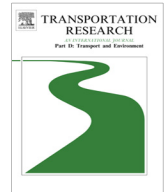




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Modeling the causal linkages between transport, economic growth and environmental degradation for 75 countries



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ABSTRACT

This article investigates the causal relationships between freight transport, economic growth and environmental degradation for 75 countries over the period 2000–2014. Based on the income level of countries, we divide the global panel into three sub-panels; namely, high-income, middle-income and low-income panel. The distinction between panels allows the employing of dynamic panel data models in simultaneous-equations estimated by the Generalized Method of Moments. The main results note the existence of feedback effect among income and transport. For the high-income panel, a bi-directional causality exists between environmental degradation and economic growth and a unidirectional causality goes from transport to environmental degradation. The results give the same findings for the middle and low-income panels where we found an environmental degradation mainly affected by economic growth and freight transport while, in the reverse direction, the effect is weak and statistically insignificant. This empirical evidence supports strongly the coupling relationship between economic growth and freight transport, but rejects the feedback effect between environmental degradation and economic growth for the middle and low-income countries.

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1. Introduction

The coupling relationship between economic growth and transport activity becomes a very critical topic, at both national and international level. Several research studies argue the positive effects of the phenomenon. They indicate that the economic growth is the mainstay of any country's economic development. Moreover, they insist on the critical role of transport in the economic activity and investigate the relationship between transports and economic development (Pradhan and Bagchi, 2013; Fedderke et al., 2006; Kim, 2002). On the opposite side, the energy economists' say that the climatic change and global warming have emerged as some of the most serious problems facing the international community. Schäfer (2005), Sorrell et al. (2009) and others realize several studies proving that the transport affects effectively the environmental quality; it is among the greatest consumers of fossil energy which contribute significantly on the emissions of greenhouse gases.

In the recent years, climatic changes have had a strong influence on the human system and environmental quality. Therefore, to promote the environmental protection, a considerable attention has been paid to reducing the energy consumption (EC) and limiting the pollutant emissions. For the majority of studies, the economic development and energy demand are the two most main causes of environmental degradation. They have become decisive factors in environmental pollution and var-

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ious studies limit their analyses only to greenhouse emissions, particularly CO₂ emissions, which is mainly correlated with energy consumption and economic growth. In the same vein, we inspect that EC and EG alone may not explain environmental degradation (ED) (Zhang and Lin, 2012; Ozturk and Acaravci, 2013). Therefore, we need to consider other variables that are associated with carbon emissions. In the present work, we introduce the freight transport (FT) as a key factor that we seek to explain its relationship with the economic growth (EG) and the environmental degradation (ED).

The nexus between FT, EG and ED has treated in three lines. (i) In a first one, the economists analyze the relationship between income and freight transportation. For a few decades, the issue of coupling/decoupling between growth and freight transport is analyzed and well treated in several works (Joignaux and Verny, 2004; McKinnon, 2007; Meersman and Van de Voorde, 2013; Yao, 2005; Mraïhi, 2012). (ii) In a second line, we found that a higher economic growth means necessary more energy use, which causes higher levels of pollutant emissions especially the carbon dioxide. Also, the economists have used several methods and techniques to study the significance of the relationship between economic growth and environmental degradation under the heading of the environmental Kuznets curve (EKC) hypothesis (Chandran and Tang, 2013; Borhan et al., 2012; Zhu et al., 2012; Omri et al., 2014; Shahbaz et al., 2015b; Magazzino, 2014; Dogan and Turkekul, 2016). (iii) In a last line, the literature investigates the causal relationship between freight transport and carbon dioxide emissions as indicator of environmental degradation. Several studies have interested in this causal relationship and on some of its main factors (Tanczos and Torok, 2007; Léonardi and Baumgartner, 2004).

As far as we know, none of the empirical studies has focused on investigating the nexus among environment-transport-growth via the simultaneous equations model. To analyze the causality between the three variables, we adopt a dynamic simultaneous-equations model with panel data. In other words, we have three structural equation models examined simultaneously. The first notes the impact of freight transport and environmental degradation on the GDP growth. The second exposes the effect of economic growth and environmental degradation on the freight transport and the last model explores the impact of economic growth and transport on environmental degradation. Furthermore, the present paper investigates the critical relationship between transport, growth and environment in an original way. On the one hand, the transport is essential for the economic development of nations and it has an important role to stimulate the production function. Moreover, the transport ensures the effective functioning of public and private sectors and affects strongly their competitiveness. On the other hand, it has numerous negative impacts that affect negatively the environment and life quality especially in the large cities. For these reasons, we can say that the contribution of this study to the literature on the environmental Kuznets curve is the modification and extension of the model by including additional variables. In this study, we use a simultaneous equations model and we add the transport as one of the endogenous variables. In fact, the transport is also endogenous to the system, being affected by economic growth, carbon dioxide emissions, energy use and other variables.

For the econometric investigation, we use the data of a global panel consisting of 75 countries over the period between 2000 and 2014. The model allows the examining in the same time the interrelationship between environmental degradation, freight transport and economic growth estimated by the Generalized Method of Moments (GMM). The present paper starts by introduction followed by theoretical study in which, we present the previous works in relation with our subject. The methodological framework is explained in section two and in section three, we have the used data and the obtained results. The last section concludes the study, and gives some policy implications.

2. Literature review

2.1. Transport and environmental degradation

According to International Energy Agency (IEA, 2009)¹ the transport sector consumes 2231 million tons of oil equivalent of energy in the world. In OECD North America and Europe, the transport is considered as the biggest consumer of energy and economists expect an increase by 80% of the fuel use between 2005 and 2050. They say that 27% of the global transport energy in 2006 is consumed by trucks and rail transport. Furthermore, we find that several research studies expect an increase by 50% of the trucking energy use for double quantity of freight moved by trucks, by 2050 which gives an augmentation of energy efficiency by 20%. For the rail transportation, the freight volume is expected to rise by around 50% and the energy efficiency will be multiplied by 120% for the same period. The same reference (IEA, 2009) indicates that in all the world regions, the transportation sector remains strongly dominated by petroleum fuels. Recently, the general policies in the world trends attempted to decrease the quantities of fossil energy used by transport. They try to improve the efficiency of new resources like Biofuels (ethanol and biodiesel), liquefied petroleum gas (LPG), and compressed natural gas (CNG) and electricity.

To investigate the major factors of greenhouse gases, Steenhof et al. (2006) have used decomposition of energy intensity. Their findings note that if the share of freight road transport continues to increase in Canada, the technical progress becomes an inadequate solution to decrease the emissions of greenhouse gases (GHG). In England, Sorrell et al. (2009) say that the augmentation of vehicle transportation capacity and the decrease of vehicle average energy consumption are effective solutions that can reduce significantly the CO₂ emissions and ameliorate the environmental quality. In a study concerning Germany, France, Spain, Italy and England, Gleave (2003) found that the environmental degradation is positively affected by the big volumes of dioxide carbon emissions and the reducing of the share of freight transported by roads in these countries

¹ For more details see: <http://www.iea.org>.

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