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Analysis

The Trade-off Between Income Inequality and Carbon Dioxide Emissions

Nicole Grunewald [a], Stephan Klasen [a], Inmaculada Martínez-Zarzoso [a,b], Chris Muris [c,*,1]

[a] University of Goettingen, Germany
[b] University Jaume I, Spain
[c] Simon Fraser University, Canada

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ABSTRACT

We investigate the theoretically ambiguous link between income inequality and per capita carbon dioxide emissions using a panel data set that is substantially larger (in both regional and temporal coverage) than those used in the existing literature. Using an arguably superior group fixed effects estimator, we find that the relationship between income inequality and per capita emissions depends on the level of income. We show that for low and middle-income economies, higher income inequality is associated with lower carbon emissions while in upper middle-income and high-income economies, higher income inequality increases per capita emissions. The result is robust to the inclusion of plausible transmission variables.

1. Introduction

Reducing global poverty and mitigating climate change are two major challenges facing mankind in the twenty-first century. Economic growth leads to absolute poverty reduction, particularly if it is not associated with rising income inequality (e.g. Dollar and Kraay, 2002; Bourguignon, 2003). There is a substantial literature that investigates the relationship between income and carbon dioxide emissions (the main driver behind the increase in global surface temperature). This literature suggests that economic growth, at least up to a certain level of economic development, increases greenhouse gases (IPCC, 2014; Jakob et al., 2014). Consequently, from the perspective of a developing country, economic growth may alleviate poverty, but intensify climate problems. A related issue is whether there is also a tradeoff between income inequality and carbon emissions, as stated by Ravallion et al. (2000). As we discuss below, the theoretical and empirical literature generates mixed results on this question, pointing to different mechanisms and effects (for a survey see Berthe and Elie, 2015). Much of this literature is, however, based on econometric methods that are biased in the presence of time-varying unobserved heterogeneity, and on older data on both inequality as well as emissions. We improve upon the existing literature in both of these respects.

A particular innovation with respect to the existing literature is that we use a group fixed effects estimator (Bonhomme and Manresa, 2015) as opposed to a standard fixed effects estimator. This grouped fixed effects estimator takes into account that different regions of the world adopt clean technologies at different rates or face different structural challenges and dynamics. Furthermore, the estimator arguably deals better with endogeneity due to unobserved heterogeneity. Finally, the within transformation associated with the standard country-based fixed effects estimator would eliminate most of the variation in the Gini data, leaving only the relatively small intertemporal variation (see the literature on the debates on inequality and growth literature, e.g. Forbes, 2000, Banerjee and Duflo, 2003, Scholl and Klasen, 2016).

To the best of our knowledge, only five papers are closely related to our empirical investigation of the link between per capita carbon dioxide emissions, per capita output, and inequality. There are also related studies investigating the link between inter-country inequality and emissions (e.g. Guo, 2013; Coondoo and Dinda, 2008). First, Ravallion et al. (2000) use a pooled OLS model that interacts inequality with a third-order polynomial of income, a time trend, and population size. The panel data set consists of 42 countries over the period from 1975 to 1992. The authors use one (average) inequality measure per country. They find that there is a static tradeoff between reducing carbon emissions and reducing income inequality. Second, Borghesi (2006) applies OLS and fixed effects panel data estimators to a panel data set of 37

* Corresponding author at: Department of Economics, Simon Fraser University, 8888 University Drive, V5A 1S6, BC, Burnaby, Canada.
E-mail address: cmuris@sfu.ca (C. Muris).

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countries for the period 1988 to 1995. He prefers the fixed effects estimator and finds that inequality does not have an effect on emissions. For the pooled OLS estimator, he finds a statistically significant negative effect between income inequality and carbon dioxide emissions. Third, Heerink et al. (2001) use a cross-section design with 65 country observations from about 1985. The specification includes income, its square, and the Gini coefficient. Similar to Ravallion et al. (2000), they find that income inequality is negatively associated with carbon emissions per capita. All three studies rely on the inequality measure from the data set described in Deininger and Squire (1996). Two further studies use the University of Texas Inequality data which proxies household inequality with the between sector wage inequality in non-agricultural sectors. Drabo (2011) finds, in a 2SLS fixed effects framework using 86 countries finds that inequality increases emissions. Gassebner et al. (2008) use extreme bound analysis for a sample of up to 120 countries in 1960–2001 and find that inequality is robustly associated with smaller CO2 emissions. The use of the UTIP data, which relates to a particular aspect of industrial wage inequality, as a proxy for overall inequality is, however, controversial and can lead to biases (Scholl, 2016).

Our analysis uses expanded and improved data from Solt (2009), which is derived from the much broader, more consistent, and more reliable WIDER[2] World Income Inequality Database. This allows us to use a larger set of countries (158) than the existing literature, and observations from 1980 to 2008, which is larger and more recent than most existing studies. Furthermore, we argue that cross-section estimates based on pooled OLS or related methods are arguably not the most appropriate tools for this analysis, and argue that the group fixed effects estimator (Bonhomme and Manresa, 2015) is more suitable for the analysis. We also compare our analysis to a standard fixed effects estimator.[3]

We find that the relationship between income inequality and emissions depends on income levels. At lower levels of incomes higher income inequality reduces emissions while at higher levels of income, the effect is reversed. The group fixed effects also generate interesting differentiated time trends linked closely to trends in energy intensity in the different groups.

The rest of the paper is structured as follows. Section 2 reviews theoretical arguments in the existing literature, emphasizing that the relationship between income inequality and emissions is ambiguous. Section 3 describes the panel data set. Section 4 outlines the fixed effects model for our setting, and reveals its shortcoming in the current context. We then argue that a group fixed effects estimator is more appropriate, and describe that model. The main results and a sensitivity analysis are presented in Section 5. Section 6 concludes.

2. Theory

Starting in the mid-1990′s, economists have developed several theoretical arguments to explain the relationship between economic inequality and environmental degradation. For a full review, please see Cushing et al. (2015) and Berthe and Elie (2015). Here we only provide a condensed summary of this very large literature. While some of the arguments entail a positive association, namely the "equality hypothesis" proposed by Boyce (1994), Torras and Boyce (1998) and Borghesi (2006), others argue that greater inequality could also be negatively associated to emissions (Heerink et al., 2001; Ravallion et al., 2000; Scruggs, 1998). If the second argument prevails, there will be a tradeoff between redistribution policies and environmental quality.

Boyce (1994) proposes that greater inequality could increase environmental degradation via the impact on the rate of time preference and via a modified cost-benefit analysis that considers power-weighted costs and benefits. Boyce (1994) and Torras and Boyce (1998) assume that environmental quality is a public good and effective demand requires public policy solutions to this market failure. The factors which allow economies to redress market failure more efficiently are "vigilance and advocacy", as pointed out by Grossman and Krueger (1995) in earlier work. These two factors increase with per capita income because individuals gain greater power to make their demand effective through the political process. In particular, some individuals benefit from economic activities that generate pollution, whereas other citizens, adversely affected by pollution, bear net cost. The latter exercise vigilance and are in charge to demand for environmental controls, whereas the former attempt to prevent that those environmental controls are established or strengthened. Assuming that in more unequal societies those who benefit from pollution are more powerful than those who bear the cost, the benefit-cost rule will lead to predict an inefficient high level of pollution. This implies a positive correlation between income inequality and pollution. A controversial assumption they made to reach this outcome is that net benefit from polluting activities is positively correlated with individual income. However, Scruggs (1998) claims that wealthy and powerful individuals do not necessarily prefer more degradation than the rest and he also questions Boyce's underlying assumption that more democratic societies produce better environmental results than other political regimes. Also, it is unclear whether this argument, which has been formulated for environmental degradation more generally, also holds for carbon emissions. In the case of carbon emissions, costs are not only felt locally but globally and emission control is a global public good, where it is unclear that national income inequality will necessarily play a critical role in this mechanism.

In the same line of reasoning as Boyce (1994), Borghesi (2006) suggests that an increase in inequality hinders the way for public policy solutions to environmental problems and therefore greater inequality can contribute to increasing emissions. Also Marsiliani and Renstrom (2003) argue that higher inequality leads to less environmental protection and consequently higher emissions in an overlapping generations model with a majority elected representative. The author points to the anecdotal evidence that Scandinavian countries are the most protective of their environment among the developed countries, being as well the most egalitarian. A different argument is put forward by McAusland (2003) and Gassebner et al. (2008). Both suggest that inequality may influence emissions through the channel of factor ownership and voting. According to McAusland (2003), the relationship between income inequality and demand for pollution policy depends on the level of ownership concentration and openness to trade in countries. Hence, empirical tests of the relationship between income inequality and environmental quality are expected to yield ambiguous results. The author suggests controlling for the source of income inequality in each country as well as for the endogenous price effects of its pollution policy.

Gassebner et al. (2008) argue that, at least in richer countries, rising income inequality is associated with accelerated industrial decline (through increasing outsourcing of industrial production as well as skill-biased technical change), which in turn reduces the political power of industrial producers and workers, thereby reducing their ability to bloc measures to reduce pollution or emissions. Extending this line of argument, one could imagine that in poorer countries, the political clout of the rising industrial sector is rising as well, leading to less environmental regulation, particularly when richer population groups are associated with the rising industrial sector. Thus this line of argument could predict a different correlation between income inequality and emissions in poor and rich countries.

[2] Wider: World Institute for Development Economics Research.

[3] Other papers less related to our work consider the inequality-emissions relationship for small groups of industrialized countries. Magnani (2000) uses public expenditure for environmental protection as the dependent variable, and uses only 17–52 observations for developed countries. Marsiliani and Renstrom (2003) use sulfur, nitrogen and carbon dioxide and a different inequality measure: ratio of households ranked at top 90th percentile to the median household and two panels of 7 and 10 industrialized countries over 1978–97. Finally, Fourth, Baek and Gweisah (2013) use an autoregressive distributed lag specification and U.S. data to find that income inequality is negatively associated with short and long run per capita carbon emissions.