

Navigable rivers and transport infrastructure in the Democratic Republic of the Congo

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Abstract

This paper analyzes the effect played by the transport infrastructure in the development of the Democratic Republic of the Congo (DRC). Navigable rivers have a twofold ‘nature’: they are a pure geographical condition (*first-nature* geography) and act as a transport infrastructure (*second-nature* geography). On the other hand, together with the man-made infrastructure, navigable rivers constitute an integrated system of complementary ‘goods’: areas, where rivers are navigable, do not have railways or main roads. If both railways and roads, although in a dilapidated condition, positively affect contemporary economic development, the Congo River and the whole network of tributaries and small rivers fall short of the role they could have in the economic growth of the country. The inter-modal river-rail-road transport system is still far from being a real opportunity for the country: the waterway transport benefits from the existence of the man-made one, but the reverse does not apply.

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Historically, water was the main mean of transport for the movement of goods and people. However, thanks to advances in technology, during the last two hundred years, railways, first, and highways, then, became the main means of transport in modern economies.

In the developing and underdeveloped world, rivers hold their key historical role. States that benefit from the existence of navigable inland waterways (like rivers or canals) take advantage of their transport function. In these countries, the often poor, ruined, and fragmented rail and road networks represent the main obstacles that prevent the positive effect that transport infrastructure could have on economic growth ([World Bank, 2010](#)), and the dependence on natural means of transport is higher compared to the developed world.¹

Rivers, if navigable, entail a ‘dual role’. On the one hand, they are a pure geographical condition that shapes territories (*first-nature* geography) and might represent a barrier to economic activity. On the other, navigable rivers are a natural means of transport and constitute a transport infrastructure that facilitates trade and economic development (*second-nature* geography). This twofold ‘nature’ is still neglected and has not explicitly been considered in the literature.

This paper tries to shed some light on the ‘dual role’ of navigable rivers and analyzes the particular relationship existing between natural and man-made transport infrastructure, focusing on the Democratic Republic of the Congo (DRC). The DRC is characterized by a very peculiar distribution of its transport networks: railways and paved roads are completely absent in areas crossed by a portion of a navigable river, making the river the main means of transport used in those areas. In these terms, the existence of the river and the high dependence on inland navigation determines the absence of other ways of transport. Indeed, the Congolese state takes exactly its name from the Congo River, formerly known as the Zaire River. Longer than 4,000 *km* and navigable for almost its entire length, the Congo river crosses the country from East (where it starts) to West (where it flows into the Atlantic Ocean) sketching an inverted ‘U’. And together with a list of other navigable rivers, it constitutes an intricate transport system of waterways of more than 15,000 *km*. In those territories where the river does not exist, is not navigable, or is interrupted by waterfalls and rapids the continuity of the network is performed through railways and roads. In this way, both rail and road infrastructure is built for the most part in connection and complement of the river network ([World Bank, 2010](#)), and the Congolese territory relies on an inter-modal network of transport infrastructures, where river transport

¹In developed countries, the majority of freight transport is by road or railway and rely on inland waterways to alleviate congestion ([UNESCO, 2009](#)).

alternates to railways and roads.² In this perspective, the link with navigable rivers makes the Congolese man-made transport infrastructure less endogenous compared to typical human transport systems.

This leads to a key point that has to do with the geographic fortunes of countries. Some physical features are considered in the literature as a condition of ‘bad’ or ‘good’ geography, with important consequences in economic terms. Being landlocked, for example, raises costs of logistics and makes transportation complex (Arvis *et al.*, 2010). In these terms the Congolese state, like one-third of African countries, lies in an adverse geographic condition: the only access to the sea is represented by a narrow portion of the territory (35 *km* long) on the Atlantic Ocean. On the other hand, the DRC benefits from the presence of an intricate system of navigable rivers that has been considered beneficial for freight transport. However, the fact that areas endowed by rivers are lacking man-made transport infrastructure raises a question: how beneficial is the existence of navigable rivers in the country, and does the river-rail-road inter-modal network represent an opportunity?

To provide an answer to these questions, this paper uses contemporary data at a fine spatial level (10x10 *km* grid cells) and measures the causal correlation of transport infrastructure on economic development. As one of the poorest Sub-Saharan African countries with serious political, institutional and military problems,³ the DRC suffers from the lack of extensive data in time⁴ that prevent a panel analysis. Nevertheless, this paper collects geocoded data on infrastructure, geography, urban development, and sources of income for the entire Congolese state and compares three different forms of transport: natural (rivers), colonial (railways), colonial and post-colonial (paved roads).

Usually, any analysis aimed at investigating the role played by transport systems on development is compelled to consider all those natural (i.e. geography) and artificial (i.e. urbanization) elements that make the position of roads and railways non-casual. However, in the Democratic Republic of the Congo less than 4% of the entire territory is endowed with a type of primary

²However, particularly for long distances, people and goods cannot be moved using a single mode of transport. Goods need to be loaded and reloaded many times before arriving in their final destination. And people need to use at least two different means of transport, spending many hours waiting for the connection.

³Under the Belgian colonial regime, first, and then under the power of President Mobutu, the Congolese state has one of the longest and dramatic histories of exploitation. During the Belgian Congo, an intricate river-rail-road transport system was constructed. But it gradually fell into dilapidation during the Mobutu era and it went seriously damaged during the First and Second Congo Wars (Tefron, 2011).

⁴This problem is also detected in Canning (1998) and by Jedwab and Storeygard (2019).

man-made infrastructure (paved roads and railways), and simply identifying geographic features and urban settlements might be misleading. In this perspective, this paper adopts three different lenses, considering, on the one hand, the entire territory and, on the other hand, focusing first on a buffer zone of 10 *km* around the transport network representing 21% of the Congolese land and then looking at the cells crossed by a type of main transport infrastructure (man-made or natural), constituting 9% of the entire territory. As a first result, the analysis reveals a strong negative relationship between man-made and natural transport systems: all those cells where water navigation is possible are deficient in roads and railways. A second point has to do with the *first-nature* vs *second-nature geography* character of navigable rivers. The ‘pure nature’ feature of waterway systems prevails. This links to the third aspect of this research: the different effects man-made and natural transport infrastructure have on development: positive and negative, respectively. Areas crossed by navigable rivers show lower levels of nightlight luminosity. Also when isolating the sole ‘infrastructural’ part of waterways, rivers do not play any effect on economic development. On the other hand, both railways and roads, although in disrepair, positively affect economic development and poverty reduction. Indeed, when considering only those territories crossed by one type of transport infrastructure, the effect played by navigable rivers turns to be positive, but not statistically significant once railways or roads are included in the specification, suggesting that the potential of navigable rivers emerges if artificial means of transport are constructed as the complement of natural ones. A fourth issue has to do with the inter-modality of the Congolese network. Areas where the transport system is inter-modal benefit from having more than one means of transport, and from a reduction in travel times. However, if cells crossed by navigable rivers take advantage of the presence of roads or railways, the reverse does not hold: areas crossed by paved roads or railway lines do not benefit from the existence of rivers, and improving travel times are more effective in uni-modal man-made transport zones. Results suggest that navigable rivers are the counterpart of man-made networks, and *vice-versa*, and that the network of navigable rivers alone fails in the role it could have in supporting sustained economic growth. Using an analogy with the consumption microeconomics theory, the way to organize transport infrastructure seems a matter of choice between *complementarity* and *substitutability*.

Results of this paper are linked to the contributions on transport infrastructure, development and trade and on the role that geography plays on economic activity. How geography correlates

with development and trade has extensively recognized by the economic literature ([Gallup *et al.*, 1999](#); [Sachs, 2001](#)); and the impact of transport infrastructure on the economy of a country or a region has been deeply investigated ([Devarajan *et al.*, 1996](#); [Boarnet, 1998](#); [Fernald, 1999](#); [Cohen and Morrison Paul, 2004](#)). The positive effect played by these infrastructure projects, particularly railway and road systems, has been at the core of scholars' interests for a long time ([Aschauer, 1989](#); [Aschauer, 1990](#); [Munnell, 1992](#); [Gramlich, 1994](#)). In recent years the focus has been put on the legacy left by historical transport infrastructure on the modern economy and on the impact of colonial transportation projects on economic growth and exports ([Donaldson, 2012](#), [Atack *et al.*, 2010](#); [Banerjee *et al.*, 2012](#); [Berger and Enflo, 2017](#); [Donaldson and Hornbeck, 2016](#); [Jedwab and Moradi, 2017](#)). This literature also underlines the link between bad geography and poor infrastructure as a main obstacle to economic growth and trade expansion in Africa ([African Development Bank, 2003](#); [Ulimwengu *et al.*, 2009](#); [Buys *et al.*, 2010](#); [Calderón and Servén, 2010](#); [Jedwab and Storeygard, 2019](#)).