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## Path choice of developing bio-energy while keeping food security ---A general equilibrium model

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### Abstract

This paper focused on a discussion whether developing bio-energy will threaten food security in China. It constructed a general equilibrium analysis model based on demand-supply theory. The model contains two types of bio-energy resources and different factors influencing crops demand and supply. The model took price as endogenous variable. Under different conditions, the paper studied how the exogenous variables influence the equilibrium. The model also includes a bio-energy production function to interpret the different responds of the bio-energy supply with the change of exogenous variables. Two constraint conditions and four results simulated the real bio-energy development. Using pure economics method rather than the gimcrack econometrics method is an innovation on applied energy economics study, and it is thought to make a slight contribution to the new energy industrial development model. Building a dynamic stochastic general equilibrium (DSGE) model to solve the problems that were not solved in this paper is the work going on next.

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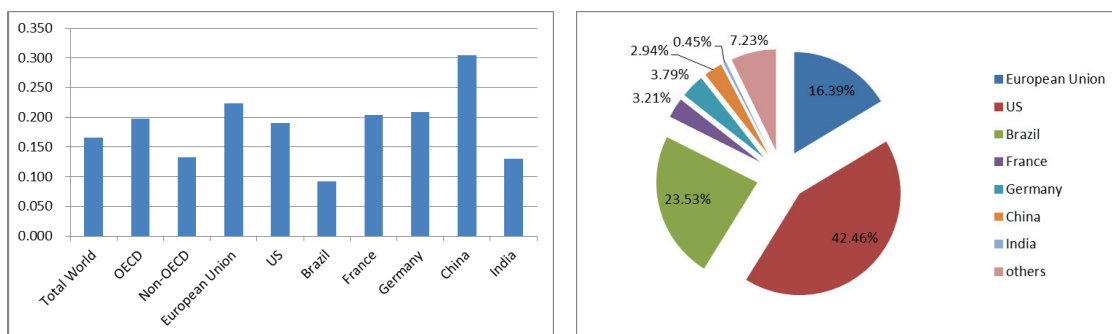
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**Keywords:** Bio-energy; Food Security; Demand-Supply Model; Equilibrium Analysis

### 1. Introduction

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With the fast development of world economy, the massive energy demand increases every year. The world is faced with severe traditional fossil fuel constraint. Searching alternatives to fossil fuels becomes much important. What's more, with the deterioration of environment, it is urgent to look for clean energy. Bio-energy is selected as one of the ideal substitution for it has so many good characteristics such as reproducibility, less CO<sub>2</sub> emissions, almost no emissions of SO<sub>2</sub>, widely distributed, various user forms, a huge number of reserves, which makes many countries, especially the major energy consumption ones, pay much positive attention on promoting the development of bio-energy. It indeed develops rapidly around the world which has been the forth energy already. On above, to keep the scale of domestic energy supply safe and to keep energy consumption structure clean, each country takes a lot of measures to develop the bio-energy. Figure 1(a) shows the world's bio-energy developing rate from 2002 to 2014<sup>†</sup>. That average rate of world bio-energy growth is 16.6%. Among the major bio-energy countries, the annual growth rates are all higher than the world's average level, which are 21%, 22.4%, 19.8%, and 19.1% respectively. China has the highest growth rate of the bio-energy. Figure 1(b) depicts the distribution of bio-energy in the world. Bio-energy develops to be more and more concentrated, which several main bio-energy production countries occupy the most of the share proportion. Actually, in 2014, America and Brazil both produce nearly 70% of the whole world bio-energy. Though it grows fast, China only makes up a moderate proportion of 2.94%.



(a) The average growth rate of bio-energy production, year 2002-2014(%)

(b) The share of bio-energy production among the total world, in 2014(%)

Figure 1 Development of Bio-energy in the world

In fact, China didn't develop bio-energy before the 21st century. Only in the national Eleventh-five year, the government begins to attach importance to bio-energy. Here come a lot of problems in practical. Rapid expansion of bio-energy leads food price soaring because most of raw materials derive from the crops which makes a competition between energy crops and food crops. Although bio-energy contributes to energy supply and energy security, China's National Development and Reform Commission still issued an emergency notice to halt some domestic new corn fuel ethanol projects on Dec.18, 2006 by considering the food security problem. In domestic, China's bio-energy industry develops not so quickly these years.

<sup>†</sup> According to the BP2012 statistics that China biomass energy production is 4 units in 2001, while this number is to 146 units in 2002. So, in order to maintain overall data smoothly, this paper calculates the average speed of 2002-2014.

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