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An analysis of rail freight operational efficiency and mode share in the British port-hinterland container market

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ABSTRACT

The growth in container shipping poses considerable challenges to efforts to reduce the negative externalities associated with freight transport. There are particular concerns about the impacts of the associated port-hinterland freight flows. Through empirical research, this paper examines trends in the operational efficiency of the British port-hinterland container rail freight market and to assess the impacts of any changes on the overall sustainability of this market. Original survey work conducted in 2007 and 2015 has allowed longitudinal and cross-sectional analysis of the characteristics of this market.

The survey findings reveal that rail's mode share of port container throughput (in TEU) has increased from 14.7% in 2007 to 16.6% in 2015 and it is likely that its share of the associated hinterland activity has also risen. Rail was carrying 25% more TEU by 2015 without an increase in train service provision. Increases in mean train capacity and mean load factor were observed, leading to growth in the mean train load from 44 TEU in 2007 to 55 TEU in 2015. This considerable improvement in operational efficiency is expected to have reduced the negative externalities per unit of transport activity associated with the rail-borne hinterland container flows, though scope is identified for further improvements in sustainability.

1. Introduction

The growth in container shipping poses considerable challenges to efforts to reduce the negative externalities associated with transport activity. Containerisation has been a major catalyst for trade growth, with the standardisation of transport and handling equipment leading to lower unit transport costs and increased efficiencies (Levinson, 2008). According to UNCTAD (2015), estimated global container trade volumes increased from 69 million TEU[1] in 2000 to 171 million TEU in 2014 (UNCTAD, 2015), an average annual increase of almost 7% despite the global economic downturn during the second half of this period.

While maritime transport itself is coming under increasing scrutiny for its environmental performance (Asariotis and Benamara, 2012; European Commission, 2013), there has for some time been concern about the negative economic, environmental and social impacts of the port-hinterland (i.e. landward) movement of freight, including container traffic (see, for example, Notteboom and Rodrigue, 2007; UNECE, 2010). In its vision for a "competitive and sustainable transport system", the European Commission (2011, 6) set out the need for the transport sector to use less and cleaner energy. Rail has an important role to play, particularly for medium- to long-distance freight flows, since typically it has lower negative

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[1] TEU = twenty-foot equivalent unit (i.e. a container with a length of 20′).

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externalities than road per unit of activity (Woodburn and Whiteing, 2015) and, in theory at least, can use non-fossil fuel energy sources on electrified routes (RSSB, 2007). Intermodal freight is believed to offer considerable growth potential for rail in the European Union (EU) (European Commission, 2015) and is the rail freight activity which has experienced the greatest growth in the United Kingdom (UK) in recent years (ORR, 2016).

Official statistics (ORR, 2016) provide evidence of efficiency gains in British rail freight. Freight transport may become more sustainable if these gains lead to an increase in rail's mode share at the expense of road and/or reduce the negative externalities per tonne or container carried. The intermodal market, including port-hinterland container flows, is a challenging one for rail since it experiences considerable competition from road haulage, more so than in the bulk markets (e.g. coal, steel, construction materials) (ORR, 2006). However, the movement of consumer goods (and some other commodities) in unit loads has become an increasingly important part of freight transport activity. This paper aims to examine trends in the operational efficiency of the British port-hinterland container rail freight market and to assess the impacts of any changes on the overall sustainability of this market. Specifically, through empirical research, the paper seeks to answer the following research questions (RQs):

- RQ1: To what extent (if any) is the European policy objective to increase rail's share of freight transport activity being achieved in the British port-hinterland container market?
- RQ2: Has there been any change in the efficiency and sustainability of rail service provision within this market?

Published statistics at a sufficiently disaggregated level to inform the research are extremely limited. As a consequence, the paper's analysis relies heavily on original survey work conducted in 2007 and 2015, allowing longitudinal and cross-sectional analysis of the characteristics of the port-hinterland container rail freight market in Britain.

The paper is structured as follows. Section 2 identifies and discusses the relevant literature, followed in Section 3 by an account of the methods adopted to answer the research questions. Section 4 analyses rail's role in the British port-hinterland container market while Section 5 assesses changes in the efficiency of the rail operations in this market. In Section 6, the implications of the study's findings for port-hinterland sustainability are discussed, while Section 7 sets out the paper's conclusions. In essence, therefore, Section 4 focuses on RQ1 and Sections 5 and 6 deal with RQ2.

2. Literature review

To place the study in context, this section reviews the key literature relating to rail freight sustainability (Section 2.1), rail in the port-hinterland stage of international supply chains (Section 2.2) and, specifically, port-hinterland rail freight efficiency (Section 2.3).

2.1. Rail freight sustainability

There is a broad consensus that rail is typically one of the more sustainable modes of freight transport and its use rather than road should be encouraged where appropriate. Ideally, logistics network design and sustainable logistics policies should go hand in hand (Zhang et al., 2016) so that the use of modes such as rail is built in at the planning stage. In reality, mode choice decision-making commonly takes place less strategically and in a more ad hoc manner (Directorate General for Internal Policies, 2015). This poses particular challenges for rail freight use when road haulage is the dominant surface transport mode (Woodburn, 2003).

It should be noted that the relative performance of the freight modes is not fixed, as changes in technical and operational characteristics over time or in different operating environments can alter the balance. In their study of Spanish freight transport trends between 1993 and 2007, Pérez-Martínez and Vassallo-Magro (2013) identified that, while rail retained a clear sustainability benefit over road per unit of freight transport activity, the gap had narrowed as road haulage had considerably reduced its external costs. Improving transport efficiency is a well-established route towards realising sustainability benefits within freight transport (see, for example, Arvidsson et al., 2013; Palander, 2016; Sanchez Rodrigues et al., 2015). It is therefore important that the rail industry seeks continuous improvement in its operations (Network Rail, 2013).

Unlike the passenger side of the industry in Britain, where there has been an improving trend in the last 10 years, the published annual emissions per rail freight tonne kilometre over the same period have fluctuated between 26.4 and 30.9 g/CO_2e (ORR, 2015), with no clear trend evident. The sustainability agenda within the rail industry, in the UK at least, suffers from a lack of clarity over its focus and direction (Rail Technology Magazine, 2014), although the national infrastructure manager (Network Rail) has made progress in setting out the agenda (Network Rail, 2013, 2015) and some of the rail freight operating companies (FOCs) have started to emphasise rail's environmental credentials. The Rail Sustainable Development Principles emphasise the role for rail in tackling sustainability issues, not least because "the railway's green credentials compare favourably with other modes" (RSSB, 2016, 12) and offer scope to reduce transport's carbon footprint. While there is little explicit mention of freight, operational efficiency improvements are promoted as a means of optimising the railway and reducing negative externalities. Other research (e.g. Toletti et al., 2015) has modelled the relationship between rail freight operational characteristics (e.g. train length), energy efficiency and thus sustainability, demonstrating considerable theoretical potential to make improvements.