

## PERTURBATION ANALYSIS OF INPUT-OUTPUT COEFFICIENTS ON ECONOMIC MODULE IN THE MRICE-E MODEL

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**Abstract.** MRICE-E model is a new integrated assessment model (IAM) applied on evaluating climate change and the loss of economic welfare. Its economic module for China adopts a dynamic, nonlinear and multi-sectional CGE model. In this paper, we are concerned with the effects of perturbations in input-output coefficients in the CGE model. In the analytical framework, some concepts such as the Lyapunov exponent and the condition number from dynamic system and numerical linear algebra are employed to measure the errors brought by perturbations of the I-O coefficients. We finally derive the upper bound estimation of errors growth through time. To reduce the effects of the possible perturbations, some suggestions about categorization of the industrial sectors are given in the end.

**Key words.** climate change, IAM, CGE model, input-output analysis, dynamic system, Lyapunov exponent.

### 1. Introduction

Multi-factor Regional Integrated Model of Climate and Economy System Equilibrium (MRICE-E) model established by [18] is one of IAMs to evaluate interaction between the climate change and the economic system. There are two mainlines of IAM researches, one kind of which is the programming models represented by DICE and RICE (see [22] and [23]). The other kind is the computable general equilibrium (CGE) models. MRICE-E model integrates these two kinds of models, absorbing their respective advantages. It can reveal the impact of climate change on economy as DICE and RICE models. In the meantime, it can allow great details of sectoral disaggregation as CGE models can. Also, it is an extension of MRICES system by [21], reflecting the idea of equilibrium.

MRICE-E model has four interactive systems: the climate system, the economic system, GDP spillover mechanism system and the policy adjustment system as showed in Figure 1. The economic system is the center part of the model and interacts with the other three systems.

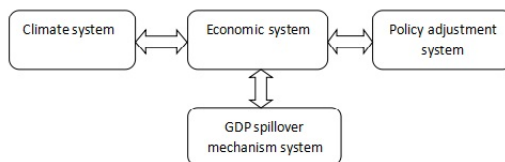


FIGURE 1. The framework of MRICE-E model.

The model divides the world into eight regions: China, the US, Japan, the European Union (EU), the high-developing countries, the medium-developing countries, the low-developing countries and the developed countries. Each region has its own economic system and shares the global climate system. The climate change is added into the economic system as a factor in production function. The emission mitigation strategies can change the climate in return as investment activities in economy. Consequently, the economic system and climate system are re-integrated in the MRICE-E model as showed in Figure 2.

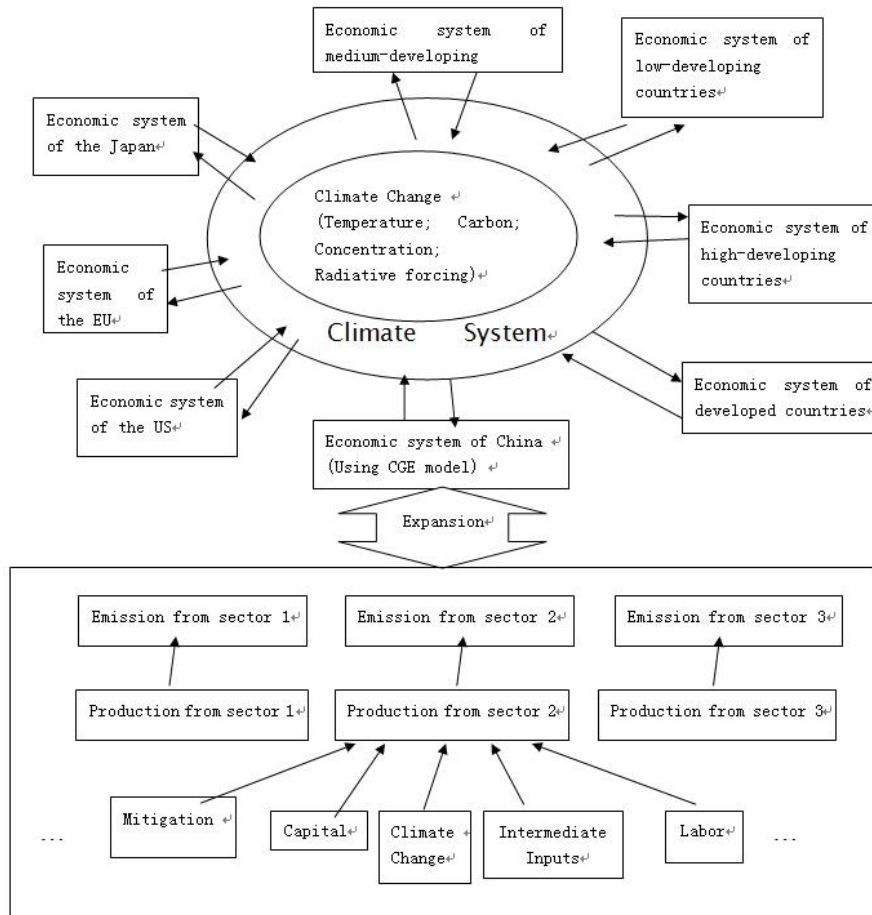


FIGURE 2. The static structure of economic and climate systems in MRICE-E model.

While macroeconomic model is used in other regions in the world, the dynamic CGE model is used to describe the economic activities in China. Usually, a CGE model consists dozens of equations in order to describe the details of the sectoral variables. Accordingly, there are hundreds of parameters consistent with the equations. It is a well-recognized issue that these parameters may diverge from the real values. In this paper, we focus on the perturbations in one kind of very important parameters: input-output coefficients. They represent the transactions among the different industrial sectors. Their perturbations may stem from technological