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Comparing climate policies to reduce carbon emissions in China

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HIGHLIGHTS

- We develop a static general equilibrium model to simulate the impacts of climate policies.
- We compare the potential impacts of various climate policies in China.
- We discuss how to design these policies to make them more effective.

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ABSTRACT

Currently, China is the largest carbon emitter mainly due to growing consumption of fossil fuels. In 2009, the Chinese government committed itself to reducing domestic carbon emissions per unit of GDP by 40–45% by 2020 compared to 2005 levels. Therefore, it is a top priority for the Chinese government to adopt efficient policy instruments to reduce its carbon intensity. Against this background, this paper develops a general equilibrium model and seeks to provide empirical contributions by comparing the potential impacts of several different policy options to reduce China's carbon emissions. The main findings are as follows. Firstly, these climate policies would affect the structure of economy and contribute to carbon emissions reduction and carbon intensity reduction. Secondly, there would be significant differences in the economic and environmental effects among different climate policies and hence, the government would trade-off among different economic objectives to overcome any potential resistances. Thirdly, there would be considerable differences in the emissions effects of absolute and intensity-based carbon emissions controls, implying that the government might adopt different climate policies for absolute or intensity-based carbon emissions controls. Looking ahead, the government should trade-off among different objectives when designing climate reforms.

1. Introduction

As the largest carbon emitter, China would have to face the challenge of carbon emissions reduction. Climate change and global warming are highly related to human survival and development and hence capture more global and more attention. Against such backgrounds, there would be increasing clamor for carbon emissions reduction globally. At present, China is the largest carbon emitter in the world with large annual incremental carbon emissions. Therefore, China would have to face intense international pressures to control its domestic carbon emissions. In 2009, the Chinese government committed itself to reducing domestic carbon emissions per unit of GDP by 40–45% by 2020 compared to the 2005 levels. Therefore, it is a top priority for the Chinese government to adopt efficient policy instruments to reduce its carbon intensity.

However, the Chinese government might not be well prepared for how to reduce its carbon intensity. China is a large developing economy and it is an unprecedented challenge for a developing country to reduce its carbon emissions when it is still in the process of urbanization and industrialization. In 2010, some local authorities adopted power rationing in order to fulfill the targets of energy conservation and carbon emissions reduction of the 11th Five-Year Plan. Many argued that these local authorities should not adopt power rationing since it would result in significant distorting effects to the economy. To adopt power rationing indicated that these local governments might not get prepared for how to fulfill the commitment of carbon intensity reduction. In this paper, we would compare the potential impacts of different climate policies, which might be a good help to policy-makers.

A number of papers evaluate the impacts of climate policies and CGE (computable general equilibrium) models are frequently

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used to estimate the potential impacts of climate policies. Goulder (1995) simulates the effects of carbon taxes with pre-existing taxes through an inter-temporal dynamic CGE model in the United States. Gottinger (1998) uses CGE model to simulate the impacts of some unilateral and multilateral policy instruments to curb carbon emissions in EU. Fisher-Vanden and Ho (2007) consider whether reforms in capital market of China will affect effects of carbon tax and argue that tax-interaction effect would result in smaller carbon emissions reduction in a subsidized economy. Li and Zhang (2012) compare the regional effects of carbon motivated border tax adjustments and carbon tax, wherein these policies would achieve the same level of carbon emissions reduction. Meanwhile, there are other papers assessing the impacts of climate policies, such as Bye (2000), Kemfert and Welsch (2000), Wendner (2001), Zhang and Baranzini (2004), Lu et al. (2010) and Wang et al. (2011).

Many papers evaluate the scale of energy subsidy and the corresponding economic and environmental implications. Some papers discuss the size of energy subsidies, such as Myers and Kent (2001), UNEP and IEA (2002), Riedy and Diesendorf (2003) and Vedenov and Wetzstein (2008). Some studies evaluate the economic and environmental implications of subsidy removal. Anderson and McKibbin (1997) simulate the impacts of coal subsidy removal on carbon emissions. OECD (2005) argues that coal subsidy removal in OECD countries would not be necessary to reduce the overall carbon emissions. Lin and Jiang (2011) estimate the scale of energy subsidy and implications of subsidy removal in China. Also, there are some other papers that evaluate the impacts of subsidy removal, such as Burniaux et al. (1992), IEA (1999, 2006, 2008, 2009a, and 2010), Saunders and Schneider (2000), Global Subsidies Initiative (2009), Burniaux et al. (2009), Burniaux and Chanteau (2010) and Lin and Li (2012).

There are some papers discussing VAT (value-added tax). Whalley and Wang (2007) argue that VAT would not necessarily produce distorting effect and impose welfare costs in the framework of fixed exchange rates, non-accommodative monetary policy and endogenous trade deficits in China. Lin (2008) simulates the potential impacts of VAT reform in China. Kind et al. (2008) explore the efficient provision of goods and argues that imposing negative VAT may reduce output levels. Keen and Lockwood (2010) investigate the causes and consequences of VAT.

Currently, it is a top priority for the Chinese government to reduce its carbon intensity. In this paper, we develop a general equilibrium model and seek to provide empirical contributions by comparing the potential impacts of 8 different climate policies. The rest of this paper is organized as follows. In Section 2, we present some features of China's economy. In Section 3, we introduce the model and data. In Section 4, we report the model-based simulation results. In Section 5, we present the concluding remarks.

2. Features of China's economy

In this section, we present an overview of some important relevant backgrounds of China's economy.

Firstly, China is a large transitional economy with rapid economic growth and it is still in the process of industrialization. In 1978, the Chinese government adopted the reform and opening-up policy and consequently there have been rapid economic growth in China. According to National Bureau of Statistics of China (2012), China's GDP in 2010 reached 40151.28 billion RMB (Renmenbi, or CNY, China's currency) and was about 20.5 times of that of 1978, wherein CPI was adopted to consider pricing factors. Likewise, there have been significant changes in the structure of China's economy, which was illustrated in Fig. 1. Due to

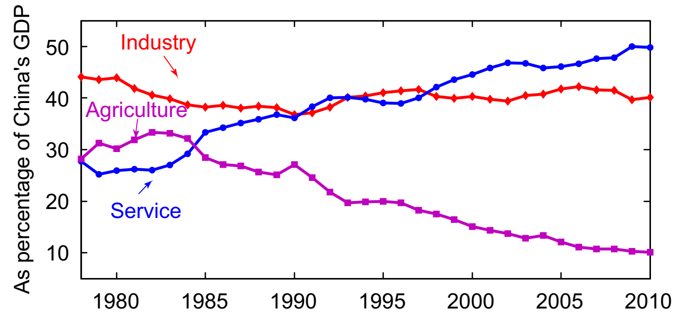

Fig. 1. The structure of China's economy. *Note*: The data of fishery and forestry are grouped into agriculture, the data of mining are grouped into industry, and the data of construction sector are incorporated into the data of service. .
Sources: CECI China Database and National Bureau of Statistics of China (2012)

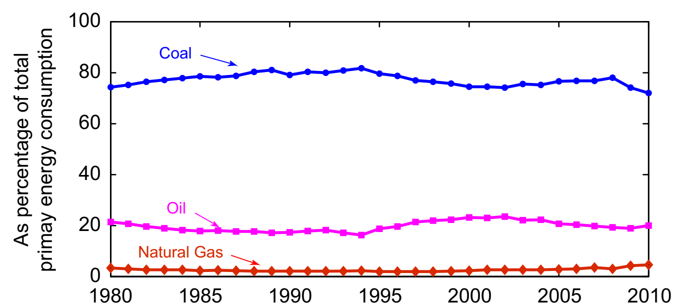

Fig. 2. Energy consumption mix in China. .
Sources: CECI China Database and National Bureau of Statistics of China (2012)

industrialization and urbanization, there was a significant fall in the share of agriculture in terms of overall GDP, from 28.2% in 1978 to 10.1% in 2010. At the same time, there was a marked increase in the share of service in terms of overall GDP, from 27.7% in 1978 to 49.8% in 2010. At the same time, there was not a clear upward or downward trend in the share of industry in terms of overall GDP, which remained around 40% during these periods. Therefore, industry played an important role in the economy, implying that China was still in the process of industrialization.

Secondly, China has experienced rapid increase in energy consumption with coal-dominated energy mix and consequently there have been rapid increase in China's carbon emissions. Due to rapid economic growth, China's energy consumption increased rapidly. According to National Bureau of Statistics of China (2012), China's total primary energy consumption reached 3249 Mtce in 2010, which was about 5.7 times of that in 1978. In particular, industry was the most important energy consumer, wherein about 71% of energy was consumed in industry in 2009.

China's energy mix remained coal-dominated. From 1978 to 2010, coal remained the most important primary energy in China and accounted for around 70% in terms of China's total primary energy consumption. (See Fig. 2) In particular, industry was the most important coal consumer. In 2009, about 94.6% of coal was consumed in industry, wherein about 48.7% of coal was used to generate electricity.

Due to the rapid growth in fossil fuel consumption and coal-dominated energy mix, China's domestic carbon emissions increased rapidly. Currently, China is the largest carbon dioxide emitter. Further, there was a rapid increase in the share of China's carbon emissions over the world's total, from 12.9% in 2000 to 23.6% in 2009. (See Fig. 3) These data imply that China contributed significantly to the increase of the world's total carbon emissions. Due to industrialization and urbanization, it is expected that China's carbon emissions would continue to grow at a high rate.