A SEA OF TROUBLES? JOURNEY TIMES AND COASTAL SHIPPING ROUTES IN SEVENTEENTH-CENTURY ENGLAND AND WALES.

1. INTRODUCTION

In the age of the sailing ship, a rich tapestry of coastal trade routes connected sea and river ports across England and Wales. Coastal sailing ships and smaller river vessels were once an everyday sight. Fernand Braudel referred to England’s enormous coastline as its ‘first natural advantage’, because of this trade, but also the extensive island geography that made it all possible. And Gillis has shown more recently how England’s coast was second only to agriculture on land as an area of production for the commons given the opportunities it afforded for fishing and local trade.

From the sixteenth century, mariners increasingly ventured away from old European coastal routes, thus initiating the Age of Discovery. However, specialist coasting ships continued to outnumber international vessels in England long after this time. And they continued to be immensely important until the twentieth century. Yet, despite its near ubiquity and influence, this critical transport service has received less attention than it deserves, even from maritime historians. This subject is particularly significant given Britain’s history of industrialisation and

---

1 I address England and Wales and not Scotland or Ireland because the latter are not covered by the Port Books and were governed by institutions that have left different historical records.
urbanisation, a field that has been revised significantly by the Cambridge Group for the History of Population and Social Structure. Transition away from an economy oriented around local agricultural production seems to have started long before the “classical” periodisation of the Industrial Revolution. Given that Britain had a large national market from an early date, and that the unparalleled expansion of London was a catalyst for economic growth, coastal shipping must have been of crucial importance given that it was the primary mode of transportation for resources like coal, which were vital to industrialisation and its corollary: urbanisation.

This paper supports an umbrella research project, within the same research group, into transportation networks and their connectivity in England and Wales 1690-1911. Historical Geographical Information Systems (hereafter “H-GIS”) are used extensively to address, more fully than has been possible before, integrated transport systems, and their impact on economic development in Britain. We follow in the wake of other research into transport and the economy that exploits H-GIS.

---

6 https://www.campop.geog.cam.ac.uk/ (accessed 2 October 2019).
Coastal shipping played a key part in England’s industrialisation and urbanisation. Road transport was important for high-value goods like textiles and passengers;\textsuperscript{12} but it was prohibitively expensive for long-distance carriage of other heavier goods. Coastal cargoes tended to be bulky and of a low per-unit value, such as coal, but they were critical to England’s prodigious early economic development. Concerns about “storms, wars, and privateers” meant that merchants sometimes switched from coastal ships to the roads.\textsuperscript{13} But in the end, as Adam Smith wrote, “it required only six or eight men to bring by water to London the same quantity of goods which would otherwise require fifty broad wheeled waggons, attended by a hundred men, and drawn by four hundred horses”\textsuperscript{14}

Coastal shipping, despite its historical prominence, appears to be under-researched. In order to understand its fundamental characteristics better, I use new quantitative methods to measure average journey speed, time ships spent in port on voyages, and the seasonality of different coastal trades. The focus though, as with similar studies in this field, is on the speed of ships.\textsuperscript{15}

I describe below my research into ship speed in sections of England’s wider coastal shipping network in the seventeenth century. The results given below shine a new light on the

\textsuperscript{12} Dorian Gerhold, \textit{Carriers and Coachmasters: Trade and Travel Before the Turnpikes} (Chichester: Phillimore, 2005).
\textsuperscript{14} Quoted from his \textit{The Wealth of Nations}, 1776, Bk II, ch. 5, in, Philip S. Bagwell, \textit{The Transport Revolution from 1770} (London: Batsford, 1974), 61.
broader coastal transport system early on in its history. In this quest, I rely on local port records of the historic English customs service (covering modern day England and Wales), which provided data for thousands of recorded departures and arrivals of coasting vessels. I investigated customs records from the seventeenth-century period, enlarging the knowledge we have about later periods. The “Coast Port Books”, issued by the Exchequer, are the archival reference for this paper. These were created from government attempts to document all coastal ship movements in England and Wales from 1565-1790.

The paper features three sections: firstly, historical context is given; secondly, I describe sources and methods; finally, the paper gives results, subdivided by calculations using H-GIS and panel-data analyses.

COAST BONDS AND COAST PORT BOOKS

The customs system in England between 1565 and 1790 recorded movements of coastal trading ships using a system of dated documentation that recorded cargoes moving between ports. The exchequer enforced this system to deter merchants from exporting goods overseas when engaged in the coasting trades. Coastal trade was (mostly) tax free, whereas international trade was heavily taxed and regulated. Therefore, the state kept coasting and international trade separate for accounting purposes. The reason the state recorded the coastal trade was to

---

16 These three sections provide data that we compare with numerous other sources like Board of Trade Crew Lists for 1830 to chart changing coastal shipping speed to 1830 using comparable metrics: see, Dan Bogart, Oliver Dunn, Eduard Alvarez-Palau, Leigh Shaw-Taylor, "Speedier Delivery: Coastal Shipping Times and Speeds During the Age of Sail" (Cambridge Group for the History of Population and Social Structure Working Paper), 2019: https://www.campop.geog.cam.ac.uk/research/projects/transport/publicationplans/ (accessed 2 October 2019).
17 These are now held by the UK National Archives in London.
ensure coasters did not stray into foreign waters to trade while not paying taxes and abiding by various regulations on exports. Strict rules forced coastal trade through certain “legal ports”, allowing for mass-observation of coasters to make sure they travelled between home ports and not abroad.\textsuperscript{18} Merchants were required to register goods at these ports before any coastwise departures could be made. Customs officers searched through boxes, crates, and bales on boats to establish cargo composition. They then provided a dated receipt that carried the original Latinised name for a customs seal, the “cocket”, that detailed the cargo, for the ship master to carry to the next port. This document included ship name, home port, and merchant, names of ship master, a detailed cargo description, port of origin and destination, and voyage dates. Sometimes, ship capacity was recorded in tons.\textsuperscript{19} Merchants posted a bond with the local customs house to guarantee not to export the goods listed.

On arrival, the master presented the cocket to local customs who searched the cargo to ensure it matched the list of goods on the document. If the contents matched the official cargo description, it was assumed no illicit export could have occurred between the two recorded ports. After, officers wrote out a certificate that confirmed this. This was used to retrieve the bond later. Cockets coupled with other information copied into the coast books could be used to prosecute and seize coastal bonds through the courts if wrongdoing was suspected. Different rules covered goods on which customs had already been paid, and untaxed goods like fish passed freely via the \textit{transire} document system. A \textit{transire} certified that cargoes consisted of

\begin{itemize}
\item \textsuperscript{18} Stephen Gadd, "Illegal Quays: Elizabethan Customs Reforms and Suppression of the Coastal Trade of Christchurch, Hampshire", \textit{The Economic History Review} 71:3 (2018), 727-746.
\item \textsuperscript{19} “Ton” is archaic and was used interchangeably for ship capacity (100 cubic feet) and freight weight (20 cwt). See entry 2. for “ton”, \textit{n.}, in, \textit{The Oxford English Dictionary} (web).
\end{itemize}
goods that were not subject to any export controls or taxes, and therefore did not require a cocket because they could be traded freely at home or abroad. Similar rules covered cargoes valued under 20s (£1), which due to their low value were not subject to any customs at all. Customs officers dated these cargoes along with controlled cargoes meaning that, in theory, all coastal cargoes small and large were recorded. However, when Bronwen Cook examined the accounts of the Content of Maldon, a coaster that operated in this period, she found that nearly a third of its voyages went unrecorded by customs because cargoes were valued below the 20s threshold. Based on this information, we must accept that customs in some ports may not have recorded all small cargoes, which a weakness of the source.

The details of ships, cargoes, and the dated customs searches and receipts were copied into the Coast Port Books and today they amount to a detailed record of thousands of cargo movements between ports. The customs dating and port location details they contained were originally copied into the port books that have survived. I used these data to track voyages using route modelling in H-GIS to measure time and ship speed.

The coast books that record the documents produced by this system, like all early modern sources, have their limits in terms of accuracy. Importantly, there is fraud and evasion to consider. Merchants and officials were regularly accused of abusing customs in England.

---

Smuggling became a national sport after the establishment of new customs in 1558\textsuperscript{23} and the customs and excise from the 1640s.\textsuperscript{24} The accuracy of customs records should always be questioned, especially where they record valuable customs that were particularly prone to evasion. However, coastal trade was not taxed, and so malpractice is less pressing problem.\textsuperscript{25} There may have been collusion to defraud coastal customs by misrepresenting cargoes at the point of departure. And sections of cargoes may likewise have been concealed and sent abroad. But I do not use detailed cargo descriptions to study ship movements, meaning I argue this fraud is also less problematic.

Elizabeth Hoon found some contemporary complaints about the practice of pretending that a ship encountered storms that pushed them into foreign harbours, when they sold goods.\textsuperscript{26} Customs officers may also have been negligent or maybe merchants evaded the system altogether. Missing or adulterated records of ship movements in the Coast Port Books would reduce our ability to link ship records over time reliably. Because I cannot identify such fraudulent entries in the source, I compare certain data that I know was reliable (explained later) with suspected data, and with entirely different sources, to test for robustness.

Aside from source reliability, another major limitation with the source is that only a minority of coast books have survived. Glue-makers, rodents, customhouse fires and explosions have destroyed many volumes. Moreover, today, conservation work greatly restricts public

\textsuperscript{23} Evan Jones, Inside the Illicit Economy: Reconstructing the Smugglers’ Trade of Sixteenth Century Bristol (Farnham: Ashgate, 2012).
\textsuperscript{25} David Hussey, Coastal and River Trade in Pre-industrial England: Bristol and Its Region, 1680-1730 (Exeter: University of Exeter Press, 2000), 8.
\textsuperscript{26} Hoon, Organization of the English Customs System, 268.
access to the remaining collections: and the majority are currently being cleaned of mould. So, all in all, this paper cannot then give an ideal random sample of surviving coast books. This would ideally sample ports equally from across the country while accounting for their relative size. Finding such a sample would require more research, and naturally, some ports are overrepresented here due to source survival disparity across ports. Still, the books investigated here can offer insight into coastal shipping and its patterns. And the methods are worth documenting because they could be applied to a larger and more geographically balanced sample in the future.

I transcribed data from twenty coast books created in fourteen ports in archival series E122 in the National Archives, London (hereafter “TNA”). The earliest hail from 1649, the start of the Interregnum period, and end with the Glorious Revolution in 1689. Institutional reforms during this time seem to have resulted in the surviving port books from this period being catalogued separately from the main port book series E190. Series E122 has escaped conservation work – apparently because of its distinct classification.

I collected 4,382 observations from E122. And I improved sample coverage later by transcribing four coast book volumes from Bridgwater on the west coast covering 1672-76 and 1677, and two volumes from King’s Lynn on the east coast covering 1661-62. I found these books to be free of mould and accessible within the main E190 port book series. I collected a further 2,421 coastal voyage observations from these. Both E190 and E122 series provided

27 TNA: Arundel E122/196/29; Barnstaple E122/196/28; Bridgwater E190/1091/2, 3, 5, 9; Colchester E122/198/16, 17; Exeter E122/232/21; Faversham E122/232/18; Hastings E122/231/12; Ilfracombe E122/218/30; King’s Lynn E190/436/3; Looe E122/230/11; Maldon E122/232/10,12; Milford Haven E122/231/17; Sandwich E122/232/16; Scarborough E122/232/11; Shoreham E122/230/18; Spalding E122/230/13, 19, 20, 21, 15, 4.
comparable types of information. Variance source detail mainly arises from the recording styles
of officers and the way ships traded of the time. The Bridgwater and King’s Lynn books have
very few outwards ship movements, for example, because they were net importers of
Newcastle and Sunderland coal.

I transcribed details from both sets and created 6,803 timed coastal voyage
observations of different kinds described below.\textsuperscript{28} Ship names and ports were standardised to
enable record linkage. Ports were located and given coordinates in the data. A second pool of
data were dates of cockets carried on the ships and the dates of ship arrivals in port. These
allowed for journey time and speed calculations between ports with H-GIS support.
Transcription of tonnage was also made, and in some cases cargoes and crew names.

Figure 1 shows the distribution of the data: sixteen ports yielded coast books that
provided the set of voyage observations. These link to 105 ports described as either
destinations or ports of origin of ships. This linked port set significantly increased the sample’s
geographical coverage from the limited number of ports where the books were originally
created. These ports are connected by 377 routes defined by the H-GIS. The 176 homeports
where individual ships were registered is larger still. A total of 453 distinct coasting vessels are
recorded.

\textsuperscript{28} I used handwritten text recognition tool Transkribus in combination other automated methods to transcribe E190
volumes and create the database.
Figure 1 Coast book sample structure and key variables.

Sample vessels tended to be from smaller ports that could be tiny and far inland, such as the three vessels from the village of Reach in Cambridgeshire that traded between Boston and Kings Lynn. The trades of London and Newcastle were likewise served by coasting ships from much smaller ports.²⁹

Customs rarely described ship types. Sometimes, ketches, shallops, skiffs, barges, duddles or simple “open boats” are mentioned. Ships of 30 tons were most commonly recorded when ships’ burthen was given. The largest ship recorded was 130 tons and the smallest just four. Unfortunately, tonnage data was not recorded for colliers. Other sources indicate these were probably larger than most other ships in the data. Barker provided a detailed logbook of a ketch, the Judith of Whitby, a coastal collier sailing around 1680, and estimated its weight as 75 tons.³⁰ Welsh colliers are thought to have been smaller than this, and these populate the

²⁹ Coastal fleets were not registered in large ports, perhaps because of higher mooring costs.
³⁰ Rosalin Barker, “Thomas Rogers and the Judith of Whitby; the Voyage Accounts of a Seventeenth Century Merchant Ketch”, The Northern Mariner/Le Marin du Nord, 17:3, (2007), 19-39, here 23. Nef used port books to calculate the size in tons burden of colliers visiting London, which were much larger, increasing from 139 tons in
Bridgewater voyage data. Our records for colliers that once sailed on the east coast show they did so at a higher average speed than other ships in the sample. These were likely to be of the Judith’s size and above because bigger sails generated faster speeds.

**MEASURING JOURNEY SPEEDS**

A routing matrix was created to connect the 377 pairs of ports. This is where H-GIS came to the fore. It was essential to the mapping and analysis of routes described in the source, mainly because it provided sailing distances separating ports. Therefore, it allows for measurement of individual voyage journey speed on routes in conjunction with the documented dates of departure and arrival. Virtually nothing was known about coastal sailing routes of the seventeenth century; in another paper, we describe research and sources used to identify routes mariners likely followed that enabled the writing of this paper. This paper draws on historical coastal charts, bathymetric depth rasters, topographic elevation rasters and parliamentary reports to create a database of ports and routes.

I would estimate that this is a reasonably accurate model representing the routes coasters used. However, sailing ships did not always sail in straight lines because of winds, and


there would have been deviation from our H-GIS routes. Prevailing winds are not accounted for in the model either. Winds would have critically impacted on ships, routes, and their prevailing direction could explain certain seasonal voyage patterns described below. We can add this data later to improve the system.
H-GIS allowed the measurement of ship speed on individual voyages. Speed reveals key aspects of shipping performance and provides a way of measuring this over time using comparable metrics. Ship speed has been researched in various historical contexts as it serves as a good proxy for shipping profitability, technology, and levels of organisation.\(^{35}\) In the historical past, the speed ships could travel determined the types of goods that were transported by sea in the first instance. In English coastal shipping, slow average speeds resulted in cargoes consisting more commonly of non-perishables, and those with low per-unit value, like grain or coal. Speed impacted on ship profitability because it determined the number of voyages that could be made over a given period, which is important because profitability impacted on consumer prices.\(^{36}\) Researchers report averages for journey times using common metrics like miles per hour to compare speed across historical periods.\(^{37}\) Duration ships spent in port is sometimes measured for similar purposes.\(^{38}\) This paper adds to this area of research by providing the first large set of journey time data for the speed of seventeenth-century English coastal shipping.

The dataset I have prepared is arranged by date of cockets and ship name. Cocket dates could be compared directly with arrival dates at receiving ports because both date forms are listed together in individual ship arrival records. These allow calculation of days elapsed on journeys between given ports. I calculated the average journey speed of thousands of coastal


\(^{37}\) This is something I am pursuing further with colleagues using this method and source in, Bogart *et al.*, "Speedier Delivery".

voyages between ports using this information to report average miles travelled per day by ships.

<table>
<thead>
<tr>
<th>Port of cocket and arrival port, i.e. the route.</th>
<th>H-GIS route miles</th>
<th>Ship</th>
<th>Depart (cocket) date</th>
<th>Arrival date</th>
<th>Journey in days</th>
<th>Miles per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newcastle – Kings Lynn</td>
<td>201</td>
<td>Ann of Scarborough</td>
<td>16/08/1662</td>
<td>01/09/1662</td>
<td>13</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Table 1 Example of journey time and speed calculation. Arrows show dates compared.

To show how this is done, Table 1 provides an example from observations of the entrances of the Ann of Scarborough. The 1662 coast book for Kings Lynn records that this ship arrived there from Newcastle on 1 September 1662. The date of the departure cocket it carried was recorded on arrival alongside the ship’s arrival date. The cocket was dated 13 days previously on 16 August 1662 in Newcastle. The coastal H-GIS provided the route distance from Newcastle to Kings Lynn as 201 miles. Dividing mileage by journey time in days shows average miles travelled per day in this case was 15.5.39

Code was run through the database to compare cocket and arrival dates on mass this way. 2,906 journey speed observations were collected, amounting to about half the full sample of voyages. These observations provided the right data to connect voyages between ports and make the comparison between departure and arrival dates. Other observations were dropped

39 Note that this calculation of days elapsed between dates does not require matching between entries or separate coast books. All requisite information such as ship name, domicile port, port connections, and cocket and arrival dates, is given in single records of ships.
because they missed some temporal or spatial information required to calculate speed. The aggregate results for journey speed calculations were analysed regarding various characterises like the cargo carried, departure month and location.

This large-scale data mining approach allowed for the definition of three distinct groups of ships and routes. These varied significantly in terms of their speed between ports:

1. East coast coal trade routes from Newcastle and Sunderland, which were major coal exporters, to ports in southern and eastern England. (633 observations).

2. West coast coal trade routes from Neath and Swansea in South Wales, which also specialised in the export of coal. These journeys connect with Bridgwater in North Devon in south-western England (1,031 observations).

3. The “other – not coal” group. These include voyages between ports that did not normally trade in coal (1,242 observations).

The summary statistics for journey speed are in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>East coast – coal</th>
<th>West coast – coal</th>
<th>Other – not coal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average mileage</td>
<td>197</td>
<td>70</td>
<td>83</td>
</tr>
<tr>
<td>Mean</td>
<td>24.2</td>
<td>16</td>
<td>12.4</td>
</tr>
<tr>
<td>Median</td>
<td>22.3</td>
<td>11.3</td>
<td>8.6</td>
</tr>
<tr>
<td>Mode</td>
<td>28.7</td>
<td>18</td>
<td>20.9</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>12.9</td>
<td>15.2</td>
<td>11.8</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.6</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Maximum</td>
<td>67</td>
<td>72</td>
<td>84.1</td>
</tr>
<tr>
<td>n</td>
<td>633</td>
<td>1031</td>
<td>1242</td>
</tr>
</tbody>
</table>

Table 2 Average speed coal and non-coal routes. Average route journey mileages and average sailed “miles per day”. My own elaboration.
Newcastle and Sunderland ships achieved higher average speeds than all other categories. Despite their relatively fast speed, colliers travelling on the east coast only sailed at 1mph when averaged over 24 hours. On the west coast this reduces to 0.066mph, and for the rest 0.52mph. Coasting ships could sail at around 5mph in the right conditions according to Armstrong, i.e. a lot faster.\(^{40}\) The fastest ships in our sample travelled between 67 and 84 miles per day, and thus averaged between 2.8mph and 3.5mph, and this small sub-sample is closer to 5 miles per hour. However, only 52 journeys averaged these speeds out of 2,906 other journey speed observations (the latter is a subset of the full sample, as I explain later). These were the fastest speeds the sampled coasters achieved if few delays were experienced or stops made. Most journeys were delayed for unknown reasons, and therefore speeds were on average much lower than “plain-sailing” speeds that Armstrong reported.\(^{41}\)

These results strongly indicate that delays and stoppages were normal. Ships may have stopped intentionally to allow crew to trade on their own account, to resupply, or to rest if they feared trouble ahead, for instance from privateers. Unfortunately, the source rarely describes journey events. Coasting ships also sailed more slowly when they faced more complex routes that required lots of manoeuvring in and out of port, especially those that navigated tidal rivers or sailed against adverse winds.

\(^{40}\) Armstrong, *The vital spark*, xiii.

\(^{41}\) Our results are slower than contemporary Atlantic voyages which in 1686 averaged 2.5 mph from Shepherd *Shipping*, 78; Kelly and Ó Gráda calculate a median of 4.7mph for British East India Company ships in the eighteenth century. However, the median for slowest ship type they record, the *Navio*, was 2.6mph: Morgan Kelly & Cormac Ó Gráda, "Speed under Sail during the Early Industrial Revolution" (c. 1750–1830)", *Economic History Review* 72:2 (2019), 459-480, here 471.
Some very slow outlying times in the data have a significant downward bias on the estimated results for speed. I considered expunging these observations, but this would have acted to speed up averages unduly and would have masked real long delays. I instead present the full results as they are subject to certain checks on accuracy of transcriptions. The mode and median averages indicate average speed without the influence of very slow times.

Rosalin Barker found “elastic” journey times in her study of a rare surviving logbook that dates from the time of this study. Some logged voyages were much slower than others. The logbook once belonged to a master of a Whitby ketch: the Judith. I compared our journey times with Barker’s results drawn from the log to see if the varied results for speed as found in my source are realistic. The Judith travelled from London to Whitby over periods of between seven and 22 days. Crudely, the average here is 14.5 days.\footnote{Rosalin Barker, \textit{The Rise of an Early Modern Shipping Industry: Whitby’s Golden Fleet, 1600-1750} (Chippenham: Cambridge University Press, 2011), 87.} In my data, I have 140 voyages that travelled on this 300-mile route at least in part. These ships sailed from Sandwich or London, to Scarborough, Newcastle and Sunderland. Average journey time on this leg precisely matched the Judith’s more limited data, resulting in a 14-day average. This offers a positive cross-analysis. Moreover, the ratio between the shortest and longest of my journeys was eight and 16 days, or 2:1; for the Judith it was seven and 21 days, or 3:1.\footnote{Experimental archaeologists compare the performance of historic sailing vessels and find high rates of speed elasticity – up to 5:1 on some routes. See Anton Englert, “Trial Voyages as a Method of Experimental Archaeology: The Aspect of Speed!”, in Lucy Blue et al. (eds), \textit{Connected by the Sea. Proceedings of the Tenth International Symposium on Boat and Ship Archaeology, Roskilde 2003} (Oxford: Oxbow, 1996), pp. 35–42, here. 38-9.} The great range in times is therefore supported by another source of information about voyage speed irregularity.
A persistent question that arose when conducting this research was whether unrecorded stops on voyages between ports make them slower unduly. Did coasters stop in intervening ports between declared legal ports to trade or resupply? These stops should have been recorded in the coast books according to one guide; but I found only a handful of instances in the coast books.\(^4^4\) This suggests to me that coasters normally shuttled goods between specific ports and did not “tramp” along the coast, the latter an activity that would have made for very slow recorded journey speeds as I record them.\(^4^5\)

In sum, it seems that coastal shipping was just very irregular in its speed and timing, and this depended on lots of uncertain causes. This raises questions about the types of challenges crews of coasters habitually faced as well as about overall efficiency. Why were they so often delayed? Wartime disruption must have caused delays particularly if ships waited for naval escorts before sailing. Around a third of data analysed here coincides with the Spanish War (1660-65) and three Dutch Wars (1652-54, 1664-67 and 1672-74).\(^4^6\) Unfortunately, the data does not allow analysis of war effects on shipping speeds and regularity because my sample does not coincide well enough with these wars. It would be necessary to resample the port books to gain enough data that cover the same route equally in both years of war and of peace to measure the difference in performance between these times on the same route.

Whatever the reasons, the real aggregate network speed was surprisingly slow, much slower than speeds ships were capable of sailing. Delays, often critical, were normal in


\(^{4^5}\) Ships sailing in English coasting trades seem to have shuttled goods between two declared ports. Customs controls prevented ships from discharging goods at intervening stages without a full record made at a customs post.

seventeenth-century coastal transport, and this factor contrasts starkly with timetabled shipping services established in the nineteenth century with mechanisation, which allowed the forces of nature to be managed better. Moreover, British coasts were pacified at this time, and piracy had been eradicated. I wonder whether with more research using similar data a narrowing of the irregularity in coastal shipping in later periods will become apparent as new technology and forms of organisation emerged.

**Measuring “Voyage Cycles”**

We have seen how the coastal H-GIS enabled the modelling of individual voyages based on single records of ship movements between two given ports. Panel-data analysis, by contrast, allowed for the comparison of voyages for named ships matched across several entries in individual Coast Port Book volumes. This method made use of the many observations of repeated voyages of ships between two identical ports where they were recorded chronologically throughout the volumes. I reordered departures of these vessels to group individual ships chronologically by their cocket dates. This brought together clusters of the individual vessels’ repeating voyages when they shuttled between two connecting ports over time. Ordered chronologically, panel data for individual coasters covers periods of up to a year. It allowed us to see the careers of individual ships and the frequency of their departures between ports.

The rate of individual ship departures is the time taken to start out on repeated voyages, the “voyage cycle”, which is time in days between two consecutive departures of the
same ship on an identical route. Voyage cycles I think were undertaken by ships that specialised in certain trade routes and followed them repeatedly as circumstances allowed.

Table 3 shows the panel data arrangement and how I matched ships, linked their repeated voyages along identical routes, and then calculated the time elapsed between departures. The table represents the panel data arrangement for the Constant of Sandwich, which carried wheat, cheese, and malt repeatedly to London from Sandwich. It shows voyages ordered by departure date. The Constant sailed to London 24 times in 1652, according to the source.47 It seems its name advertised its “constant” sailings to London.48

Rows one and two show its departures over time from Sandwich or London. If the very next departure in the data was from the same port as the ship’s previous departure, as in rows one and two, I define it as voyage cycle type one. Connections between rows two to four, four to six, and six to eight show cycles with an intervening return journey recorded back to Sandwich. This shows the Constant’s departure, return, and departure again and is defined as voyage cycle type two. It gives more detail than type one about the voyage. Voyage cycle time for both types were calculated automatically in columns four and five.49

<table>
<thead>
<tr>
<th>Route</th>
<th>Ship</th>
<th>Depart date</th>
<th>Voyage cycle type one</th>
<th>Voyage cycle type two</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandwich-London</td>
<td>Constant</td>
<td>10/03/1652</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Sandwich-London</td>
<td>Constant</td>
<td>01/04/1652</td>
<td></td>
<td></td>
</tr>
<tr>
<td>London-Sandwich</td>
<td>Constant</td>
<td>10/04/1652</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

47 Sandwich E122/232/16
48 Note that record linkage for individual ships were made over several pages within the same coast book volume; no linkage was made between volumes from different volumes from different ports.
49 I only record departure entries once to avoid mixing data.
A formula found and calculated all voyage cycles like those of the Constant. Voyage cycles over periods longer than 365 days were discounted because ships that cycled at such low rates were seemingly not fully operational and are discounted. The formula calculates time, in days, that elapsed between consecutive departure dates on mass.

This method relied on record linkage methods, namely standardisation of ship names, and the identification of single ships across pages, and even between volumes in one or two cases. Some ships had common names, but their “domicile” or identifying port enabled disambiguation. There are many ships called the John, but I assume that there were not two ships called the John of Sandwich operating in the same period and place. I believe that such conflation would have created untenable confusion in the original records and would defeat the point of ships’ names that were originally used to identify them in the records. Sometimes names were similar, like the “Content” and “Consent”, so caution was required when transcribing these.
In all, I found 3,186 voyage cycles in the total dataset of 6,803 observations. Over 50 per cent of the full sample was omitted because ship matches could not be made across pages or because ships did not “cycle” between ports. Sometimes information like cocket date or ship name were missing, which also prevented voyage cycle calculations.

It was necessary to check for reliability in the voyage cycle measure because record linkage may be a problem, particularly as cycle type one does not include detail for recorded return journeys. Ships could have sailed onwards unrecorded to third ports, or even abroad, during these recorded cycles. Ships might have been sent elsewhere if a profitable venture arose, even if they habitually sailed between certain ports. Cargoes may not have been recorded at all because if valued under the 20s threshold when cargoes should have been recorded. The *transire* should have been recorded for such voyages, and often is present in the data, but it may not have always been obtained, meaning a ship could have traded but was unrecorded by customs and so would not appear in the data supporting this article. These unrecorded onward voyages that may have taken place within voyage cycle periods created by the panel data arrangement would make cycles appear longer. Therefore, unrecorded sailings may well distort aggregate voyage cycle type one measurements. I introduce a test to check whether there is any significant distortion in these.

Voyage cycle type two is more reliable than type one because ships like the Constant can be seen to return home before starting out on a second voyage on the same route,

---

50 As above, minus return journey record back from London to Sandwich.
meaning they were unlikely to have sailed elsewhere unrecorded. I could focus solely on type two except there are only 394 observations to analyse. I instead use the more reliable type two measure to compare against the more numerous type one cycles. I compared the standard deviation from the mean of both cycle types. If this varied greatly between the two, then unrecorded onward voyages would be implicated as being responsible for longer outlying voyage cycle times. I compared cycles only for vessels that produced types one and two together, like the Constant, so as not to mix different types of routes and ships.

98 ships produced both type one and type two values for similar routes over the same periods of time in the panel data. Standard deviation in the more numerous type one voyage cycle data is 39.77; for the more reliable but fewer type two, it is less at 33.9. Therefore, standard variation in type two is high, meaning the range of times was great everywhere, and based on the most reliable data, it almost certainly mostly resulted from real delays and not recording errors. The percentage difference between the standard deviation of types one and two is about 15 per cent. Based on this, 15 per cent of variation in type one might be down to recording errors that resulted from ships sailing off the record.

Other evidence supports the robustness of the observed wide distribution in voyage cycle rates. Barker reported that the Judith’s return journeys from Newcastle to London ranged from 16 to 43 days. This range can be represented as a ratio 1:2.68 between slowest and fastest journeys. I do not have exact matches for this route and journey type; I do, however, have 268 observations of 46 ships on repeated voyages between Newcastle and Kings Lynn.

---

52 See table for such return journeys: e.g. Sandwich to London; London to Sandwich; Sandwich to London is type 1.
These followed much of the same coastline within a few decades of the Judith’s voyages. The average ratio between shortest and longest voyage cycle is uncannily similar at 1:2.97. Therefore, I think overall, the wide voyage cycle distribution is realistic, and that observed voyages really did vary greatly in their timing.

I can now examine all recorded voyage cycles split by east and west coasts of England for collier routes, and then by the many other routes in the data that I cannot analyse further due to space restrictions. There are 447 eastern voyage cycles between Newcastle, Sunderland and King’s Lynn. The most common, mode average, cycle time was 25 days on this route, and the mean average 34.1, showing outlying times resulting from delays, but perhaps also some recording errors. I generated another 561 observations for voyages with coal from Neath and Swansea to Bridgwater for western England. This group, with a short distance journey of about 70 miles, gives mode average cycles of 14 days but a mean of 29.7, again representing a long tail to the right showing delays. “Other” route category voyage observations exhibit similar distributions.

<table>
<thead>
<tr>
<th>Miles per day</th>
<th>East coast (coal)</th>
<th>West coast (coal)</th>
<th>Other (not coal)</th>
<th>Type two results, for comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. return mileage</td>
<td>395</td>
<td>140</td>
<td>210</td>
<td>116</td>
</tr>
<tr>
<td>Mean</td>
<td>34.1</td>
<td>29.7</td>
<td>37.4</td>
<td>35.4</td>
</tr>
<tr>
<td>Median</td>
<td>25</td>
<td>19</td>
<td>24</td>
<td>27</td>
</tr>
<tr>
<td>Mode</td>
<td>25</td>
<td>14</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>35</td>
<td>37.5</td>
<td>43.6</td>
<td>33.9</td>
</tr>
<tr>
<td>Minimum</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Maximum</td>
<td>309</td>
<td>325</td>
<td>346</td>
<td>244</td>
</tr>
<tr>
<td>n</td>
<td>447</td>
<td>561</td>
<td>2178</td>
<td>321</td>
</tr>
</tbody>
</table>

*Table 4 Descriptive statistics: voyage cycle data.*
The voyage cycle measure mixes both time at sea and in port. I can estimate how much resulted from time spent in both situations. Crews spent a lot of time in port undertaking scheduled tasks like ship maintenance, loading, and selling goods on market days. Unscheduled delays in port were a significant problem too due to contrary winds that kept ships in port, but also because of lack of supply of goods for shipment. If winds delayed ships’ arrivals into ports this could cause “famine prices” when prices rose significantly through scarcity, followed by oversupply and price crashes when the wind changed again.  

Port time was therefore an important part of the equation.

If ships were given a date of arrival and a subsequent cocket departure date from the same port, then I could also calculate the time they spent in that port by comparing the two dates using the panel-data. Often ships left without cargoes and therefore no onward cocket was produced and no departure date could be derived that would give the “port time”. Only the Spalding and Maldon sub-samples provided the required data to make these calculations. These were middling regional ports, but locally important as hubs for exports of agricultural produce from Lincolnshire and Essex.

Table 5 illustrates the panel data observations for the Success of Spalding and how I generated results showing its time spent in port. The ship arrived in Spalding on 25 June 1679, as shown in column four row one, and I observe it departing from Spalding next 17 days later, on 12 July 1679, as shown in column three, row two. Therefore, I automatically calculated “port time” in this case as 17 days using a formula in the database.

---

55 For Maldon’s status as “chiefest” port in around 1655 see, Cook, “A True, Faire and Just Account”, 1.
Table 5 Example of arrival and departure matching to calculate port times from a 1679 coast book from Spalding. Arrows show dates compared.

<table>
<thead>
<tr>
<th>Route</th>
<th>Ship</th>
<th>Depart date</th>
<th>Arrival date</th>
<th>Direction</th>
<th>Port time</th>
</tr>
</thead>
<tbody>
<tr>
<td>London-Spalding</td>
<td>Success of Spalding</td>
<td>17/06/1679</td>
<td>25/06/1679</td>
<td>inwards</td>
<td>17</td>
</tr>
<tr>
<td>Spalding-London</td>
<td>Success of Spalding</td>
<td>12/07/1679</td>
<td></td>
<td>outwards</td>
<td></td>
</tr>
<tr>
<td>London-Spalding</td>
<td>Success of Spalding</td>
<td>29/07/1679</td>
<td>14/08/1679</td>
<td>inwards</td>
<td>15</td>
</tr>
<tr>
<td>Spalding-Kings Lynn</td>
<td>Success of Spalding</td>
<td>29/08/1679</td>
<td></td>
<td>outwards</td>
<td></td>
</tr>
</tbody>
</table>

153 port observations were made for Spalding. The average time was 18 days. 42 observations were made for Maldon, and the average there was 14 days. These times show that business and manoeuvres in ports normally took several weeks.

Unfortunately, the voyage cycle measure, as described earlier, does not distinguish sailing and port times. However, the port time measure can be used instead to estimate the proportion of time ships spent on sea and in port on voyage cycles, at least for voyage cycles involving Maldon and Spalding. The data includes 221 voyage cycle observations for ships using Maldon, and 212 for those that visited Spalding. Average voyage cycle time for ships that used both ports is 46 days. By using the available port time results, I estimate 78 per cent of the recorded voyage cycle time was expended at either end of voyage cycles for ships that visited Spalding, and 60 per cent of total time for ships cycling to and from Maldon. This indicates that coasters spent most of their voyage cycle time, and their working lives, in port, which makes sense given the need for repairs, marketing, and all tasks that were performed when not at sea.
The story of variation is slightly different for port times. Standard deviation from the mean (of 17.4 days) for 195 port-time observations for both Spalding and Maldon taken together is 22.4. Therefore, time spent in these ports varied quite a lot, but less than time on the water, probably because conditions on land were more controllable. I would like to know how port waiting times changed with infrastructural development and other improvements in the future.

**SHIP PRODUCTIVITY AND SEASONALITY**

Seasonality is known to have been an important aspect of coastal shipping, and one that I can examine further using this data set. I looked for seasonal patterns in the journey speed data, voyage cycle and port time metrics but did not find much deviation between winter and summer. I looked instead at the total number of departures by month and, by contrast, found that many ships left port only in non-winter months.

![Graph showing ship departure observations by month and category](image_url)
Our data shows that Newcastle ships normally waited until the spring to sail, presumably to avoid winter weather, which made the shallower, sandbank-ridden North Sea coasts lethal to mariners. Hatcher previously found this seasonal pattern on this route using different sources. He explained that transporting heavy cargoes of coal was avoided in winter because coal shifted around in rough seas, which could also cause ships to capsize.\(^{56}\)

The data includes numerous observations of collier voyages on this seasonal but busy route between Newcastle or Sunderland in north-eastern England, and, to the south, Kings Lynn on the eastern coast of Norfolk. I found that the winter shut down strongly restricted the time ships could operate and their annual rates of utilisation, measured as voyages per year. This is because, of the 627 observed departures from Newcastle or Sunderland, 75 per cent departed over a short five-month window from April to August. Because the average voyage cycle rate is about 25 days, I estimate that about 6 voyages per year from Newcastle to Kings Lynn in the mid-seventeenth century was normal. However, some ships sailed much more often even during this short window of opportunity, as is shown by the 16 colliers in our data that made 10 or more voyages between Newcastle or Sunderland and Kings Lynn. Their performance ranged from an impressive 18 made by the Ann in 1662 and the 16 by the Charity in the same year. All but two of their relatively numerous voyages departed from March to October. Even these high-performing ships were seasonal. Productivity on this important route at this time would have been far higher if it was safe to sail 12 months a year instead of 5.

\(^{56}\) Hatcher, *The British Coal Industry*, 477-78.
The “other non-coal” sample shipments were seasonal to a similar degree, probably because many of these were also on the dangerous east coast. In this category there is a seasonal pyramid pattern of departures across the year that peaks in July. But unlike the coal trade, most other services continued year-round, if at a reduced rate during winter.

Despite the risks of poor weather to colliers, our sample of 1,105 west coast coal voyages shows departures in this region with coal were hardly seasonal at all. This data comes from the coast books of Bridgwater, an important distribution hub for South Wales coal.57 Trade held steady until October and November when activities increased before declining slightly in December and January. These colliers did not stop in winter, perhaps because the west coast area posed fewer risks compared to the North Sea.58 I counted voyages made per year by colliers sailing to Bridgwater from Neath or Swansea where they are available in the data for 1674. I found 18 of 310 ships sailed 12 voyages per year or more, with the best performing ship registering 18 voyages per year. However, 161 ships appear only once or twice in the record. Like in Kings Lynn, a smaller group of specialists sailed often, whereas more still sailed much less frequently.

Shipments of coal to large eastern cities such as King’s Lynn and London were fundamentally seasonal in the seventeenth century. Dealers and households must have stockpiled coal during summer when supplies arrived. Coal prices fluctuated with shortages of fuel when ships were delayed.59 Other services were also seasonal to a lesser degree, but

57 Bridgwater imported 36,500 tons of coal and its derivative, culm, over the four years from 1696 to 1699. Hussey, Coastal and River Trade, 185.
58 Mathews, Shipping and local enterprise, 141.
59 Willan, Coasting Trade, 57.
Welsh collier crews took little heed of winter weather. Seasonality thus affected regions differently.

**CONCLUSIONS**

This paper shows how Coast Port Books can be analysed, within limits, to quantify the speed and timing of the coastal shipping they recorded. The non-random sample is limited in size and coverage and could be improved with the introduction of more data from a more balanced set of ports. Yet, I show, that when analysed carefully, the source can provide an extremely rich source of data.

I can draw a few conclusions based on this limited sample. An important point that Fernand Braudel once made about all pre-modern shipping is that shipping speed long suffered from delays resulting from the vicissitudes of natural and man-made delays, like the weather, piracy, and wars etc. Improvement during the Transport Revolution, usually placed sometime between the eighteenth and nineteenth centuries, therefore, must have consisted not just of a reduction in times and costs, then, but a massive reduction in the variance of times and speeds. England’s coastal waters presented opportunities, but also “troubles” and delays for the thousands of mariners who sailed them in the seventeenth century. This paper provides firm evidence for this, and moreover provides the data to compare with later periods to research declining variance (technically: coefficient of variation) in speeds and journey times.

---

Times and speed, so central in this paper, were also essential service components, and thus I focus on them both to address Braudel’s questions and, secondly, in the future to define long-term improvement (or lack of it) in the coastal services. The benchmarks given in this paper can be used for further study of other periods or routes in this way. And, once the port books that are currently unavailable are cleaned and put back on their shelves, more data could be collected from them to improve this work. It would be straightforward now to apply the same methods to a larger set of transcriptions from more coast books. Other sources of similar timing data will allow the study of change in this vital service for later periods.61

As said above, even with this paper’s non-random selection of sources, the sample reveals the speed, regularity and seasonality of certain trades, and points to highly unpredictable services in general. It shows that seasonality impacted on important routes, making them less productive than if they could sail safely year-round. It was not previously known for certain how many voyages per year colliers made annually before the eighteenth century. Nine to twelve voyages have been estimated for the route between Newcastle and London, which although possible, seems high given the winter shutdown.62 Port times were also found to be lengthy and variable, although our data are more limited here. Journey times were long, and their variation was high not just across seasons and places but also between individual voyages.

Given the acknowledged importance of coastal transportation, the problem of delays must have impacted the wider economy (although it is not assessed in this paper). Whilst they are thought to have been very important in their context, coastal ships do not appear to have

61 Bogart et al, “Speedier Delivery”.
62 Willan, The English Coasting Trade, 221-223; for ship utilisation in the long run; Bogart et al, "Speedier Delivery".
been sufficiently productive in the seventeenth century to supply the large industrial society that emerged in Britain over the next two hundred years. This strongly suggests that advances in service speed and timing were necessary for improvement in the long term.

**BIBLIOGRAPHY**

**Archival and oral sources**

British Library Additional MS 12555

TNA: Arundel E122/196/29; Barnstaple E122/196/28; Bridgwater E190/1091/2, 3, 5, 9; Colchester E122/198/16, 17; Exeter E122/232/21; Faversham E122/232/18; Hastings E122/231/12; Ilfracombe E122/218/30; King's Lynn E190/436/3; Looe E122/230/11; Maldon E122/232/10, 12; Milford Haven E122/231/17; Sandwich E122/232/16; Scarborough E122/232/11; Shoreham E122/230/18; Spalding E122/230/13, 19, 20, 21, 15, 4.


**Published sources**


Dorian Gerhold, *Carriers and Coachmasters: Trade and Travel Before the Turnpikes* (Chichester: Phillimore, 2005).


