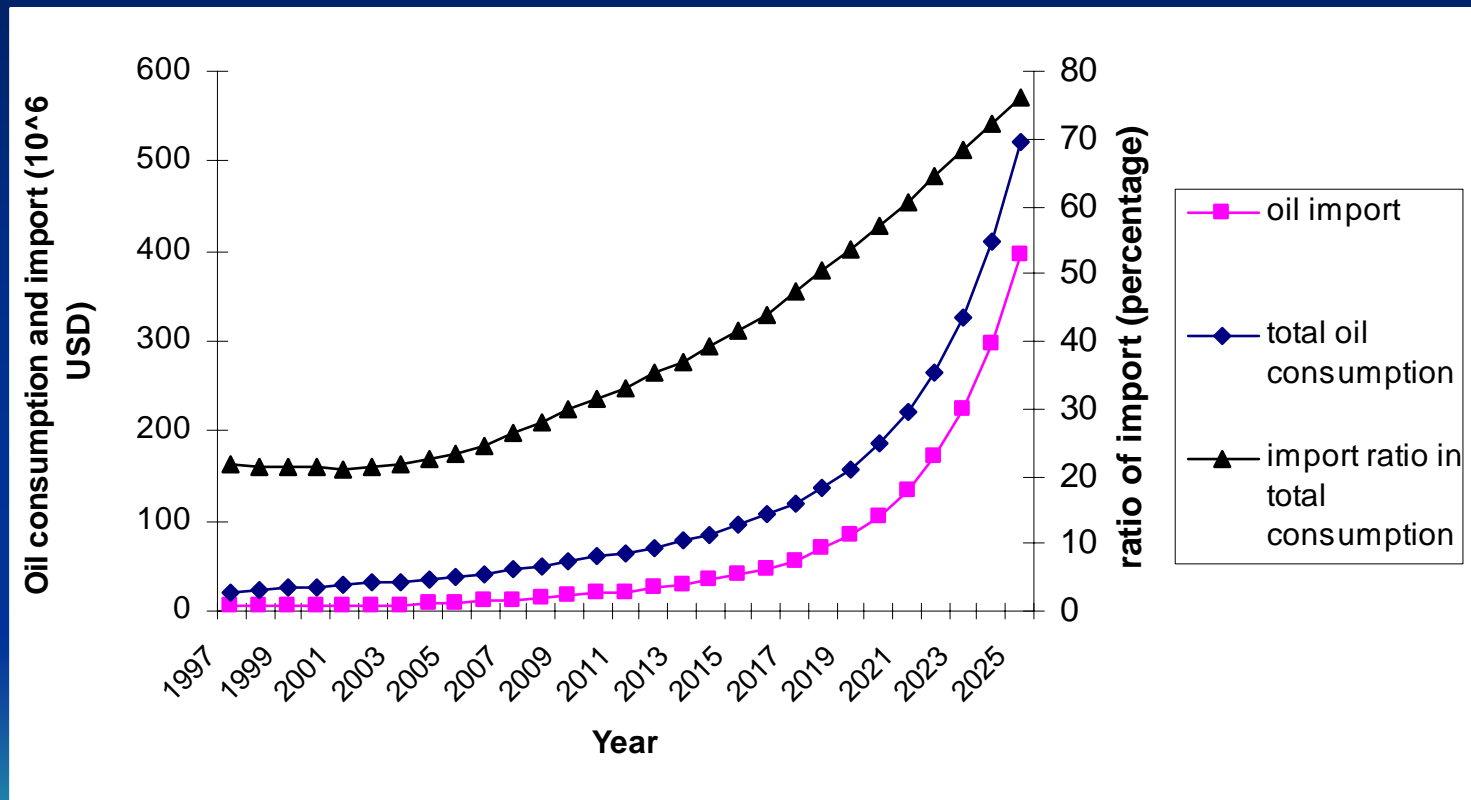


Divisia Decomposition

SO2 emission changes for some manufactures



Crude Oil Absorption Trends



Conclusions

China's economy has attained levels of growth and modernization that seemed beyond imagining only a generation ago. Along with its many successes in improving material living standards, however, have come new risks to sustainability and environmental quality.

- Without more effective emission control policies, China's economic growth will give rise to very significant SO₂ emission problems, especially in the period of 2015-2025.
- After a period of industrialization, structural transformation induces rapid expansions of energy-intensive final demand, mainly private electricity, heating, and transport services.
- To meet the needs of a consumer society, SO₂ emissions shift from the other manufacturing and service sectors into intermediate energy generation (electricity generation and petrol and coke sectors), and petroleum refining.
- Coal will be significantly replaced by relatively cleaner intermediate energy sources such as electricity, oil products and natural gas in manufacturing.
- Higher crude oil price may slow or even reverse this trend.
- Even these pessimistic results understate the the problem, since final consumption emissions are not even considered.
- What is to be done? A very good question.

Quo Vadis?

