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Merchant Networks in Big Cities*

David Gomtsyan[†]

February 5, 2022

Abstract

In the 18th century, every second merchant ship sailing from Britain to the Baltic did not carry any exports. This was caused by trade imbalances that were driven by high demand for grains and other raw materials in Britain. Trip level data show that merchant ships based in larger British cities were more likely to make non-empty trips and carried more varieties. This paper argues that wider and denser networks of merchants in large cities, which facilitated information flows and improved the efficiency of matching, allowed them to outperform merchants from smaller British ports. Furthermore, ships that were based in smaller ports did not improve their performance when they departed from larger cities. This finding and additional tests provide evidence against competing explanations.

Keywords: Merchant networks, transportation, trade imbalances, agglomeration.

JEL code: F14, N73, R12.

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1 Introduction

Merchant networks and connections have been the fundamental factors ensuring the reliability and efficiency of trade since the early stages of human development. Densely populated areas served as fertile ground for the development and evolution of merchant networks. More specifically, such areas provided merchants better access to sharing and matching opportunities. These forces lie in the foundations of agglomeration economies and have been the subject of the theoretical literature (Duranton and Puga, 2004). However, there is little direct empirical evidence corroborating the idea that merchants were more likely to have access to better information and matching technologies in larger market-towns.

In this paper, I use a detailed 18th century dataset on trips made by merchant ships to show that ships based in larger British cities were more likely to overcome the “backhaul” problem on trade routes compared to ships based in other British ports. The backhaul problem exists on trade routes where the movement of goods takes place predominantly in one direction and ships have to make empty trips (ballast) in the opposite direction. In the 18th century, Britain and other Western European countries imported large quantities of grains, flax and other commodities from Russia (Kaplan, 1995; Alder, Colmer, and Cosar, 2020). Meanwhile, exports to Russia were relatively low and the data show that ships had to ballast frequently. In the dataset, 60% of ships traveling from Britain to Russia are reported to ballast, while the corresponding figure for return trips is 0.2%. This setting intensified the competition between merchant ships sailing from the British ports to the Russian ones. Consequently, the ability of merchants to avoid ballasting can be considered as a measure of successful performance.

A plausible explanation behind the superior performance of merchants from larger cities is that such places had more advanced manufacturing sectors and hosted markets trading goods produced in Britain and in different parts of the vast trading empire. As a result, large cities provided access to a wide variety of goods that increased the likelihood of matching the demands of trading partners in the destination region. To properly test this hypothesis, I use information on both the port of departure and the homeport of the ship. The results show that departures from large cities did not decrease the likelihood of ballasting of merchant ships that were based in other ports. In fact, it exacerbated the problem. This implies that simply being in a location with a wide variety of goods was not sufficient to address the ballasting problem and there were other factors in action. Scholars studying the networks of regional merchants in Britain indicate that these networks had a strong local geographic bias and merchants tended to specialize in the exchange of specific goods (Stobart, 2004). Consequently, it was not sufficient for ships to visit large cities in order to benefit from the wide variety of goods available in those places. What mattered more was whether merchants had the necessary connections with other merchants to secure the supplies of goods that were demanded in the destination location. The specialization of merchants on specific goods further increased the importance of communication when it came to dealing with new products and varieties. In this environment, merchants based in large cities

were in an advantageous position because they already had a wider network and could more easily establish new links with other merchants to secure the supplies of varieties that were beyond their conventional area of specialization.

To support this argument, I estimate specifications with home and departure port fixed effects and show that ships based in large cities were able to decrease the likelihood of ballasting only when they departed from their homeports. At the same time, homeport departures in general were not associated with decreased likelihood of ballasting. The proposed mechanism is also supported by the fact that ships based in larger cities carried more varieties of goods when they departed from their own ports.

The role of merchant networks has been analyzed in the influential study by [Greif \(1993\)](#). The author argues that, in the absence of formal contract enforcement mechanisms, informal institutions emerge as an alternative to facilitate exchange. Increasing volumes of trade led to the gradual transition to formal institutions in Medieval Europe ([Greif, 1994](#)).¹ Studying the London Quaker community, [Sahle \(2017\)](#) argues that informal institutions continued to play a critical role in the 17-18th centuries by complementing public order institutions. The importance of informal contracting mechanisms remains apparent even in modern economies, especially in environments with weak institutions. [Kamal and Sundaram \(2019\)](#) provide evidence that US imports from countries with weak formal contract enforcement are more spatially concentrated because local supplier networks improve information sharing and facilitate matching. This point is very similar to the central hypothesis of the current paper. Thus, better understanding of the relationship between European merchants can shed light on the mechanism of alternative contractual arrangements that exist in modern developing economies.

In a recent review, [Hanlon and Hebllich \(2021\)](#) point out that there was a rapid growth in studies using insights from history to answer central questions in urban economics. Among those studies, my paper is most closely related to the ones that investigate the productivity effects of agglomeration ([Borowiecki, 2013](#); [Mitchell, 2019](#); [Klepper, 2010](#); [Buenstorf and Klepper, 2010](#); [Cabral, Wang, and Xu, 2018](#); [Hanlon, 2019](#)).

This paper is also related to the international trade literature that studies the backhaul problem ([Behrens and Picard, 2011](#); [Wong, forthcoming](#); [Brancaccio, Kalouptsi, and Papageorgiou, 2020](#)). These studies have emphasized that trade imbalances can generate asymmetric trade costs and reduce the level of trade. I contribute to this literature by highlighting the role of heterogeneity in matching probabilities of transportation firms (merchants).

The rest of the paper is organized as follows: Section 2 discusses the historical context, introduces the data and describes the estimation strategy. Section 3 presents results for the main dependent variable and introduces some alternative ones to corroborate the proposed mechanism. Section 4 investigates the factors that affected merchants' decisions to select ports of departure and its implications for the main results. The last section provides some concluding remarks.

¹[Puga and Trefler \(2014\)](#) provide an interesting discussion of the rise and fall of such institutions in Medieval Venice.

2 Data and empirical methodology

2.1 Data and setting

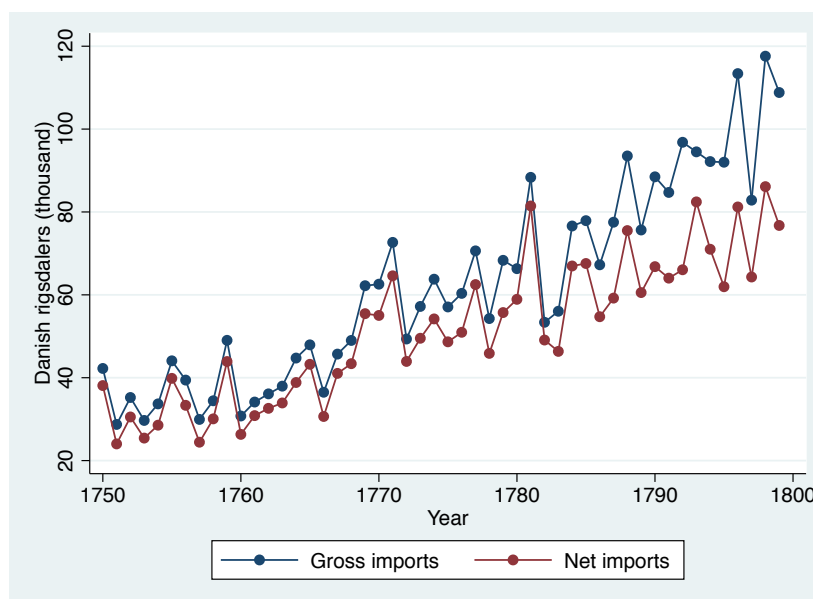
The dataset used in this paper comes from the Sound Toll Registers. From 1429 to 1857, Denmark collected dues from ships passing through the strait that separates modern Denmark and Sweden, known as the Sound. Danish authorities, which administered the collection of dues, recorded detailed information related to ships and cargo for each passage. These records include information on the origin and destination ports, homeport of the ship, value and quantity of each product on board. For earlier periods, the coverage is sporadic and not all records have been preserved. Starting from 1633, the coverage is almost universal. This data source is well known and has been explored by historians and more recently by economists (Alder et al., 2020). This literature has also cross checked the volume of trade flows based on Sound Toll Registries with other national sources and found no large discrepancies (see, for instance, Dow, 1964). The analysis in this paper focuses on the 1750-1800 period. The choice of the starting point is motivated by the fact that the main Russian port before the founding of Saint Petersburg (1703) was Archangel, which is located on the shores of the White Sea. Prior to the Great Northern War, Russia did not have access to the Baltic Sea. Since the route from European ports to Archangel does not pass through the Sound, there is no information about those trips. Trade flows did not shift to Saint Petersburg immediately after its foundation either. In order to facilitate the transition, Peter the Great had to resort to some controversial administrative measures. Starting from 1714, he signed several decrees that prohibited trading in grains and some other goods through the port of Archangel (Zakharov, 2019). Later, he also prohibited foreign vessels to call at Archangel. Additional measures were taken to resettle merchants who were reluctant to move from Archangel to Saint Petersburg. The organization of the physical delivery of grains and other goods from places where production took place to the new port was another problem. Existing canals and roads connected central regions of Russia to Archangel, while the internal links to Saint Petersburg were poor. The construction of internal canals that were required to transport grains and other goods from provinces to the new capital took many years.² As a result, during the first half of the 18th century, trade flows gradually increased from very low levels. The choice of the end period is motivated by the Napoleonic Wars which dramatically disrupted trade flows with the Baltic region (Alder et al., 2020).³

According to the dataset, the main trading countries in the North Sea were Great Britain, the Netherlands and the German States. My analysis focuses on Britain because it has (i) a large central city; (ii) relatively long coastline with many ports of various sizes; (iii) no land connection with the Baltic; (iv) no special agreements with Denmark that could allow British merchants to

²The broad network of canals connecting the Neva and the Volga, known as Vyshny Volochyok Waterway, started to function properly from the 1740's (Nikolayev, 1900).

³According to de Caulaincourt, Hanoteau, and Libaire (2005), one of the main objectives of the Napoleon's invasion to Russia was to deprive Great Britain of its supplies.

Figure 1: Dynamics of imports



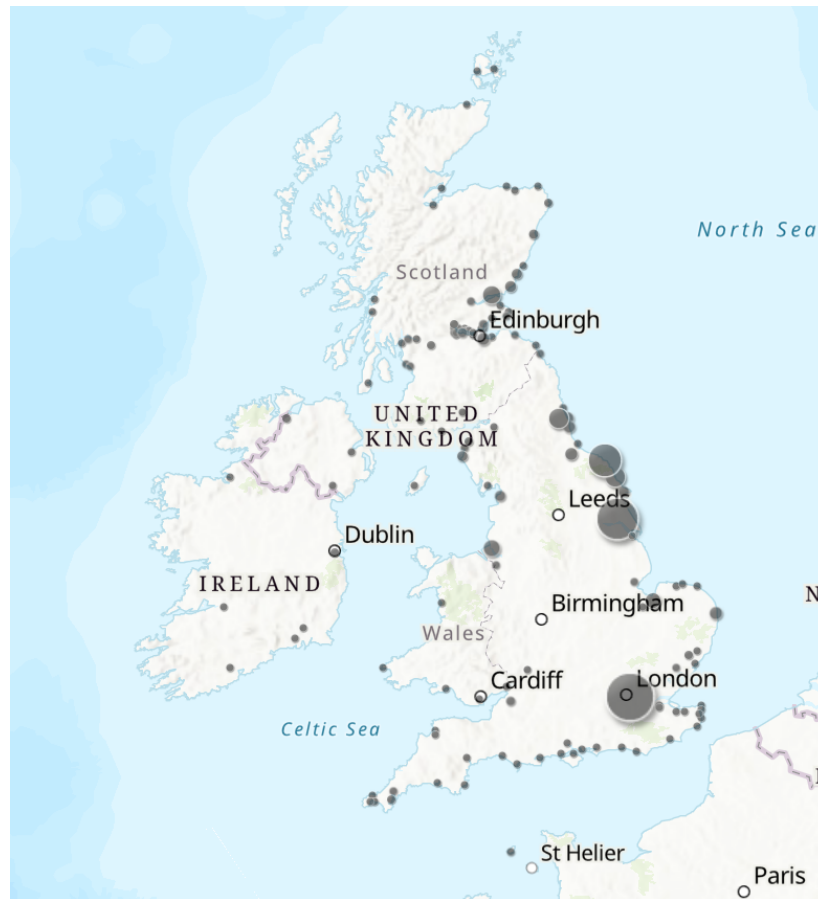
Notes: The dynamics of gross and net imports from Russia to Great Britain in thousands Danish rigsdalers.

avoid the Sound toll. The last point requires some further clarification. Some years in the dataset, for example 1799, have no records for any Dutch ship. One possible explanation could be that the Netherlands had a special treaty with Denmark. According to the *Redemptionstraktaten* treaty of 1649, the Netherlands paid an annual fixed fee which allowed its ships to pass the Sound without paying any additional dues. Several such treaties were signed but it is hard to recover their timeline and details. The same applies to some large German cities. Dow (1964) reports that ships from some German cities were allowed to sail through the Great Belts. This is also confirmed in the data because several large German ports do not have records for some years. On the Baltic side I focus on Russia, according to its 1750 borders, because it was the least developed country in the region and exported large volumes of bulky goods, so the asymmetric trade problem was especially acute.

Figure 1 shows the dynamics of gross and net imports from Russia to Great Britain from 1750 to 1800 in thousands of Danish rigsdalers. Time series are constructed by aggregating trip level values of all goods at year level for both imports and exports. The first observation is that imports were substantially higher than exports during the entire period. Second, over time the volumes of both net and gross imports were on increasing trajectories. During the first decade of the study period the dynamics were even stable. These facts are consistent with the description of events provided above.

Figure 2, presents the locations of ports in the dataset marked by grey circles. The size of each circle is proportional to the number of trips made by ships based in the corresponding port. The leading ports by this measure were London, Hull, Whitby, Newcastle and Scarborough, all of which are located on the East coast of Great Britain. Among the western ports, the largest numbers

Figure 2: Locations of ports



Notes: Circle size is proportional to the number of trips made by ships based in the corresponding port.

of trips were made by ships based in Liverpool and Whitehaven.⁴ In the analysis I also use data on population size of cities and towns in 1750 from [Bairoch, Batou, and Chevre \(1988\)](#). As can be seen from Figure 2, some of the ports were very small towns and villages. Because population data are not available for such places, I set them to zero and use log plus one of population (population figures are in thousands). Figure A1 plots the distribution of ports by population size (transparent bars). As can be seen, there are many small ports with populations below 1000; then the distribution follows a hump-shaped pattern, by peaking around towns with populations in the range of 6000-8000. The same figure also plots the distribution of port size weighted by the number of trips (grey bars). Naturally, the share of trips made by ships from the smallest ports is not very high. On the other extreme, ships based in London account for a substantial share. There is also a mass point around towns with a population of around 6000. Table A1 presents the descriptive statistics of the main variables used in the analysis. The most exported goods in terms of value were salt, sugar, tin, cloths, stockfish and cotton.

A final important detail that deserves discussion is that British ships, until the 19th century,

⁴I include the entire island of Ireland in the sample but it should be noted that there are very few trips made by ships from the Republic of Ireland, so its exclusion has negligible effect on the results.

were managed by merchants, and merchant networks played an important role in arranging contracts. [Davis \(1978\)](#) notes that “in the 18th century there was no such thing as the shipping firm; a ship was managed – as a minor part of his general activity – by one of the merchants who owned a share in it.” In the dataset there is no information on the merchant who managed the specific ship. I assume that the homeport of the ship and the merchant who managed it coincide. [Davis \(2012\)](#) reports that always, or nearly always, the homeport was the place where the managing owner was to be found. The same source also reports that trade with the Russian ports was carried on almost entirely by English ships. This claim can be verified also in the data. There are only 61 trips made by captains based in Russia. The corresponding figure for British ships is over 20000 (see [Table A1](#)). I limit the sample to only trips made by British ships.

2.2 Empirical methodology

In order to assess the role of agglomeration forces on the performance of merchant ships, I estimate an OLS specification where the unit of observation is a trip (i) made from Great Britain to Russia and the dependent variable is an indicator variable (z_i) taking a value of one if the ship was ballasting. Later I also consider a set of alternative variables, such as the value of the cargo and the number of distinct items. The estimating equation is given by:

$$z_i = \beta_0 + \beta_1 HomeSize_i + \beta_2 DepSize_i + \beta_3 Home_i + \beta_4 HomeSize_i \times Home_i + \gamma_{y(i)} + \theta_{m(i)} + \varepsilon_i, \quad (1)$$

where $HomeSize_i$ is the log population of the homeport of the ship making trip i , $DepSize_i$ is the log population of the port from which the trip was made and $Home_i$ is an indicator variable if the trip was made from the homeport. The specification also includes year ($\gamma_{y(i)}$) and month ($\theta_{m(i)}$) fixed effects for each trip. Year fixed effects are included with the objective to absorb global shocks that affect trade between Great Britain and Russia. Month fixed effects, in turn, are included to absorb the role of seasonality. Given that agricultural goods, the production of which is seasonal, accounted for a large share of exports from Russia such effects are necessary. Furthermore, ice created obstacles for navigation during winter periods. Following the recommendations in [Abadie, Athey, Imbens, and Wooldridge \(2017\)](#), I cluster standard errors at the level of homeports, the treatment variable (homeports were displayed in [Figure 2](#)).

If merchants based in large ports had better networks and these networks allowed them to arrange better deals, regardless of the departure location, then the coefficient β_1 should be negative. If larger ports provided access to a wider variety of goods and all merchants, regardless of their origin port, could benefit from this advantage, then the estimations will deliver a negative β_2 coefficient. It is intuitive to anticipate that departures from homeports gave advantage to merchants because they had the strongest connections in their locality. The coefficient β_3 captures this effect. Finally, it is plausible that home departures were especially valuable in larger ports because in such places merchants could combine their strong connections with the large-market effect. This

should be reflected in a negative β_4 coefficient.

I also estimate a modified version of equation 1 by introducing homeport and departure port fixed effects. This specification more flexibly controls for port-specific characteristics that can affect the performances of merchants. The modified equation is given by:

$$z_i = \beta_0 + \beta_1 Home_i + \beta_2 HomeSize_i \times Home_i + \eta_{h(i)} + \phi_{d(i)} + \gamma_{y(i)} + \theta_{m(i)} + \varepsilon_i, \quad (2)$$

where $\eta_{h(i)}$ and $\phi_{d(i)}$ are homeport and departure port fixed effects for each trip.

Danish authorities also collected information on the names of ship captains. I use this information and estimate specifications that also include individual-level fixed effects. Names are recorded as text information and the name of the same person may not exactly coincide in different trips. For this reason, I use the Levenshtein distance between two names to group them.⁵

An important assumption for the identification is that exports to Russia did not play an important role in the development of British cities and towns until 1750.⁶ There is a good reason to believe that this assumption is satisfied because, as was shown in Figure 1, exports to Russia were at very low levels. Moreover, it is unlikely that even overall trade with Russia had a substantial effect on population growth. For example, in the small town of Whitby, which had one of the highest number of trips made to Russia and hence the highest level of exposure across all ports, there were a number of other more important sources of economic activity, such as shipbuilding, whaling, fishing and shipping of coal from Newcastle to London (Jones, 1982).⁷

3 Results

3.1 Main Results

The first three columns of Table 1 present the results of estimations of equation 1, where the dependent variable is an indicator for ballasting ships. In the first column, the only explanatory variable is the log population of the port where the ship was based. The estimated coefficient shows that a 1% increase in population size implies a 0.05 pp decrease in the probability of a ballast trip (or a 7% reduction relative to the mean probability to ballast of 0.712). This means that there were wider varieties and quantities of supplies in such places. Thus, ships departing from large cities had better chances to match the specific needs of partners in the destination port. Since the port of departure frequently coincided with the homeport, the result in column 1 can capture this effect. To test this idea, in the second column, I control for the population size of

⁵The results were manually checked for various threshold levels. A careful inspection revealed that mismatches were very rare for the 90% threshold.

⁶Bosker, Buringh, and van Zanden (2013) and Wahl (2016) study the role of trade in urban growth during the Medieval period.

⁷Another step that can be taken in this direction is to use population numbers from periods prior to 1750, when trade volumes were even lower. This exercise does not substantially affect the main results of the paper. The disadvantage is that in the Bairoch et al. (1988) dataset the population data are available for fewer numbers of towns.

the departure port. If departures from large ports were the key driver behind the result, then we should observe a negative coefficient, meanwhile the homeport effect should disappear. It turns out that the coefficient on homeport becomes larger. The estimated coefficient on departure port size, in contrast, is positive and large, meaning that, if anything, ships based in other ports did worse when they departed from larger ports. This can be the result of weak networks of merchants from other locations in the host ports. As such, they could not source supplies.

Table 1: Likelihood of ballasting

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Homeport size	-0.049*** (0.010)	-0.077*** (0.010)	-0.047*** (0.012)	0.008 (0.006)						
Departure port size		0.043*** (0.014)	0.015 (0.009)	0.037*** (0.007)						
Homeport departure			-0.201*** (0.068)	0.033 (0.085)	-0.005 (0.047)	-0.147*** (0.038)	-0.003 (0.046)	0.025 (0.036)	-0.039 (0.038)	-0.042 (0.039)
Port size X homeport departure				-0.087*** (0.015)	-0.070*** (0.008)		-0.071*** (0.018)	-0.103*** (0.035)	-0.053*** (0.007)	-0.052*** (0.007)
London X homeport departure						-0.316*** (0.055)	0.009 (0.115)			
(Port size) ² X homeport departure								0.005 (0.006)		
Experience										-0.061** (0.027)
R-Adj.	0.081	0.116	0.141	0.156	0.374	0.372	0.374	0.374	0.466	0.470
N	20599	20599	20599	20599	20543	20543	20543	20543	17122	17122
Homeport FE					X	X	X	X	X	X
Departure port FE					X	X	X	X	X	X
Individual FE									X	X

Notes: OLS regressions of equations 1 and 2. Dependent variable is a dummy for ballasting. Port population size variables are in thousands and in logs. Homeport is an indicator variable if the departure was made from the same port where the ship was based. London is an indicator variable for ships based in London. Experience is the number of trips made to Russia by a given captain before trip i and is in logs plus one. All regressions include year and month fixed effects. Standard errors are clustered at the level of homeports. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Another important factor that needs to be taken into account is the effect of homeport departure. Column 3 includes an indicator variable that takes a value of 1 if the trip was from the port where the ship was based. As can be seen, the estimated coefficient is negative and large, implying a 20 pp reduction in the likelihood of ballasting. Homeport size remains significant in this specification and in terms of magnitude it is close to the one in the first column, which means that the advantageous effect of larger homeports is not mechanically driven by the tendency of ships from larger ports to depart from their own ports.

In the fourth column, I interact the indicator for homeport departure with port size. This new term is significant and almost twice larger in absolute size, compared to the coefficient for homeport size in the previous column. This means that merchants in larger ports did not have superior connections and always excelled others in all locations. Merchant ships based in larger ports had an advantage only when they were departing from their own city.

These findings are also supported by the descriptions of merchant networks and their connections by historians. [Stobart \(2004\)](#), who studied the correspondences and connections of Chester merchants, argues that merchant connections had a strong geographical local bias. Of course, merchants also had contacts in London which were especially valuable. However, they were fewer compared to local contacts and the physical distance further reduced the speed of communication. Matching efficiency and information flows are important driving mechanisms of agglomeration economies and critically depend on distance ([Duranton and Puga, 2004](#)).

Some valuable insights about mechanisms ensuring trust between traders located in various regions of Britain can be found in [Bennett \(2012\)](#) who studies Trade Protection Societies. The first such society was established in London in 1776; later they spread to other British cities during the 19th century. [Bennett \(2012\)](#) argues that Trade Protection Societies started as individual local societies but to be effective they had to form a network of exchange between regions to meet the needs of a growing and increasingly integrated economy. This indicates that prior to the 19th century there were no well-established mechanisms facilitating the exchange of information and ensuring trust among traders and merchants located in various areas of Britain.

Another important point relates to the specialization of merchants on specific goods. Describing Hull merchants, [Jackson \(1975\)](#) argues that merchants traded various types of goods depending on their *connexions*. However, the author admits that “what in the Hull context is described as a ‘general’ merchant would in the London context become a narrow specialist.” Further anecdotal evidence regarding merchants’ specialization can be found in [Stobart \(2004\)](#), who describes an episode in which a Chester merchant engaged in a trade involving a small quantity of goods that were beyond his specialization. These new goods were combined in a joint shipment with goods in which he specialized. Because of the lack of knowledge of some details related to these goods, the entire shipment was suspended and he could not release the remaining cargo from customs officials in Plymouth. The specialization of merchants in specific goods and local geographic bias of their connections indicate that it was more difficult for merchants from smaller ports to take

advantage of larger markets in other ports and arrange profitable deals by loading their ships that were destined to Russia.

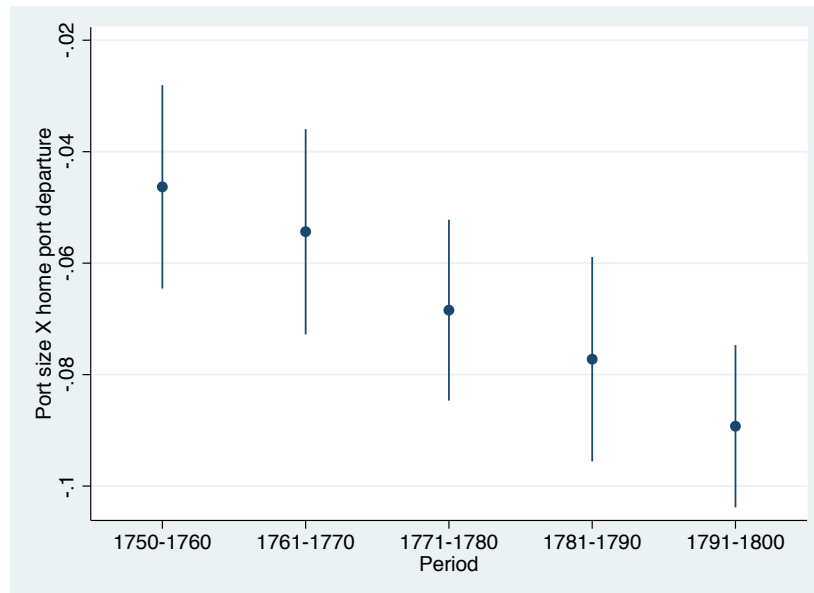
In the fifth column of Table 1, I report the estimates of equation 1 which includes homeport and departure port fixed effects and hence more flexibly controls for port characteristics. The coefficient of interest is estimated very precisely and in terms of size it is close to the one in the previous column, which did not include port fixed effects. This specification is the most preferred one and I adopt it as a baseline.

To what extent are these results driven by London? As was shown in Figure 2, London was ahead of other ports in terms of trips made by ships based there. It was also the leading host port, measured by the number of departures made by ships from other ports. Moreover, it was substantially larger in terms of population size, compared to other cities, and played a distinct economic role. In column 6, I interact an indicator variable for London-based ships with the homeport departure dummy. The estimated coefficient is very large in absolute value and implies that, on average, ships based in London experienced a 32% lower likelihood of ballasting, as opposed to other ships. Given this large effect, the next natural question is related to the role of London in driving the overall result. To answer this question, I simultaneously interact the indicator for homeport departure with log port size and the London dummy in column 7. The London effect disappears completely, while the general size effect continues to be significant and similar to the ones observed in previous columns in terms of magnitude. This result indicates that the relationship between city size and the likelihood of ballasting is well approximated by log population size, and that London did not deviate from this rule. To shed further light on the shape of the relationship between city size and the likelihood of ballasting, I add another term which interacts the square of log population size with the homeport departure dummy in column 8. The estimation shows that the quadratic term is not significant, while the linear term gets somewhat larger in absolute size and remains highly significant.

The dataset also provides information on the names of captains which can be used to introduce individual-level fixed effects. Of course, captains had very limited influence on the arrangement of deals and the decision-making process. Nevertheless, in the absence of merchant information, captains' names can be used as a proxy to associate them with merchants. This is a very rough proxy because, most likely, new relationships were formed over time and old ones were terminated. That caveat in mind, this estimation can shed light on the competition between merchants at a given port. For example, it could be that merchants who were based at smaller ports but frequently departed from larger ones, had poor connections and were more likely to ballast, regardless of the port of departure. The estimation results in column 9 show that the coefficient on the interaction term remains precisely estimated but in terms of absolute size it decreases somewhat. This suggests that there was a competition between merchants within ports which led to the sort of selection described above.⁸

⁸If the specification in column 5 is run with the same subset of observations as the one in column 9, then the estimated coefficient on the interaction between port size and homeport departure is -0.075 (SE 0.007).

Figure 3: Effects by decade



Notes: This figure plots the estimated coefficients of the interaction of $HomeSize_i$ term with decades from a modified version of equation 2.

Captains' name information can also be used to construct a measure of individual experience and study its effect on the likelihood of ballasting. I construct this measure as the log number of trips made by a specific captain. The variable is time-varying and increases as captains make new trips and hence generates a variation even in the presence of individual fixed effects. Of course, this measure is not perfect because captains made many domestic journeys or international ones in other directions, so it can be considered as a route-specific measure of experience. As in the previous column, this measure should be thought of as a proxy for the merchant's trade experience. The estimated sign in column 10 is negative, implying that an increase in experience decreased the likelihood of ballasting. This result is intuitive because the merchant improved his network, reputation and knowledge of the market and became more likely to make non-empty trips by trading more with a specific destination.

3.2 Dynamic effects

As was shown in Figure 1, the level of net imports from Russia to Great Britain increased during the study period. Does this dynamics have any implications for the coefficient of interest? To answer this question, I estimate equation 2 but interact both $Home_i$ and $HomeSize_i$ terms with decade dummies. The estimated coefficients for the $HomeSize_i$ term by decade, along with 95 % confidence intervals, are displayed in Figure 3. The estimations show that the effect became larger by decade. A plausible interpretation of this result is that as the volume of net imports increased over time, the level of competition intensified and this, in turn, further raised the importance of merchant networks.

In all regressions presented so far, the port size variable was based on population data in 1750.

As argued in the last paragraph of Section 2.2. This is the preferred approach because it is less likely to suffer from reverse causality. Nevertheless, I also estimated the specification in 2 by constructing yearly population series. Since such data are not available, I linearly interpolated population figures from [Bairoch et al. \(1988\)](#) between 1750 and 1800. Using this time-varying variable I ran the analogue of the specification in column 5 of Table 1. The estimated coefficient on the interaction between port size and homeport departure is -0.076 (SE 0.010).

3.3 Alternative outcome variables

In this subsection, I estimate equation 2 (the baseline specification in column 5 of Table 1) but use alternative dependent variables to shed further light on the mechanisms. In column 1 of Table 2, the outcome variable is the log of the value of reported cargo plus one. In the dataset the values of items are expressed in Danish rigsdalers. Since all specifications include year dummies, possible effects caused by inflation and exchange rate movements do not affect cross sectional differences on which the identification relies. The results are consistent with Table 1 and provide further support for the arguments laid out above. As can be seen, the interaction between port size and home departure variable is positive and significant, implying that ships from larger cities carried more cargo measured in terms of value when departing from homeports. According to this specification, home departures by themselves did not increase the value of cargo. Since there are many observations with zero values I present the results from the PPML estimation ([Silva and Tenreyro, 2006](#)) in column 2. The interaction term becomes larger in this specification.

Table 2: Values and product varieties

Dependent variable	$\ln(Value + 1)$ (1)	$Value$ (2)	$\ln(Items + 1)$ (3)	$\ln(Value)$ (4)	$\ln(Items)$ (5)	$\ln(Items)$ (6)
Homeport departure	0.218 (0.146)	0.618** (0.265)	-0.033 (0.059)	0.186 (0.165)	0.120 (0.077)	0.152 (0.254)
Port size X homeport departure	0.284*** (0.026)	0.362*** (0.074)	0.131*** (0.014)	0.058 (0.052)	0.043* (0.024)	0.103** (0.049)
Homeport size						-0.023 (0.019)
Departure port size						0.129*** (0.022)
R-Adjusted	0.367		0.307	0.332	0.529	0.377
R-Pseudo		0.473				
N	20543	19946	20543	5795	5885	5929
Homeport FE	X	X	X	X	X	
Departure port FE	X	X	X	X	X	
Estimation method	OLS	PPML	OLS	OLS	OLS	OLS

Notes: Estimation results of equations 1 and 2. The dependent variables are shown at the top of each column. Port population size variables are in thousands and in logs. Homeport is an indicator variable if the departure was made from the same port where the ship was based. Estimation methods (OLS or PPML) are displayed at the bottom row of the table. All regressions include year and month fixed effects. Standard errors are clustered at the level of homeports. * (**) (***) indicates significance at the 10 (5) (1) percent level.

Next I explore the extensive margin of the home advantage of large cities. If merchants in large cities had access to a wide variety of goods, then it is intuitive to expect that more goods were included in their shipments. This expectation is confirmed by the results presented in column 3 where the dependent variable is the log of the number of distinct items plus one. As in previous regressions, the interaction term between the homeport departure dummy and port size is positive and precisely estimated. This means that ships based in larger cities carried more varieties when they were departing from their own ports.

In columns 4 and 5, I limit the set only to non-ballast trips. This is a selected group of trips and merchants who initiated those trips were able to overcome the problem of ballasting. Even among those selected trips, the interaction terms are positive and in the case of the number of items statistically significant at conventional levels. The smaller sizes of the estimated coefficients are the natural consequence of excluding ballasting trips because those trips had zero value and number of items.

In the last column, I run the specification of column 5 where the dependent variable was log number of items but, instead of using home and departure port fixed effects, I use the sizes of respective ports, similar to the specification in column 4 of Table 1. The main objective of this exercise is to explore the relationship between departure port size and the number of items. As can be seen, loaded ships that departed from larger cities carried more items. This result is consistent with the underlying assumption that there were more varieties of goods in larger cities from which departing ships could potentially benefit if their managers could tap into the merchant networks of those cities.

4 The selection of departure ports

An important part that is missing from the analysis so far is related to the factors that lead merchants to select one port over the other when making departure decisions. The discussion of these factors can help us better understand the broader historical context and its implications for the estimation strategy. I proceed by estimating regressions which investigate the relationship between port characteristics and their relative attractiveness as a port of departure. To measure the latter, I construct a ratio where the numerator is the number of departures made by all ships except the local ones from a given port and the denominator is all departures made from the same port. This measure shows the relative fraction of departures made by non-local ships. Following the same logic, I also construct a measure of port unattractiveness by taking the ratio of the number of non-home departures over total departures made by ships from a given port. Higher values of this ratio indicate that ships from that port were more likely to depart from other ports, presumably because their own port did not provide good business opportunities.

I regress these measures on several key port characteristics. The main explanatory variable is the log population of the port. Population can serve as a proxy for local market size and pro-

duction, which imply a wider supply of exportable goods. I also consider the log of non-coastal urban population of the region in which the port was located. The intuition behind this variable is similar to the previous one but since hinterland towns do not have direct access to sea, goods produced or traded in such places eventually need to be exported via regional ports. Thus, higher levels of economic activity in the hinterland region increases the level of potential supplies and hence the attractiveness of regional ports. Regions are defined as modern NUTS2 and NUTS1 units. I also include a dummy for the East coast ports, because those ports were relatively more specialized on the Baltic trade, compared to the West coasts ports, which primarily traded with the colonies (Jackson, 1975). I estimate weighted regressions because a non-negligible number of ports appear as departure ports or homeports only a couple of times, so the attractiveness measure for such places can be very noisy. Weights are based on the number of departures made from a given port.

The estimation results are presented in Table 3. As can be seen, there is a positive relationship between the attractiveness measure and port size. The estimated coefficient is highly significant. The hinterland urban population in NUTS2 region is also positively associated with the attractiveness measure and is significant at conventional levels. According to the results reported in the second column, the estimated coefficient on the indicator variable for the East coast is negative. A plausible interpretation for this result is that western ports, such as Bristol, Liverpool and Glasgow, which were trading with the colonies, were able to offer goods that were rare in other European cities. This feature increased the attractiveness of those ports. For example, Glasgow specialized in tobacco re-export activities (Davis, 2012). In columns 3 and 4, I report the results of similar exercises for the unattractiveness measure. Population size continues to be a statistically significant predictor in these regression but with the opposite sign.

Overall, the results presented in Table 3 are in line with the intuition discussed above. Larger population size is associated with higher levels of economic activity and it increased the attractiveness of ports, while ships based in smaller towns were more likely to travel to other ports in search of business. The historical description of the 18th century shipping industry in Whitby further corroborates this line of thinking. Whitby represents an interesting case because it was a small town and has the largest number of non-home departures in the dataset. According to Jones (1982), this town had a large shipbuilding industry and it had many merchants who owned ships. At the same time, it did not have other export industries. According to the author, Whitby ships were engaged in deliveries of coal from Newcastle to London and some of them ballasted in the direction of the Baltic region after unloading in London.

The results in Table 1 showed that homeport departures did not give any advantage to merchants from small towns, so they had no incentive to return to their homeports before departing to Russia. It is worthwhile to provide one additional piece of information to reassure that ships from smaller towns were unlikely to find exportable goods in their homeports. According to the data, there was a strong regional concentration in non-home departures. More specifically, 91%

Table 3: Determinants of departure ports

Dependent variable	Attractiveness		Unattractiveness	
	(1)	(2)	(3)	(4)
Port population size	0.055*** (0.006)	0.053*** (0.007)	-0.048** (0.020)	-0.050** (0.021)
Hinterland urban population in NUTS2	0.026** (0.012)	0.044** (0.020)	0.049 (0.047)	0.064 (0.054)
Hinterland urban population in NUTS1	-0.005 (0.017)	-0.012 (0.017)	-0.016 (0.038)	-0.022 (0.037)
East coast		-0.111* (0.063)		-0.097 (0.069)
R-Adjusted	0.554	0.577	0.200	0.215
N	135	135	130	130

Notes: Weighted OLS regressions of port attractiveness and unattractiveness on port characteristics. Port attractiveness (columns 1 and 2) is defined as the ratio of the number of departures made by all ships except the local ones over the number of all departures made from a given port. Port unattractiveness (columns 3 and 4) is defined as the ratio of the number of departures made by ships from a given port from non-homeport over all departures made by ships based in the same port. East coast is an indicator variable for all ports located on the East coast of Great Britain. Regression weights are based on the number of departures made from a given port. The number of observations differ because for some observations there are zeros in the denominator of the dependent variable. Robust standard errors are reported in parentheses. * (**) (***) indicates significance at the 10 (5) (1) percent level.

of non-home departures made from the East coast of Britain were made by ships based in other eastern ports. Whitby is a case in point. Compared to the distance from the East of England to Saint Petersburg, the distance from London, Newcastle or Hull to any other small town was very small, so if ships could source supplies from their homeports then they would have returned back before embarking on the long journey.

Combining these pieces of evidence allows concluding that, in the absence of local supply of exportable goods, the primary business of ships based in small ports was to serve larger ones. Furthermore, the managing merchants of those ships underperformed relative to their competitors because they did not have the same level of access to networks in larger cities.

5 Conclusions

In this paper I show that during the 18th century, merchant ships that were based in large British ports outperformed other ships from smaller ports by avoiding ballast trips on trade routes that experienced imbalanced trade. I argue that dense merchant networks in large cities improved

information sharing and matching possibilities and enabled merchants to arrange deals with local suppliers that made it possible to meet the demand in the destination market.

The results of the paper provide quantitative evidence on how agglomeration effects operated in the historical context. The highlighted mechanism is important for understanding urban growth in the past and in modern times, especially in countries with weak contracting institutions. The results of the paper also have important implications for the modern maritime industry. There is an expanding literature that applies trip level data to the analysis of international trade ([Brancaccio et al., 2020](#)). However, this literature treats shipping companies as homogenous firms. Exploring the relationship between the size and networks of shipping companies and their performance and pricing is an interesting venue for future research.

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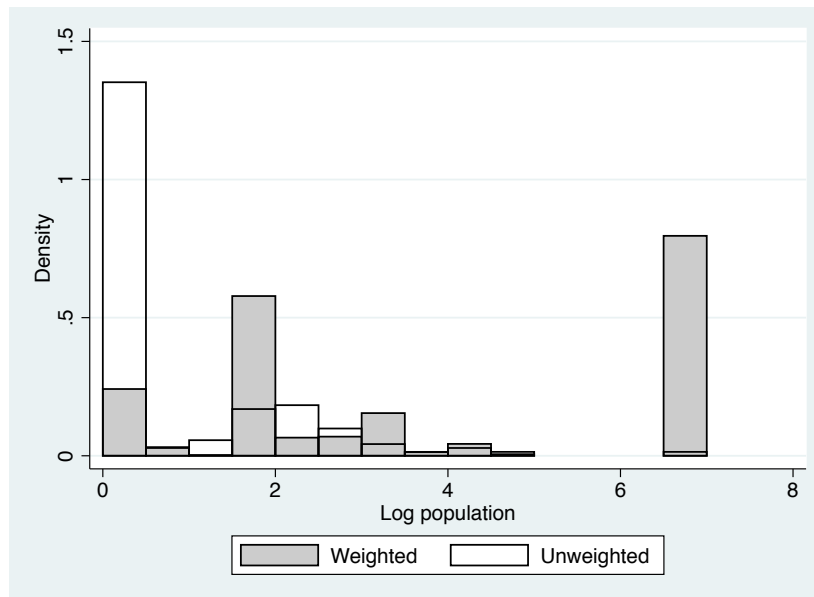
Appendix

Table A1: Descriptive statistics

	Obs	Mean	Std	Min	Max
Ballast trip	20600	0.712	0.453	0.000	1.000
Homeport size	20600	2.627	2.124	0.000	6.516
Departure port size	20600	3.587	2.428	0.000	6.516
Homeport departure	20600	0.665	0.472	0.000	1.000
Port size X homeport departure	20600	2.022	2.359	0.000	6.516
(Port size) ² X homeport departure	20600	9.652	15.356	0.000	42.461
London X homeport departure	20600	0.170	0.376	0.000	1.000
Experience	20600	1.726	1.199	0.000	5.746
$\ln(\text{Value} + 1)$	20600	1.087	1.869	0.000	6.982
$\ln(\text{Items} + 1)$	20600	0.390	0.699	0.000	3.434
Value	20600	26.461	75.555	0.000	1076.000
$\ln(\text{Items})$	20600	0.390	0.699	0.000	3.434
$\ln(\text{Value})$	5842	3.757	1.471	-0.693	6.981
$\ln(\text{Items})$	5930	0.964	0.848	0.000	3.401

Notes: Port size variables are in logs. Experience is in log plus one. London is an indicator variable for ships based in London. Homeport departure is an indicator variable if the home and departure ports are the same.

Figure A1: Distribution of ports by population



Notes: This figure port the distribution of port size by population. Population figures are in logs plus one. Grey bars show the distribution weighted by the number of trips made by ships base in the corresponding port. Transparent bars show the unweighted distribution.