



Green development determinants in China: A non-radial quantile outlook



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ABSTRACT

China is at the stage of industrialization and urbanization and because the energy demand and consumption for this process is rigid, coupled with emissions and global warming awareness, China is on a path to cut back emissions as she focuses on alternative and sustainable way to green the economy. This research investigates determining factors in measuring the dynamic changes in green development growth index (GDGI) over a given time frame. By adopting a non-radial directional distance function (NDDF), where more pollutants are added like sulphur dioxide emissions, solid wastes, waste water, and carbon dioxide emissions instead of using only one pollutant in measurement and using a global distance envelop analysis (DEA) to model green performance by considering both desirable and undesirable outputs, the model was decomposed into efficiency change (EC) index, best practice gap change (BPC) index, and technology gap change (TCG) index and these three indexes were employed to measure the green development performance in thirty provinces across china from 2000 to 2012. Results showed that provinces in the eastern region of China are greener than the central and western regions. Analyzing all three calculated dependent variables from a quantile perspective revealed that effects of EC, BPC, and TGC varied across different quantiles of GDGI. The coefficients of BPC were more significant than EC across quantiles, and TGC coefficients only became significant from Q(0.35), and continued on this path until the last observed quantile Q(0.95) however it was less than EC in terms of significance. The values of pseudo R^2 also continued to increase from Q(0.20) until the last observed quantile with 86% accuracy in prediction recorded at Q(0.95). Analyzing the 80th percentile revealed that the coefficient of BPC was highest in this percentile which implies that a unit increase in best practice gap change, will influence green development growth by 102.3 percent, and a unit increase in efficiency change, will accelerate green development growth by 99.41 percent while a unit increase in technical gap ratio change will produce 99.38 percent increase in green development growth of China.

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1. Introduction

Growth and economy are inseparable when considering the economy of a nation, however not all growth are sustainable meaning that, some growth are actually detrimental to the economy in the long run. Suffice to say that green development is not synonymous with sustainable development. Some consider green

development as a specific and practical way in achieving a sustainable development while others argue that green development is a far more advance concept than sustainable development. However comparing both, green development is proactive in nature which aims to benefit future generations while sustainable development is passive aiming not to harm future generation. Green growth is not a replacement for sustainable development, it rather provides a practical and flexible approach for achieving concrete, measurable progress across its economic and environmental pillars while taking detailed account of the social consequences of greening the growth dynamics of economies (OECD, 2011). In china, the general view of green development is that it is a means required to achieve a sustainable development. Since the

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central government of China proposed the concept of green development in the 12th Five Year plan in 2011, theoretical framework and practice of green development have become an indispensable research interest for policy discussions among policy makers. Green development is simply an innovative economic development model that encompasses the constraints of environmental and ecological carrying capacity and strives to achieve sustainable development with environmental protection as one of its major focus, or in a nutshell, it can be defined as the pathway of an economic growth where the usage of natural resources are sustainable which provides an alternative outlook to a typical industrial economic growth.

The general perspective about economic growth in China is that, Chinese economy is unsustainable, unstable, and unbalanced (Chen and Golly, 2014). However, China has prioritized green development in almost all of its leading economic sectors like energy, transportation, and forestry just to name a few with a potential promise for expanded employment in industries and economic sectors that can reduce the country's environmental impact. The current scale of investment and employment in the following sectors really sheds more light on the greening activities taking place in different sectors of the economy. For instance, the energy sector of China that was coal dependent, has in recent times seen increasing share of renewable energy in the country's energy mix which will significantly reduce emissions and play a vital role in greening the energy supply, this is seen in solar hot water, solar photovoltaic (PV), and wind power. During the 11th Five Year Plan, China's solar PV power sector generated around 2700 direct jobs and 6500 indirect jobs annually on average. This is projected to increase to an average of 6680 for direct jobs and 16,370 for indirect jobs annually between 2011 and 2020. Given the rapid growth in China's solar industry, these estimates for future green jobs could increase immensely in the coming years. China's wind power industry consisting the power generation and turbine manufacturing sectors created an average of 40,000 direct green jobs annually between 2006 and 2010, factoring in increased productivity, China's wind power development between 2011 and 2020 is projected to generate around 34,000 green jobs annually on average (Pan et al., 2011). Formerly regarded as a kingdom of bicycles, china is expected to add around 220 million new vehicles between now and 2020, Chinese market for alternative fueled vehicles is really expanding rapidly despite its newness because by mid 2010, China was home to 5000 such vehicles. Assuming the government continues on the path of prioritizing the development of hybrid and electric vehicles during the 2011–2020 period, cumulative production could reach 16.7 million which is an average of 1.67 million hybrid vehicles annually. This will lead to the creation of about 1.2 million green jobs annually on average. Already at the forefront in high speed rail (HSR) development, china aims to reach 18,000 km of HSR by 2020 which will create more green jobs on an average of 230,000 for direct jobs and 400,000 for indirect jobs annually. Considering Beijing as a case study, as one of the most populated cities across the globe, the municipal government stepped up its urban rail ambitions where 660 km of lines were completed in 2015 at a total investment of \$77 billion and construction for another 340 km of lines during 2016–2020 at a total investment of \$69 billion. This could guarantee more than 437,000 green jobs each year by 2020. In the area of forest resources, China is home to more than 2000 tree species, more than 1800 species of wild animals, and more than 6000 species of bushes, hundreds of which are only found here in China. It is certain that nourishing these forested areas is very important for sustaining China's green transition, and the pattern of economic and employment prospects in forestation, forest management, and forest tourism is really encouraging even though not having abundant forest resources. According to (Pan

et al., 2011), government led forestation efforts have led to an impressive expansion in nationwide forest cover where the forestation sector has employed more than 1.8 million full time workers in 2010 with an average of 1.6 million workers annually between 2005 and 2010. China's forestation activities could offer more 1.1 million direct and indirect jobs annually during 2011–2020 in order to achieve its 2020 goals, and the management of all newly added forest area during this period would create around a million green jobs. There is also a great expansion potential in forest park tourism because it is home to more than 2000 forest parks, and this green sector alone could provide 392000 green direct jobs and 607000 green indirect jobs which is almost a million green jobs totally. Considering only the three sectors mentioned here - energy, transportation, and forestry, could create around 4.5 million green jobs by the year 2020. If these sectors continue on their path of rapid expansion in addition to other emerging green sectors following same pathway, it is obvious that there is a huge potential for green jobs in the economy.

The measurement of green development garnered attention several decades ago among developed and developing countries as we try to cut back on emissions and global warming. By adopting a non-radial directional distance function (NDDF), where more pollutants are added like sulphur dioxide emissions, solid wastes, waste water, and carbon dioxide emissions instead of using only one pollutant in measurement and using a global distance envelop analysis to model green performance by considering both desirable and undesirable outputs respectively, quantile analysis was employed to clearly ascertain the effects of all calculated explanatory variables in the model and visualize their deterministic trend in greening the economy due to the flexibility in quantile for modeling data with heterogeneous distributions. Furthermore, median analysis is more robust to outliers and embodies richer characterization and description of data. The remainder of this research is organized as follows: section 2 reviews some existing literature, section 3 presents methodological issues and data used in the analysis, section 4 provides empirical outcomes and discussion, while section 5 shows conclusion of the analysis, with summary and policy implications.

2. Literature reviews

It is obvious that the energy consumption and environmental pollution of china increased significantly, however several research in the past mainly focused on productivity improvement where they analyzed and studied how sustainable was the economic growth of china either through a non parametric framework (Yang et al., 2015) or by a total factor productivity (TFP) approach, with the assumptions that a rising total factor productivity is the vital and only option in attaining a sustainable growth in an economy (Li, 2009; Chen et al., 2008). This approach is misleading in a way because total factor productivity does not recognize the environmental cost of economic growth which gives a false estimate about the true contribution of total factor productivity to economic growth. We believe that this and other factors really gave a false outlook in the past about economic growth in China, where growth was pursued at the detriment of the state of the environment because policy makers overestimated growth trends. In order to efficiently account for undesirable output to an extent in economic growth, green development was introduced as a strategy to enhance production and good environmental performance that ensures green development (Choi, 2015; Ahmed, 2012). This is derived by the integration of both environmental protection and productivity improvement, definitely, this approach will account for undesirable outputs that were left out of the equation by total factor productivity. Some studies on green development

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