The Rising Issue of Negative Economic Growth and Environment Improvement: An Extended Environmental Kuznets Curve (EKC) Hypothesis

<table>
<thead>
<tr>
<th>Journal:</th>
<th>EnvirarXiv Preprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Submitted by the Author:</td>
<td>2021-03-16</td>
</tr>
<tr>
<td>Complete List of Authors:</td>
<td>Jiping Jiang</td>
</tr>
<tr>
<td>Keyword:</td>
<td>COVID-19, Degrowth, Emission, Environmental Kuznets Curve, Negative</td>
</tr>
</tbody>
</table>
The Rising Issue of Negative Economic Growth and Environment Improvement: An Extended Environmental Kuznets Curve (EKC) Hypothesis Based Discussion

Jiping Jiang*

School of Environment Science and Engineering, Southern University of Science and Technology, Shenzhen 518055, China

*Email: jiangjp@sustech.edu.cn

Most recently, the COVID-19 pandemic has suspended global economic activity for almost half a year, and the negative impacts on the economy will continue longer in many countries. Interesting environmental changes are being observed, including the following: reduced carbon emissions and air quality improvements. For example, NASA and the European Space Agency detected a significant reduction in NO$_2$ pollution near Wuhan and it eventually spread across China in Feb 2020; Bauwens et al. (2020) identified Western Europe and US have robust NO$_2$ decrease in 2020, 20-38% relative to the same period in 2019. There are rising the question whether environmental quality can be improved during a recession?

In history, short-term economic recessions periodically occur either globally (e.g., Great Depression, Great Recession) or regionally (e.g., 1997 Asian financial crisis) despite long-term economic growth. However, the relationship between negative economic growth (NEG, recession or suspension) and environmental quality (improvement or degradation) is seldom discussed in the literature. As a classic hypothesis describing the relationship between economic growth and environmental degradation, Environmental Kuznets Curve (EKC) may provide a general framework applicable in this circumstance to offering new insights (Grossman and Krueger (1991), Panayotou (1993)).

EKC hypothesizes that the environmental quality begins to deteriorate as income increases (e.g.,
per capita income), then improves as income increases after the income level reaches a certain point. EKC is most commonly presented as an inverted U-shape, but in some cases it is an inverted N-shape or an inverted L-shape (Dinda 2004, Zhang et al. 2015). It has been widely proved for various countries and environmental quality indicators (e.g., the water pollution index; carbon dioxide (CO$_2$), sulfur dioxide (SO$_2$), and nitrogen oxides (NOx) emissions; deforestation; energy consumption; the ecological footprint (Hettige et al. 2000, Stern 2017)). However, several empirical studies did not support the hypothesis. Despite it being criticized almost from the start, the EKC theory has been widely used in the formulation of national environmental policies and the promotion of clean production and emissions reduction technology around the world.

However previous studies of EKC provide a macro perspective by regression on the long-term historical time series. Period of economic recession is smoothed, neither short-term nor long-term, such that a negative economic development mode of EKC has been largely neglected. Now we setup a time arrow for the EKC as an extension to the traditional EKC hypothesis, named as a roll-back mode of EKC (rEKC).

To describe the abovementioned phenomenon, we proposed a diagram in Fig. 1 to explain the r-EKC hypothesis where the roll-back happens in different stages of economic development. Apparently, such a roll-back does not simply work as the direct reversal of time along the historical EKC trail. Four types of roll-back modes are proposed, as shown in Fig. 1 (red arrows connected to the original blue EKC curve). Type-A appears at the postindustrial economy stage or after the turning-point, and Type-B appears at the industrial economy stage or before the turning-point. They present better environmental changes. Typical examples (Huang et al. 2017) are Japan's reduction of NO$_2$ emissions in 2008 and 2009 during the world financial crisis, and Russia's reduction of NO$_2$ emissions in the
In the 1990s after the breakup of the Commonwealth of Independent States, which are shown in the subplots to the right of Fig. 1. This is because factors other than the intensity of social and economic activities determine environmental pollution. In addition, the level of technology, environmental awareness and others also determine environmental pollution, and these things will not regress with the recession.

Theoretically, NEG can also lead to the degradation of the environmental quality under some circumstances, identified as Type C and Type D in Fig. 1. For example, it is reported that household waste production are increased during the COVID-19 pandemic (Ouhsine et al. 2020). The economic structure may also become non-environmental or non-sustainable, which is more likely to happen in a postindustrial economy. For example, Latin America's Over-urbanization, turn to be urban poverty and ecological environment deterioration, are typical C and D types (Roberts et al. 2017).

Note: The subplots of types A and B in the right are modified according to Huang et al. (2017)

Some theoretical questions arise. In the case of known GDP, how does one distinguish or predict Type A or C or Type B or D after negative economic growth? What is the difference in the abovementioned internal driver? What kind of effect will NEG have on the arrival of the turning point? Will it come ahead of time, or will a step back make a step forward? What environmental indictors are...
prone to be negatively affected by NEG? Quantitatively, the econometric models of the EKC, such as
the log-quadratic function, need to be separated before and after the NEG period and a rEKC model
can be applied in the NEG period. Obviously, some may argue that the EKC hypothesis cannot be used
to predict future trends since it is normally based on time series data or panel data analysis. More
rigid structure models like IPAC (Integrated energy and environment Policy Assessment model for
China) model, CGE (Computable general equilibrium) model (Zhang et al. 2017) are more reliable for
detailed analysis.

Furthermore, the policy implications of the rEKC hypothesis can be concluded in two ways. 1)
Passive way. This is the response to the inevitable negative economic growth when controlling
environmental degradation. If economic negative growth cannot be avoided, how to maintain scenario
B or A instead of D or C, to keep the environmental improvement, will be particularly important. As
COVID-19 epidemics will very likely continue for years, it is necessary to watch off the potential
environment degradation from this long-run economic impacts.

2) Proactive way. This means partially suspending economic activities to improve the recovery of
the environmental quality. It is consistent with the recently radical ‘Degrowth’ movement in Europe
(Brossmann and Islar 2020, Robra and Heikkurinen 2019). In this context, the ‘Earth Hour’ activity
proposed by the World Wildlife Fund and long holidays are typical cases of the proactive way. Human
beings can implement longer-term suspensions of economic activities, at least partially, when GDP
achieves a certain level. Such regulation is similar to a forest fire that automatically regulates the
ecosystem. Perhaps such suspension of activity, i.e. degrowth, could facilitate meeting the UN
Sustainable Development Goals. More empirical investigations and debates of the both pathways are
worthy to be conducted.
Keywords: COVID-19, Degrowth, Emission, Environmental Kuznets Curve, Negative economic growth

Acknowledgments

This work was financially support by the National Natural Science Foundation of China (Grant No. 51979136). We are grateful for constructive comments provided by Dr. Shunze Wu from Policy Research Center for Environment and Economy, Ministry of Ecology and Environment of P.R. China, Prof. Min Xu from University of Michigan, Ann Arbor, and Prof. Yi Zheng, Lan Song, and Bin Ye from Southern University of Science and Technology.

References


