AIM/CGE model for China

XU Yan (NIES) and Jiang Kejun(ERI)

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Content

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- Future research

Past research

- Focus on air pollution:
- Wang Yue, Estimation of economic impacts suffered from air pollution by using AIM/CGE model and AIM/local model
- Zhu Songli, Environmental and economic impact of SO2 policies
- XU Yan, Local air pollutant emission reduction and Ancillary Carbon Benefits of SO2 control policies

Background

- Acid rain and SO2 emission status in China
- In 2004, the total amount of SO2 emission was 22.549 million tons across China, the top one in the world;
- the average annual pH value of precipitation in 218 cities was below 5.6, taking up 41.4% of the total ;
- sulfur dioxide-caused acid rain has cost China an annual economic loss of over 110 billion yuan (13.3 billion US dollars);
- and air pollution results in an annual loss equivalent to two or three percent of China's GDP.

Main air pollution control policies in China

- *Pollution Levy Systems*

210Yuan/t-SO2 → 630Yuan(78$)/t-SO2

- *Total Emissions Control*

SO2 emission in 2010 should be 5% lower than 2005, and emission in 2020 would be further 20% lower than that in 2010

- *Emissions Trading*
- *Energy efficiency improvement*

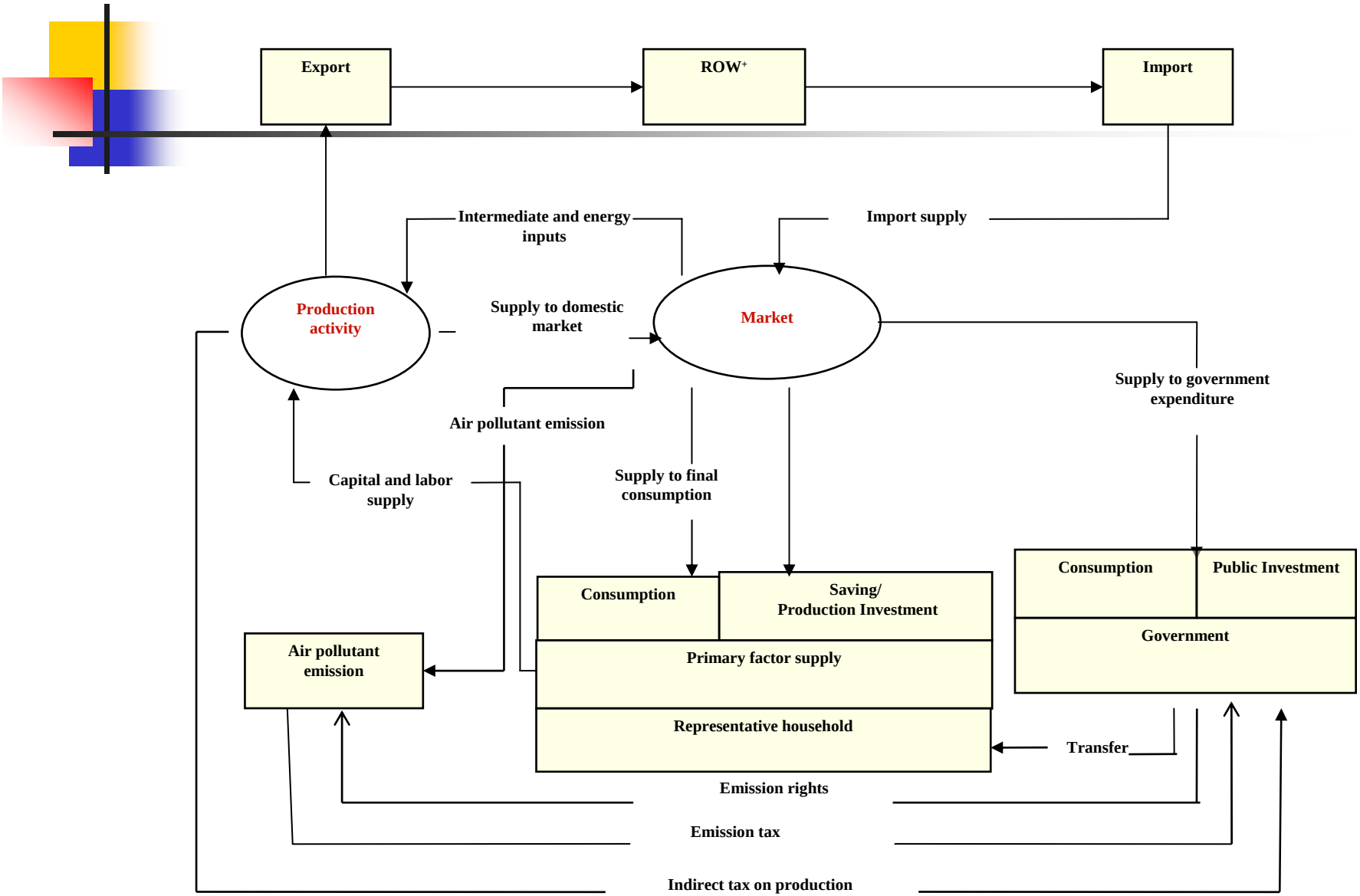
in 2010, energy consumption per GDP should be 20% lower than that at the end of Tenth Five-Year (i.e. 2005)

The objective of this exercise

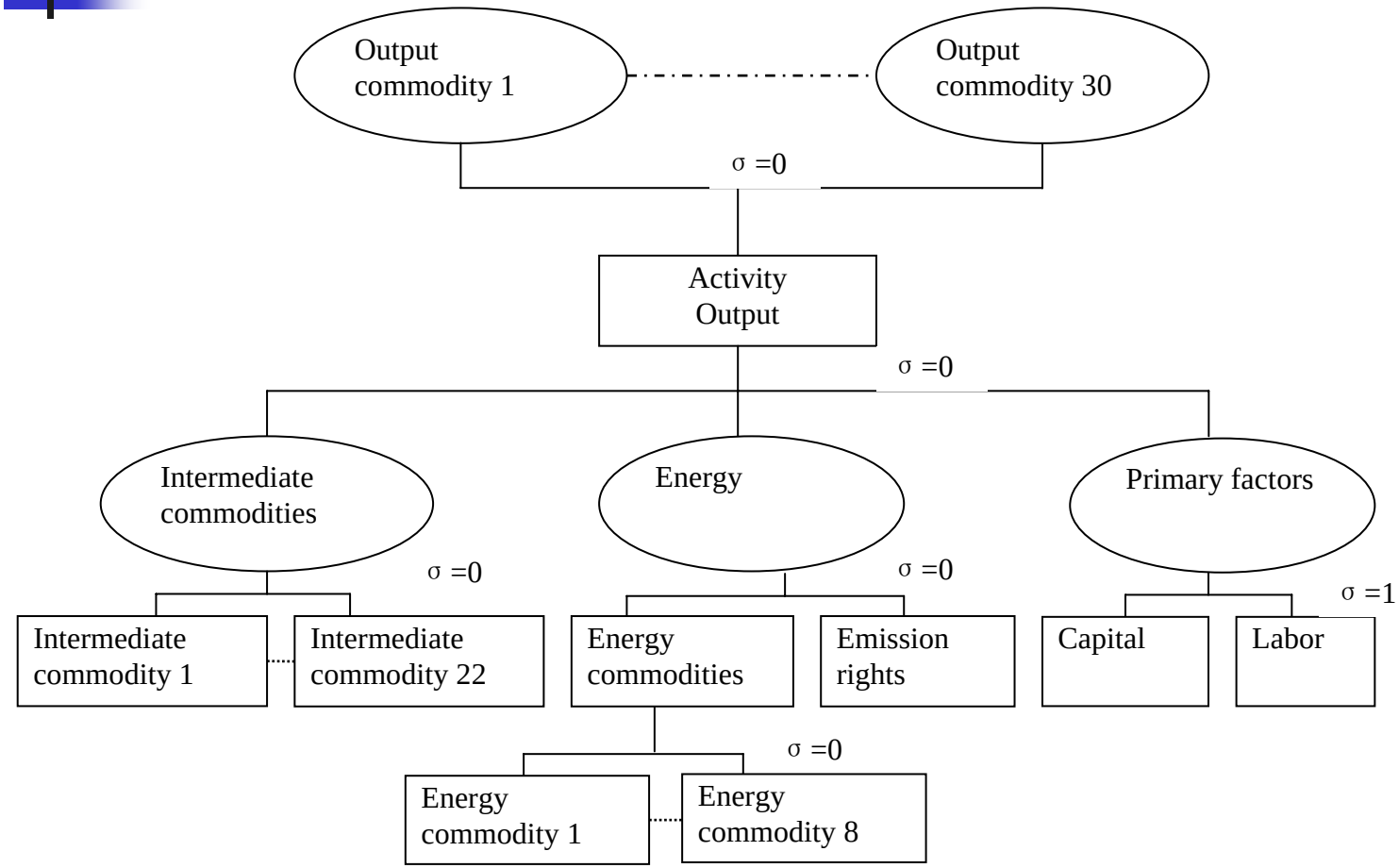
Based on China1997 I-O table and AIM/CGE, assess the impact of SO2 control policies in China on the local air pollutant emission, CO2 emission, energy consumption and GDP change during the period of 1997-2020

Model description

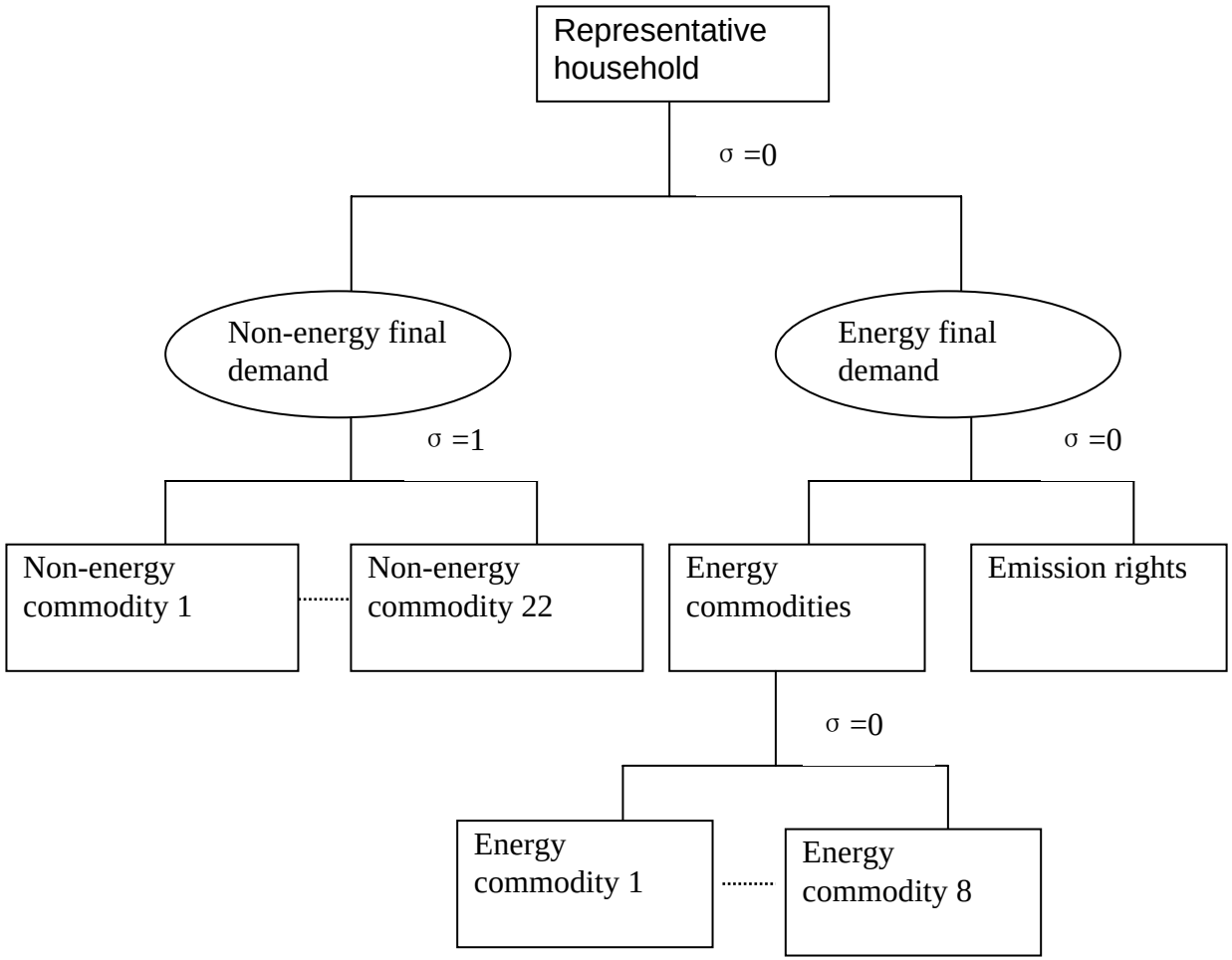
- The analytical model used is a dynamic recursive CGE single country model;
- Nested CES function for production and consumption ;
- The capital stock in each sector is estimated from the investment;
- The total investment in each year is calculated from the depreciation of capital stock and growth of capital stock by the production increase.
- The investment to each sector is calculated by the expect capital income in each sector.


Export
ROW+
Import
Intermediate and energy inputs
Import supply
Production activity
Supply to domestic market
Market
Supply to government expenditure
Air pollutant emission
Capital and labor supply
Supply to final consumption
Consumption
Saving/ Production Investment
Consumption
Public Investment
Government
Air pollutant emission
Primary factor supply
Representative household
Transfer
Emission rights
Emission tax
Indirect tax on production

Nesting of the production structure



Nesting of the consumption structure



Model data

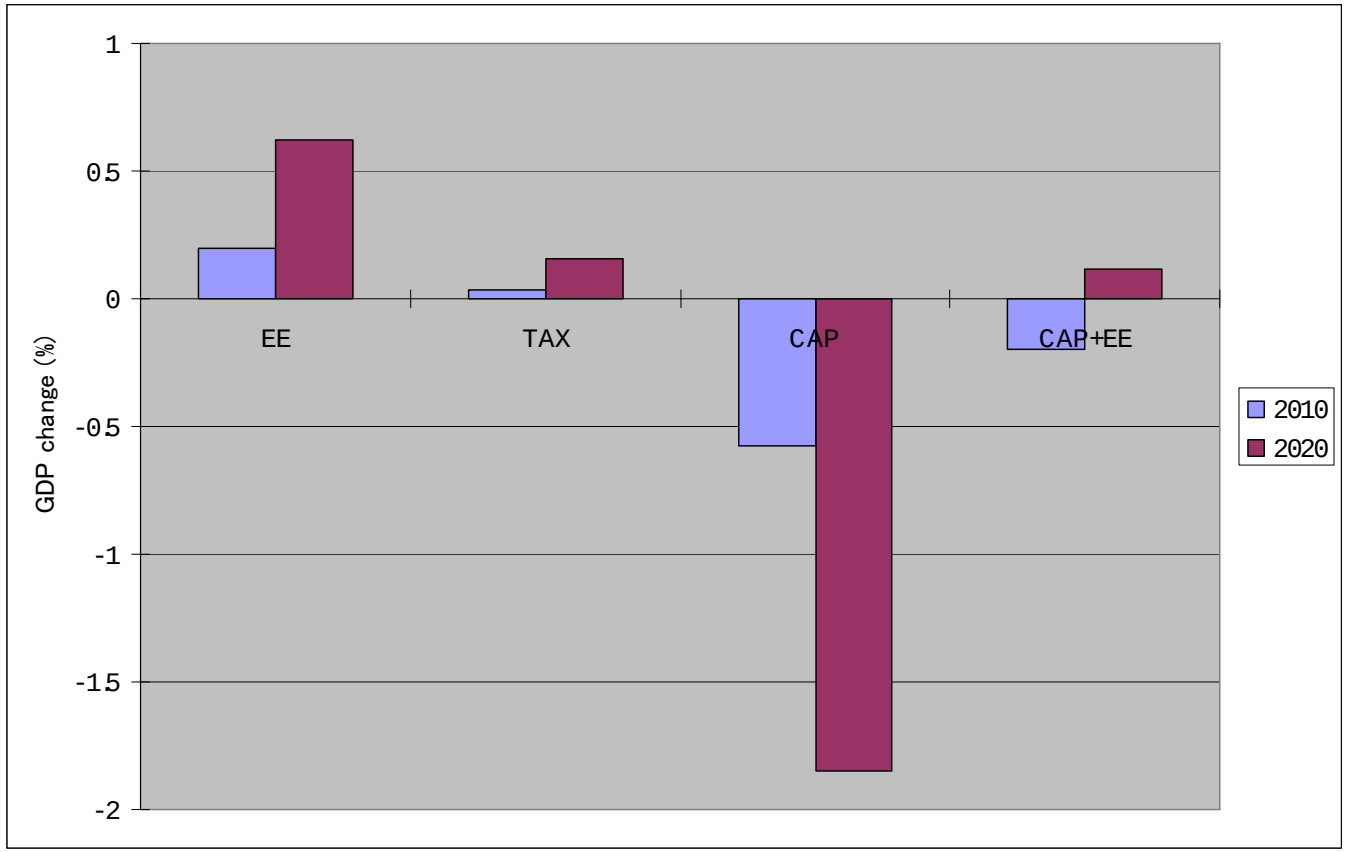
Data	Description	Source
Input-output table	IO part: 30 commodities, Final Consumption: household, government, FCF, stock inventory, export, import, Value added part: capital income, labor income, indirect tax	China's 1997 Input-output table (124*124); reconstruction was done (30*30)
U-matrix	30 commodities and 30 sectors including 8 energy goods: Coal /crude oil/natural gas/ oil products/ coke/ Electricity/heat/town Gas	China's 1997 Input-output table; reconstruction was done
V-matrix	30 sectors and 30 commodities (including 8 energy goods)	China's 1997 Input-output table; reconstruction was done
FCF data	Production investment by sector , Public investment	China's 1997 Input-output table and China Statistic Yearbook on FCF, re-calculation
Energy data	Energy consumption by fuel in base year, emission characteristic of each fuel, fuel price; Combustion rate(By sector and by fuel)	China Energy Statistic Yearbook (1997-1999), IPCC Manual, EIA website, AIM/Local-China

Scenarios definition

	Reference Scenario (RS)	Energy efficiency improvement Scenario (EE)	SO_2 tax scenario (TAX)	SO_2 constraint scenario (CAP)	Mixed scenario (CAP+EE)
annual GDP growth rate	same	same	same	same	same
annual labor growth rate	same	same	same	same	same
annual labor production growth rate in new investment	1%	1%	1%	1%	1%
annual energy efficiency improvement change in new investment	2.5%	1997-2004:2.5% 2005-2015:5% 2016-2020:3%	1997-2004:2.5% 2005-2020:3%	2.5%	1997-2004:2.5% 2005-2015:5% 2016-2020:3%
SO_2 emission tax	no	no	1998-2004: 210Yuan/t-SO_2 2005-2020: 630Yuan/t-SO_2	SO_2 price is endogenous	SO_2 price is endogenous
SO_2 emission constraint	no	no	no	Yes: annual down 1.5% from the year 2005	Yes: annual down 1.5% from the year 2005

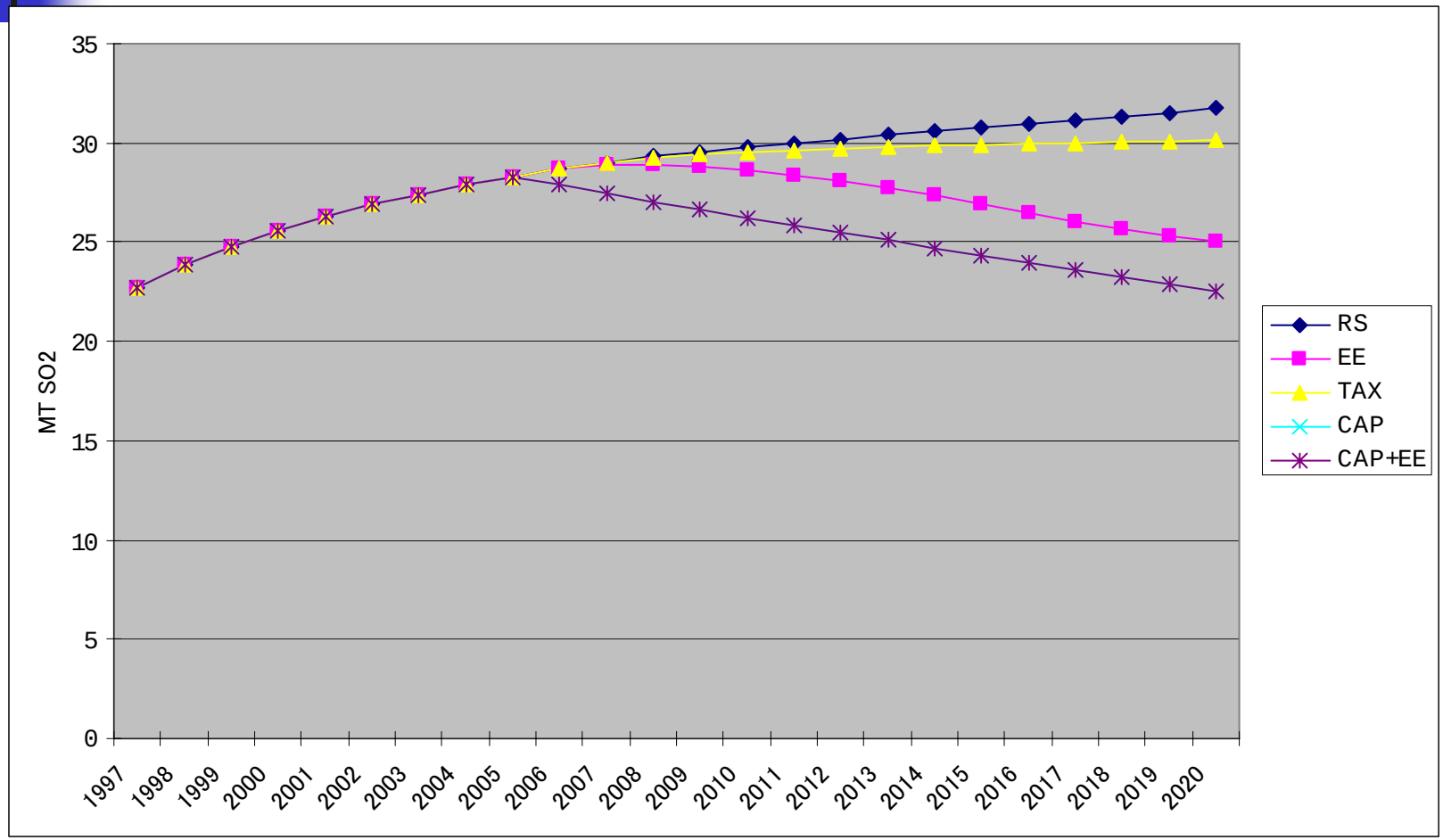
Simulation Results

GDP change



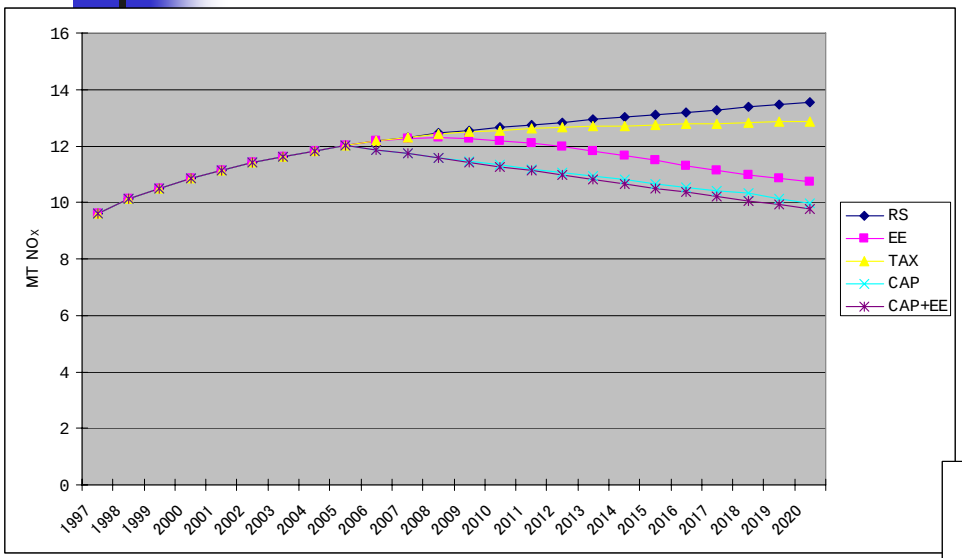
Simulation Results

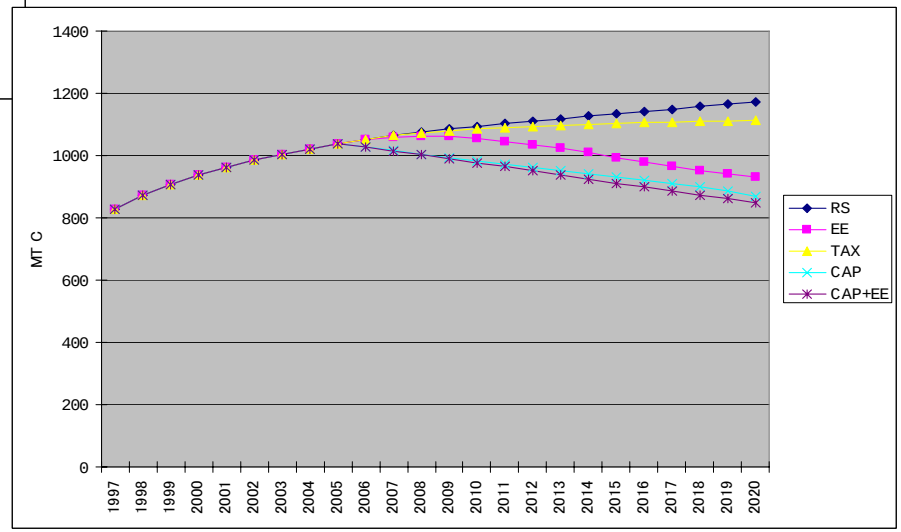
SO2 emission



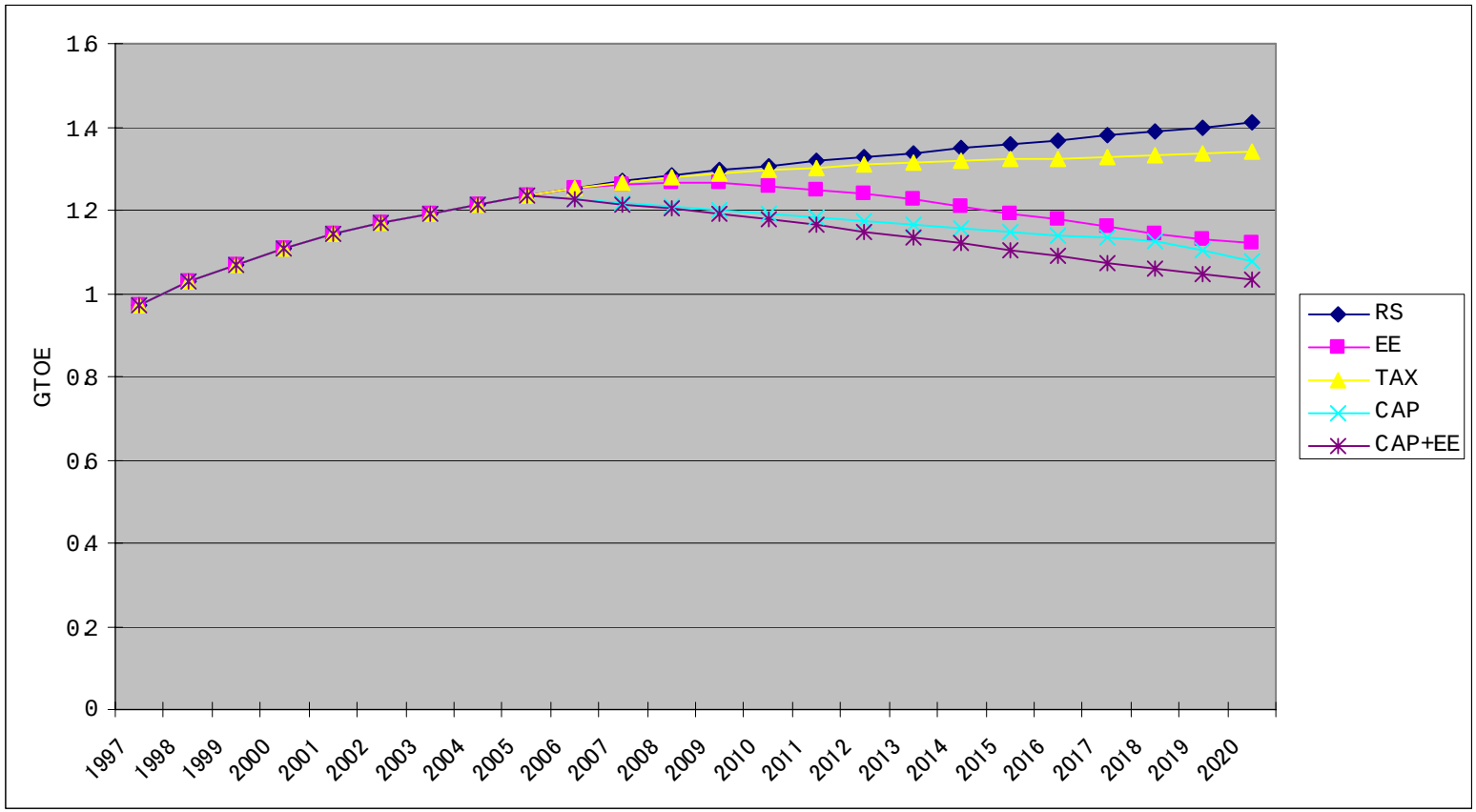
Simulation Results

NOx and CO2 emission

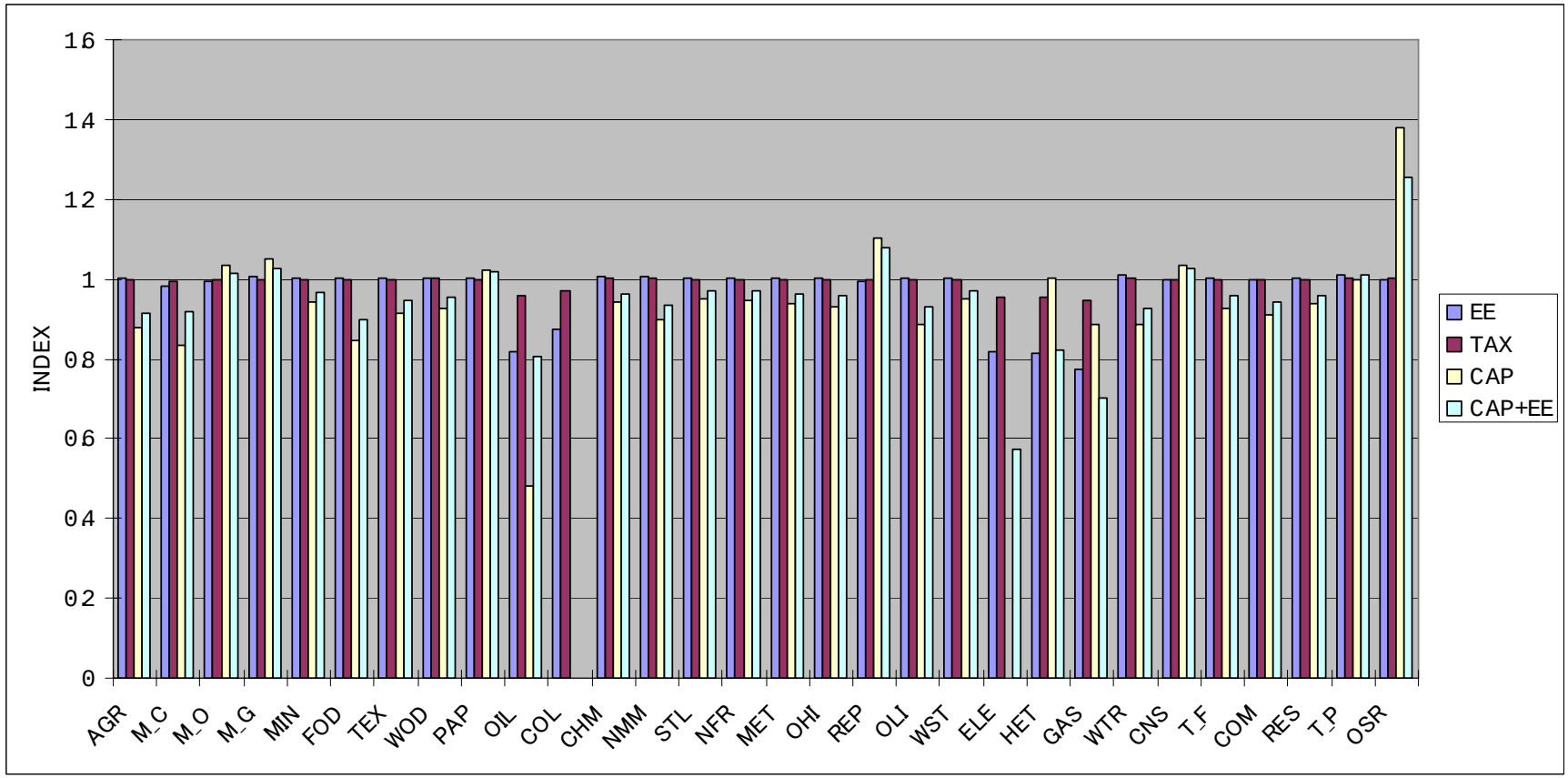




Simulation Results
energy consumption

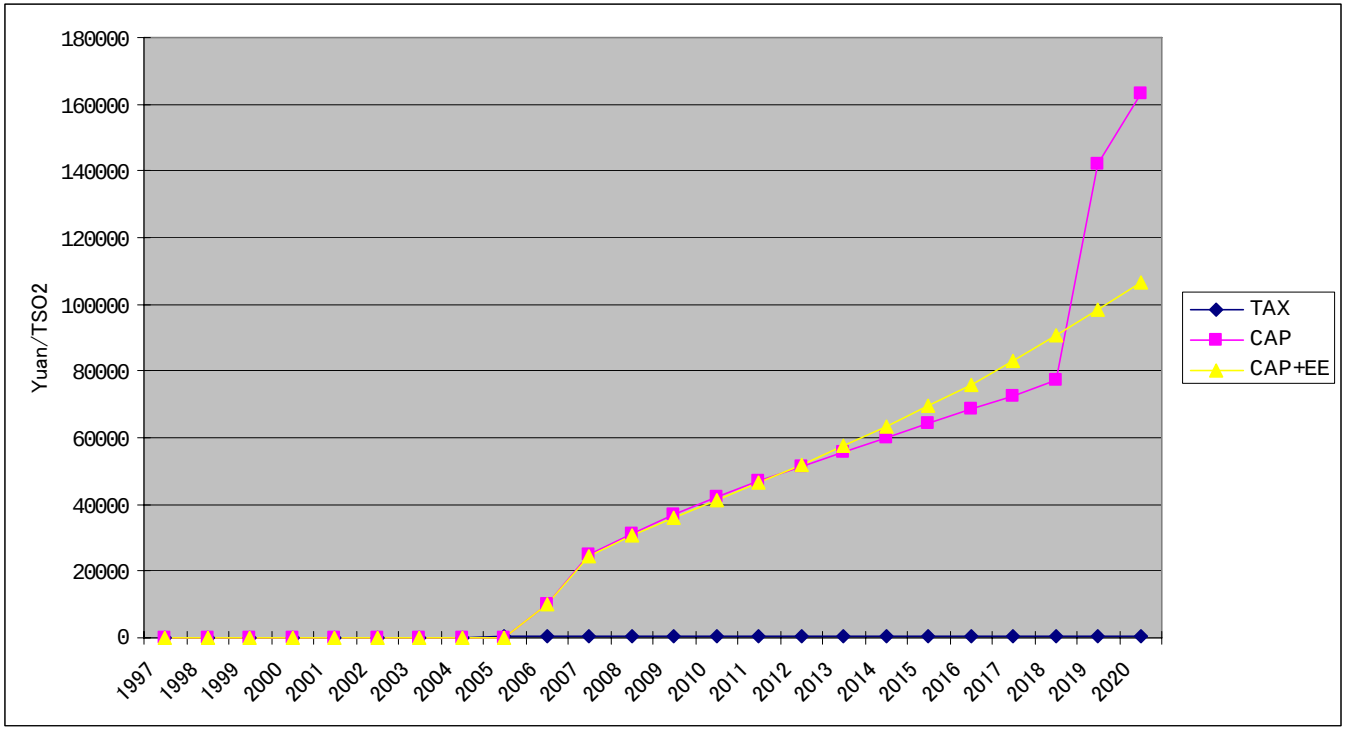


Simulation Results
output of sectors



Simulation Results

SO2 price



Message from simulation

- SO2 emission cap will help to control SO2 emission, but result in a large GDP loss, if there is no other countermeasures introduced;
- Under enhanced energy efficiency improvement, it will be possible to achieve SO2 control goal with high GPD growth rate and huge energy demand;
- Both the shifts within energy sectors and the shift within non-energy sectors can be seen under the strict limitation of SO2 emission;
- The role of SO2 emission tax at present level is very limited to control SO2 emission;
- Local air pollutant emission reduction and ancillary carbon reduction benefit can be achieved after introducing SO2 control policies in China;
- Energy efficiency improvement induced by China's efforts itself is not enough to reduce SO2 emission and also CO2 emission. Hence, international collaboration on knowledge transfer will play a very important role in not only local environment improvement but also global environmental conservation.

Future research(1)

- **Model sustainable development in China**
- Since 1992, sustainable development is set forth as a basic national strategy in China.
- Chinese government have already set a set of policies in the plans, such as cleaner production, energy efficiency improvement, total pollutant control, enlargement of environmental investment, and pollutant fees or taxes.
- Extend the model
  - waste water;
  - Solid waste;
  - Renewable energy;

Future research(2)

- **Link top-down model with bottom-up model**
- AIM/CGE model is a kind of top-town model. In order to simulate the future scenarios, assumptions related to technology advance and social change are required.
- How to link?
  - Complicated link;
  - Soft link

Future research(3)

- **Link AIM/CGE China model with AIM/CGE Japan model;**
- Energy efficiency in China is much lower than that in Japan.
- The transfer of advanced technologies from Japan to China is helpful to improve China's energy efficiency. Japan' economy can also get benefits from this.
- it can be expected that such technology transfer will become more and more in the near future.
- So it is very meaningful to assess the impacts of technology transfer between China and Japan on economic growth of two countries, energy efficiency, local environment, and also CO2 emissions.
- How to link?
- environmental investment;
- FDI

Future research(4)

- **Develop AIM/CGE China local model**
- China is a big country, and there is much difference between regions. Therefore, develop several AIM/CGE local models is necessary and useful.
- AIM/CGE Beijing model has very high priority.
- In Beijing, after winning the bid for 2008 Olympic Game, a large amount of environmental investment (14.1 billion Yuan in 2004)has been introduced to improve the local environment.
- Environmental investment can be taken as the focus in developing AIM/CGE Beijing model.

Thanks for
your attention!