On the trade-off between quantity and quality in cargo handling: An application to the Norwegian port sector

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Abstract:

There is a vast literature that addresses the potential for ports to reduce their operating costs by technical efficiency improvements and exploitation of scale economies using either econometric or programming techniques. Tongzon’s (2001) paper stands out by considering both the quantity of cargo handled and the quality of port services. The latter is operationalized by the ship working rate, i.e., number of containers moved per working hour per ship. Notteboom et al. (2000), on the other hand, consider the speed of loading/unloading to be a potentially inappropriate indicator of efficient resource use, e.g., by leaving resources idle between ship arrivals. Wang et al. (2005) argue that high-quality ports attract more clients, thus ensuring a strong correlation between cargo throughput and service quality. Correspondingly, they propose to include only the throughput variable in port performance assessments. Most of the published papers on port performance measurement follow this approach. We are, however, unaware of any previous studies that have undertaken empirical testing of the claim that quantity and quality are complements.

A recent paper by Suárez – Alemán et al. (2014) provides an empirical illustration showing that defining outputs in terms of “throughput per hour” as opposed to
“throughput” (without reference to the time dimension) significantly alters the efficiency scores. Our paper extends their results. We hypothesize that quality improvements are costly, and thus that quantity-quality trade-offs exist for given resource endowments. In this case, studies that only emphasize the throughput of cargo are likely to provide biased estimates of technical and scale efficiencies: If ports spend resources on improving their service quality, their input consumption is overstated and their productivity is understated by most of the existing studies on port performances.

Better insights to the quantity-quality trade-off in cargo handling contributes to better port management. First, the ships’ generalized costs related to port arrivals comprise time costs and port fees. Hence, faster loading/unloading have major economic implications for them. While port fees usually are charged based on the quantities of cargo loaded/unloaded, our approach promotes differentiating the fees based on the relative costs of quantity and quality. Second, by reducing the amount of time that ships spend in ports, service quality improvements also contribute to reducing the external costs of maritime transport, in particular air pollution and noise emissions affecting port cities.

This paper introduces the ratio distance function that allows evaluating technical and scale efficiencies without estimating multiple Data Envelopment Analysis (DEA) technologies. We implement the distance function using DEA to a unique dataset containing information on the duration of loading/unloading activities for each ship arriving in the 26 largest ports in Norway in 2011 and 2012. First, we calculate technical and scale efficiencies when service quality is and is not accounted for in the production
analysis, and compare the corresponding sets of efficiency scores using non-parametric tests. This step allows us to pinpoint measurement biases related to neglecting the ports’ provision of service quality. Second, we develop a two-stage DEA approach that allows us to examine how the service quality is affected when the ports alter their scale of operations, where the latter is defined solely in terms of cargo throughput. This step is intended as an empirical test of Wang et al.’s (2005) hypothesis, that there is a positive correlation between quantity and quality in cargo handling. Third, we modify the method of Podinovski and Førsund (2010) to calculate the marginal rate of substitution between quality and quantity.

We are currently working on finalizing the compilation of the dataset, and will continue with the estimations as soon as the dataset is completed. Consequentially, we are unable to present preliminary results at this point.

References: