



# Panel estimation for income inequality and CO<sub>2</sub> emissions: A regional analysis in China



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## HIGHLIGHTS

- We investigated the impact of income and its inequality on China's CO<sub>2</sub> emissions.
- Income growth increases China's CO<sub>2</sub> emissions.
- The effects of income growth on CO<sub>2</sub> emissions vary across regions.
- Income inequality impacts on CO<sub>2</sub> emissions in Eastern and Western regions.

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## ABSTRACT

With rapid economic growth, China is facing tremendous pressures of emission–reduction and serious income inequality issues. The existing research is concerned with the relationships between income inequality and CO<sub>2</sub> emissions in recent years, but little attention has been paid to the regional differences in China. This paper investigated the impact of income and its inequality on CO<sub>2</sub> emissions at the national and regional levels using the panel data from 1995 to 2010 in China. The empirical results show that income growth increases China's CO<sub>2</sub> emissions. The effects of income growth on CO<sub>2</sub> emissions vary across regions. Further, the impact of income inequality on CO<sub>2</sub> emissions in the Eastern region is greater than that in the Western region. This research reveals that a more equitable income distribution may help control CO<sub>2</sub> emissions in developing China, and there is a win–win situation of income redistribution and emission–reduction. Our findings merit particular attention from policy makers in China.

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## 1. Introduction

China has undergone rapid economic growth since the 1980s, and has passed Japan to become the world's second-largest economy. However, with rapid economic growth, China is facing serious challenges of massive carbon emissions; its emissions increased from 0.671 billion metric tons in 1995 to 2.248 billion metric tons in 2010, and will increase to 10.300 billion metric tons by 2035 [2]. The massive carbon emissions have not only caused ecological deterioration, a serious threat to sustainable development, but also brought tremendous international pressures of emission–reduction [13].

Meanwhile, China is also facing serious income inequality issues. The Gini coefficient, a rich–poor index, reached 0.47 in China in 2012, higher than the warning level of 0.40 set by the United Nations [43]. Although income inequality is a common phenomenon in the process of rapid economic growth, fairer income

distribution is a fundamental move to safeguard equity and justice as well as social stability and harmony. If the income gap continues to widen, it will become conducive to internal contradictions and social instability.

As an inherent requirement of “building a harmonious society”, China needs to develop an economy with emission–reduction strategy, and to solve the problems of equity and efficiency in order to prevent the country from stepping into the “middle-income trap”. These issues have drawn nationwide attention in China. In the Outline of the 12th Five-Year Plan, China aims to reduce CO<sub>2</sub> emissions per unit of GDP by 17% compared with the 2010 level. Income distribution reform was eventually introduced in February 5, 2013 after a ten year investigation process that started in 2004. Increased attention to policy has provided renewed stimulus to investigating nexus between income disparity and emission–reduction in China.

In the existing literature, the relationships between income inequality and CO<sub>2</sub> emissions have been discussed [23,18,12]. Some scholars hold the view that income inequality is detrimental to carbon reduction efforts, while others maintain the effect is uncertain and time-varying. A consensus has not been reached in

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academic circles. Furthermore, China has vast territory and large regional differences, but little of the existing research is carried out with consideration for regional differences in China [15].

Our study investigated the relationship between income inequality and CO<sub>2</sub> emissions in China by whole and regional analyses based on the theoretical framework of Environmental Kuznets Curve (EKC), with a panel data covering 28 provinces in China over the period 1995–2010. Considering regional differences in China, we divided the provincial database into three subsamples: the Eastern region, the Central region and the Western region. This paper aims to investigate whether the relationship between income inequality and CO<sub>2</sub> emissions differs across regions, and whether income redistribution goes hand in hand with emission-reduction in China. Our research merits particular attention from policy makers in China.

## 2. Literature review

The EKC hypothesis plays an important role in analyzing the environmental consequences of economic development. The theory illustrates an inverted-U shaped relationship between income growth and environmental quality. A common consensus is that environmental quality would deteriorate with income growth, and improve when income level rises to a certain degree, and the process of economy growth itself will solve any environmental problems caused in the earlier stages of development [20]. Environmental quality is specified as a function of income growth by a simple reduced-form model [33]. Further studies recognized that the development of aggregate pollution depends not only on the income growth, but also on income distribution. Coondoo and Dinda [7] introduced the factors of income distribution other than income growth to be an important determinant in EKC.

Some scholars are convinced that an imbalanced income distribution is detrimental to the improvement of environmental quality. The pioneering study was published by Boyce [5] who argued that the greater inequalities of power and wealth lead to more environmental degradation resulting from an unequal income distribution. Joan [17] also concluded that the imbalance of income distribution harms the improvement of environmental quality. Later, Torras and Boyce [37] and Magnani [24] introduced the public good choice approach to explain how the income inequality affects society's environmental quality demand, and Marsiliani and Renstrom [25] conducted a similar study through the go-between theory, since the demand of the environment-goods is more flexible, the relative increased go-betweens with high level of income will consume more environment-friendly goods. Gawande et al. [11] adopted the *GINI* coefficient to measure the gap in income distribution and confirmed that a greater gap in income inequality would deteriorate environmental quality. Others maintain that the effect of income inequality upon environmental quality is uncertain. Scruggs [32] questioned the assertions of Boyce [5], and concluded that income distribution has nothing to do with environmental policy and the relation between income inequality and environment quality should be reversed when the income per capita reaches a certain level. Ravallion et al. [31] detected a reciprocal relationship between income inequality and environmental quality and the relation would be weakened over the long-term. In addition, Heerink et al. [14] draw the conclusion that the imbalance in income distribution does help improve the environmental quality.

With expansion of income gap and deterioration of environmental quality, research related to China has attracted widespread concerns in recent years. Lu and Lo [23] analyzed China's economic-environmental disparities using the method of Data Envelopment Analysis, and found that the coastal regions perform on



Fig. 1. The map of China showing the three regions.

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