The long-run relationships between transport energy consumption, transport infrastructure, and economic growth in MENA countries

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\begin{abstract}
This paper investigates the impact of transport energy consumption and transport infrastructure on economic growth by utilizing panel data on MENA countries (the Middle East and North Africa region) for the period of 2000–2016. The MENA region panel is divided into three sub-groups of countries: GCC panel (containing the Gulf Cooperation Council countries), N-GCC panel (containing countries that are not members of the Gulf Cooperation Council), and North African countries (called MATE—Morocco, Algeria, Tunisia and Egypt). Using the Generalized Method of Moments (GMM), we find that transport energy consumption significantly adds to economic growth in MENA, N-GCC and MATE regions. Transport infrastructure positively contributes to economic growth in all regions. The Dumitrescu-Hurlin panel causality analysis shows the feedback effect of transport energy consumption and transport infrastructure with economic growth. The empirical results add a new dimension to the importance of investing in modern infrastructure that facilitates the use of more energy-efficient modes and alternative technologies that positively affect the economy with minimizing negative externalities.
\end{abstract}

1. Introduction

The transport-economic growth nexus is among the most important issues addressed in the recent economics literature. The majority of empirical studies demonstrate the positive impact of transport infrastructure on economic growth and unveil that transport plays a vital role in economic activity either directly or as a complement to other factors of production. Pradhan and Bagchi (2013), Marazzo et al. (2010), Chi and Baek (2013) argue that transport affects economic activity positively and accelerates the development of nations. They also find that private firms decide to agglomerate/disperse based on the interaction between increasing returns to scale and transport costs that affect regional economic growth. Ades and Glaeser (1999) and Hausmann (2001), among others, show the important role of international transport infrastructure (seaports, railroads, airways) in increasing trade openness and accelerating the economic development of countries. They also note that landlocked countries have less access to the global market, which significantly decelerates their economic growth.

Many other studies investigate the long-run relationship among transport, energy consumption, and economic growth and expose the negative externalities of transport by focusing in particular on pollutant emissions (Liddle, 2009; Gao et al., 2015; Achour and Belloumi, 2016; Llorca and Jamasb, 2017). They note that despite the critical role of transport as one of the main economic sectors, it...
is also one of the major energy-consuming and pollutant emission sectors. According to the International Energy Agency (2012), transport energy consumption represents 27% of global energy demand and accounts for 22% of total carbon emissions. IEA (2013) foresees an increase of 50% in world transport energy consumption and carbon emissions by 2030. For developing and transition countries, which seek to modernize their economies, there are major challenges related to the environmental impact of transport. Similarly, numerous research studies investigate the strong relationship between transport infrastructure and economic growth. For example, Yeaple and Golub (2007), Anam et al. (2016), Brida et al. (2016a), Ibrahim (2017), Maparu and Mazumder (2017) note that transport infrastructure affects economic growth by boosting economic activity in developing and developed countries. In fact, transport infrastructure motivates firms and people to invest in the periphery, which increases the urbanization and spatial distribution of households and activities. Moreover, developed transport systems contribute to attracting international investors and support the economic development of host countries (Erenberg, 1993; Fernald, 1999). The citations “Fernal (1999), LLC (2002), Al-Ghandoor et al. (2012), Liddle and Lung (2013), Liddle and Tang (2013), Pradhan (2010b)” have been changed to match the author name/date in the reference list. Please check here and in subsequent occurrences, and correct if necessary. the same line of thinking, Saidi (2016) notes that transport infrastructure contributes to economic growth by improving the attractiveness of a territory to foreign direct investments in MENA countries.

The International Energy Agency (IEA, 2012) says that transport consumes 27% of global fossil energy and accounts for 22% of total carbon dioxide emissions. The IEA (2012) also notes that road transport energy consumption rose from 0.7 billion tons of oil equivalent in 1976 to 1.8 billion tons in 2010. During the same period, the global energy consumption and economic growth grew by 1.7% and 3.2%, respectively. In 2012, the IEA argued that the road share of transport energy consumption in China and India grew from 39.6% and 42% to 77.3% and 88%, respectively. Both countries doubled their share, while in South Africa, road transport energy consumption increased from 66.7% to 90.8% of total transport energy consumption. For rail transport, the same source indicates that the share of rail transport in total transport energy usage decreased in three countries during that period. In China, the share grew from 42.3% to 6.9%, in India from 55% to 6.7%, and in South Africa from 31.4% to 2.6%. In that vein, road transport accounts for the highest percentage of transport energy in G7 countries, with 94.7% of total transport energy in Germany, 93.8% in France, and 92.7% in Italy and the United Kingdom. BP (2017) notes that MENA countries are home to more than half the world’s crude oil reserves and more than a third of its natural gas. Their production reached more than 20 million barrels a day in 2014, and their per capita energy consumption is forecast to overtake North America by 2035. MENA countries have an increasing consumption of natural gas (+3.5%), oil (+0.9%), nuclear energy (+75.3%) and renewable energy (+42%) and decreasing hydroelectric (−20.5%) and coal (−9.5%) consumption. The World Energy Council (2011) indicates that Middle East countries consume about 0.939 million barrels of gasoline per day and about 1.082 million barrels of diesel per day. This consumption is expected to triple by 2050. Similarly, fossil energy consumption displays the same trend for the North African countries, where transport accounts for the highest consumption. For example, in Egypt, total transport energy consumption increased 4.8% annually for the 1981-2013 period. Gasoline and diesel fuel have the largest average annual growth rates, at 5% and 5.2% (ESCWA, 2014). In Tunisia, transport accounted for about 26.9% of total energy consumption and about 30% of total carbon emissions in 2010; in particular, road transport consumed around 70% of total transport energy consumption (IEA, 2012).

The linkages between transport and economic growth and, between transport and energy consumption have been examined in the existing literature (Beyzatlar et al., 2014; Gao et al., 2015; Achour and Belloumi, 2016; Lee and Yoo, 2016; Dale et al., 2017; Zhao, 2017). The majority of these studies have focused on various countries and used a variety of empirical techniques for different data periods. Additionally, studies have used different proxy variables to estimate the relationship among transport, energy consumption and economic growth. Their empirical findings are ambiguous and diverse across countries and periods. However, none of the previous studies has explored the relationship among transport energy consumption, transport infrastructure and their impact on economic growth. Therefore, we are strongly motivated to explore the economic impact of transport infrastructure and transport energy consumption for the MENA region. This attempt enables us to investigate whether increasing transport infrastructure stimulates economic growth and energy consumption or economic growth and energy demand act as a stimulus for any consequent growth in transport infrastructure since research in the economics of transport has received little attention in the existing literature. The existing studies in literature examined the effect of transport infrastructure on economic growth (e.g., Achour and Belloumi, 2016; Zhao, 2017) or transport energy consumption on economic growth but in return (e.g. Beyzatlar et al., 2014; Shabbaz et al., 2015a), economic growth may also affect transport infrastructure or transport energy consumption. This causes and effects i.e. the direction of causal relationship between the variables also helps policy makers in making policy implications and effective decision-making to develop better transport systems and thus sustainable development based on causal empirical results. Furthermore, we consider the specific impact of transport infrastructure and transport energy consumption in production function to help environmentalists and economists to simultaneously boost transport infrastructure not only to improve environmental quality but also to speed up long-run economic development, contributing to sustainability. The contribution of this study to the existing literature is summarized in four principal points: (i) This study is a pioneering effort in the MENA region to investigate the associations among transport energy consumption, transport infrastructure and economic growth. (ii) The MENA region is divided into three sub-panels: Gulf Cooperation Council countries (GCC), non-members of Gulf Cooperation Council countries (N-GCC) and North Africa, which is also termed the MATE panel. The MATE is formed by Morocco, Algeria, Tunisia, and Egypt. This distinction makes the panel data analysis more homogeneous and helps us to investigate the issue comprehensively. (iii) The Generalized Method of Moments is applied for the dynamic panel data model following the GCC, N-GCC and MATE panels. (iv) The Dumitrescu-Hurlin panel causality

\footnote{Economic and Social Commission for Western Asia.}
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