Luca Riccetti - Comments to Yang et al. (2019)
March 21, 2019 - 13:12
The paper of Yang et al. (2019) is a very interesting study. It performs an econometric analysis based on a “quasi-natural experiment”: in July 2010, China started the China’s Low-Carbon Pilot policy (CLCP), that is, five provinces and eight cities were selected to be the pilot areas for controlling greenhouse ...[more]

... gas emissions. The authors study the effects of the environmental regulation both at macroeconomic and microeconomic levels.
At macroeconomic level, they find that it significantly improves regional GDP and per capita GDP and this effect grows year after year. Moreover, environmental regulation is conducive to the export competitiveness of the clean industry and improves the accumulation of regional human capital. A series of robustness checks confirm these results.
At microeconomic level, they find that firms strengthen management, improve efficiency and increase investment in innovation activities to gain greater competitiveness, and all these activities offset (and not only offset) the increase in production costs caused by environmental regulation. In addition, enterprises could choose to transfer across regions to avoid the impact of environmental regulation, but they decide improving operating efficiency and carrying out innovation instead of supporting transfer costs.
These results are extremely relevant because a substantial reduction of greenhouse gas emissions is immediately needed. However, many economists, entrepreneurs and politicians often stop or slow down this process on the basis of studies on the relationship between environmental regulation and economic growth that do not arrive to a unified conclusion. The success of this "quasi-natural experiment" is surely a very relevant result with extremely important policy implications.
Some remarks (beside some typos):
- I am not very convinced by the use of the logarithm of the GDP, that is surely a not stationary variable. I suggest to perform the analysis on GDP growth rate.
- Size, debt, right and also labor are very connected variables and they could present multicollinearity problems. I suggest to check the Variance Inflation Factors.
- Figure 2 and 3 seems to show a starting trend already in 2009. I suggest to check this feature that could partially weaken the results.
- The “PSM-DID Method Test” section seems to be added later. Please explain better what PSM is.

Beibei SHI - reply
March 29, 2019 - 10:40
（1）I am not very convinced by the use of the logarithm of the GDP, that is surely a not stationary variable. I suggest to perform the analysis on GDP growth rate.

First, thank you very much for your attention to variable selection in this article. In order to ...[more]

... further illustrate the robustness of the results, the rate of GDP growth(g) is selected here to measure economic growth. The regression results are shown in columns (1) and (2) in TABLE 1. It can be seen that the regression results do not change significantly, indicating that the difference in index selection does not affect the conclusions of this study.

（2）Size, debt, right and also labor are very connected variables and they could present multicollinearity problems. I suggest to check the Variance Inflation Factors.

By performing a multicollinearity test on the above variables, it is known that Mean VIF=4.05, which is much smaller than 10, indicating that there is no serious multicollinearity between the variables.

（3）Figure 2 and 3 seems to show a starting trend already in 2009. I suggest to check this feature that could partially weaken the results.

Thank you for your suggestion of this detail. The reason why such a result appeared in 2009 is that policy making may lead companies to be aware of it in advance and affect its behavior in advance. To ensure the accuracy of the assessment results, we excluded this potential impact by eliminating the 2009 sample. The results are shown in columns (3)-(6) in TABLE 1. It can be seen that the results do not changed significantly.

（4） The “PSM-DID Method Test” section seems to be added later. Please explain better what PSM is.

Propensity Score Matching (PSM) is a statistical method used to process data of Observational Study. In observational studies, for various reasons, there are a lot of data biases and confounding variables. PSM can reduce the effects of data biases and confounding variables for a more reasonable comparison between the experimental and control groups. It was first proposed by Paul Rosenbaum and Donald Rubin in 1983 and is commonly used in medicine, public health, economics and so on.

Anonymous - Referee Report 1
April 23, 2019 - 08:27
see attached file

Beibei SHI - Revision Report
May 20, 2019 - 05:44
Question 1: What kind of actions does local government actually take after the LCP policy? This paper discusses the mechanism through which the policy works in section 3.2. However, they are the central government’s requests. Do the pilot cities and provinces actually follow these requirements?

Modify reply ...[more]

... 1:
We are grateful to the reviewer for doubts about the implementation of LCP policy and whether the local government implements the specific requirements of the central government. We believe that the existence of these problems is the logical

starting point of the full-text analysis, which directly relates to the specific effects and practical significance of this research. Therefore, the questions raised by the reviewer can be described as a hit. Of course, because we did not elaborate on the results of the implementation of LCP policy in the initial manuscript, the reviewer was puzzled by the actions taken by local governments and whether they followed the different measures set by the central government. We apologize for this and hope to get reviewer's forgiveness through this revision.

In order to make up for the shortcomings in the first draft that did not elaborate on the specific implementation and implementation effects of LCP policy, in this revision, we focus on the specific policies adopted by local governments and the effects of this series of implementation strategies to explain the behavior of local governments and whether they comply with the requirements of the central government. First, we have sorted out the specific measures that the central government has required local governments to implement. These measures stipulate specific behaviors of local governments, so it is very necessary to sort out them. The results are shown in Table 1. It can be seen that local governments are required to prepare low-carbon development plans, establish industrial systems characterized by low-carbon emissions, establish greenhouse gas emission data statistics and management systems, formulate supporting policies of low-carbon and green development, and actively advocate low-carbon green lifestyles and consumption patterns to achieve carbon emissions reduction from all aspects. The above requirements and specific implementation contents are also the behaviors prescribed by local governments in reducing carbon emissions.

Second, although the local government has been supervised by the central government, has the local government really implemented a series of strict measures? It is not sufficient and true to interpret local government's behavior only from the perspective of government documents and policy making. In view of this, we measure the carbon emissions at the provincial level to illustrate the changes in carbon emissions in pilot areas, thus directly demonstrating the effectiveness of LCP policy, and indirectly indicating the degree to which local governments have implemented various measures. It should be noted that the carbon emission calculation here is calculated according to the standard calculation formula, that is, carbon emission = coal consumption×0.7329 + oil consumption×0.5574 + natural gas energy consumption×0.4226, where the emission factors of various energy sources are the average of the carbon emission factors published by the DOE, the Japan Energy Economic Research Institute, the China National Science and Technology Commission Climate Change Project, and the National Development and Reform Commission Energy Research Institute. In order to better compare the carbon emissions between pilot areas and non-pilot areas, we compare total carbon emissions and per capital carbon emissions in each region. The specific results are shown in Figure 1. It can be seen that compared with non-pilot areas, the carbon emissions of the pilot areas after the implementation of the LCP policy have been significantly reduced. Although there is a time lag in the reduction, it is undeniable that implementation of LCP policy has effectively reduced carbon emissions in the pilot areas and achieved the expected environmental benefits. Therefore, from this perspective, the local government has followed the policies formulated by the central government, actively implemented measures, and achieved regional carbon emissions reduction.

Question 2： I’d like to see a graphic illustration of the differences between the treatment group and the control group’s GDP with time before the regression results. Similarly, I’d also like to see a figure about the comparison of firms’ profits between the treatment group and the control group with time.

Modify reply 2:
First, thank the reviewer for the suggestions on this important issue. The way to visually demonstrate changes in gdp and corporate profits between treatment and control groups will further consolidate and enhance the empirical results of this paper. The reviewer's questioning helps authors to further improve the analysis of the paper, and lays out new ideas for future research, which benefits the authors. Therefore, this paper draws the time series changes of gdp and enterprise profit respectively. The specific results are shown in Figure 2 and Figure 3.

Among them, Figure 2 is mainly time series change of gdp and per capital gdp, while Figure 3 is mainly time series change of corporate profits. It can be seen that before LCP policy implementation, there was no significant change between the treatment group and the control group, and they maintained long-term and parallel growth. On the contrary, after the implementation, there is a big difference in the economic growth between regions. Treatment group’s economic growth is gradually higher than that of control group, and the change of per capital gdp also shows the same trend. At the same time, although the degree of change in corporate profits is not as obvious as that of economic growth, the corporate profits in pilot areas are still growing, which fully demonstrates that LCP policy has increased corporate profits in pilot areas. The results in the figure preliminarily indicate that LCP policy is conducive to economic growth and corporate output expansion in pilot areas, laying foundation for subsequent empirical analysis.

Question 3: The treatment group includes both provinces and cities. The paper pools them as a treatment group. Are they comparable with the control city group? In addition, the pilot cities such as Tianjin and Chongqing are centrally administered municipalities. Shenzhen, Xia-men, and Hangzhou are highly developed cities. I think it is better to keep the provinces and the centrally administered municipalities and use other provinces as the control group.

Modify reply 3:
Thanks to the reviewer for the doubts about the comparability of the sample cities in the treatment and control groups. This doubts also made us aware that there are significant differences between the treatment group and the control group, and it can inevitably affect the results of the full-text analysis. We are extremely grateful to the reviewer and hope that this paper will be improved through a new round of revision. In view of this, we have dealt with the differentiation of pilot cities, and it is handled in full accordance with the solution proposed by reviewer. Details are as follows: first, we exclude economically developed cities in pilot cities, namely Shenzhen, Xiamen, and Hangzhou, thus preserving provinces and centrally managed cities for comparison. Second, cities such as Beijing, Shanghai and Tianjin are excluded from

pilot cities. Because the political influence and system level of these cities are higher than those of others, it is necessary to eliminate them. The specific regression results are shown in Table 2. Among them, the columns (1) - (4) are mainly the regression results after removing Shenzhen, Xiamen and Hangzhou, while the columns(5)-(8) are the regression results after eliminating Tianjin, Chongqing, Shenzhen, Hangzhou and Xiamen. It can be seen that sample elimination has not changed the promotion effect of LCP policy on economic growth, which further consolidated and strengthened the research conclusions of this paper.

Question 4: on page 11, the authors mention existing studies about the variable selection. What are the studies? I think it is common to control the industry in the regression. Similarly, for the macro analysis, are there reference studies for variables selection? How many firms are in the data?

Modify reply 4:
Thanks to the reviewer for the doubts about lack of literature support for indicators selection and companies number in the micro analysis section in the text. We believe that your opinions will contribute to the improvement and consolidation of this paper. In view of this, we answers the reviewer's questions one by one. First, in order to further support indicators selection, we re-add relevant literature, and re-express the part of macro indicators selection, paying more attention to the support of research literature. Details are as follows:

Control variables selection mainly considers the following factors. Investment level is a key factor that influences regional economic growth, and investment driving is an important transmission path for economic growth (Anderson, 1990; Munnell, 1992). Therefore, this article selects the logarithm of social fixed asset investment to measure it. China's demographic dividend produced by labor force input plays an important role in economic growth, and is an important resource endowment that affects the economic development of a region (Hondroyiannis and Papapetrou, 2001; Mello, 2008) ; accordingly, this article chooses the logarithm of total employment to measure the labor input in this area. On the macrolevel, government fiscal expenditure scale can influence economic growth through public services and public fiscal expenditure channels (Landau, 1986; Yan and Gong, 2009), and the proportion of government budget expenditures to GDP is chosen to measure it. At the same time, the level of industrialization. is an important indicator for determining the economic development path of a country (Moreno-Brid et al., 2010; Iya et al., 2016). This article chooses the ratio of the output value of the secondary industry to GDP to measure the level of industrialization. The higher this indicator, the higher the level of industrialization, and vice versa. The education level of the region is expressed by the ratio of the number of students in the general colleges and universities to the total population of the region (Stevens and Weale, 2004; Hanushek and Woessmann, 2010), which reflects the level of human capital accumulation in the region. At the same time, considering the impact of the savings rate on economic growth through social investment and consumption (Hamberg, 1969; Wang et al., 2012), we choose the ratio of the total savings of urban and rural residents to GDP to measure it because China’s rapid economic growth shows a sustained high savings rate. In

addition, FDI promotes regional growth by reducing inefficient domestic production and accelerating technological progress (Alfaro et al., 2002; Berthélemy and Démurger, 2010). Therefore, through the calculation of “total foreign direct investment/regional GDP”, this article measures regional openness.

For the above-mentioned literature, we list them one by ones follows:

[1]Anderson D. Investment and economic growth[J]. World Development, 1990, 18(8):1057-1079.
[2]Munnell A H. Policy Watch: Infrastructure Investment and Economic Growth[J]. Journal of Economic Perspectives, 1992, 6(4):189-198.
[3]Hondroyiannis G, Papapetrou E. Demographic changes, labor effort and economic growth: empirical evidence from Greece [J]. Journal of Policy Modeling, 2001, 23(2):169-188.
[4]Mello M. Skilled labor, unskilled labor, and economic growth [J]. Economics Letters, 2008, 99(3):428-431.
[5]Landau D. Government and Economic Growth in the Less Developed Countries: An Empirical Study for 1960-1980[J]. Economic Development & Cultural Change, 1986, 35(1):35-75.
[6]Yan C, Gong L. Government expenditure, taxation and long-run growth[J]. Economic Research Journal, 2009, 4(4):505-525.
[7]Moreno-Brid J C, Santamaría J, Valdivia J C R. Industrialization and Economic Growth in Mexico after NAFTA: The Road Travelled[J]. Development & Change, 2010, 36(6):1095-1119.
[8]Iya I B, Anono A Z, Abubakar A. Industrialization and economic growth relationship in Nigeria[J]. Journal of Advances in Social Science and Humanities, 2016, 2(06).
[9]Stevens P, Weale M. Education and economic growth[J]. International handbook on the economics of education, 2004, 27: 205-311.
[10]Hanushek E A, Woessmann L. Education and economic growth[J]. Economics of education, 2010: 60-67.
[11]Hamberg D . Saving and Economic Growth[J]. Economic Development & Cultural Change, 1969, 17(4):211-7.
[12]Wang V, Yun H C, Lee L S. An empirical study of Taiwan's 1978-2006 financial development, export, saving and economic growth[J]. African Finance Journal, 2012, 14(1):87-101.
[13]Alfaro L, Chanda A, Kalemli-Ozcan S, et al. FDI and economic growth: the role of local financial markets[J]. Journal of International Economics, 2002, 64(1):89-112.
[14]Berthélemy J C, Démurger S. Foreign Direct Investment and Economic Growth: Theory and Application to China[J]. Review of Development Economics, 2010, 4(2):140-155.

Second, after perfecting indicators selection, we have a detailed interpretation of the Chinese industrial enterprise database used in the micro analysis section, especially showing distribution of enterprises number in each year between 2001 and 2013, in order to illustrate the changes in sample companies number in different years during the inspection period. The specific results are shown in Table 2 below. It should be specially stated that due to the availability of data, the data selected in this study does not contain the data in 2012, so enterprises number in 2012 is not presented in the table.

Table 2 Distribution of enterprises number in different years

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013
Enterprises number	31420	34464	38581	57103	56386	60865	67450	75779	71557	76532	52597	54124

Question 5: p12 the descriptive statistics for education is not right as this variable is defined as “Number of students in the general colleges and universities/Total population of the region) 100”. It can not range from 17.246 to 926,660.3.

Modify reply 5:
Thanks to the reviewer for careful reading, please forgive us for the inconvenience caused by the carelessness. In response to this problem, we carefully examined the original data, and found that the unit of students number of ordinary colleges and universities in the initial manuscript was processed by 10,000 people, which caused the bias of the indicators. We corrected this error, and the corrected percentage was 92.66663, which met the basic logic requirements.

Question 6: in the abstract and line 2 of the literature review,the authors use “ecological economics”. It should be environmental economics.

Modify reply 6:
Thanks to reviewer for pointing out this term, we appreciate your careful guidance. In the process of this revision, the authors not only changed the ecological economics used in the second line of the literature review and the abstract into environmental economics, but also made a unified revision to the rest of the text, thus ensuring that the analysis of the full text is more standardized and rigorous. Once again, we would like to express my gratitude to the reviewer for rigorous academic attitude.

Question 7: on page 26, the “pollution paradise hypothesis” should be “pollution haven hypothesis”.

Modify reply 7:
Thanks to the reviewer for correcting this term, your serious and rigorous attitude has benefited the authors and played a leading role in the academic research of the authors. In the process of revision, we replaced the term "safety haven hypothesis" with “pollution paradise hypothesis” to ensure consistency with existing literature research, avoid misunderstandings caused by inappropriate expression of words, and ensure comparability of the conclusions of this paper based on reality of China and the conclusions of other countries.

Anonymous - Referee Report 2
July 09, 2019 - 08:40
see attached file

Beibei SHI - Reply2
September 11, 2019 - 16:43
Dear reviewer:

Thank you for time and effort to read this paper named “Can Reducing Carbon Emissions Improve Economic Performance? Evidence from China”. And thank you very much for valuable review suggestions. Your constructive review comments are very important for us to further revise and improve it. After revision, ...[more]

... the quality of this paper has been further improved, and once again thank you for painstaking review.

The revision report is presented in the attached PDF.

Thank you very much again.