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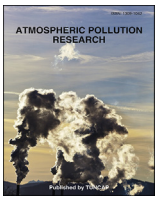

Impacts of urbanization-related factors on CO_2 emissions: Evidence from China's three regions with varied urbanization levels

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ABSTRACT

With the development of the economy, China is undergoing a phase of swift urbanization since 1980s. However, the CO_2 emissions are skyrocketing as a byproduct. Although there are plenty of researches focused on China's CO_2 emission, only a few are interested in regional disparity, especially in the difference caused by the variation of urbanization development phases. In this paper, we divided China's 30 provincial-level administrative units into three parts based on the urbanization level. Then a STIRPAT model innovatively modified with a view of the urbanization is applied to get a deeper understand for the impact of the urbanization-related factors on CO_2 emissions in varied regions. The analysis shows that the urbanization rate of the population decreases the per capita CO_2 emissions in the urbanized region but has a positive impact in other two regions and the national level. In the industry structure's part, the share of the secondary industry in the economy has a positive relationship with the CO_2 emissions while the share of the tertiary industry has a negative impact on the CO_2 emissions. Furthermore, the improvement of the life standard measured by the dropping Engel coefficient and the surge of the private vehicle ownership increase the CO_2 emissions significantly. However, the improvement of the technology increase the CO_2 emissions in all the models except the under urbanized one. Based on the results and discussions on the disparity of different parts of China, policymakers can get some scientifically rational suggestions to reduce the CO_2 emissions.

1. Introduction

Over the last decades, China has undergone a period of skyrocketing economy development along with a faster and faster pace of urbanization transformation. Driven by China's economy growth, the climbing demand for the fossil fuel made China consumed the largest amount of energy in 2010 and emitted most CO_2 in 2007 (Chang, 2010). It was estimated that China's primary CO_2 emissions would reach 31% of all the CO_2 emissions caused by human activities in the world (International Energy Agency, 2012). It is urgent for China to find out a way to improve the efficiency of economy development as well as the urbanization transformation. To meet the promises in the Paris Agreement, the Chinese government confronted with new challenges to peak its CO_2 emissions in 2030 and cut CO_2 emissions per unit of GDP by a notable margin by 2020 from the 2005 level, say, 50%–60%.

Besides, for the broadness of the area and the complexity of the culture difference among people living in different parts of the country, different parts of China are at different phases of economy development and varied stages of urbanization. Because of the restrictions imposed on population flow by the government before the policy of reform and opening up in China initiated in 1978, the country's rural and urban areas had been long isolated and made two different worlds. That had caused the problem of extremely low working efficiency in rural area at a backward stage as well as the cities lacking the fundamental construction and workforces to specialize the division of labor. After the restrictions imposed on population flow released, China has seen the greatest human migration within 3 decades, which helps to make a miracle of economy with the average growth rate per annum of the GDP more than 10%. However, coming with the taking-off economy is the even bigger gap between the fast developing city area and the rural parts far behind, which again offered the driving force of the migration of

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population. China is now thinking about balancing the development gap existing between varied parts as part of its economic New Normal plan.

Based on the analysis given above and considering that the studies dealing with China used to focus on either the national level or one single province, we have made the plan to understand the differences deeper between the urbanization experienced by varied parts of China with the method of Factor Analysis. Besides, we will employ the STIRPAT (Stochastic Impacts by Regression on Population, Affluence and Technology) model to examine the impact of the systematic urbanization factors on energy-related CO_2 emissions at both the national level and regional levels. However, the previous studies using the STIRPAT model mainly focused on the traditional factors. So they lack an innovative point of view with reorganized dimensions. The systematic urbanization includes varied dimensions with the urbanization of the population, the urbanization of the industry and lifestyle along with the urbanization of the technology instead of the traditionally demographical urbanization rate (as shown in Fig. 1). On the other hand, for the absence of some data after 2012 and the purpose to focus on the fastest economic growth and urbanization phase, we choose the period from 1997 to 2012 including four of the existing 13 five-year plans ranges in China before the country started its New Normal in the economy. We chose 1997 as the beginning year for China's main land witnessed the birth of a new provincial-level administrative unit, Chongqing, which made the new administrative division sustained until now. On the other hand, in 2012 the growth rate of the GDP in China dropped below 8% for the first time in the 21st century to 7.65% after the 9.30% in 2011. Following that year, the GDP never grows faster than 7.5% again, which made 2012 viewed as the end of the ultra-high speed economic growth era. Furthermore, the country witnessed the new top administrating team by the end of 2012, which lead to a different economic policy in China. So, it is off great value to analyze the years from 1997 to 2012. And finally, with the analysis results obtained, we will offered some suggestions to lead the ways for further economic reform and urbanization transformation which can balance the benefit for the environment and people's goodness from the construction and development.

2. Literature review

Within the human activities factors, widespread concerns have been on the relationship between age structure, household size, urbanization and CO_2 emissions as well as other greenhouse gases. In addition, the relationships between urbanization transformation and CO_2 emissions have caused greater attention in recent studies. Some researchers came with the result that urbanization transformation increases the level of greenhouse gas emissions. Based on the findings made by the STIRPAT model, Lin et al. (2009) found urbanization and industrialization transformations are driving the increase of the environmental impact. Besides, Poumanyvong and Kaneko (2010) came to a conclusion with a higher urbanization rate, energy consumption drops in low-income countries while climbs in countries with higher income. However, urbanization's effect on emissions is positive. For China's part, Zhang and Lin (2012) along with Wang et al. (2014) got the results that urbanization transformation adds to energy consumption and CO_2 emissions in China, the second largest emitter then. And He et al. (2011) assessed the r urban sustainability within the context of China in the view of ecological planning with some similar views. Also, in terms of analysis at the regional level, there are researchers who identified urbanization to foster increase in CO_2 emissions in Shanxi (Zang et al., 2016) and Shanghai province (Liu et al., 2015a,b). In the other counties with higher urbanization level and economy development, analysis also come to the same thing (Menz and Welsch, 2012; Knight et al., 2013). Rafiq et al. (2016a,b) analyses the impact of urbanization and trade openness on emissions and energy intensity in twenty-two increasingly urbanized emerging economies with the finding that while urbanization is found to be insignificant in impacting emissions, it seems to be a major factor behind increasing energy intensity. On the contrary, other researchers held that urbanization transformation helped to gain scale economies effect of public infrastructures and thus to reduce energy use and CO_2 emissions (Liddle, 2003; Chen et al., 2008). And some studies have indicated that urbanization transformation had an impact to reduce per capita road energy use in OECD countries, however, there was no significant impact on aggregate carbon emissions (Liddle et al., 2010). Sharma (2011) also found that economic growth can help to increase emissions while the urbanization transformation has a negative impact on greenhouse gas emissions at the global level. Although a majority of the past studies have found urbanization transformation's positive affiliation with carbon emissions, Liddle's (2014) research shown that population density has a greater explanatory power compared with economic development. Thus, Liddle (2014) gave suggestions that the regional studies on human activities and environment should focus on population density rather than urbanization transformation. Solarin and Lean (2016) examine the impact of natural gas consumption, output, and urbanization on CO_2 emission in China and India, and similar results are found in both countries.

In recent years, researchers have dug deeper and deeper into one

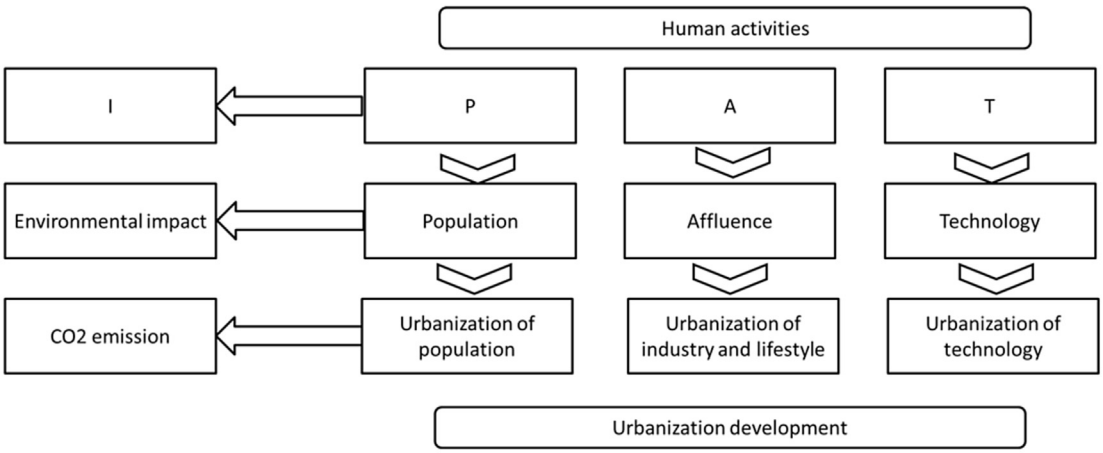

Fig. 1. Urbanization and its impact on CO_2 emissions.

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