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Environmental upgrading in global value chains: The potential and limitations of ports in the greening of maritime transport

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ABSTRACT

Ports are crucial hubs in the functioning of the global economy, and maritime transport is a major emitter of air pollutants. Ports have considerable potential for promoting environmental upgrading in maritime transport and along global value chains more generally, but so far have been only partially successful in doing so. We examine results, limitations and future potential of voluntary initiatives that have been carried out by selected European and North American port authorities, which are considered frontrunners in environmental management. Drawing from the insights of global value chain analysis and organizational theory, we find that low 'tool implementation complexity' and high 'issue visibility' concerning emissions are key facilitators of environmental upgrading. We suggest that ports can intervene in two main ways to improve the environmental performance of maritime transport beyond their organizational and physical boundaries: by lowering tool implementation complexity through stronger collaboration within global value chains; and by enhancing emission visibility through alliances with cargo-owners and regulators.

1. Introduction

Sustainability has become a mainstream concern in the operation of the global economy, as indicated by the reframing of the international development agenda from the Millennium Development Goals to the recently-adopted Sustainable Development Goals (SDGs). The 2015 Paris Agreement on Climate Change will have important implications on economic activity as well, as it seeks to limit greenhouse gas (GHG) emissions. The SDGs and Paris Agreement goals have to be attained in a world that over the past century has seen a true trans-nationalization of economic activity and a movement away from market exchange and vertical integration within transnational corporations – and towards the operation of Global Value Chains (GVCs) (Ponte and Sturgeon, 2014; Gereffi, 2014).

Ports are crucial hubs in the functioning of GVCs, as they integrate different transport modes. More than 80% of world trade travels over the quays of ports (UNCTAD, 2017), and maritime transport is a major emitter of greenhouse gases (mainly CO_2), Sulphur Oxides (SO_x), Nitrous Oxides (NO_x), and Particulate Matter (PM), the latter including Black Carbon (BC) (Smith et al., 2014). Maritime transport is expected to grow in coming decades, and forecasts show that maritime emissions will increase in absence of further environmental upgrading (Smith et al., 2014). An urgent need for emissions reduction in maritime transport is thus needed to cope with its impact on global climate, human health, ocean acidification and marine environments – and to minimize the environmental impact of GVC operations more generally.

Port authorities, who are responsible for managing the landside and seaside of ports, can play important roles in facilitating environmental upgrading (Chang and Wang, 2012; Giuliano and Linder, 2013; Merk, 2014; Gibbs et al., 2014; Davarzani et al., 2015; Erdas et al., 2015; Wang and Notteboom, 2015; Styhre et al., 2017) through four key functions they perform: (1) as landlords (providing land and basic infrastructure); (2) as regulators (setting tariffs, environmental standards for tenants and other port users, and engaging in spatial planning); (3) as operators (having their own fleets of harbor craft and equipment to provide safe fairways and basic infrastructure); and (4) as community managers (bringing together a variety of port stakeholders to improve collaboration and port performance) (Verhoeven, 2010; Acciaro et al., 2014a). An array of organizational and technological tools available to port authorities has already been identified, including pricing and incentives, monitoring and measuring, market access control, environmental standards regulation, alternative energy supply and demand, and a range of emission reducing technologies (Bailey and Solomon, 2004; Lam and Notteboom, 2014; Gibbs et al., 2014; Acciaro et al., 2014b). However, their potential for environmental upgrading has not been assessed, and no comparative study has yet examined what factors

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lead port authorities to voluntarily adopt certain tools but not others.

Several port authorities have already launched voluntary abatement initiatives, and in 2008 a consortium of 55 ports established the World Ports Climate Initiative (WPCI) (Fenton, 2017). In a joint declaration, WPCI members argued that 'ports occupy a unique place as key "hubs" in global supply chains, which enables them to influence the sustainability of those supply chains' (WPCI, 2008). However, the impacts of these initiatives have been geographically limited to a minority of ports, and even in these ports they have applied mainly to their operational areas – so far with minimal effect on ships' operations while sailing between ports.

In this article, we examine what factors facilitate or hinder the uptake of environmental upgrading tools by ports, what limits these tools have in abating air emissions in particular, and what can be done to improve this situation. We focus on selected ports that have engaged in emission abatement for at least a decade, which we identify as 'frontrunners'. We analyze two key dimensions that can shape the uptake of environmental upgrading: (1) tool implementation complexity; and (2) emission visibility. Each combination of these two dimensions is examined through the lenses of the four main functions of ports (landlords, regulators, operators and community managers). We find that high issue visibility concerning maritime emissions is a key facilitator in the adoption of environmental upgrading tools. While low tool implementation complexity helps as well, higher implementation complexity can be tackled through stronger collaboration and information sharing within maritime GVCs. At the same time, we observe that increasing the levels of emission visibility is more challenging outside the operational areas of ports, and we provide suggestions on how to tackle this challenge. Our results feed into current reflections on the potential and limitations of environmental upgrading in maritime transport, and in GVCs more generally.

2. Environmental upgrading

2.1. Environmental upgrading in GVCs

The concept of value chain refers to 'the full range of activities that firms and workers perform to bring a specific product from its conception to its end use and beyond' (Gereffi and Fernandez-Stark, 2011:4). This includes activities such as design, production, marketing, transport, retail, and disposal or recycling. The concept of '*global* value chain' (GVC) refers to the configuration of these coordinated activities that are 'divided among firms and that have a global geographical scale' (Gibbon and Ponte, 2005: 77). GVCs result from the outsourcing and offshoring of functions previously operated within multi-national corporations, and/or from the development of contractual linkages with suppliers that were previously approached through open market transactions (Gereffi, 1994; Cattaneo et al., 2010). The emergence and expansion of GVCs have increased the importance of logistics (Memedovic et al., 2008; Coe, 2014) and transport – including maritime shipping. In the context of rising trade in intermediate products, leaner and more agile procurement and inventory systems, and heightened flexibility of supply systems (Dicken, 2003; Gereffi, 2014), maritime transport remains essential in the operation of the contemporary global economy (UNCTAD, 2017).

At the same time, business actors operating along GVCs are increasingly assessing and seeking to address the environmental impact of their activities and those of their suppliers and service providers. This trend arises in the context of increased consumer awareness of the environmental impact of production and transportation of goods, of numerous environmental campaigns by civil society groups, and of the multiplication of national, international and transnational environmental regulation. Because production activities have become geographically fragmented but organizationally coordinated, GVC actors seeking to reduce their environmental footprint need to coerce, convince, provide incentives and/or nudge their buyers and suppliers (including those providing maritime shipping services) to do the same – in order to avoid reputational risk (Nadvi, 2008).

One of the ways in which this set of issues has been examined is through the lenses of upgrading in GVCs. In GVC research, the concept of upgrading has been used to identify paths for actors to 'move up the value chain' for economic gain. The literature has highlighted a complex set of upgrading and downgrading trajectories (Gereffi, 1999; Humphrey and Schmitz, 2002; Giuliani et al., 2005; Ponte and Ewert, 2009; Taglioni and Winkler, 2016), which can variously combine improvements in product, process, volume and/or variety, and may involve changing, adding and/or abandoning value chain functions (Ponte et al., 2014). What is most important in relation to the focus of this article is that recent efforts have also attempted to go beyond the discussion of 'economic' upgrading to also examine 'social' upgrading trajectories, and the interactions between the two (Barrientos et al., 2011; Barrientos et al., 2016; Lee et al., 2015).

This research agenda is now expanding to unpack the environmental aspects of upgrading in GVCs, the relation between 'green business strategies' and GVC upgrading, and the effect that *environmental upgrading* has on further consolidation in GVCs – as buyers can use it to extract concessions from suppliers (Jeppesen and Hansen, 2004; Ivarsson and Alvstam, 2011; De Marchi et al., 2013a,2013b; Goger, 2013; Khattak et al., 2015; Poulsen et al., 2016; Khattak and Stringer, 2017; Krishnan, 2017). In this context, environmental upgrading is conceived as the process of improving the environmental impact of value chain operations – including production, processing, transport, consumption, and waste disposal or recycling. It can be carried out reactively (e.g., in response to regulatory or customer demands) and/or proactively (e.g., as part of greening strategies, optimization of energy use, the development of new product/service portfolios, and brand repositioning). In this article, we focus on environmental upgrading in the maritime transport function of GVCs, and the particular potential of ports in this process.

2.2. Environmental upgrading in maritime transport

The specialized literature on maritime transport has so far focused mostly on the main *internal* drivers of environmental upgrading within shipping companies: fuel savings and energy prices. Much of this literature is focused on energy efficiency gaps, examining the causes for failures in implementing cost-effective fuel saving measures (Johnson et al., 2014; Johnson and Styhre, 2015; Jafarzadeh and Utne, 2014; Poulsen and Sornn-Friese, 2015; Poulsen and Johnson, 2016; Adland et al., 2017).

To some extent, the literature on internal drivers of environmental upgrading also covers port operations. Acciaro et al. (2014b) investigated port energy management practices in Genoa and Hamburg, and advocated a more active role for port authorities, and Cerceau et al. (2014) showed the potential for industrial symbiosis in ports through densified interactions between port stakeholders. Chen et al. (2013) discussed emissions from different sources in ports and proposed a methodology to optimize truck arrival patterns to reduce emissions from idling truck engines at marine container terminals. Gibbs et al. (2014) suggested that emissions generated by ships during transit between ports are far greater than those generated by activities in the port. This suggests that ports might have more impact by focusing their efforts on reducing shipping emissions rather than on reducing their own emissions. Johnson and Styhre (2015), Eide et al. (2011), Gibbs et al. (2014) and Moon and Woo (2014) emphasized the need to look beyond ports' organizational and physical boundaries, because port efficiency influences energy efficiency along the entire value chain. With a similar view, Golias et al. (2010) presented a berth-scheduling model to reduce vessel turnaround time and thus minimize the total emissions and fuel consumption for all vessels in transit between ports. Idle time for ships translates into higher service speed and significantly higher emission levels. Johnson and Styhre (2015) conservatively estimated an energy efficiency potential in European short sea