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Transportation intensity, urbanization, economic growth, and CO_2 emissions in the G-20 countries

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ABSTRACT

This paper examines linkages among transportation intensity, the extent of urbanization, CO_2 emissions, and economic growth. We use two measures of transportation intensity: (i) per-capita rates of utilization of air-passenger transport facilities and (ii) per-capita rates of utilization of air-freight transport facilities. By studying the G-20 countries over the period 1961–2012 and employing a panel vector auto-regressive model for detecting Granger causality, we find a network of causal connections among these four variables in the short run. We also find that economic growth tends to converge to its long-run equilibrium path in response to changes in the other variables. Our fundamental conclusion is that passenger carriage intensity should be improved in the developing countries within the G-20 for the purpose of propelling economic growth.

1. Introduction

Transport facilities[1] are among the world's most vital infrastructure. Their creation and usage contribute significantly to economic growth and thus to the achievement of other national and socio-economic development goals (Kuştepeli et al., 2012; Anaman and Ose-Amponsah, 2007; Kim, 2006; Lem, 2002; Bougheas et al., 2000; Gramlich, 1994). Transport facilities can contribute to economic growth both directly and indirectly (Beyzatlar et al., 2014; Pradhan and Bagchi, 2013; Phang, 2003; Bhatta and Drennan, 2003; WDR, 1994): They do so in three significant ways: (i) by improving the overall productivity of production units (Bougheas et al., 2000; Lakshmanan, 2007); (ii) by promoting technological spillovers across economies; and (iii) by raising the profitability of transport-connected businesses, either by increasing the scope of their sales or by reducing their production and delivery costs.

This research focuses on transportation intensity: the extent to with which transportation facilities are used, and their economic, urban and environmental linkages and consequences of transportation intensity. Transportation has been the subject of detailed academic analysis, particularly since the seminal works of Aschauer (1989) and Eisner (1991). The central remaining questions are whether transportation intensity enhances economic growth, whether economic growth increases transportation intensity, whether they reinforce one another (see Fig. 1 for the feedback loop), and whether they jointly impact upon other related variables.

This paper sheds light on linkages between transportation intensity and economic growth in the presence two other macroeconomic indicators that operate adjacently: the extent of urbanization and carbon dioxide (CO_2) emissions. Although the causal relationship between economic growth and transportation activity has been studied before, the core contribution of this paper is to study this relationship conjointly with the degree of urbanization and CO_2 emissions. Thus, we study the causal links among all four variables identified. The case for developing transportation in the interest of nurturing long-run economic growth is propounded in a litany of articles using different measures of transportation activity (Beyzatlar et al., 2014; Lean

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[1] Transportation involves all the facilities that enable physical goods, human beings and services to move between locations. Thus, transportation activity can be interpreted as the usage of railroads, highways, water courses and canals, conveyor systems, streets, airports, sea ports, rail heads, terminals, and the like.

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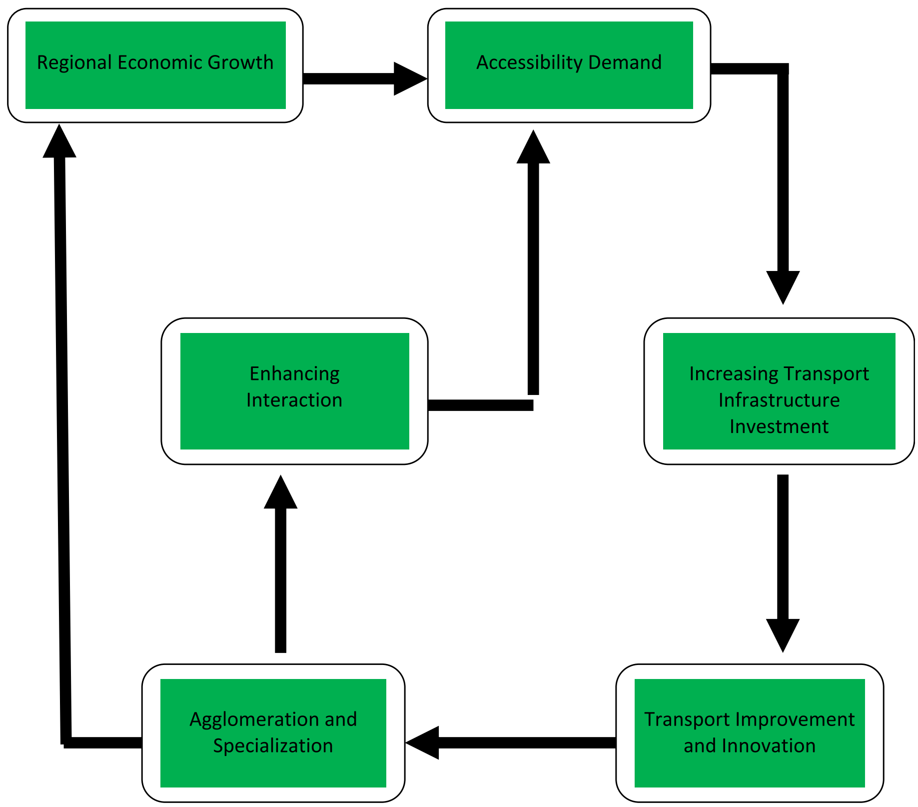

Fig. 1. The feedback loop of economic growth to transportation activity.
Source: Zhang (2009).

et al., 2014; Pradhan and Bagchi, 2013; Yu et al., 2012; Fernandes and Pacheco, 2010; Tervo, 2009). At the same time, some researchers have suggested linkages between the extent of urbanization *or* CO_2 emissions and transportation development *or* economic growth (Abdallah et al., 2013; Hossain, 2011; Liddle and Lung, 2013; Salim and Shafiei, 2014). Logically, transportation intensity may affect economic growth both directly (through productivity channels) and indirectly (through effects on urbanization and CO_2 emissions). However, previous work on the transport-growth nexus has not considered urbanization and CO_2 emissions.

Fig. 2 presents the conceptual framework of the relationships between transportation intensity, urbanization, CO_2 emissions, and economic growth. Two additional novel features of this study are that: (i) we consider a group of countries that have been relatively neglected in previous research in this area, namely the G-20 countries; and (ii) we use panel cointegration and Granger causality tests to uncover interesting and relevant causal links among the variables deriving uniquely from our use of more advanced econometric techniques that have not been commonly used in this literature.

The balance of this paper is organized as follows. Section 2 surveys the literature. Section 3 describes the variables, the data structure, and the sample selection. Section 4 delineates our estimation strategy. Section 5 outlines our results. The final section concludes with some policy implications.

2. Survey of the literature

Prior research in this literature has attempted to link economic growth *separately* to transportation activity, urbanization, and the state of the environment, often represented by carbon dioxide emissions. This section reviews three strands of the literature concerning the Granger causal relationship between economic growth and each of the other three variables that are included in our analysis.

2.1. Causality between transportation activity and economic growth

The first strand of the research focuses on the causal nexus between economic growth and transportation activity.[2] The basic notion is that improvements in transportation and greater transportation activity cause economic growth but economic growth may also increase transportation activity. Recent published research includes work by Lean et al. (2014), Beyzatlar et al. (2014), Pradhan and Bagchi (2013), Liddle and Lung (2013), Kustepeli et al. (2012), Chia (2011), Yu et al. (2012), Eruygur et al. (2012), Fernandes and Pacheco (2010), Tervo (2009), Anaman and Osei-Amponsah (2007), Lean (2001), Gramlich (1994), Munnell (1992) , and Aschauer (1989). The results found in this body of work, however are contradictory; some studies suggest the existence of a unidirectional causality while others support bidirectional causality between the variables (see Table 1 for a summary).

[2] The studies in this literature do not have a common definition of transportation or transportation activity or intensity. In this study we use the notion of transportation intensity and define it as the air-passenger transport facility usage and also that of air-freight facilities (see Section 3 for more precise definitions).