Brazil's rail freight transport: Efficiency analysis using two-stage DEA and cluster-driven public policies

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A B S T R A C T
This paper uses Data Envelopment Analysis to assess the efficiency of Brazilian rail concessionaires between 2010 and 2014, when new competitive regulations were introduced. In a second stage, a Bootstrap Truncated Regression was used to test the significance of exogenous variables on concessionaire performance: main type of cargo, track gauge, railway operation type (shared infrastructure or monopoly), in order to address an important gap in the literature. Secondary data came from the National Land Transport Agency (ANTT). The findings have significance for broad-gauge track commodities transport, while shared-infrastructure operations had no significance on efficiency, despite regulator incentives. Well directed regulations must encourage concessionaires to increase efficiency, particularly through incentives for agricultural and mineral commodities carried on the broad-gauge track characteristic of North and Center-West Brazil. Public policies designed to boost cluster efficiency are presented, addressing options such as upsizing, downsizing and resizing inputs, restructuring, best management practices and infrastructure upgrades.

1. Introduction

Due to the continent-sized dimensions of Brazil, cargo transport plays a leading role in lowering transportation costs. It is vital for servicing economic boundaries, increasing the competitiveness of companies and enhancing the well-being of the population through more affordable access to materials (industrial inputs) and goods. However, the cargo transport matrix is unevenly structured in Brazil, with the road mode accounting for around 67% and railways accounting for around only 18% [1]. There are several reasons behind this situation going back many years, which outside the scope of this paper. It is important to stress only that the road mode has higher total costs per unit carried than rail, for long-distance transport of goods [1], which is typical in Brazil. Brazil’s cargo transport matrix structure holds the entire nation hostage to higher environmental and transport costs than countries with better balanced cargo transport matrices [2]. It is, thus, a matter of strategic importance for Brazil to achieve an even balance for its transport mode matrix from the standpoint of the competitiveness of its companies and of the transport industry as a whole, lowering their overall CO2 emissions [3]. It will be important to make good use of potential reductions in outlays on logistics (freight fees, inventory, cargo handling costs and overhead) resulting from more intensive use of alternative means of transport with greater cargo unit capacity (railways and waterways) to service new economic frontiers in the Center-West, North and Northeast Regions, as well as areas with more mature economies.

For the transport infrastructure to function efficiently, its operations must be efficient in terms of sector-specific benchmarks. Thus, when presenting the topic of this survey — the cargo-carrying efficiency of Brazilian rail concessionaires — one must address the development of the Brazilian economy. For comparative measurements of concessionaire efficiency, a commonly used technique was used, which is Data Envelopment Analysis (DEA) [4–6]. The model allows comparative assessments to be made of a set of Decision-Making Units (DMUs), to see which of them are on the efficiency boundary of the production possibility set and thus benchmarks for other inefficient DMUs. From a methodological standpoint, this paper contributes in the second stage with an analysis using Bootstrap Truncated Regression (see Methodology) of the significance of contextual variables in DMU performance. The selected variables are ‘predominant cargo’ (agricultural...