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Examining performance change and its drivers in Irish ports 2000-2016

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Abstract

Purpose – The purpose of this paper is to examine performance change in the Irish state-owned port sector over the 2000-2016 period using a case study approach.

Design/methodology/approach – For analysis, qualitative sources are used to construct an explanatory account for the quantitative measures of productivity, profitability and traffic shift-share change across the major ports within the system.

Findings – The results show that overall change in performance largely follows that of the macro-economic performance of the region, characterised by pre-recession growth, decline during the recession and post-recession recovery. Across the ports, however, there was a notable divergence in performance post-recession. Identified factors affecting performance change across the period include demand-side structural change, labour rationalisation and degree of private sector participation.

Originality/value – This study addresses a gap in the formal evaluation of port performance in Ireland. The study further demonstrates the potential of in-depth case study analysis for uncovering insights into the drivers of performance across a number of dimensions, thus allowing for the contextualisation of results. The study of a small number of cases enables the use of rich qualitative sources to create strong narratives, which combined with quantitative measures of performance, can lead to new insights.

Keywords Mixed methods, Total factor productivity, Case study, Seaports

Paper type Research paper

1. Introduction

Accounting for 85 per cent of the total volume and 56 per cent of the total value of merchandise trade, the shipping sector is a critical enabler of Ireland's trading capacity (Vega and Hynes, 2017). Despite its importance, the volume of demand for port services is limited by the relatively small size of the Irish hinterland and peripherality of the region towards major trade lanes (making Irish ports unsuitable for trans-shipment traffic). Without a sizeable volume of demand, there are concerns as to the viability of a market mechanism for ensuring competition and subsequent competitiveness within the sector

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(Competition Authority of Ireland, 2013). Thus, the effective performance of the Irish seaport sector is a strategic objective at the national policy level with the sector seeing a number of reforms and policy initiatives since the initial reform with the passing of the Harbours Act 1996-2000 (Department of Transport Tourism and Sport, 2013).

However, despite its recognized importance, there has been little formal evaluation of performance within the port sector in Ireland. Mangan and Cunningham (2000) performed an early performance evaluation of the effects of the full enactment of the Harbours Act in 2000. The authors found that the programme of reform was largely successful in commercializing the ports. However, they argued that it would take more time and further reviews to fully assess the impact of reform. In 2002, a review into the success of the governance reform was officially commissioned and undertaken by Raymond Burke Consulting (Burke, 2003). The resulting report was largely supportive of the trajectory of reform and supported the view that there were improvements from commercialization. The report did, however, highlight a few outstanding issues as causes for concern, most prominently, ambiguity surrounding the future exchequer funding of port infrastructure development. Subsequent to these initial reviews of post-reform performance, there has been little further evaluation of the performance of Irish ports.

This paper seeks to address this gap through an examination of performance change within Irish ports for the 2000-2016 period. A key challenge in examining performance change over an extended period of time is accounting for the environmental factors external to the control of the individual port managers who drive performance. Ports and port systems evolve over time and in response to various forces in the port and maritime industry (meso), and wider macro-economic environment in which the ports are embedded (Beresford *et al.*, 2004; Sánchez and Wilmsmeier, 2010; Wilmsmeier and Monios, 2016). Demand for port services is derived from the requirements of international trade, and ports evolve relative to changes in the nature of this demand. The capability of ports to sustain performance because of changes in the ports contextual environment represent a key aspect of port performance, which was recently identified by Notteboom (2016) as the ports' adaptive capacity. In the Irish situation, the time period under review includes a period of unprecedented boom and bust and subsequent recovery.

To measure performance using conventional comparative methods, there is a need to account for this complexity. Without doing so, creates a risk of confounding cause and effect in inference between managerial effectiveness (or Leibstein's X inefficiency) and naturally occurring heterogeneity occurring in the port authorities' (PA) contextual environment (Bergantino *et al.*, 2013; Pilcher and Tseng, 2017). Respective of this challenge, a mixed methods case study approach is adopted to analyse performance change over time. Here productivity, profitability and traffic shift-share growth are measured for selected ports within the state-owned port system. Qualitative sources are then referenced to contextualise the change in observed productivity in terms of external environmental and internal managerial factors that influenced the change in observed performance. Thus, the approach allows for the contextualisation of performance in respect of the key drivers that have influenced observed performance change. Given the case study's longitudinal nature, this affords the opportunity to examine how port managers have adapted to major economic environmental change over time. Therefore, the objective of the paper is to examine performance change across Irish ports and identify the internal and external drivers that have influenced performance change over time.

The remainder of the paper is structured as follows. Section II introduces the case description, detailing the policy framework. Section III outlines the methodology used and data sources used to complete the analysis of performance. Section IV presents the case

study results and includes a discussion and synthesis. Section V examines the implications of the result for Irish policy makers as well as the conclusion.

2. Case description

The state-owned port sector in the Republic of Ireland was created in its current guise under the Harbours Acts 1996-2000. Prior to 1996, Irish port infrastructure was controlled by harbour authorities, which had a high degree of direct government departmental control (Mangan and Furlong, 1998). There was a growing concern regarding the suitability of these governing arrangements for the effective development of port infrastructure. Mangan and Furlong (1998) reported the inadequacy of board of directors composition and highlighted the degree of ministerial approval required for operational change, including the setting of rates, borrowing money, carrying out harbour improvements and acquiring and disposing property. Such concerns and a growing culture of public administration reform (owing to the advancements of new public management in the late 1980s) led to the appointment of a review group in 1991. The findings of the review recommended reform by concluding that Ireland's ports have been severely constrained in their ability to commercially respond because of the restrictive legislation under which they operate (Mangan and Furlong, 1998).

Based on the recommendations of the review group, the Harbours Act 1996-2000 was enacted[1]. The act commercialised the 10 largest state-owned ports and created commercial state-owned enterprises. The government retained ownership as the sole shareholder with the resulting "port companies" given a largely commercial mandate. Most operating restrictions were removed; however, the port companies still required ministerial approval regarding large-scale borrowing and the establishment of subsidiary companies. New boards of directors were established to be responsible to the minister for the conduct and operation of the port companies. As described in the Ports Policy Statement 2005, the legislation was intended to give key Irish ports the commercial freedom to operate as modern customer-oriented service industries, and in the process providing more cost-effective and efficient services to meet the needs of their customers. In commercialising the ports rather than fully privatising them, the recommendations of the review group were followed. The group found that privatisation was not at the time a realistic option given the complexity of the process and uncertain additional benefits.

The sector was further reformed in 2013 with the introduction of National Ports Policy (2013) (NPP), which outlined a strategy to tier state-owned ports based on a combination of their throughput, market share and capability to provide capacity for future growth to serve the national interest. Tier 1 and 2 ports were classified as ports of national significance and are to be retained under full state ownership, while Tier 3 ports of regional significance are to be transferred to local authorities. NPP states that Tier 1 ports are mandated to 'lead the response of the State commercial ports sector to future national port capacity requirements' with Tier 2 ports also recognised as having a responsibility to develop additional national capacity. In this way, NPP is a move away from the previous policy of multiple independent competing ports. NPP cites the wider trend towards consolidation in the shipping market and the use of larger ships as influencing factors.

While, in total, ten ports were subject to initial reform under the Harbours Act 1996, it is not possible to look at all ten ports in sufficient detail. For this reason, the largest four state-owned ports were selected for examination: Dublin Port, Port of Cork, Shannon Foynes Port Company and the Port of Waterford. After NPP, these are the ports that remain under state governance in addition to Rosslare[2]. Figure 1 shows the location of each of the ports sampled as well as the other large ports on the island, while Table I lists the key characteristics and competitive position of each of the ports in 2000.

Source: Irish Maritime Development Office

Figure 1.
Map of the Irish port system

3. Methodology

A case study approach involves an in-depth analysis of a limited number of cases that involve generally more variables than large sample studies (George and Bennett, 2005; Yin, 2013).

3.1 Analytical approach

The analysis comprises a quantitative summary of the evolution of performance among the sub-units from 2000 to 2016. In completing the quantitative summary, a mixed methods approach is used as described by Gertler *et al.* (2016) as follows:

> Qualitative data provide context and explanations for the quantitative results, to explore outlier cases of success and failure, and to develop systematic explanations of the program's performance as it was found in the quantitative results.

The approach comprises first measuring performance using quantitative methods and second using qualitative sources to construct an explanatory account for quantitative measures of productivity change across the major ports within the system.

The conventional approach in the literature toward the effect of contextual factors on port performance is to use quantitative methods, which are mostly regression approaches. Examples of recent studies include Bergantino *et al.* (2013) who examined the effect of regional GDP, employment, population density and access on port efficiency, and De Oliveira and Cariou (2015) who looked at the effect of market competition on efficiency in container terminals. A restriction of this approach is that it, by design, limits the scope for discovery of new explanatory sources of heterogeneity to variables identified in advance. This is not always desirable because, given the complexity of port infrastructure systems, what influences behaviour is not necessarily apparent to the researcher. The advantage of the approach is that by not restricting the analysis to a chosen set of ex-ante variables

Dublin Port Company	Dublin port is the largest port on the island of Ireland, handling all five major traffic types. In the year 2000, the port held market leading positions in both the RoRo and LoLo markets. To service these markets the port benefits from close proximity to the largest population base in Ireland, the Dublin metropolitan area, and the UK, Irelands largest trading partner. The port facility is located in the city and consists of dedicated terminals and common user facilities.				
Traffic in year 2000 000's tonnes (Market Share)	RoRo	LoLo	Liquid Bulk	Dry Bulk	BreakBulk
	6536 (35%)	4176 (55%)	3342 (24%)	1588 (11%)	250 (16%)
Port of Cork	The port of Cork is the third largest port on the Island of Ireland and second largest port in the Republic of Ireland. It handles all five major traffic types and in the year 2000 was seen to specialise in liquid bulk traffic. The port is located on the south coast and has a number of separate facilities located around Cork harbour.				
Traffic in year 2000 000's tonnes (Market Share)	RoRo	LoLo	Liquid Bulk	Dry Bulk	BreakBulk
	191 (1%)	968 (13%)	6365 (46%)	1556 (11%)	139 (10%)
Shannon Foynes Port Company	Shannon Foynes Port Company specialises in the handling of Bulk traffic, and is the largest Bulk port on the Island of Ireland. In the year 2000 the port consisted of a number of user dedicated terminals and two common user terminals, spread out across the deep water Shannon Estuary on the west coast.				
Traffic in year 2000 000's tonnes (Market Share)	RoRo	LoLo	Liquid Bulk	Dry Bulk	BreakBulk
	N/A	N/A	1903 (14%)	8230 (57%)	150 (9%)
Port of Waterford	The Port of Waterford is located on the South East of the island and handles four of the five major traffic types. In the year 2000 the port company was overseeing the movement of facilities from the ports traditional location in the city quays to a new location further along the coast.				
Traffic in year 2000 000's tonnes (Market Share)	RoRo	LoLo	Liquid Bulk	Dry Bulk	BreakBulk
	N/A	1014 (13%)	245 (2%)	498 (3%)	115 (7%)

Source: Own authors composition based on Eurostatt data

Table I.
Key characteristics and market position of ports sampled in year 2000

(which is by design necessary for a large sample study), we increase the probability that new variables and critical relationships among them are discovered (Eckstein, 2000).

3.2 Measuring total factor productivity and profitability

The main metric used is a measure of total factor productivity (TFP). Productivity relates to the process by which a production unit converts inputs into outputs. TFP measurement is distinct from partial productivity measurement as it relates all inputs in the production process to outputs. Changes in TFP, therefore, provide a good approximation to how effectively the port enterprise is managing its resources. Increases in productivity occur when the ratio of output produced to input consumed increases (Coelli *et al.*, 2005).

There is an extensive literature that has examined productivity change in the port sector. Studies can primarily differentiate between those that examine TFP at the terminal level (Wilmsmeier *et al.*, 2013; Song and Cui, 2014) and those that examine productivity at the port and port authority level (Barros and Peypoch, 2007; Barros *et al.*, 2012). With the exception

of a number of early studies such as Kim and Sachish (1986), TFP in port studies has been measured using frontier methods. This approach involves using either parametric (stochastic frontier) or non-parametric (data envelopment analysis, free disposal) estimation methods to estimate production possibility frontiers or using TFP indices to measure the change in productivity over time. The major advantage of a frontier approach is by estimating a production possibility frontier, which allows for the decomposition of productivity change into its constituent parts, i.e. TFP changes because of shifts in the production possibility frontier (technical change), because of increases in technical efficiency and by changes owing to increases in scale.

There are, however, significant challenges in the current case for estimating the production frontier. A sample of homogeneous production units is required to reliably estimate a production possibility frontier. In the Irish case, the number of firms in the set is quite small and there is a high degree of heterogeneity between relatively small break bulk and large multimodal ports. This limits our capability to properly estimate the production frontier. For this reason, an index price approach is adopted to measure TFP change in Irish ports over time.

The index price approach uses input and output prices to weight the contribution of respective outputs and inputs to TFP, and it has been used to examine performance change in productive units when data limitations are in place (See and Coelli (2013) and Palcic and Reeves (2015)). In the current study, following See and Coelli (2013), a Tornqvist index is calculated using price information. This involves a simple calculation of an output index over the input index. Both input and output indexes are generated using cost/price shares to weight the contribution of inputs of outputs. Productivity change is then calculated relative to a base year as follows:

$$\text{Tornqvist TFP Index} = \frac{\textit{Tornqvist Output Index}}{\textit{Tornqvist Input Index}} \tag{1}$$

$$= \frac{\prod_{j=1}^{m} \left[\frac{y_{jt}}{y_{js}}\right]^{\frac{\tau_{js}+\tau_{jt}}{2}}}{\prod_{n=1}^{n} \left[\frac{x_{nt}}{x_{ns}}\right]^{\frac{\omega_{ns}+\omega_{nt}}{2}}} \tag{2}$$

where y represents output j at time t, while τ represents the output price. Similarly, x represents input j at time t, while ω represents input cost. In this manner, taking year s a reference year productivity change is simply interpreted as a result of a change in input consumption relative to output production. The change in respective output is easily related to the qualitative data describing the consumption of inputs in a given year and major factors that have influenced output generation.

The drawback of using an index number approach is it is not possible to decompose the source of productivity change as described above. Secondly, any interpretation of productivity is relative to the firm in the base year chosen, and, as such, comparisons between the productivity of two firms are not possible. All that is possible is a comparison of rates of productivity changes over time.

To select inputs for the index, an approximation of labour and capital were chosen as the two inputs. Labour was measured as the number of full-time employees of the respective port companies. Cost share was calculated as the staff cost in a given year as reported in the financial accounts[3]. Capital is typically more complex to measure. As information on

capital assets is available from vesting day for each port company, the perpetual inventory method was chosen following the method outlined in See and Coelli (2013), which was used in the Irish context by Cahill *et al.* (2017). Measuring capital in this way allows for control for the use of different depreciation methods across companies, which can affect the true value of tangible assets, represented in the company's accounts. The quantity of capital is measured as follows:

$$K_t = K_{t-1} + I_t - \theta_t - R_t \tag{3}$$

where K_t is the real depreciated capital stock in period t and $t-1$. I_t is the real investment in period t, θ_t is a real value of disposals in period t and R_t represents real retirements[4]. Cost of capital was calculated following Cahill *et al.* (2017) as follows:

$$CK_{kt} = \sum_{K=1}^{N} (i_t + \delta_{kt}) NomFA_{kt} \tag{4}$$

where:

k = each asset group;
i = ten year bond yield on government securities;
δ = depreciation rate; and
NomFA = Nominal value of each group of fixed assets.

In terms of outputs, while it is desirable to use all possible outputs of the firm, a lack of price data means we were restricted to using revenue as a single output[5]. In addition to TFP, the operating margin was measured to account for profitability. While there should be a positive correlation between profitability and productivity, an increase in productivity means that a firm is now producing output with proportionately less input. In practice, it is not always the case because factors often related to external to operations can affect profitability (Bai *et al.*, 1997). Therefore, the operating margin (ratio of operating profit to revenue) is measured to examine whether increases in productivity are translated to profit.

3.3 Other measures

The use of an aggregated measure such as revenue facilitates measurement; however, does not reflect the multi-output nature of PAs as productive units (Gonzalez and Truijio, 2009). The further examine the source of output growth, annual tonnage growth is reported per port across all major cargo markets served by each respective port. In addition, growth in tonnage relative to overall market growth is also reported per port. To measure relative growth in respective markets, we measure the percentage of which actual growth in a period is above expected growth if the tonnage in the port grew at the same rate as tonnage growth in the period. This measure is an adapted form of the shift-share analysis introduced by Notteboom (1997) and, as such, is termed the ports shift share margin (percentage of actual growth above expected growth):

$$shftsharemg_{im} = \frac{\left(tng_{imt_1} - \left(\frac{\sum_{i=1}^{n} tng_{imt_1}}{\sum_{i=1}^{n} tng_{imt_0}} \right) * tng_{imt_0} \right)}{\left(\left(\frac{\sum_{i=1}^{n} tng_{imt_1}}{\sum_{i=1}^{n} tng_{imt_0}} \right) * tng_{imt_0} \right)} \tag{5}$$

Here i represents port i and m represent the cargo mode. In this way, the shift-share margin is a normalised measure of growth relative to the market for each cargo market. A positive shift share indicates a relative growth in competitiveness of services running through the port. The shift-share analysis is examined over two periods: firstly, the pre-crash boom period from 2000 to 2007, and secondly the post-crash inclusive of the recessionary (2008-2013) and recovery periods (2013-2016).

3.4 Data sources

The above measures were constructed using data extracted from various sources. All measures of inputs, outputs and profitability were obtained from the audited financial accounts reported in the annual reports of the respective Port Companies with descriptive statistics reported in Table II. Data on the ten-year bond yields, the consumer price index and Gross Fixed Capital Formation deflator were obtained from the Ameco database. Port traffic statistics were obtained from Eurostat.

Qualitative sources used in the completion of the analysis include periodic policy reports; the annual industry statistical bulletin, i.e. the Irish Maritime Transport Economist (IMTE); and available corporate documents of the individual port companies (including a full series of annual reports and available master-planning documents).

4. Results

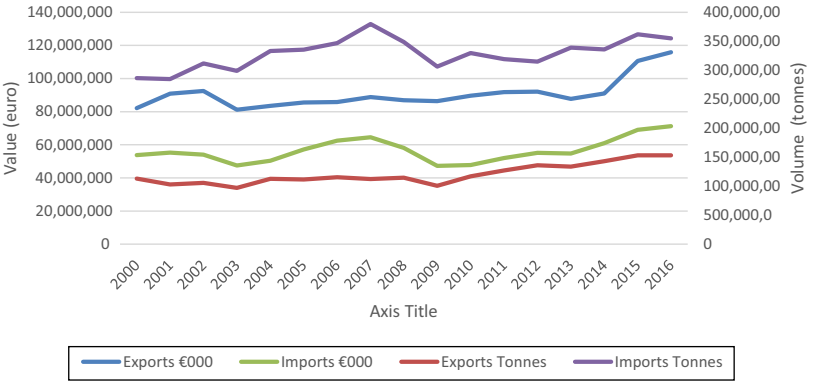
The findings of the case study are presented in four parts. Section 4.1 outlines the major macro-economic developments that have affected the port sector over the period. Section 4.2 outlines the major changes at an industry level. The purpose of both these sections is to outline the major external factors that have influenced performance over the period. Section 4.3 details the performance at the individual port level. This section reports the performance change using the metrics outlined in Section 3, and proceeds to construct an explanatory account of observed changes using qualitative sources. Section 4.4 summarizes the key findings and discusses the key drivers of port performance in the context of the major macro environmental and industry level changes that have affected the port sector over the period.

4.1 Major macro-economic developments

The 2000-2016 period was characterised by pre-recession boom, a financial crisis beginning in 2007 and a subsequent economic recovery beginning in 2013 (Whelan, 2014). This pattern has translated to trade in international goods as represented in Figure 2. In terms of the structure of trade in the early 1980s and 1990s, the structure of Ireland's merchandised exports shifted from low-value to high-value low-volume manufactured goods (Brunt, 2000). As with most developed countries, this creates an imbalance in shipping terms because the volume of imports exceeds the volume of exports (despite the value of exports far exceeding the value of imports). This has largely been consistent over the period with euro per tonne ratios at an average of €8,000 per tonne for exports and €1,700 per tonne for imports. However, examining the tonnage imbalance following the crash, there has been a closing of the gap somewhat, with tonnage imbalance falling from 27 ml tonnes in 2007 to 20 ml tonnes in 2016, with the number falling as low as 17 ml tonnes in 2013. The export activity in volume and value terms has risen above pre-crash levels (up 30 per cent in value terms and 36 per cent). The rise in exporting activity is consistent with economic commentary on the recovery, which has been described as export-led. In contrast, imports in volume terms had not yet reached 2007 levels by 2016.

Table II.
Summary of input and output data

Port	Inputs				Output
	Mean Quantity of Capital (€ 000's)	Mean Cost of Capital (€ 000's)	Mean Labour (number of employees)	Mean Cost of Labour (€ 000's)	Mean Revenue (€ 000's)
Dublin Port Company	€239,834	€40,718	216	€15,531	€66,723
Port of Cork	€95,5656	€10,671	111	€8,180	€22,865
Shannon Foynes Port Company	€36,291	€3,526	48	€3438	€10,765
Port of Waterford	€31,135	€2,398	40	€2,463	€8,269



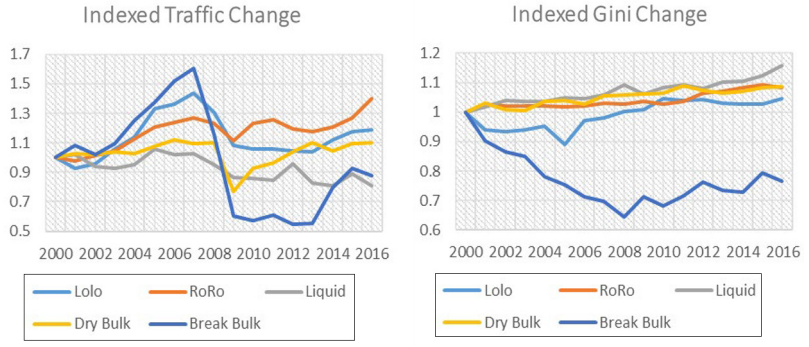
Source: Authors composition based on CSO data

Figure 2. International merchandise trade

4.2 Major industry (meso) changes

As displayed in Figure 3, the boom bust and recovery cycle largely translated to growth across the cargo market sectors in the Irish case. The exception to that is liquid bulk, which has seen steady decline. This market is largely driven by demand for petroleum products, which has decreased in line with changing consumption patterns and increased energy efficiency (SEAI, 2016). The cyclical pattern was most pronounced in break bulk. High prerecession growth in this market was largely fuelled by a sectoral boom in construction, which has been most strongly affected by the crash (Whelan, 2014). Dry bulk quickly recovered, reaching pre-recession highs in 2013. The dry bulk market is driven by input demand for the agri-food industry and large-scale industrial production.

The unitised sector (comprising of Roll on Roll off (RORO) and Lift on Lift off (LOLO) traffic) is more closely aligned with activity in the domestic economy. Here, contrasting recovery rates can be seen, with RoRo recovering at a much quicker rate than LoLo. This may be explained by two factors. Firstly, RoRo traffic is more closely aligned with trade with the UK, which was less affected by the recession. Secondly, there has been a redistribution of traffic from LoLo to RoRo. This is attributable to the introduction of a new hybrid "conro" service operated by Cobbelfret, a Belgian company that had previously



Source: Authors composition based on Eurostatt data

Figure 3. Traffic and concentration index change

operated LoLo services through its sister company C2C[6]. This service operates from Dublin to Zeebrugge and Rotterdam and directly competes with short sea and feeder LoLo services to the continent. When taken on a whole, total unitised traffic volumes have just returned to pre-crash in 2016 rising to 35.5 ml tonnes up from 35 ml tonnes in 2007.

Unitised traffic moves primarily from ports on the east and south coast. Examining the evolution of competitive dynamics in the RoRo sector first, there has been increased concentration over time. Traditionally, RoRo traffic has consisted primarily of trade with the UK (accounting for 90 per cent of total traffic in 2016, and 99 per cent in 2009, with the change mainly because of the Cobbelfret service outlined above). At the beginning of the period, Dublin was the market leader; however, it faced significant competition because of the mobility of RoRo traffic. Competition was strongest with Larne (24 per cent market share) and Belfast (24 per cent) in Northern Ireland and Rosslare to the south (10 per cent percent market share). However, following the recession, there was a large-scale restructuring and rationalization of existing routes and operators particularly on the primary UK–Ireland Corridors favoring the ports of Dublin and Belfast. Stena in 2013 transferred service from Dún Laoghaire to Dublin. In Northern Ireland, Stena Line transferred services from Larne to Belfast.

The LoLo sector has followed a similar pattern with increased concentration post-crash. At the beginning of the period, Dublin was also the market leader in LoLo traffic at 55 per cent at the start of the period, with sizeable traffic flows in Waterford, Cork and Belfast (17 per cent market share). There was de-concentration prior to the recession because of congestion at the larger ports. This trend reversed post-recession with the top three ports, i.e. Dublin (55 per cent) Cork (21 per cent) and Belfast (18 per cent), accounting for 94 per cent of the total market in 2016 up from 83 per cent in 2007. Similar to the RoRo market, there was a restructuring following a contraction of demand of almost 2 ml tonnes, which caused significant over-capacity in terms of port and carrier capacity. In response, carriers responded by rationalising routes and increasing the use of Vessel Sharing Agreements (VSAs) to improve utilisation rates. Murphy (2010) estimated that 14 routes were rationalised in 2009; however, by 2011, the three largest VSAs on the market accounted for 70 per cent of total market traffic (Murphy, 2013). The move toward VSA's led to an increase in ship size and reduction in the number of calls as evidenced in Figure 4. Larger vessels and less frequent call favour the competitiveness of the larger ports. Firstly, there is greater depth available at the larger ports of Dublin, Belfast and Cork. Secondly, given their location, they have greater proximity to the larger hinterland markets they have a better potential for achieving utilisation of larger vessels (O'Connor *et al.*, 2018).

In the bulk sector concentration, trends in liquid and dry bulks have followed that of the unitised sector. In both sectors, similar to Lolo, there has been an increase in the size of

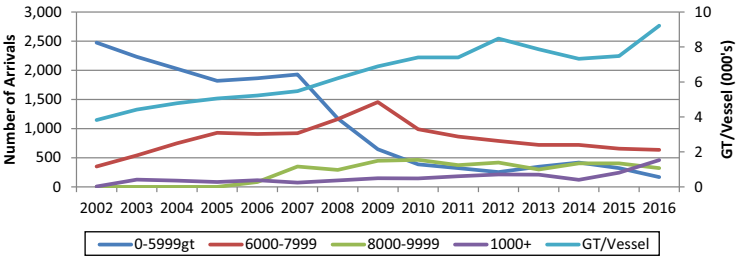


Figure 4.
Change in LoLo Vessel Profile

Source: Authors composition based on Eurostatt data

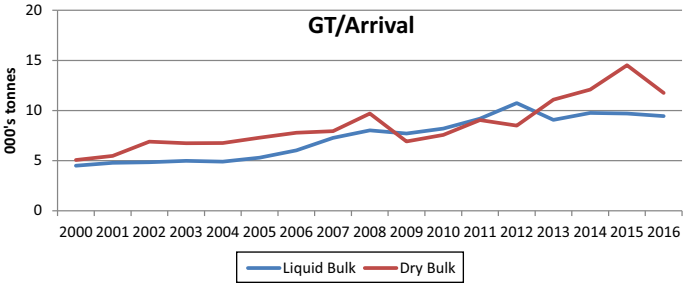
vessel used as displayed in Figure 5. Noticeably, the break bulk sector has become deconcentrated. Vessel sizes in this sector tend to be smaller; therefore, they are possibly better suited to regional ports. In addition, break bulk cargos typically consume a relatively large amount of land space within ports; thus, given competition from other modes, break bulk may be deprioritised. This is the case in Dublin as per the ports masterplan ports "b*reak bulk, which is the most land intensive cargo mode, has largely disappeared from Dublin Port due to unitised trade and use of smaller east coast ports*".

4.3 Port level performance changes

4.3.1 Dublin port company. TFP growth in the pre-crash period was staggered. Initially, TFP fell, largely driven by a reduction in the output index, with TFP dropping to a low of 79 in 2002. Subsequent to 2002, TFP began to recover as a decline in the input index was matched with an increase in output with TFP peaking at 108 in 2006. There were two major factors influencing TFP change over the period. Firstly, the port implemented a series of reforms in the early part of the decade to reduce operating costs by withdrawing from the provision of non-core services, mainly warehousing and crane operations. As reported in the annual reports, non-core service provision had become loss-making activities and withdrawal from such activities in a programme of modernisation was intended to allow the port to focus on developing infrastructure. This represented a further move toward the landlord model because the port replaced the PA provision of these services with a system whereby private third parties compete to provide these services (Figure 6 and Table III).

The major effect of these reforms was a reduced level of staffing with the PA employees dropping from 416 in 2000 to 208 in 2006, i.e. a drop of over 50 per cent. The shift in business model appears to have been highly successful in terms of allowing for a focus on capital investment. In 2000, labour costs accounted for 48 per cent of total input shares; however, by 2011, at the height of the recession, input shares accounted for 18 per cent of total input shares. Further, after 2008, capital accounted for approximately 80 per cent of total input costs every subsequent year, up from just over 50 per cent at the turn of the millennium. The port has thus been able to significantly increase the capital stock (up 66 per cent over the period) while keeping its overall input shares constant.

The second major factor affecting TFP growth in the pre-crash period was a loss in revenue because of the movement away from non-core activities and an initial loss of market share in the LoLo market because the port suffered from the effects of congestion. There was a significant loss of volume in 2001 where LoLo traffic declined by from 4.2 ml tonnes to 3.3 ml tonnes in 2000. Traffic volume did not recover to 2000 levels until 2005. This period



Source: Authors composition based on Eurostat data

Figure 5.
Change in Bulk Vessel Profile

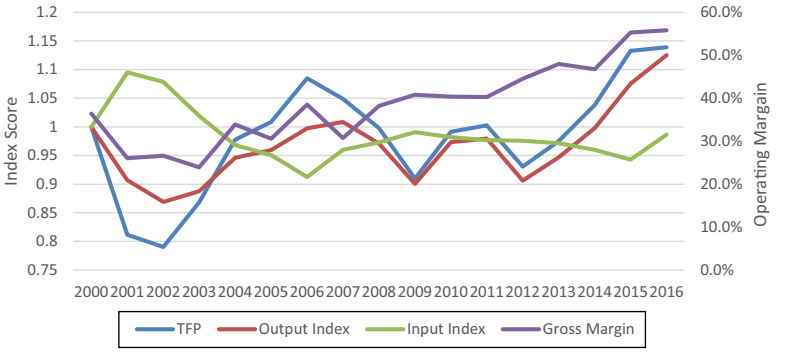


Figure 6.
Dublin TFP and Profitability Change

Source: Autors own composition

Traffic Sector	Tonnage 2000 (Mrkt share)	Tonnage 2016 (Mrkt share)	Shift Share Margin 2000-07 (%)	2008-16 (%)
RORO	6,536 (35%)	12,667 (48%)	14	21
LOLO	4,176 (54%)	5,062 (55%)	−5	7
Dry Bulk	1588 (11%)	2053 (13%)	27	−14
Liquid Bulk	3342 (24%)	4017 (36%)	19	16
Break Bulk	250 (16%)	50 (4%)	4	−72

Table III.
Dublin Tonnage growth

Source: Autors own composition

coincided with growth in all other ports in the network, resulting in Dublin Port's market share dropping from 54 per cent in 2000 to 45 per cent in 2005. However, this trend had begun to reverse in the years immediately prior to the recession with Dublin's market share recovering to 51 per cent in 2007 because of an expansion of routes through Dublin and increase in capacity in two of the ports' three terminals. Coupled with the recovery, the port saw the continued rise of RoRo traffic through the port. This continued a trend that began in the 1990s as Dublin Port won a market share from the major ports in Northern Ireland (Brunt, 2000).

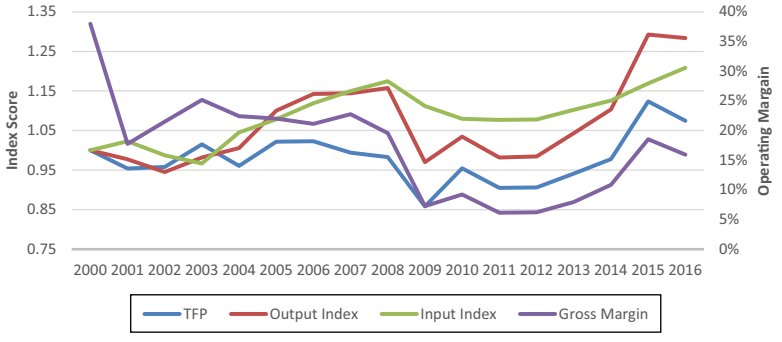
Change in the TFP index following the crash followed a similar trajectory to change in the index pre-crash. This involved an initial decline, followed by a gradual increase with TFP peaking at 1.13 at the end of the period. TFP index change was largely driven by an increase in output with the input index constant over the period. Initially, output declined given the effect of the financial crisis but it subsequently recovered. Growth in the most recent periods was driven by the RoRo sector, with the port benefiting from increased concentration in the market and the success of the ConRo service. There were also increases in market share in the LoLo and liquid bulk sectors over the period.

Profitability, as measured by the operating margin, showed stronger growth in the post-crash period than the pre-crash period. This is despite revenue only returning to pre-crash levels in 2014. Furthermore, after examining the port company accounts, led to an indication as to what caused this rise in profitability rate. Initial improvement in the profitability rate was driven by a lower cost of sales, which fell owing to rationalisation within the company

with the cost of sales to revenue ratio dropping from 50 to 34 per cent from 2000 to 2007. This ratio, however, has been stable and averaged 33 per cent percent from 2008 to 2016. The major driver in the operating margin in the subsequent years has been a decrease in admin and exceptional costs, which dropped from 25 per cent of total revenue in 2007 to 13 per cent in 2016.

4.3.2 The port of Cork. There was limited change in the TFP index in the port of Cork for the pre-crash period. While there was growth in output, it was closely matched by growth in the input index. This is largely explained by a rise in input consumption because the port underwent a period of capital expansion coupled with a period of rising labour costs. Most significantly, the port had a net investment of 22 ml in 2004 because it net purchased land at the former Buckeye manufacturing facility adjacent to the ports Ringaskiddy Terminal (Figure 7 and Table IV).

In the immediate aftermath of the crash period, TFP fell significantly and hit a low of 86, with a 16 per cent drop in output in 2009. Subsequent to 2009, the ports TFP gradually recovered driven by a reduction in the ports input index and recovery in output. Influencing this was dock labour reform initiated in 2009, which improved competitiveness in the LoLo sector. The port bought out the pre-existing causal labour force and assumed responsibility for stevedoring (through the pots subsidiary Cork Port Terminals Services). Finally, TFP has increased significantly in the most recent periods following the integration of what was Bantry Bay Port Company into the auspicious of the Port of Cork Port Company in 2014.



Source: Autors own composition

Figure 7.
Port of Cork TFP and Profitability Change

Traffic Sector	Tonnage 2000 (Mrkt share)	Tonnage 2016 (Mrkt share)	Shift Share Margin 2000-07 (%)	2008-16 (%)
RORO	191 (1.01%)	84 (0.3%)	−64	72
LOLO	968 (14%)	1,889 (23%)	15	39
Dry Bulk	1556 (11%)	1435 (9%)	3.00	−19
Liquid Bulk	6365 (46%)	5430 (48%)	−4	7
Break Bulk	651 (41%)	139 (10%)	-63	−36

Source: Authors own composition

Table IV.
Port of cork tonnage growth

Accordingly, in 2015 and 2016, the ports output and input indexes step changed, reflecting its expanded operations.

Profitability at the start of the period as reported in the annual accounts was artificially high becaise of a failure to account for an administrative expense that was accrued in subsequent years. Therefore, 2001 acts as a better base from which to compare the change in profitability for the port company in the period. The Port maintained a steady operating margin prior to the financial crisis despite rising operating costs (increased 51 per cent between 2000 and 2007). Following the recessionary period, the port's profitability dropped, corresponding to a drop in output. As revenue has increased, however, the ports profit margins have not grown accordingly. This related to an increase in operating cost over the pre-recessionary period (with the cost sales ratio in 2014 at 65 per cent versus 54 per cent in 2007).

Examining the output mix of the port may provide a clue to why this has occurred. At the start of the period, the port was seen as a specialist liquid bulk port (Brunt, 2000). Gradually, the activity in this category declined as the container business has become increasingly important for the port. In addition, dry bulk activity has declined over the period with its overall market share dropping to 2 from 9 per cent in 2016. This drop in the market has been largely in the last number of periods because the port has suffered a decline in exports owing to a cessation of the exportation of minerals. Profit per euro of revenue generated in the LoLo sector is likely to be lower than the bulk sector owing to the public rather than private stevedoring and the additional costs of labour.

4.3.3 Shannon Foynes Port Company. Shannon Foynes Port Company was the last port in the sample and was formed as an amalgamation of previously separate harbor companies responsible for the various sites along the Shannon Estuary. The previous entities had run into financial difficulty, which was reflected in the negative operating margin at the start of the period. The port returned to profitability in 2003 and continued to run profits in the build up to the recessionary period. Similar to Dublin and in contrast to the other ports in the sample, the port's profitability rose rather than declined in the recessionary period. The growth rate in profitability has continued to increase with the operating margin peaking in the last period at 35 per cent (Figure 8).

TFP has similarly risen over the period. In the run up to the recession, this was mainly attributable to rising outputs as inputs remained stable between 2000 and 2008. Notably, there is a strong divergence between profitability and TFP growth in 2006. TFP is measured at a peak of 80 per cent over the base period owing to growth in revenue to over 16 ml euro. In contrast, the operating margin dropped to 6 from 16 per cent in 2004. Referring to the annual reports much of this sudden rise is attributed to the launching of a LoLo service,

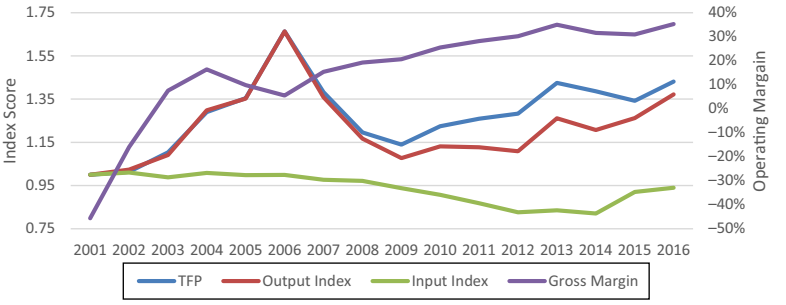


Figure 8.
Shannon Foynes TFP and Profitability Change

Source: Autors own composition

which the port was actively involved with running. This rise in income is subsequently matched by exceptional costs again, attributed to the launching of the LoLo service and court cases the port was engaged with at the time. Such exceptional costs, while effecting profitability, do not factor into the input index.

Aside from this anomaly, TFP growth largely mirrored that of profitability with consistent increases from 2010 to 2016. This increase in TFP has been driven by both growth in output and rationalisation in inputs. Much of the ports business is related to large industrial clients and sector specific production, particularly agriculture. Therefore, it is possible that the ports output level was less affected by in the downturn in the domestic economy than in other ports, which largely serve markets more closely related to domestic consumption. Rationalisation of input began in 2007 with the initiation of a programme to improve manning efficiency, including a scheme to introduce annualised operating hours to increase working flexibility. This process accelerated during the recessionary period, with the ports input index reaching a low of 80 per cent of base value in 2014. Subsequent to this, in the last two years of the period, there has been an increase in input consumption as the port has begun its most significant programme of capital expenditure over the period.

Output growth over the period has largely been driven by dry bulk traffic, as evidenced in Table V. In examining traffic patterns traffic in Shannon Foynes, it is important to segment between traffic serving single user large-scale industrial clients with processing sites along the Shannon estuary and bulk traffic that serves demand that occurs in the immediate hinterland at multi-user terminals in Foynes and Limerick. Evidence from the ports corporate documents allows us to examine the evolution of traffic in the two categories at varying points in time. As per the 2007 annual report peak, traffic at the port reached 11.35 ml tonnes, of which 2.4 ml tonnes (approximately 21 per cent) were handled at multi-user terminals. In 2011, during the recessionary period, at the time of the ports master planning exercise, traffic had declined 9.9 ml tonnes of which 1.66 ml tonnes (approx. 17 per cent) were handled at multiuser facilities. Finally, in 2016, traffic volumes increased to 11.1 million tonnes of which 2.4 ml tonnes (approximately 22 per cent) were handled at multi-user facilities.

4.3.4 Port of Waterford. Waterford Port Company, in direct contrast to the position of Dublin, decided to assume responsibilities for container operations at the newly developed Bellview Container Terminal at the start of the period. In the run up to the recessionary period, this move was initially very successful. Between 2000 and 2008, the ports output grew 112 per cent, largely driven by an increase in container volume and subsequent revenues from port dues and terminal handling charges (container volumes peaked at 1.3 ml tonnes in 2007 up from 1 ml tonnes in 2000). The ports input index over the same period was subject to a step change as expected; however, the rise in input consumption was more modest at 55 per cent, enabling overall TFP to increase by 56 per cent. This strong performance was reflected in the port's profitability with the ports operating margin rising to 46 per cent (Figure 9 and Table VI).

Traffic Sector	Tonnage 2000 (Mrkt share)	Tonnage 2016 (Mrkt share)	Shift Share Margin 2000-07 (%)	2008-16 (%)
Dry Bulk	8,230 (57%)	9,714 (61%)	1	7
Liquid Bulk	1,903 (14%)	1,050 (9%)	−22	−16
Break Bulk	150 (9%)	184 (13%)	58.00	-2

Source: Autors own composition

Table V. Shannon Foynes tonnage growth

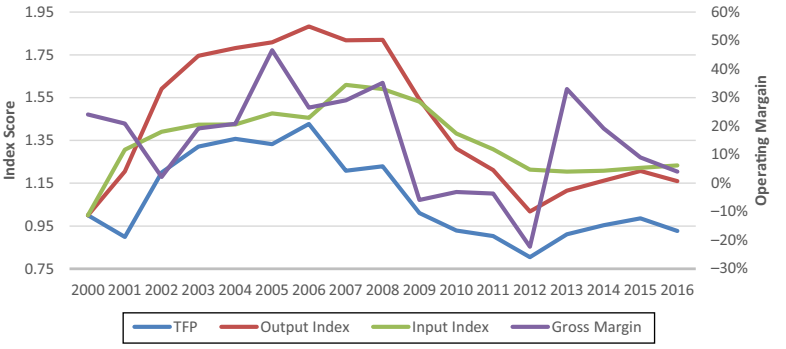


Figure 9.
Waterford TFP and Profitability Change

Source: Autors own composition

Traffic Sector	Tonnage 2000 (Mrkt share)	Tonnage 2016 (Mrkt share)	Shift Share Margin 2000-07 (%)	2008-16 (%)
LOLO	1014 (14%)	279 (3%)	−10	−74
Dry Bulk	498 (3%)	970 (6%)	42	37
Liquid Bulk	245 (1.8%)	0 (0%)	−94.00	−100
Break Bulk	115 (7%)	76 (5%)	−19	−41

Table VI.
Port of Waterford tonnage growth

Source: Authors own composition

As outlined, the effect of the recession and changing structural demand conditions particularly affected the container trade through Waterford, with container traffic dropping from the high of 1.3 ml tonnes in 2007 to a low of 268 ml tonnes in 2014. Prior to the recessionary period, LoLo volume was served by seven weekly services: four by operator C2C and 3 by DFDS. C2C subsequently pulled out of the port and consolidated its operations through its sister ConRo service in Dublin. DFDS reduced the number of services to two operated on a VSA with Samskip. Initially, the port struggled to readjust inputs to account for the fall in output level, with TFP and profitability being significantly affected. Most recently, however, the port has been able to decrease its cost base with inputs dropping from 1.53 in 2008 to 1.2 in 2013. In addition to a rationalisation in the consumption of inputs, there has been a rise in output in recent years driven by a rise in dry bulk traffic with a shift share of +37 per cent in the post recessionary period. These developments have led to an increase in TFP and return to positive profit margins for the port company since 2013 (note the high operating margin of 2013 is attributable to exceptional income accrued to the port company).

4.5 Summary of findings

The key findings and identified drivers of performance are summarised below.

Key Policy Drivers:

(1) 1996-2000 Commercialisation introduced with passing of the Harbours Act; and

(2) 2013-2016 Introduction of National Ports Policy (2013) and subsequent Tiering of Irish Ports.

Key Macro Environmental Drivers:

(1) 2000-2007 is characterised by a pre-crash boom period;

(2) 2008-2013 is characterised by a financial crisis and recessionary period; and

(3) 2013- 2016 is characterised by a subsequent economic recovery.

Key Meso Level Drivers:

(1) Unitised Sector (RoRo and LoLo):

- Growth follows wider macro-economic trend with pre-financial crash growth, decline and subsequent recovery in both LoLo and RoRo. Recovery is stronger in RoRo primarily because of the commencement of new "ConRo service."
- Increased concentration in traffic across ports in both sectors with large-scale consolidation of the number of services across operators.
- Trend toward the use of larger vessels and Vessel Sharing Agreements in the LoLo sector.

(2) Bulk Sector (Liquid, Dry and Break Bulk):

- Growth in break and dry sectors largely follow wider macro-economic trends with pre-financial crash growth, decline and subsequent recovery, and gradual decline in the liquid bulk sector.
- Increased concentration across the Dry and Liquid Bulk sectors with a trend toward increased vessel size.
- Decreased concentration in break bulk sector.

Key Drivers of Port level Performance:

Dublin Port Company.

(1) Pre Financial Crash:

- Staggered TFP growth overall with an initial loss driven by output reduction because of lost revenue owing to a change in business model and subsequent divesture in operational activity and a loss in traffic in the LoLo sector.
- Subsequent recovery and growth in TFP driven by input reduction because of the change in business model and movement toward the full landlord model. There was also strong growth in RoRo traffic over the period and a recovery and growth in the LoLo following the initial loss of market share.

(2) Post Financial Crash:

- TFP growth also staggered post-crash with TFP change largely driven by the output index with the input index remaining relatively stable over the period. The output index initially declined because the effect of the financial crisis and subsequently recovered because of recovery and growth. Growth was strongest in the RoRo sector because the port benefited from increased concentration.
- A large increase in the profitability rate because of the port benefitting from a reduced cost of sales to revenue index from 2000 to 2007 and subsequently a large decrease in admin and exceptional costs from 2008 to 2016.

Port of Cork:

(1) Pre Financial Crash:

- Limited growth in the TFP index as a rise in the output index was matched with rising input because of an increase in labour costs and significant capital investment. The profitability rate was also largely stable.

(2) Post Financial Crash:

- Significant decrease in the TFP index initially because of the financial crisis followed by subsequent recovery and increase at the end of the period. The recovery was driven by a growth in traffic in the LoLo sector as the port became more competitive following labour reform. Growth TFP in the most recent period was driven by the integration of Bantry Bay port company

Shannon Foynes Port Company.

(1) Pre Financial Crash:

- Growth in the period in both the TFP index and profitability rate as the port recovered from financial difficulty incurred by previous harbour authorities prior to company vesting.

(2) Post Financial Crash:

- Decline in TFP index immediately following the crash, followed by a relatively quick recovery in the TFP rate with output recovery and rationalisation in inputs because of labour reform.

Port of Waterford.

(1) Pre Financial Crash:

- Strong growth in both TFP and profitability in the period as the port successfully assumed responsibility for container terminal operations in newly constructed container terminal. Increase in input index over the period but increase modest relative to output index growth.

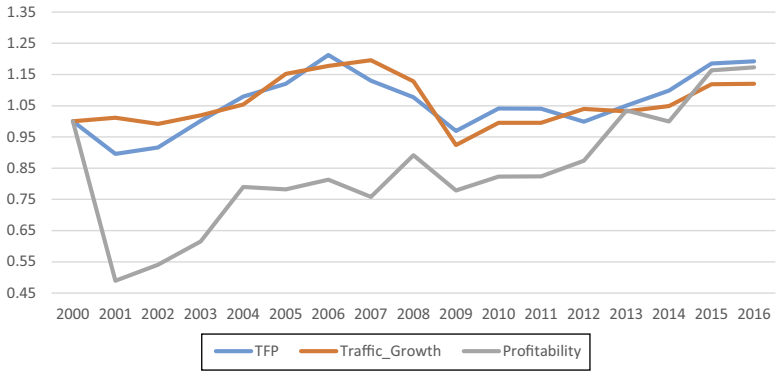
(2) Post Financial Crash:

- TFP and profitability decline over the period, as the ports output index drops due to loss of traffic in the LoLo sector. Loss in traffic driven both by the recession and concentration at the industry level. The port subsequently saw a recovery in TFP and profitability toward the end of the period due to labour rationalisation and a decrease in the input index and an increase in bulk traffic.

After examining the effect of macro-environmental level drivers first, as would be expected, performance in the sector was cyclical and closely related to the underlying Irish economic business cycle. This is clearly demonstrated by the close correlation between network traffic and TFP growth, as shown in Figure 10.

However, across the ports, there was a divergence in the effects of the major macro environmental changes. This is particularly apparent when the performance is compared before and after the recessionary period. All four ports saw decreased performance after 2007; however, the duration of the decline and subsequent recovery is different across the port. Shannon Foynes Port Company returned to 2007 productivity levels in 2013. The ports of Cork and Dublin returned to 2007 levels in 2015. Finally, the port of Waterford is still 23 per cent below 2007 levels of performance when measured in terms of productivity change.

The varying rates of recovery in the respect ports have likely been affected by the longer term meso level trend toward concentration in the major cargo markets. This is most clearly illustrated when examining productivity change in Dublin and Waterford over the period as both ports had similar growth trajectories preceding the recession. Pre-recession both ports experienced similar increases in productivity, as the output of the port grew through increases in unitised trade. In addition, both ports had increased capacity through capital investment. Post-crash, however, the shift in demand and acceleration in the centralisation process favoured Dublin and greatly worked against Waterford. Dublin Port, in the



Source: Authors own composition

Figure 10.
Network TFP and Profitability Change

post-crash period, managed to grow its output largely through attracting new services in the RoRo sector while keeping its cost base low.; hence, its productivity grew significantly. In contrast, the port of Waterford saw its throughput fall unexpectedly. The port suffered a significant fall in productivity in the immediate years following the crash as it took a number of years to adjust its input consumption. Subsequently, the port has managed to recover its productivity somewhat as both its input level had reduced, and the growth in Dry Bulk business substituted to some degree for the loss in its LoLo business.

Focusing on the initiatives of managers, a notable driver of performance has been a trend toward rationalisation of labour across the ports. In Dublin, this began at the beginning of the period as the port moved to divest itself from non-core operating activities. In the Port of Shannon-Foynes and Cork, there were dock labour rationalisation schemes aimed at improving the competitiveness of port services. In the Port of Waterford, a rationalization in response to the loss of business has allowed the port to recover from a difficult period. There have thus been active attempts on the part of the major companies to control the cost base of operations.

A second managerial initiative that has driven performance is the degree to which operating activities are outsourced to the private sector. In the bulk sector, the operating structure used across the ports closely followed that of the landlord model with mainly private provision of stevedoring. In the unitised sector, however, there was a divergence between Dublin, which moved closer to the Landlord model, and the ports of Cork and Waterford, both of which fully assumed responsibility for terminal operations. This appears to have had an effect on productivity. In Dublin, after the initial change in business model, increases in scale were largely unmatched by the input index. In contrast, increases in unitised trade in Waterford (pre-crash) and Cork have been matched by increases in the input index. This difference points toward differing marginal returns to scale depending on the model that has been used. In the landlord model, the effective outsourcing of operations to the private sector reduces the marginal cost of additional output (with the exception of expansion that requires capital investment). In the public provision model, the port company potentially has scope for greater returns based on its capacity to charge for the full terminal handling service; however, the port company faces the full additional cost of providing services in labour.

The divergence in operating model activity is mainly attributable to scale of operations as outlined in the competition authority report (2013). Dublin operates at a higher volume

than the other two ports and, as such, sustainably manages to maintain a number of separate terminals. The reduced scale of the LoLo business in the smaller ports is viewed to impact the commercial feasibility of having more than one operator provide services from the port. Private participation in a single operating terminal runs the risk of the creation of a private monopoly. Without the regulating force of intra-port competition, it is feared that private monopolies with little commercial incentive to invest and innovate will produce poorer quality services. Discussing this directly, the port of Cork outlines that the 'challenge for the port sector arises from the fact that the sector is small in scale, scope and profitability, and there is little benefit or attraction for the private sector to invest in local facilities'. Port Company provision, therefore, mitigates this risk and helps ensure quality of service.

4.6 Policy implications and conclusions

4.6.1 Policy implications. The purpose of the initial reform in the sector, as outlined in Section II, was to create commercially responsive port companies. It is difficult to say with certainty whether the reforms were successful without access to data regarding the performance of the ports prior to reform or an adequate counterfactual of sample of non-commercialised ports to compare Irish performance with. There is, however, evidence of responsiveness on the part of the ports, which would suggest some degree of success. Across the ports, there was labour rationalisation in an effort to improve efficiency. In addition, all ports sampled showed a responsiveness to recover from the negative effect of market contraction because of the recession. Lastly, net investment is easily derived from the change in capital stock and can be seen, as shown in Figure 11. Here, it can be seen that there was positive investment across all ports over the period.

NPP 2013 represented a departure from the previous policy position through a move to concentrate state support in the largest ports. The decision to tier the ports in National Ports Policy (2013) appears to be largely consistent with meso level dynamics toward concentration and performance of the largest ports. The tier 1 ports appear to be better positioned both in terms of access to deep water and financial resources to develop capacity in line with changing trends. As outlined in the Introduction, ports require sustained traffic flows to make the necessary capital investments to remain competitive. The market for port services in Ireland is limited by the size of the Irish hinterland and relative peripherality of Irish ports to the major trade lanes, which makes it unsuitable for transhipment traffic. There is a strong case to be made that, with limited traffic, there is not a sizeable enough

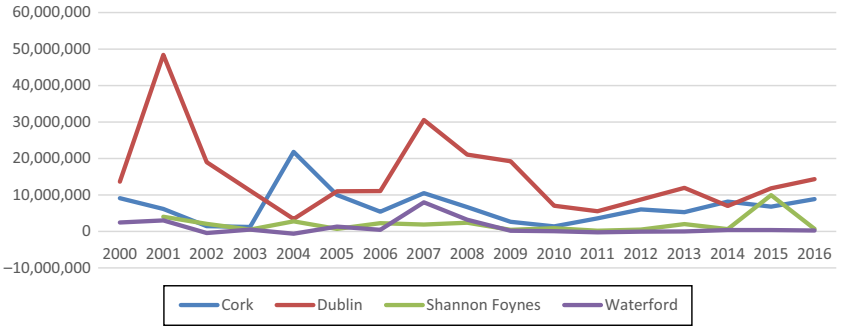


Figure 11.
Net Investment Across Sampled Ports

Source: Authors own composition

market to support multiple competing ports. The increasing concentration in all sector except break bulk would support this conjecture. In addition, in Figure 10, it is clear that Dublin port has invested far more over the period than any other port.

Looking to the future, land constraints in Dublin Port may potentially limit future development of the port at its current city centre location. Given the importance of the port, this poses a threat to future development of the port system. Traditional port system development models point to limits to concertation (Notteboom and Rodrigue, 2005). For example, Notteboom and Rodrigue's (2005) popular framework suggests that as central ports continue to expand. space constraints lead to diseconomies of scale leading to a period of de-concentration. While there may not be immediate concern regarding space constraints in the long term, this may become an issue. A growing gap in size and performance between the large and small ports creates doubts as to whether smaller ports may be able to adequately develop to provide substitute capacity should capacity constraints occur in Dublin. One potential may be amalgamating ports as proposed by the *Report of the Review Group on State Assets and Liabilities*. Here, it is proposed that ports are amalgamated into three port companies representing east, south and west coast ports.

5. Conclusion

By applying a case study approach, this paper provides a descriptive account of the evolution of performance change throughout the Irish Port system over the 2000-2016 period. In this way, the paper provides the first review of Irish port performance in the academic literature since Mangan and Cunningham (2000). It is clear from the analysis that performance was majorly effected by the macro-economic changes of the 2000-2016 period. Through the in-depth case study, it was possible to identify how port management adapted in respect to the short term shock of an unexpected reduction in traffic after a period of unprecedented growth. Clearly, the impact of the recession was divergent across the ports largely because of the scale and nature of operations of the respective ports. This has had an effect on the actions taken and rate at which productivity has recovered. A longer-term trend at the meso level toward concentration in traffic volumes appears to further favour the performance of larger ports. As identified, a growing gap in performance between smaller and larger ports creates a potential issue for the future development of port infrastructure should space constraints become an issue at the most dominant ports.

There are, however, several limitations to the study. As outlined in the methodology, the productivity measures used restrict the analysis to relative change in productivity over time in individual ports. This was largely motivated by the small and heterogeneous available sample. In future studies, the use of frontier methods to measure productivity may enrich the analysis. Similarly, the study does not measure all aspects of port performance. The effectiveness of service delivery and environmental performance are increasingly important in port performance studies (Brooks and Pallis, 2008; O'Connor *et al.*, 2016). Historical data to measure the performance on such dimensions was not available for this study. In future studies, including such measures would further enrich any future performance analysis.

From a policy evaluation perspective, the results show the importance of contextualising the effects of macro-environmental changes and demand-side dynamics when considering supply-side performance factors. It is argued that the study demonstrates the potential of in-depth case study analysis for uncovering insights into the drivers of performance across a number of dimensions, thus allowing for the contextualisation of results. The study of a small number of cases enables the use of rich qualitative sources to create strong narratives that combined with quantitative measures of performance can lead to new insights. Recently, this form of case study

approach has been used to examine performance in a number of other sectors including energy (See and Coelli, 2013), food production (Palcic and Reeves, 2015) and airports (Cahill *et al.*, 2017). It is proposed that this form of approach has particular potential for use in conjunction with large sample studies that are more typical in the port performance literature. Here, case studies can be used to generate insights and propositions that can be more formally examined in large sample studies.

Notes

1. The act was largely amended in 2000
2. Rosslare falls under a different governance system because of an historical arrangement whereby the port is a part of the state rail company Iaranoid Eireann.
3. Labour costs were converted to constant prices using the consumer price index with 2000 as the base year.
4. Real capital stock was calculated by taking the deflated nominal capital level in the vesting year. The gross fixed capital formation deflator was used to convert capital to constant prices with 2000 as the base year. To account for different asset classes, two groups of assets were formed, land, terminals and quays, which were depreciated at 3 per cent followed by plant and equipment, which was depreciated at 12 per cent.
5. Revenue was also converted to constant costs using the consumer price index with 2000 as the base year.
6. This service involves the movement of stackable containers that are driven onto specialised vessels using mafi trailers and is termed colloquially as 'ConRO'.

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