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Does income growth relocate ecological footprint?

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ABSTRACT

The aim of this paper is to investigate whether countries tend to relocate their ecological footprint as they grow richer. The analysis is carried out for a panel of 116 countries by employing the production and import components of the ecological footprint data of the Global Footprint Network for the period 2004–2008. With few exceptions, the existing Environmental Kuznets Curve (EKC) literature concentrates only on the income-environmental degradation nexus in the home country and neglects the negative consequences of home consumption spilled out. Controlling for the effects of openness to trade, biological capacity, population density, industry share and energy per capita as well as stringency of environmental regulation and environmental regulation enforcement, we detect an EKC-type relationship only between per capita income and footprint of domestic production. Within the income range, import footprint is found to be monotonically increasing with income. Moreover, we find that domestic environmental regulations do not influence country decisions to import environmentally harmful products from abroad; but they do affect domestic production characteristics. Hence, our findings indicate the importance of environmental regulations and provide support for the "Pollution Haven" and "Race-to-the-Bottom" hypotheses.

1. Introduction

This paper intends to detect whether countries tend to export negative environmental consequences of their consumption as they grow richer, and uncover the factors that drive such behaviour. With the ever-expansion of the world economy notably in the last three decades, the observation that our globe has already gone beyond its limits in terms of resource use is backed by several environmental indicators, e.g. the ecological footprint developed by Wackernagel and Rees (1996). According to the data provided from the Global Footprint Network (GFN), current global consumption is 50% beyond the Earth's biological capacity (World Wildlife Fund for Nature, 2012). Moreover, among the 199 countries reported, only 60 countries have higher biological capacity than their ecological footprint as of 2008. That means 139 countries ran biological deficits that can only be covered by either importing biological capacity and/or depleting their biological stock, which are not environmentally sustainable ways given the available stocks and their limited regenerative capacity.

The impact of income growth on domestic environmental quality and natural resources has been investigated extensively in the literature. According to one of the most popular hypothesis, called Environmental Kuznets Curve (EKC), there is an inverse-U-shaped relationship between environmental degradation and economic growth; that is, environmental degradation increases as income increases up to an income threshold and starts to fall. In the majority of the EKC studies, a one-dimensional environmental quality indicator (such as CO_2 emissions, waste, etc.) has been employed and the effects of income on the environment have been measured in the country where production and consumption take place. Yet, it is clear that the effects of economic activities on environmental quality are multi-dimensional rather than one-dimensional. Moreover, in today's globalized world, locations of production and consumption have been changing rapidly. This necessitates the measurement of environmental degradation and natural resource exploitation not only in the location where consumption takes place but also in the production location given the fact that international trade and capital flows make it possible to import rather than produce domestically the goods which are ecologically destructive (Peters et al., 2011; Weinzettel et al., 2013).

Previous EKC literature brings us to the discussion of whether the EKC relationship is quasi-automatic or policy-induced

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(Grossman and Krueger, 1995; Van Alstine and Neumayer, 2010). Heavy regulation at home may force companies to adopt cleaner technologies at home and/or force dirty industries to migrate abroad where regulations are laxer. Apart from these push factors, it is also observed that many developing countries are forced to lower their environmental standards in the aim to gain international competitiveness and to attract foreign direct investments which are perceived as essential for sustaining economic growth. Therefore, it is plausible to think that increasing environmental quality in a rich country could be gained at the expense of degrading environmental quality abroad. In other words, from a global perspective, an EKC-type relationship at home does not necessarily imply that domestic consumption patterns have been put back on an environmentally sustainable path. By importing rather than producing those goods causing environmental degradation, a society can simply continue its "unsustainable" life-style (Schütz et al., 2004; Mayer et al., 2005; Berlik et al., 2002).

In this paper, we deal with these two less frequently addressed topics in the EKC literature. First, we focus on the multidimensional property of environmental degradation and natural resource use. Second, we distinguish between environmental pressures created in the domestic economy versus abroad. We employ the multi-dimensional ecological footprint data to measure environmental quality and natural resource depletion with a panel fixed-effects analysis to detect the relationship between income and footprints that result from domestic production and imports for 116 countries in the period 2004–2008 within the EKC framework. Ecological footprint data enable to track the effect of income on domestic and foreign biological capacities and hence provide a better understanding. Moreover, as a multi-dimensional indicator, ecological footprint might help us to portray a more general picture.

The outline of the paper is as follows. The following section reviews the relevant literature. Section 3 describes the data and the model used. In Section 4, we report the regression results, and finally, Section 5 concludes.

2. Background and relevant literature

The EKC hypothesis suggests that the effects of economic growth or income on the environment are carried out through three channels called the "scale", "composition and "technology" channels. The pioneering study by Grossman and Krueger (1991) asserts that the negative scale effect (increasing consumption due to increasing affluence) tend to prevail in the initial stages of economic growth, but after a threshold level of development it should be outweighed by the change in the composition of production (shift towards cleaner sectors) and by the change in technology employed (shift towards cleaner technologies). Following this study, numerous studies have been conducted in search of the existence of an EKC in different countries using various environmental quality indicators. Yet the empirical evidence is mixed; that is, it is not possible to assume a unique curve for all types of environmental degradation (see Dinda (2004) and Carson (2010) for a critical survey of the recent EKC literature). Whether it exists or not, the question which the majority of the EKC studies leave unanswered is whether environmental pressure is decoupled from income growth on the global scale or not.

In contrary to the bulk of the literature that focuses on single pollution indicators to investigate the EKC hypothesis, there are a limited number of studies that address the consumption-based approach to the EKC. Among them, Bagliani et al. (2008) utilize ecological footprint data for 141 countries in 2001 and conduct Ordinary Least Squares and Weighted Least Squares analysis on linear, quadratic and cubic functions, in standard and logarithmic specifications, as well as a nonparametric regression. Their results suggest that using ecological footprint as a dependent variable does not reveal an EKC-type relationship. Instead they find that environmental pressure is intensified as income per capita increases. These findings are supported by both York et al. (2004) and Caviglia-Harris et al., 2009, who emphasize that ecological footprint rises significantly with gross domestic product (GDP) per capita. Al-mulali et al. (2015, p. 315) point out that the EKC "only occurs in a stage of economic development in which technologies are available that improve energy efficiency, energy saving and renewable energy" in their panel analysis of 93 countries. Chen et al. (2010), on the other hand, examine the relationship between ecological footprint and social development level rather than GDP per capita and fail to evidence an inverted U-shaped relationship. Most of these studies do not make use of relevant control variables such as industry share and environmental regulation in search for this relationship where as our analysis contributes to the literature by acknowledging the importance of various factors other than income.

An increase in environmental quality after a certain level of income (hence an EKC-type of turn) at home can easily be achieved without altering the unsustainable consumption patterns thanks to the increasing international trade and capital flows. Andersson and Lindroth (2001) lists four different ways of how trade may affect ecological footprint: (a) positive *allocative effect*, which reduces ecological footprint as trade enables specialization of countries on products which are produced with a higher yield, (b) negative *income effect*, which increases ecological footprint as trade helps countries raise their income, and thereby, consumption, (c) negative *rich-country-illusion effect*, which highlights the false impression in rich countries that their lifestyle is sustainable which might be formed thanks to the possibility of importing bio- and sink-capacity from poorer countries, and (d) negative *terms-of-trade distortion effect*, which hints to the tendency of poorer countries to exploit natural resources beyond sustainable scales to protect themselves from falling terms-of-trade during boost periods in world demand.

The possibility of importing bio- and sink-capacity with rising income also creates another illusion on the side of poor countries that economic growth is the necessary condition for a better environment (Nordström and Vaughan, 1999). This, at the end, causes ecological footprint to climb up both in rich and poor countries. Therefore, it is indispensable to consider the effects of international trade when dealing with income-environmental quality relationship *a la* EKC. This is where this paper departs from others: analysing separately the effect of income (after controlling for several factors) on ecological footprints caused by domestic production and imports.

The positive effects unleashed by increasing income in richer countries (through channels of composition, technology and increasing sensitivity reflected in tightened regulations) could help to clean up the domestic environment; but this does not guarantee an overall reduction in environmental degradation globally, if not an increase. There are several ways of importing environmental burden of consumption in rich countries that can be understood in the context of "unequal ecological exchange" among countries (Andersson and Lindroth, 2001). One explanation is that less developed countries extract natural resources and export them to more developed ones so that the latter externalize pollution and environmental costs by means of importing resource-intensive goods or energy materials. Schütz et al. (2004) describes how improvements in the motor-car emission technology, possibly triggered by tightened regulation in the EU countries, relocate polluting production processes in the form of ecological rucksacks and how such relocation increases pollution. They find that the pressure on the environment due to "ecological rucksack" of the EU imports from developing countries stood at 5 to 1: that is, one tonne of imported raw materials resulted in 5 tonnes of erosion or unused extraction

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