Native-borns and migrants do not contribute equally to domestic CO_2 emissions

Carlo Andrea Bollino, Univ. Marconi, Univ. Perugia, Univ LUISS, Roma, carloandrea.bollino@unipg.it
Marzio Galeotti, University of Milan, Italy and Fondazione Eni Enrico Mattei, Italy marzio.galeotti@unimi.it

Overview

Most studies dealing with climate change highlight the role of economic growth and population growth for the dynamics of carbon dioxide emissions. In the framework of the celebrated IPAT identity (*I* = *P* x *A* x *T*), we investigate whether or not migration affects CO2 emissions, augmenting the empirical equation by including the number of international migrants who each period arrive at the destination country. i. Thus we consider *M*, the number of migrants from any origin country.

In particular, a critical element of the population structure is net immigration, which impacts on the environment, via migration from rural to urban, i.e., urbanization, cross-regional migration within a country, and international migration. The history of the 1900s has seen waves of mass migration across countries, usually motivated by economic necessity, political unrest, religious differences, and natural disasters. In recent years global warming and other alterations of the climate system are increasingly important determinants of both internal and international migration.

The consideration of the ways in which migrants impact the environment relative to native-born individuals requires comparing their knowledge and technical skills, wealth and access to resources with those of non-migrants. As most GHG emissions are caused by combustion of fossil fuels for transportation, electricity generation, industrial and domestic use, relocation affects residential energy consumption through numerous channels, including transportation (private and public), electricity and home heating (Hill, 2024).

In this framework, it is surprising that there is no evidence in the extant literature whether the impact on carbon emissions by native-born individuals of a country differs from that of international migrants.

This paper fills this gap proposing two new contributions to literature. First, this paper estimates a new version of the Stochastic Impacts by Regression on Population, Affluence, and Technology equation (STIRPAT) of Dietz and Rosa (1994), analyzing separately the impact on carbon emissions of natives and migrants to a (destination) country. Estimating the emission elasticity of these two groups of people allows us to assess whether the difference is statistically different from zero. Second, this paper looks at the different impact within the group of 38 OECD and the group of 134 non-OECD destination countries, because an increasing portion of international migration has been taking place across countries belonging to this group.

Methods

Following the bulk of the literature we adopt the stochastic extension of the well-known IPAT equation originally proposed by Erlich and Holdren (1971). Our version of the STIRPAT model originally put forth by Dietz and Rosa (1994) accommodates the stocks of native-borns and of migrants when considering their impact of emissions of carbon dioxide. Assuming a cross-country panel dataset is available, the model is:

(1) $$CO_{2,it} = \left(N_{it}^{\beta_1} M_{it}^{\beta_2}\right) A_{it}^{\beta_3} T_{it}^{\beta_4}$$

where $CO_{2,it}$ are the CO_2 emissions of country i at time t, N and M are the stocks of native-borns and of migrated people or migrants respectively, A is affluence proxied by real per capita GDP and T is technology. Note that unlike the other variables, technology is treated differently across studies. While some studies use a specific variable or a combination of variables representing technology (e.g. energy intensity or energy/environmental R&D, population structure such as urbanization rate or population density), others consider technology to be included in the error term. Here we follow Casey and Galor (2017) by assuming that:

(2) $$lnT_{it} = \alpha_i + \gamma_t + Z_{it}'\delta + \epsilon_{it}$$

where α_i is a fixed effect capturing time-invariant differences between countries, γ_t is a fixed effect capturing differences in global technology over time that affect all countries, and Z_{it}' is a set of control variables affecting carbon emissions. Our STIRPAT specification thus becomes:

(3) $$lnCO_{2,it} = \alpha_i + \gamma_t + \beta_1 lnN_{it} + \beta_2 lnM_{it} + \beta_3 \ln{(Y/P)}_{it} + Z_{it}'\delta + \epsilon_{it}$$

As seen in the previous section, the literature has been especially interested in the population elasticity and in the difference between the elasticities of emissions with respect to (total) population on the one hand and to affluence on the other. If the estimated coefficient on population is significantly larger than the coefficient on income per capita, then decreases in population could potentially lower carbon emissions even while substantially increasing income per capita, overcoming the trade-off central to most environmental policies. With respect to (3) we are especially interested in comparing the emissions elasticities of native-borns and of migrants and assessing whether or not they differ from each other.

Results

We estimate (3) where our controls are $Z = \{RES, URB\}$ (RES= share of renewables in energy consumption , URB= share of urban population and fixed country and time effects are included. These variables control for the technology component of the IPAT equation and for the structure of population.

Let $X_{it} = \{N, M, (Y/P), RES, URB\}_{it}$. We write the Auto Regressive Distributed Lag (ARDL) version of (3) as follows:

(4) $\Delta lnCO_{2,it} = a_i + b_t + \sum_{j=1}^{J} c_j \Delta lnCO_{2,it-j} + \sum_{k=0}^{K} d_k \Delta lnX_{it-k} + \theta_1 \ln CO_{2,it-1} + \theta_2 \ln X_{it-1} + e_{it}$

We perform bound test, CD (cross-sectinally dependence) test and estimate the long-run "levels relationship" (4) with OLS, a DOLS method (Mark and Sul, 2003) and CCE (Common correlated effects).

The DOLS methodology involves estimating the following relationship:

(5) $\Delta lnCO_{2,it} = a_i + b_t + \varphi \ln X_{it} + \sum_{h=-H}^{+H} \sigma_h \Delta lnX_{it-h} + u_{it}$

where $H = 1$ or 2 with annual data.

The CCE methodology involves estimating the following relation

(6) $\Delta lnCO_{2,it} = a_i + b_t + \varphi \ln X_{it} + \lambda \ln X_{*t} + u_{it}$

where X_{*t} is the cross secrtino average in every period t.

We estimate the model for 38 OECD countries and 134 NON OECD coutris obtain significant and robust estimation results.

Conclusions

We find significant differences in the CO2 elasticities of native and migrants and in OECD and NON OECD samples. In the OECD group, the elasticity of CO2 to native population is around 0.90 - 0.98 and the elasticity of CO2 to migrants is around 0.09 and 0.12 These elasticity in the NON OECD group are lower, aounr 0.75 – 0.90 for natives and 0.003 – 0.06 for migrants.

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