



Environmental pollution emissions, regional productivity growth and ecological economic development in China



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ABSTRACT

Environmental pollution emissions have become an extremely serious problem in China that makes its rapid economic growth unsustainable. This paper estimates the energy and emission adjusted total factor productivity (TFP) and reveals the ecological economic transition by province in the light of their contributions to output. The results indicate that China's ecological development fluctuated before 1992, then turned to improve, and peaked between 1999 and 2002. Due to the reappearance of heavy industrialization, China's ecological development process has reversed course since the beginning of this century.

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1. Introduction

Against the background of the international economic crisis, the transition of existing economic growth models has become imperative for many countries seeking to promote economic recovery and sustainable development in the long-run. Due to the depletion of resources, rising energy prices, environmental pollution and climate change, ecological economic development is an important concern for economic policy makers, especially in China. Beginning in the 1990s, China has emphasized energy and environmental conservation, but its economic growth continues to entail resource waste and pollution emission due to the emphasis on GDP growth as the main objective of local governments. For instance, China's gross output rose from 2.6 trillion RMB in 1980 to 124.5 in 2012 with an annual growth rate of 12.9%. About 600 million tons of coal equivalent (tce) of energy was consumed in 1980 and 4554 was consumed in 2012, the most for any country. As shown in Fig. 1, in the meantime, 34.3 billion tons of waste water and 7.4 trillion m³ of polluting gasses were emitted in 1986, and these levels reached 68.5 and 63.6 respectively in 2012, growing annually by 2.6% and 8.3%. As the major components of waste water and gas, chemical oxygen demand (COD) and sulfur dioxide (SO₂) increased from 1403 and 1966 tons in 2000 to a peak of 1427 and 2586 in 2006 and fell to 1159 and 2127 in 2012. Obviously, with rapid economic growth and the reappearance of heavy industrialization in the first decade of this century, the need for ecological development and sustainable transition became inevitable in China beginning with the period of the 12th Five-Year Plan. It also is a major issue that confronts the new leadership of Xi Jinping and Li Keqiang who seek to update China's economic structure and lead it into the ranks of high-income countries in 2020.

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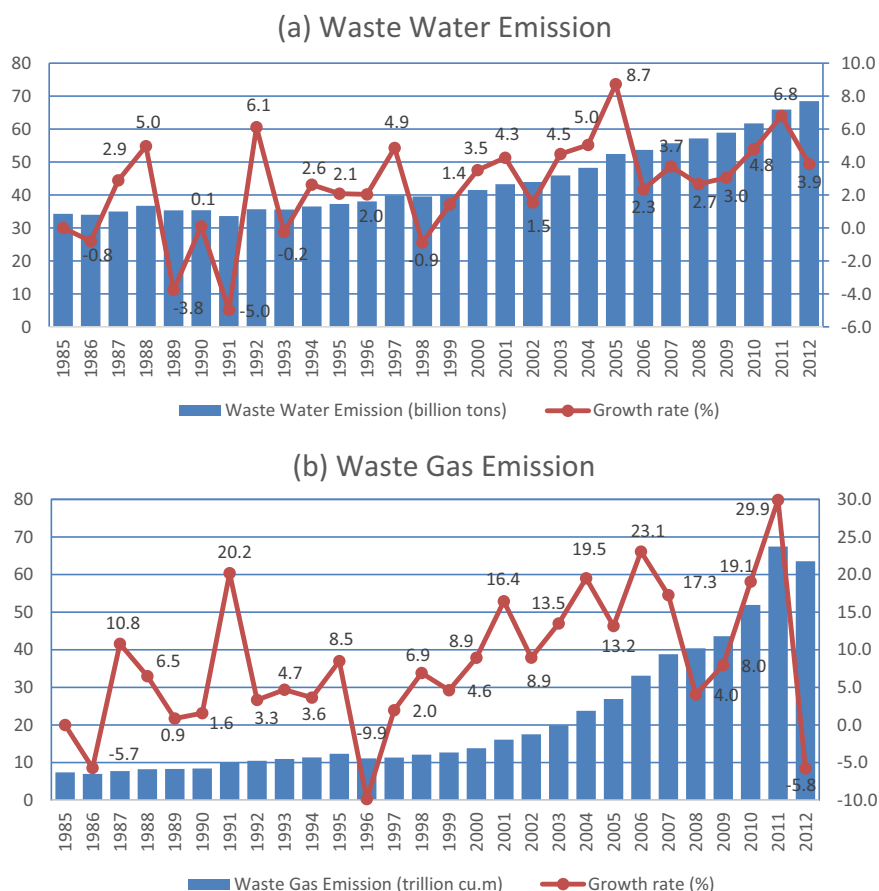


Fig. 1. Emissions of waste water and waste gas in China since 1985.
Source: China Environmental Yearbook, 2013.

An appropriate measure of energy and environmental constraint actual total factor productivity (TFP) and the degree of ecological development is essential for assessing whether the Chinese government stands any chance of succeeding in their latest reform endeavor. However, in the existing literature, many studies focus on the measure of TFP without the consideration of energy consumption and pollution emissions and, not surprisingly, there are very few studies theoretically and empirically on the topic of ecological economic development. The structure of the rest of the paper is organized as follows. [Section 2](#) surveys the literature and discusses the choice of appropriate methodology to introduce energy and emission into the analysis of ecological economic transition. [Section 3](#) introduces the principle of the selected slacks based measure (SBM) approach under the data envelopment analysis (DEA) framework, in which the pollution emissions are appropriately treated as the undesirable outputs. [Section 4](#) describes the database used in this study. In [Sections 5 and 6](#), the estimated actual TFP growth and the ecological development evaluation are discussed in detail. [Section 7](#) concludes the paper.

2. Literature survey

The idea of an ecological economy or green growth came originally from the concept of sustainable development that was officially accepted by the United Nations Environmental and Development Committee in 1987. The definitions of ecological economy development are many but, obviously, they cannot ignore the dimension of energy and environment. However, its definition is still not conclusive now. Because ecological development has become the important way for many countries to recover the economy from the current financial crises, the urgent work is to investigate how to transform the economic growth model from extensive to ecological and intensive in nature and provide the local governments the appropriate and convenient index to evaluate the ecological development process. This is what we attempt to do in the study.

The first task is to choose the appropriate theoretical framework for analyzing ecological development. In this paper I use growth accounting to analyze the economic development, in which, the total factor productivity (TFP) is measured to quantify the growth quality and its contribution to the output growth, as compared to the factors quantitative contribution to the output, could be employed as the index to evaluate whether the economic development is sustainable or not. [Wu \(1995, 2011\)](#) once discussed and surveyed the estimates of TFP growth in China. The analysis of ecological economic development in this paper will also follow the general economic framework and choose the same evaluation index but, different from this, it would include ecological dimensions such

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