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Trade Persistence and Trader Identity - Evidence from the Demise of the Hanseatic League

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How do trade networks persist following disruptions of political networks? We study different types of persistence following the decline of the Hanseatic League using a panel of 21,590 city-level trade flows over 190 years, covering 1,425 cities. We use the Sound Toll data, a dataset collected by the Danish crown until 1857 that registered every ship entering or leaving the Baltic Sea, forming one of the most granular and extensive trade data sets. We measure trade flows by counting the number of ships sailing on a particular route in a given year and estimate gravity equations using PPML and an appropriate set of fixed effects. Bilateral gravity estimation results show that trade among former Hansa cities only shows persistence after its dissolution in 1669 for about 30 years, but this persistence is not robust across different regression specifications. However, when we incorporate the flag under which a ship is sailing and consider trilateral trade (where an observation is a combination of origin, destination, and flag), we find that trade persistently exceeds the gravity benchmark: Hansa cities continued to trade more with each other, but only on ships that were owned in another former Hansa city and thus sailed under a Hansa flag. Similar effects are found for trade among former Hansa cities and their trading posts abroad, yet again only conditional on the ship sailing under a former Hanseatic flag. Trade flows among the same pair of origin and destination cities, but under a different flag, do not show this persistence. Our main result shows that the identity of traders persists longer and more strongly than other forms of trading relationships we can measure. Apart from these new quantitative and qualitative insights on the persistence of trade flows, our paper is also of historic interest, as it provides new and detailed information on the speed of decline of trade amongst members of the Hanseatic League.

JEL Classification: F14, N73, N93

Keywords: Hanseatic League, Hansa, Gravity

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1 Introduction

How long and why do trade networks persist following disruptions of political networks? An increasing body of evidence points towards past trade links as one important determinant of current trade patterns. However, estimates of the degree of persistence of such past trade links differ and the relative importance of various possible channels is not clear. On the one hand, even centuries after the demise of the Roman Empire, regions that were better connected during Roman times still have more business links (Flückiger et al. 2021). Similarly, inter-German trade patterns persisted after German reunification (Nitsch and Wolf 2013). On the other hand, when colonies become independent, their trade volumes with their former metropolis revert gradually to a standard gravity benchmark (Head, Mayer and Ries 2010). A similar decline arose in the case of former parts of the Austro-Hungarian Empire after the fall of the Iron Curtain (Beestermöller and F. Rauch 2018).

What drives these different degrees of persistence? In this paper, we study the role of formal trade institutions that lead to the accumulation of trading capital at the aggregate and at the individual level. Studies of the persistence of trade need to observe trade flows for a long period of time, and hence are usually limited in the spatial resolution of data. They also typically cannot distinguish the identities of different types of traders. We address both issues by using a historic laboratory: the demise of the Hanseatic League in the late 17th century. This confederation of merchant cities had dominated trade in the Baltic region during the Middle Ages, but was dissolved in 1669, after a long period of time and already gradual dissolution. We draw on Danish tax records that recorded seaborne transits between the North and the Baltic Seas over centuries, allowing us to develop and use a panel of city-level, high resolution trade flows in which we also observe the flag under which ships of trade sail.

We first consider trade between former Hansa cities and their key trading partners: Does the size of trade flows between two cities, measured by the number of ships sailing between them, depend on past membership in the Hanseatic League? Using city-level gravity equations based on data from the years 1668 to 1857, we find some evidence for such trade persistence. However, in line with Head, Mayer and Ries 2010 and Beestermöller and F. Rauch 2018, this persistent trade effect disappears after about 30 years. It is also not robust across different model specifications and data restrictions. Motivated both by the historical literature (Dollinger 1964) and the recent literature on the importance of social connections as a determinant of trade (Bailey et al. 2021, Fang, Wang and Yang 2020, Campante and Yanagizawa-Drott 2017, Cristea 2011,

J. Rauch and Trindade 2002, J. E. Rauch 2001), we then consider 'trilateral trade', by adding a third dimension, namely the flag under which a ship sailed. In this specification, an observation is a combination of origin, destination, and ship ownership. Here, we find substantial and long-lasting persistence: Hansa cities continued to trade with each other more, but only on ships that were also registered in a former Hansa city. Thus, while trade persistence at the aggregate bilateral city-level was relatively short-lived, former trade institutions continued to shape the identity of the people that facilitated trade between cities.

Our main result shows that the identity of traders persists longer and more strongly than other forms of trading relationships we can measure. This relates to a long literature on the importance of identity, culture, and history in trade. For example, Greif 1993 shows how a coalition of Maghribi traders could build a reputation mechanism to reduce transaction costs in trade relationships in the 11th century. Puga and Trefler 2014 present evidence that a small group of merchants blocked access to trade in medieval Venice, using marriage alliance to build trust and monopolize trade. Head, Mayer and Ries 2010 show how trade slowly declines after colonial breakup. More recently, Bailey et al. 2021 find that countries that are better connected on Facebook trade more, while Felbermayr and Toubal 2010 highlight the relationship between trade and cultural proximity as measured by voting patterns in the Eurovision song contest. In the context of online labour markets, Xu 2015 finds an important role of collective reputation as proxied by nationality. What we add to this literature is to show that in the case of the Hansa, the identity of Hanseatic traders built longer lasting trading links than trade overall, highlighting the long run persistence of this specific form of trading relationship.

Identity was introduced into the field of economics by Akerlof and Kranton 2000 and Akerlof and Kranton 2010. It has since then also influenced the literature on trade. For example, cultural trade networks of migrants persist for decades (Parsons and Vézina 2018, Gould 1994, J. Rauch and Trindade 2002, Dunlevy 2006). Special interest groups have been document to influence trade policy (Gene M. Grossman and Helpman 2001, Gene M. Grossman and Helpman 2002) and the identity of groups perceived to benefit or lose from trade influences political attitudes to trade (Gene M Grossman and Helpman 2020). The identity of the traders themselves has found less attention, likely due to data limitations. What we add to this literature is to show that the identity of participants in trade is non-random and has measurable effects on the strength and persistence of trade flows.

Apart from our new quantitative and qualitative insights on the persistence of trade flows, our paper is also of historic interest, as it provides new and detailed information on the speed of decline of trade amongst members of the Hanseatic League. While there is a literature discussing the economic origins of the Hansa (Greif, Milgrom and Weingast 1994, Greif 2006), the decline has not received the same attention. This paper contributes to the debate on dating the decline and end of this trade network, and on the speed at which the Baltic region rearranged to the new political environment.

This paper proceeds as follows. In the next section, an historical overview is given. Section 3 explains the data and the choices made while working with it. In section 4, we will put forward our research hypotheses. Bilateral estimation results can be found in section 5. Section 6 turns to trilateral results, and section 7 concludes.

2 Historical overview

2.1 The Hanseatic League

The Hanseatic league was initiated in the late 12th century in what is now Northern Germany and grew to incorporate dozens of cities on the Baltic and North Sea[1]. It was primarily a commercial confederation, but it was was also able to engage in common military operations. At its height, the Hansa was a powerful independent political and economic entity, successfully taking on large kingdoms such as Denmark and England. Hanseatic networks played an important role in facilitating exchange by imposing a set of rules and guaranteeing their merchants' trading privileges abroad. The Hansa built a large and successful transnational trading network. Of great importance were the Hansa's trading posts abroad, called Kontore or Faktoreien. These hubs sometimes encompassed a whole neighbourhood within a foreign city and had their own jurisdiction. The list of member cities of the Hanseatic League changed over time. Figure 1 gives an overview of the main Hansa cities based on a list compiled by Dollinger 1964.

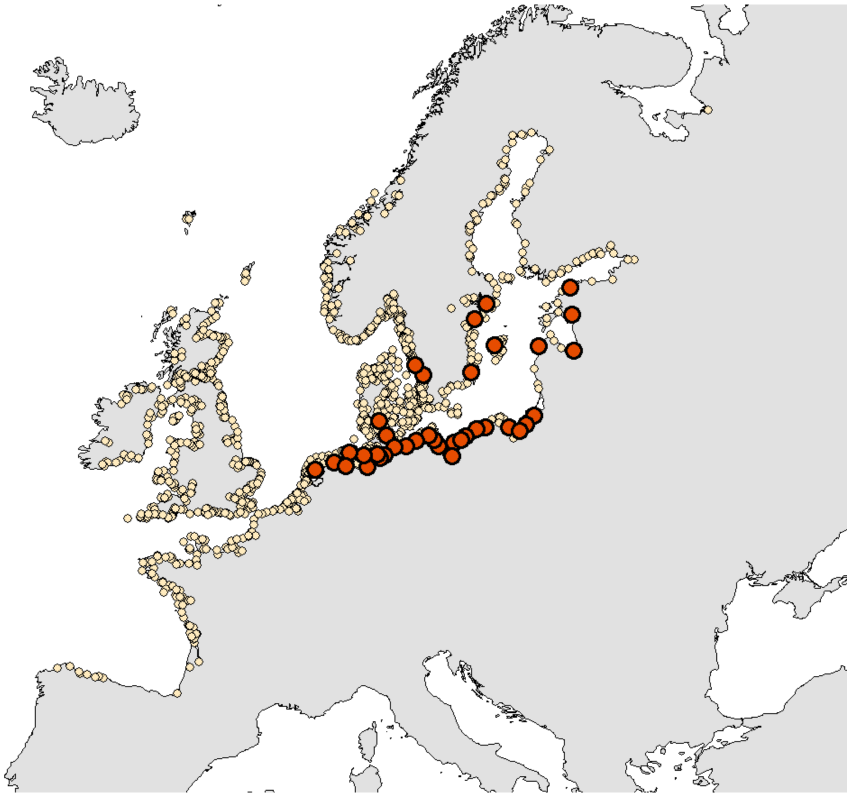
Until the mid 14th century, the Hanseatic League mostly existed abroad. During this time, the most salient feature of Hanseatic trade were the privileges granted to Hanseatic merchants abroad, to which there were two sides. Rulers would assure Hanseatic merchants politically and legally of certainty of justice concerning people and goods on the one hand and would further grand fiscal privileges to Hanseatic merchants. Generally speaking, treaties permitted trade to Hanseatic merchants, assured them of the legal enforceability of their contracts and protection against arbitrariness and even encouraged trade by granting financial privileges such

[1]The following discussion is mostly based on Dollinger 1964. Other sources are cited where used.

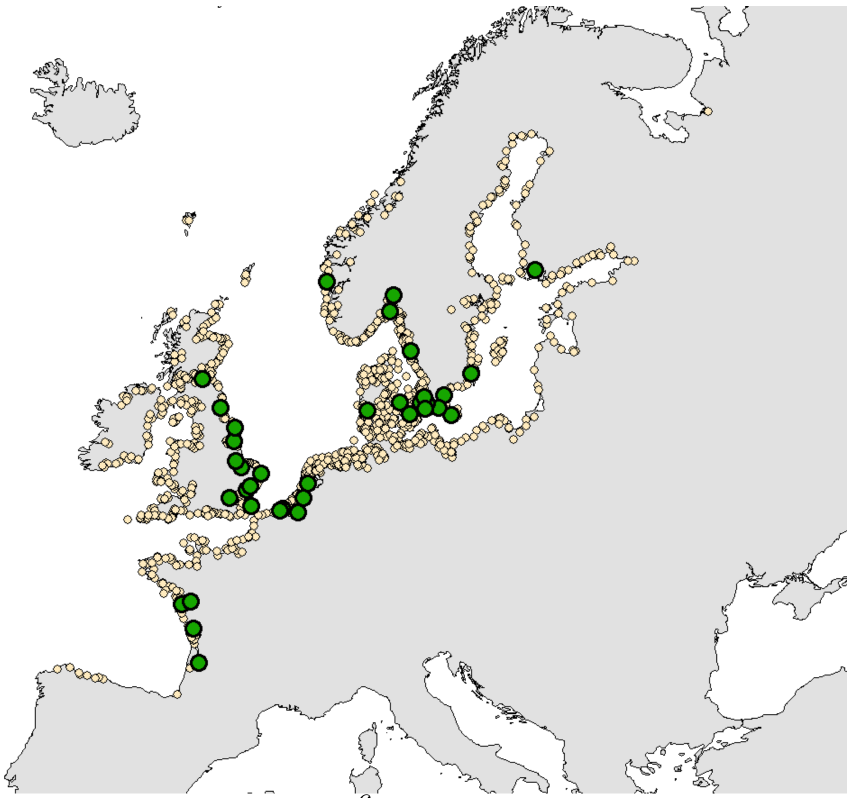
as tax alleviations. Importantly, during Hanseatic centuries trade privileges granted to its member cities depended on the merchant's citizenship. Ultimately, the acquisition of a Hansa citizenship was too attractive and this privilege was overused, so that from 1434 on privileges were confined to merchants born in a Hanseatic city. Dollinger 1964 calls this first period the "Hansa of merchants". In this period, the strongest links were created between Hanseatic cities and their trading posts abroad, most importantly the Kontore. Kontore grew out of initial trading posts when these trading posts grew in importance and benefited sufficiently from privileges. In most Kontor cities, with the exception of Bruges, Hansa merchants had to live in a particular part of town; they were only partially subject to the jurisdiction of the local ruler and elected their own administrators, the so called Olderleute. Figure 1 displays all cities with a Kontor on a map. The four most important Kontor cities were Novgorod in Russia, Bergen in Norway, London in England and Bruges in what is today Belgium.

After the mid 14th century, Dollinger 1964 argues for the rise of a "Hansa of towns". City constitutions, a similar language, privileges linked to the citizenship of merchants and common military and political objectives led to the creation of strong bilateral links between Hansa cities. Gaimster 2005 notes the importance of "social and genealogical links which developed between trading partners and towns and families the length and breadth of northern Europe"(p. 412). Hanseatic trade was usually carried out by self-employed merchants or small firms. These firms were too small to establish trading outposts in many cities and therefore relied on networks. Partners could, for example, employ each other as commercial agents. This was often done without written contracts. Instead, Hanseatic merchant networks relied on other coordination mechanisms such as a common language and cultural identity, law, habits, reciprocity, and trust and reputation. (Ewert and Selzer 2015). Kinship also helped to make networks more dense: "[I]t was a common strategy of merchants to make occasional partners friends and friends relatives."(Ewert and Selzer 2015, p. 184f.) Migration and return migration further supported this process (Gaimster 2005, Ewert and Selzer 2015).

Due to its strong network nature, it is natural to bring forward theories of trading capital and ask whether trade flows displayed a persistent pattern after the dissolution of the league. The trade routes connecting Hanseatic cities and their Kontore abroad are the ones that we expect to have built up the largest stock of trading capital in the first period, the Hansa of merchants. The importance of bilateral links between Hanseatic cities grew enormously from the mid 14th century onwards, creating bilateral trading capital among Hansa cities, an era referred to as the Hansa of towns.



Panel A



Panel B

Figure 1: Red circles in Panel A show Hansa cities according to Dollinger 1964, green circles in Panel B show Kontore according to Hammel-Kiesow 2000; all other cities and towns in yellow.

In the following centuries, two major trends led to the demise of the Hanseatic League. First of all, early modern states evolved throughout Europe, and their fiscal capacity began to outstrip the political and military potential of the Hanseatic League. In the spirit of mercantilism, these states were more inclined to favour their own merchants. As states imposed taxes and were able to strip the Hanseatic League of its privileges, membership became less and less valuable to cities in the region, illustrated by the decreasing attendance at the Hanseatic League's General Assemblies. Furthermore, the rise of the Atlantic powers, mostly Britain and the Netherlands, meant that Hanseatic merchants no longer enjoyed their monopoly power over some of the most lucrative trade routes. More generally, it is well documented that the economic centre of gravity moved towards Western Europe (Acemoglu, Johnson and Robinson 2005). Based on voluntary cooperation rather than centralized power, the Hanseatic League was unable to compete with these two developments. The League was never formally dissolved, but its last General Assembly (*Hansetag*) which took place in 1669 is usually considered its last official event.

2.2 The Danish Sound Toll

To measure trade flows between cities in the Baltic region, we rely on Danish toll data. Introduced by the Danish King in 1429, the Sound Toll was levied on all ships entering or leaving the Baltic Sea at Helsingor (henceforth "the Sound"). These dues were an asset of the royal income until 1816, as clarified by Hill 1926, who was also the first author to have traced the origin of the dues back to 1429/1430. At the time, both sides of the Sound were Danish, and the narrow strait between Denmark and what is now Sweden was protected by a fortress that would attack vessels unwilling to pay the duties.

The toll had flat fee elements (such as a fee for the maintenance of lighthouses) and proportional elements, relative to the value of goods as declared by captains (Degn 2017a). In order to disincentivise declarations of low values, captains were obliged to be willing to sell to toll collectors at the declared prices. This mechanism ensured truth telling regarding the information on the value of cargo. The data are extensive, usually covering the origin and destination of a trading ship, the city in which it is being owned, the name of the captain, goods aboard, and further tolls levied. Danish (and up to breaking with the dynasty also Swedish) ships were subject to markedly lower tolls, yet also these vessels were recorded.

The aforementioned privileges for Hanseatic merchants extended, to a degree, also to the treatment of their vessels when passing the Sound. Hanseatic ships enjoyed, for example, the privilege of not paying the so called cargo toll, a privilege only enjoyed by Danish (and at the time also Norwegian and Swedish) ships (Degn 2017a). Degn notes a hierarchical system in the collection of duties: ships from Denmark, Norway and Sweden made up the most privileged group, whereas the Wendish towns were a little less privileged. The second class compromised the eastern Hanseatic cities, most notably Danzig. These ships paid both a reduced ship toll (lump-sum) and enjoyed lower ad valorem duties on copper, wine and salt. The third group covered the western Hanseatic cities and the Netherlands. Ships from England, Scotland, France and Emden enjoyed no privileges at all. Importantly, this differentiated treatment ended in the 1640s and 1650s, after Denmark had signed a treaty with the United Provinces in 1645 reducing the toll to the level at which it was in the 16th century for Dutch traders. Toll inspections were abolished for Dutch and Swedish ships and similar treaties followed with all major trading partners including the Hanseatic cities, all stating the toll conditions the Dutch had secured. From this time onwards, no further major changes in the toll system were introduced until its abolition in 1857. Information on destination cities is only consistently reported from 1668 onwards, such that the bilateral data is collected at a time when merchants from formerly Hanseatic cities enjoyed no particular privileges at the Sound any more; the toll conditions did not change in any comprehensive way throughout the period we are looking at, namely 1668 to 1857.

3 Data

3.1 The Sound Toll Data

The original Sound Toll records were digitized by a team of Dutch economic historians (Soundtollregisters 2020). An important limitation of this data set is that observing a shipment depends on it passing through the Oresund. This is to say that trade flows between cities on either side of the Sound will not be observed: trade between Danzig and Stockholm or London and Amsterdam will not feature in this dataset; yet trade between Danzig and London will be, as it passes through the Sound. In our analysis, we only include trade flows that would, in theory, be observed, such that not observing a trade flow most likely implies a true zero. For trade between Danzig and Stockholm, we will not assume true zero trade, but rather not include these trade flows at all; it is, however, highly unlikely that any trade between Danzig and London occurred other than through the Sound. Other straits, such as the Little Belt, were difficult and dangerous to navigate for larger ships such as the ones used for trading with the West and alternative transport over land was expensive (Raster 2019). Note further that trade over land faced a high number of tolls, too: whereas a ship from Danzig to Amsterdam needed to only cross one border, so to speak, transport over land, even abstracting from the true transport cost, would become way less attractive due to the high number of land borders to be traversed and the tolls to be paid which were associated with them, as described for the case of the Holy Roman Empire by Mintzker 2012.

The original source from which we take these trade data is from the Soundtoll project (http://soundtoll.nl/), which also provided helpful material on commodities, units, currencies and city names, and for additional documentation and clarification Degn 2017a proved a useful resource. Information on currencies, units and notation is based on this source, too[2]. Other sources are indicated.

Our main source for identifying cities in the trade data are two files provided by the Soundtoll team, one of which maps every mentioning of a city, however cryptic or historic, to a unique identifier, the "soundcoding", and the other one linking these unique identifiers to a unified way of naming the city. Using these files, we convert 90,737 original city names to 3,085 unique place identifiers. Membership in the Hanseatic league is determined based on Dollinger 1964. In his accounts, he explicitly includes cities as Hansa members under the condition that their merchants benefited from Hanseatic privileges abroad. Kontore and Faktoreien (trading posts abroad) are based on Hammel-Kiesow 2000. We use a different source here, as Dollinger 1964 does not provide a list of Kontor cities.

Our general source for units is the Soundtoll project's information (Soundtollregisters 2021). We work with a version of the full dataset which we downloaded on November 23rd 2019 from http://soundtoll.nl/. Historical units suffer from a lack of comparability (a ton from Danzig isn't the same as a ton from Königsberg, a Faad is 930 liters or 950 kg, depending on the good), overlapping names in the data ("barrel" refers to both a unit and a good), overlaps with kinds of goods (boter/botter/boeter is a unit that butter, carrying the same names, is sometimes measured in) and poor documentation (many units are abbreviated to "D." or "F." leaving ambiguity whether this refers to the currencies of Daler and Faad or other units of measurement). Aggregation over all kinds of goods and several centuries and languages implies

[2] Alder, Colmer and Coşar n.d. use the Sound Toll Data to study the impact of environmental shocks. Gomtsyan 2021 focuses on merchant networks in cities.

high degrees of noise. We therefore prefer to use a more aggregated unit of account, namely the number of ships, as our measure of bilateral trade. In theory, other proxies could be used, say, the carrying capacity of vessels. As noted by Degn 2017b, from 1632 to 1644 a specific duty was collected in proportion to a ship's carrying capacity, such that from the duty records carriage capacity can easily be recovered. This, however, does not extend to the entire time frame, as tolls and duties were constantly modified. Degn 2017b notes how the size of ships varied by its origin, with notably Dutch ships being particularly large. In our trilateral estimation below, homeport × time fixed effects absorb these differences.

The particular properties of our dataset, and the lens through which trade is observed, has implications on data selection. However, our regression specifications, described below, consider balanced datasets in which we follow the same bilateral trade links over time. Such a setting is more robust to selection problems than cross-sectional gravity results would be, especially when it comes to time-invariant differences.

3.2 Distance over sea

We compute cost distances for each city pair in our dataset using a raster approach and the CostDistance tool in ArcGIS similar to Bakker et al. 2021 or Nunn and Puga 2012. As in the latter paper, our pixel resolution is 30 arc-seconds, corresponding to square cells of about 1 km side length (in fact, the longitudinal dimension is even less than that given our latitude). In total we compute 1,425 × 1,425 distances. Our key parameters are that we set land transportation to ten times the cost of transportation over water. For our sample of mainly coastal cities, most least-coast routes are overwhelmingly over water, but we occasionally may observe land transportation, typically from a large city a bit inland to the nearest port.

3.3 Sample restrictions

The time frame of our analysis starts in 1668, from which on destination cities were systematically recorded. It ends in 1857, when the Soundtoll was formally abolished.

We restrict our sample geographically to the region near the Sound, i.e. to Northern and Western Europe. Specifically, we only keep cities to the North of Bayonne[3]. We drop parts of Southern France and Italy that are to the north of Bayonne, but not on the Atlantic coast.

[3] This includes some cities in Northern Spain that are situated to the North of Bayonne.

We further restrict our sample to cities to the west of Saint Petersburg, with the exception of Arkhangelsk, as it was a major export harbour at times and in particular when the Baltic harbours were inaccessible for Russia. The Northern limit we choose is the Arctic Circle; to the West, our cut off is Ireland. This selection is motivated by the fact that data for cities located further away from the Baltics are very sparse. By this selection, we cut about 20 per cent of cities. In the next step, we only keep cities that are either 25 km or less away from the coast or are 100 km or less away from the coast, but only 25 km or less away from a major river (namely Loire, Seine, Rhine, Elbe, Oder, Vistula, Neman, and Daugava). By this selection, we cut a further 40 per cent of cities. Overall, this leaves us with 1,425 cities and towns in sixteen modern day countries. Among these 1,425 cities, we observe 21,590 bilateral trade relationships over 190 years, with about 1.5 million passages. Our dataset is a balanced panel to begin with, such that if in any of the 190 years there was a passage connecting a pair of cities, this connection is included. Missing values for a given year and city pair mean that in this year, no passage from city A to city B across the Oresund was recorded. Hence, we set these missing values to 0.

Some city pairs only record very few passages. For example, over 190 years, only one ship passed the Oresund with cargo from Dunkerque to Visby. To reduce noise, we cut out city-to-city flows for which we barely observe any trade. In particular, we drop trade connections for which, over the course of 190 years, less than 60 passages are observed, so less than about one ship every three years. This restriction keeps 906,000 out of 1,029,000 passages, so about 88 per cent. Similar results can be obtained for a cut-off of 100 passages; about 84 per cent of passages are kept here. Cutting out cities in the above-described manner is observationally almost equivalent to restricting the data to the most common bilateral connections. Ultimately, places further inland or far away from the Sound rarely show up in the data. Passages are recorded at a daily level, yet we aggregate them to the yearly level. For some estimations, we further aggregate to five-year half-decades. Trade flows are measured in a directed way, such that flows from A to B and flows from B to A are stored as different observations in our dataset. Directed trade flows are helpful for two reasons. First, we discard possibly valuable information by turning the data into an undirected data set. Second, Feenstra 2016 points out that the estimation method by Silva and Tenreyro 2006 requires directed trade flows. Section 5 will be concerned with theory and estimation.

The Sound Toll data only features trade flows which enter or leave the Baltic Sea through the Sound near Helsingor. This introduces a number of selection problems. The first one is land transport around the Sound. On short distances around the Sound, we likely miss trade, as land transportation was a viable alternative. This potentially biases distance coefficients upwards. As a robustness check, we exclude short-distance connections for which we likely observe only part of trade due to land transport. Secondly, observations are conditional on passing through the Sound - places further away from the Sound can send vessels way further without featuring in the data. Trade buffers around the cities whose flows we do not observe grow proportionally with distance to the Sound. We also run robustness checks by including pair fixed effects which account for these time-invariant bilateral selection problems. Overall, a lot of selection issues are alleviated by the fact that we use a balanced panel of trade connections.

3.4 Smuggling, fraud and unobserved passages

Another potential concern is that smuggling to escape the tax could lead to selection bias. Several rules were in place to tackle smuggling: from 1708-1752, ship masters were paid 3.5 per cent of the calculated toll amount to give incentives for truthful reporting (Degn 2017a); non-declared goods were confiscated; even after a ship had paid its duty at Helsingor, subordinate duty ships patrolled in the North Sea and could confiscate all goods on board that had not previously been declared at Helsingor. Over time, official papers documenting carried goods and proving the right to benefit from trade privileges were demanded in order to tackle untruthful reporting. Fraudulent or missing reporting seems to have been commonplace, however, further motivating our choice of only looking at the number of ships. This measure is described as very reliable by Degn 2017a: the Sound is very narrow and passing through it unobserved is almost impossible. A particular duty, called guilt money, had to be paid when ships did not quickly enough lower their topsails to greet the fortress of Kronborg, and a cannon was fired to remind the ship master of his obligations. Degn 2017a further notes that other water ways into the Baltic Sea were narrow and dangerous; we would add that all these straits have narrow points, such that the Danish Crown could have easily erected further toll fortresses if it had been desirable for it to do so. We conclude therefore that all ships passing the Sound were counted. As fraudulent reporting and smuggling were commonplace, measures using the exact units given are unreliable in at least a good amount of cases, but this leaves the measure of number of ships untouched: it was basically impossible to smuggle an entire ship, that is, to pass Kronborg unseen and untaxed.

3.5 Ship ownership or captain's place of residence

In the trilateral section below, we condition on the variable "schipper plaatsnaam". There is a debate over the meaning of this variable, documented by the Sound Toll team. It either denotes the home port of a ship or the place of residence of the captain. The latter might be harder to interpret. As pointed out by Raster 2019, significant migration of ship masters was a common feature of Baltic trade. In particular, he notes the large number of captains with Dutch names with domiciles in the East. Dollinger 1964 also speaks of sizeable immigration to Hansa cities and concludes that up to the 17th century, immigrants made up the majority of citizens of all Hansa cities, which suggests that having been a recent immigrant did not preclude the acquisition of citizenship. On the contrary, even high political offices were frequently filled with men who had only very recently acquired citizenship.

Dollinger 1964 goes on describing the particular attributes of captains. Captains were always (partial) owners of their ships and their main remuneration consisted of the share of profit accruing to their partial ownership of the ship. In order to counterbalance the impossible supervision of captains by other merchants, captains had to be married men and have children, as they were liable with their possessions on land. This measure was aimed at making the outside option of simply migrating to another city less attractive. For these reasons, we consider it plausible to link the city of ship ownership or the captain's place of residence to Hanseatic privileges. While Raster 2019 is right in pointing out large migratory flows, a recent migratory past did not preclude the acquisition of citizenship; captains, in particular, were bound to their home ports in numerous ways, not least through their possessions on land.

Either view acknowledges that this variable is the equivalent of the modern principle of 'sailing under a flag'. In addition, we think it measures a cultural affiliation of captain and crew to former (German-speaking) Hansa cities[4]. This is why, in the trilateral section, conditioning on "schipper plaatsnaam" having been a Hanseatic city in the past is interpreted as sailing under a flag that, in the past, would have come with Hanseatic privileges. Below, we will usually speak of "home port" or "city under whose flag a ship is sailing" or "city of ship ownership" and this also encompasses the alternative interpretation as place of residence. While there is a debate on how to interpret this variable, we interpret it as a proxy for past Hanseatic privileges.

[4]The five most common last names of captains commanding a ship under a former Hanseatic flag are Schultz, Meyer, Blanck, Schmidt and Schröder, whereas the five most common last names of captains commanding a ship under a non-Hanseatic flag are Hansen, Nielsen, Andersen, Jansen and Smith.

4 Persistence in trade patterns

There is ample empirical evidence that shared institutions, languages and currencies increase trade flows (Head, Mayer and Ries 2010, Jacks, O'Rourke and Taylor 2020), as well as capital flows (Ferguson and Schularick 2006). However, previous studies have also pointed out that the "trading capital" generated by such institutions or informal networks depreciates once the underlying institutions and networks disappear.

Beestermöller and F. Rauch 2018 classify the "trading capital" created by past interactions into three components: physical capital like infrastructure that reduces trade costs, capital related to personal networks and built-up trust, and other components that lower bilateral trade costs, but are unrelated to personal networks or physical capital. In the context of our paper, physical capital is of little interest as we study a setting with trade over water, where roads and railway lines do not improve bilateral trade. Personal networks and built-up trust, however, are likely to have outlived the Hanseatic league. As argued in section 2, Hanseatic trade relied heavily on merchants' networks, reciprocity and trust, and we would thus expect this category of trading capital to be particularly important in our setting. The last category encompasses cultural proximity, shared languages and trading habits. From our point of view, the last two categories can hardly be distinguished precisely, but in some cases this is possible. A prime example are city constitutions.

In the context of the Hanseatic League, trading capital thus consisted, among others, of a more symmetric distribution of information, well-aligned legal systems, similar units of measurement, a shared language and a close-knit network of merchants, features that become particularly salient in the latter phase of the Hansa of towns. Wubs-Mrozewicz 2017 stresses the importance of the Hanseatic league as an institution of conflict management with formalized mediation mechanisms for conflict among individuals and conflict among cities. Such mechanisms and other legal principles, such as the symmetry of Hanseatic privileges abroad for all members, outlasted the league as concepts in law and are likely to have lowered trade costs for cities involved even after the dissolution of the league through better bilateral legal institutions; thus, trading capital was built up through these legal institutions. Privileges abroad created trading capital in the first era of the League's existence, in what Dollinger 1964 refers to as the Hansa of merchants. Lower bilateral exchange rates and political and cultural similarities led to the creation of bilateral trading capital among Hanseatic cities in the latter phase of the League's existence, the Hansa of towns.

Against the backdrop of the literature and with an understanding of Hanseatic privileges, we would expect that after the demise of the Hanseatic League the trading capital between its former members would gradually decline. Excess trade flows due to this trading capital would thus go to zero over time. We expect a similar pattern for trade between former Hansa cities and former Kontor cities.

5 Bilateral Results

We start by using a gravity equation framework to study persistence in aggregate city-to-city trade after the demise of the Hansa. For this, we draw on a bilateral dataset that consists of 21,590 directed trade flows over 190 years. For convenience, we introduce a shorthand notation. "HH" refers to both the origin and destination city having been members of the Hanseatic League. "HK" denotes a Hanseatic origin city and a destination city that used to be a Kontor or a Faktorei. Generally, the first letter refers to the origin city and the second one to the destination city. "KH" denotes a Kontor origin and a Hanseatic destination; "KK" denotes trade among former Kontor cities. We estimate this equation on the bilateral directed dataset, which is to say that trade flows from A to B are treated as different from trade flows from B to A.

Our empirical model is:

$$T_{ijt} = exp(\alpha + \beta_t HH_{ij} + \gamma_t KK_{ij} + \delta_t HK_{ij} + \kappa_t KH_{ij} + \rho_t smc_{ij} + \lambda_t dos_{ij} + \eta_{it} + \chi_{jt}) \times \epsilon_{ijt}, \quad (1)$$

where T_{ijt} denotes the number of ships sailing from city i to city j in year t, our measure of trade between cities. HH, KK, KH and HK are dummies that code the Hanseatic city or Kontor status of the two cities as described above. The coefficient estimates for these dummies indicate by how much bilateral trade flows are beyond or below the prediction of a standard gravity model. The dummies are time-invariant, so we interact them with a complete set of year dummies to see how the effect of Hanseatic trade linkages evolves over time. As control variables, we include an indicator for both cities being located within the same historic country[5],

[5]We assume all cities that would later be part of the German Empire to be within Germany, although this country did not exist at the time. This applies notably (beyond Polish harbours) to Kaliningradskaya Oblast,

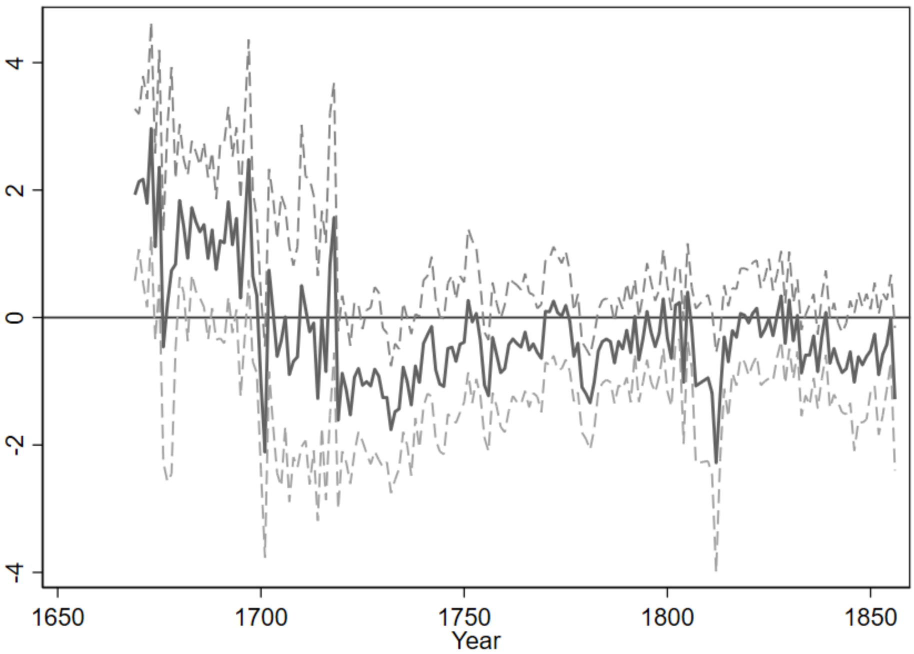
and the log distance over sea between the two harbours. As in the case of our main variables of interest, we interact these variables with year dummies, thus allowing them to have time-varying effects. η and χ are origin x year and destination x year fixed effects. Following Head and Mayer 2013, these are included to take care of multilateral resistance terms. Some authors further include pair fixed effects in order to account for endogenous trade policies and time-invariant bilateral trade costs. In our baseline specification, we do not do so, as our Hanseatic dummies are bilateral, such that our estimates would have to be interpreted relative to the time-invariant bilateral fixed effect. Further, given that the data span several centuries, we believe the time-invariant fraction of trade costs to be of less interest. We estimate this model using PPML (Silva and Tenreyro 2006), clustering standard errors at the bilateral level (i.e. on a unique identifier of an origin-destination pair) throughout.

Our main result from this estimation are 190 yearly parameters for our four Hanseatic dummies. In the following figures, we graph their point estimates and 95 percent confidence intervals over time.

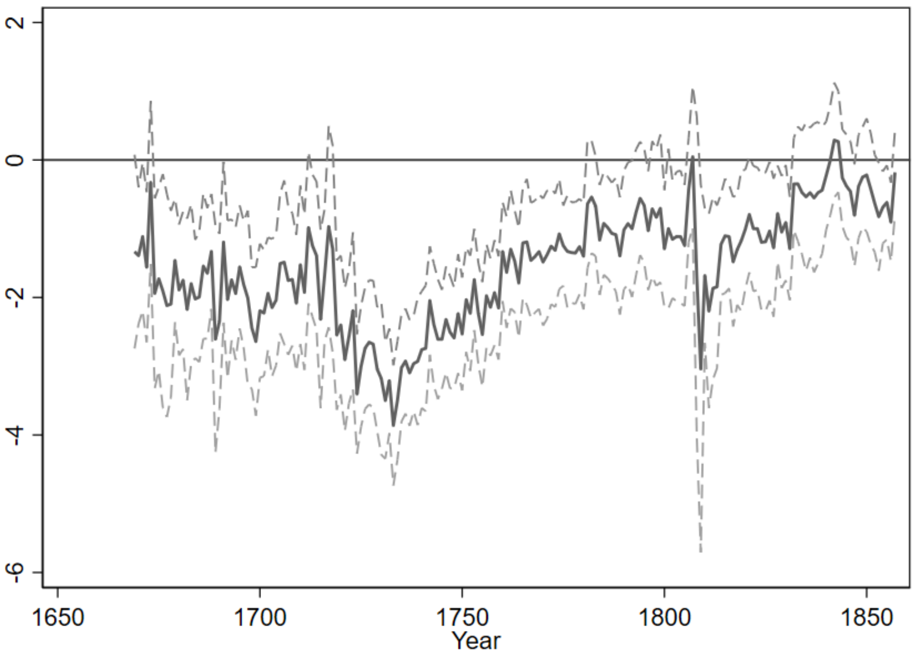
Figure 2a shows how the effect of both cities having been Hansa cities evolved over time. Up to around 1700, former Hansa cities traded more with each other than predicted by a gravity benchmark. This effect then decreases and finally fluctuates around zero for about one and a half centuries. These results are similar to those found by Head, Mayer and Ries 2010 and Beestermöller and F. Rauch 2018. Figure 2b shows the same graph, but for both cities having been former Kontor cities. Here we observe significantly negative estimates until the second half of the 18th century. This is not surprising: cities with a Kontor were not members of the Hanseatic league and while trade between Hansa cities and Kontor cities benefited from Hanseatic privileges, no such measures existed for trade between Kontor cities.

On the other hand, Dollinger 1964 highlights the importance of privileges granted to Hanseatic merchants abroad. In figures 3a and 3b, we therefore turn to trade between Hanseatic cities and those where Hanseatic Kontore had been established. Hanseatic merchants were granted large benefits in these cities and further selected themselves into the most lucrative foreign ports. These trade routes are thus the ones for which one would predict persistence based on

which is now a part of Russia, and Klaipeda (Memel in German) which is now part of Lithuania. Since the Treaty of Copenhagen in 1660, the borders between Norway, Sweden and Denmark remained the same and are identical to today's borders, such that the dummy uses, in fact, historical borders, if one were to accept the strong simplification of considering all cities in the South Baltic up to Memel (Klaipeda) as German. Given that all these cities were dominated by German urban elites and almost entirely settled by Germans, it is not an assumption that is completely out of place.

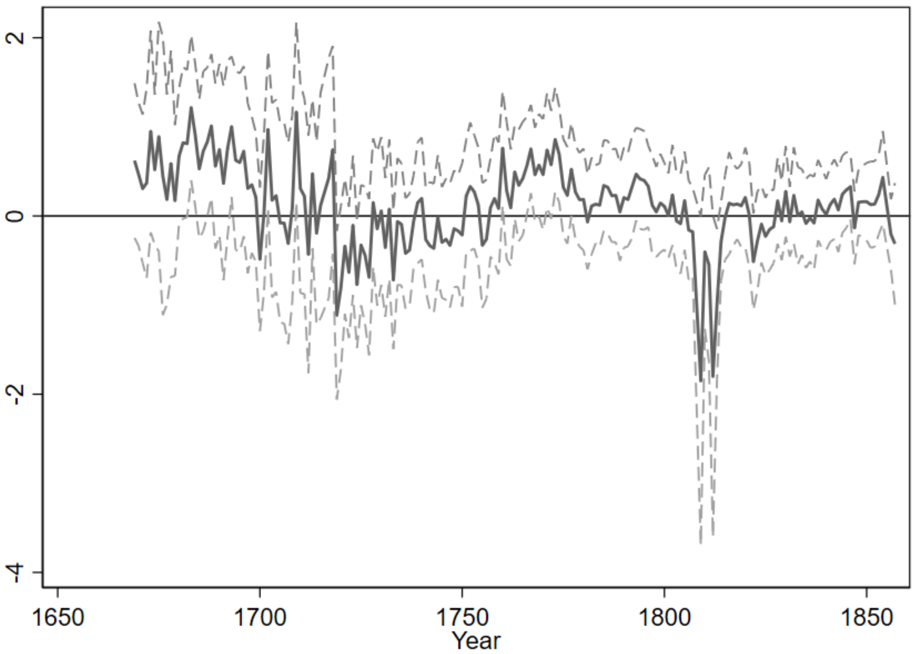


(a) HH

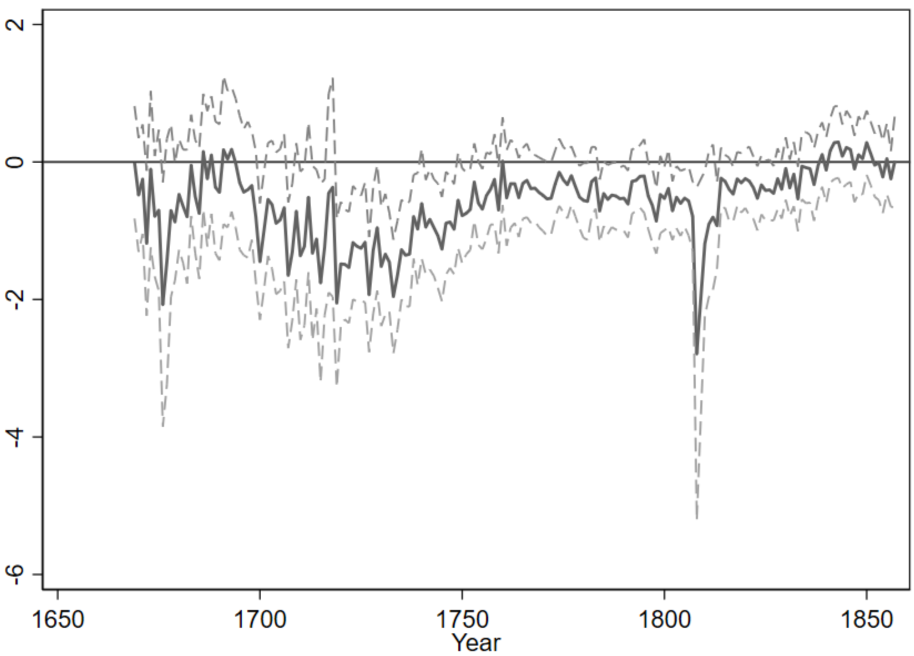


(b) KK

Figure 2: Bilateral estimation on yearly data. Estimation of equation 5 using PPML and a complete set of year-interacted origin and destination fixed effects. Shown are point estimates accompanied by confidence intervals. Standard errors clustered on city pairs.



(a) HK



(b) KH

Figure 3: Bilateral estimation on yearly data. Estimation of equation 5 using PPML and a complete set of year-interacted origin and destination fixed effects. Shown are point estimates accompanied by confidence intervals. Standard errors clustered on city pairs.

the discussion of trading capital in section 4. For trade from a Hansa city to a Kontor city, the picture looks similar to the Hansa-Hansa trade: Some persistence until around 1700 with a zero effect afterwards. Again, trade capital seems to have depreciated after the end of the Hanseatic League. For trade flows from Kontor to Hansa cities, we find a zero effect throughout[6].

In the appendix, we report results from two robustness checks. First, we include a pair fixed effect on the data aggregated on 5-year intervals, choosing 1670-1674 (the first full 5-year interval) as the reference time. Due to the inclusion of the fixed effects, bilateral terms which are constant (such as distance or shared country characteristics) drop out. Graphs 6a, 6b, 6c and 6d in the appendix show the results. The trade persistence among among former Hansa cities or among Hansa and Kontor cities is not robust to the inclusion of bilateral fixed effects. In another robustness check, we tackle the potential selection of trips into our dataset. As discussed above, it is likely that around the Sound, much trade was done over land, while further away, this was much less likely. We therefore exclude the bottom ten percent of distances, thereby excluding trips just around the Sound for which land transport is a plausible alternative.[7]. Graphs 7a, 7b, 7c and 7d in the appendix hold the results, which again show no trade persistence anymore. We therefore find only short-term persistence in the bilateral data which is not robust to the inclusion of pair fixed effects or the exclusion of short-distance connections.

All in all, our main bilateral results are in line with those of Head, Mayer and Ries 2010 and Beestermöller and F. Rauch 2018: After the final demise of the Hanseatic League in 1669, Hanseatic cities still traded more with each other (and to some extent with former Kontor cities) than implied by a gravity benchmark. Consistent with depreciating trading capital, persistence in inter-Hanseatic trade and Hanseatic exports to former Kontor cities vanished after just a few decades. However, given our robustness checks, we cannot rule out that any trading capital created by the Hanseatic network was already gone by its final dissolution in 1669. We next incorporate trader identity into our analysis.

[6] In both cases, the large fluctuations in the early 19th century and the imprecise estimates are due to the Continental Blockade, critically lowering the number of observations.

[7] In both robustness checks, data are still restricted to connections with at least 60 ships over 190 years

6 Trilateral estimation

6.1 Data and estimation

As the historical discussion has shown, the identity of traders was very important in medieval Baltic trade: During the existence of the Hanseatic League, privileges granted to its member cities depended on the merchant's citizenship (Dollinger 1964), and merchants heavily relied on personal networks to facilitate transactions (Ewert and Selzer 2015). The trading capital that was created during Hanseatic times thus likely hinged not only on trade routes, but also on the traders' identities. While we cannot ascertain a merchant's city of birth or their networks, we believe that a ship's home port is a good proxy for this trading capital: We expect ships from Hanseatic cities engaged in trade between Hanseatic cities or Hanseatic and Kontor cities to have accumulated more of this capital than others.

To empirically examine the persistence of this trading capital, we create a trilateral dataset, where an observation is the number of ships sailing from city A to city B owned by merchants in city C in a particular year. With 1,425 cities, there are in theory billions of possible permutations (1,425×1,424×1,425). However, most of these permutations never occur, and as before, we exclude combinations that we never observe over our 190 years of analysis. This leaves us with 140,456 trilateral combinations. We again measure the size of trade flows by counting the number of ships sailing from A to B on a ship owned in C. Passages that are mapped onto several cities are dropped –this is the case if a ship is indicated to be owned in several cities, which we find hard to interpret –but this only concerns 412 out of 1,482,175 observations. There are further some unidentified cities ("Unknown") which we drop. As before, if in a given year no trade is reported for one of our remaining trilateral combinations, we set the trade flow to zero.

In the appendix, we show how the gravity framework by Head and Mayer 2013 can be extended to the trilateral case with origin city i, destination city j and city of ship ownership n. This extension yields an an equation of the form

$$logT_{ijn} = logS_i + logM_j + logK_n + log\phi_{ijn} \tag{2}$$

where S_i are "capabilities" of exporting city i, and M and K measure the same for importing city j and ship owning city n, respectively. The trilateral term ϕ_{ijn} now incorporates some bilateral elements, such as distance between the origin and destination cities, and trilateral elements such as trilateral Hansa dummies.

These trilateral Hansa dummies are our key coefficients of interest. Let the first letter denotes either no condition (-) or a Hansa origin (H) or a Kontor origin (K); the second letter denotes the destination and the third letter the city in which the ship is being owned/the flag under which it is sailing. We are then interested in eight trilateral dummies: HHH is one if origin city, destination city, and ownership city all used to be part of the Hanseatic League. This dummy tells us whether trade between former Hansa city on ships owned by a merchant from a former Hansa city was more pronounced. Similarly, the dummy KKK is one if all three involved cities were former Kontor cities. We further include dummies for trade between Hansa and Kontor cities on Hansa ships (HKH, KHH), or on Kontor ships (HKK, KHK), trade between former Hansa cities on Kontor ships (HHK), and trade between former Kontor cities on Hansa ships (KKH). As before, trade flows are directed. Thus, HKK and KHK capture the same characteristics of a trade flow and ideally we would like to see symmetric results.

For the standard bilateral case, it has already been mentioned that Head and Mayer 2013 note that, as long as the assumptions on the model mentioned in the theory section are met, using time-interacted fixed effects will ensure consistent estimation of the components of ϕ_{ij}. We therefore use time-varying fixed effects for importer and exporter and further also time-varying fixed effects for the city in which a ship is owned (or the flag under which it is sailing, depending on the interpretation). These absorb not only cities' outputs and populations, but also the multilateral resistance terms. To avoid multicollinearity issues, we do not include 'bilateral' dummies, e.g. for both origin and destination being former Hansa cities[8]. As before, we further control for time-interacted indicators for both origin and destination city having been located in the same historic country, and the time-interacted log distance over sea.

Our estimation equation thus becomes

$$T_{ijnt} = exp(\alpha + \sum \beta_t^\iota Hansa_{ijn}^\iota + \rho_t smc_{in} + \lambda_t dos_{in} + \eta_{it} + \chi_{jt} + \xi_{nt}) \times \epsilon_{ijnt} \quad (3)$$

where T_{ijnt} denotes the number of ships sailing between cities i and j and owned in city n in year t, and $Hansa$ are the eight trilateral Hansa dummies discussed before: HHH, KKK, HKH, KHH, HKK, KHK, KKH, and HHK. η_{it} are origin x time, χ_{jt} are destination x time and

[8]To see this, remember that we are interested in triple dummies, say KHH or HKH. A condition on the origin (or destination) being a former Kontor city in combination with a dummy on (-HH) (or (H-H)) will always imply KHH (or HKH), however; this logic holds for all triple dummies, such that we include triple dummies and city fixed effects (for origin, destination and the city of ship ownership) and do not include double dummies.

ξ_{nt} are harbour x time fixed effects.

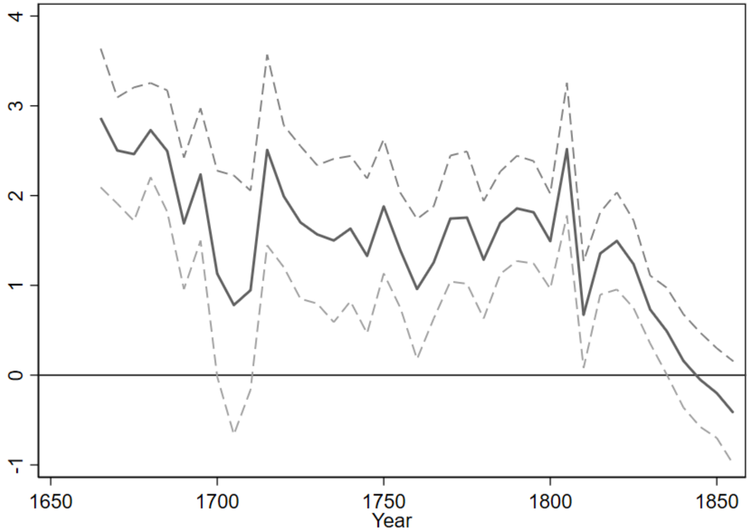
While we have annual data, using yearly observations, dummies and fixed effects would require too much computing power. We therefore aggregate to five year intervals. Standard errors are again clustered on the bilateral (i.e. origin-destination pair) level.

6.2 Results

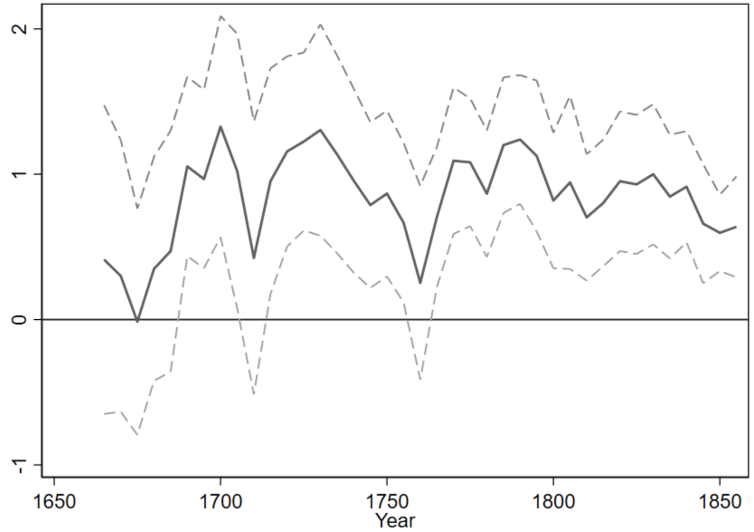
As before, we plot coefficients and confidence intervals. Figure 4a shows that all three cities having been a member of the Hanseatic league implies trade flows larger than the predictions of a gravity model; this is highly significant and continues to be the case until the mid-19th century when the estimators fall to zero. The estimate displays a clear pattern of depreciation over time, as we would expect to see in the context of depreciating trading capital. However, eben by the late 18th century, effects are still positive and both economically and statistically significant.

Figures 4b and 4c show estimates on dummies for trade among former Hansa and Kontor cities on Hansa ships. Along the lines of the argument above, it is not surprising to see HKH/KHH consistently and significantly above zero: this captures trade from a Hansa city to a Kontor city (or from a Kontor city to a Hansa city) on Hanseatic ships. The comparison group here are ships that are neither Hanseatic, nor Kontor ships; therefore, trade flows among formerly Hanseatic and Kontor cities on Hanseatic ships are significantly larger than trade flows among formerly Hanseatic and Kontor cities on any other ships. This, together with HHH, speaks to the relevance of Hanseatic privileges, trading capital and trader identity, here captured by ship ownership, in creating persistence in trade flows.

In the appendix, we show results graphs for the remaining triple dummies. We find that all cities having been Kontor cities (=KKK) is usually not significant and its point estimates are much smaller thatn those for HHH for most of the time. Similarly, the estimates on Hanseatic-Kontor trade on Kontor ships are usually not significant apart from early years. We also show that trade flows are not significantly different from the predictions of a gravity model if they are among Hanseatic cities but on Kontor ships. This is consistent with the historical record - Kontor merchants did not enjoy particular privileges in Hanseatic cities, so we do not expect trading capital to have accumulated in this dimension. Trade flows among Kontor cities on Hanseatic ships, on the other hand, are significantly smaller than the predictions of the model during the later half of our sample.



(a) HHH



(b) HKH

(c) KHH

Figure 4: Trilateral PPML estimation of equation 6.1 on levels, controlling for time-interacted distance over sea, time-interacted same country dummies and a complete set of trilateral Hansa dummies, with time-interacted fixed effects for origin, destination and home port. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.

In our bilateral dataset, we found limited persistence in trade among Hansa and Kontor cities. Bilateral persistence was found to be only short-term and not robust to either the inclusion of pair fixed effects or the exclusion of short-distance connections. However, once we identify which of these flows were carried out under Hanseatic flags, we find persistence that lasts way longer, suggesting an important role for trader identity in trade persistence. Moreover, the trilateral results are robust to the exclusion of short-distance connections, as can be seen in the appendix.

An alternative explanation could be that ships owned in a certain city usually trade between this city and another one, independent of former Hansa status. This could drive the results on HHH and KKK. In order to control for this, we include a time-interacted dummy on either the harbour of origin or the harbour of destination being identical to the harbour where the ship is owned. This leaves our results unchanged for HKH and KHH, as reported in the appendix in graphs 10b and 10c. Results for HHH are weakened, as shown in graph 10a, but still remain positive until around the mid-18th century. We conclude that trade flows among former Hanseatic and Kontor cities on Hanseatic ships were significantly larger than trade flows among former Hanseatic and Kontor ships on any other ships. Our trilateral results show therefore not only very long-lasting, but also very robust persistence.

7 Conclusion

In this paper, we employ an extensive city-level trade panel to shed light on the factors that contribute to the persistence of trade. We study the consequences of the demise of the Hanseatic League, a confederation of merchant cities in Northern Europe. After the Hanseatic League was dissolved in 1669, we find that formerly Hanseatic cities still traded more with each other than predicted by a gravity framework. However, this excess trade diminished rapidly and has completely disappeared by around 1700. This confirms similar findings by Head, Mayer and Ries 2010 on former colonies and Beestermöller and F. Rauch 2018 on the former Austro-Hungarian Empire. It is in line with the idea that historic trade generates trading capital between partners, which then depreciates over time. However, the bilateral results are not robust to the inclusion of pair fixed effects or the exclusion of short-distance connections.

The quality of our data allow us to further analyse the origins of such trading capital. Guided by the historical narrative which highlights the role of merchant networks and privileges granted to traders from Hanseatic cities, we incorporate traders' cities of origin into our analysis. We find that former Hanseatic trade patterns persisted much longer, but only if not only origin and destination city were part of the Hanseatic trade network, but also the captain owning the ship. These trilateral results show not only very long-lasting persistence, they are further robust to the exclusion of short-distance connections (which the bilateral results are not) and to the inclusion of a large set of plausible controls that could drive the results independent of former Hansa status. This highlights the role of social networks and trader identity in shaping trade flows, a point further illustrated by the prevalence of German last names among captains of ships sailing under Hanseatic flags. As seen in this particular example, trading capital may be hidden in specific relationships and may sometimes only be uncovered by using high-resolution data and careful investigation of historical circumstances. The high spatial resolution of our data and the amount of detail provided allow us to formulate a historically informed research question.

While our paper uses a historic setting to highlight the important role of social networks and trader identity for trading capital, the underlying mechanism should in our view not be seen as a mere relic of the past. Countries trade more with each other when they have more social media connections (Bailey et al. 2021), and in online labour markets, collective reputation based on nationality has been found to affect hiring decisions (Xu 2015). The pattern we find might thus be as relevant for a globalised world as it was for the 18th century Baltic.

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A Appendix

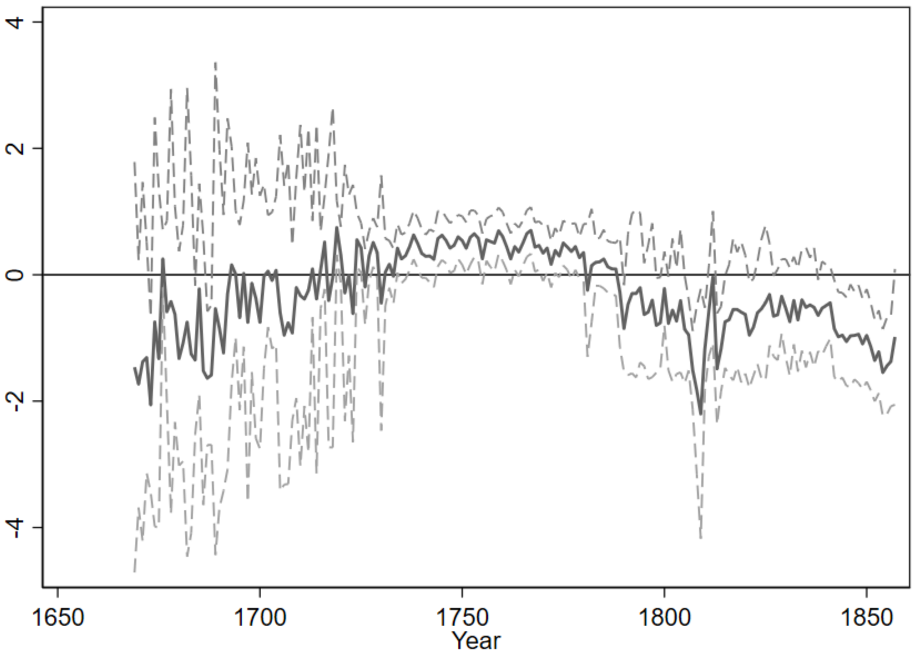
A.1 Bilateral Estimation- Further Results and Robustness checks

In our analysis, we always controlled for bilateral distance (interacted with time) and for origin and destination being in the same historic country (interacted with time). The results on distance are presented in figure 5a. The effect of distance over sea is estimated to be negative at most times, yet sometimes is insignificant. Trade is observed almost along a line, given the geography of the Baltics, and the prevalence of straight East-West routes in our data. As shown in F. Rauch 2016, distance coefficients can become insignificant if trade occurs along a line instead of on a plane.

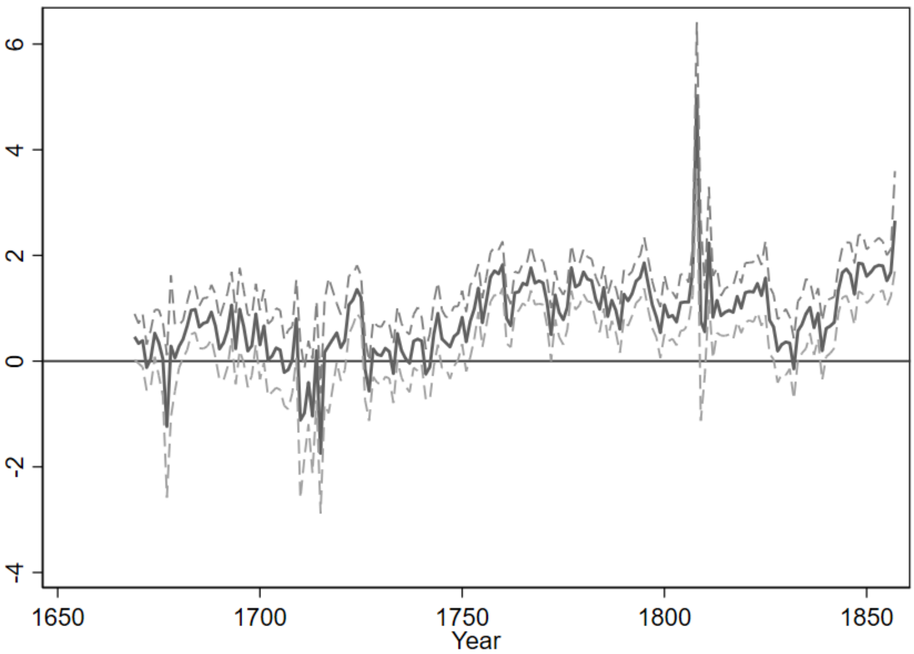
Figure 5b shows the coefficients for being in the same historic country. The pattern of estimated coefficients reflect the increasing importance of states in trade. Through mercantile policies, early modern states heavily favoured their own merchants and trade networks to their benefit. Wubs-Mrozewicz 2017 suggests that the formation of the Hanseatic confederation in 1557 ought to be seen in precisely this light, as a tightened cooperation of cities in response to increased state powers elsewhere. The effect of mercantilism and stronger statehoods is clearly reflected in these estimates, which, initially undistinguishable from zero, increase to be positive and highly significant. It has to be noted that the dummy on both origin and destination having been located in the same historic country only captures Denmark, Sweden and Germany, for these are the only historic countries (Germany clearly being an abstraction here) that had ports on either side of the Sound. Trade has to go through the Sound in order for it to be observed in this data. A discussion of this dummy is provided in section 3.

As noted in the text, we also perform two robustness checks. First, we include a pair fixed effect on the data aggregated on 5-year intervals, choosing 1670-1674, the first full 5-year interval, as the reference time. Graphs 6a, 6b, 6c and 6d show the results.

In a further robustness check, we exclude the bottom ten percent of distances. The idea behind this check is that we only observe sea-borne trade across the Sound. For two cities close to the Sound (e.g. Hamburg and Kiel), land transportation might have been a viable alternative, so that we might be systematically missing passages. On the other hand, the further away cities are from the Sound, the less likely it is that shipments do not pass the Sound (consider the example of London and St. Petersburg). By excluding short-distance trips, we focus on city pairs where it is less likely that we are systematically underobserving trips. Graphs 7a, 7b,



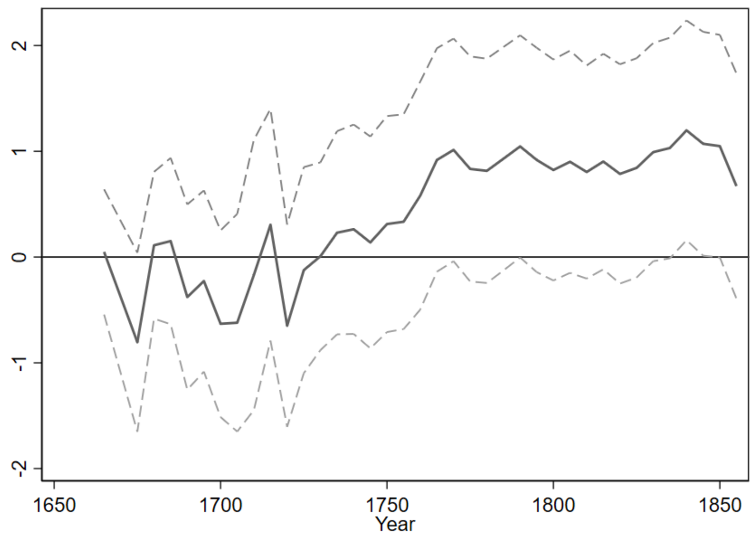
(a) Distance over sea



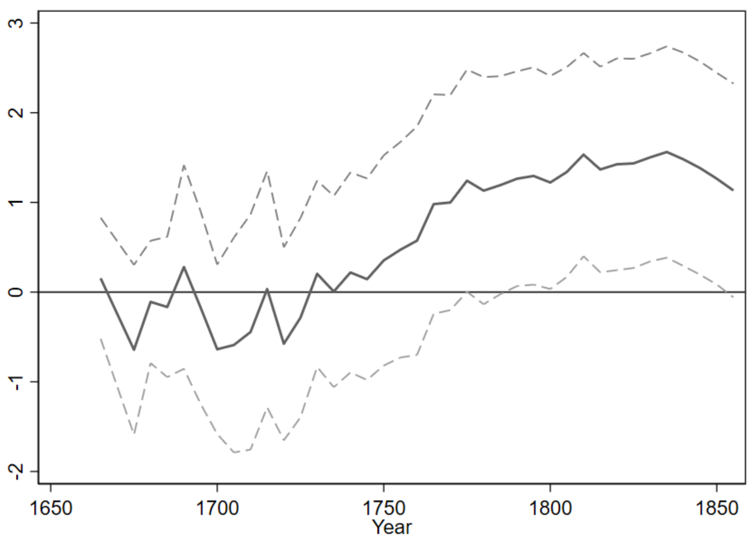
(b) Same historic country

Figure 5: Bilateral estimation on yearly data. Estimation of equation 5 using PPML and a complete set of year-interacted origin and destination fixed effects. Shown are point estimates accompanied by confidence intervals. Standard errors clustered on city pairs.

(a) HH



(b) HK



(c) KH

(d) KK

Figure 6: Bilateral PPML estimation of equation 5 including a bilateral fixed effect on levels with time-interacted fixed effects for origin and destination. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.

7c and 7d show these results. As can be seen, both robustness checks eliminate most of the Hanseatic trade persistence, both between Hansa cities and between Hansa and Kontor cities. The bilateral trade persistence that we found is thus not only relatively short-lived but also appears to be quite unrobust to specification and sample changes.

A.2 Derivation of trilateral gravity equation

In this section, we will show that also trilateral trade can be pinned down by a gravity equation and that estimation requires another set of time-interacted city dummies.

This derivation follows Head and Mayer 2013 very closely. Notation: i –origin, j –destination, n –city of ship ownership. This derivation will treat the data as cross-sectional and therefore drop the time subscript for legibility, but the data is still a panel and will be estimated as such.

Starting from a gravity model, we will now lay out the conditions under which this model is a trilateral structural gravity model and motivate an estimation strategy. The flow of trade from city i to city j on ships owned in city n can be written as $X_{in} = \pi_{ijn} X_j$, where π_{ijn} is the share (or expected share in case of count variables such as the number of ships) of j's total expenditure X_j that is allocated to goods from city i transported on ships owned in city n. Naturally, this needs to fulfil $\pi_{ijn} \geq 0$ and $\sum_{i,n} \pi_{ijn} = 1$.

Proceeding from here requires that this (expected) share can be expressed in the following form:

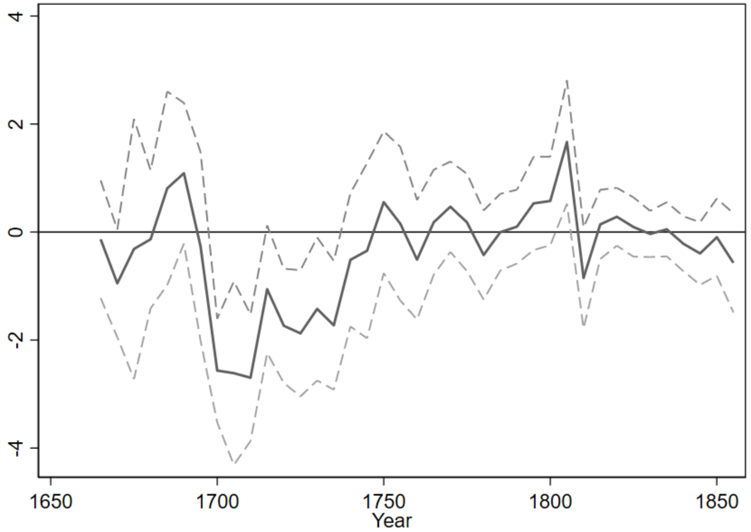
$$\pi_{ijn} = \frac{S_i K_n \phi_{ijn}}{\Phi_j}, \tag{4}$$

where $\Phi_j = \sum_{l,k} S_l K_k \phi_{ljk}$ is the accessibility-weighted sum of exporter capabilities. Note the parallels to the condition one requires for the bilateral trade flows above. Thus, we again require that budget shares are independent of income. Here, we simply add a third dimension, that of ship ownership, by introducing K_n and adding a third dimension to ϕ. Φ_j is defined such that (expected) shares add up to 1:

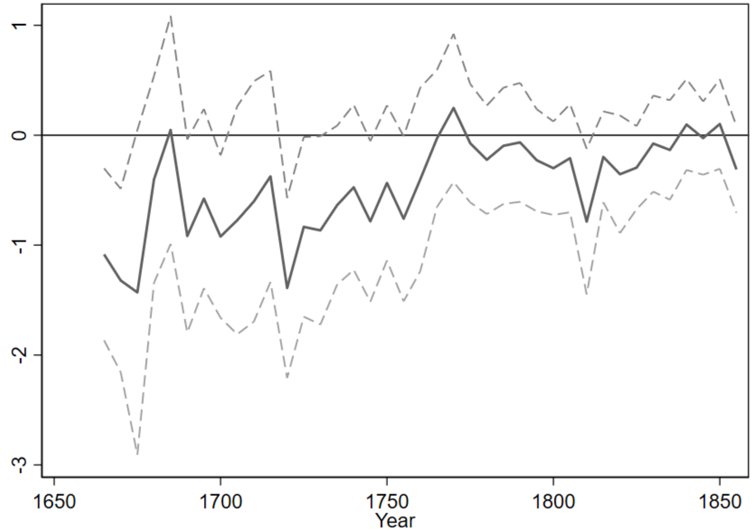
$$\pi_{ijn} = \frac{S_i K_n \phi_{ijn}}{\Phi_j} = \frac{S_i K_n \phi_{ijn}}{\sum_{l,k} S_l K_k \phi_{ljk}}$$

which naturally implies

$$\sum_{i,n} \pi_{ijn} = \sum_{i,n} \frac{S_i K_n \phi_{ijn}}{\sum_{l,k} S_l K_k \phi_{ljk}} = \frac{\sum_{l,k} S_l K_k \phi_{ljk}}{\sum_{l,k} S_l K_k \phi_{ljk}} = 1.$$



(a) HH



(b) HK

(c) KH

(d) KK

Figure 7: Bilateral PPML estimation of equation 5 excluding the 10 percent of shortest trips on levels with time-interacted fixed effects for origin and destination, controlling for distance over sea and same modern country dummies interacted with half decades. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.

We now proceed focusing on the following accounting identity, which constitutes the second condition one requires for this to be an instance of structural gravity: the sum of i's exports to all destinations, including to i, must equal the total production of i, Y_i. This is essentially market-clearing for exporting city i and is again very closely related to the bilateral case and simply adds the additional dimension of ship ownership.

$$\begin{aligned} Y_i &= \sum_j X_{ij} = \sum_j \sum_n X_{ijn} = \sum_j \sum_n \pi_{ijn} X_j \\ &= \sum_j \sum_n \frac{S_i K_n \phi_{ijn} X_j}{\Phi_j} = S_i \sum_j \sum_n \frac{K_n \phi_{ijn} X_j}{\Phi_j} \end{aligned} \tag{5}$$

Rearranging for S_i yields

$$S_i = \frac{Y_i}{\Omega_{i,n}}, \tag{6}$$

where $\Omega_{i,n} = \sum_j \sum_n \frac{K_n \phi_{ijn} X_j}{\Phi_j}$.

Plugging this into the definition of Φ_j,

$$\Phi_j = \sum_{l,n} S_l K_n \phi_{ljn} = \sum_l \sum_n \frac{Y_l \phi_{ljn} K_n}{\Omega_{l,n}}$$

and this back into our initial conjecture that $X_{ijn} = \pi_{ijn} X_j$, this yields

$$X_{ijn} = \frac{S_i K_n \phi_{ijn}}{\Phi_j} X_j = \frac{Y_i K_n}{\Omega_{i,n}} \frac{X_j}{\Phi_j} \phi_{ijn}. \tag{7}$$

Note that $\frac{X_j}{\Phi_j}$ depends only on j, the destination city, such that we can simplify equation 7 to

$$X_{ijn} = S_i K_n M_j \phi_{ijn}$$

where $M_j = \frac{X_j}{\Phi_j}$. Putting this into logs yields a straightforward equation to be estimated:

$$log X_{ijn} = log S_i + log M_j + log K_n + log \phi_{ijn} \tag{8}$$

The trilateral term ϕ_{ijn} now incorporates some bilateral elements, such as distance between the origin and destination cities, and trilateral elements such as trilateral Hansa dummies.

A.3 Trilateral Estimation- Further Results and Robustness checks

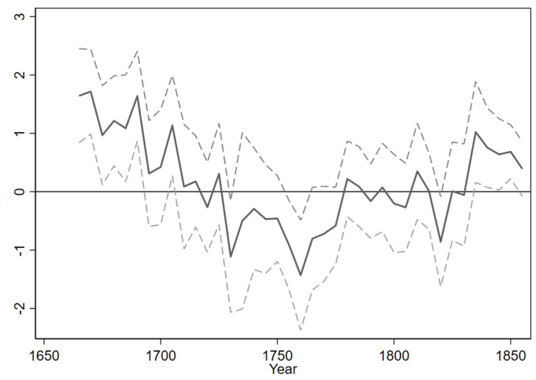
When presenting the trilateral results, we focussed on trade between Hansa and either Hansa or Kontor cities on Hansa ships (HHH, HKH, KHH). Results for the remaining five categories are shown below

In addition, as in the bilateral case, we show the coefficients on distance and being in the same historic country.

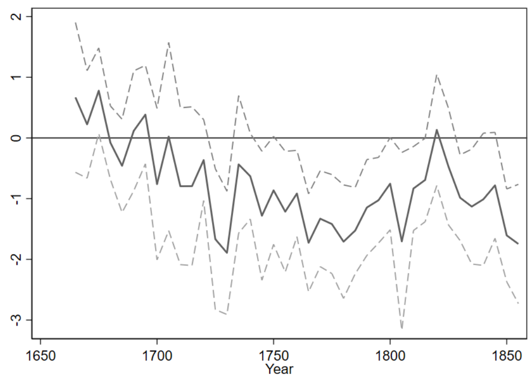
Figure 9a shows mostly insignificant estimates on distance. One of the main reasons why the Hanseatic league lost its importance was the rise of the nation state and the rise of mercantilism. Wubs-Mrozewicz 2017 asserts firmly that the formation of the Hanseatic confederation in 1557 was but a response to this development. The estimates shown in figure 9b ascertain the increasing relevance of two cities (namely, origin and destination) being located in the same country (which is less clear in the case of Germany which we assume to be a unified country for this purpose), just as was the case in the bilateral estimation. Note, however, that trade is only observed when ships pass through the Sound, such that the only countries for which we can observe within-country trade in this sample are Denmark, Sweden and Germany.

To see whether the results are driven by one of origin or destination coinciding with the flag, we include a dummy for this and interact it with time dummies. Results are shown in figures 10a-10c. As can be seen, the results for HHH are weakened, but stay positive and often significant until the mid-18th century. Results for HKH and KHH are very similar to the baseline.

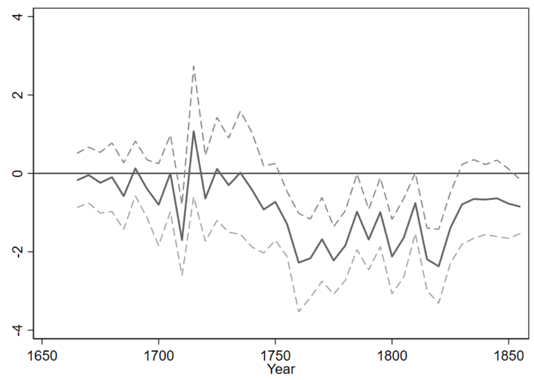
Finally, graphs 11a, 11b and 11c show trilateral results excluding the ten per cent of shortest trips. Results are very similar to our baseline ones. Incorporating trader identity not only shows that trade becomes more persistent, but also more robust to the sample definition.



(a) KKK



(b) HHK

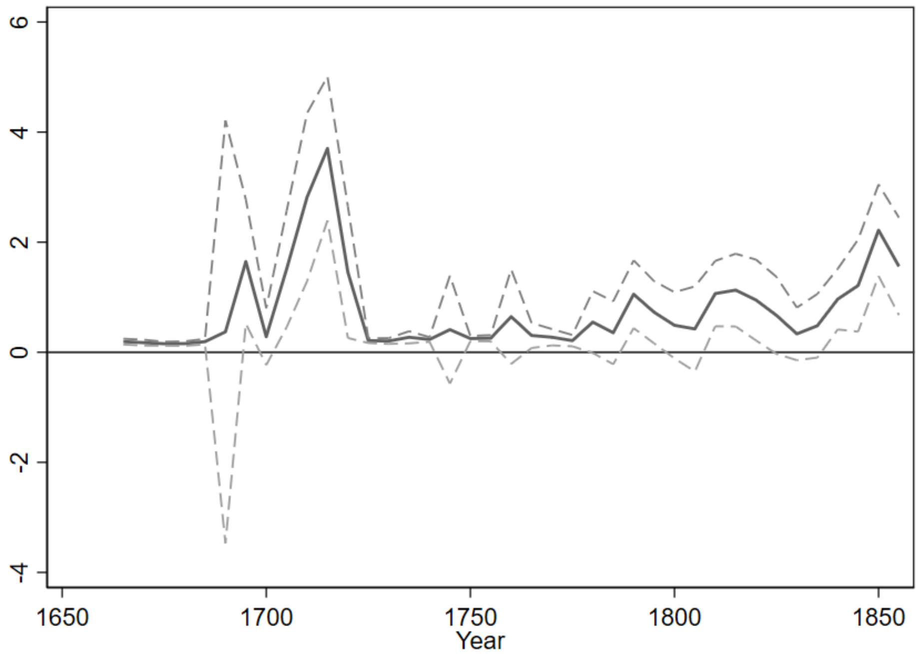


(c) KKH

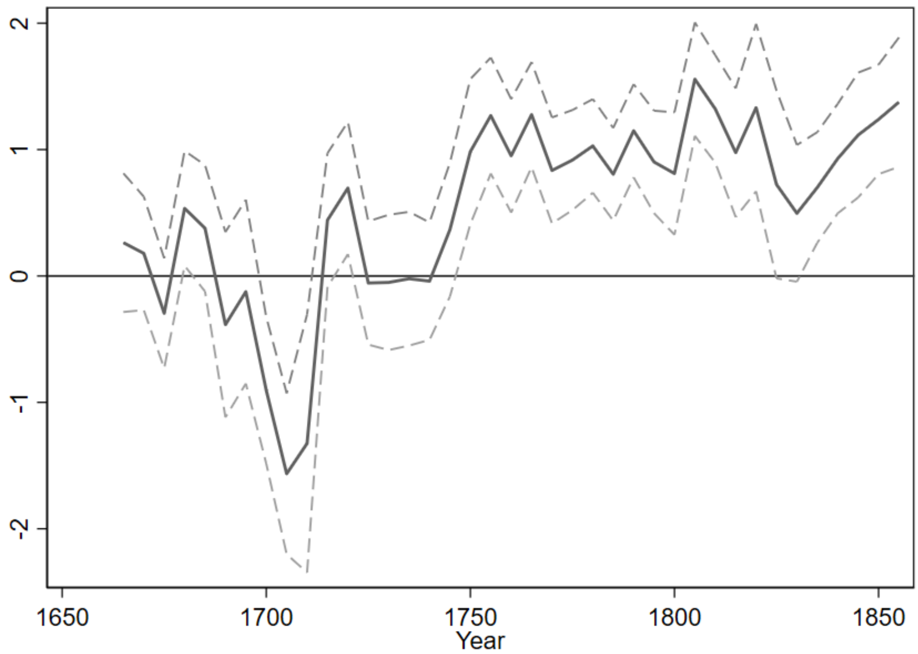
(d) HKK

(e) KHK

Figure 8: Trilateral PPML estimation of equation 6.1 on levels, controlling for time-interacted distance over sea, time-interacted same country dummies and a complete set of trilateral Hansa dummies, with time-interacted fixed effects for origin, destination and home port. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.

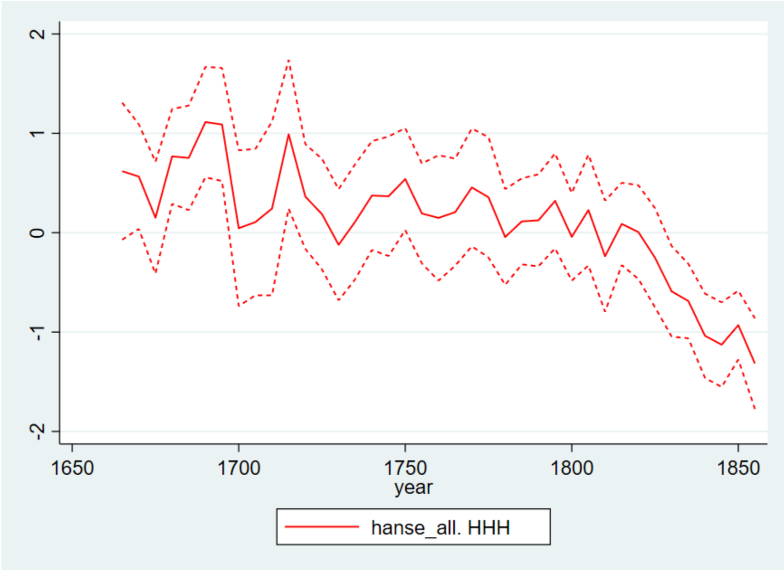


(a) Distance over sea



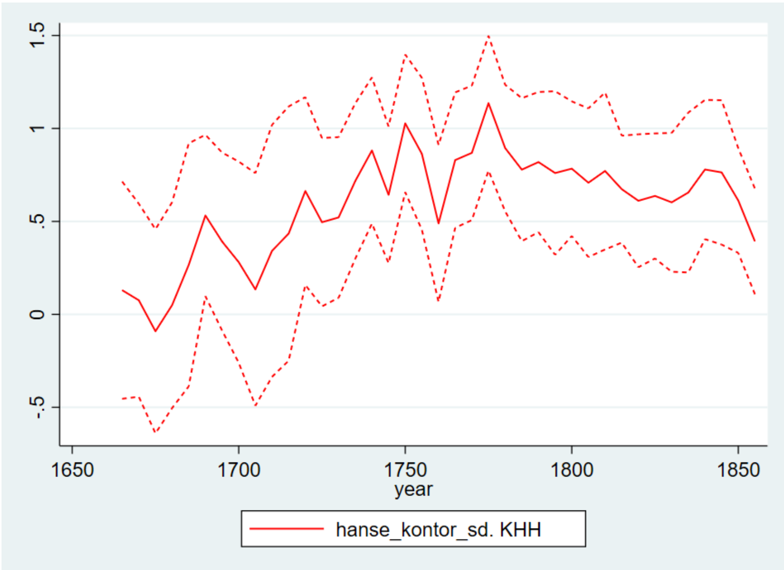
(b) Same historic country

Figure 9: Trilateral PPML estimation of equation 6.1 on levels, controlling for time-interacted distance over sea, time-interacted same country dummies and a complete set of trilateral Hansa dummies, with time-interacted fixed effects for origin, destination and home port. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.



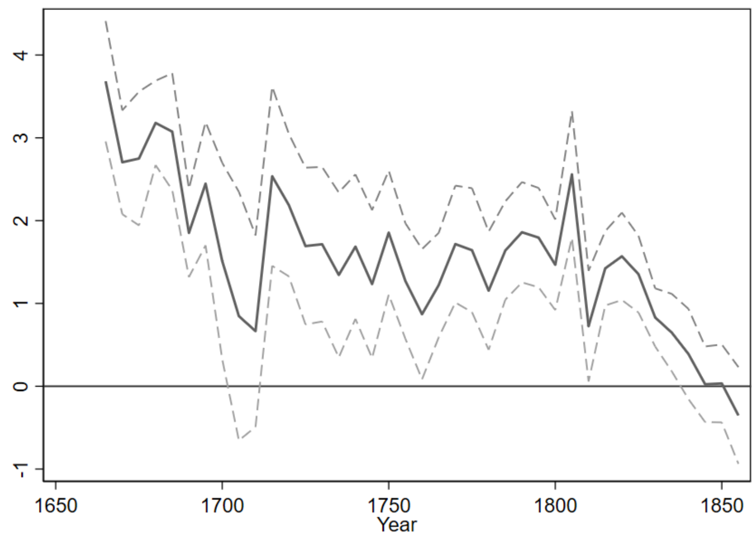
(a) HHH

(b) HKH



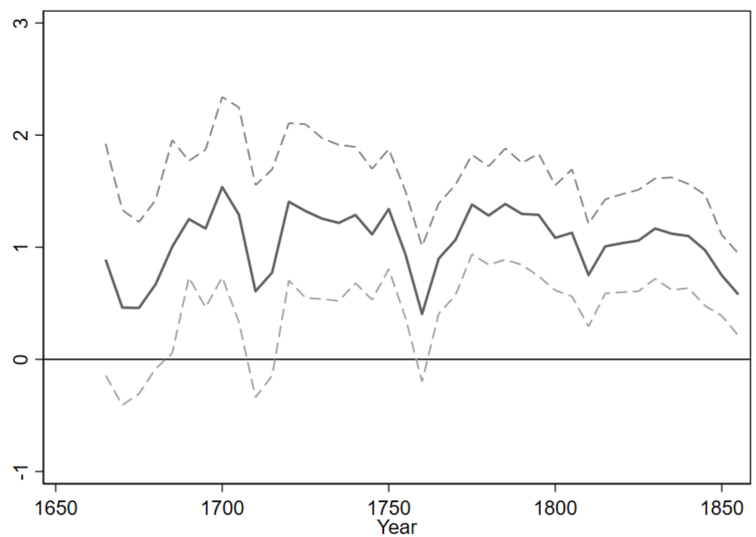
(c) KHH

Figure 10: Trilateral PPML estimation of equation 6.1 on levels, controlling for time-interacted distance over sea, same harbour and same historic country dummies, with time-interacted fixed effects for origin, destination and home port. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.



(a) HHH

(b) HKH



(c) KHH

Figure 11: Trilateral PPML estimation of equation 6.1 excluding the 10 percent of shortest trips on levels, controlling for time-interacted distance over sea, time-interacted same country dummies and a complete set of trilateral Hansa dummies, with time-interacted fixed effects for origin, destination and home port. Standard errors clustered on (origin, destination) pairs. Data aggregated on five year intervals.