Environmental Degradation and Migration in Italy:
an Empirical Evidence at Provincial Level

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Abstract.
It is now recognized that the question of human mobility in relation to climate change and environmental degradation has been gaining increasing prominence in the public and policy debates. Gradual environmental degradation is expected to cause most environmental migration in the long term, but all of these phenomena may result in large-scale population movements. Making predictions about environmental migration is a complex undertaking, involving numerous variables. It is often extremely difficult to isolate environmental factors as the sole drivers behind the decision to move. This research explores the possibility that concern with environmental risk may also be reflected in the choice of residential location. More specifically, we consider the relationship between the presence of environmental risk and migrations streams among provinces in the different regions within and outside Italy. While many factors can come into play on mobility decisions, it is suggested that the increased concerns with environmental risks may be influential in shaping internal and external migration patterns. We aim to investigate whether population flows move away from areas/provinces which pose high levels of environmental risk, toward those characterized by low risk levels, net of the other contextual factors associated with migration streams. Specific attention is paid to the environmental risks presented in sites contaminated by air and water pollution, hazardous waste facilities and toxic releases.

1. Introduction

Over the last few years there has been an upsurge of interest in the likely impact of economic degradation and climate change on human migrations. Estimates (IOM, 2009) have suggested that between 25 million to one billion people could be displaced by climate change over the next 40 years. This increasing awareness on whether and how environmental degradation impairs human security and forces people to leave their homes and migrate to place with a better quality of life, has created more attention on the effects of environmental degradation, climate change, population and has begun to realize that environmental risk can be found in their own backyard. Many studies demonstrate that climate change is taking place, that human activity has clearly contributed to the phenomenon, and that it will have far reaching repercussions for ecosystems and humans (IOM, 2011).

The role of environmental factors prompted some to classify the new breed of movers as "eco-migrants"(Gober, 1993, p. 32) or as people going "back to the wilderness" (Degler, 1971, p. 3). Terms and concepts such as environmental migration, climate change-induced migration, ecological or environmental refugees, climate change migrants and environmentally-induced forced migrants are found scattered throughout the literature. Yet there is no full consensus about to define the links between environmental change and migration: migrants or refugees[1]? [2] This lack of a commonly agreed definition presents difficulties in defining and measuring the phenomena. The main reason for the lack of definition relating to migration caused by environmental degradation is linked to the difficulty of isolating environmental factors from other drivers of migration. In this paper we refer to people who have an environmental degradation signal in their reason for migration as EIM, in line with the 2007 working definition provided by IOM.

Although many experts accept that environmental degradation and climate change are factors which can impact on the decision to migrate, the conceptualization of these factors as a primary cause of migration or forced displacement has been questioned (Black, 2001). Given the multi-causal nature of migration, which can result from a combination of various "push" and "pull" factors that can be inter-alia economic, social, political, establishing a direct causal link is a challenge. The key is assessing the extent to which the environment or climate change is the

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[1] The term "environmental refugee" was first popularized by Lester Brown of WorldWatch Institute in the 1970s and further by El-Hinnawi in the early 1990's. The term "environmental refugees" has been used 19 Migration, Environment and Climate Change: Assessing the Evidence Enhancing the Knowledge Base to describe the whole category of people who migrate because of environmental factors. This broad definition, while evoking an image that has brought public attention to the issue, is not sufficiently precise to describe all the various types of movements which may be linked to environmental factors.

[2] For a more detailed analysis see: Renaud et al. (2007); Bates (2002); Black (2001), Conisbee and Simms (2003); El-Hinnawi (1985); Myers (1993).

primary driver or simply one of many drivers of migration. Interestingly, a direct relationship between environmental degradation and migration is proposed primarily by environmental policy specialists. Other academic fields of inquiry do not regard environmental factors as key determinants of migration. Neoclassical economists, for example, emphasize either that potential migrants calculate their expected earnings in their place of origin in comparison to various places of destination (Sjaastad 1962; Todaro 1969); or that migration decisions are taken by the household as a whole as part of its survival strategy. As to the latter approach, migration of a household member is seen as a way for the household to minimize risks and maximize its chances of survival under conditions of economic uncertainty by diversifying its sources of income (Stark 1991; Stark and Bloom 1985). Sociologists highlight migrant networks and a 'culture of migration' (Massey 1990a; Kandel and Massey 2002). Political scientists stress political instability and armed violence as driving forces of migration (Moore and Shellman 2004; Davenport et al. 2003). To the extent environmental factors are considered in these approaches, they are regarded as either 'stressors' or 'locational characteristics' that provide physical amenities or disamenities influencing the likelihood of migration (Wolpert 1966; Speare 1974; Knapp and Graves 1989).

The international community, even though it has long recognized it particular vulnerability of the environmentally displaced, does not agree on a unique definition of environmental migrations given the complexity dynamics of migratory flows. The displacement of populations due to the degradation of the ecosystem is a phenomenon that is repeated in the history of humanity. Always the climate has conditioned human's life forcing him to look for forms adaptation to more hospitable environments. Unlike the past, however, the scenario that is currently emerging shows new elements: the modification of the environment by human is so rapid and the magnitude of the impacts so high, to far outstrip its own evolution. Human activities are significantly affecting them ecosystems and this is confirmed by a considerable amount of data, information, analysis of the state of health of our planet.

Development policies have begun to trace paths other than the ones so far followed. The same territorial unit of reference has changed. The trans-nationality of the phenomena caused by pollution, which is determined by the fact that all States are contributing to externality environment, has made global need for joint action plans. About 89% of the 606,000 lives lost in these events occurred not in Europe but in lower income countries where under-recording of disaster-related mortality remains an issue. Soil degradation, deforestation, pollution and water scarcity contribute to the decline global quality of the natural environment and the growth of the vulnerability of people increasingly forced to abandon them own lands.

Empirically, the existing literature on the environment-migration nexus is rather fragmentary. It relies mainly on case studies (Mortreux and Barnett 2009; Henry et al. 2004; Ezra, and Kiros 2001; Mese-Hausken 2000). These studies offer interesting insights into the complex relationship between environmental conditions and migration, suggesting that migration dynamics are context specific and thus findings are hard to generalize (Hunter 2005). Most of these studies focus on migrants (e.g., Doevenspeck 2011, van der Geest 2009; Gray 2008). This focus might result in biased results because it cannot account for decisions not to migrate. That is, these studies cannot consider the possibility that environmental degradation does not affect all people the same way, and that people do not respond to environmental degradation in a unified, singular manner. Moreover, the existing literature does not tell us much about how different types of environmental degradation affect incentives and decisions of people to migrate or stay.

When environmental degradation is a contributing but not major factor, it becomes questionable whether such migration can be called environmental migration. The main purpose of this paper is to come to a judgment on the likely impacts of environmental pollution on population migration within (and outside) the Italian provinces bridging the gap between the most classical theories on migration which tend to ignore the environment as a driver of migration and the most theories on environmental governance which tend to ignore migration flows.

This paper contributes to the environmental migration literature by addressing the shortcomings mentioned above. We develop a theoretical argument that links different types of environmental problems – notably short- vs. long-term problems – to decisions to migrate in Italy. Moreover, we use new micro-level data from provinces that covers those persons who migrated. The next section reviews the relevant literature. We then develop our theoretical argument and discuss the empirical approach and present the results. The final section summarizes the findings and discusses their policy implications.

2. Key References in the Literature

If the relationship between climate change and potential human migration has been captured by several studies[3], there are few studies about the interplay between climate change and environmental degradation, resulting socio-economic vulnerability and potential outcomes in terms of population displacement or induced migration (Warner et al., 2010). So far these relationship are poorly conceptualized and are reduced to simplistic casual explanations. This leads to misleading conclusions that deny the complex multivariate processes-environmental, political, social, and economic-which are the root causes of environmentally induced migration and/or conflict. Recent

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[3] See for example: Hugo, 1996; Myers, 2002; Warner et al., 2009;

international reports show a continuous increase in the frequency in manifestation of many hazards of natural events such as floods, droughts, storm surge, and others affecting people, generating increased damage globally. There are many factors that can explain these trends, including improved recording of disasters and their impacts, increased exposure of population to hazards (through for example, natural demographic trends or increased settlement in flood plains) or because of environmental degradation processes including climate change. Regarding the last point, many recent reports on global environmental trends have highlighted the degradation of the environment and the capacity of our ecosystems to provide or maintain services. According to the Global Environment Outlook[4] environmental degradation observed worldwide (air pollution, land and water resources degradation, loss of biodiversity) undermine development, human well-being, and the achievement of some of the Millennium Development Goals[5]. This report has similar general conclusions that other recent studies and notes that one of the many consequences of environmental degradation is human migration even though establishing direct link is difficult because of the potentially many push factors at play. Recently, the migration literature has paid more attention to climatic and environmental factors, such as sea level rise, environmental degradation, weather-related crop failures, and extreme weather events (Hugo, 1996; Myers, 2002; Warner et al., 2009; Piguet et al., 2011; Gray and Mueller, 2012), founding a significant influence of climate on human migration. Over the last thirty years, many researches have tried to identify the mechanisms through which climate change has an impact on migration. Forced migrations for climatic reasons are not new to our times. Unlike the past, however, the scenario that is currently outlining shows new elements: the modification of the environment is so rapid and the magnitude of the impacts so high, to far outstrips its own evolution.

Human activities are significantly influencing the ecosystems and this is confirmed by a considerable amount of data on the health of our planet. In our day, environmental degradation and climate change are turning into structural causes for migration. Many scholars claim that climate change will cause population transfers due to food shortages and water, floods, storms and pollution. The magnitude of the dynamics of migration flows is one of the causes which underlies the lack of a unique definition of "environmental migration", coupled with the unpredictability of the duration of events, to their variety, the geopolitical dimension as well as the additional factors that they intervene in the decision to migrate.

Although many experts accept that environmental degradation and climate change are factors which can impact on the decision to migrate, the conceptualization of these factors as a primary cause of migration or forced displacement has been questioned (Black, 2001). Given the

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[4] http://www.unep.org/geo/sites/unep.org.geo/files/documents/geo5_report_full_en_0.pdf
[5] http://www.un.org/sustainabledevelopment/

multi-causal nature of migration, which can result from a combination of various "push" and "pull" factors that can be inter-alia economic, social, political, establishing a direct causal link is a challenge. The key is assessing the extent to which the environment or climate change is the primary driver or simply one of many drivers of migration. Whether movements in relation to environmental or climate change are forced or voluntary is also the subject of much debate. In some situations, such as natural disasters, people may have little choice but to move. However, migration patterns beyond the immediate move may shift between forced and voluntary. In other situations where environmental change is gradual, movement is more likely to be voluntary and linked to other economic, social and political factors.

Recently a new debate emerges on Environmentally Induced Migration (EIM), the debate on potential for large displacements of factors caused by factors environmental issues have become part of the international discussion. Its effects on the global economy, international development and national budgets could be profound, with significant implications for almost all dimensions of human security, in addition to political and state security. The increased interest in environmental matters and the quality of life has led to a propagation of researches and studies relating to the factors affecting migration from one area to another. In the literature on migration and environment the focus of research has clearly been an environmental change as a cause of migration rather than a consequence. Yet the concept of environmental induced migration remains a contested one (Black 2001; Castles 2002). Castles (2002) suggests that there are three major elements in the debate on environmentally induced migration: i) a debate over the terminology and definition of 'environmental refugee' (Hinnawi 1995; Jacobsen 1988); ii) can environmental factors be recognized as a root cause of migration?; iii) who will provide protection for environmentally displaced people?

Fundamental to the consideration of environment as a cause of migration is the distinction which is conventionally recognized in migration study between forced and unforced migration (Fairchild 1925; Peterson 1958). However, the distinction between voluntary and involuntary migration is not as clear-cut as it would appear at first glance. Environmentally induced migration is concerned with moves toward the forced end of this continuum. While the occurrence of a disastrous environmental event is a significant and increasingly important cause of environmentally induced migration, more migration occurs due to less dramatic, gradual, deterioration of environments. It is not sufficient to consider the migration-environment relationship only in terms of migration induced as a response to the occurrence of particular environmental events. As Suhrke (1992, 5) points out:

'From a broader development perspective, environmental degradation appears as a proximate cause of migration. The underlying causes are found in increasing population pressures on land and the patterns of resource use. Demography and political economy, in other words, are most salient causal factors. Yet these obviously interact in critical ways with specific environmental variables. Sometimes the result is stress of a kind that leads to massive outmigration. But to understand why, it is necessary to focus on the broader development process.'

Similarly, Richmond (1993, 8) argues: '… *when environmental degradation leads to migration it is generally as a proximate cause linked to questions of economic growth, poverty, population pressure, and political conflict.*' Richmond (1993) recognizes that certain contexts are more susceptible to environmental disruptions likely to force outmigration than others. These, for example, would include: ecologically fragile ecosystems which, when subject to excessive cropping, forest removal or other human use impacts, become less productive areas at high risk of natural disaster – earthquake zones, low lying areas subject to inundation, etc.; marginal agricultural or pastoral areas subject to frequent drought; and areas of poverty where the residents do not have the accumulated reserves to prevent, ameliorate, or cope with the onset of a natural disaster. Hence, the predisposing factors for environmental migration can be environmental but also are related to population pressure upon natural resources, the way in which the environment is being exploited by people, and the wealth and capacity of the occupants of the area.

Environmentally induced migration is likely to be worsened by particular environment-related events which effectively can force people to move. Recent studies show that environmental degradation does have an impact on international migration. In the examination of the impact of environmental degradation on population it is important to remember that migration is only one of the ways in which populations affected respond. It can be argued that there needs to be more attention paid to other responses, in particular in situ adaptations to the effects of environmental processes. This is of particular significance when considering the provision of assistance to population impacted by environmental degradation.

The existing literature on the environment-migration nexus is dominated by neo-Malthusian and push-pull theories. The prevailing argument holds that environmental changes deprive people of their livelihood and force them to migrate to better environments, usually permanently. This argument identifies a direct, unidirectional, causal relationship between environmental changes and migration. Several authors (e.g. Lonergan 1998; Castles 2002) argue that environmental, economic, social, and political factors are interrelated and need to be examined jointly in order to understand the role environmental factors play in population movements. However, there is no a single and

coherent theory of migration, but it necessary to consider various economic, social, demographic, environmental, and other factors that may influence migration.

Most of the existing scientific literature on this topic regards the relation between environment and migration flows from one country to another. Empirical research shows that migration can in fact be a response to environmental degradation. Environmental degradation (or risk) can contribute to migration by pushing people out of affected areas, thus, migration may be driven by environmental changes. Among the studies that considered whether pollution can cause within-country migration, Cebula and Vedder (1973) examine to what extent migration within the U.S. can be explained by air pollution, crime rates, or climate; they do not find that air pollution is a significant causal factor. Hsieh and Liu (1983) also consider migration within the U.S. and find that the difference between two regions' environmental quality is an important factor in explaining interregional migration. They argue that in the short-run, pursuance of better environmental quality is the dominant factor in explaining interregional migration in the United States. The environmental factors which they consider include climatological data and information on recreational areas and facilities, as well as solid waste production and air, water and noise pollution.

Yet there is no full consensus about to define the links between environmental change and migration: migrants or refugees[6]? [7] This lack of a commonly agreed definition presents difficulties in defining and measuring the phenomena. This working definition encompasses people who are displaced by natural disasters as well as those who choose to move because of deteriorating conditions. It also acknowledges that environmentally induced movement or displacement can be internal as well as international. The above definition further recognizes that environmentally induced migration can be a short-term or long-term phenomenon. In presenting this definition, the intent is not to ignore other intervening political, economic and social factors, but rather to focus policy on a key driver of human mobility that has all too often been overlooked. The intent is also to offer an alternative definition to "environmental refugees", a term that UNHCR has stressed has no legal grounding in international refugee law. In this paper we refer to people who have an environmental degradation signal in their reason for migration as EIM, in line with the 2007 working definition provided by IOM.

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[7] For a more detailed analysis see: Renaud et al. (2007); Bates (2002); Black (2001), Conisbee and Simms (2003); El-Hinnawi (1985); Myers (1993).

The topic of environmental migration has often been studied within separate fields in the natural and social sciences or within a sub-set of the larger field of environment studies. How the subject has been framed impacts on both data collection as well as the methodological approaches used. Though migration theory does historically take into account environmental indicators, it is only recently that it has received renewed attention. There are several factors which make it difficult to measure current levels of environmental migration and to predict the likely scale of future follows. It is extremely difficult to predict the impact of climate change and climate modeling techniques to date have not yet begun to account adequately for the impact of individual choice, the potential for international action and the variability of future emissions and meteorological scenarios. The absence of an adequate definition to cover migrants affected by climate and environmental change, discussed above, also presents a challenge for statistics gathering. Disaggregating the role of climate or other environmental change from other economic, political and social factors which drive migration, while also taking into account migrants' perception and behaviour in relation to such change, is a difficult task.

Gradual environmental change and slow onset natural disasters influence population migration patterns in different ways. Natural disasters may include geological hazards such as earthquakes or volcanic eruptions. They may also be of an atmospheric or hydrological nature, such as tropical storms or floods, with secondary impacts such as landslides. Any natural disasters may cause affected populations to leave their homes at least temporarily, although return is often feasible in the long run. A larger number of people overall is expected to migrate due to a gradual deterioration of environmental conditions. According to ILO (2015), environmental factors have long had an impact on global migration flows, as people have historically left places with harsh or deteriorating conditions. However, the scale of such flows, both internal and cross-border, is expected to rise as a result of accelerated climate change, with unprecedented impacts on lives and livelihoods. When people are faced with severe environmental degradation they have one of three options: 1. stay and adapt to mitigate the effects; 2. stay, do nothing and accept a lower quality of life; 3. leave the affected area. The process of movement and migration is usually subject to a complex set of push and pull forces, where push forces relate to the source area while pull factors relate to the destination. This brief review of the literature shows that environmental changes *can* act as a driver of migration.

3. Data description and empirical strategy

3.1. Data and variables description

As broadly discussed, the main objective of this work is to test whether outflows migration at

provincial level could be explained using pollution, economic as well as socio-demographic variables. Our dependent variable measures the transfers of residence by province of origin and place of destination in the years 2011-2015. The Tagliacarne Institute and the Union of Italian Chambers of Commerce provide the relative data. For our main independent variable, we use the information on air pollution provided by the Italian Institute for Environmental Protection and Research (ISPRA)[8] which is responsible for the National Emission Inventory. The ISPRA dataset includes data on air emissions in all the Italian provinces (110 provinces distributed over 20 regions).[9] This is a comprehensive database that collects all emission estimates of the major pollutants including greenhouse gases, ozone precursors, benzene, particulate matters, heavy metal and polycyclic aromatic hydrocarbon. The national inventory is reported to the European Commission at the national aggregated level, but it is calculated at the regional level and then disaggregated at the provincial level. In the 2015 ISPRA "Disaggregation of the National Inventory 2010" Report, data related to the disaggregation of the emissions of the national inventory at the provincial level are available, divided by activity according to the SNAP (Selected Nomenclature for Air Pollution) classification.[10] The SNAP classification consists of 11 macro-sectors. We use data relative to sector 01 (combustion in energy and transformation industry), sector 03 (combustion in manufacturing industry), sector 04 (production processes), sector 09 (waste treatment and disposal), and sector 10 (agriculture) and since we want to base our analysis on air pollution emissions released by these sectors and not also from road, air, or sea transportation. All explanatory variables are lagged to reduce the risk of endogenous regression: air pollution emission data and all the socio-economic variables are, in fact, from 2010 and they were combined with the averaged outflow migrations from 2011 to 2015.

The other independent variables were chosen according to the most commonly used in studies on eco-migrations. Income and educational levels are also considered relevant variables that can affect migration (Xu and Sylwester, 2016). Some indicators of local economic conditions are considered such as the provincial level unemployment rates, the healthcare facilities index, the infrastructural endowment, the Legambiente (a prominent environmental Italian NGO) quality of

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[8] ISPRA is the Institute for Environmental Protection and Research established by Italian Law 133/2008. The Institute performs the functions of three former institutions: APAT (Agency for Environmental Protection and Technical Services), ICRAM (Central Institute for Applied Marine Research), and INFS (National Institute for Wildlife).

[9] We are aware of the fact that the use of too broad a scale or unit of analysis has been discouraged (Anderton et al., 1994), but the most disaggregated available Italian data are only at provincial level.

[10] This classification includes all activities which are considered relevant for atmospheric emissions. The ISPRA database is characterized by three different typologies of emissions: area, point and linear sources. For area emissions (emissions from sources distributed on the territory) a direct measurement is not feasible, and it is necessary, therefore, to estimate them from statistical data and specific emission factors. The approach that ISPRA has applied is based on a linear relation between source activity and emission, following this relation: $E_i = A * FE_i$, where: E_i = emission of the pollutant i (g year^{-1}); A = activity indicator (i.e. produced amount, fuel consumption, etc.); FE_i = emission factor for the pollutant i (i.e., g t^{-1} of product, kg/kg of solvent, g inhabitant^{-1}).

life index, the rate of deaths for cancer pathologies. Demographic variables like the percentage of male and female population and the age class of population are also examined (Chaix et al., 2006; Greenberg, 1993).

3.2. Econometric Methodology

In this section we implement a simple model of eco-migrations, which posits a relationship between (2011-2015) migration flows in each province and (2010) provincial-level environmental quality variables, plus some (2010) socio-economic-demographic control variables in order to explore the main research question, namely, to what extent does pollution lead to migration to other provinces in the same region/in other regions/or outside the country? The estimated model takes the following form:

$$envmigration_{it} = \beta_0 + \beta_1 pollution_{it} + \beta_2 X_{it} + \varepsilon_{it}$$

where the subscripts i and t represent province and time period, respectively. The dependent variable measures the migration of the population, which is estimated against a set of independent variables; those individuals who reported a change of residential location, across provinces are considered migrants. X is a set of socio-economic and demographic variables (i.e., income, unemployment, level of education, gender, age, density, etc.).

4. Results

Table 1 provides the OLS estimates, which shows that the *income* variables in their linear and quadratic specification are both statistically significant. The linear specification is positively associated with emigration while the quadratic specification being negative allows us to identify an inverse U- shaped relationship with the dependent variable. Coefficient estimates for the proportion of male population and for population density are positively related to the dependent variable revealing that migrants can be attracted to move in high-density areas (that may be also more susceptible to the environmental degradation) due, perhaps, to greater job opportunities that bigger provinces might offer. The coefficient estimate for proportion of the young adult population aged 15-39 is statistically significant but is negatively related to the dependent variable: this result might support the idea that in Italy young adult internal migration is generally low, especially when compared with other countries, such as the USA (Faini et al., 1997) mainly due to the lack of dynamism and flexibility of the job-market at national level. We can notice that the level of education and the level of both indicators of air pollution (global and local pollutants) that we calculated are not statistically significant. Hence, so far, our results provide no support for the contention that environmental degradation plays a role and it is associated to migration. These

results are novel in the Italian context, but provided that our findings are based on cross-section data, caution must be taken in interpreting the findings reported here.

Dependent variable: outmigration 2011-2015	coefficients	robust standard errors	$P>|t|$
per-capita income	0.0005	0.0002	0.041
per-capita income ^{2}	-0.00002	0.0000	0.025
air pollution local	-4.46e-08	3.01e-07	0.883
air pollution global	1.41e-07	3.45e-07	0.684
education	-0.0007	0.0005	0.165
pop_density	1.41e-06	4.37e-07	0.002
males	0.1167	0.0569	0.043
popaged_15-39	-0.0530	0.0172	0.003
constant	-0.0251	0.0266	0.348

Number of obs= 109
$F_{(8, 100)} = 3.62$
Prob > F = 0.0010
R-squared = 0.1865
Root MSE =0.00211

5. Conclusions

Environmental degradation can pose significant challenges to human security and sustainable economic and this can result in substantial human movement and displacement. While research on the environment-migration nexus has been conducted for some time, the issue of the relationship between environmental degradation and migration in Italy is relatively scant and new. Even though, so far, our analysis does not allow us to say that the decision to migrate can be somehow affected by environmental degradation, it does allow us to increase our understanding of eco-migrations in Italy. The estimates obtained indicate that migration is positively associated with income and they are also consistent with an inverse U-shaped relationship: once income exceeds a turning point, migration flows tend to decrease with increasing income. Our findings do not allow saying internal migration in Italy might be explained by environmental degradation suggesting that awareness on environmental-related issues is still low and people can be willing to tolerate pollution in favor of increased economic activity that raises income.

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