



Public-private partnerships and scale efficiency in Brazilian ports: Evidence from two-stage DEA analysis[☆]



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ABSTRACT

This paper assesses the impacts of public-private partnerships on major Brazilian public ports. It is proposed that these kinds of arrangements with private terminal operators could help achieving higher levels of scale efficiency by enhancing coordination processes, providing more adequate information technologies, and higher connectivity with other transportation modes. Methodology relies on factor extraction of inputs/outputs as a first step to compute DEA efficiency estimates, followed by truncated bootstrapped regression analysis to test different contextual variables. Results indicate a strong positive impact of public-private partnerships on port scale efficiency, corroborating their impacts in relation to the most productive scale size.

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1. Introduction

The development of world class infrastructure is a difficult task for governments to pursue alone, especially in light of fiscal constraints and other monetary liabilities. Notwithstanding, and especially in developing countries, reforms to improve and extend infrastructure level and quality have a huge effect on economic growth, mainly in terms of production and provision of goods and services and significantly affect an economy's productivity, costs and competitiveness [40].

In tune with growing needs vis-à-vis foreign trade and strengthening and supplementing the existing infrastructure facilities, the Public Private Partnerships (PPP) model has emerged as a preferred mode of funding infrastructure [48]. According to Tang et al. [77], there is a global trend for financing public works via PPPs. In Brazil, for instance, port operations were completely controlled by the federal government until the mid-1990s; until then, investment in port infrastructure was performed solely by state-owned companies. However, Brazil's Ports Act 8630/93

established the path for ports to contract private terminal operators, partially breaking up the state monopoly of the sector and inaugurating the use of PPPs in Brazil [38].

Since then, accelerated growth on foreign trade has increased the demands for port services in Brazil. Between 2006 and 2010, the physical aggregate throughput handled within Brazilian ports – measured in tons/year – grew at an average rate of 10% per year [16]. This increasing demand for reliable services has placed enormous pressure upon the infrastructure of Brazil's ports. Even though public investments in infrastructure expansion have remained at minimal levels for the last three decades – 2.1% of GDP [53], the capability of addressing the growth of demand for port services by means of PPPs is now being questioned [3,19,73].

In this sense, the Brazilian government recently reopened the debate on the regulatory agenda. Legal barriers to the contracting of private terminal operators still exist, the main one being the bureaucracy faced by the state-owned company Companhia Docas to perform the various steps that precede such contracting; indeed, the entire process can take years [38]. The idea now is to speed up capacity expansion projects to better serve Brazil's major hinterlands. It is likely that the current model of public-private partnerships will be enhanced to also encompass the funding of private ports. However, the control of crucial decisions on port concession agreements – such as the types of ports and cargoes that should be prioritized within each region and how port connectivity to access

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channels, highways, and railroads could be improved – will still be held by the federal government.

This paper presents a benchmark and efficiency analysis of 27 major Brazilian ports based on data for 2012, putting their scale efficiencies into perspective in light of current PPPs, where public ports owned by Companhia Docas conceded the administrative rights of their terminals to private operators. Although recognizing the potential of PPP agreements, it is important to consider that some academic findings and empirical observations lead to mixed conclusions about their actual benefits [22]. This opens up opportunities to keep investigating the theme.

Our particular contribution lies in an empirical application, inspired not only by the current debate in the Brazilian port sector concerning the role of private terminal operators, but also by using scale efficiency as a cornerstone measure to assess the impact of PPPs on port operations. Furthermore, according to Ross and Droge [72], scale efficiency is a measure that better fits large-scale investments, such as ports, airports and railroads. Zelenyuk [95] highlights the relevance of scale efficiency, once it combines both the notion of optimal scale and the notion of (relative) production efficiency; also, it is showed how important the analysis of economies of scale has been one of the fundamental subjects in economics, operations research and production management, both in theory and especially in practice. Kao and Hwang [47] show the necessity of the decomposition of scale efficiency into two-stage production systems, such as the case of ports that can be decomposed in physical infrastructure and shipment consolidation stages [90]. It also contributes to the port regulatory agenda in terms of potential empirical application, expanding the literature of transportation analyses from new perspectives, in line with the goals of the Journal.

The empirical results corroborate the evidence that although most of major Brazilian ports are facing capacity constraints PPPs are responsible for achieving a better fit between the physical resources of ports and their respective service demands. More precisely, PPPs seem to be an effective way, under the Brazilian regulatory system, to move port operations towards their most productive scale size. The rationales behind these issues are further discussed over the next four sections.

This paper is structured as follows. The literature review section addresses not only the backgrounds of PPPs and Brazilian port regulation, but also focuses on previous studies on port efficiency, with a particular emphasis on the Brazilian case. Additionally, it explores the relationship between PPPs and scale efficiency, leading to the major proposition of this study. The methodology section deals with data collection related to aspects and the subsidiary steps necessary to perform Data Envelopment Analysis (DEA) properly: variable reduction and bootstrapped regression. The conclusion follows the results and discussion, where policy implications are discussed in light of the findings for the Brazilian case.

2. Literature review

2.1. Background: PPPs and Brazilian port regulation

A PPP can be defined as “an arrangement of roles and relationships in which two or more public and private entities coordinate/combine complementary resources to achieve their separate objectives through joint pursuit of one or more common objectives” [51,62]. It is observed that PPPs are rapidly becoming popular, and one contributing factor for such popularity is their capability to harness the managerial practices, innovative capabilities, and capital from private sector [59,78].

It is relevant to highlight that there is no single definition to PPP. To Grimsey and Lewis [39], generally speaking, PPPs fill a space between traditionally procured government projects and full privatization. Besides, it is a refinement of the private financing initiatives for infrastructure that started in the early 1990s and describe the provision of public assets and services through the participation of the government, the private sector and the consumers.

While PPPs can be created to pursue a variety of activities [51], some empirical evidence suggests that they are most commonly used by governments for infrastructure projects [11], as Grimsey and Lewis [39] emphasized. In the context of infrastructure projects, PPPs are long-term agreements between a public entity and a private partner, with the objective of assuring the financing, construction/renovation, and operation of a public infrastructure service [69].

The Private Participation in Infrastructure Database [94], for example, shows that 139 developing countries are aggressively inviting private participation in infrastructure projects. The trend is also evident in developed countries/areas such as US, UK, EU, Canada, Japan and South Korea. Notably, the number of PPP-related publications in transportation and construction journals increased from 2.94% in 1998 to 5.1% in 2008 [49], further evidence of this global trend to PPPs.

Regarding ports infrastructure, the choices as to the scope of public sector participation in ports range from the strong involvement of governments in the provision of both port services and also of port infrastructure to the total privatization of ports, as in England [81]. Most PPP models in the ports sector sit within a landlord port structure in which a public sector port authority (often autonomous) enters into PPP contracts for a series of individual terminals [36]. In this sense, according to Debie et al. [30], the public authority owns the land and infrastructure and leases these to private operators as a concession, with equipment and operations in the hands of the private sector. This is the most common model found in Latin America, although some fully private port experience can be found in Mexico and some of the Caribbean countries.

In Brazil, the landlord port model was adopted as the cornerstone format of the current PPPs between Companhia Docas and several private terminal operators. Under this scenario, port operations and management of terminals are responsibility of private enterprise, while (as is the case of investment in land and waterway access to ports) the administration of common-use infrastructure is maintained with the public sector [52].

Specifically, a part of the port infrastructure in Brazil – the areas for cargo loading and unloading, and storage areas – was transferred to private operation via leasing under the 1993 Ports Act [26]. Prior to the Ports Act, port authorities were responsible for the majority of ports operations, including cargo loading and unloading from vessels, and transport, storage and handling of cargo. After the port areas had been leased, these activities were, in general, transferred to private operators, and port administrations became managers of the common port areas, being made responsible for construction procurement, renovations, expansion, improvements and conservation of port facilities, including infrastructure for water and land access to ports [52].

According to Goldberg [38], there is little doubt that the expansion of Brazilian port capacity was enabled by the PPP-landlord port model, especially with respect to the handling of containers. More specifically, and still in accordance to Goldberg [38], between 1996 and 2005, total import/export revenue in Brazilian ports grew 6.6% per annum, with the vast majority of this expansion centering around container loads, driven by private terminals contracts established in 1995 for the ports of Santos, São

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