Does income inequality matter for CO_2 emissions?

Oleg Mariev, Natalia Davidson and Sophia Turkanova
Ural Federal University, Ekaterinburg, Russia

Globalization and its socio-economic consequences 2020
Slovak Republic, Rajecke Teplice, 21–22 October 2020

Plan

1. Motivation and aim
2. Literature review
3. Data and methodology
4. Results
5. Conclusion

1. Motivation and aim

Intensive economic growth that took place in the Russian regions during the recent decades is associated with the environmental issues, particularly, CO_2 emissions, and with income inequality. To achieve sustainable development path, it is necessary to resolve these issues.

Our objective is to shed more light on the impact of income inequality on CO_2 emissions based on the Russian regional data covering the years 2004-2018.

2. Literature review

The link between economic development and environmental quality is captured primarily by the hypothesis of Kuznets Environmental curve (Kuznets, 1955; Grossman and Krueger, 1995):

> the relation between the economic development and environmental pollution is characterized by the inverted U shape, meaning that an increase in GDP per capita leads to increase in environmental pollution at the early stages of development, but after a certain GDP level is attained, further development results into decrease in the environmental pollution.

The discussion of the link between inequality and greenhouse gas emission took place in the 1990ies.

Economic activity, leading to deterioration of the environmental quality, balances the power between those who benefit from such activity and those who incur net costs (Boyce, 1994).

2. Literature review

All approaches to study the income inequality effect on CO_2 emissions can be grouped into two categories: those addressing *production* and those dealing with *consumption.*

The production approach: two methods

(1) *Based on the political economy* (Boyce, 1994). Rich population groups receive economic benefits from the types of economic activity associated with environmental pollution, for example, due to owning a polluting company.

Countries with low income inequality levels and low emissions levels are associated with high standards and requirements.

High standards and costly decrease in CO_2 emissions in the developed countries lead to the transfer of carbon-intensive production to the developing and poorer countries.

Income inequality leads to deterioration of the environment. Increasing income gaps and deteriorating environmental quality coexist in the low-income countries (Torras and Boyce, 1998).

Wealthy groups of population, who often possess substantial political power, take into consideration only economic costs and benefits, while environmental consequences are borne mainly by the relatively poorer majority of population. Policy resulting from such balance of powers leads to deterioration of the environment (Grossman and Krueger, 1995).

(2) *'Veblen effect'* (Bowles and Park, 2005). Income inequality increases the working time, which results into increase in energy consumption and CO_2 emissions.

2. Literature review

The consumption approach: two methods

(1) Based on working time allocation.

Poorer groups of population work more in order to imitate the lifestyle of people with higher incomes. While the working time increases, consumption increases, including that of carbon-intensive products, leading to increase in pollution (Bowles and Park, 2005).

(2) Based on the individual economic consumption by the households.

It unites the theory of marginal accepted emissions and 'Veblen effect' and states that under different income distribution levels, people's propensity to consume goods of a certain level of environmental pollution varies depending on the consumption structure (Borghesi, 2006; Grunewald et al. 2017).

Consumption trends are the key factor behind the emissions level. It is assumed that the poorest groups of population have higher marginal propensity to CO_2 emissions than the wealthiest groups, as low carbon products are generally characterized by much higher technical requirements and, therefore, by higher prices, which poor groups of population cannot afford (Jorgenson et al., 2017).

Moreover, poorer groups of population are more likely than wealthier people to utilize inefficient sources of energy, which are again associated with higher marginal propensity to CO_2 emissions (Ravallion et al., 2000).

3. Data and methodology

We employ data covering 73 regions of Russia provided by the Russian Federal State Statistical Service (Rosstat), the Unified Interdepartmental Statistical Information System (UISIS) and the Ministry of Energy of the Russian Federation for the years 2004-2018.

We apply *Gini index* and *decile dispersion ratio* (income inequality between 10% of people with the lowest income and 10% of people with the highest income) to measure income inequality.

To study the impact of income inequality on CO_2 emissions in the Russian regions we estimate econometric models with fixed and random effects, and apply GMM method.

The hypothesis of the Environmental Kuznets curve is tested, to find out the impact of economic growth on the CO_2 emissions.

3. Data and methodology

Based on the literature analyzed above, the model was specified as follows:

$$C_{i,t} = \beta_0 + \beta_1 ln(Y_{i,t}) + \beta_2 [ln(Y_{i,t})]^2 + \beta_3 F_{i,t} + \beta_4 G_{i,t} + \varphi z_{i,t} + \varepsilon_{i,t}$$

Fixed and random effect methods have a limited capacity to deal with the endogeneity problem. This can lead to biased coefficients. One of the options is to apply generalized method of moments (GMM) (Arellano and Bond, 1998).

$$C_{i,t} = \beta_0 + \beta_1 C_{i,t-1} + \beta_2 ln(Y_{i,t}) + \beta_3 [ln(Y_{i,t})]^2 + \beta_4 F_{i,t} + \beta_5 G_{i,t} + \varphi z_{i,t} + \varepsilon_{i,t}$$

Dependent variable: CO_2 emissions per capita, tons per thousand people

Independent variables:

GRP per capita, roubles
Decile dispersion ratio, %
Gini coefficient, %
Share of natural resources extraction in GRP, %
Share of manufacturing in GRP, %
Energy consumption per capita, thousands kWh
City population share, % of total regional population
Consumption expenditures per capita, thousands rouble
Alternative energy sources, Dummy-variable, 0 – missing, 1 – at least 1
Population density, people/sq.km.

4. Results

Dependent variable: CO_2 emissions per capita	RE	FE	Driscoll-Kraay (FE)	GMM
CO_2 emissions per capita $_{i,t-1}$				0.652***
				(15.9)
Ln ($GRP\_pc_{i,t}$)	-18.81*	-14.4	-14.4	40.28**
	(-2.07)	(-1.56)	(-0.65)	(3.08)
Ln ($GRP\_pc_{i,t}$)^2	0.595	0.38	0.38	-1.907***
	(1.47)	(0.92)	(0.42)	(-3.33)
Decile dispersion ratio$_{i,t}$	1.962***	1.959***	1.959***	0.903*
	(5.32)	(5.25)	(3.58)	(2.17)
Gini coefficient$_{i,t}$	-1.297***	-1.277***	-1.277***	-0.910**
	(-4.14)	(-4.05)	(-4.34)	(-2.73)
Natural resources extraction $_{i,t}$	0.226***	0.232***	0.232*	0.195**
	(5.01)	(4.9)	(2.57)	(3.16)
Manufacturing $_{i,t}$	0.114*	0.196***	0.196***	0.0165
	(2.54)	(4.12)	(3.66)	(0.27)
Energy cons. $_{i,t}$	0.133	0.129	0.129	0.574*
	(0.78)	(0.56)	(0.4)	(2.08)
City popul. share $_{i,t}$	0.107	0.198	0.198	-0.0681
	(1.33)	(1.33)	(1.29)	(-0.23)
Cons.expenditures $_{i,t}$	0.367***	0.426***	0.426**	0.492***
	(4.34)	(4.98)	(2.86)	(4.94)
Alternative energy$_{i,t}$	-0.104	-0.0361	-0.0361	-0.321
	(-0.39)	(-0.14)	(-0.16)	(-1.39)
Population density$_{i,t}$	-0.267***	-0.313*	-0.313***	-0.123
	(-6.78)	(-2.15)	(-3.52)	(-0.42)
Const	167.8**	138.0*	138.0	
	(3.22)	(2.51)	(1.05)	
Number of obs.	1022	1022	1022	949
R-sq		0.109		
AR(2)				0.305

4. Results

CO_2 emissions *increase* with growth in income inequality between 10% of people with the lowest income and 10% of people with the highest income.

CO_2 emissions *decrease* with growth of Gini coefficient.

The hypothesis of the Environmental Kuznets curve was confirmed based on GMM method.

The results show that the increase in the share of extraction and manufacturing sectors result into the increase in CO_2 emissions.

The increase in consumption expenditures and energy consumption result into the increase in CO_2 emissions.

5. Conclusion

Concerning CO_2 emissions, various administrative and economic measures are being introduced and are discussed in literature.

Among the possible measures for decreasing the CO_2 emissions is carbon tax. It allows decreasing CO_2 emissions in production and leads to decrease in consumption of carbon intensive products due to their price increase.

The other measures include:

- increase in energy efficiency in all spheres of production and consumption;
- modernization of equipment with the priority of environmentally friendly technologies;
- development of the emission trading system based on the 'cap and trade' principle;
- improvement of public transport infrastructure in the cities.

The measures aimed at decreasing CO_2 emissions and environmental pollution overall, is an important issue for further study.

Extracting industry and manufacturing being the main sources of greenhouse gas emissions caused by human activities, it is essential to develop *circular economy* approach and to implement low-carbon and carbon-free technologies.

Specific features of various technologies implying lower CO_2 emissions and their impact on the economy also require further investigation.

Thank you!

email: natalya.davidson@gmail.com