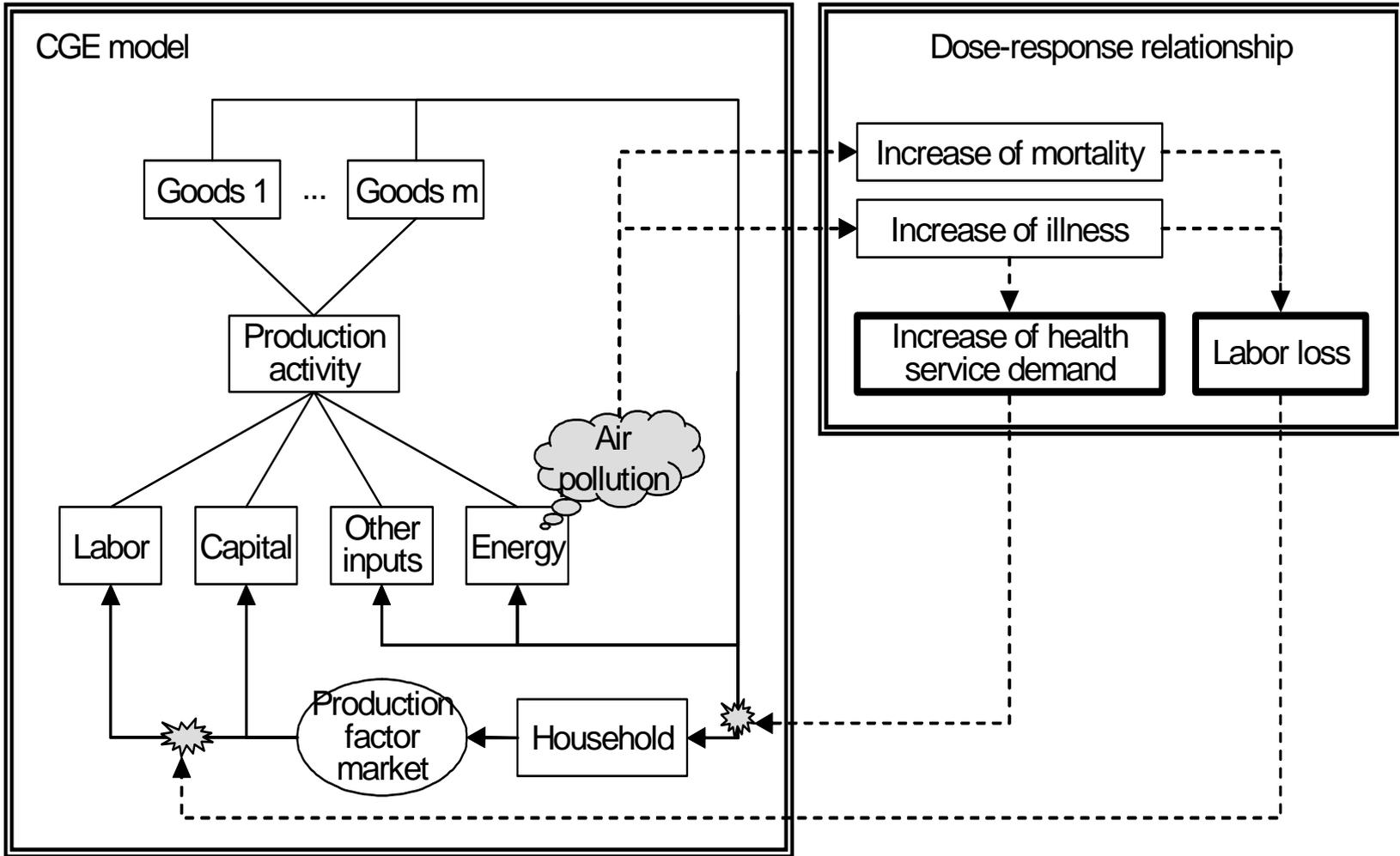# Health Effects of Air pollution and Its Impact on China's Economy

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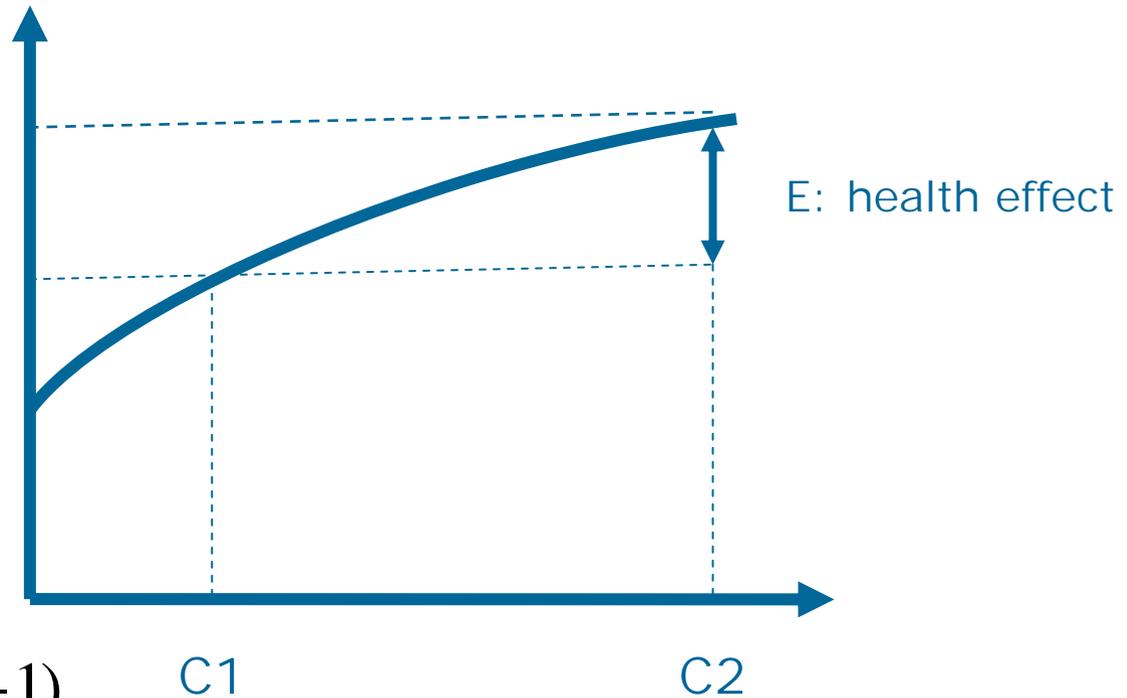
Dose-response relationship

$$\beta = \frac{\ln RR}{C_2 - C_1}$$

: coefficient of D-R

RR: relative risk

E: health effect

C1　　　　　　　　C2

$$E = POP \times M \times (e^{\beta \Delta C} - 1)$$

Coefficients from large scale and long term epidemiological studies are preferable

Meta analysis (mean and 95% CI): Reduce the uncertainties of individual study

The quantifiable health effects associated with PM_{10} exposure

➢ Mortality (all-cause)
➢ Morbidity
--hospital admission
  respiratory, cardiovascular, cerebrovascular
--hospital visit
  pediatrics, internal medicine
--other diseases
  chronic bronchitis
  acute upper respiratory disease

Exposed population of China in 2000

- ➤ China's air quality standard
  - ➤ Outdoor (annual average): 100ug/m^3 → Grade II
  - ➤ Indoor (daily average): 150ug/m^3
- ➤ PM$_{10}$ concentration
  - ➤ Urban areas: 160ug/m^3←Beijing
  - ➤ Rural areas: 596 ug/m^3 ←local studies
- ➤ Exposed population
  - ➤ Urban: 0.29 billion← SEPA
  - ➤ Rural areas: 0.10 billion ←NDRC and local studies

The avoidable cases

Total deaths	294,337 (89804, 491221)	
Labor deaths	88,786 (26588, 149255)	
Hospital admissions	797,037 (516076, 1041412)	
Hospital visits	78,663,418 (61882607, 94678006)	
Chronic bronchitis	2,281,430 (1113152, 2943635)	
AURTI	190,330,712 (0, 253456080)	
Workday loss	125,519,112 (58434858, 155769628)	
Medical expenditure	**3.51 (1.32~4.96) billion Yuan**	*1.22 (0.46~1.72) %*
Labor loss	**588862 (259395, 776486)**	*0.68 (0.30~0.89) ‰*

CGE model: AIM/Material China model

➢ 39 sectors and 32 commodities

➢ Health sector is isolated

➢ Health expenditure is isolated from household final consumption

➢ Household sector is divided into two parts: urban and rural

Setting of Scenarios

- BAU

- Scenario 1: combination impacts on national economic activities from labor loss and medical expenditure

- Scenario 2: impact only from labor loss

- Scenario 3: impact only from medical expenditure

CGE Results

commodities	Scenario 1	Scenario 2	Scenario 3
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.			
.			
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HEL	12.13	-0.47	12.60
Total	-0.63	-0.56	-0.07

Health impacts on final consumption (‰)

CGE results

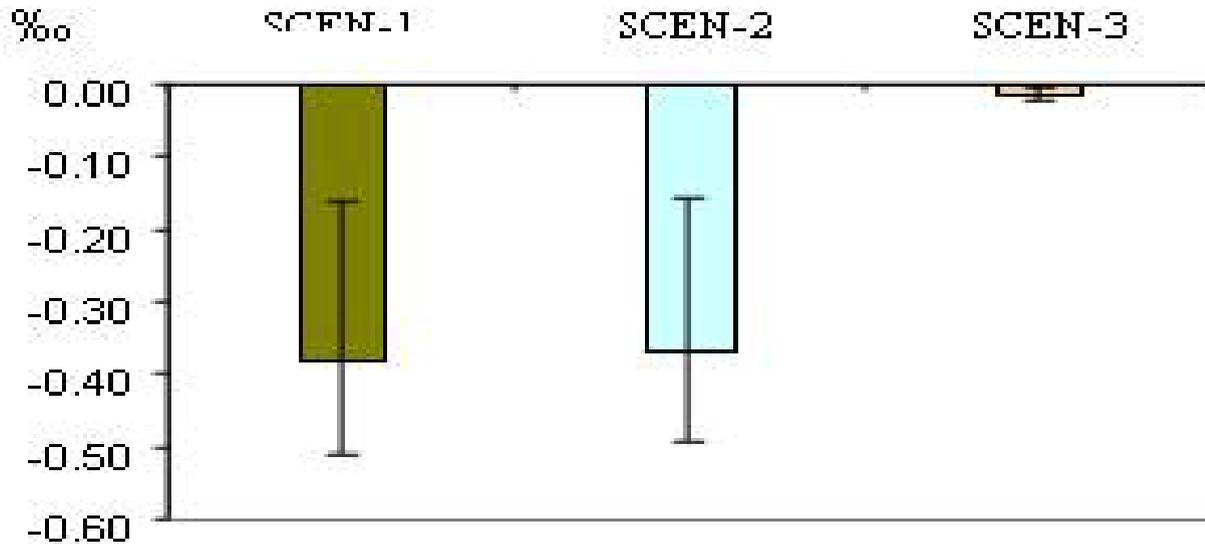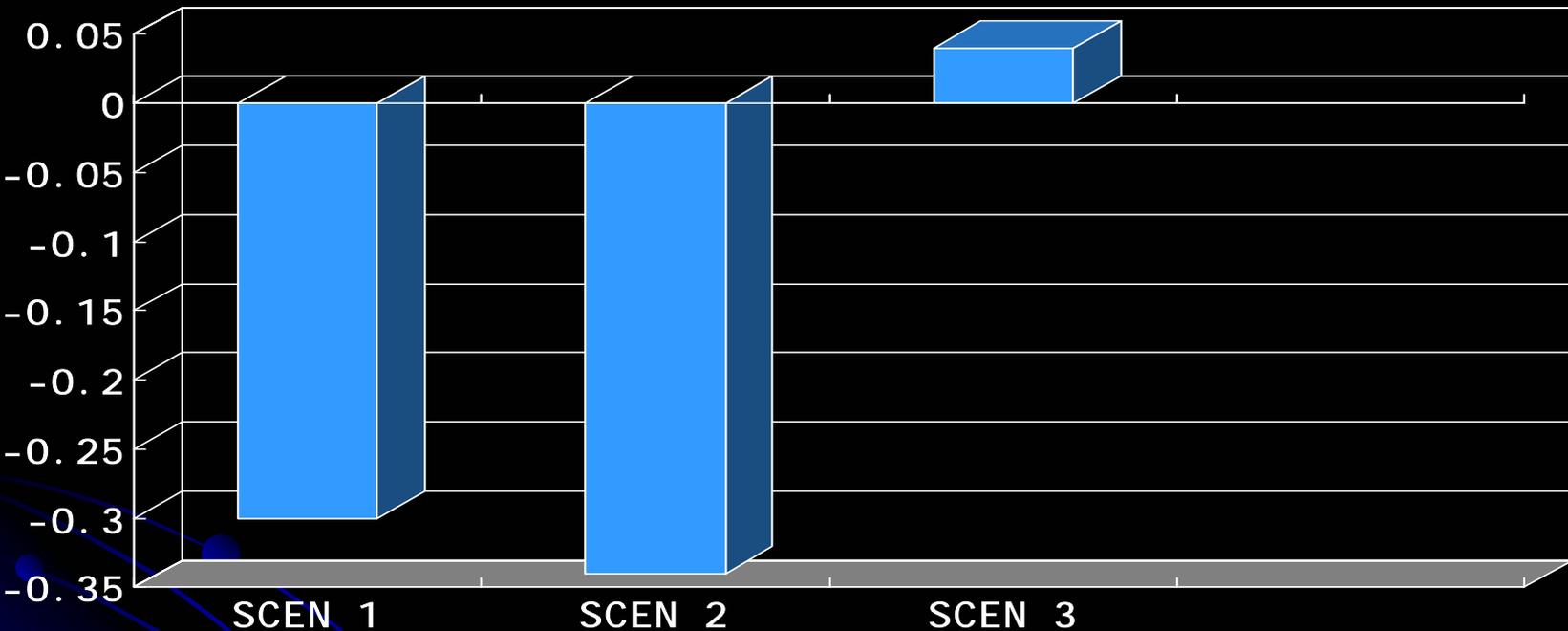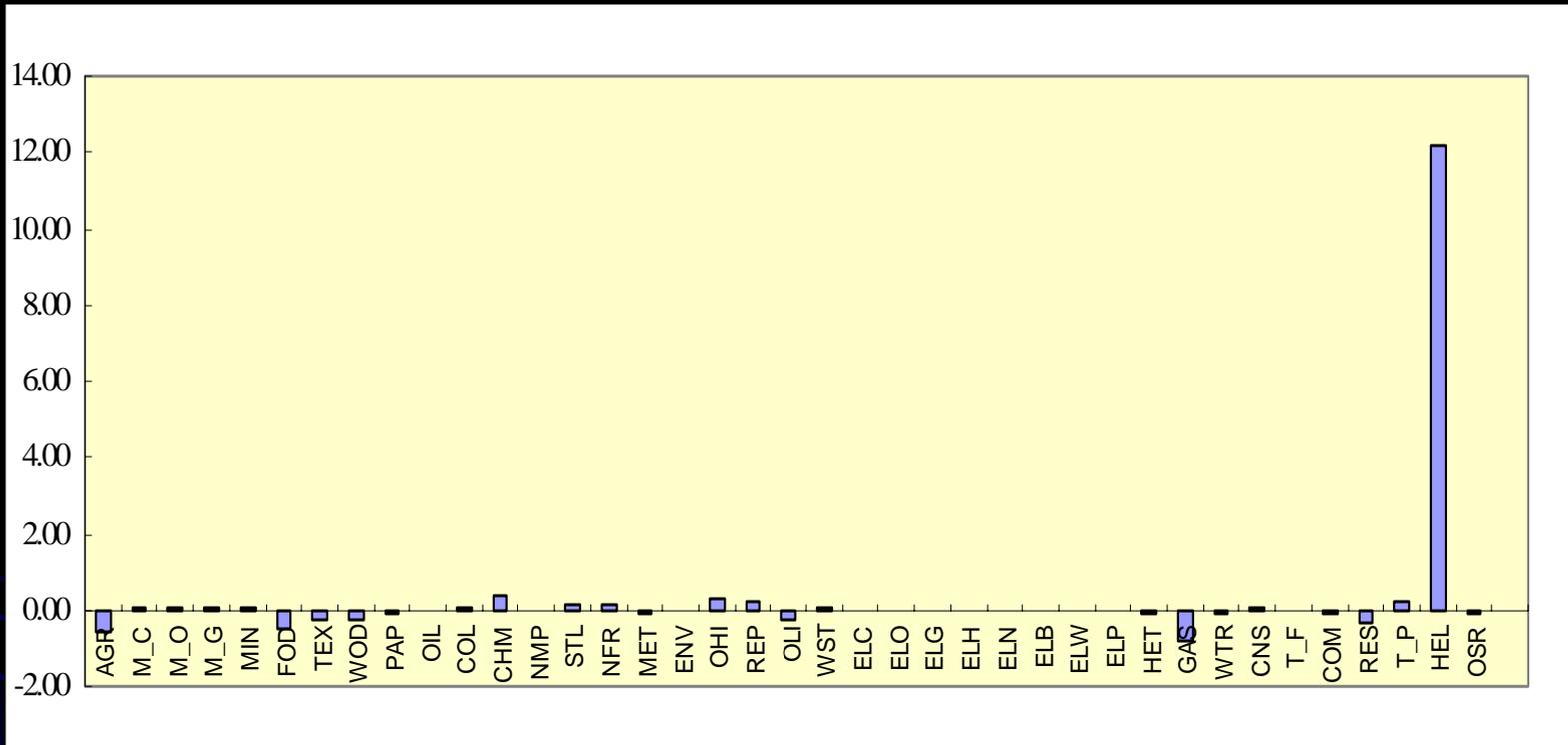Figure 6. Changes of GDP under the different scenarios when comparing with BAU

➢ *Labor loss is dominant in economic impacts from health effects of air pollution in China*

CGE results

Health impacts on total output of production sectors (‰)

CGE results

Impact on output of each production sector from medical expenditure (‰)

Human Capital Approach

	billion Yuan
Medical expenditure	3.51 (1.32, 4.96)
Premature death	5.01 (1.49, 8.25)
Workday loss	2.58 (1.13, 3.41)
Total	11.1 (3.92, 16.5)
Loss/GDP (‰)	*1.24 (0.44, 1.85)*

Approach comparison

	HCA	CGE
Economic loss	1.24‰ (0.44~1.85‰) of GDP	0.38‰ (0.16~0.51‰) of GDP
Time horizon for labour loss	Future	Only the target year
Calculation for labour loss	Average income level	Actual number
Health demand	Negative impact	Synthetic assessment

Major findings

- Economic loss from health effects: a tricky term
  - CGE approach$\rightarrow$ impact on national economy
  - Human capital approach$\rightarrow$ economic burden of disease
- Under the same condition (achieve national air quality standard)
  - CGE approach: 0.38‰ (0.16~0.51‰)$\rightarrow$avoidable GDP loss
  - HCA: 1.24‰ (0.44~1.85‰) $\rightarrow$avoidable economic burden of disease
- Health effects of air pollution do harm to both the national economy and people's living conditions$\rightarrow$ both the government and individuals should take actions to fight against air pollution.

Future research

➢ Expected results
  ➢ *Improve the impact assessment of environmental policies on national economy* by adding the consideration of health impacts
➢ From static analysis to dynamic analysis
  ➢ Support policy making process
➢ Soft linkage to air diffusion model
  ➢ concentration ⬅➡ exposed population
➢ Design of scenarios:
  ➢ Policy scenario

Thank you!