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Essays in Historical Political Economy: Trade, Innovation, and Forced Labor

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Abstract

This thesis is a collection of three essays on trade, innovation, and forced labor that leverage natural experiments and novel microdata in economic history.

Chapter 1 provides the first causal evidence of the effect of individual pioneers–first movers on trade links–on aggregate trade. I collect detailed data on all 1.4 million voyages between Baltic Sea ports and the rest of the world from 1500 until the 1850s, including 47,000 pioneering voyages that first connected two towns. I study the effect of pioneering on subsequent trade in a gravity model of yearly port-pair trade and instrument pioneering at the granular voyage level with (i) quasi-random en-route encounters with captains from new ports and (ii) rerouting due to the unpredictable obstruction of previous destinations by sea ice. I find that 10% of the total value of the trade is due to recent pioneering. A single pioneering voyage increases town exports by 25–33% for the 12% links that persist. Survival is higher for pioneered ports that are more distant from the origin port or existing trade partners in terms of kilometers, product mix, religion, or language. However, pioneers tend to select less distant ports. Therefore, returns are greatest when sea ice removes this selection and forces pioneers to experiment with exogenously determined ports. Pioneering spills over onto other traders, reducing the private returns of pioneers. This raises concerns about insufficient ex-ante pioneering and underlines the importance of policies that foster pioneering, particularly with distant destinations.

Chapter 2 studies a major hypothesized driver of entrepreneurship and innovation: Admiration of business people and the bourgeoisie that incentivizes individuals to emulate the achievements of those with high social status, the so-called Bourgeois Values (McCloskey, 2010). We test this theory by devising a new measure of bourgeois values from first names in the US census, which we find to be strongly correlated with entrepreneurship and income. For identification, we leverage the ad hoc road trips of two prominent public exponents of bourgeois values in the early 20th century: Henry Ford and Thomas Edison. Referring to themselves as the Vagabonds, Edison and Ford quasi-exogenously exposed different localities to prominent bourgeois role models across several road trips between 1918 and 1924. Visits by the Vagabonds cause an increase in our measure of bourgeois values, which in turn increase income and the frequency of entrepreneurship. Our findings suggest that culture and values drive innovation and that even moderate shocks to cultural values can have lasting effects.

Chapter 3 empirically tests the main hypothesized determinant of labor coercion (Domar, 1970): labor scarcity. I obtain quasi-exogenous variation in labor scarcity from immense spatial dispersion in deaths from three plagues in the Baltics (1605-6, 1657, 1710-2), which I show is uncorrelated to a host of local, pre-plague characteristics. To measure the intensity of labor coercion, I hand-collect thousands of serf labor contracts in Estonia, which capture the work obligations of serfs. I find that labor scarcity substantially increases coercion. I find that this effect is enhanced by the lack of outside options and increased labor monopsony power, in line with theoretical models. Investigating the consequences of (labor-scarcity instrumented) coercion, I find negative effects on education and increased migration. Taken together, these findings highlight the conditions under which labor scarcity raises coercion and provide suggestive evidence of why it does not in other cases (e.g., in Western Europe following the Black Death).

Résumé

Cette thèse consiste en un ensemble de trois essais sur le commerce, l'innovation et le travail forcé qui exploitent des expériences naturelles et des micro données inédites en histoire économique.

Le chapitre 1 fournit la première preuve causale de l'effet des pionniers individuels — les premiers à établir des liens commerciaux — sur le commerce agrégé. Je collecte des données détaillées sur les 1,4 million de voyages entre les ports de la mer Baltique et le reste du monde de 1500 jusqu'aux années 1850, incluant 47 000 voyages pionniers qui ont connecté deux villes pour la première fois. J'instrumentalise le pionnier au niveau du voyage granulaire avec des rencontres quasi-aléatoires avec des capitaines de nouveaux ports et un réacheminement dû à l'obstruction imprévisible de destinations antérieures par la glace de mer. Je trouve que 10% de la valeur totale du commerce est due aux pionniers. Un seul voyage pionnier augmente les exportations des villes de 25 à 33% pour les 12% de liens qui persistent. La survie est plus élevée pour les ports pionniers qui sont plus éloignés du port d'origine ou des partenaires commerciaux existants en termes de kilomètres, de mix de produits, de religion ou de langue. Cependant, les pionniers ont tendance à sélectionner des ports moins éloignés. Par conséquent, les retours sont les plus importants lorsque la glace de mer supprime cette sélection et force les pionniers à expérimenter avec des nouveaux ports. Les retours bénéficient également aux commerçant non-pionniers que soulève des préoccupations concernant l'insuffisance du pionnier ex-ante et souligne l'importance des politiques qui les encouragent en particulier avec des destinations lointaines.

Le chapitre 2 étudie un moteur hypothétique majeur de l'entrepreneuriat et de l'innovation : l'admiration des gens d'affaires qui incite les individus à émuler les réalisations de ceux ayant un statut social élevé, les soi-disant Valeurs Bourgeoises. Nous testons cette théorie en concevant une nouvelle mesure des Valeurs Bourgeoises à partir des prénoms dans le recensement américain, que nous trouvons fortement corrélée à l'entrepreneuriat et au revenu. Pour l'identification, nous exploitons les voyages routiers ad hoc de deux éminents exposants publics des valeurs bourgeoises au début du 20e siècle : Henry Ford et Thomas Edison. Edison et Ford ont exposé de manière quasi-exogène différentes localités à des modèles bourgeois éminents lors de plusieurs voyages entre 1918 et 1924. Leurs visites provoquent une augmentation de notre mesure des Valeurs Bourgeoises, qui à son tour augmente le revenu et la fréquence de l'entrepreneuriat. Nos découvertes suggèrent que la culture et les valeurs stimulent l'innovation et que même des chocs modérés aux valeurs culturelles peuvent avoir des effets durables.

Le chapitre 3 teste empiriquement le principal déterminant hypothétique de la coercition du travail : la pénurie de main-d'œuvre. J'obtiens une variation quasi-exogène dans la pénurie de main-d'œuvre à partir de la dispersion spatiale immense dans les décès de trois épidémies en Estonie (1605-6, 1657, 1710-2), que je montre être non corrélée à une multitude de caractéristiques locales avant la peste. Pour mesurer l'intensité de la coercition du travail, je collecte à la main des milliers de contrats de travail de serfs, qui capturent les obligations de travail des serfs. Je trouve que la pénurie de main-d'œuvre augmente substantiellement la coercition. En enquêtant sur les mécanismes, je trouve que cet effet est renforcé par l'absence d'options externes et par l'augmentation du pouvoir de monopsone du travail, en ligne avec des prédictions théoriques. En enquêtant sur les conséquences de la coercition, je trouve des effets négatifs sur l'éducation et une augmentation de la migration. Pris ensemble, ces résultats mettent en lumière les conditions sous lesquelles la pénurie de main-d'œuvre augmente la coercition.

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General Introduction

This Ph.D. thesis covers several topics in trade (Chapter 1), innovation (Chapter 2), and forced labor (Chapter 3). It sheds new light on core questions in economics, such as the following: How does the world become connected by trade? Does ideology drive innovation? What factors determine the intensity of forced labor?

To answer these questions, I draw on different episodes of economic history: new (pioneer) trade connections between Baltic Sea towns and the rest of the world from 1500 to the 1850s (Chapter 1), entrepreneurship in the 20th century US (Chapter 2), and labor coercion in the Baltics from 1560 to the 19th century (Chapter 3).

The topics covered in this thesis are related to each other. Pioneering new trade connections (Chapter 1) is a form of innovation and entrepreneurship, which is also the focus of Chapter 2. The entrepreneurship and innovation of pioneers in trade has the potential to shape aggregate trade between localities and even countries. Both Chapters 1 and 2 demonstrate that the success of innovation and entrepreneurship depends on the characteristics of the innovator and how they interact with institutions. These chapters also illustrate how small, idiosyncratic shocks (encounters between captains, temporary obstruction of ports by sea ice, or visits by business and science elites) can generate persistent effects not only on treated individuals but also on aggregate outcomes.

The potentially beneficial effects of encounters between individuals are also relevant for policy. Policymakers can foster such encounters, e.g., through export promotion or school curricula that foster exchanges with professionals in different sectors. Policies can also improve the outcomes of such encounters, e.g., by targeting interactions with distant, unfamiliar markets or role models that would otherwise not have taken place.

Innovation and entrepreneurship (Chapters 1 and 2) also have the potential to affect forced labor (Chapter 3). Forced labor regimes are the most common type of labor transaction in history and remain prevalent today. Chapter 3 studies the causes and consequences of forced labor. The main focus is on labor scarcity created by plagues, but trade booms are also analyzed as potential drivers of coercion. In fact, the trade studied in Chapters 1 is in no small part made up of primary products (mainly grain) that forced laborers in the Baltic Sea area produced.

Economic history is well suited to provide insight into the topics. It provides unique natural experiments, vast and untapped microdata, and a *longue durée* perspective that is made possible by the large temporal dimension of the data.

The questions I address in this thesis are also relevant to the present world. For example, pioneering new trade connections has become increasingly important as global supply chains are increasingly threatened by climate change and conflict. The challenges that face today's world also require leaps in innovation; thus, understanding the roots of innovation, such as ideology, is crucial. With such profound changes, it is also vital to understand their implications for labor relations, which even today continue to be marked by coercion in numerous contexts.

Two chapters involve Eastern Europe (Chapters 1 and 3): its forced labor regimes and its trade with Western Europe and the rest of the world. Eastern Europe remains a relatively understudied region and current events make it clear that studying this region in more depth is crucial. For Russia in particular, "there are few studies on economic history of the periphery [...], such as the Baltics, the Caucasus, Central Asia, Siberia, and the Far East" (Zhuravskaya, Guriev, and Markevich, 2024, p.104). Therefore, such studies "remain important avenues for future research" (Zhuravskaya, Guriev, and Markevich, 2024, p.50). Chapters 1 and 3 make progress in this direction, studying the trade of Russia and its peripheries and forced labor in the Baltics, respectively.

1. Outline and Summary

Chapter 1, titled "Breaking the Ice: The Persistent Effects of Pioneers on Trade Relationships", provides the first causal evidence that individual pioneers—first movers on trade links—significantly impact aggregate trade. I collect data on over 1.4 million voyages from Baltic Sea ports to global destinations from 1500 to the 1850s, focusing on 47,000 pioneering voyages that initially connected two towns. My findings reveal that pioneering accounted for 10% of the total trade value, with a single pioneering voyage boosting town exports by up to 33% for the 12% of trade links that persist. These findings highlight the importance of policies that encourage such pioneering ventures, especially to distant destinations.

Chapter 2, co-written with Lars Harhoff Andersen (University of Copenhagen) and titled “From Vagabonds to Virtues: The Ideological Roots of Entrepreneurship”, explores how admiration for business figures and the bourgeoisie, termed Bourgeois Values (McCloskey, 2010), drives entrepreneurship and innovation. Using first names from the US census as a novel metric for bourgeois values, we find strong links to entrepreneurship and income. We analyze the impact of cultural exposure through the early 20th century road trips of Henry Ford and Thomas Edison, known as the *Vagabonds*. *Vagabond* visits significantly increased bourgeois values and subsequently increased income and entrepreneurial activity among treated individuals. These findings show how ideology influences innovation and that even short events that impact ideology can have profound and lasting effects.

Chapter 3, titled “Contagious Coercion: The Effect of Plagues on Serfdom in the Baltics”, examines the impact of labor scarcity on labor coercion based on an influential theory by Domar (1970). For exogenous variation in labor scarcity, I use three separate plague outbreaks in the Baltics (1605-6, 1657, 1710-2). Collecting the labor contracts of thousands of Estonian serfs, I demonstrate that labor scarcity significantly increases the intensity of coercion. This effect is exacerbated by the limited outside options of serfs. I also show that higher coercion intensity leads to lower educational levels and higher migration rates. These findings underscore how specific conditions (limited outside options) can intensify labor coercion following population losses.

2. Overall contribution

The overall contribution of this thesis can be divided into advances in theory, methodology, and data, which I will discuss each of them in turn below.

2.1. Theory

Each chapter tests an influential theory on which (causal) empirical evidence is lacking.

Chapter 1 tests a theory in trade economics by Hausmann and Rodrik (2003) that individual first-movers on trade links, so-called pioneers, play a key role in aggregate trade. A key aspect of this theory is that information about the market discovered by the pioneers spills over to others so that the pioneers create a public good.

Chapter 2 tests the theory by McCloskey (2010) that admiration of a businessoriented bourgeoisie, the so-called bourgeois virtues, incentivize entrepreneurship and innovation. According to this theory, societies and individuals who look up to inventors and business people, i.e., adopt bourgeois virtues, are more likely to devote their time and effort to innovation and entrepreneurship, which induces economic development.

Chapter 3 tests the long-standing hypothesis of Domar (1970) that labor scarcity increases labor coercion. According to this theory, when labor becomes scarce, employers resort to increasing coercion in order to avoid paying higher wages. The theory has been amended by Acemoglu and Wolitzky (2011) and Brenner (1976) who note that outside options in non-coercive sectors that experience similar labor shortages can mitigate or even reverse the effects of labor scarcity on coercion.

My findings provide the first (causal) empirical support for each of the tested theories. In addition, I highlight the mechanisms that channel the effects. The mechanisms also provide suggestive evidence on settings in which similar findings can be expected.

2.2. Methodology

In all three chapters, I draw on so-called natural experiments to estimate causal effects. Natural experiments rely on quasi-exogenous shocks that permit identifying causal effects.

In Chapter 1, I develop two novel instrumental variable strategies that rely on natural experiments that turn individual captains into pioneers who first connect two towns by trade. As a first natural experiment, I exploit chance encounters between captains who meet at a trade bottleneck on the same day. These encounters, which cannot be planned, quasi-exogenously provide captains with up-to-date market information about a set of ports. If this set of ports includes new ports, captains are incentivized to pioneer these new ports in the period in which this chance encounter took place. A second natural experiment is the temporary obstruction of ports by sea ice, which forces affected captains to pioneer new ports.

In Chapter 2, we exploit the ad hoc route planning of Henry Ford and Thomas Edison, two of the most prominent representatives of the bourgeoisie, who road tripped in different parts of the US in the early 20th century. With this identification strategy, certain localities, including very rural ones, are quasi-randomly exposed to bourgeois values.

In Chapter 3, I exploit three plague waves in the Baltics as quasi-exogenous shifters of local labor scarcity. I establish that the intensity of the plague is locally quasi-exogenous by showing that there is no systematic correlation between the share of plague deaths and a host of geographic and socio-economic variables that were collected before the plagues. The erratic spread of the plague, even between adjacent villages, is also consistent with qualitative sources.

2.3. Data

For all three chapters, I assemble vast and new datasets. For two chapters (1 and 3), these datasets range particularly far back in history, starting in the 16th century. Due to the specificities of certain episodes of history or 'accidents in history,' such data can be vast and very detailed. For example, between 1429 and 1857, the Danish crown had a tight grip on the Sound sea narrow (Danish: *Øresund*) and blocked international shipping through all other maritime gateways (Chapter 1). This geopolitical setting led to the creation of unparalleled trade records, the *Sound Toll*, as the Danish levied a tax on all ships sailing into and out of the Baltic Sea. In total, more than 1.4 million voyages were recorded with information on the origin and destination ports, goods, quantities, and captain names and domiciles. The *Sound Toll* stands out even when compared to today's trade data. For example, the EU's single market implies that no internal customs receipts are available to capture trade. In general, few contemporary trade data record flows at the dyadic subnational level, e.g., between regions or towns, as is the case in the *Sound Toll*.

For Chapter 2, we devise a new measure of admiration for a bourgeois business elite that is based on first names. Specifically, we measure how non-bourgeois individuals imitate the first names of the bourgeoisie when naming their children while controlling for a host of socioeconomic variables. We apply our methodology to a secure-access version of the US census (1790-1940) in which the names of the hundreds of millions of individuals are not redacted. Therefore, we are able to create new proxies of ideology in the existing and vast historical data that is captured in the US census.

Another example of unusually rich historical data that is compiled for this thesis are the Estonian and Latvian *Wackenbücher* (Chapter 3). The *Wackenbücher* record serf's dues (corvée labor, in-kind, and monetary), allotted land, and demographics in great detail and consistently across centuries at the household level. The 'accident in history' that led to the creation and reliability of the *Wackenbücher* is once more geopolitical. Starting in the 1560s, the Baltics fell to Sweden, which mandated vast land surveys in order to assess the newly conquered lands. Skeptical of serfdom, which did not exist in Sweden proper, the Swedish Crown intended to abolish serfdom.

However, this plan never came to fruition because the Baltics fell to Russia following the Great Northern War (1700-21). Still, the Swedish ambition led to the precise enumeration of serfdom—a practice kept even under Russian rule, since legally binding records of serf dues avoided disputes.

Future economics and economic history research will increasingly benefit from large historical microdata, such as those used in all three chapters, given that new technology for processing vast amounts of (handwritten) historical data is becoming increasingly available.

Chapter 1

Breaking the ice: The persistent effects of pioneers on trade relationships

"*The men who manned these ships performed the essential, but not necessarily profitable, task of pioneering the trade, of discovering which mercantile houses were the most trustworthy, which goods were the easiest to peddle. [...] These pioneers performed this task so well that by 1790 [American] trade with Russia would follow the patterns and techniques discovered by the McNeills and Buffingtons. The first task of these pathfinders had been to discover products that would appeal to Russian tastes [such as] whale oil, dried fish, spermaceti, and rice.*" – Crosby (1965, p.47)

1.1 Introduction

Is there sufficient experimentation in trade? Are new export destinations and products sufficiently explored? An influential but untested theory by Hausmann and Rodrik (2003) argues that pioneers—first movers on trade links—play a pivotal role for exports and growth. However, there are too few pioneers relative to a societal optimum ("missing pioneers").[1] Pioneers are important given that exporting requires paying a fixed cost to acquire key information about, e.g., demand, business partners, and regulations in the new export destination (Das, Roberts, and Tybout, 2007; Melitz, 2003). Pioneers pay these fixed costs, and this information becomes a public

[1] Missing exploration is a concern across many fields in economics, see e.g. Jones and Summers (2022) and Mansfield et al. (1977)

good that is accessible to all traders in the exporting location. The public-good nature of the pioneered information is both a blessing and a curse. On the one hand, it benefits other traders through spillovers and, therefore, also aggregate trade. On the other hand, it hurts pioneers who cannot reap the private benefits of their discovery, which can result in too little ex-ante pioneering relative to a social optimum. This missing-pioneers market failure has potentially large negative consequences for trade and growth. It is particularly likely to occur in developing countries, which have achieved most of their export growth since the 1980s on the extensive margin (Evenett and Venables, 2002) but continue to show low levels of export diversification and high barriers to pioneering (Besedeš and Prusa, 2011; Wei, Wei, and Xu, 2021).

Empirically assessing the causal effects of individual pioneers on aggregate trade has proven difficult for two reasons. First, long-run data on the exports of individual firms are scarce, particularly, at the market level where firms are located in different countries. Second, pioneering is highly endogenous and confounded with policies: pioneers usually select promising markets and respond to export promotion policies.

The principal contribution of this paper is to provide the first estimates of the causal effect of pioneers on aggregate trade. I focus on both the short and long run. To overcome both the data and identification challenges, I draw on a historical setting: the trade between Baltic Sea ports and the rest of the world from 1500 to 1856 (henceforth: Baltic trade). My findings confirm that pioneers play a pivotal role in aggregate trade, which is not adequately reflected in either the current academic literature or in policy making. However, their private returns are likely small, raising concerns about insufficient pioneering relative to a social optimum. This, in turn, highlights the importance of export promotion policies that foster pioneering.

The first key advantage of historical Baltic trade is the data, the *Sound Toll*, which holistically captures it. These archival records are unparalleled even by modern data for their combination of granularity (voyage level, N > 1.4 million), time coverage (T > 350 years), and detail (origin and destination port, type of product, quantity, price, name of the captain). The *Sound Toll* records were created by Danish tax collectors on the Sound, the narrow main gateway to the Baltic Sea.[2] Among the

[2]The Sound Toll data are generally viewed to represent trade very reliably. Trade on land was minimal given the bulky nature of most goods and fractured polities (Degn, 2017b). Trade that did not cross between the Baltic and the North Sea is not recorded in the Sound Toll. However, this trade is not comparable given the particular comparative advantages between the Baltic Sea area and the rest of the world. A literal transcription of the data was created by an extensive crowd-sourcing project (Veluwenkamp, Scheltjens, Woude, et al., 2021).

million recorded voyages, there are more than 47,000 pioneering voyages that first connected two towns by trade (e.g., Hamburg and Helsinki), in some cases even countries, as Crosby, 1965 above quote on American-Russian trade illustrates. After years of data cleaning, I create the first fully prepared version of the *Sound Toll*. I harmonize origin, destination, and captain domicile towns and standardize prices, weights, and products. I also successfully match captains between their voyages based on their name and domicile town. The resulting captain panel enables me to study the rerouting of captains by comparing the stated destinations on their outbound journey with the origin port on their return journey.

The second key advantage of historical Baltic trade is identification. The absence of advanced technology (fast communication, weather forecasts, and icebreakers) during this period allows me to exploit two types of quasi-random *events at sea* as a series of natural experiments. Specific to each captain's voyage, these events are unforeseeable and insurmountable and turn individual captains into pioneers.

The first *event at sea* concerns encounters at the *Sound* with captains who come from new ports. Before the advent of fast communication technology, captains obtained up-to-date information on market conditions en route from encounters with other captains who had recently visited those markets. Because they were unable to effectively communicate with the merchant who hired them, en-route captains also received a certain degree of independence to reroute based on this market information. Historical evidence highlights the Sound and the port of Elsinore, where ships were stopped to pay the *Sound Toll*, as crucial hubs of information exchange for captains sailing between the Baltic and the North Sea. Often, the captain's destination choice was based on who they met at the Sound, as this was a crucial way to obtain current market information in the absence of fast communication technology (Ojala, 2017). I empirically confirm this, showing that encounters with oncoming ships at the Sound on the same day incentivized captains to sail to the port of origin of those ships.[3] Importantly, the voyages created by encounters also include pioneering voyages that first connect the captain's origin and destination. I further demonstrate that the origin ports of ships and the share of new, pioneer ports among them are quasirandom on a given day at the Sound. Therefore, encounters with oncoming ships from new ports are a plausibly exogenous instrument for pioneering.

[3] Brief encounters have also been shown to shape the choice of destination for migrants. For 20th-century migrants to the US, Battiston (2018) and Dippel and Heblich (2021) show that their two- to ten-week exposure to fellow passengers on ocean liners impacted their final destination choice within the US.

The second *event at sea* is sea ice. Uniquely in the Baltic Sea, there are immense and unforecastable variations in sea ice due to unpredictable atmospheric fluctuations and its short thermal memory, which rules out any interannual correlation.[4] As a result, captains were surprised by ice, which before the introduction of sea icebreakers caused a complete halting of trade in affected ports. For example, while in most years captains entering the Baltic Sea through the Sound in April could sail unobstructed to Saint Petersburg, in some years their journey was cut by 1,500 kilometers and they could only sail as far as Copenhagen. Large climate models reconstruct ice conditions in each of the Baltic Sea's 13 basins at daily frequency, starting on January 1, 1500 (Omstedt, 2011). To obtain daily ice conditions at the finer port level, I create my own climate machine learning model. I train my model on thousands of hand-collected historical freezing and ice breakup observations at the port level that date back to the 18th century. The model produces highly accurate predictions of daily ice conditions for each of the more than 400 Baltic ports. Based on my machine learning predictions, I construct two instrumental variables that capture sea ice conditions at the voyage level. The first instrument captures forced wintering in the Baltic as involuntary exposure to existing trading ports—the opposite of pioneering. Forced wintering occurs when captains from outside the Baltic cannot leave the Baltic before the first winter ice. The second instrument uses the ice-induced closure of existing destination ports in the early season. That is, captains whose intended destination port is frozen are forced to reroute to a new port, turning them into "accidental pioneers."

In addition to data and identification, several other features of historical Baltic trade make it particularly well suited to study pioneering. Compared to other trade at the time, Baltic trade was the most "modern:" There was no risk of appropriation by pirates, competitors, or power holders, greatly reducing costs by eliminating the need to sail in convoys (Glete, 2007). As a result, the number of trade dyads between towns surged from 200 in 1640 to almost 4,000 in the 1850s (see animations see here), as the importance of entrepôts, such as Amsterdam, declined in favor of direct trade connections between smaller towns. This diversification of trade was aided by the decline of merchant guilds, especially the Hanseatic League, which had restricted the

[4] The maximum sea ice extent can fluctuate between 20 and 95% in adjacent years (Hansson and Omstedt, 2008). At the port level, this implies a large variation in the freeze and ice break-up dates, e.g., in Stockholm, ice breakup ranges between 15 March and 15 May (Leijonhufvud et al., 2010). The obstruction of trade through sea ice is shorter than the changes affecting trade in existing studies, which last either multiple years (Feyrer, 2021; Juhász, 2018) or are permanent (Ellingsen, 2021; Pascali, 2017; Vedel, 2023).

diversification of trade flows. Nevertheless, pioneering was costly, as the above quote by Crosby (1965) suggests: "Breaking the ice" with new destinations required finding trustworthy business partners and goods that appealed to local taste—a description that matches modern-day pioneering (Hausmann and Rodrik, 2003).

I estimate the causal effects of pioneering on aggregate trade in two steps. In the first stage, I instrument pioneering at the voyage level with the mentioned *events at sea*: encounters between captains and sea ice. In the second stage, I study the effect of instrumented pioneering on subsequent trade in a gravity model of yearly trade between ports. While pioneering mechanically increases bilateral trade in the year of pioneering, it is an open question to what extent the pioneered trade link is pursued in subsequent years and whether trade is diverted from existing destinations. The identifying assumption of the IV approach is that the *events at sea* only affect subsequent trade through their effect on pioneering. The fact that the instrumental variables are specific to the voyage of an individual captain and a host of tests suggesting the absence of other effects makes this assumption plausible. With this micro-macro approach, I create one of the few instrumental variable approaches in trade, and the first that relies on granular instruments. I also study the effect of pioneering in a difference-in-differences framework, using recent (event-study) estimators.

I find that 10% of total trade value is due to recent pioneering. A single pioneering voyage increases town exports by 25–33% for the 12% links that persist. Survival is higher for pioneered ports that are *more* distant from the origin port or existing trade partners in terms of kilometers, product mix, religion, or language. However, pioneers tend to select *less* distant ports, which reduces the average returns of pioneering to 3–4%. Therefore, returns are greatest when sea ice removes this selection and forces pioneers to experiment with exogenously determined ports. Pioneering spills over onto other traders, reducing the private returns of pioneers. This raises concerns about insufficient ex-ante pioneering and underlines the importance of policies that foster pioneering, particularly with distant destinations. While this paper studies a historic setting, there are striking parallels with trade today. Both today and in my historic setting, about 10% of trade is due to recent pioneering (own calculations based on COMTRADE, 2023) and the 5-year survival rate of pioneers is about 12% (Wagner and Zahler, 2015).

This paper relates to four main strands of literature. First, the literature on pioneers in trade (Chen and Huang, 2022; Hausmann, Hwang, and Rodrik, 2007; Hausmann and Rodrik, 2003; Wagner and Zahler, 2015; Wei, Wei, and Xu, 2021). Studying pioneers is particularly important because of their relevance for policy. Export promotion policies aim to create pioneers, e.g., through export subsidies, trade fairs, or trade missions (Buus et al., 2022; Munch and Schaur, 2018; Van Biesebroeck, Yu, and Chen, 2015). Both the pioneer and export promotion literature face challenges in data and identification. The existing literature studies the pioneering of exporting firms from a single country over one or two decades (e.g., Koenig, Mayneris, and Poncet, 2010; Wagner and Zahler, 2015). Although most countries engage in some form of export promotion, it is commonly remarked that there may still be too little export promotion and effective targeting (Department for International Trade, 2022; Lederman, Olarreaga, and Payton, 2010; Martincus and Carballo, 2008; Srhoj, Vitezić, and Wagner, 2023). However, without causal or long-run evidence on the role of pioneers, such claims cannot be fully verified.

To the best of my knowledge, my findings provide the first causal evidence on the effect of pioneers on aggregate trade. These effects are large and persistent and should place pioneers at the center of trade. My findings that small events (encounters and rerouting) impact pioneering and trade also put the spotlight on export promotion policies that can emulate such events through platforms that create encounters and nudges to explore new destinations. I also discover an additional effect of pioneering, *the snowball effect*: pioneering spawns a subsequent wave of pioneering. This suggests that the expected profitability of pioneering is corrected upwards at the exporting location following pioneering. The snowball effect amplifies the social benefits of pioneering and is not captured in existing models (Hausmann and Rodrik, 2003; Wei, Wei, and Xu, 2021).

Second, the literature on path dependence in trade (Allen and Donaldson, 2022; Bleakley and Lin, 2012; Campbell, 2010; Morales, Sheu, and Zahler, 2019; Olivero and Yotov, 2012). This literature demonstrates that past trade significantly shapes current trade. Campbell (2010) shows that trade connections in 1870 strongly predict contemporary trade flows, even when accounting for gravity variables. Morales, Sheu, and Zahler, 2019 extended gravity framework demonstrates that existing export destinations substantially predict future destinations. In a spatial framework, Allen and Donaldson (2022) demonstrate how small historical shocks can lead to long-run persistence. My findings add a new channel to this literature that focuses on individuals. I provide the first evidence that individuals (pioneers) can affect aggregate trade. With my instrumental variables, I also show that small events (brief encounters and weather) can alter the behavior of these individuals and lead to aggregate effects. This can explain the surprisingly large effects of small events (Allen and Donaldson, 2022). I also provide the first evidence that the priors of individuals are important: pioneers mostly select less distant destinations, although more distant places are, on average, the more persistent trade partners. Combined with my findings on the importance of pioneering, this selection can explain the high correlation between the characteristics of past and future export destinations (Morales, Sheu, and Zahler, 2019).

Third, the literature on forced experimentation (Larcom, Rauch, and Willems, 2017; Nakamura, Sigurdsson, and Steinsson, 2022; Sarvimäki, Uusitalo, and Jäntti, 2022). This literature shows how nudging individuals out of their comfort zone by temporarily restricting their choice set can persistently improve their outcomes. For example, Larcom, Rauch, and Willems (2017) demonstrate how London metro commuters discover improved travel paths after temporary station closures during a strike rerouted them. I provide the first evidence that forced experimentation is also important in trade. In particular, I show that forced rerouting due to sea ice leads to pioneering and, therefore, increases aggregate trade.[5] Consistent with the forced experimentation literature, these effects are larger relative to "non-forced", endogenous pioneering.

Fourth, the literature on historical trade and institutions (Ellingsen, 2021; Juhász, 2018; Juhász and Steinwender, 2019; Marczinek, Maurer, and Rauch, 2022; Ogilvie, 2011; Pascali, 2017; Steinwender, 2015, 2018). Prominent historians of maritime regions (e.g. Braudel, 1972) have emphasized the physical features of their coastlines and surrounding areas. In doing so, they focused less on individuals "who dipped their toes" into these waters (Abulafia, 2011, p.221). By providing a first quantification of the importance of historical pioneers, my findings contribute to a more recent historiography that highlights the role of merchants and captains (Abulafia, 2011; Buti, Basso, and Raveux, 2017). Maritime history also often involves merchant guilds, which are said to have become entrenched and impeded trade as alternative ways of organizing trade became viable (Ogilvie, 2011). My findings provide the first quantitative evidence showing that the Hanseatic League, a large merchant guild,

[5]With the sea ice instruments I also provide evidence on the effect of climate variability on trade and contact between communities. Buggle and Durante (2021) show that climate variability fosters intercommunity exchange and trust. My findings suggest the chance encounters created by climate variability as a mechanism.

impeded trade by stifling pioneering. I also demonstrate that Baltic trade was of great historic importance, carrying a wide range of products, including large amounts of grain to the Low Countries. In fact, my calculations reveal that Baltic trade was the largest recorded trade between 1500 and the 1850s, both in value and volume.

The remainder of the paper is as follows. Section 1.2 summarizes the existing pioneer theories and evidence. Section 1.3 provides a historical background on Baltic trade from 1500 to 1855, highlighting in particular why it was a favorable environment for pioneering. Section 1.4 provides details on data sources, particularly the Sound Toll trade and the reconstructed ice data. Section 1.5 discusses the empirical strategy, including the encounter and ice instrumental variables. Section 1.6 presents the results, focusing on the effect of pioneers on trade and growth and highlighting various mechanisms. Section 1.7 concludes.

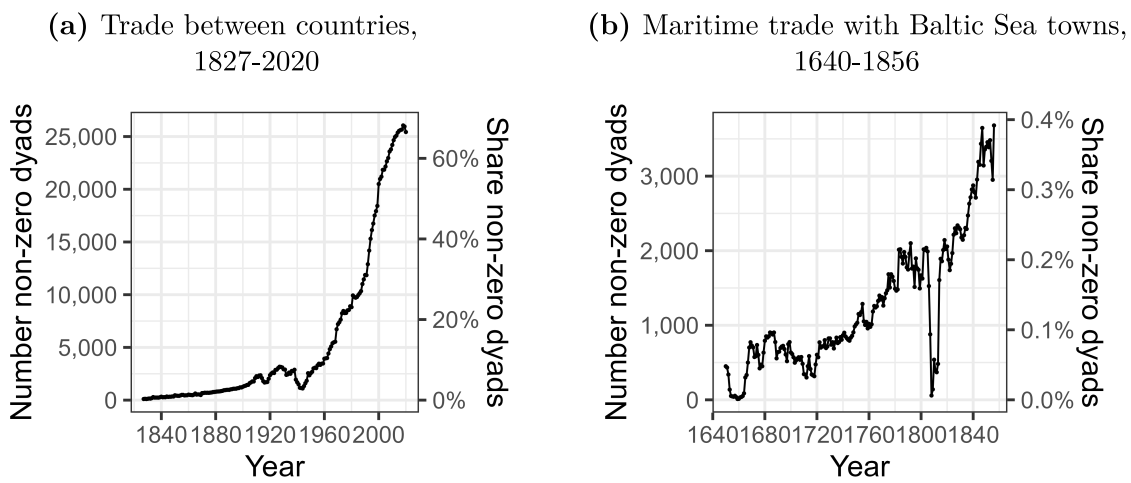
1.2 Pioneer theory and relevance

An influential theory suggests that pioneers are key catalysts of trade (Hausmann and Rodrik, 2003). The rationale is that a certain home location (e.g., country, region, or town) has no or insufficient information about certain export markets. Pioneers engage in costly learning about these export markets and return with, according to the theory (Hausmann and Rodrik, 2003), information that is publicly available to all firms at the home location. This public good nature of the information is both a blessing and a curse. It benefits other traders through spillovers and, therefore, also aggregate trade.[6] It hurts pioneers who cannot reap the private benefits of their discovery, which can create an undersupply of pioneers, "missing pioneers", relative to a social optimum.

One metric to track successful pioneering, i.e., pioneering that leads to a lasting trade dyad, is the number of non-zero trade dyads. Panel 1.1a plots the number of non-zero for trade between countries between 1827 and 2020. Surges in the number of non-zero are apparent for the waves of globalization before WWI and after WWII. New trade dyads have been particularly important for the growth of exports of developing countries since the 1980s (Evenett and Venables, 2002). There are striking parallels in the surge of non-zero dyads between countries and the earlier surge of trade of Baltic Sea towns with the rest of the world (Panel 1.1b) that occurred between 1680

[6] As I will show, an additional benefit of pioneering that is not captured in the current models is that it spawns a wave of subsequent pioneering.

Figure 1.1: Parallels in the surge of trade dyads: trade between countries & with Baltic towns



Sources: Panel 1.1a: 1827-1947: Fouquin and Hugot (2016); 1948-2020: Conte, Cotterlaz, and Mayer (2022), Panel 1.1b: author (Sound Toll).
Notes: The number of non-zero trade dyads both for trade between countries from 1827 to 2020 resembles the earlier rise in maritime trade dyads with Baltic Sea towns from 1500 to 1856. However, in both cases, the share of non-zero dyads out of the maximum possible number of dyads is still far from 100%.

and the 1850s. Focusing on this earlier integration with a region (the Baltic), this paper provides insights that can help rationalize the later globalization. For both global and Baltic trade, it is also apparent that this integration is incomplete: only 66% of countries trade with each other. For Baltic trade this number is even lower: At maximum, only 0.3% of towns in the Baltic traded with towns in the rest of the world (which trade with at least one Baltic port).[7].

Types of pioneers. Pioneers can be categorized based on two types of extensive margins: geographic (new destinations) and product (new products). The combination of these margins gives rise to three types of pioneers (Figure 1.2): (i) Product pioneers export new products to existing destinations. (ii) Geographic pioneers export existing products to new destinations. (iii) Product & geographic pioneers export new products to no destinations. Traders who export existing products to existing destinations are not pioneers as they operate on the intensive margin. To

[7]The comparatively lower share of non-zero dyads for Baltic trade is certainly due to early-modern communication technology and institutions. However, it is also due to the greater spatial granularity of the data (town-level) relative to the country-level. The effects of granularity are also apparent today. For example, despite European integration, only 63% of 269 NUTS 2 regions (population 0.8 to 3 million) traded by road between 2011 and 2017 (own calculation based on data by Santamaría, Ventura, and Yeşilbayraktar, 2021).

Figure 1.2: Types of pioneers

	Existing product	**New Product**
Existing destination	No pioneer	Product
New destination	Geographic	Product & geographic

quantify the importance of pioneering, it is necessary to define how long a destination or product is considered 'pioneered' or new. I classify products as 'new' for the first 10 years that a given locality (town, country) exports them. Similarly, destinations are classified as 'new' for the first 10 years that a given locality (town, country) exports to it.

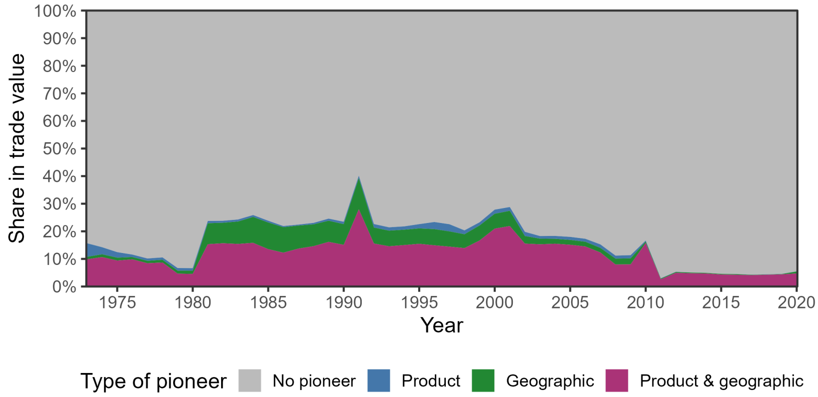
Applying these definitions, I quantify the importance of each type of pioneer in the value of trade between countries (Panel 1.3a), for Baltic imports (Panel 1.3b), and for Baltic exports (Panel 1.3c). It is clear that all three trades are in flux. On average, 10% of aggregate trade is not 'older' than 10 years. This implies that the extensive margin and therefore pioneering are responsible for a substantial share of trade. It is also apparent that all three types of pioneers are important. Hausmann and Rodrik, 2003 founding contribution of the pioneer literature focuses on product pioneers.[8] In this paper, I instead focus on the other two type of pioneer (geographic and product & geographic). This choice is guided by the relatively greater importance of these types of pioneers (see Panels 1.3b and 1.3c) and by the fact that my identification strategies hinge on quasi-random exposure to geographies (towns). As I will show, new products play a key role in that they both increase a town's pioneering of new export partners and substantially increase the survival of newly formed trade dyads between towns. I provide specific examples of pioneers in Appendix A.10.[9]

[8] One example they give is the emergence of cut flowers as a new product among Columbia's exports to the United States. Columbia had already exported other products to the United States, so there is no extensive geographic margin. The pioneering act of the first firm to export these flowers resulted in Columbia "self-discovering" its comparative advantage in cut flowers.

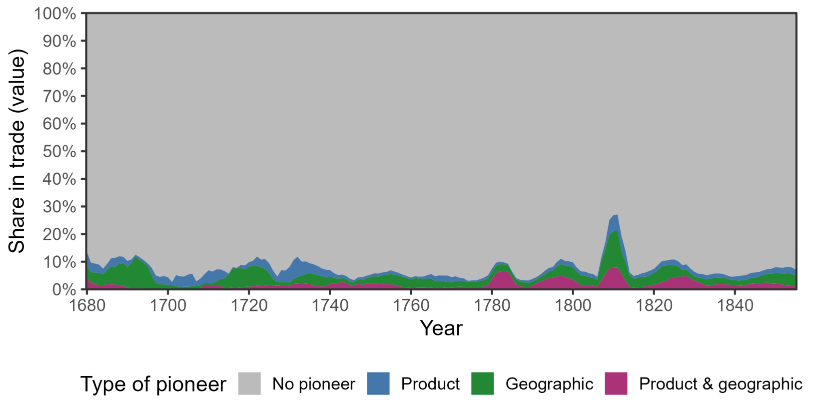
[9] Unlike for explorers, qualitative records of pioneers rarely existed or have survived less often.

Figure 1.3: Share of different types of pioneering in total trade value

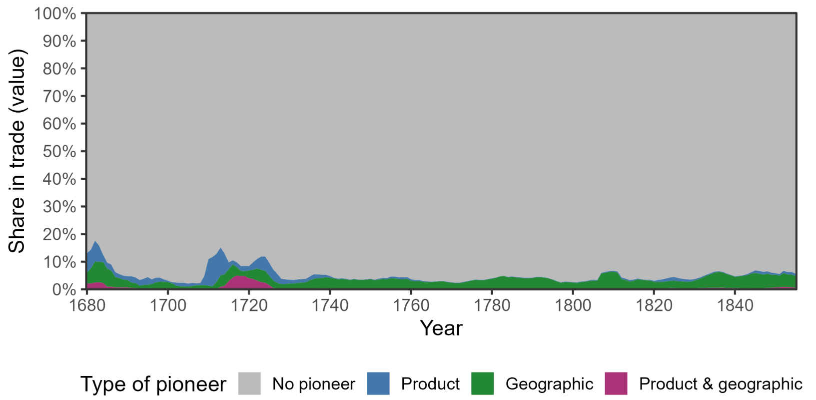
(a) Trade between countries, 1973-2020



(b) Baltic towns' imports, 1680-1856



(c) Baltic towns' exports, 1680-1856



Sources: Panel 1.3a: Comtrade (COMTRADE, 2023), Panels 1.3b and 1.3c: author (Sound Toll). Product data are unavailable for world trade before 1962. See Appendix Figure A.4 for earlier years of geographic pioneering (irrespective of product) in world trade.
Notes: At dyad and SITC (version 4) 4 digit level. New products and new destinations are defined as those that entered dyadic trade no more than 10 years ago.

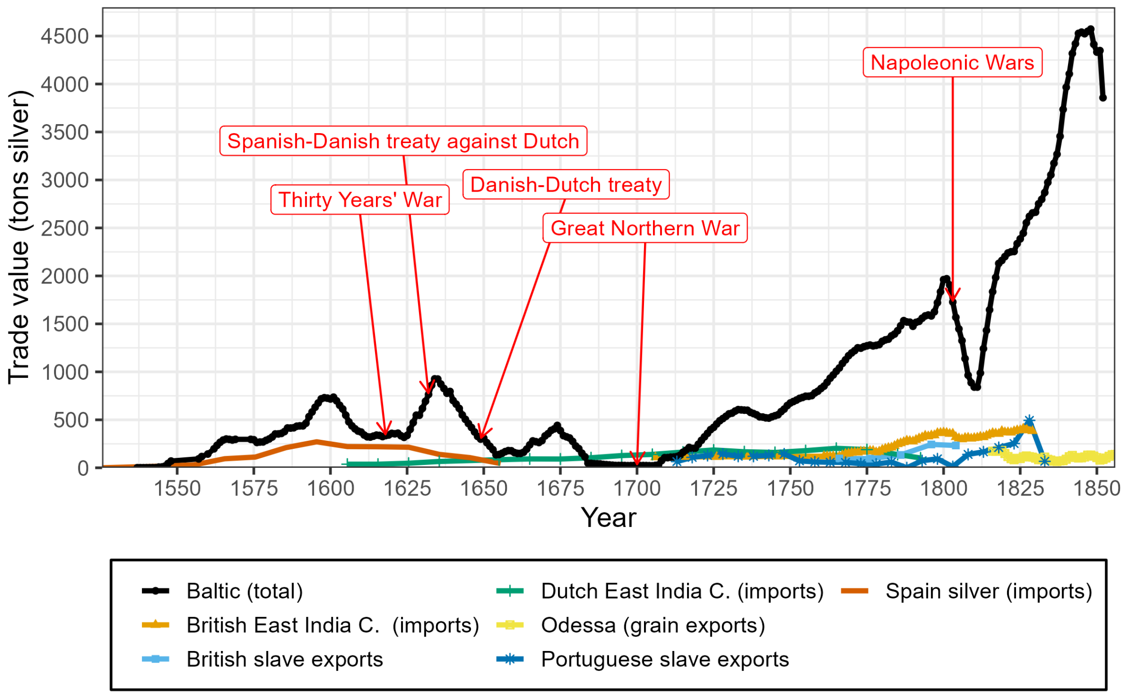
1.3 Historical background: Baltic trade

The aim of this Historical Background is to provide some general information about Baltic trade and its importance (Section 1.3.1) and to illustrate the, at the time, uniquely favorable conditions for pioneering (Section 1.3.2). Given that I exploit sea ice in some of my identification strategies, I also describe how Baltic trade responded to ice (Section 1.3.3).

I already include some descriptive statistics throughout this Historical Background that are created with the Sound Toll, a trade dataset that holistically captures the Baltic Sea area's maritime imports and exports. I describe the Sound Toll data later in detail in a dedicated data Section (1.4.1).

1.3.1 Importance and characteristics of Baltic trade

Figure 1.4: Baltic trade exceeds other trades, 1500-1856



Sources: Baltic: author (Sound Toll, 10-year rolling mean), British East India Company: Bowen (2007), British slave exports: Anstey (1975), Dutch East India Company Steensgaard (1990), Odessa: Papadopoulou and Petmezas (2022), Portuguese slave exports: Silva (2021), Spain silver: Hamilton (1934).
Notes: Sound Toll value obtained by multiplying product quantities with (intrapolated) product prices reported in Sound Toll or by backing out value from ad-valorem tax rates (see Section 1.4.1 for details). All currencies are converted to their silver equivalent based on Allen and Unger (2019).

The Baltic trade with the rest of the world was vital during the Early Modern period, particularly for Britain and the Low Countries, which imported Baltic grain to support their growing (urban) population. The Dutch referred to this trade as 'the mother of all trades', given its vital importance and long history that dates at least to the Hanseatic League (Van Tielhof, 2002). These Baltic grain exports allowed for an increase in preindustrial urbanization and development in the United Kingdom and the Low Countries while the Baltic region and the rest of Europe fell behind as part of a preindustrial 'Little Divergence' (Allen, 2001; De Pleijt and Van Zanden, 2016). Some scholars have argued that the Baltic's export of primary goods, mainly grain, and the forced labor regimes that were established to produce them are responsible for this lagging behind (Malowist, 1958).[10]

With the Sound Toll, I create the first estimates of the value of the Baltic trade. As shown in Figure 1.4, Baltic trade, in fact, exceeded all other long-distance trades between 1500 and 1855, including trade with the Americas and Asia. This is not surprising given that the Baltic was the most immediate periphery region and granary to the 'Western core' (Rönnbäck, 2010b). In particular, Baltic exports used the factor endowments of the region, particularly its great land abundance relative to the West (Theodoridis, Rönnbäck, and Scheltjens, 2019). Therefore, this East-West difference in factor endowments should explain in part the vast amount of trade.[11]

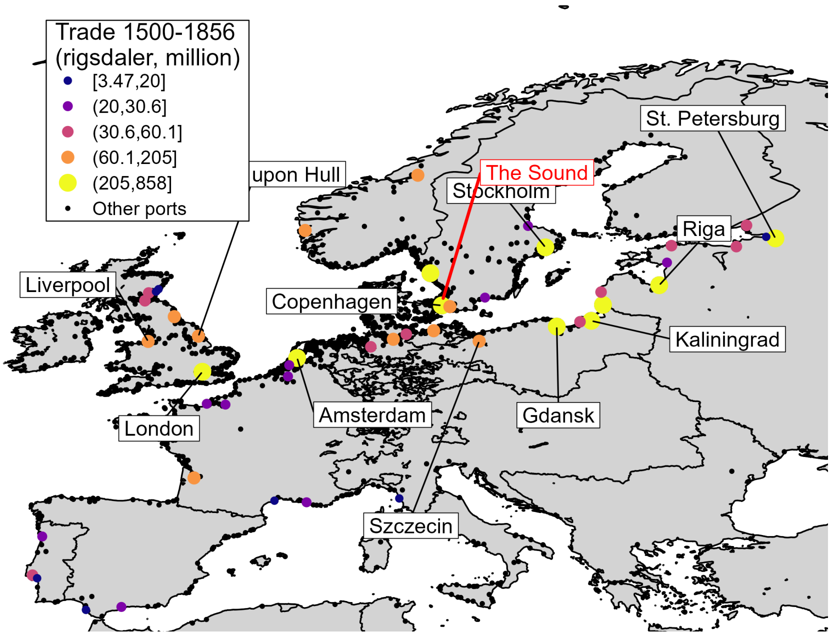
The Sound Toll allows me to decompose trade by destination and origin town, which is shown in Figure 1.5. As shown in Panel 1.5a, the largest trading towns in the Baltic correspond to the large grain exporting towns of Gdansk (with its access to the Vistula River), Szczecin, Kaliningrad, and Riga, as well as other major ports such as Copenhagen, Stockholm, and St Petersburg. In the North Sea area, Amsterdam and London are the most important towns, primarily as grain importers and exporters of manufactures (e.g., textiles) and New World goods. Panel 1.5b shows that the largest trade routes are also between those towns, particularly between Gdansk and Amsterdam where most grain is traded. However, it is apparent that the map is dotted with many other ports, including on the French Atlantic coast, in Portugal, on the Mediterranean, and, not shown on this map, also overseas.

[10]On forced labor systems in Eastern Europe, see, e.g., Raster, 2023c analysis of the Estonian serf economy that produced grains for export.

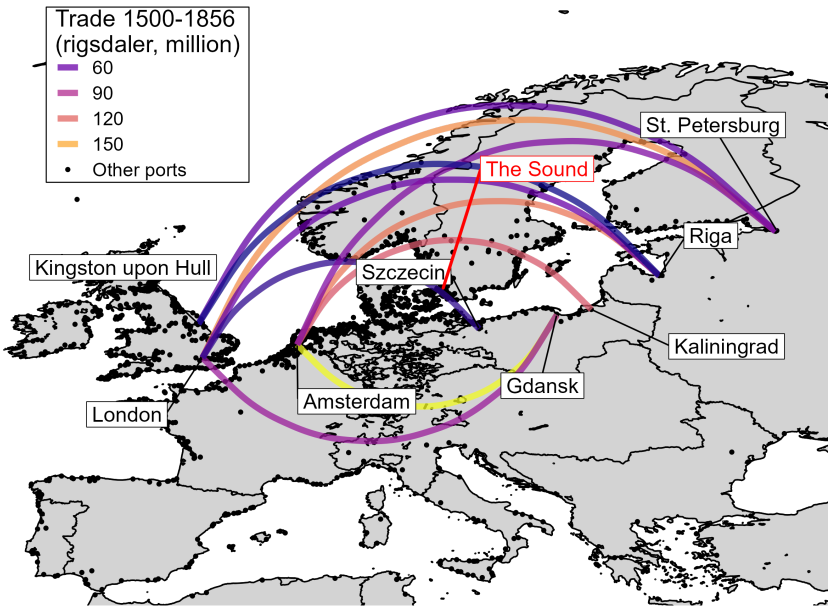
[11]The importance of Baltic exports diminished in the late 19th century as foodstuffs and raw material imports from the Americas increased in importance (Nelson, 2022; Pomeranz, 2000). Imports from the Americas, such as sugar and cotton, were not substitutable for Baltic goods (Rönnbäck, 2010b). From 1815, Odesa also gradually became Russia's most important grain export port, replacing its Baltic ports, but only after the 1850s (Puryear, 1934).

Figure 1.5: Trade by towns

(a) 50 largest ports



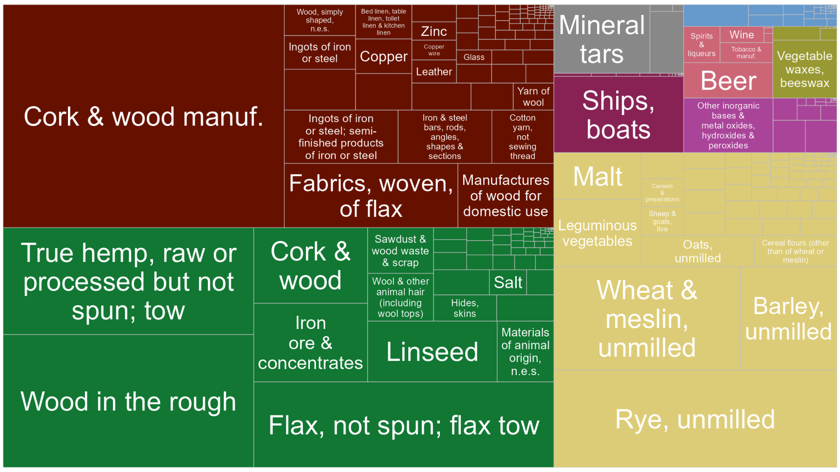
(b) 20 largest trade routes



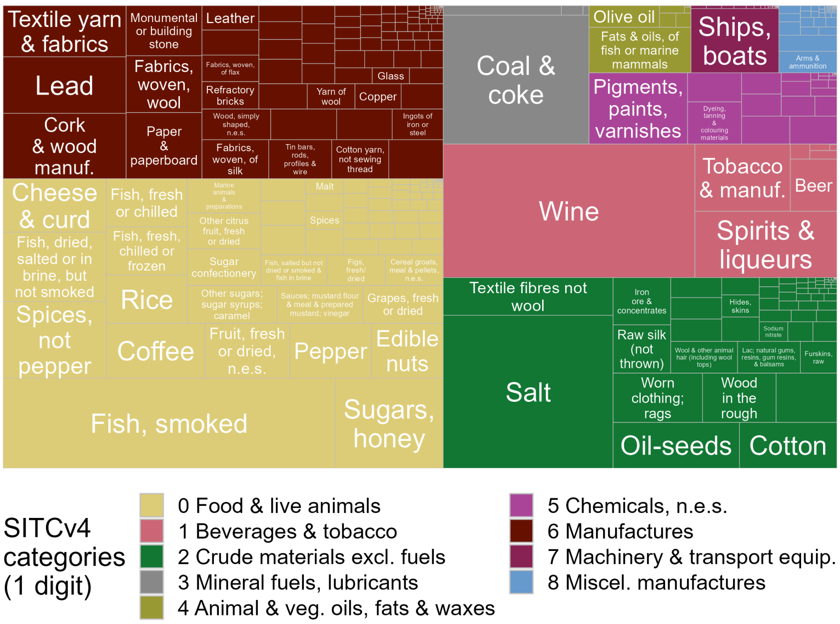
Source: author (Sound Toll), borders as of 1800.
Notes: Link to animations. The largest ports include London, Amsterdam, Copenhagen, Szczecin, Gdansk, Kaliningrad, Riga, and Saint Petersburg. Amsterdam-Gdansk is the largest trade route, carrying a substantial share of the grain trade. Similar conclusion for the number of shipments as an alternative measure of trade, see Appendix Figure A.1.

Figure 1.6: Product mix by number of shipments, 1500-1856

(a) Baltic exports



(b) Baltic imports



Source: author (Sound Toll).
Notes: Classification according to SITCv4, 4-digit level with colors corresponding to the 1-digit level. For product mix by value, see Appendix Figure A.3.

Breaking down Baltic trade by product category, Figure 1.6 confirms that different types of grains, such as rye, wheat, and barley, were important components of the Baltic Sea Region's export mix. However, trade diversified during the sixteenth and seventeenth centuries (Sandström, 2016). From Falun in Sweden, copper, often used for roofing, was exported through Stockholm (Jahnke, 2015). Other raw materials were also important, such as timber from forests in present Lithuania or flax and hemp from Riga (Kirby, 2014). Bee wax produced in the forests of the eastern and southern Baltic region was vital for the production of candles, which were integral to English Christianity until the mid-16th century (Sapoznik, 2019). The British Navy purchased beer and other goods used in rations, mainly from Denmark (Aldridge, 1964). Regarding Baltic imports, salt was essential and, given the region's lack of natural deposits, was mass marketed (Kirby, 2014). The Low Countries, with their advanced textile industry, continued to create new types of garments (Huang, 2015).

1.3.2 Pioneering in Baltic trade

The description of Baltic trade so far masks a large degree of variation, across time and space, with some towns achieving greater importance than others, as well as in the product sphere: "the trade and trade system of the Baltic were in a constant flux" (Jahnke, 2015, p.194). Changes over time are visible in the number of trade dyads (Panel 1.1b in the Introduction), in changing trade links (see animations here) and in the aggregate amount of trade (Figure 1.4 in the previous Section).

1.3.2.1 The three phases of Baltic trade, 1540-1860

Generally, three phases can be distinguished according to long-run trends, each approximately one hundred years long (Van Tielhof, 2002): (i) expansion (1540-1650), (ii) contraction and volatility (1650-1760), and (iii) renewed growth (1760-1860).

The *first* phase, expansion (1540-1650), was marked by increases in demand for grain to feed the growing populations of England, France, Ireland, the Low Countries, Portugal, Scotland, and Spain. In 1590, trade expanded even further when demand in Italy surged (Braudel and Romano, 1951). In the 1620s, demand declined and the Baltics experienced crop failures. Trade plunged further during the Polish-Swedish war of 1626-29, when Gdansk was blocked before resurging during the booming 1640s.

The *second* phase, contraction and volatility (1650-1760), began with the onset of a long agricultural depression characterized by decreasing prices and population growth. Baltic grain exports were further lowered by the concurrent in domestic grain production in England and the Netherlands. Another reason for the decline of Baltic grain exports was severe supply shocks related to a further Polish-Swedish war (1655-60) and the Great Northern War (1700-21) that brought great population losses.[12] However, following these wars and aided by crop failures in Western Europe, Baltic trade recovered starting in the 1720s.

The *third* and final phase, renewed growth (1760-1860), built on this recovery of trade that had already begun. Soon, Baltic trade surpassed its previous peak from the 1640s. This is mainly due to a renewed increase in population in Western Europe that led to an upswing in grain prices.[13] With the exception of the Napoleonic Wars (1803-15) which dramatically decreased trade, Baltic trade continued to grow, reaching an all-time high during the 1840s, the 'hungry forties', when potato blight and other crop failures hit Western Europe. During this time, other large grain suppliers emerged, such as America and Odessa. However, American exports to Europe only superseded the Baltic's after the end of the Civil War in 1865, and Odessa mainly supplied the Mediterranean rather than the traditional buyers of Baltic grain.

1.3.2.2 Changing destinations

There are many documented examples of new trades in the Baltic. For example, following a construction boom in Britain from 1760, the then Prussian port of Klaipėda (German: Memel) experienced a surge in timber exports from the vast and heretofore unexploited forests of the Lithuanian hinterland (Kirby, 2014). Another example is Swedish salt imports, which following rapidly growing herring catches after 1750, led to a great number of foreign captains bringing salt from 14 different ports (Fusaro et al., 2016). Theodoridis, Rönnbäck, and Scheltjens (2019) note that even with increasing trade openness in the 19th century, Baltic towns did not further specialize, but rather kept a broad portfolio of exports.

Also outside the Baltic, there was change: following the Spanish Fury at Antwerp in 1576, many merchants migrated to Amsterdam, which subsequently became a

[12]Wars, such as the Second Anglo-Dutch War (1665-1667) and the Nine Years' War (1688-1697), also endangered shipping in the North Sea.

[13]A brief stagnation is notable from 1772 to 1793 due to Prussian interference at Gdansk during the second partition of Poland. Additionally, Sweden became a major grain importer, so this grain did not leave the Baltic.

dominant entrepôt. However, from 1700, Amsterdam experienced growing domestic competition from Rotterdam, but also from smaller Dutch ports (Draper and Duijl, 2018).[14] From 1750, Papenburg, a town in the very west of present-day Germany, started exporting peat on a grand scale, including to the Baltic (Scheltjens and Veluwenkamp, 2012). During the 16th and 17th centuries, when the Baltic grain trade expanded, many ships bypassed the Netherlands and its customs duties (Dutch: *voorbijlandvaart*), connecting the Baltic directly with, for example, France, Spain or Portugal (Van Tielhof, 2002).[15].

1.3.2.3 Changing trade by flag

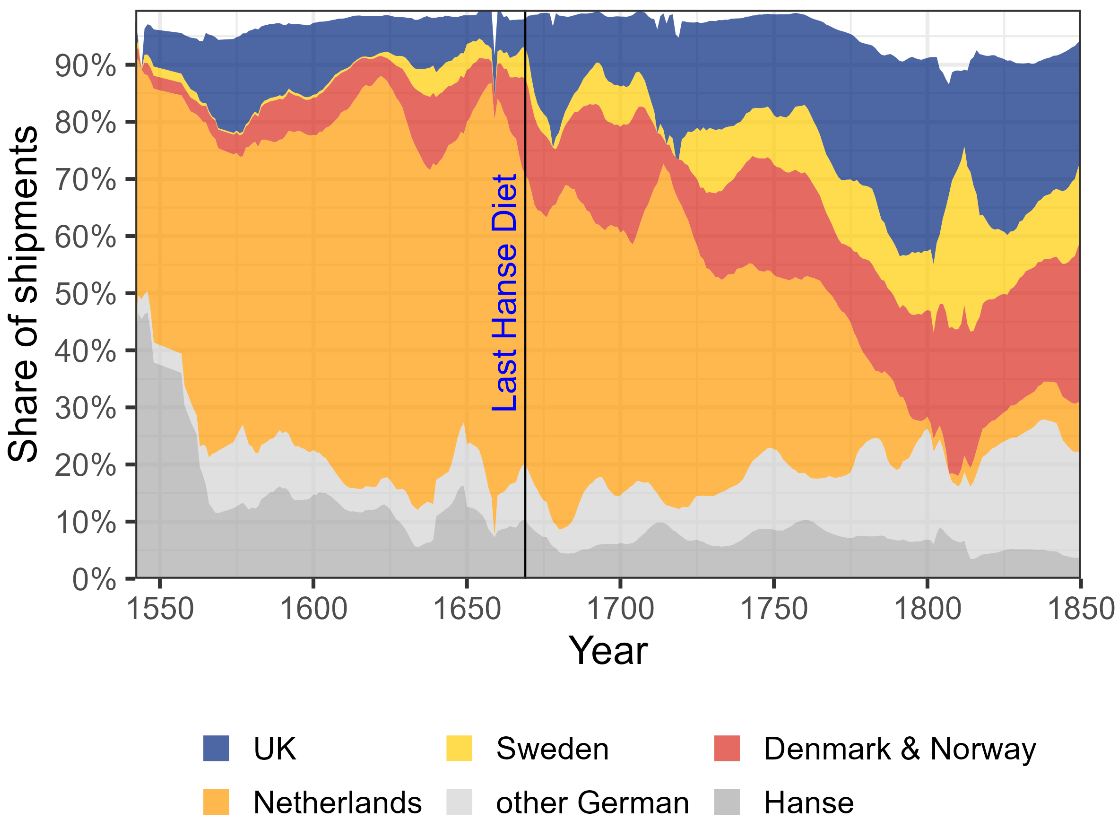
There were also important changes in terms of who traded. Figure 1.7 decomposes Baltic trade in the Sound Toll by the domicile region or the captain's trade regime. The dramatic decline of the Hanse (Raster, 2023a) (described below in Section 1.3.2.5), is notable at the beginning of the period (1540-80). The Hanse succumbed to immense competition by Dutch individual merchants who subsequently dominated trade. The Baltic became a "Dutch lake" (Glete, 2007, p.22). The merchant fleet of Amsterdam is described as "sailing to every possible destination" (Gelderblom, 2003, p.631). During this time, the word interloper was first recorded in English. Derived from Dutch, it denotes "an unauthorized trader; one who trespasses on the rights or privileges of any trade monopoly" (Dictionary, 2023). There were also a lot of contacts between groups, e.g., Sephardic Jews based in Amsterdam often traded outside their in-group (Roitman, 2011).

What explains this ascendancy of the Dutch and their later diminished role in Baltic trade? A common point of departure is the assumption that early-modern trade required a "fixed, stable base, or staple market" given that "transport was highly irregular as well as slow, expensive, and prone to disruption by a variety of factors" (Israel, 1989, p.14). After the fall of Antwerp in 1585, which had been the focal point of the Dutch revolt against Spain, Amsterdam emerged as this new entrepôt, receiving a vast number of migrants from Antwerp (Gelderblom, 2003). Amsterdam, similar

[14] Such changes in trading centers occurred also for other trades, e.g., with the rise of the Atlantic trade (Acemoglu, Johnson, and Robinson, 2005), or with the decentralization of Spanish colonial ports in the Americas (Ellingsen, 2021).

[15] Trade patterns also diversified with the founding of new towns, e.g., in Sweden where urbanization accelerated and towns such as Kristianstad (1614), Gothenburg (1621), Karlskrona (1680), and many towns on the coast of the Bothnian Bay were established (Ersgård, 2018). Most important was the founding of Saint Petersburg in 1703, which Tsar Peter the Great quickly promoted as the main center of Russian trade at that time (Evans and Rydén, 2007)

Figure 1.7: Baltic trade by flag, 1540-1850



Source: author (Sound Toll)
Notes: Decomposition by captain domicile. Hanse if the captain's domicile is Hanse town, see Appendix A.8. The vertical line denotes the year of the last Hanse Diet (1669). For a similar-looking decomposition by trade value, see Appendix Figure A.5.

to Antwerp, was conveniently located at the intersection of the Atlantic, Baltic, and Rhine waterways. It was essential as a stopover, as, for example, French wine was ready to be exported too late in the season to be exported to the ice-prone Baltic (Israel, 1989).Yet, this view alone does not explain why, for example, Amsterdam's large market share did not spawn monopolistic practices or why a similar entrepôt did not develop in England. A combination of additional factors likely enables Dutch primacy, such as its supremacy in shipbuilding, advanced methods of shipowning, and the intricate interplay between different Dutch towns and the hinterland. Undeniably, the Dutch also benefitted from their aforementioned interloper and pioneering spirit that is often contrasted with the Hansa: "The Hansa towns lost their age-old struggle with the Hollanders for trade supremacy in the Baltic bulk trade, essentially because they found it more difficult than their Dutch competitors to adapt to the growing scale and complexity of the traffic" (Israel, 1989, p.18).

With these favorable circumstances for success in mind, the increasing and ultimately decreasing Dutch dominance in Baltic trade that is evident in Figure 1.7 can be explained primarily by geopolitical changes. Between 1585-90, just after capturing Antwerp, Spain's Philipp II imposed a general embargo on Dutch shipping, particularly on trade with Spain and Portugal. This embargo benefitted the Hanse, which took over the trade with the Iberian Peninsula, as it had done previously whenever the Dutch and Spanish had conflicts. However, in 1590 Spain took a more defensive approach in the Netherlands. Needing grain as he turned his attention to France, Philipp II even lifted his embargo against the Dutch but not against other enemies such as England, leaving the Netherlands in a dominant position.

Aside from geopolitics, the products of the Dutch Baltic trade also changed drastically. As mentioned when describing the phases of Baltic trade, the Dutch were the dominant importers of Baltic grain and also imported significant quantities of timber for shipbuilding. However, prior to 1590, Dutch trade Baltic trade was mainly confined to these commodities. Often, Dutch ships sailed only in ballast (without cargo) or carried salt, a bulky, low-value commodity (Israel, 1989). The Hanse and the English controlled Baltic trade in valuable goods, exporting textiles, spices, sugar, and other colonial products to the Baltic, and importing leather, furs, tallow, tar, Swedish copper, and yarns. At the same time, the Dutch exported priced textiles to southern Europe and imported 'southern luxuries', such as pepper, sugar, figs, raisins, almonds, and olive oil. After 1590, the Dutch began to capitalize on this southern trade, by exporting both Dutch textiles and southern luxuries, and later tobacco and gin to the Baltic, building on the low freight costs that they achieved in bulk trade. This highlights the interdependence that different trades can have. With their product portfolio broadened, the Dutch also penetrated new Baltic markets.

During a twelve-year truce between 1609 and 1621 Dutch power consolidated further and direct Dutch shipping between the Iberian Peninsula and the Baltic increased. This trend was reversed when between 1621 and 1647 when the Dutch-Spanish conflict resumed and Dutch ships were barred again from Spain and Portugal. The position of the Netherlands was reaffirmed with the founding of the Dutch Republic as part of the Peace of Münster of 1648. In response to gains in Dutch power, the first English Navigation Act was passed in 1651, declaring that only English ships could bring goods to England.A concerted Anglo-French attack on Holland in 1672 led to a temporary contraction in the share of Dutch shipping.

Dutch dominance, in the Baltic and elsewhere, was brought to an end mainly by "new-style industrial mercantilism" (Israel, 1989, p.383) that began around 1720 across Europe. After having benefited from Dutch technology and sometimes also from skilled migration, France shut out Dutch products with high tariffs or prohibitions. Similarly, Prussia banned all exports of raw wool, a key input for the Dutch market, from 1718, and from 1720 banned imports of foreign cloths. Russia enacted a similar ban on cloth imports in 1718. In 1732, Denmark-Norway banned imports of Dutch woolen goods, silks, and sugar. In 1738, Sweden-Finland banned foreign manufacture altogether. Concurrently, the spread of Dutch technology created serious competitors; for example, "[t]he adoption of Dutch multiple-blade saws in Russia and Scandinavia broke the hegemony of the Zaan timber mills and accelerated the decline of Dutch shipbuilding" (Israel, 1989, p.385). Similar stories can be told for the adoption of Dutch tobacco-processing techniques in Sweden and the adoption of fine-cloth weaving techniques in Prussia, Savoy, and Spain.

What followed was a rapid expansion of English, Danish, Swedish, and German trade at the expense of Dutch trade after 1720, which is evident in Figure 1.7. As was the case for the previous changes in trade by flag, post-1720 Baltic trade was marked by multiple new trade routes, created by the geographic, product and product & geographic pionners (Scheltjens, 2015b; Unger, 1959; Van Tielhof, 2002).[16]

1.3.2.4 Pioneering in Practice

How did early-modern Baltic trade manage to adapt to such immense flux? In general, "during the sixteenth and early seventeenth centuries, the number of [new trades] greatly increased as a result of escalating foreign demand for both bulky and high-value commodities" (Israel, 1989, pp.406). On top of that, multiple factors specific to trade with the Baltic created an environment that was particularly suitable for pioneers. As a result, Baltic trade had certain features that can be considered modern:

> *"By the mid-seventeenth century, the Baltic Sea was the most modern region for maritime trade in Europe. Foreign merchantmen could sail unarmed and alone with practically no risk of being attacked by pirates, competitors or local power-holders. Conditions were widely different along Europe's Atlantic coast and in the Mediterranean."*

[16] See also Panel 1.1b in the introduction, which shows a marked increase in trade dyads after 1720.

– Glete (2007, p.21)

This relative security in the Baltic Sea also spurred the development of a new type of vessel, the *fluyt*, a clunky and slow-moving Dutch vessel that, however, could be sailed with a much smaller crew. This, in addition to not having to sail in convoy, dramatically cut cost (Pomeranz and Topik, 2018).

Pioneering was also helped by the fact that captains were aware of the location of most towns. Maps were drawn in the 16th century (Israel, 1995). Published merchant guides (e.g., Brûlons, 1765; Schumann, 1797) captured the existence of most ports and provided instructions for navigation, as well as information on language, currencies, weights, and customs. Such guidebooks also portray some towns more favorably for trading than others, which may have steered trade. In addition to these sources, the captains were frequently reminded of the existence of towns, even those they had never sailed to, as ships generally sailed along the coast and navigated based on sightings of landmarks, such as church spires (Kirby, 2014).

Merchants. The way Baltic trade was conducted also supported its flexibility, particularly vis a vis chartered companies, which in the form of the Dutch and English East India Companies dominated trade in other parts of the world. In the Baltic, however, any attempts by the English to set up chartered companies succumbed to the competition and dynamism of the Baltic.

Without chartered companies, merchants, who resemble firms in this setting, directly traded with the Baltic. Merchants found it inefficient to travel with their goods (Greif, 1989). Instead, they hired captains to transport and often also to sell their goods. Usually, the costs of hiring a ship, captain, and crew are spread over several merchants with stakes in the cargo. Typically, one of the merchants owned the ship. After the voyages had been completed, the final balance was drawn and the gains or losses were divided between all merchants according to their share before the partnership was dissolved (Vliet, 2015).

Captains. Upon being hired by merchants, captains enjoyed a great deal of autonomy in mustering crew, transporting, and selling. Captains drafted the crew's labor contract, the muster roll. Muster rolls provide further evidence of the independence of captains: instead of a destination port, many of the Amsterdam muster rolls would state 'op Avontuur' (on an adventure). Even when a muster roll stated a destination, a captain could always deviate from the state destination, as captured in the phrase 'waar de Capt. Syn orders sullen komen te vallen' (whatever the captain's orders will be) (Vliet, 2015). Although no common legal framework existed at the time, widely applied legal codes also gave captains flexibility in deviating from stated destinations. One such code is the Laws of Wisbuy, which, dating from the 1400s, was widely applied in early-modern Europe and stated that: "If a ship freighted for one port enters another, the master, together with two or three of his chief mariners, ought to clear themselves upon oath, that it was by constraint and necessity that they went out of their way. After which he may proceed in his intended voyage." (Twiss, 2012, p. 280, Article LII). This mirrors the voyages of Finnish vessels which were "typical of the time: neither the master [captain] nor the shipowner knew what would be the exact unloading place for the cargo" (Ojala, 2017, p.341).

Combined, these various aspects of Baltic trade suggest that captains are better understood as "entrepreneurs at sea" rather than as simple transporters of goods (Buti, Basso, and Raveux, 2017; Vanneste, 2019), and how these circumstances encouraged pioneering. Captains and crew also had a stake in profits, as they were able to carry and sell their own goods onboard the ship on both inbound and outbound trips (Blakemore, 2017).

The independence that merchants granted captains who sailed to the Baltic was sensible given that, in the absence of fast information technology[17], it was almost impossible to communicate with en route captains. More so, captains traveled ahead of information about markets as they neared their destination and were therefore often better informed than merchants at their port of origin (Ojala, 2017). I exploit this in my 'chance encounter' instrumental variable strategy that leverages random encounters between captains at the Sound.

Costs of pioneering. Still, experimenting by traveling to new ports was costly. Building new relationships was costly (Ewert and Selzer, 2016), much like it is costly for present-day firms to engage in exporting (Melitz, 2003). This cost was well summarized in the introductory quote by Crosby (1965) on the first Russo-American trade. Furthermore, in new ports, captains had to understand the bureaucracy and procedures and pay tolls (Springmann, 2016). Talking about the Mediterranean, Abulafia (2011, p.228) remarks that "[i]ts opposing shores are close enough to permit easy contact, but far enough apart to allow societies to develop distinctively under

[17]Telegraph lines connecting Western Europe to the Baltic Sea area only after 1865. The speed of letters sent by post between the North and Baltic Sea region also remained largely constant (Vinnal, 2014, 2018). Information, mainly transported by ships, also flowed slower during winter (Van Tielhof, 2002; Vinnal, 2018).

the influence of their hinterland as well as of one another". Similar things can be said about the Baltic Sea region, as well as its interaction with particularly the North Sea region. Thus, Baltic pioneers face 'foreign lands' but exploring them is not prohibitively costly.

Changes in trading patterns between two towns can occur due to a host of factors. At the extensive margin, pioneers are the trailblazers, but pioneering is highly endogenous, e.g., pioneers may have heard about trade opportunities in that town. Both pioneers and the intensive margin of trade is also influenced by geopolitical factors. For example, after regaining control over Pomerania from the Swedish, Prussia promoted Szczecin as its main port (Scheltjens, 2015b). This discussion highlights the need for both an instrumental variable for pioneering and controls for other factors that impact trade.

1.3.2.5 Guilds and trading networks

Pioneering is closely related to guilds and established trading networks. Pioneers can be seen as breaking with the habit of relying on such types of institutions. In the case of guilds and some networks, pioneers are also *cheaters* in that they break with the rule to not trade with outsiders - the core rule of these institutions. Familial, personal, or ethnic networks, whose importance is highlighted for other trades (e.g., Greif, 1989; Rauch and Trindade, 2002; Trivellato, 2009), were also influential in trade with the Baltic, within or outside guilds. Among guilds, the Hanseatic League or Hanse particularly marked Baltic trade (Dollinger, 1970; Marczinek, Maurer, and Rauch, 2022), especially until the mid-16th century. Dating from the 12th century, the Hanse formed a defensive and trade alliance of, at its peak, 200 towns, mainly in the German Lands, but with important outposts in Russia, Norway, the UK, and the Low Countries.

The Hanse's demise, which occurred already before its last meeting in 1669, is often related to its inflexibility in responding to a changing trade opportunities.[18] Other networks were more dynamic, for example, Roitman (2011) discusses Sephardic Jews based in Amsterdam in the early 17th century who were experimental and flexible in seeking and adapting to trade opportunities. Similar findings emerge for Dutch merchants in Stockholm (Müller, 1998) and Gdansk (Gelderblom, 2003). For the Hanse, it is known that cheating was not uncommon and varied greatly by town

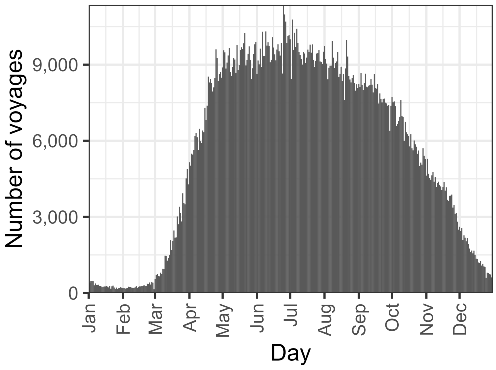
[18] The Hanse (Lindberg, 2007, 2009) and merchant guilds more generally (Ogilvie, 2011) are viewed as providing club goods and as detrimental to growth in early modern times.

(Lindberg, 2009), which I explore in related research (Raster, 2023a). Thus, there was scope for pioneering even in settings that are rigid de-jure.

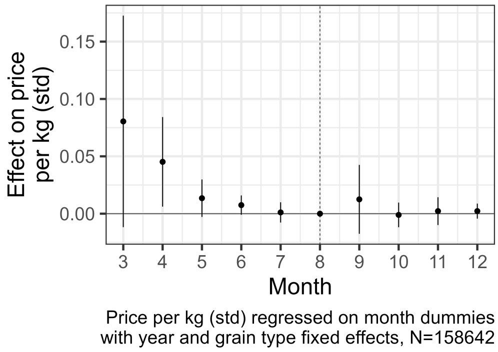
1.3.3 Baltic trade and ice

Figure 1.8: Trade during the icy season

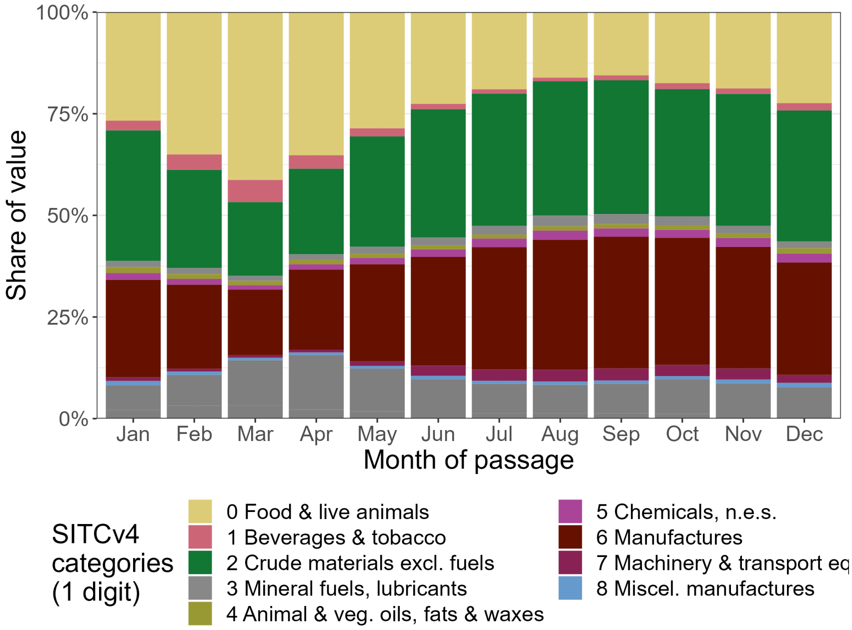
(a) Voyages through the Sound by day, 1500-1856



(b) Grain prices in West. Europe by month



(c) Product mix of Baltic exports by month



Source: author (Sound Toll), product classification as in Figure 1.6.
Notes: Panel 1.8a shows that while most trade occurs during late spring, summer, and early fall, some trade occurs during the icy season (November to April). Panel 1.8b shows that grain prices in the West (as reported by Baltic exports in the Sound Toll) were higher from March through May, which may motivate captains to sail during those months despite the risk of ice. Panel 1.8c confirms that proportionally more grain was exported from the Baltic in the spring.

Given that I will draw on sea ice as a temporary obstruction of trade, it is worth discussing how Baltic trade reacted to ice. In fact, ice played such a major role that it should be addressed in any description of Baltic trade. Most importantly, substantial parts of the Baltic Sea freeze every winter and, as a consequence, Baltic trade came to a near complete standstill. Even after the introduction of the first icebreakers in the 1870s, ice continues to present a treacherous obstacle to shipping even today. During the period of this study, "it was the freezing over of the Baltic that was the most serious hindrance to the transport [...]. Nothing could be done to counteract it; it simply had to be endured" (Evans and Rydén, 2007, p.93).[19]

Why is the Baltic Sea so prone to freezing? The large extent of annual ice in the Baltic can be explained by its northern location, the fact that it is enclosed by large landmasses, its low salinity, and its slow water exchange.[20] Additionally, some of the most important Baltic ports (e.g., Gdansk, Stockholm, Szczecin, and Kaliningrad) are located close to shallow freshwater runoffs or lagoons that are even more prone to freezing. Importantly for the purposes of this study, the Baltic is also prone to stark interannual *variability* in sea ice. As I will show in Section 1.4.3, the annual maximum ice extent ranges between 20 and 85% in Hansson and Omstedt, 2008 reconstructed ice data between 1500 and 1995. Crucially, these interannual swings are not serially correlated:

> *"There is no correlation between consecutive ice seasons because the thermal memory of the Baltic Sea is only 2–3 months. Interannual variability in sea ice conditions is principally driven by the large-scale atmospheric circulation, described by the North Atlantic Oscillation."* – Haapala et al. (2015, p.145)

The North Atlantic Oscillation, the pressure difference between the Azores Islands and Iceland, is, thus, responsible for Northern European ice conditions. Big pressure differences result in comparatively warm winters in northern Europe, while low-pressure differences lead to cold winters. Scientists have only very recently been able to forecast the North Atlantic Oscillation (Smith et al., 2020). For sailors during my period of study, there was certainly no way to forecast ice conditions.[21] These 'ice

[19] Ice classifications distinguish different threat levels that are defined by the risk to shipping. The lowest level indicates a high threat to wooden vessels.

[20] I focus exclusively on the Baltic Sea rather than the North Sea since it experiences more ice on average and is exposed to greater variation.

[21] I confirm in Appendix Table A.8 It was indeed not an interannual correlation in the extent of the ice. Furthermore, Appendix Figure A.15 shows that temperatures only late in the year predict ice.

surprises' are the key feature I exploit in my empirical strategy to obtain exogenous exposure to ports.

The first is *forced wintering*, which occurred if ice conditions did not allow the captains to leave the Baltic before winter. There are many examples of ships that involuntarily winter in the Baltic (see Appendix A.11). One telling piece of evidence is found in English judgments (The English Reports, 1924) that mandate crew compensation in case of forced wintering in the Baltic:

> *"In case of vessels being detained, as my ships have been many times in the Baltic ports, by the ice, and obliged to winter there, the crews are always put on half pay."*
>
> – The English Reports (1924, p.345)

Next to the financial obligations towards the crew, wintering in the Baltic was disliked by the captains and crew who had to hold out in a foreign place.[22] Additionally, vessels could be put to productive use outside the Baltic during the winter, as most other seas were much less prone to ice. Therefore, even for captains and crews originating in the Baltic (Müller, 2012) wintering outside the Baltic Sea was common. Vessels that sailed in the Baltic during spring and summer would, for example, buy wine in France (Davis, 1973) and rice in the Carolinas (Evans and Rydén, 2007) in late autumn and winter when the Baltic was already frozen.

The second 'ice surprise' was *forced rerouting*, which occurred when captains entered the Baltic Sea in the early season (January to April) and were unable to reach their intended destination. Again, Appendix A.11 provides specific examples, including one of a famous reroutee John Quincy Adams who was then the US ambassador to Russia in St. Petersburg.

> *"From Padis Kloster, a short journey brought us on to Baltisport, a small seaport never before acknowledged in the range of my geography, about fifty wersts south of Reval, where vessels land their cargoes before the ice admits them higher."*
>
> –Eastlake (1849, p.113)

[22] As mentioned, captain and crew could also bring their own merchandise on board to sell it at ports, which was not possible during forced wintering.

When faced with ice, ships would try to reach the next ice-free harbor (Eriksson, 2014; Frankot, 2012). There, the vessel's hearth was used to heat until the conditions improved (Eriksson, 2014). Such a change of destination was legal given the before-mentioned flexibility that the captain enjoyed (Section 1.3.2.4). Furthermore, marine insurance, which was increasingly available, particularly in England and the Netherlands (Go, 2009; Rossi, 2019), covered rerouting due to ice as a case of force majeure. Summarizing common English insurance policies, Owen (1883, p.27) states that changing the destination port due to ice does not violate insurance terms: "Should the Navigation be interrupted by Ice, the captain [is] to have liberty to proceed to and discharge at any neighbouring Port." Similarly, Bergsma (1892) states that the loading agreements were void in the case of ice.[23]

Why did captains risk encountering ice? Put differently, why did they not wait until the risk of ice was zero? Plotting voyages through the Sound by day, Panel 1.8a shows that there was a non-negligible number of voyages during the ice-risk period (November to April). There are several reasons why captains would sail during those months. Combined, this evidence suggests that captains were motivated to sail during the early season to benefit from lower purchase and higher sales prices.

First, grains fetched higher prices in Western Europe, as shown in Panel 1.8b for prices recorded in the Sound Toll. In Appendix A.12 I present similar findings for prices observed at ports. Additionally, Panel 1.8c confirms that the Baltic exported proportionally more grain from February through May.

A second reason to sail during the early season is that an early entry into the Baltic Sea is advantageous to also leave earlier in the year, thus avoiding the undesirable wintering in the Baltic:

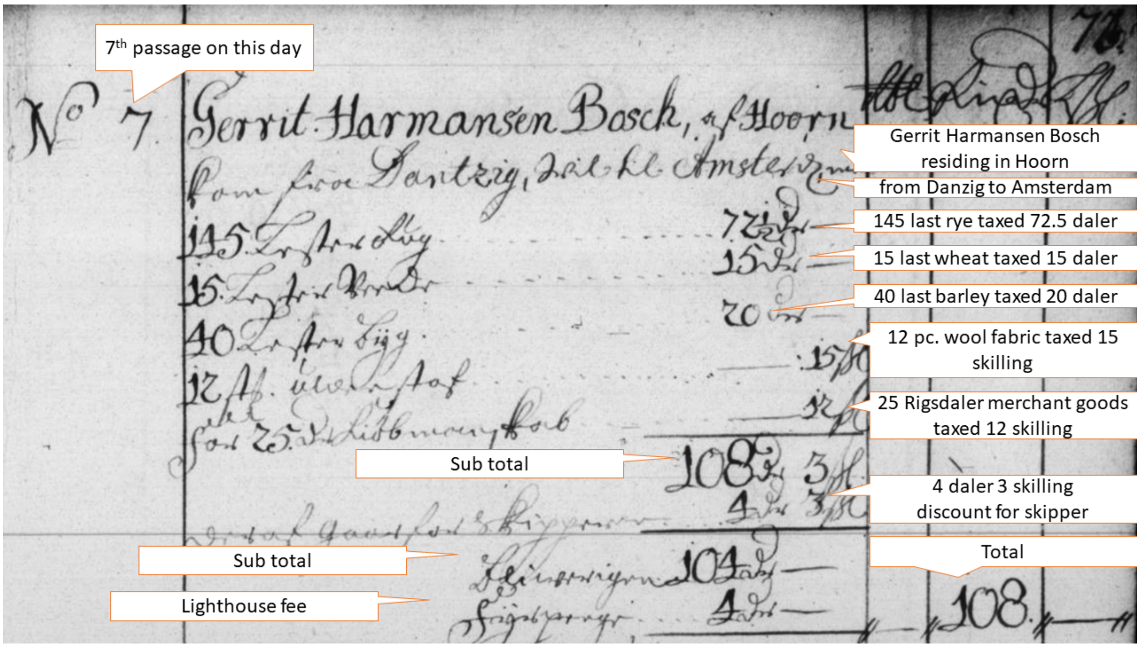
> *"[Baltic-bound traders] were confronted by a circumstance peculiar to the northern trade and dictated by the elements: the importance of timing. A ship bound for a Baltic port, and particularly one sailing to the north-east Baltic, had a tight schedule in which to unload her cargo at her destination, load [...] and get clear of the Sound before the winter weather and ice set in. Any delay could well mean that she would have to spend the winter ice-bound, awaiting the spring. This predicament was to be avoided at all costs [...]."* – Aldridge (1964, p.14)

[23] Generally, insurance premia for winter voyages were higher (Go, 2009; Van Tielhof, 2002)

1.4 Data

1.4.1 The *Sound Toll* - millions of captain voyages

Figure 1.9: Unit of observation: a voyage recorded in the Sound Toll



Source: Sonttolregisters-175_0238 (film), 632752 (record id) with annotations by author. **Notes:** Example of the entry of a ship on April 18, 1711, whose captain resides in Hoorn (the Netherlands) and who I thus classify as an unorganized Dutch trader. All shipments originate in Gdansk and are bound for Amsterdam. A last is approximately equal to 1.8 tons. Shipments can also include the per-unit price.

This paper relies on unusually rich trade statistics recorded by the Danish Crown as a byproduct of its collection the so-called Sound Toll. From 1429 to 1857, the Sound Toll was a tax levied at Elsinore on ships passing through the Sound (Danish *Øresund*); a sea narrow between modern-day Denmark and Sweden and the main access to the Baltic Sea. For each of the more than 1.4 million ships that passed through the Sound, tax collectors recorded information like for the ship that passed on April 18, 1711, whose record is shown in Figure 1.9. First, the ship captain's (Gerrit Harmansen Bosch) and the captain's domicile town (Hoorn, a town north of Amsterdam) are recorded. Second, the origin (Gdansk) and destination (Amsterdam) are listed.[24]. Third, the quantity (145), unit (*Last* $\approx$ 1.8 tons), type of good (rye), and tax amount (72.5 Daler) are listed. Each row represents a different type of good. The tax rate was ad valorem and different rates were applied depending on the type

[24]Destinations are not recorded systematically before 1680, such that most of the analysis is confined to 1680 to 1856.

of good and the origin of the shipment (Degn, 2017a). Typical rates ranged from 1 to 3% of value, and tax collectors relied on the captain's own declaration of the value; however, to prevent fraudulent declarations, the tax collectors themselves had the option to purchase the goods at the declared value. This right to purchase has been shown to reduce the undeclaration of the value of the goods (Kanstrup, 2017).

The example given in Figure 1.9 constitutes the unit of observation of this research, which I refer to as *voyage*. Specifically, I define a voyage as a captain's journey between an origin and destination town. Thus, if the captain is also stating other origin or destination, which is the case in a non-negligible number of cases, multiple voyages can be recorded in a single Sound Toll entry.

The Sound Toll records capture the vast majority of trade between the Baltic and North Seas, the Atlantic, the Mediterranean, and more distant locations, including those on other continents.[25] This is due to several reasons. First, most of the trade was conducted by sea (Jahnke, 2015) since the bulky nature of most of the goods was not suitable for overland transport, which was also subject to tolls and disputes (Jeannin, 1982; Kikuchi, 2018).[26] Second, Denmark prohibited trade through the other waterways connecting the two seas. Given that these other waterways were substantially more difficult to navigate, trade on Danish ships was also minor (Jeannin, 1996).[27] Third, smuggling and fraud were only feasible for light goods (Jeannin, 1996).

Note, however, that the Sound Toll does not capture voyages that do not pass between the two Seas, e.g., a voyage from Stockholm to Saint Petersburg. While trade within the Baltic is important, it is of a different nature given that, as mentioned, the larger comparative advantages could be exploited through trade *between* the Seas (Theodoridis, Rönnbäck, and Scheltjens, 2019). The focus of this paper is thus confined to this type of trade, which also more closely resembles other long-distance trades. The absence of within Baltic Sea trade in the Sound Toll also conceals some of the origins and final destinations of the products, in case of re-exportation. Re-exportation is significant as, for example, grains could and often were shipped to larger entrepôts, such as Gdansk, to then be transported through the Sound to

[25]Comparisons of the STR to port-level trade statistics have demonstrated a good correspondence (Gøbel, 2010).

[26]By the 18th century, even colonial goods were considered bulky rather than costly commodities, given the large quantities they were traded in (Kikuchi, 2018; Rönnbäck, 2010a).

[27]A canal cutting through Sweden was completed in 1832 but was only of minor importance. The more important Kiel canal that traversed Germany was only opened in 1895. Railroads only gradually replaced maritime trade (Alexandersson, 1982; Sombart, 1921)

other entrepôts, such as Amsterdam, from where they were distributed onward.[28] However, the establishment of direct trade links is precisely what this research is concerned with and, as I will show, many new direct trade links were created over the period.

Data preparation. The Sound Toll records, such as the one shown in Figure 1.9, comprise nearly 700 leather-bound books in the Danish National Archives and have been transcribed in an 11-year-long crowd-sourcing project, the Sound Toll Registers online (Veluwenkamp, Scheltjens, Woude, et al., 2021). I spent a significant amount of time manually cleaning and standardizing the Sound Toll data.[29] Importantly, I am the first to classify all products - and their varied, but identifiable spellings - in the Standard International Trade Classification (SITC, revision 4) (United Nations, 2006), as shown earlier in Figure 1.6. This framework allows different levels of aggregation, achieved by changing the number digits of the code, e.g. from code 0, Food and live animals, to code 05456, Cucumbers and gherkins, fresh/chilled. In addition, I identify and convert all measurement units to kilos, using the conversion that is common at the port of origin of the shipment. To this end, I transcribe merchant manuals that reflect the differences in measurement units in different ports (Doursther, 1840; Wagner, 1855).[30]

I also standardized all place names mentioned in the data as either the origin and destination of a product or the captain's domicile, leading to a total of 3084 unique towns and a few broader geographic areas.[31] Particularly in the early periods, towns rather than nations (which still had to rigidify) are the appropriate unit of observation. As Polanyi (1944, p.66) remarks, "the trade map of Europe in this period should rightly show only towns, and leave blank the countryside".

Additionally, I harmonize captain names that, in combination with their domicile towns, I use to link captains across voyages, as detailed in the next Section (1.4.2). While the Sound Toll has been used in a number of studies (e.g., Gomtsyan, 2022; Marczinek, Maurer, and Rauch, 2022; Scheltjens, 2012; Van Tielhof, 2002), to the best of my knowledge this is the first paper to utilize it in its disaggregated form (voyage level), to construct a complete captain panel, or to classify all products.

[28] Similarly, a hinterland was crucial to most towns trade.

[29] The Sound Toll Registers online data are available at www.soundtoll.nl. Additionally, the website provides numerous crucial resources to clean the data that I have used and extended.

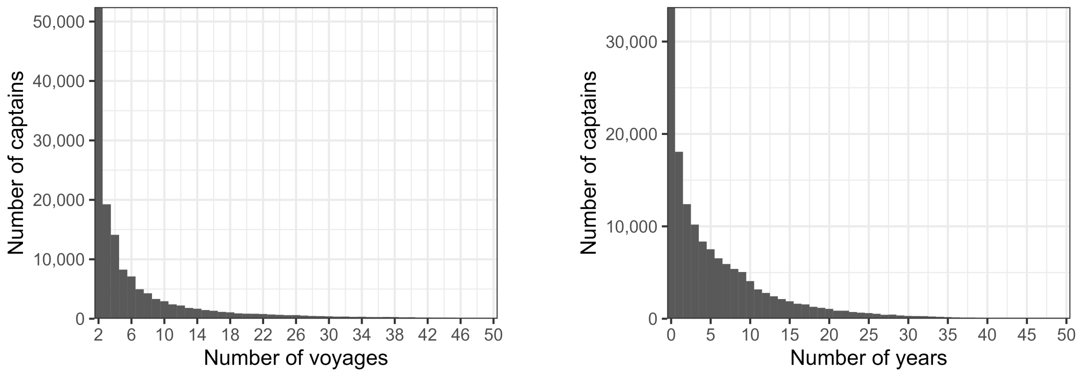
[30] For products made of timber I use the conversions proposed by Gallagher (2016).

[31] I calculate the sea distance (in kilometers) between all locations taking into account the absence of ship canals at the time. In most regression specifications, the few cases where locations denote geographic areas rather than towns are removed.

1.4.2 Captain Panel

Figure 1.10: Career length of captains

(a) Number of voyages **(b)** Number of years



Source: Panel created by matching captains across voyages as described in the main text. **Notes:** Unique captains plotted. Captains not matched are removed. 55% of voyages are matched to at least one other by the same captain.

I construct a panel of captains to study deviations in the habitual ports they sail to, that is, pioneering. Linking captains across voyages is possible since their name and domicile town are recorded for each voyage in the Sound Toll (as shown in Figure 1.9). I harmonize captain names, accounting for common abbreviations of first names (e.g., "Wilh" denotes "Wilhelm"), and by using an adapted phonetic algorithm.[32] I apply five different matching procedures that each rely on different information about the captain: 1) first name, second name, infix, last name, domicile town, 2) first name, infix, last name, domicile town, 3) first name, last name, domicile town, 4) initials, last name, domicile town and 5) first name, last name, geographic area.

The rationale for applying these procedures is to account for certain specificities in the Sound Toll that are documented in the literature (Scheltjens, 2015a) and obvious when inspecting the data. For example, in certain cases, only a captain's initials are recorded, or the captain reports a larger city rather than his small domicile town at the Sound (Scheltjens, 2015a).

For each procedure, I apply stringent checks that rule out false matches, including removing unreasonably long careers and too quick returns from the stated origin town.[33] After applying these checks, I select for each voyage the procedure among the

[32]Phonetic algorithms are particularly relevant as the Danish Sound Toll enumerators sometimes spelled foreign names rather phonetically.

[33]Note that I use the stated origin of a captain's current voyage rather than the stated destination in his potential previous voyage in order to not exclude re-routed journeys. I flag matches as false

five that produces the most matches. Importantly, this automated linking produces links identical to the manual linking done by researchers for a subset of the Sound Toll (Kikuchi, 2018; Vliet, 2015).

In the resulting panel, 55% of the voyages can be matched with at least one other voyage. Figure 1.10 shows the distribution of matched voyages according to the number of times (Panel 1.10a) and years a captain is observed. Apart from irreconcilable differences in name recording across voyages, the unmatched 15% also comprises captains who only made a single trip in or out of the Baltic Sea; in general, or as the captain of a ship.

1.4.3 Sea ice

I focus on Baltic sea ice as a temporary and insurmountable obstacle to trade as described in Section 1.3.3. Baltic sea ice has been reconstructed from 1500 to 1995 by Hansson and Omstedt (2008) and thus fully covers the period for which the Sound Toll data is available (1500-1856). The reconstructions are based on a large climate model that is estimated using numerous meteorological observations and reconstructions (sea level pressure, temperature, humidity, cloudiness) as well as river runoff and ocean forcing data. With all these data as inputs and parameters, the model's predictions are highly accurate.

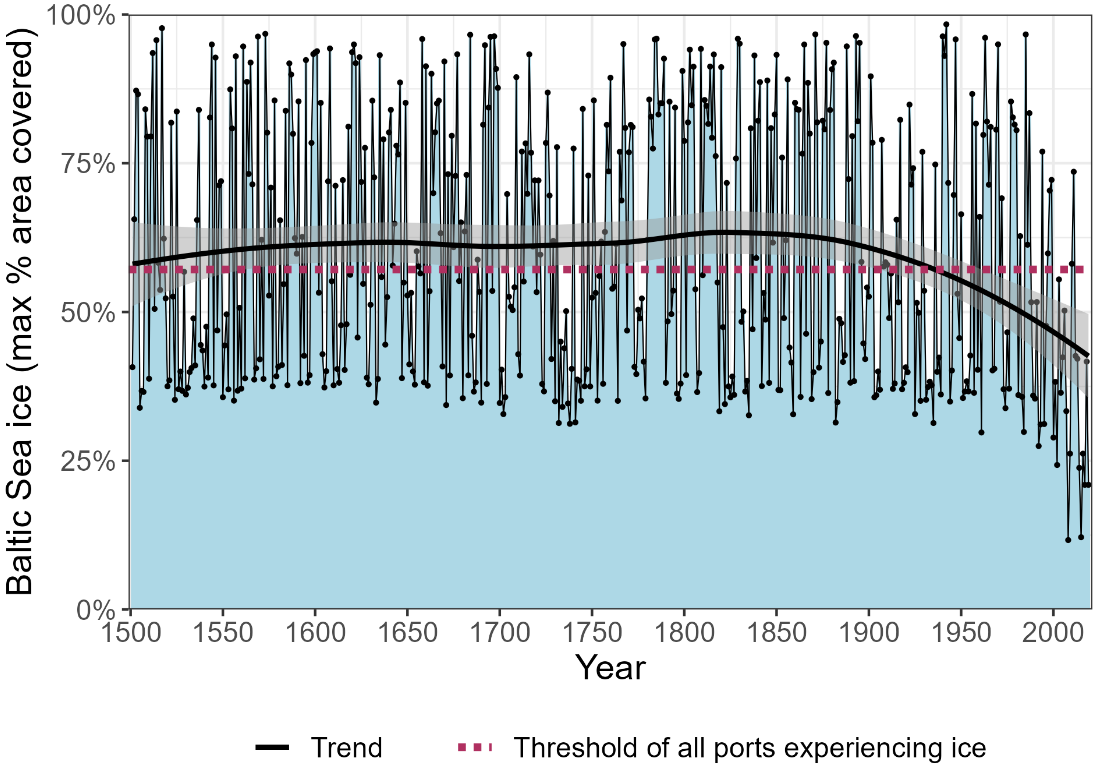
I plot Hansson and Omstedt, 2008 reconstructed annual maximum extent of ice (the share of the surface area of the Baltic Sea covered with ice) in Figure 1.11. The great variation between years, ranging from 11 to 98%, makes it clear that there is no interannual correlation in the extent of the ice. As mentioned before (Section 1.3.3), this is due to the fact that the degree of ice in the Baltic Sea is mainly driven by the North Atlantic Oscillation. The mean extent of the ice (the gray line in Figure 1.11) has remained fairly constant during my period of study, which coincides with the Little Ice Age (1300-1870). After that, the effects of climate changes are clearly visible as the mean maximum ice extent decreased significantly (Hansson and Omstedt, 2008).[34]

I take advantage of this drastic year-to-year variation in Baltic sea ice in my empirical strategy. To construct instrumental variables from the ice data (detailed as part of the

that suggest that the distance to the stated origin to the Sound divided by the time between the two voyages implies a speed of more than 15km/h.

[34]Still, the Baltic Sea occasionally completely freezes, such as in early 1987 when the max ice extent was 96%.

Figure 1.11: Reconstructed annual maximum Baltic Sea ice extent, 1500-2019



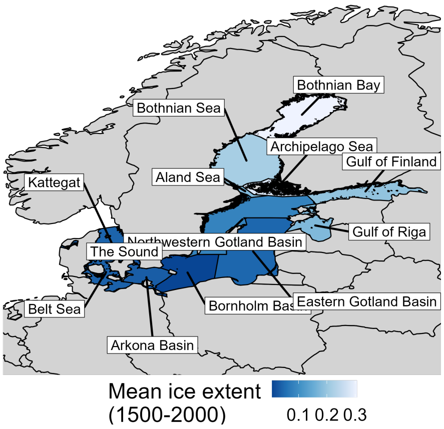
Sources: 1500-1995: Hansson and Omstedt (2008), 1996-2019: European Environment Agency (2019).
Notes: Stark annual variation in ice due to the North Atlantic Oscillation. The dashed line represents the extent of ice needed for all ports to experience ice. The trend line shows that the Little Ice Age subsided after c. 1870 and that climate change led to, on average, significantly less ice.

empirical strategy in Section 1.5.4.2), I draw on more granular data (Omstedt, 2011) that Anders Omstedt kindly shared with me. This data contains the reconstructed extent of ice for each day between 1500 and 1995 for each of the 13 basins of the Baltic Sea depicted in Panel 1.12a.[35] Panel 1.12a shows that the northern basins (Bothnian Bay and Bothnian Sea) and the easternmost basins (Gulf of Finland) on average experience the most ice. Panel 1.12b exploits the daily frequency of the data, plotting the extent of ice throughout the year for each basin. A similar pattern emerges; the basins that face the largest annual average ice extent also experience, on average, the largest daily ice extent, freeze earlier in the season, and take longer to unfreeze. Daily ice cover peaks around the end of February and the beginning of March in the south and west basins.

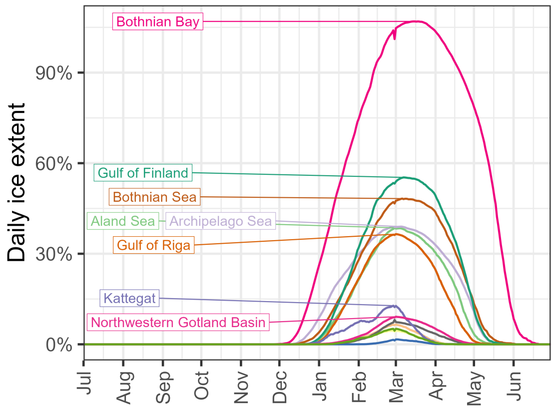
[35] For documentation, see here.

Figure 1.12: Sea ice at different levels

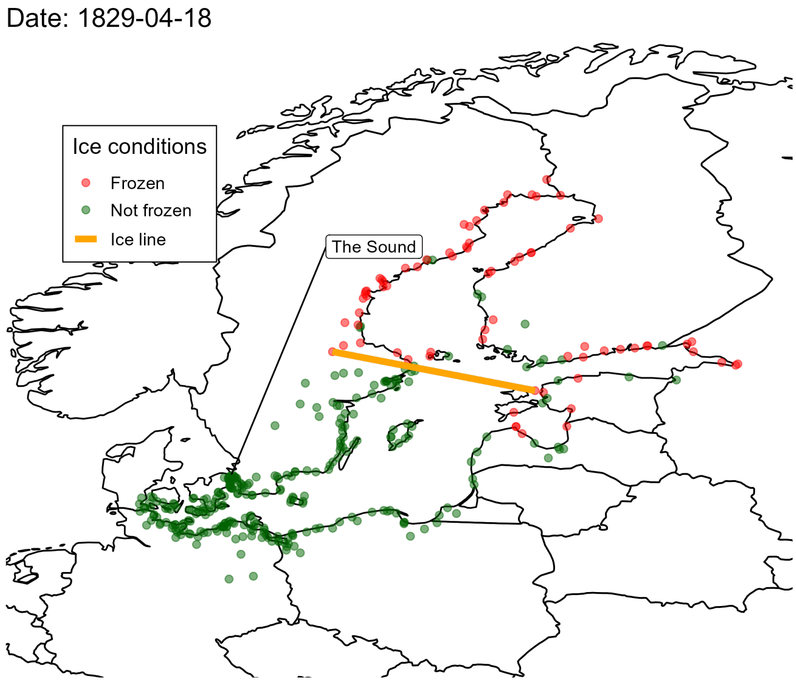
(a) Basin-level mean, 1500-2000



(b) Basin-day-level, throughout the year



(c) Town-day-level based on machine learning model, example day: April 18, 1829



Source: Data provided by Anders Omstedt (Omstedt, 2011) used as input in own climate model.
Notes: This basin-day level reconstructed ice data is used to construct the instrumental variable. See text and Appendix A.6 for details. See here for animations.

In the next step, I transform the extent of the basin-day-level ice to the even finer town-day level. I do so to obtain instrumental variables that connect with the most disaggregated version of the Sound Toll data. To do so, I devise a multistep procedure (see Appendix A.6 for details):

First, I first collect a large amount of archival data on port-level freezing and ice breakup. Such observations were recorded by town officials and meteorological institutes and are found in numerous archival and secondary sources as well as databases. I am able to compile a novel data set that covers annual observations of freezing and ice breakup for hundreds of ports, often dating back to the nineteenth century or earlier.[36]

Second, I merge Omstedt, 2011 extent of the daily ice of the basin with the observed freeze and breakup and dates. With this, I devise a machine learning model that predicts freeze and breakup dates for each season and town using the extent of basin sea ice. The model is trained on a subset and predicts both freeze and breakup dates very accurately with a mean error of -0.2 and 0.1 days, respectively (see Appendix A.6). Panel 1.12c shows an example of a particular winter day in which some ports were frozen while others were ice-free. For animations of an entire season, see here.

1.4.4 Additional data

I also compile numerous additional data that is used as controls in the gravity model, to investigate heterogeneous effects, and as alternative shocks to trade (for the case of wars, plagues, and territorial changes). Data and sources are listed below.

- town population (Buringh, 2021; Kayser, 1939, 1952).
- town-level plague outbreaks (Biraben, 1975; Kallioinen, 2006; Kayser, 1939, 1952; Liisberg, 1901; Noordegraaf and Valk, 1996; Rommes, 2015; Schmid et al., 2015).
- location of battles (Chambru and Maneuvrier-Hervieu, 2022; Kitamura, 2021). I code dummies that indicate whether there was a battle within 10, 25 or 50km of a town in a given year.
- Hanse participation: own collection of the archival notes of Hanse Diet meetings

[36]Note however that port-level ice observations are not available for the majority of ports for the period of this study. Therefore, I resort to predicting the ice conditions in ports using machine learning.

joint with Angela Huang, see Appendix A.8 and Raster (2023a).

- town-level territorial history and reformation year based on Cantoni, Mohr, and Weigand (2019) and manual additions.
- colonial possessions (Becker, 2019) with manual additions of Danish, Swedish, and Russian colonial possessions.
- linguistic distance (Levenshtein distance) constructed from Wichmann, Holman, and Brown (2022). If a country is a colonial possession, I assign the language of the colonizer.[37]

1.5 Empirical strategy

In this research, I combine micro-level trade (at the captain voyage level) with aggregate trade flows between towns.[38]

1.5.1 Town level

To relate pioneering to trade between towns, I use a panel gravity model for my main specifications. Gravity models are the workhorse tool in the trade literature (Head and Mayer, 2014; Yotov et al., 2016) and seek to explain bilateral trade. To account for the large share of zero-trade dyads, I adopt the standard approach and specify the gravity model as a Poisson pseudo maximum likelihood (PPML) model (Santos Silva and Tenreyro, 2006) rather than in log-linearized form. I estimate the PPML model on a version of the Sound Toll that I prepare in two steps. First, I create all combinations of Baltic Sea towns and towns in the rest of the world for each year. Combinations in which both towns are in the Baltic Sea area or outside it are dropped because they are not observed in the Sound Toll data.[39] Second, I collapse the Sound Toll data to town pairs (dyads) and years and merge it with the data created in the first step. Following the PPML literature (Correia, Guimarães, and Zylkin, 2019; Silva and Tenreyro, 2010), I drop dyads of towns that never trade

[37] I code Estonia and Latvia as German-speaking given the large role of German-speaking merchants. The dominance of foreign merchant diasporas in other locations is less clear and is not systematically recorded.

[38] This approach has some conceptual similarities to Gabaix and Koijen (2023) who exploit idiosyncratic shocks to large firms which affect the aggregate.

[39] As mentioned, trade that crossed between the Baltic and North Sea was quite distinct from other trades as it exploited certain large comparative advantages, mainly the land abundance in Eastern and Northern Europe.

with each other. This leaves a sample of more than 4.2 million observations.

Equation 1.1 shows the PPML panel gravity model

Gravity model/second stage:

$$Y_{odt} = \exp(\beta_1 Pioneer_{odt-1} + \mathbf{C'}_{odt}\beta_2 + \pi_{ot} + \chi_{dt} + \mu_{od})\epsilon_{odt} \tag{1.1}$$

for origin town o, and destination town d in year t. Y denotes annual exports from o and d. The coefficient of interest (β_1) is on *Pioneer* is a dummy that equals 1 if at least one captain sailed between towns o and d in the previous year. **C** is a vector of controls, such as outbreaks of the plague, wars, and Hanse participation (see Section 1.4.4). Following the literature (Head and Mayer, 2014; Yotov et al., 2016), I also include fixed effects for origin-year (π_{ot}), destination-year (χ_{dt}), and dyad (μ_{od}).[40] The remaining variation is thus at the dyad year level. ϵ denotes the error term. I also run an event study version (Chaisemartin and d'Haultfoeuille, 2023) of Equation 1.1.

As mentioned throughout this paper, *Pioneer* is likely endogenous; for example, captains strategically search for new trading partners, or towns may strategically attract traders. To overcome this difficulty in identifying causal effects, I zoom in on the circumstances under which the pioneering voyages of individual captains took place. In particular, I employ several instrumental variable strategies that affect pioneering. When using instrumental variables, *Pioneer* is replaced with $\widehat{Pioneer}$ from a first-stage regression at the voyage level that I discuss in the next Section (1.5.2). In this case, Equation 1.1 becomes the second stage.

PPML complicates the use of instrumental variables given an incidental parameter problem when fixed effects are used (Santos Silva and Tenreyro, 2022). As a remedy, I use a control function approach (Wooldridge, 2015) and the iterative two-stage least squares estimator (i2SLS) by Bellégo, Benatia, and Pape (2022). I also report results based on OLS first stages, since the incidental parameter problem decreases in the number of time periods (T), which are many ($T = 356$) in my case. In addition to the Results Section (1.6), these specifications are found in Appendix A.3.

[40] π_{ot} and χ_{dt} account for multilateral resistance terms, i.e., the trade barriers that each town faces with all the towns it trades with. μ_{od} accounts for time-invariant bilateral trade costs, e.g., the bilateral kilometer distance

1.5.2 Voyage-level First Stage

My first stage occurs at the voyage level since the instruments are specific to a captain's voyage. Equation 1.2 presents the first stage from which I derive $\widehat{Pioneer}$ which transforms Equation 1.1 into a second stage.

First stage:

$$PioneerIndiv_{vcodt\tau} = \delta_1 D_{vcodt\tau} + \mathbf{C'}_{vcodt\tau}\delta_2 + \xi_{vcodt\tau} \tag{1.2}$$

for voyage v of captain c from town o to town d in year t on day τ. $PioneerIndiv$ is a dummy that equals 1 if the specific voyage was the pioneering voyage. D is one of three instruments described below (Section 1.5.4): random encounters at the Sound, forced wintering, and forced rerouting. $\mathbf{C}$ is the same vector of controls as in Equation 1.1. ξ denotes the error term.

1.5.3 Captain Habits

To gain a better understanding of the roles of individual captains, I further exploit the captain panel and study deviation from captains' own habits. I follow the approach of Larcom, Rauch, and Willems (2017) who study the effects of having deviated from a modal choice in the previous period on the same individual's choices in the current period. To do so, I draw on the captain panel (Section 1.4.2). I estimate the following model:

Breaking Individual Habits:

$$NonPioneerIndiv_{vcodt\tau} = \gamma_1 PioneerIndiv_{vcodt\tau-1} + \mathbf{C'}_{vcodt\tau}\gamma_2 + \phi_c + \eta_{vcodt\tau} \tag{1.3}$$

for voyage v of captain c from town o to town d in year t on day τ. $\tau - 1$ denotes a captain's previous voyage.$NonPioneerIndiv_{vcodt\tau}$ is a dummy that equals 1 if the captain sails to an established (non-pioneered) port as of $\tau - 1$. ϕ_c denotes captain fixed effects. η is the error term. I also estimate a modified second stage version of Equation 1.3 in which $PioneerIndiv$ is replaced by $\widehat{PioneerIndiv}$ that is instrumented in the first stage (Equation 1.2).

1.5.4 Instrumental variables

Pioneering suffers from endogeneity: captains or towns likely strategically scout out destinations. Similarly, destinations may seek to attract captains. An ideal experiment to estimate the causal effects of pioneering would be sending individual captains to new ports at random or forcing them to stay at existing ports.

My instrumental variable strategies pick up this idea. I exploit random encounters between captain at the Sound that provide captains with up-to-date information about new ports (Section 1.5.4.1). I also exploit the mentioned drastic variability in sea ice (Section 1.5.4.2) that forces some captains to winter at a Baltic port. Other captains who sail in the early season are forced to re-route to different ports.

1.5.4.1 Random encounters at the Sound

Due to a lack of fast communication technology, captains received the most up-to-date information on their journeys. One particular place where this information was obtained was the port of Helsingor on the Sound sea narrow where ships were stopped by tax collectors (Ojala, 2017).[41]

> *"[The Sound played a role] as an information exchange between merchants, shipowners and skippers. The problem of slow communication could, at the time, be mitigated by the practice of skippers sailing between eastern and western Europe meeting each other in the narrow waters between the two areas. The markets, for example, could shift before the skippers reached their destinations, so it was important for the merchants and shipowners to be able to change their destination."* –Ojala (2017, p.19)

In Appendix A.5 I show that the share of shipments from specific towns cannot be systematically predicted within a given month. I set the instrument (*SoundEncounter*) equal to 1 when the pioneered stated destination of the captain matches the origin of an oncoming ship. The instrument is 0 otherwise:

[41] The fact that the large volume of trade at the Sound created rich information flows is consistent with Gomtsyan, 2022 findings that merchants in English towns with more Baltic trade were better informed.

IV1 random encounter:

$$SoundEncounter_{vdt} = \begin{cases} 1, & \text{if } d = o^{\text{oncoming captain}} \\ 0, & \text{otherwise} \end{cases} \tag{1.4}$$

I only consider oncoming voyages as those captains have the most up-to-date information about market conditions. I only exploit encounters on the same day at the Sound.

1.5.4.2 Sea ice

I construct two instruments from the town-day-level Baltic ice data that I construct (see Section 1.4.3). Importantly, these instruments are specific to a captain's voyage, as they vary by the 423 Baltic destination ports and the almost 130,000 days between 1500 and 1856.

The *first* instrument (Equation 1.5) captures 'forced wintering,' that is, the probability that a captain (whose domicile is not in the Baltic) is unable to leave the Baltic due to the freezing of ports. Specifically, this instrument captures the *Days until freezing*:

IV2 forced wintering:

$$\text{Days until freezing}_{dtv} = \text{Ice freezing day}_{dt} - \text{Predicted arrival day at } d_{dtv} \tag{1.5}$$

for a captain's voyage v to a Baltic destination port d in year t. The smaller *Days until freezing*, the more likely a captain is forced to winter at port d and thus is exposed to the port for an extended period of time.

The *second* instrument (Equation 1.6) proxies 'forced ice-induced rerouting,'; the probability that a captain sailing in the early season is not reaching his stated destination. This probability increases in the waiting time that is the *Days until breakup* of ice at the destination:

IV3 forced ice-induced rerouting:

$$\text{Days until breakup}_{dtv} = \text{Ice breakup day}_{dt} - \text{Predicted arrival day at } d_{dtv} \tag{1.6}$$

Both instruments are made up of two components.

First, I predict the freezing day of port d in a given year (*Ice freezing day*) for Equation 1.5 and the day of breakup (*Ice breakup day*) for Equation 1.6.

Second is the predicated arrival date at d, which is composed of the day a captain is reported to pass through the Sound into the Baltic (*Day at Sound*) and the days a captain's journey is predicted to take from the Sound to port d (*Days to d*):

$$\text{Predicted arrival day at } d_{dtv} = \text{Day at Sound}_{vt} + \text{Days to } d_d \tag{1.7}$$

I calculate *Days to d* as the product of the km distance to the destination and an estimate of the travel speed. The travel speed is estimated from the return journeys to the Baltic of the same captain (see Appendix A.6.2). A stable estimate is about 4.68 km/h.

The evidence shown so far (Figure 1.8) has described Baltic trade by month, disregarding the large annual variations in the extent of the ice. In Appendix A.7.4 I provide descriptive evidence of how the ice extent in a given year affects trade. In general, these analyses reveal a very close correspondence between the reconstructed ice extent and trade in the Sound Toll. Overall, despite basing my ice intensity measures on reconstructed data (Hansson and Omstedt, 2008), there is a strikingly close correspondence with Sound Toll shipping; a data source on which the reconstruction had not been based on. In summary, I show that:

- Trade in years with more ice was only reduced between January and April and not throughout the entire year (Appendix Table (A.10). While the empirical strategy primarily relies on *within-year* comparisons, it is nevertheless important that trade in icy years did not differ systematically.

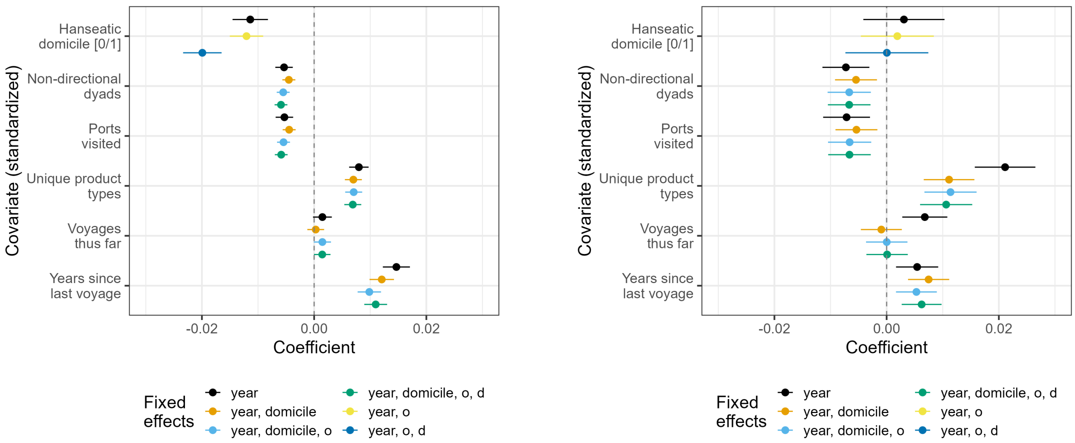
- A higher degree of Baltic sea ice substantially delays the arrival of the first Baltic imports and exports (Appendix Table A.11). The delay is comparable to the variation in ice breakup at ports, suggesting that ships leave almost immediately when ports unfreeze, which is consistent with historical evidence (Evans and Rydén, 2007).

- Important for the rerouting instrument, I show that in years with more sea ice captains ex-ante, i.e. when sailing into the Baltic, declare destinations that are less far into the Baltic Sea (Appendix Table A.12). There is also strong evidence for ex-post rerouting. Captains whose initial stated Baltic destination experienced more ice on their return (west-bound) journey report coming from ports that are less far into the Baltic Sea (Appendix Table A.13). This means that they have rerouted from their initially stated destination to one that is less distant from the Sound, which is on average less affected by ice.

These analyses reveal that ice is highly relevant to trade, but that its effects are confined to the early season. In the early season, ice reroutes trade both ex ante and ex post.

Figure 1.13: Captain characteristics and early-season sailing or sailing into ice

(a) Early-season sailing [0/1] **(b)** Destination frozen at arrival [0/1]



Source: author (captain panel, Sound Toll).
Notes:. At voyage level. Figure shows that captain characteristics do not or only with very small magnitude predict whether a captain sails in the early season (January-April) or when he sails during the early season, whether his destination is frozen upon predicted arrival (Equation 1.6). Combined, this analysis suggests that early-season and those sailing into ice do not systematically differ from the general population of captains, .

One remaining concern is that captains who sail in the early season or who encounter ice are systematically different, e.g. they are more or less experienced. However, Figure 1.13 shows that the characteristics of a captain do not predict systematically sailing in the early season (Panel 1.13a) or sailing to a stated destination that is frozen (Panel 1.13b). The magnitudes of various captain characteristics are very small.

1.6 Results

Results are presented in the following order. First, I show the results from estimating the gravity model of bilateral town trade and pioneering in the previous year as the main variable of interest (Section 1.6.1). I also show the results when pioneering is instrumented by one of the three instrumental variable strategies: encounters, ice-induced forced wintering, and ice-induced forced rerouting. Second, I focus on the exports of towns to investigate the effects of pioneering on trade with pioneered and existing destinations (Section 1.6.2). Third, exploiting the captain panel, I study how (instrumented) affects the habits of individual captains throughout their careers (Section 1.6.3). Fourth, I focus on the mechanisms (Section 1.6.4). I investigate the determinants of pioneering as part of extended gravity (Section 1.6.4.1). Next, I study the determinants of the *success* of pioneered dyads (Section 1.6.4.2). Additional results and robustness checks are found in Appendix A.3.

1.6.1 Gravity model

Table 1.1: Pioneering and subsequent trade - OLS and ice IV

	Trade volume t (# shipments)				
	PPML	IHS	Log+1	IHS - IV	Log+1 - IV
#pioneer	0.006***	0.003***	0.002***		
shipments t-1	(0.001)	(0.000)	(0.000)		
Instrumented				0.100***	0.083***
# pio shipm t-1				(0.015)	(0.013)
N	1,310,334	1,310,334	1,310,334	1,310,334	1,310,334
Adj. R^2	0.783	0.520	0.532	−0.548	−0.553
Adj. R^2 w/o FE		0.001	0.001	−2.103	−2.189

Notes: Gravity model at dyadic town level with dyad, year, origin town and destination town fixed effect. IV: days until ice breakup at stated destination in t-1. Standard errors clustered at dyad, $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table 1.1 shows the results from estimating the gravity model of bilateral town trade and pioneering in the previous year as the main variable of interest (Equation 1.1). The dependent variable is the number of shipments, which proxies for trade volume. The first three columns do use the instrumented number of pioneering shipments on the dyad in the previous period and differ in their specifications: Poisson pseudo-maximum likelihood (PPML Santos Silva and Tenreyro, 2006), inverse hyperbolic sine (IHS), and log plus 1. Given the, for gravity equations common, set of fixed effects (dyad, year, origin town, destination town), the remaining variation is at the dyad-year level.

In all specifications, the number of pioneer shipments on the trade dyad in the previous year is positively related to trade on the same dyad in the current year. The estimates range from 0.6% to 0.2%. When pioneering is instrumented with the wait time a captain would face for the stated destination port to unfreeze ($D_{1,d\tau}$), the size of the coefficient increases substantially. This provides evidence that forced experimentation leads to more successful trade relationships.

Table 1.2 also estimates the gravity equation (Equation 1.1) and uses Bellégo, Benatia, and Pape, 2022 iterative regressions. Relative to the iterative OLS specification (Column 1), the effect of pioneering in the previous year increases 12-fold when instrumented by the encounter IV (Column 2).

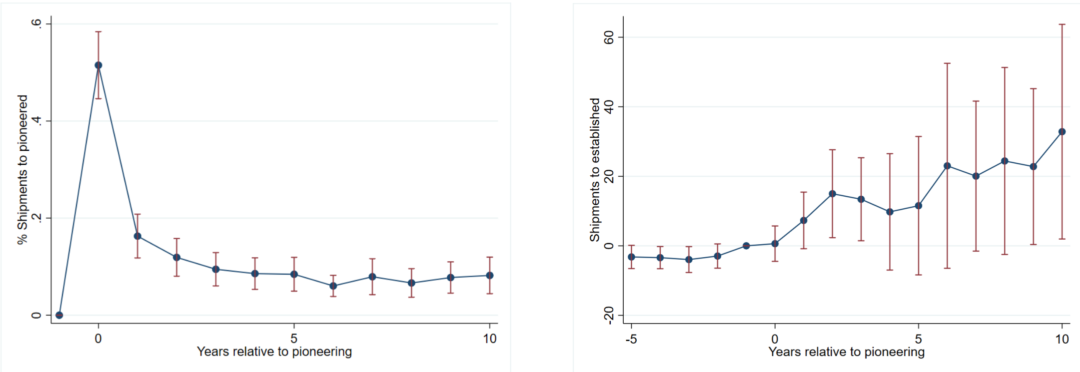
Table 1.2: Encounters with captains, pioneering, and subsequent trade - iterated regressions

	Shipments in t	
	iOLS	i2SLS
Pioneer t-1	0.37***	
	(0.02)	
Inst. Pioneer t-1		4.47***
		(0.13)
Dyad FE	Y	Y
Year FE	Y	Y
Origin FE	Y	Y
Dest. FE	Y	Y
Mean dep. var.	0.93	0.93
SD dep. var.	10.93	10.91
Num. obs.	4,208,864	4,208,864

Notes: Gravity model of town trade. Iterative regressions (Bellégo, Benatia, and Pape, 2022). Instrument is share of oncoming shipments from new ports at Sound. Table shows that effect of pioneering on trade in the next period is substantially larger when instrumented. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Figure 1.14: Event study of pioneering and town exports

(a) Shipments to pioneered **(b)** Shipments to established



Notes: town-level exports dynamic DiD of pioneering (Chaisemartin and D'Haultfoeuille, 2020, 100 bootstraps). Panel 1.14a shows that the pioneered port enters as a representative port in the export mix given the survival rate of pioneered ports of about 12%. Panel 1.14b shows that at the same time, trade with established destinations is not cannibalized.

1.6.2 Town exports

To investigate the effects of pioneering on a towns's total exports, I collapse the data by exporting towns. I consider both trade to pioneered and established destinations. Figure 1.14 plots the event studies of pioneering on trade with the pioneered port (Panel 1.14a) and established ports (Panel 1.14b).[42] The dependent variable in Panel 1.14a is the share of shipments to pioneered. I find that following pioneering, pioneered ports enter the export mix of a town with about 10 to 15% of shipments annually over the next 10 years (Panel 1.14a). As I will show, this matches the average probability of a town. This close match between the extensive and intensive margins implies that pioneered ports, on average, enter the trade mix like existing trade partners.

Panel 1.14b studies the effect of pioneering on exports to established (rather than pioneered) destinations. Here, it emerges that shipments to established destinations appear to not be cannibalized by trade with pioneered locations - by contrast, also shipments to established destinations experience an upward trend. Taken together, these findings suggest that pioneering is persistently positively related to both trade volume to pioneered and established destinations, that is, to an increase in overall trade.

[42]Chaisemartin and D'Haultfoeuille, 2020 DiD estimator allows for such a continuous treatment variable and also incorporates Callaway and Sant'Anna, 2021 estimator. By definition, there is no pre-period for pioneered ports.

1.6.3 Breaking individual habits

Table 1.3: Modal and non-modal ports - captain panel

	Modal_{dt}	Non-modal_{dt-1}	Modal_{dt}
	OLS	1st stage	2nd stage
Non-modal_{dt-1}	-0.57591^{***}		-0.88920^{***}
	(0.00287)		(0.08146)
Max Ice×East km_{dt-1}		0.00008^{***}	
		(0.00001)	
Captain-Sea FE	Y	Y	Y
Year FE	N	N	N
Mean dep. var.	0.59426	0.26237	0.59426
F-stat 1st stage		58.28	
Kleibergen-Paap p-val		0	
Wu-Hausman p-val		0	
N	144169	144169	144169
Number: captain-Sea	33953	33953	33953
Adj. R^2	0.47957	0.19527	0.41609
Adj. R^2 w/o FE	0.29190	0.00140	0.20552

Notes: At captain-voyage level for Baltic-bound voyages. d denotes Baltic destination. Instrument is ice conditions at Baltic destination. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

I now focus on the individual captain level. I study how (instrumented) pioneering influences the behavior of individual captains. Inspired by the 'forced experimentation' literature (Larcom, Rauch, and Willems, 2017), I study how likely pioneering captains are to say to modal ports (those visited before) in subsequent periods. The results of estimating the corresponding model (Equation 1.3) are shown in Table 1.3. Column 1 shows that endogenous pioneering (going to a non-modal port in the previous period) decreases the likelihood of going to a model port in year t by 57%. Column 2 presents the first stage of regressing sailing to a non-modal on ice condition in that town. As expected, the coefficient is significant and positive, indicating that sea ice induces captains to sail to non-modal ports. In the second stage (Column 3), it is apparent that instrumented pioneering makes returning to a modal port 88% less likely - a larger fraction than under OLS, indicating the extra benefits of forced experimentation echoed in the literature.

1.6.4 Mechanisms

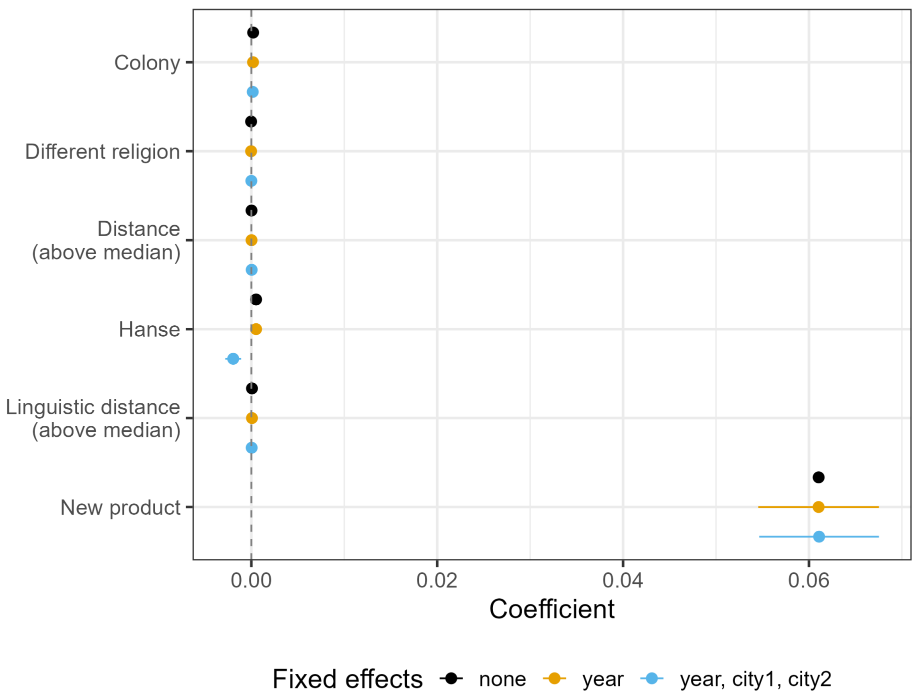
I now focus on the mechanism behind the persistent effects of pioneering on aggregate trade (Sections 1.6.1 and 1.6.2) and individual habits (Section 1.6.3). To this end, I draw on a rich list of common gravity variables that I constructed (see Section 1.4.4) as well as characteristics of the pioneering captains. I divide the analysis in two.

First, I first focus on the determinants of pioneering (Section 1.6.4.1). Second, focus on the determinants of the *success* (intensive and extensive margin) of pioneered trade dyads (Section 1.6.4.2).

1.6.4.1 Determinants of pioneering

What covariates explain pioneering? Figure 1.15 investigates the role played by bilateral port characteristics. Specifically, the coefficient of each covariate is plotted for different combinations of fixed effects. The outcome variable is whether a trade dyad is first active, i.e., pioneered. All trade dyads that have been active for more than a year are removed.

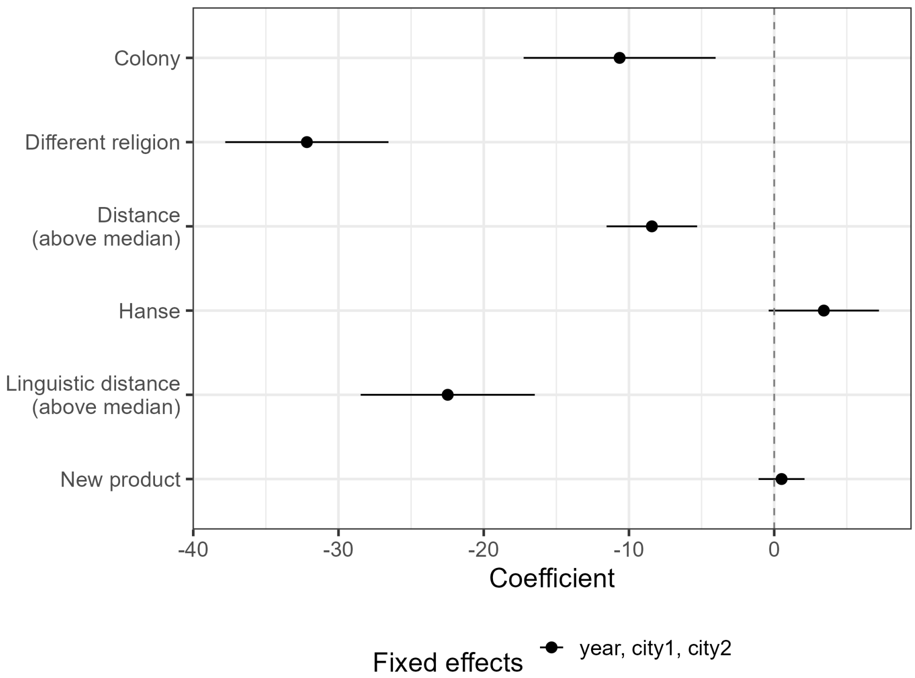
Figure 1.15: Bilateral port characteristics as pioneering determinant



Notes: Figure shows that except for new products, non of the bilateral port characteristics that increase the likelihood of a trade link surviving (Figure 1.17) are endogenously determining pioneering.

Figure 1.16 changes the outcome variable to the order of pioneering. It becomes clear that more dissimilar ports are pioneered only later. The next Section (1.6.4.2) will show, however, that trading relationships with more dissimilar ports have a *higher* likelihood of surviving.

Figure 1.16: Bilateral port characteristics as determinants for which port to pioneer first

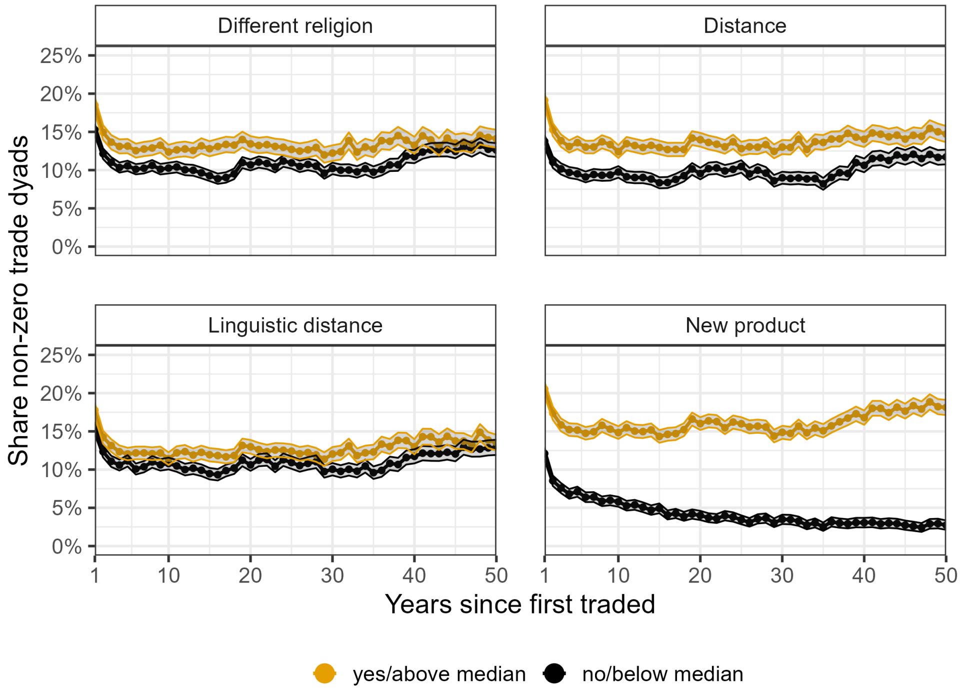


Notes: Figure shows that ports pioneer more dissimilar ports later.

1.6.4.2 Determinants of pioneering success

Figure 1.17 shows that pioneered dyads are more likely to be different the more dissimilar they are and when a new product (from the perspective of the exporting town) is exported on the dyad.

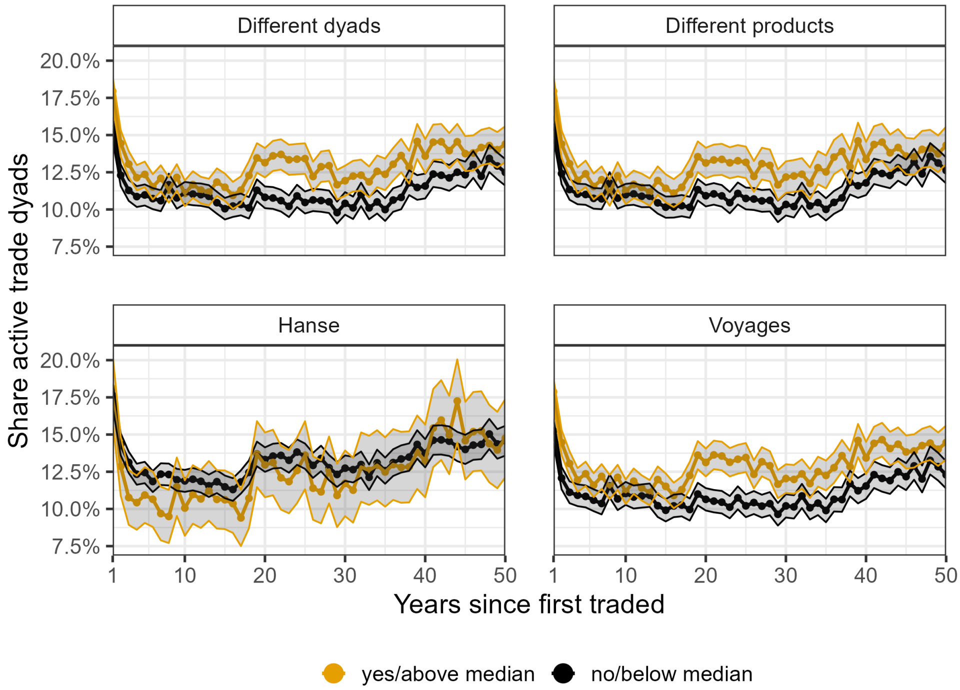
Figure 1.17: Survival of pioneered link by bilateral port characteristics



Source: author (captain panel, Sound Toll).
Notes: Figure plots the survival of pioneered town dyads across 50 years following establishment based on bilateral port characteristics. It shows that pioneered dyads are more likely to survive if their religions differ, the kilometer and linguistic distance is above the median, and particularly when the dyad involves a new product from the perspective of the importer.

Do pioneer characteristics determine the success of pioneered trade links? Figure 1.18 shows that more experienced captains (those who sailed more different dyads, traded in more distinct products, and completed more voyages) create trade dyads that last longer. Thus, in addition to port characteristics, also the characteristics of the individual pioneer captain appear to impact subsequent trade relationships.

Figure 1.18: Survival of pioneered link by pioneer captain characteristics



Source: author (captain panel, Sound Toll).
Notes: Figure plots the survival of pioneered town dyads across 50 years following establishment based on characteristics of the pioneer captain. It shows that more experienced captains create trade links that last longer. Experience is expressed as either the number of different dyads, products, or voyages in a captain's career at the time of pioneering. For captain residing in Hanse towns there is no differential effect.

1.6.5 Effect of pioneering on food security

Having demonstrated that pioneering lastingly shapes trade, I now investigate whether pioneering, through its effects on trade, also has second-order effects. I consider the effect of import pioneering on food security. Specifically, I study whether pioneering new import ports in the Baltic impacts the probability of mortality crises.[43]

To this end, I draw on an annual panel of mortality in English parishes between 1538 and 1838 provided by Wrigley and Schofield (1989). In this data, Wrigley and Schofield (1989) define mortality crises as years during which at least 1 month reached a death rate that exceeded a 25-year moving average of mortality for this particular month and parish by at least 10%. To translate the Sound Toll data from

[43] The existing literature documents that the expansions of infrastructure such as railroads (Burgess and Donaldson, 2010) enhance resilience against famines. By contrast, I study the effects of changes in trade while infrastructure remains constant.

Table 1.4: Pioneering and mortality crises in English parishes

	Mortality crisis [0/1]
	(1)
% pioneer shipments t-1	-0.005^{***}
	(0.002)
Mean dep. var.	0.055
N	24,816
Num. groups: parish	176
Num. groups: county×year	3,948
Adj. R^2 (full model)	0.086
Adj. R^2 (proj model)	0.000

At yearly English parish level. Table shows that parishes that have recently diversified their imports through pioneering experience fewer mortality crises, i.e., they are more food secure. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

the port to the parish level, I consider the five closest ports for each parish (up to 50km) and weigh them inversely to their distance. I apply this procedure to the share of pioneered ports in the Baltic in total imports of English ports.

Table 1.4 shows that when trade in the previous period consisted of more pioneered import trade partners, the probability of a mortality crisis is reduced. Hence, import pioneering is associated with increased food security.

1.7 Conclusion

How does the world become connected by trade? This paper has provided the first causal and long-run evidence for the role of pioneers who first connect two localities by trade. Drawing on millions of captain voyages between Baltic Sea towns and the rest of the world from 1500 to the 1850s, my findings confirm the hypothesized importance of pioneers, demonstrating that pioneers persistently increase exports.

This relevance of pioneers for aggregate trade highlights the role of individuals, who tend to be overlooked in approaches to trade that focus solely on 'gravity' variables such as distance, borders, or tariffs. I show how pioneers interact with these 'gravity' variables and how this can explain the observed path dependence in trade (e.g., Allen and Donaldson, 2022; Morales, Sheu, and Zahler, 2019): when choosing which destination to pioneer, pioneers tend to be biased towards destinations that are less distant (in kilometers, language, religion) from their origin or their existing trade partners. However, more distant trade destinations are more likely to survive in the long run. Such bias among firms has been suggested for firms in 'extended gravity' models, but their implications might be even more severe when the extensive margin of firms determines the extensive margin of entire locations through (the absence of) pioneering.

One may question the relevance of pioneers in modern contexts where institutional protection and communication technology are far superior. These conditions could have resulted in a world that is already sufficiently connected by trade, leaving little scope for pioneering. However, this is doubtful for a number of reasons. Today, only two-thirds of countries trade with each other (Helpman, Melitz, and Rubinstein, 2008, and Panel 1.1a) and borders and distance continue to impede trade (Head and Mayer, 2013; Santamaría, Ventura, and Yeşilbayraktar, 2021). At the same time, the trade of developing countries has grown substantially on the extensive margin since the 1980s (Evenett and Venables, 2002) and especially least developed countries have continued potential to become successful exporters (United Nations, 2008). There are numerous examples of successful pioneers in these contexts (Hausmann and Rodrik, 2003). Future research should further dissect the margins of trade and investigate the, as I documented (Panel 1.3a), staggering 10% of modern-day trade that originates from recent growth on the extensive margin. Additionally, today's increased focus on regionalization as a substitute or complement to globalization (Frankel, Stein, and Wei, 1997; Hirata, Kose, and Otrok, 2013) should also incentivize research on pioneering in regional micro-trade data. In such granular settings, as my sample of towns has demonstrated, the scope of (geographic) pioneering tends to be greater.[44]

Policy makers can create pioneers in various ways, particularly through export promotion. Recent evidence points toward the efficiency of export promotion (Buus et al., 2022; Munch and Schaur, 2018), and most countries engage in some form of export promotion (Lederman, Olarreaga, and Payton, 2010; Martincus and Carballo, 2008). Still, there is too little export promotion and effective targeting is lacking (Department for International Trade, 2022). The findings of this paper suggest more investments in export promotion in order to foster pioneering. These investments should particularly target markets that are more dissimilar from existing ones, as those have higher potential and tend to be selected less by pioneers.

[44]For recent research constructing trade microdata in the EU, see Graff and Raster (2023).

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Chapter 2

From Vagabonds to Virtues: The Ideological Roots of Entrepreneurship

2.1 Introduction

Entrepreneurship and innovation are key determinants of growth (Lucas Jr, 1978; Schumpeter, 1911; Smith, 1776) and therefore important areas of research. Many proposed causes of innovation and entrepreneurship have been studied, including the role of institutions (Elert, Henrekson, et al., 2017), education (Sluis, Van Praag, and Vijverberg, 2008; Squicciarini and Voigtländer, 2015), market structure (Loury, 1979), religion (Squicciarini, 2020), and personal traits (Levine and Rubinstein, 2017). While culture is often proposed as another major determinant of entrepreneurship (McCloskey, 2006; Mokyr, 2009), empirical evidence testing the hypothesis remains scarce.

In a series of influential books, Deidre N. McCloskey hypothesizes that bourgeois values are the key determinant of entrepreneurship, innovation, and growth.[1] McCloskey argues that societies and individuals who look up to inventors and business people are more likely to devote their time and effort to innovation and entrepreneurship, which induces economic development.

In this paper, we test this hypothesis by estimating the causal effect of bourgeois

[1]While McCloskey tends to use the term ‘Bourgeois Virtues’, we have opted to use the more neutral ‘Bourgeois Values’ in the present paper.

values on entrepreneurship and economic success. By observing naming patterns across hundreds of millions of individuals across the US censuses (1850–1950) we are able to construct estimates of bourgeois values. Specifically, we measure to what extent parents choose to mimic the naming patterns of high-income individuals when they name their children. We use this to construct a bourgeois name index (BNI), which proxies for the parents' admiration of the bourgeoisie, i.e., to what extent they have bourgeois values. The BNI compares how frequent a name is among the bourgeoisie and compares it to the frequency among the rest of the population, in a given time period and part of the country. This allows us, for all names included in the census, to estimate how strong a signal it is for bourgeois values among the parents who give it to their children. We validate our measure by showing that it correlates strongly with entrepreneurship and income, even when controlling for parental income, and various fixed effects. In other words, the extent to which parents imitate the naming patterns of the Bourgeoisie can be used to predict their income trajectory even when conditioned on their socioeconomic background.

To identify causal effects, we exploit a unique natural experiment: the road trips of car magnate Henry Ford and inventor and business owner Thomas Edison. Two of the most prominent members of the US bourgeoisie in the early twentieth century, they went on a series of road trips through multiple US states between 1918 and 1924, referring to themselves as the *Vagabonds*. These road trips are described as notable events in the lives of the often very rural locals who lined the streets the *Vagabonds* took (Guinn, 2020). However, crucially, interacting with the local population was *not* the goal of road trips. Instead, the *Vagabonds* sought to enjoy nature, camping, and try the capabilities of Ford cars. As a result of this and the self-reliance of the convoy, route planning was very ad hoc and often in a straight line, providing us with quasi-exogenous variation in exposure to the *Vagabonds*, i.e., the bourgeoisie. We use this variation in a difference-in-differences framework that exploits both spatial (visited and not visited) and temporal (before and after visit) variation.

Our main results estimate the causal effects of bourgeois values on outcomes, such as entrepreneurship and income, by comparing individuals in the same county, year, and age cohort. To obtain exogenous variation in bourgeois values, we instrument them with a dummy variable indicating whether or not an individual lived in an enumeration district close to the itinerary of the *Vagabonds*. Across a variety of specifications, we find evidence of a positive effect of bourgeois values on economic outcomes for the individual. First, we find that being visited by the *Vagabonds* in the

1910s and 1920s is associated with significant increases in income in 1940, the first year for which the Census reports wage income. Using visits from the *Vagabonds* as an instrument for bourgeois values, we find that even moderate increases in bourgeois values can lead to significant income increases in later life. This holds when using wage income in 1940, as well as for occupation-based measures of income in 1930 and 1940. Second, observing the prevalence of employer status among individuals, we find evidence that visits by the *Vagabonds* led to an increase in the rate of entrepreneurship. Our findings indicate a strong causal effect of bourgeois values on entrepreneurship. The results are robust to controlling for race and whether individuals resided on farms, as well as the inclusion of fixed effects for age, county, and year of observation.

To validate that the correlation between visits by the *Vagabonds* and BNI is not spurious, we perform a series of validation checks of the effect on a larger sample and set of controls. Using a difference-in-difference setup, we find that visits from the *Vagabonds* lead to a rise of approximately 0.01 standard deviations of the BNI at the level of individuals. This result is robust to including controls for race, parental earnings, family size, and whether the family was located on a farm. Restricting to the effect of children born to fathers who were in their formative years (aged 14 to 24) when the *Vagabonds* visited and using the same set of controls, we find larger effects of approximately 0.04 to 0.07 standard deviations. By observing the effect by separate birth cohorts, we find that the effects are strongest before the age of 20 and approach 0 as fathers reach the age of 30.

We also measure the development of BNI in the years leading up to and following a visit by the *Vagabonds*, using an event study setup. We find that a visit by the *Vagabonds* leads to a slow, gradual increase in BNI in the following years. We find no significant pretrend of bourgeois values leading up to visits, indicating that selection effects do not drive our results. Observing only children born to fathers who were in their formative years at the time of the visit, we find a more immediate and stronger effect. This indicates that the gradual increase in BNI following a visit is driven by the entry of those most affected by visits into the peak years of childbearing. We find that the development of BNI before and after a visit by the *Vagabonds* is consistent with an ideological influence of the *Vagabonds* on parents.

This paper contributes to several strands of the literature. First, we contribute to a vast literature studying the determinants of entrepreneurship and innovation.

In addition to bourgeois values (McCloskey, 2006, 2010, 2016), other hypothesized determinants of innovation includes institutions (Elert, Henrekson, et al., 2017), education (Sluis, Van Praag, and Vijverberg, 2008; Squicciarini and Voigtländer, 2015), enlightenment values (Mokyr, 2009; Mokyr, 2016; Mokyr and Voth, 2009; Squicciarini and Voigtländer, 2015), market structure (Loury, 1979), religion (Andersen and Bentzen, 2022; Bénabou, Ticchi, and Vindigni, 2022; Squicciarini, 2020) or personal characteristics (Levine and Rubinstein, 2017). To the best of our knowledge, this paper provides the first causal test of the theory of bourgeois values as the key driver of innovation.

Second, we contribute to recent literature that demonstrates the importance of individual leaders in politics (Assouad, 2021; Bai, Jia, and Yang, 2022; Cagé et al., 2022; Grosjean, Masera, and Yousaf, 2021) and religion (Becker et al., 2023). Focusing on Henry Ford and Thomas Edison, we add a new category of leaders to this literature: leaders in entrepreneurship and innovation. We find that exposure to leaders in this category can substantially and lastingly improve entrepreneurship and income. These findings also echo the positive effects of meeting role models [2] on educational attainment (Bettinger and Long, 2005; Breda et al., 2023) and, more generally, adds to an emerging literature that demonstrates how brief idiosyncratic interactions can generate lasting effects (Battiston, 2018; Raster, 2024).

Third, with our first-name-based measure of values, we add to a growing literature that uses first names as markers of values and ideology, such as individualism (Bazzi, Fiszbein, and Gebresilasse, 2020; Knudsen, 2019), nationalism (Assouad, 2021; Jurajda and Kovač, 2021), religion (Andersen and Bentzen, 2022; Becker and Voth, 2023), and ethnic identity (Abramitzky, Boustan, and Eriksson, 2020; Andersen, 2021). To this literature, we contribute a data-driven measure of values that leverages naming for 'admired groups in society'. To the best of our knowledge, we are also the first to study bourgeois values empirically and to use first names to quantify bourgeois values.

This paper proceeds as follows. Section 2.2 details the idea of bourgeois values and how we can estimate them using data on naming and income in the US census. In this section, we also validate the measure by using it to predict individual income, conditional on socio-economic background. Section 2.3 outlines the source and

[2] Like previous studies (Assouad, 2021; Cagé et al., 2022), we note that leaders should not be equated with heroes. For example, Henry Ford was admired for his engineering and business savvy, but also held strong antisemitic views.

construction of the data used in the paper. Section 2.4 details the empirical strategy, highlighting the quasi-random nature of the *Vagabonds'* road trips. Section 2.5 presents our findings. Section 2.6 concludes.

2.2 Using names to measure Bourgeois values

In an influential series of books (McCloskey, 2006, 2010, 2016) Deidre N. McCloskey suggests that the transition to modern growth occurred due to an explosion of innovation and entrepreneurship caused by the spread of bourgeois values in northwest Europe in the 17th and 18th centuries. Throughout history, most societies have seen participation in the market economy as sinful and hard work as degrading, but in the Netherlands and the United Kingdom, commerce and the pursuit of profit came to be seen as laudable pursuits (Koyama and Rubin, 2022). As societies began to admire merchants and industrialists, innovation and entrepreneurship grew as individuals attempted to join their ranks. Thus, McCloskey argues that the ultimate cause of entrepreneurship and innovation was the rise of bourgeois values.

Although culture and values play an increasing role in our understanding of the economy (Nunn, 2012), a major challenge in the field is that values, that is, what individuals and groups deem important in their lives, continue to be immensely difficult to measure. Survey data have many known drawbacks, such as response and social desirability bias, and are only available for very recent historical periods. Given these difficulties, some researchers across disciplines have turned to using first names as proxies for values in historical research (Bazzi, Fiszbein, and Gebresilasse, 2020; Coulmont, 2022; Knudsen, 2019).

In the present paper, we further this literature by devising a data-driven method for constructing measures of bourgeois values, using intergenerational data from the US census. By comparing naming patterns among high-income individuals to patterns in the general public, we are able to construct proxies for the values of hundreds of millions of Americans in the years 1850-1940. Taking advantage of the fact that parents give their children names that are more typical among the groups they admire, as has been established in sociology and psychology (Besnard, 1979; Coulmont, 2022; Seeman, 1983), we are able to measure the bourgeois values of individuals, by observing the degree to which they imitate the naming patterns of high-income individuals. This utilizes the well-documented phenomenon that first names adopted by elites tend to 'trickle down' to the lower classes over time:

> "Upper-class White individuals have distinguished themselves in part through the use of certain names. Lower-status groups may try to appropriate these upper-class names over time." – Twenge, Abebe, and Campbell (2010, p. 22)

Our measure works by constructing naming indices resembling the canonical approach of Fryer Jr and Levitt (2004). Fryer Jr and Levitt (2004) studied the strength of black ethnic identity, by looking at distinctively 'black names', i.e., names with higher popularity among African Americans than among whites. By substituting African Americans with people above a certain income threshold, we are able to construct the 'Bourgeois Name Index' (BNI) using the following equation,

$$\text{BNI}_{n,d,s} = \frac{P(n|\text{Bourgeois})_{d,s}}{P(n|\text{Bourgeois})_{d,s} + P(n|\text{Not Bourgeois})_{d,s}},$$

where BNI is the measure of how 'bourgeois' name n is in state s in decade d. $P(n|\text{Bourgeois})$ is the fraction of people born in the state and decade with the name in the Bourgeoisie, and $P(n|\text{Not Bourgeois})$ is the fraction of people outside the bourgeoisie with the name, in the same state and decade. BNI thus measures how bourgeois a name is by comparing how many percent of children to high-income parents have it relative to children not born to high-income parents. Thus, it can be seen as an indication of the desire among parents to mimic the naming practices of the bourgeoisie. A child is counted as being born in the bourgeoisie if his father has a value of 80 or more on the 'ERSCOR50' variable in the US census at his highest recorded level of earnings. The ERSCOR50 variable takes the median earnings (in 1950) for each job and assigns it a score from 1 to 100 based on what percentile of income the job falls under. ERSCOR50 is used to compare earnings across census years for which there is no direct data on income. In tables 2.1 and 2.2, the most and least bourgeois names are included, ranked by contribution to the average level of BNI.

Table 2.1: Most prominent bourgeois names (frequency-weighted)

	Name	BNI	Frequency
1	Robert	0.67	361655
2	William	0.55	342810
3	Richard	0.69	157705
4	Charles	0.41	211244
5	John	0.18	451380
6	James	0.27	298667
7	Donald	0.51	133301
8	Thomas	0.58	108811
9	David	0.75	65264
10	George	0.25	185608

Notes: Names ranked by highest contribution to the average level of BNI. Ranks are calculated by multiplying the BNI of a name, multiplying with the frequency, and ranking from highest to lowest. BNI in the table is measured by distance to the average in standard deviations (z-score).

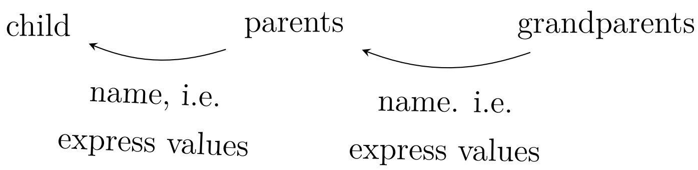
Table 2.2: Most prominent non-bourgeois names (frequency-weighted)

	Name	BNI	Frequency
1	Joseph	-0.25	195935
2	Anthony	-0.93	35283
3	Mike	-1.93	16622
4	Frank	-0.28	112559
5	Willie	-1.54	18033
6	Michael	-0.73	33600
7	Steve	-1.85	12105
8	Stanley	-0.52	39087
9	Charlie	-1.32	14757
10	Andrew	-0.62	28280

Notes: Names ranked by highest contribution to the average level of BNI. Ranks are calculated by multiplying the BNI of a name, multiplying with the frequency and ranking from lowest to highest. BNI in the table is measured by distance to the average in standard deviations (z-score).

Our indices are inherently based on an intergenerational setup. Crucially, we measure *fathers*' ideology as expressed by the name they choose (along with their wives) for their sons; (see Figure 2.1). We look only at the names of men in the paper, as women made up a relatively small part of the official labor market at the time. This implies that to elicit an individual's ideology, they must have had a son in the period in question. Using the naming of children to measure ideology has the advantage that the names of offspring are unlikely directly to influence the labor market outcomes of parents through discrimination, in contrast to the names of the parents themselves, while at the same time being a costly ideological signal, as you can only give each child one (primary) first name. Thus, by observing the names of sons and the occupations of fathers, we can isolate the effect coming from the values themselves. The fact that the census contains a rich set of socioeconomic variables further means that we are able to supplement our analysis with important geographical, demographic, and socioeconomic variables to our analysis.

Figure 2.1: Inter-generational set-up of eliciting values from naming of children



In Table 2.3, we regress the earnings of fathers -as measured by ERSCOR50 - on the names of their children as a preliminary test of the hypothesis that BNI can be used to measure values beneficial to economic success. In the first column, we estimate the relationship using only industry-fixed effects. In the second column, fixed effects for counties, states/year, and the last names of fathers are added. Finally, in column 3, we add controls for race, population, family size, and the education and income level of the previous generation. Across all specifications, we find a large and significant correlation between BNI and earnings. Although this correlation decreases after the controls for geography and socioeconomic background are added, the effect remains sizeable.

2.3 Data

This paper draws on two main sources of data. First, the US Census, which contains individuals' first names and a host of socioeconomic information. Second, the treatment in our natural experiment, the road trips of the *Vagabonds*.

Table 2.3: Bourgeois Values and Earnings

	Father earnings score		
	1	2	3
BNI (of sons)	29.87 (1.50)***	7.88 (0.62)***	5.88 (0.57)***
Pop county			−0.00 (0.00)*
Black			−9.37 (0.64)***
# siblings			−0.43 (0.03)***
Grandfather education			−0.08 (0.01)***
Grandfather earning			0.19 (0.01)***
Industry FE	9	9	9
County FE	*NA*	658	658
State*Year FE	*NA*	36	36
Father last name FE	*NA*	36429	8870
Mean dep. var.	49.37	49.37	50.45
SD dep. var.	13.97	19.01	21.96
N	7746293	7746293	732339
Adj. R^2 (proj model)	0.01	0.00	0.11

Notes: OLS regression of father's earning on BNI of sons. Data from the United States Census. Included individuals are males observed from 1900, 1910, 1920 and 1940. For descriptions of the construction of BNI as well as census and family linking, see the main text. Fathers' Earnings are measured by the erscor50 variable based on occupations. # siblings according to the concurrent number of siblings that co-habit. Educational status of grandfathers based on the edscor50 variable in the census. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. Standard errors clustered at the country level.

2.3.1 Names and socio-economic variables in the US census, 1850-1940

Our analysis uses data from the full non-anonymized US census for the years 1850-1940.[3] Crucially, the secure access of the census (Ruggles et al., 2021) contains the first and last names of all individuals living in the US for each census year. We exploit the widely-used NYSIIS algorithm to standardize names and spelling (Abramitzky, Boustan, and Eriksson, 2020). Our method improves on the current version of the algorithm by differentiating between names with the same consonants, such as "Jan" and "Jon", while we continue to pool different spellings of the same name, such as "Jon" and "John", as is the original purpose of the NYSIIS algorithm.

We are able to identify links between fathers and sons across multiple census years, by

[3]The 1890 census is lost. The 1950 census has just been made available to researchers and will be included in a future version of this research.

combining previous work on census linking (Abramitzky et al., 2021) with information on family links in the census. By doing this, we can measure the BNI of individuals from their children's names, even in cases where no children are in the household in the census year of recording. Since this can be done across multiple generations, it also allows us to control for socioeconomic background between generations.

The census also contains data on a series of geographic, demographic, and economic outcomes that we leverage in our analysis. First, it contains data on county of residence, rural status, farm status, city incorporation status, city population, latitude, and longitude. Second, the census contains information on race, birth year, birthplace, and age, as well as information on family relationships, such as the number of parents or siblings with whom the individual co-habitants reside. Finally, the census contains a well of information on the economic status of individuals. In addition to the ERSCOR50 variable used to construct the BNI, these data include income (for 1940), self-employment status, employer status, educational status, and occupation. These data allow us to analyze the effect of bourgeois values on a series of occupational and economic outcomes, while including extensive controls at the level of the individual, county, and state.

2.3.2 Road trips of the *Vagabonds*, 1914-1924

To derive quasi-exogenous variation in bourgeois values, we rely on the Road trips of the *Vagabonds*, Henry Ford and Thomas Edison, in the US between 1914 and 1924. Route planning was very ad hoc and did not factor in the local population for whom a visit by the *Vagabonds* was a life event. We show evidence in support of this claim in a later Section (2.4.1) as part of the discussion of our empirical strategy. In the present Section, we outline the data used to reconstruct the *Vagabond's* precise itinerary, including stops and camping spots. We also visualize all road trips and describe their broad geography.

We are able to identify hundreds of waypoints on the itineraries of the *Vagabonds'* road trips from travelogues summarized in Brauer (1995) and Guinn (2020). The waypoints are so numerous that we can establish the precise road that the *Vagabonds* took between them. Using these data, we plot the exact route for each trip, the result of which is presented in Figure 2.2. Panel 2.2a maps all nine of the *Vagabonds'* road trips. Among those, we exclude the first two (1914 and 1916) since those road trips only lasted a few days, were close to the property of the *Vagabonds'*, and involved sections by train and boat that did not involve contact with locals (Guinn, 2020). Among the remaining seven road trips, one took place in Appalachia (1918), traversing Pennsylvania, Ohio, Maryland, West Virginia, Virginia, Tennessee, and North Carolina. Panel 2.2b maps the reconstructed route of this trip ´in the Land of the Dixie' (Brauer, 1995, p.61). Another road trip (1923) went through Michigan, including the Upper Peninsula. The remainder of the road trips took place in or near New England.

We transpose the routes of Figure 2.2 onto the census enumeration districts, a sub-county geographical unit. Specifically, we calculate the distance from the centroid of each enumeration district to the nearest visit by the *Vagabonds*. For all road trips, we exclude entire counties that had any business venture of one of the *Vagabond's*, e.g., Dearborn, Michigan, the headquarters of the Ford operation.[4]

2.4 Empirical strategy

The main objective of our empirical strategy is to estimate the effect of bourgeois values on economic outcomes, such as entrepreneurship or income. Equation 2.1 depicts the corresponding OLS regression

$$Y_{i,t} = \beta \text{BNI}_{n,d,s} + \theta \mathbf{X}`_i + \gamma_c + \chi_t + \rho_b + \epsilon_i, \tag{2.1}$$

where Y is an outcome (such as income) for a male individual i observed in time t, born in year b, and living in county c. BNI is our measure of bourgeois values, as discussed in Section 2.2. $\mathbf{X}`$ denotes a vector of demographic and intergenerational controls for individual i, such as race and a dummy if the person lives on a farm. γ, χ, and ρ denote fixed effects for individuals born in county c, in year b, and who are observed in census year t, respectively. ϵ denotes the error term.

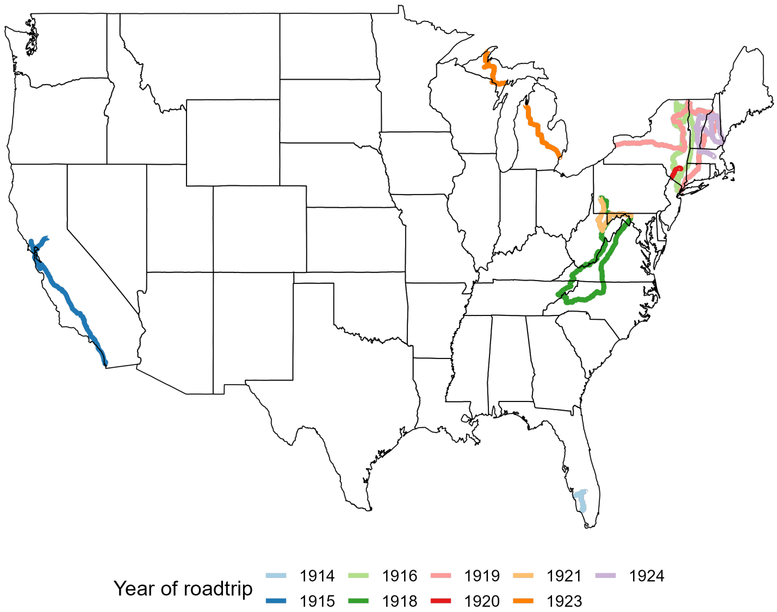
2.4.1 Instrumenting bourgeois values: Exposure to the *Vagabonds*

In Equation 2.1, BNI is endogenous, as it is determined by a host of socioeconomic and demographic factors that are likely to be correlated with ϵ, and we cannot rule out endogeneity concerns, even for restrictive controls and fixed effects. As a solution, we pursue an instrumental variable strategy in which we instrument BNI with the

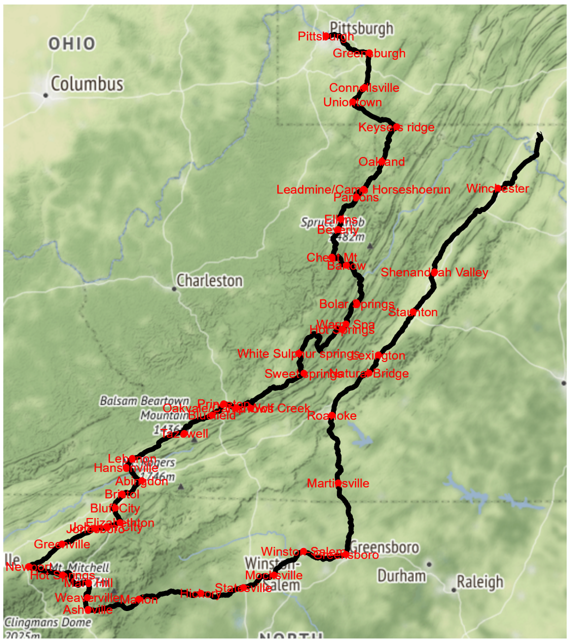
[4]Other excluded counties include those with any other Ford or Edison company operation, as well as the residences or any other properties of any of the *Vagabonds*.

Figure 2.2: Itineraries of the *Vagabonds*'s road trips

(a) All road trips



(b) Example road trip: 'The Vacation Days of 1918 in the Land of the Dixie'



Source: Authors' digitization of Brauer (1995) and Guinn (2020).
Notes: The *Vagabonds* first road-tripped in Florida, then in California, before settling on East Coast itineraries and making one trip through Michigan. In our analysis, we exclude the Florida and California road trips (1914 and 1916) since those road trips only lasted a few days, were close to the property of the *Vagabonds'*, and involved sections by train and boat that did not involve contact with locals.

timing and proximity to the itinerary of the *Vagabonds*. Specifically, we estimate the following first-stage equation,

$$BNI_{i,t} = \alpha \text{Vagabonds}_{n,d,s} + \phi \mathbf{X}`_i + \gamma_c + \chi_t + \rho_b + \eta_{i,t}, \tag{2.2}$$

where Vagabonds is our instrumental variable: a dummy that equals one if the *Vagabonds* passed within 20 kilometers of an individual's home. It equals 0 for the control group, which comprises individuals living between 20 and 100 kilometers of the *Vagabond's* route. η denotes the error term. For $Vagabonds$ to serve as a valid instrument, it needs to be both relevant in predicting BNI and exogenous, as we discuss below.

Relevance. Numerous sources document that even for localities where the *Vagabonds* did not stop, their passing by was highly publicized and constituted a major event for locals (Brauer, 1995; Guinn, 2020) as highlighted in the following quote:

> "All over America, locals hoped to glimpse the Vagabonds' car caravan cresting hills or crossing bridges into their towns. The group's arrival anywhere was always cause for celebration." – Guinn (2020, p. 262)

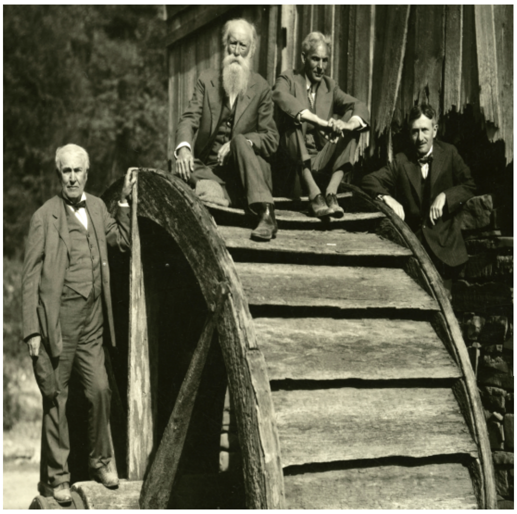
Figure 2.3 reproduces some photos from the *Vagabond* road trips. It provides further evidence of how the *Vagabonds*, depicted in Panel 2.3a, made an impression on locals. Panel 2.3b shows the long motorcade used by the *Vagabonds* that locals who lined the streets could see. Panel 3c depicts a typical camp of the *Vagabonds*. The extent to which the *Vagabonds* interacted with the people they passed is illustrated in Panel 2.3d, where Henry Ford is being cheered by the locals. Given the historical evidence of how impressive these visits were on the local inhabitants, we find the results below on the magnitude of the effect on their values to be plausible.

Exogeneity. Besides relevance, the other requirements for the instrumental variable, $Vagabond$ visit, are that it is exogenous and that it does not affect outcomes through any channel other than bourgeois values.

Regarding the exogeneity of the *Vagabond* visits, it is key that interacting with the local population was not the goal of the road trips. Instead, the *Vagabonds* sought to enjoy nature. In fact, John Burroughs, a naturalist and leader in the conservation movement in the United States, accompanied and provided explanations to the *Vagabonds* on their trips until his death in 1921. Ford, in particular, enjoyed interacting with nature and often went fishing or chopped wood in the proximity of

Figure 2.3: Photos from the *Vagabonds'* road trips

(a) From left to right: Thomas Edison, John Burroughs, Henry Ford, and Harvey Firestone



(b) Motorcade

(c) Camping

(d) Ford interacting with locals

Source: Photos reproduced from Brauer (1995).
Notes: Panel 2.3a shows the members of *Vagabonds*. Panel 2.3a shows the motorcade in which the *Vagabonds* traveled and which locals could observe. Panel 2.3c shows the camping setup used by the *Vagabonds* which was their preferred form of overnighting. Panel 2.3d depicts an euphoric crowd that came to see the *Vagabonds*.

the *Vagabond's* campgrounds.

What further supports the exogeneity is the ad hoc route planning of the road trips. This is related to another key aim of the road trips, which was to explore the capabilities of Ford cars:

> "Edison never chose a comfortable route if a rocky road was available"
>
> – Brauer (1995, p. x)

As a result, route planning was very ad hoc:

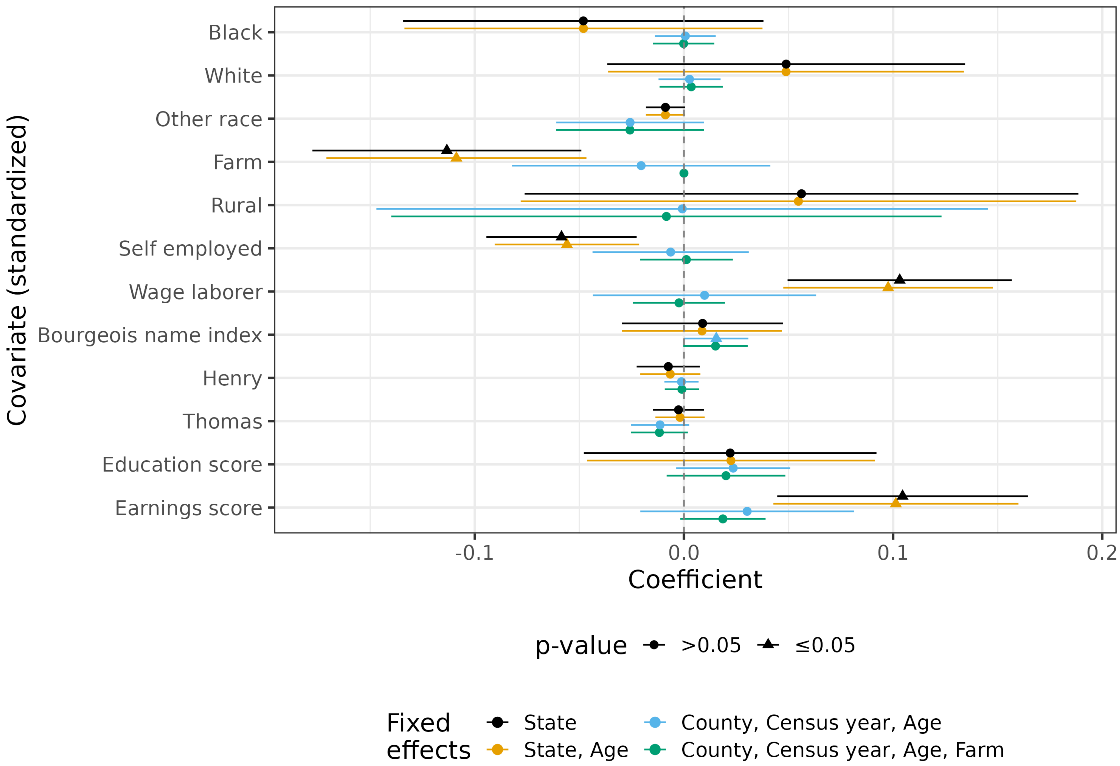
> "He [Edison] writes us, giving the route, then he writes again, giving another route and when we actually get started, he usually selects a third route. We are kept guessing where we are going and I suspect he does also!"
>
> – Harvey Firestone quoted in Brauer (1995, p. x)

Oftentimes, navigation was done, in Edison's words, by "steer by sun and compass only" (Guinn, 2020, p. x).

What enabled the *Vagabonds'* ad hoc route planning was also the fact that they did not rely on local resources. Given the low prevalence of motorized vehicles at the time, gas stations were not ubiquitous. As a result, the motorcade of the *Vagabonds* was self-sufficient for fuel and food (Guinn, 2020). Additionally, given the travel party's interest in nature, they also rarely slept in hotels, preferring to camp, which meant that they had minimal economic interactions with the places they passed.

To further test the claim that the *Vagabonds* did not systematically select localities, we run a balancedness test that contrasts the characteristics of visited and unvisited enumeration districts. Formally, we regress (standardized) co-variates on a treatment dummy indicating whether an enumeration area was visited using various sets of fixed effects. Figure 2.4 shows the results. Across the vast majority of specifications, the enumeration district characteristics are balanced.

Figure 2.4: Balancedness test: characteristics of enumeration districts visited and not visited by the *Vagabonds*



Notes: Comparison of the characteristics of the visited and unvisited enumeration districts for different combinations of fixed effects. Figure shows that for our preferred set of fixed effects (County, Census Year, Age or (County, Census Year, Age, Farm), enumeration districts visited by the *Vagabonds* do not systematically differ from those who were not visited.

Given these ad hoc route choices, we argue that it is quasi-exogenous whether a specific county or an adjacent one was on the route of the *Vagabonds*.

It is conceivable that visits by the *Vagabonds* affected outcomes such as entrepreneurship or income through channels other than bourgeois values. This would violate the exclusion restriction. It is crucial that the *Vagabonds* did not invest in the localities they visited during road trips[5]. Nor did they lecture locals about technology or business. Therefore, we argue that the treatment was solely the presence of two famous individuals representing the elite of business and engineering.

[5]We exclude counties with the Ford mills in the Michigan Upper Peninsula.

2.5 Findings

This section contains our main findings. First, we show the effect of *Vagabond* visits on bourgeois values (Section 2.5.1). Second, we study the effect of (instrumented) bourgeois values on economic outcomes (Section 2.5.2).

2.5.1 Effect of *Vagabond* visits on bourgeois values

In this section, we will see how visits from the *Vagabonds* led to an increase in Bourgeois Values, as measured by the first names parents give their children. As a first step, we run a difference in difference regression of BNI, comparing the naming of children before and after visits from the *Vagabonds*, using the following equation,

$$\text{BNI}_{n,d,s,i} = \beta_1(\text{visit} \times \text{post}) + \beta_2(\text{post}) + \beta_3(\text{visit}) + \theta \mathbf{X}`_i + \alpha_l + \rho_b + \sigma_s + \epsilon_i, \quad (2.3)$$

where BNI is the (z-score of) the value of the BNI for name n for individual i born in decade d in county l in state s. $\mathbf{X}$ is a vector of demographic and family-level controls. α, ρ, and σ denote county, birth year, and state fixed effects, respectively. ϵ_i is the error term. Finally, $(\text{visit} \times \text{post})$ is a dummy variable that takes the values 1 if the *Vagabonds* passed within 20 km of the location of individual i, before they were born and 0 otherwise, post is a dummy variable that takes the value 1 if the nearest visit by the *Vagabonds* of individual i had happened before their birth (even if not within 20 km) and 0 otherwise, and (visit) is a dummy taking the value 1 if the *Vagabonds* passed within 20 km of the location of individual i before or after their birth. The idea is that β_1 captures the effect of visits by the *Vagabonds*, while β_2 and β_3 will capture any systematic differences that arise from the timing and location of births that are not related to the *Vagabonds*. To have a comparable control group, we limit the data set to places where the *Vagabonds* passed within 100 km and only people born within 10 years of the visit. Cities with more than 500.000 individual residents in 1920 are also excluded from the data. We also exclude all people not born in their state of residence at the time of observations, as their parents may not have been 'treated' by the *Vagabonds*. Individuals identified in multiple census years are counted only once.

Table 2.4: Effect of Vagabond Visits on Bourgeois Values

	Bourgeois Name Index			
	Did	Did	Did - Formative Years	Did – Formative Years
Vagabond visit	0.010***	0.013***		
	(0.003)	(0.004)		
Father visited formative years			0.069***	0.040***
			(0.004)	(0.004)
Born after visit	0.011*	0.009	0.004	0.011*
	(0.007)	(0.006)	(0.007)	(0.006)
Black	−0.224***	−0.158***	−0.227***	−0.158***
	(0.011)	(0.009)	(0.010)	(0.009)
Other race	−0.074***	−0.018	−0.073***	−0.018
	(0.024)	(0.028)	(0.024)	(0.028)
Lives on farm	−0.112***	0.123***	−0.113***	0.124***
	(0.003)	(0.004)	(0.003)	(0.004)
Number siblings		−0.030***		−0.029***
		(0.000)		(0.000)
Father earning score		0.007***		0.007***
		(0.000)		(0.000)
Mean dep. var.	−0.000	−0.000	−0.000	−0.000
SD dep. var.	0.167	0.243	0.168	0.244
N	8,520,007	6,068,683	8,261,745	6,068,683
# FE birth year x State	462	462	462	462
# FE county	503	503	503	503
Adj. R^2	0.028	0.059	0.028	0.059
Adj. R^2 w/o FE	0.004	0.035	0.004	0.035

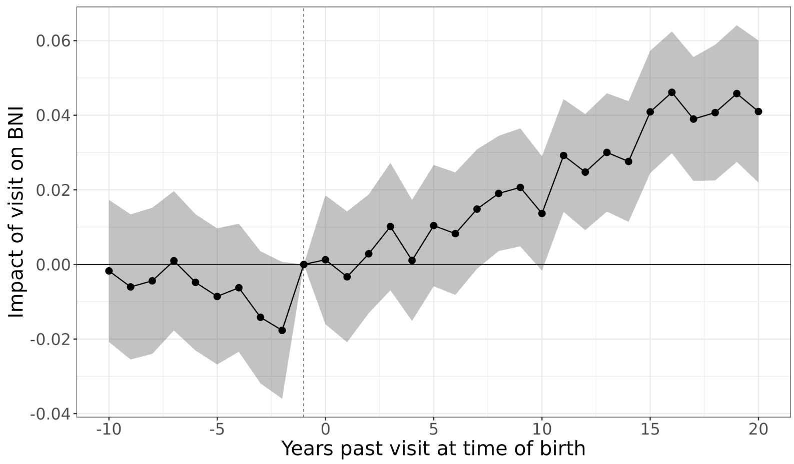
Notes: At individual level. Table shows that *Vagabond* visits increase bourgeois naming. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1,940 Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

The regressions from Equation 2.3 can be seen in Table 2.4. In column 1, only controls for race and whether or not individuals live on a farm are included. In column 2 family controls, including the number of siblings and fathers' earnings (based on the ERSCOR50) are added. In either case, the effects of visits from the *Vagabonds* are highly significant, with a visit associated with a rise in BNI of 0.010 and 0.013 standard deviations, respectively. As an alternative specification, we analyze the effect of visits by the *Vagabonds* as an event study. We do this using a series of dummies for each year before and after visits by the *Vagabonds* instead of the simple difference in difference setup, using the following regressions Equation

$$\text{BNI}_{n,d,s,i} = \sum_{k \neq -1, k \geq -10}^{20} (\beta_k TTV) + \theta X`_i + \alpha_l + \gamma_{b,s} + \epsilon_i, \tag{2.4}$$

where $\sum_{k \neq -1, k \geq -10}^{20} (\beta_k TTV$ is a series of dummies (and coefficients) corresponding to the years before and following a visit from the *Vagabonds*, and all other variables are defined as in 2.3. The results of the analysis–using the full set of controls–can be seen in Figure 2.5. The version with minimal controls can be seen in the Appendix Figure C.1.

Figure 2.5: Effects of visits by the *Vagabonds* on Bourgeois Values



Source: Sample restricted to areas within 100 km of a visit by the *Vagabonds*. We exclude individuals living in cities with a population of more than 500,000 in 1920, born in different states, and counties in which one of the *Vagabonds* had. Individuals born more than 10 years before or more than 20 years after visits are not included in the data. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.
Notes: Event study of the effect of visits by the *Vagabonds* on bourgeois values, which are measured by the BNI of children born in a given year. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it. Specification controls for race, number of siblings, father's earnings, and fixed effects for county and birth year interacted with State.

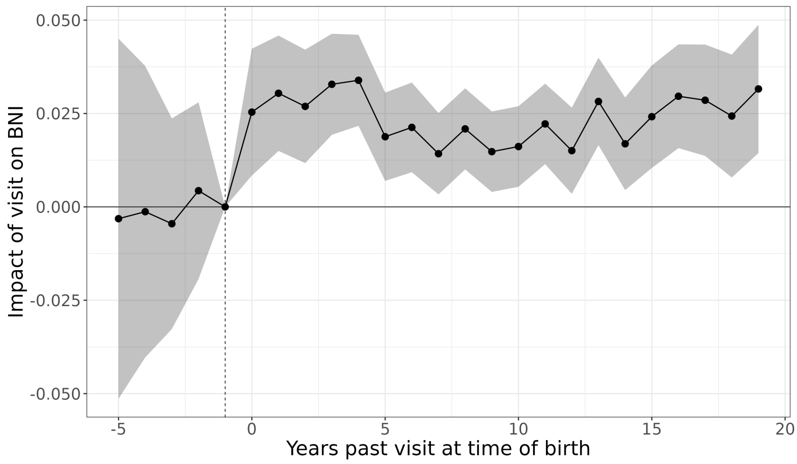
In the ten years leading up to visits from the *Vagabonds*, locations about to be visited did not show different levels or trajectories of BNI, but following visits by the *Vagabonds*, the percentage of people with bourgeois names began to increase steadily.

All of the above exercises assume that citizens–or potential parents–would be equally receptive to ideological influences, but the literature suggests that people are more receptive to such influences in late adolescence and early adulthood. In Ghitza, Gelman, and Auerbach (2023), the authors find that 14-24 are the years in which political events are more likely to influence political ideology in later life. Using this age range, we can perform the above analysis once more, but now only consider people who were visited by the *Vagabonds* during their formative years as being treated, which we do in column 3 of Table 2.4 controlling only for race and whether individuals lived on a farm. In column 4, the full set of family controls is added. In both cases, the results are significant and show much larger effects than in the specifications in columns 1 and 2. This indicates that individuals are indeed more susceptible to ideological influence during their formative years.

The event study in figure 2.5 can also be redone, treating only those children who were born to fathers visited during their formative years as treated. This we do in figure 2.6. In this specification, we also introduce fixed effects for the age of the fathers, so that our results are not driven by the effect of the father's age itself. Because the number of people who were in their formative years during the visit of the *Vagabonds*, but had children before their arrival is very small, we are not able to meaningfully include more than five years of the preperiod in the analysis.

Observing only the effect on those treated in their formative years (14-24), we see that the effect is a constant level shift rather than an upward trajectory. The level reached in year 1 is as high as that of the general population in year 10 when we looked at the effect on the entire population in figure 2.5. We suggest that the main reason for the difference is that in figure 2.5 the effect is smaller until the men visited during their formative years are old enough to begin fathering children. Assuming that the most ideologically receptive years are 14-24 and given that the mean age of fathers in our sample is 32.3, we should expect the effect to increase among the average father for the first 10-15 years, which is exactly what we see in figure 2.5. In the specification in figure 2.6, where we only look at the effect of those visited during their formative years, the effect on children is immediate, further lending credence to an ideological interpretation of the change.

Figure 2.6: Effects of visits by the *Vagabonds* on Bourgeois Values during formative years



Notes: Event study of the effect of visits by the vagabonds on bourgeois values. Bourgeois values are measured by the BNI of children born in a given year. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it during the formative years (14-24) of the father. Specification includes controls for race, number of siblings, earnings of the father, and fixed effects for county and birthyear/state. For information on data selection, see note in figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district level.

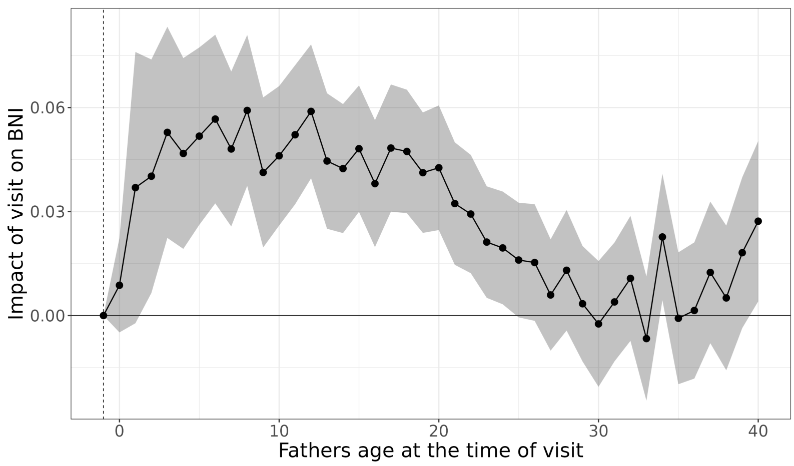
As a final exercise, we estimate the effect of visits from the *Vagabonds* separately for all ages of fathers at the time of visit, using the following regression Equation

$$\text{BNI}_{n,d,s,i} = \sum_{k=0}^{40} (\beta_k \text{Age of Father}_{i,k}) + \theta X`_i + \alpha_l + \gamma_{b,s} + \epsilon_i, \quad (2.5)$$

where Age of $\text{Father}_{i,k}$ is a dummy indicating whether or not the father of individual i, was visited by the *Vagabonds* at age k (at a time before the birth of individual i). This regression will provide a curve showing the ages at which future parents were most receptive to ideological influences. One limitation of this approach is that since our latest observation in the 1940 census, the younger someone was at the time he was visited by the *Vagabonds*, the less likely it is that he had become a father in 1940, and thus be included in our analysis. This means that the standard errors are very high for people younger than five and that we should be careful when interpreting the coefficients for the people visited in very early childhood.

The results of the analysis can be seen in Figure 2.7. We obtain a pattern similar to that found in (Ghitza, Gelman, and Auerbach, 2023), although we estimate that visits in early childhood also have had a significant effect. Although one interpretation of this difference is that early childhood could be more generally important for ideological formation than previously thought, it is also possible that the specific shock to ideology in question - visits by the *Vagabonds* - appealed more to children than the political events studied in (Ghitza, Gelman, and Auerbach, 2023). A version of the figure with minimal controls, showing very similar estimates, is included in the Appendix Figure C.3.

Figure 2.7: Effects of visits by the *Vagabonds* on Bourgeois Values - differentiated by age of the father.



Notes: The effect of visits by the *Vagabonds* on Bourgeois Values, at different ages of the Father at the time of visit. Bourgeois values are measured by the BNI of children born in a given year. The reference year is set to minus 1. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers. Specification includes controls for race, number of siblings, earnings of the father, and fixed effects for county and birth year/state. For information on data selection, see the note in Figure 2.5.

A possible concern with the above analysis is that individuals inspired by Edison or Ford might choose to name their children Thomas or Henry rather than a specifically Bourgeois name (though both Thomas and Henry have higher BNI than average). To mitigate such concerns, we repeat the analysis above in the appendix using an alternative measure of bourgeois values that takes this effect into account. The alternative measure is a dummy that equals 1 if $BNI_{n,d,s,i}$ is higher than the mean or if the person is called Henry or Thomas, and 0 otherwise. All tables and figures in this section are repeated in the Appendix, using this alternative measure of the *Vagabonds'* ideological impact, including those with minimal controls. The qualitative results are the same in all cases, though it is occasionally more noisy.

2.5.2 Effect of bourgeois values on outcomes

In this section, we use visits by the *Vagabonds* to estimate the effect of bourgeois values on economic outcomes at the level of individuals. Using visits by the *Vagabonds* as an instrument provides a series of challenges. First, since we use the names of children to measure bourgeois values, we cannot use individuals in the census where we cannot identify the father in our regressions. Second, due to external and internal migration, we cannot know if someone was visited by the *Vagabonds* with an acceptable degree of certainty unless we can observe them in earlier census years, which means that individuals that we cannot successfully link across census years are excluded from the analysis. More specifically, we only include individuals who were observed in either 1910 or 1920, as well as in either 1930 or 1940, when economic outcomes are measured. Third, since we use children's names to measure BNI, we cannot measure bourgeois values at a later time than the birth of their youngest child. This means that we cannot measure the ideological influence of *Vagabond* visits on individuals who had their last child before the *Vagabond* visits. Although we could exploit this fact to establish causality in the previous section, when we use visits as an instrument, it causes problems because the economic outcomes could still be influenced. For this reason, we do not include individuals whose youngest children were born before visits from the *Vagabonds*. In the present section, we use the BNI of the youngest child as our measure of BNI. We also restricted the data to individuals in the 20-60 age range who had employment in the year where economic outcomes were observed. As our first outcome, we look at the impact of bourgeois values on (log) wage income in 1940, which is the only year for which the census reports wage income. The results can be seen in table 2.5. In the first column, we present the OLS results for Equation 2.1. In the second and third columns, we present the results from the first and second stages of the IV regression, and in the fourth column, we present the results of the reduced-form regression.

Table 2.5: Effect of bourgeois virtues on wages

	Log wage income			
	OLS	1st stage – IV	2nd stage – IV	Reduced form
Bourgeois name index	0.070***			
	(0.001)			
Bourgeois name index (fit)			0.604**	
			(0.291)	
Vagabond visit		0.018***		0.011**
		(0.005)		(0.005)
Black	−0.551***	−0.367***	−0.354***	−0.576***
	(0.020)	(0.023)	(0.110)	(0.020)
Other race	−0.561***	−0.001	−0.559***	−0.560***
	(0.101)	(0.076)	(0.124)	(0.098)
Lives on farm	−0.320***	−0.126***	−0.253***	−0.329***
	(0.006)	(0.007)	(0.037)	(0.006)
F-stat 1st stage			14.160	
Mean dep. var.	6.926	0.000	6.926	6.926
SD dep. var.	0.369	0.164	0.363	0.363
N	308,444	308,444	308,444	308,444
# FE county	493	493	493	493
# FE census year	1	1	1	1
# FE age	40	40	40	40
Adj. R^2	0.223	0.025	−0.236	0.216
Adj. R^2 w/o FE	0.042	0.004	−0.523	0.033

Notes: At individual level. Table shows that bourgeois virtues (instrumented by Vagabond visits) increase wages. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1,940 Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

The results are significant in all specifications. In the OLS regression, we find that an increase in bourgeois values of 1 standard deviation is associated with an increase in income of 7%. However, in IV regressions, we find that such an increase is associated with a much larger increase of 60%. In the reduced form, we find that a visit from the *Vagabonds* is associated with an increase in income of 1%. A possible explanation for the large differences in effect found in the OLS and the IV is that the effect of bourgeois values on labor market outcomes is greater among those who choose to adopt them after a visit by the *Vagabonds* than in the general population.

Table 2.6: Effect of bourgeois virtues on earnings

	Earnings score			
	OLS	1st stage – IV	2nd stage – IV	Reduced form
Bourgeois name index	3.181***			
	(0.040)			
Bourgeois name index (fit)			34.147***	
			(10.029)	
Vagabond visit		0.016***		0.542***
		(0.004)		(0.120)
Black	−15.965***	−0.340***	−5.429	−17.028***
	(0.421)	(0.018)	(3.423)	(0.442)
Other race	−11.042***	−0.039	−9.763***	−11.101***
	(1.716)	(0.051)	(2.511)	(1.702)
Lives on farm	−18.347***	−0.127***	−14.400***	−18.748***
	(0.225)	(0.005)	(1.287)	(0.228)
F-stat 1st stage			14.367	
Mean dep. var.	55.897	0.000	55.897	55.897
SD dep. var.	9.894	0.158	9.384	9.384
N	640,951	641,605	640,951	640,951
# FE county	495	495	495	495
# FE census year	2	2	2	2
# FE age	40	40	40	40
Adj. R^2	0.160	0.024	−1.373	0.143
Adj. R^2 w/o FE	0.090	0.004	−1.570	0.072

Notes: At individual level. Table shows that bourgeois virtues (instrumented by Vagabond visits) increase earnings. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1940. Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Although wage income is only available in 1940, we can estimate the effect in 1930 as well by using ERSCOR50 from the census as a proxy for income. ERSCOR50 estimates income by observing the job of individuals, calculating the average earnings of someone with that occupation, and converting it to a percentile rank. Although the measure is less accurate, it allows us to expand our analysis into 1930. Therefore, we repeat the analysis using ERSCOR50 and include 1930 in our analysis in table 2.6. In the OLS regression, we find that an increase in BNI of one standard deviation is associated with an increase in ERSCOR50 that corresponds to a rise of 3.2 percentiles in the national income ladder or a rise of 6%. Once again, we get much stronger results in IV regression, where a rise in BNI of one standard deviation is associated with a rise in ERSCOR50 of 66% of the mean. In the reduced form, we find that a visit from the *Vagabonds* is associated with a 0.54 increase in ERSCOR50, corresponding to a rise of 1% of the mean, also similar to what we found when observing wages directly. We thus find robust evidence across two different measures of income to the positive effect of bourgeois values on wage income in 1930 and 1940, both in the OLS, IV, and reduced form analysis.

As a second outcome, we directly examine the impact of bourgeois values on entrepreneurship. As a proxy for entrepreneurship, we use individuals who are coded as being managers (using the OCC1950 classification system) and also coded as being employers. Although this measure does not differentiate between owner managers of established companies and those of new ones, we argue that it works as a proxy for entrepreneurship, since a rise in the rate of employers must come either from new companies being formed or from older ones not closing down, both of which would be thought off as more or better entrepreneurship, though the former arguably more so. Setting up a company and growing it to the point of having employees might take a considerable amount of time, and for this reason, we again focus on outcomes in 1940. The results are in table 2.7.

Table 2.7: Effect of bourgeois virtues on becoming an entrepreneur

	Entrepreneur			
	OLS	1st stage – IV	2nd stage – IV	Reduced form
Bourgeois name index	0.004***			
	(0.000)			
Bourgeois name index (fit)			0.065**	
			(0.033)	
Vagabond visit		0.019***		0.001**
		(0.005)		(0.001)
Black	−0.013***	−0.364***	0.010	−0.014***
	(0.001)	(0.022)	(0.012)	(0.001)
Other race	−0.013***	−0.008	−0.013***	−0.013***
	(0.002)	(0.069)	(0.005)	(0.002)
Lives on farm	−0.009***	−0.131***	−0.000	−0.009***
	(0.001)	(0.006)	(0.004)	(0.001)
F-stat 1st stage			16.472	
Mean dep. var.	0.014	−0.000	0.014	0.014
SD dep. var.	0.012	0.166	0.011	0.011
N	333,303	333,303	333,303	333,303
# FE county	493	493	493	493
# FE age	40	40	40	40
Adj. R^2	0.008	0.026	−0.248	0.007
Adj. R^2 w/o FE	0.002	0.004	−0.255	0.001

Notes: At individual level. Table shows that bourgeois virtues (instrumented by Vagabond visits) increase the probability of becoming an entrepreneur. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1940. Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

In the OLS regression, we find that an increase in BNI of one standard deviation is associated with an increase in entrepreneurship of 0.4 percentage points, corresponding to 29% percent of the mean. In the IV regression, we again find a larger effect, with a rise in BNI of one standard deviation leading to a rise of 6.5 percentage points or a 4.6 times higher than average rate of entrepreneurship. In the reduced form analysis, we find that *Vagabond* visits are associated with a 0.1 percentage point increase in entrepreneurship, corresponding to a rise of 7.5% of the mean. In all specifications, the effect is sizeable, and the IV analysis again shows very large effects, as we saw in the analysis of wages. In Table C.2 we repeat the analysis, while including the year 1930 for outcomes. As expected, we find similar results, though smaller (and insignificant) for the IV and reduced form regressions.

As an alternative measure of bourgeois ambitions, we redo the analysis above, counting all people with managerial occupations as 'entrepreneurs' even if they do not own the companies of which they are the managers. The results can be seen in Table 2.8. In all specifications, the results are statistically significant. In the OLS specification, we find that a rise of one standard deviation of BNI is associated with a rise in managerial occupations of 2.3 percentage points and corresponding to 29% percent of the mean, similar to what we found on manager employers in 1940. In the second stage, we estimate the effect of a rise in standard deviation to be 0.162, corresponding to a 2.0 times higher than average rate of managerial work, which is lower than what we found for manager employers in 1940, but on the level of results, the specifications including 1930.

In sum, we find that bourgeois values are associated with higher levels of entrepreneurs and salaried managers.

Table 2.8: Effect of bourgeois virtues on becoming a manager

	Manager			
	OLS	1st stage – IV	2nd stage – IV	Reduced form
Bourgeois name index	0.023***			
	(0.000)			
Bourgeois name index (fit)			0.162**	
			(0.080)	
Vagabond visit		0.016***		0.003**
		(0.004)		(0.001)
Black	−0.066***	−0.340***	−0.019	−0.074***
	(0.003)	(0.018)	(0.027)	(0.003)
Other race	−0.060***	−0.039	−0.055***	−0.061***
	(0.008)	(0.051)	(0.011)	(0.008)
Lives on farm	−0.045***	−0.127***	−0.028***	−0.048***
	(0.001)	(0.005)	(0.010)	(0.001)
F-stat 1st stage			14.432	
Mean dep. var.	0.078	0.000	0.078	0.078
SD dep. var.	0.053	0.158	0.048	0.048
N	641,605	641,605	641,605	641,605
# FE county	495	495	495	495
# FE census year	2	2	2	2
# FE age	40	40	40	40
Adj. R^2	0.038	0.024	−0.226	0.031
Adj. R^2 w/o FE	0.012	0.004	−0.259	0.005

Notes: At individual level. Table shows that bourgeois virtues (instrumented by Vagabond visits) increase probability of becoming a manager. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1940. Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

2.6 Conclusion

This paper investigates the impact of bourgeois values on economic outcomes in the United States in the years 1930 and 1940. Our empirical strategy employs US census data from 1850 to 1940, using the imitation of bourgeois naming patterns as a proxy for bourgeois values. This method provides a novel lens through which to examine the long-term effects of cultural influences on economic behavior.

A key element of our analysis is the utilization of the road trips by Henry Ford and

Thomas Edison, known as the Vagabonds, as an instrumental variable. These trips, which took place in the early 20th century, offer a quasi-experimental setup, allowing us to measure the causal effect of bourgeois values on economic outcomes at the level of individuals. Our results reveal a significant positive causal effect of bourgeois values on both income levels and rates of entrepreneurship. Specifically, bourgeois values are associated with higher income and a greater likelihood of entrepreneurship.

Our results support the thesis of McCloskey (2006, 2010, 2016) on the role of bourgeois values in promoting innovation. They also show that innovators can be created by exposure to leading innovators even when such exposure is short; a result that echoes a literature that has found positive effects of guest speakers in schools on education and earnings (Patnaik et al., 2023). The study contributes to understanding how culture and values influence innovation, entrepreneurship, and growth. Our findings underscore the importance of considering cultural and social factors in the analysis of economic development patterns. In future research, we plan to look at the effects of bourgeois values at the level of communities, in order to differentiate between individual and collective consequences of bourgeois ideology.

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Chapter 3

Contagious Coercion: The Effect of Plagues on Serfdom in the Baltics

3.1 Introduction

Many employment relationships, past and present, are shaped by coercion. As of 2021, at least 27.6 million people are in forced labor, a number that rose by 2.7 million from 2016 (ILO, 2022).[1] Theories of forced labor view the marginal product of labor (MPL) as the main determinant of the levels of coercion. In this literature, labor scarcity is the most commonly mentioned driver of the MPL[2] and, thus, coercion:

> "A major question in the economics of coercion, both from a historical perspective and for understanding the continued prevalence of forced labor today, is the effect of labor scarcity on coercion."
>
> – Acemoglu and Wolitzky (2011, p. 587)

This hypothesized role of labor scarcity can be traced back to Domar, 1970 famous thesis that the population losses of the Black Death (1346-53) were responsible for the subsequent intensification of serfdom, the so-called Second Serfdom, in eastern Europe. His theory was criticized by Brenner (1976), who noted that for a comparable share of plague deaths, post-Black Death western Europe experienced a decline in labor coercion. This suggests that the effects of labor scarcity on coercion are

[1] This estimate should be understood as a lower bound. The actual number is likely to be significantly higher (ILO, 2022).

[2] Trades, specifically the prices of exports are another determinant of the MPL and coercion (see e.g. Saleh, 2023).

ambiguous. Acemoglu and Wolitzky (2011) reconcile these differential responses of coercion to labor scarcity in a theoretical model by introducing outside options in an urban sector. When an urban sector provides significant outside options, rural landlords face competition following labor shortages and need to decrease the levels of coercion. This is argued to have occurred in post-plague Western Europe with its larger and more 'free' cities. On the contrary, such offsetting forces were less pronounced in Eastern Europe, where cities were fewer and smaller, resulting in an increase in coercion.

This paper provides the first causal evidence of the effect of labor scarcity on the intensity of coercion, also focusing on channels, including outside options. To this end, I hand-collect thousands of archival documents on the coercion intensity of serfs in Estonia for a panel of manors from 1590 to 1884 and leverage three plagues (1605-6, 1657, 1710-2) which create highly spatially varied labor scarcity. I demonstrate that, based on a host of covariates, plague deaths are quasi-random at the local level.[3] As a result, plagues, through their impact on labor scarcity, allow me to elicit the causal effects of labor scarcity on coercion. This exogenous variation in the levels of coercion induced by plague also allows me to study the causal effects of coercion on a number of outcomes, before and after the abolition of serfdom in 1816-19.

Estonia is an ideal (and understudied) setting, given its unparalleled and reliable documentation of both plagues and serfdom. Many of the data collection practices also remained in place after the abolition of serfdom, given that the ruling, Baltic-German, elite remained powerful. Additionally, plague deaths exhibit immense spatial heterogeneity in an otherwise fairly homogeneous territory that has common institutions.

Related literature. This paper relates to three main strands of literature.

First, it contributes to the literature on the causes of coercion. As mentioned, this literature usually considers factors that influence the MPL, such as labor scarcity (Domar, 1970; Klein and Ogilvie, 2019) but also trade (Saleh, 2023). Outside options, i.e., sectors competing with the coercive sector, are important in that they dampen or even reverse the influence of labor scarcity (Acemoglu and Wolitzky, 2011; Brenner,

[3]This is consistent with the fact that "there are no natural foci of the plague in the territory of Estonia" (Jõgiste, Varjas, and Rjabinina, 2004, p.467), which would otherwise drive spatial clustering. Likely, there was an "extra-European reservoir [that was] feeding plague into Western Europe in multiple waves" (Guellil et al., 2020, p.28328).

1976; Dippel, Greif, and Trefler, 2020).[4] To the best of my knowledge, this paper is the first to causally test the effect of labor scarcity on forced labor. I also contribute by studying the intensive margin of coercion and by highlighting the channels through which this relationship arises.[5]

Second, with my focus on plagues as shifters of labor scarcity, I contribute to the growing literature on the effects of plagues and pandemics (for a recent summary, see Alfani, 2022; Jedwab, Johnson, and Koyama, 2022).[6] While there is no clear consensus, most studies point toward the positive effects of pandemics on a variety of outcomes. This paper introduces coercion as a consequence of pandemics and, by also documenting the adverse effects of coercion on a number of outcomes, contributes to a less optimistic view of the effects of pandemics. This finding is also important for unified growth models (Galor, 2011), which usually assume that wages *rise* following pandemics. In these models, these temporary surpluses for workers are important for growth. In contrast, my findings suggest a rise in coercion, i.e., a decline in wages, in Eastern Europe after pandemics, which may explain why its growth fell behind that of Western Europe.

Third, this paper contributes to the literature on the consequences of forced labor. This literature largely finds negative effects of forced labor on education, wealth, health, infrastructure, and industrialization (Ashraf et al., 2022; Bobonis and Morrow, 2014; Buggle and Nafziger, 2021; Dell, 2010; Lowes and Montero, 2021; Markevich and Zhuravskaya, 2018; Nunn, 2008; Nunn and Wantchekon, 2011).[7] My findings highlight the negative effects of serfdom intensity on education and trust and provide a detailed analysis of channels, including migration that was strictly banned under serfdom and legalized with its abolition. Migration is a channel that has previously been overlooked in the literature (Carpio and Guerrero, 2021). When considering the post-abolition short-run, I document a worsening of conditions after abolition, echoing, for example, the US after the Jim Crow laws (Althoff and Reichardt, 2022).

[4]A recent literature in labor economics (Caldwell and Harmon, 2019; Jäger et al., 2022; Schubert, Stansbury, and Taska, 2021) shows that outside options also today are important determinants of employee wages.

[5]Most closely related is the work by Klein and Ogilvie (2019) showing that there is a strong association between the land-labor ratio and coercion in a cross section of Bohemian villages.

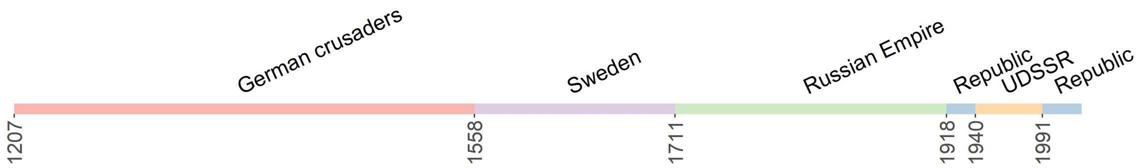
[6]The effects of labor scarcity have also been applied to non-European contexts, e.g., Sellars and Alix-Garcia (2018) finds that disease-induced population losses result in higher land concentration.

[7]A few studies also report positive long-run developmental outcomes resulting from historical forced labor regimes. This can be the case when the product produced by coercion requires upgrading of infrastructure (Dell and Olken, 2020) or when coercers face competition (Méndez and Van Patten, 2022)

Outline. This paper proceeds as follows. Section 3.2 provides background information on serfdom in the Baltics. Section 3.3 details the numerous archival data that were collected for this research. Section 3.4 provides the empirical strategy, which also establishes the locally quasi-exogenous nature of the plagues. Section 3.5 presents the findings. Section 3.6 concludes.

3.2 Historical background: serfdom & plagues

Figure 3.1: Rulers of Estonia, 1207-today



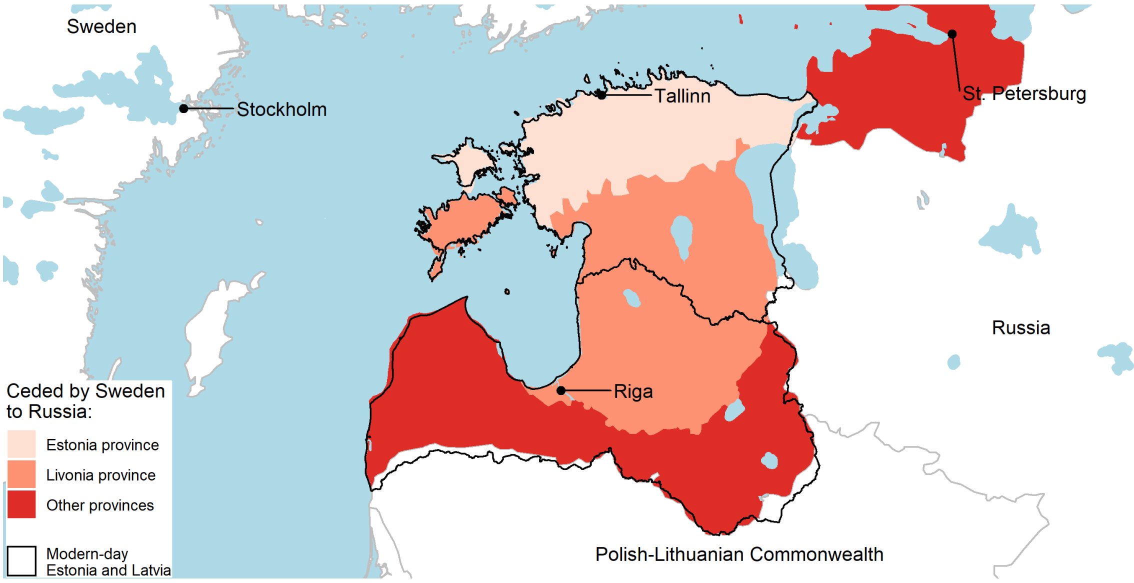
Notes: Baltic Germans, the descendants of German crusaders, concentrated most power and wealth in Estonia despite changing rulers. During the first Estonian Republic in 1919, Baltic Germans were largely expropriated and in 1945 all Baltic Germans were expelled.

Estonians, a Finnic ethnic group, have inhabited present-day Estonia and surrounding areas for thousands of years. Starting with the conquest of crusaders from Denmark and the Holy Roman Empire between 1208 and 1227, Estonia was ruled by a series of foreign powers (Figure 3.1). The Danish possessions were sold to the Teutonic Order in 1346, which was made up of the successors of the German crusaders (who referred to themselves as *Baltic Germans*). In 1558, the north of present-day Estonia, then called the province of Estonia, fell to Sweden, following an unsuccessful Russian invasion. The south of present-day Estonia fell to Poland.[8] In 1625 and 1645, Sweden annexed all of modern-day Estonia as well as northern modern-day Latvia. In 1710, Russia's ambition to conquer the Baltics was ultimately successful following its victory in the Great North War. The aforementioned division into provinces (Estonia and Livonia), now called governorates, was maintained (Figure 3.2).

Throughout these changing rulers, the Baltic Germans remained the de-facto administrators and dominant landholders for more than 700 years until their partial expropriation in 1919 due to a land reform and ultimate complete expulsion in 1945 (Raun, 2002). They retained this powerful position despite weakening ties to the German lands and their small numbers: In the late 17th century, they made up only

[8] The south then formed the northern part of the province of Livonia (see Figure 3.2). In 1559, Saaremaa, the largest island in Estonia, was sold to Denmark.

Figure 3.2: The Baltics following the Great Northern War (1700-21)



Notes: I focus on the territory of present-day Estonia, which, until 1918, was divided in the province of Estonia and the northern part of the province of Livonia. Present-day Estonia, Latvia, and the surroundings of St. Petersburg were ceded by Sweden to Russia following its defeat in the Great Northern War (1700-21).

3 to 4% of the population and were heavily concentrated in towns (forming 40 to 60% of the urban population).[9] By contrast, Estonians comprised 90% of the population and 95 to 99% in rural areas. Among the Estonian peasantry, 75% were farmers and their families, 20% were farmhands, and 5% manor staff (Palli, 1993). In related work (Raster, 2023b), I show how this resulted in an extreme concentration of wealth among Baltic German individuals and families that persisted even after the abolition of serfdom.

3.2.1 Serfdom

Estonians did not surrender unconditionally during the 12th century crusades; initially, they made contracts with the crusaders and kept their right of free movement and the ownership of their land, including the right to hand it down to their offspring (Wittram, 1954). Estonians had to work a moderate number of corvée days, about 2 days a week per serf household, and they had to pay tithe and taxes. In-kind dues consistent mainly of grain, which already during those years was an important

[9]The number of other nationalities was small in Estonia, about 2% were Swedish and 0.5% Russian. Baltic Germans made up almost all the nobility and clergy, which amounted to 1.5% of the total population (Palli, 1993).

export product. In contrast to the German colonization of other parts of Eastern Europe, only German clergy and nobility migrated to Estonia. The absence of a German peasantry prevented assimilation with native Estonians.[10] Baltic Germans established a stark delineation between themselves and the native Estonians and discriminated against them in numerous ways (Zimmermann-Schulze, 2004).

Conditions for Estonians worsened in the 14th and 15th centuries as part of a general 'crisis of free movement' across Eastern Europe. Estonians were stripped of their right to own land and to freely move. Weekly average corvée days increased to multiple days a week. On the manor, the lord could not only set labor and other dues, but would also act as the judge in local courts. To summarize, "serfdom began in the second half of the fourteenth century, grew markedly in the fifteenth, reached near completion in the sixteenth century, and received juridical confirmation in the seventeenth century" (Raun, 2002, p.20).[11]

Estonian serfs fought back on multiple occasions in response to the high number of corvée days. In 1558, when the Teutonic Order had collapsed following a Russian invasion, a rebellion was launched on the grounds that the Baltic Germans had not provided protection against the invaders. This rebellion, like others before and after it, was unsuccessful. More so, the new Swedish overlords, who had pushed back the Russians and annexed Estonia, confirmed the privileges of the Baltic German nobility. Specifically, Baltic Germans maintained the right to their Protestant faith, to their land laws, their use of German as the official language, and to self-administration. Therefore, the conditions of the serfs did not improve. However, in need of money after the war, the Swedish Crown expropriated a large number of manors, transferring their ownership from Baltic German to Swedish nobility between 1641 and the 1680s.[12] In practice, many of those expropriated manors were still administered by Baltic Germans, and the conditions of serfs did not improve. The Swedish crown had a profound distaste for serfdom, which did not exist in Sweden proper, and was appalled by the conditions of Estonian serfs, but Baltic Germans successfully resisted the attempts of the Swedish Crown to abolish serfdom. When planning to abolish

[10] The reasons for why German peasants did not migrate to Estonia include the large distance that included crossing the Baltic Sea, poor soils, harsh climate, and a lack of cleared woodland. In contrast, Prussia, another German colony at the time, had much more favorable conditions.

[11] The reformation that began in the 1520s did not challenge the relationship between Estonians and Baltic Germans and Estonians had to follow their lords in converting to the new religion. The reformation did, however, lead to the first publications in Estonians and a slow expansion of the school system.

[12] In total, half of the manors were expropriated in the Province of Estonia, a quarter on the island of Saaremaa, and 84% in the Province of Livonia.

serfdom, Swedish administrators mandated precise documentation of land allotment and serfs' dues, creating an invaluable resource, the so-called *Wackenbücher*, that makes this research possible. In 1696, 1025 manors were mentioned on the territory of present-day Estonia.

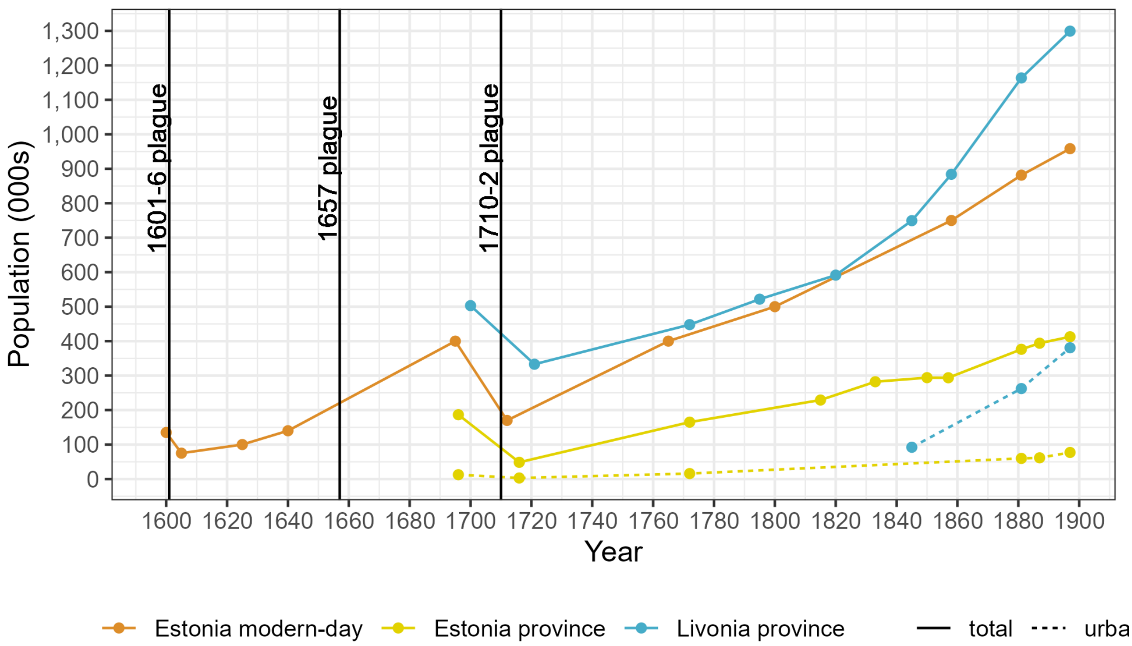
When Russia conquered Estonia and neighboring areas during the Great Northern War (1700-21), the expropriation of Baltic Germans was reversed entirely. Unlike in Sweden, serfdom was very common in the Russian Empire. The Baltic Germans obtained provincial self-governing rights. The Russian conquest was accompanied by an extremely deadly plague wave that decimated the population of the Baltics (see the next Section 3.2.2). Serfdom intensified under the Russian ruler. Labor days are said to have increased further, leaving serfs with too little time (and energy) to work in their own fields, which they relied on for subsistence farming.

In the latter half of the 18th century, some Baltic Germans changed their views of serfdom and their treatment of native Estonians. Enlightenment ideas were spreading with the immigration of young scholars from the German lands. These young scholars worked with Estonians as pastors and learned Estonian. A long struggle ensued with the Baltic German manor lords. Reforms were passed in the *Landtag*, the Baltic German parliament that had existed since medieval times. Ultimately, serfdom was abolished in 1816 in the governorate of Estonia and in 1819 in the governorate of Livonia in one of the rare abolitions that were led by the landowner elites. The abolition of serfdom in the Baltic was the first abolition in the Russian Empire and the only one before the general abolition in 1861. One should, however, be skeptical of altruistic motives among the Baltic German *Landtag*'s decision to abolish serfdom. Serf revolts preceded reforms and abolition, and it was generally agreed that agricultural reforms were needed. The post-abolition experience is perhaps the best testament to the ulterior motives of Baltic German elites for the abolition of serfdom. It is generally noted that the decades following abolition were marked by a decline in the living standards of the former serfs. This can be explained by the fact that the abolition did not outlaw the much-despised labor dues. It only legalized internal migration (requiring registration with the police) and the ownership of land for Estonians. In practice, manor lords evicted many peasants, and, due to a lack of money, the landownership among Estonians only rose extremely slowly (see Appendix Figure B.2). Labor dues were finally outlawed in 1849 in Livonia and in 1856 in Estonia.

Given this description of serfdom in Estonia, what are the predicted effects of labor scarcity on its intensity? In Acemoglu and Wolitzky, 2011 framework, this depends on the availability of outside options. In Estonia under serfdom and even in the aftermath of its abolition, many factors severely restrict outside options. As mentioned, Baltic Germans established a strict ethnic and linguistic divide between them and Estonians, making it easier to discern serfs from non-serfs. Baltic Germans also heavily controlled access to cities and collaborated in returning runaway serfs. As a result, labor scarcity can be expected to, on average, *increase* coercion intensity in Estonia in line with Domar (1970). Qualitative evidence supports this hypothesis. Bērziņš (1935, p.167) notes that the plague led to an increase in the intensity of serfdom or even "a situation that can be called de facto slavery". Sievers (1970) relates the intensification of post-1710-2 plague serfdom to manor lords' desire to compensate for the revenue lost due to plague deaths among serfs.

3.2.2 Plagues

Figure 3.3: Population of Estonia, 1696-1900



Sources: Hupel (1777), Jordan (1886, 1889), Palli (2004), Pankratov et al. (2020), and Plakans (2011); demoscope.ru. For individual town population trajectories and sources, see Appendix Figure B.1.

Notes: Vertical lines denote plagues. Following the 1601-6 plague, the Estonian population (modern-day territory) decreased by 44% from 135,000 to 75,000. After the 1710-2 plague, it decreased by 57% from 400,000 to 170,000.

Deadly epidemics were commonplace in medieval and early-modern societies (Voigtländer and Voth, 2013), including the plague which was caused by the bacteria *Yersinia pestis*. In contrast to medieval and even earlier times when isolated large plague waves occurred, notably the Black Death (1346-53), by the 17th and 18th centuries the plague had become endemic across Europe.[13] In Estonia, major outbreaks of the plague occurred in 1211-12, 1532, 1549-53, 1565-80, 1601-6, 1657, and 1710-2 (Frandsen, 2010; Jõgiste, Varjas, and Rjabinina, 2004; Oja, 1996; Winkler, 1907).[14] Given that data on the coercion intensity of serfs is available from 1624 onwards, I focus on the last three of these plague outbreaks (1605-6, 1657, and 1710-2). No plague occurred after 1712 (Frandsen, 2010). Each of the three plagues accompanied a war. The 1601-6 plague occurred during the Polish–Swedish War (1600–1611) over control of Livonia and Estonia. The 1657 plague accompanied the Second Northern War (1655-60) between Sweden and the allied Polish-Lithuanian Commonwealth and Russia (Winkler, 1907). The extremely deadly 1710-2 plague was initially spread in the Baltics by troops of the Great Northern War (1700-21), in which an alliance led by Sweden fought a coalition headed by Russia.

The impact of the plagues is clearly visible in Estonia's aggregate population figures. Figure 3.3 shows that the 1605-6 plague was associated with a 44% drop. No estimates of the total population are available in the immediate aftermath of the 1657 plague, but my estimates of population changes on manor and qualitative sources (Winkler, 1907) suggest many deaths. The 1710-2 plague was by far the deadliest, killing an estimated 57% of the population. In the province of Estonia, roughly the northern half of modern-day Estonia, mortality was even higher at 74%. Such high mortality rates are "outnumbering even those of the Black Death" (Keller et al., 2022, p.1). The deadliness of Estonia's 1710-2 plague can likely be explained by human-to-human (pneumonic) transmission that took place in addition to the more common transmission through the rat flea (Schofield, 2016).[15] Important for serfs' outside options, Estonian towns were hit to a comparable extent as rural areas (see Appendix Figure B.1). Overall, it took more than 60 years, until 1772, before the total population recovered to pre-1710-2 plague levels.[16] The three separate

[13] As mentioned, there likely was an extra-European reservoir that fed the plague into Europe (Guellil et al., 2020).

[14] It is unclear whether the 6th century Justinian Plague and the Black Death reached Estonia (Jõgiste, Varjas, and Rjabinina, 2004).

[15] This would be an indication for a pneumonic plague that is even more deadly than the bubonic plague.

[16] Birth rates increased following plagues (Palli, 1983).

plague outbreaks I study (1605-6, 1657, 1710-2) differ in their aggregate mortality rates. This allows me to test Domar, 1970 thesis for a plague that has mortality rates comparable to those of the Black Death, such as the 1710-2 plague, and for plagues with lower mortality rates (1605-6, 1657). Additionally, the wars that raged during those plagues also differed, with the Great Northern War (1700-2) that caused the initial spread of the 1710-2 plague resulting in Russian rule over Estonia. As I will show, all plagues increase coercion consistent with Domar (1970), although to different degrees.

How did the population respond to such frequent plagues? The only theoretically effective measure against plagues was the passing of plague ordinances (*Pestordnungen*), which mandated quarantine for the sick, lockdowns, border and market closures, among other measures (Hormuth, 2018). However, such measures were hardly effective in the case of Estonia (Winkler, 1907). Due to low compliance with quarantining measures and the immense speed at which plagues spread (the speed of a horse rider), the spread of the plagues was unmitigated (Jordan, 1880). Contemporary witnesses were baffled by the great degree of variation in deaths that were recognizable even between neighboring manors (Bērziņš, 1935).[17] I confirm this local quasi-randomness in my empirical strategy (Section 3.4) by showing that none of the numerous covariates systematically explain plague deaths at the manor level.

3.3 Data

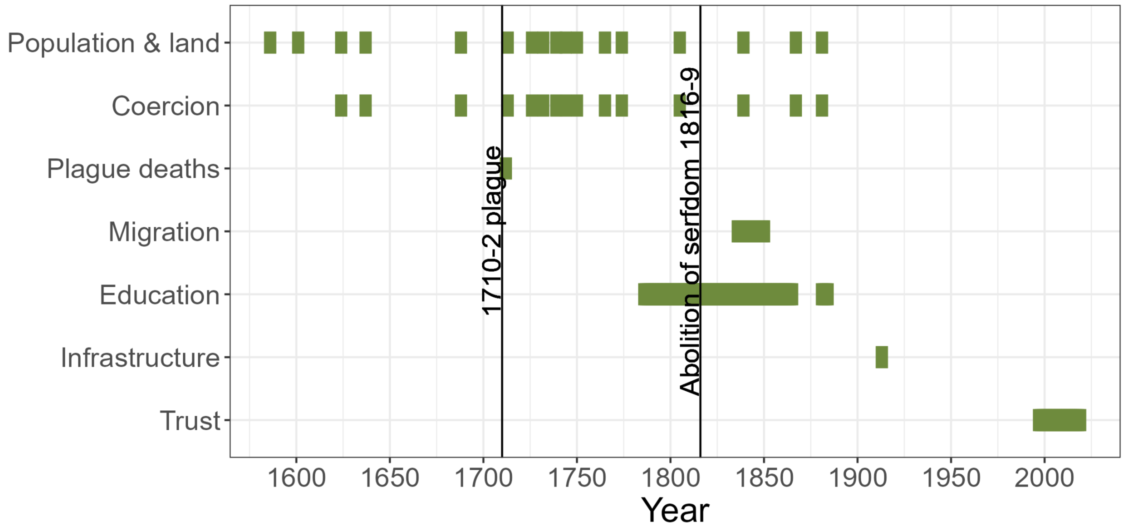
I digitize and transcribe a wealth of primary data from archives in Estonia, Latvia, Sweden, and Russia. Additionally, I collected and synthesized (statistical) information from a large number of secondary sources. Figure 3.4 gives a schematic overview of the collected data. The precise sources are listed in Appendix Table B.1. In the following, I discuss the data on coercion (Section 3.3.1), plague deaths (Section 3.3.2), several consequences of coercion (Section 3.3.3), and additional data (Section 3.3.4).

3.3.1 Coercion intensity – the *Wackenbücher*

Labor coercion is the main outcome variable in this paper. Crucially, I am able to capture the intensive margin of coercion rather than the share of serfs in the

[17] Other papers have argued that the degree to which towns in the Holy Roman Empire were hit by plagues is also quasi-random (e.g. Gingerich and Vogler, 2021).

Figure 3.4: Data overview



Sources: for detailed sources, see Appendix Table B.1.

population.[18] This is made possible by an extraordinary tradition in the Baltics to draft legal contracts between serf households and lords (*Wackenbücher*) that quantify labor, in-kind, and monetary dues. First drafted in 1564 at the beginning of the Swedish rule over Estonia (Tarkiainen, 2013), the *Wackenbücher* also include extensive information on the demographic composition and farm wealth of each serf household.

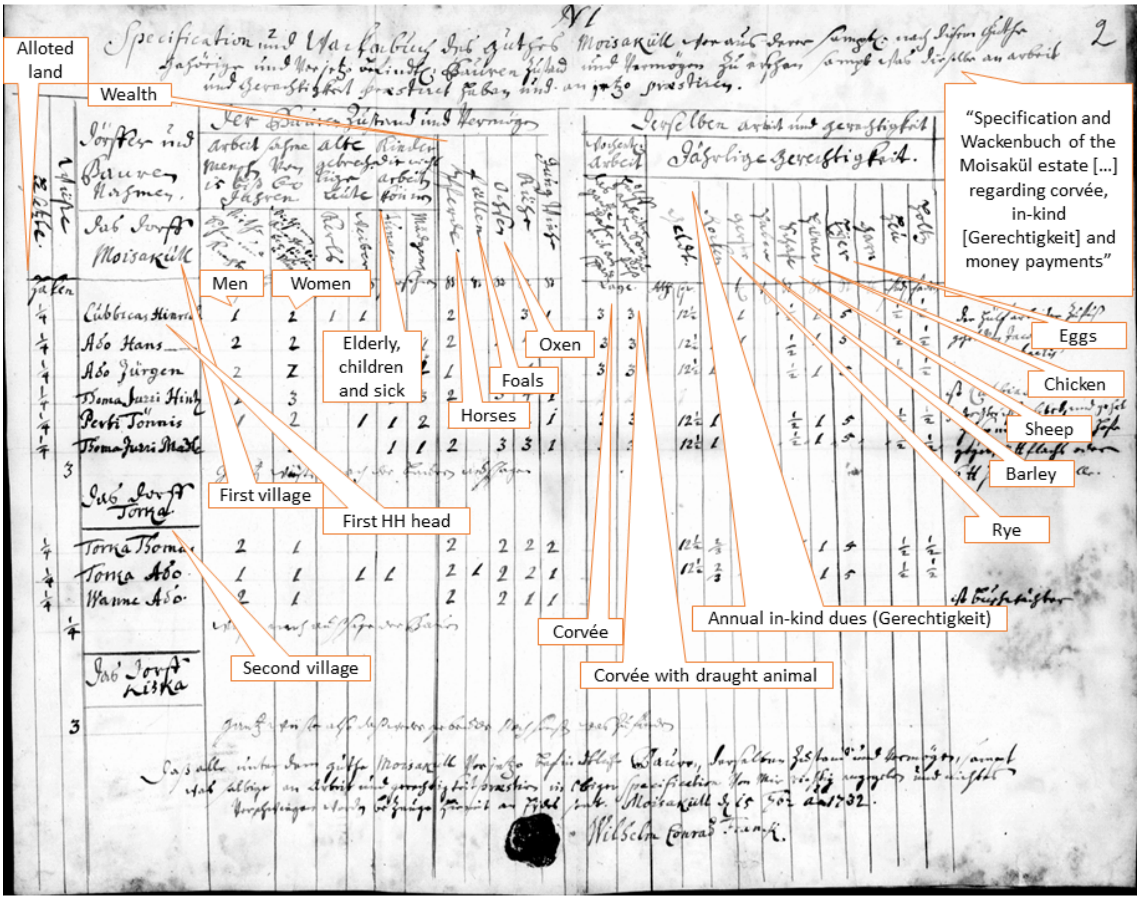
Importantly, the dues set in the *Wackenbücher* are binding for both the serfs and lords and were updated in so-called revisions approximately every 15 years. This was mandated first under Swedish rule in order to prevent conflicts and, if they arise, settle them more efficiently. An additional goal of the Swedish Crown, which had a distaste for serfdom and never permitted in Sweden proper (Seppel, 2020)[19], was to document the extent of serfdom in order to inform its decision on how to reform or even abolish it in the Baltics. However, these plans never came to fruition as plans to abolish serfdom were interrupted by Russia's annexation of the Baltics in 1710 following the Great Northern War. Several manors were nationalized by the Swedish Crown, which I explore in the analysis. Crucially, the Swedish Crown, like the later Russian rulers, never restricted or sanctioned the intensity of coercion (Seppel, 2005).

[18] The vast majority of the non-German population of the Baltics were serfs, leaving little variation on the extensive margin. Focusing on the intensive margin of labor coercion is a departure from the existing literature (e.g. Dell, 2010; Markevich and Zhuravskaya, 2018).

[19] Corveé labor, however, existed in Sweden proper (Olsson, 2006).

I transcribe numerous waves of *Wackenbücher*, prioritizing those just before and just after plagues.[20] This choice is also due to the fact that the *Wackenbücher* contain the population estimates used to measure labor scarcity and proxies for 1605-6 and 1657 plague deaths (see next Section 3.3.2). In total, I transcribe coercion data from *Wackenbücher* scans or reproductions of their information in secondary sources for 1637 (after the 1605-6 plague), 1688 (after the 1657 plague), 1732 (after the 1710-2 plague), and 1839.

Figure 3.5: Example page from a *Wackenbuch*, 1732



Source: EAA.854.7.101 with own annotations.
Notes: The book shows for each household the name of the head, a breakdown of its members, the allotted land, and other wealth. On the right, the dues are detailed, including corvée, in-kind, and monetary payments. *Wackenbücher* were first mandated by the Swedish Crown, which was opposed to serfdom, but did not regulate it. They continued to be drafted by judges and formed basis for disputes.

Figure 3.5 gives an example page of a 1732 *Wackenbuch*. Each row reports on a

[20] Transcriptions of the 1732 *Wackenbücher* for the province of Estonia were kindly provided by the Estonian National Archives. This motivated the transcription of the Livonian *Wackenbücher* in 1732, in favor of a from-scratch transcription of the 1726 *Wackenbücher* of both provinces.

household of serfs. To measure the intensity of coercion, I calculate the ratio of corvée days per land unit (*Haken*). A *Haken* is a combined measure of land area and quality used in the Baltics. It approximately equaled 6 hectares of suitable land (Tarvel, 1983). each serf household between $\frac{1}{8}$ and 1 *Haken* (i.e., $\frac{3}{4}$ to 6 hectares) depending on the size of their household, with a median of $\frac{1}{2}$ or 3 hectares. Corvée days are reported at the household level in columns 15 and 16 of Figure 3.5. They represent the number of days per week a serf household needs to work on the Baltic-German manor owner's fields. There are two types of corvée days: those where only a worker needed to be sent (German: *Fußtage*, Column 15) and those where, in addition to the worker, a draft animal needed to be sent (German: *Spanntage*, Column 16). Although all types of corvée meant hard and coercive work, corvee days where serfs had to bring their own farm animal were viewed as more coercive. In other manors and other years, an additional, even more coercive category of corvée days existed, the so-called help days (German: *Hilfstage*). On help days, the manor lords forced serfs to harvest the lord's fields, depriving them of the opportunity to harvest their own fields. In all seasons except winter, the lord mandated that corvée days be used mainly for agricultural activities: the production of grain and flax. In winter, they were mainly used for logging, transporting goods, and making brandy (see Appendix Figure B.11 for a schematic overview)

Corvée days were proportional to the amount of land a serf household was allotted by the local Baltic-German manor lord. On their allotted land, the serfs cultivated crops for consumption and sale. The allotted land is quoted in *Haken* in Column 1 in Figure 3.5.

In addition to their unparalleled representation of labor dues, the *Wackenbücher* also contain other crucial information. At the beginning of a manor's entry, a short survey of the manor's general economic conditions was provided in the form of the number of mills and ponds and the available farm equipment. On the household level, the *Wackenbücher* recorded important demographic information: the number of adult men and women, the number of male and female elderly, and the number of farm hands and maids. Also, nonlabor dues, such as those paid in-kind or with money, were recorded. In Figure 3.5 these dues are reported under the heading *jährliche Gerechtigkeit*, German for annual entitlement (of the lord), in the 11 right columns. They comprise money, live animals (sheep and chicken), eggs, thread, hay, and wood. My analysis mainly focuses on labor dues given evidence that this is the margin on which coercion was increased.[21]

The corvée days per haken ratio can be understood as a coercive rent for the land that a serf household is allotted. It is identical for all serfs in a manor, reflecting the collective bargaining and contracting in the *Wackenbücher*. However, there are substantial differences between manors in the ratio of corvée days and *Haken*.

Historians have made essential contributions to our understanding of the *Wackenbücher* related sources, and Estonian serfdom (Lust, 2020; Palli, 2004; Plakans and Wetherell, 1992; Seppel, 2005, 2009; Zimmermann-Schulze, 2004). For example, Plakans and Wetherell (1992) show how serfs without land allotments were hired by those with land allotments to complete their corvée days. However, the main focus of this literature has been to follow a small number of manors over many years (Plakans and Wetherell, 1992). With this paper, I contribute a panel data set that includes the universe of documented manors and many periods.[22]

3.3.2 Plague deaths

Plagues are used in this research as locally-varied drivers of labor scarcity. For the three plagues considered in this research (1605-6, 1657, 1710-2), plague deaths are directly reported only for the 1710-2 plague deaths. For the first two plagues, I proxy plague deaths with the change in a manor's population as recorded in the *Wackenbücher*. In the regressions that relate coercion to the 1710-2 plague, I instrument the change in a manor population with plague deaths. For the other two plagues, I use simple OLS regressions with the (uninstrumented) change in manor population as the main explanatory variable.

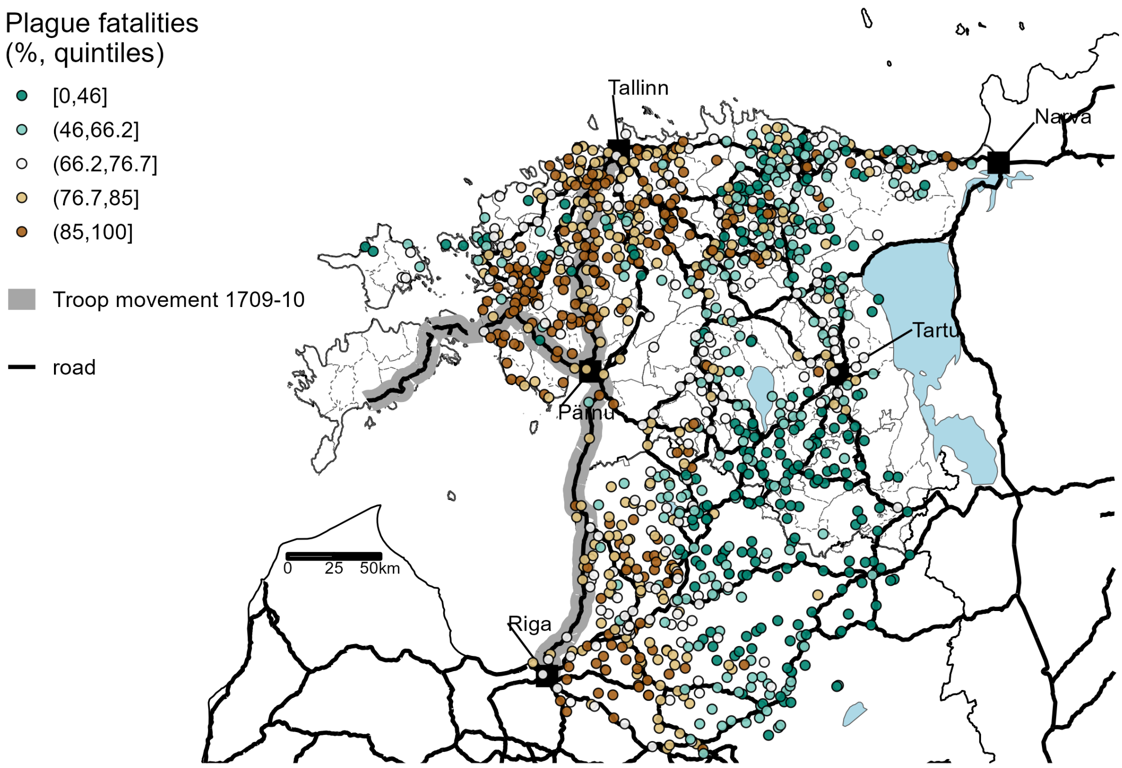
For 1710-2 plague deaths among serfs, I mainly rely on a 1712 survey of plague deaths[23] that was drafted to inform the Russian Czar about the extent to which the newly conquered territories were ravaged (Jordan, 1880). I transcribe this household-level survey from archival scans (see example page in Appendix Figure B.4). I supplement this data with additional sources (Bērziņš, 1935; Kõpp, 1929; Oja, 1996). Figure 3.6 maps plague deaths in Estonia and northern Latvia at the manor

[21] Kahk (1999) defines the timing of the transition from manorialism to estate ownership (which included directed own production by the lord) as the moment when the amount of grain produced on the lord's fields with corvée labor exceeded the grain that was collected through in-kind dues.

[22] Coercion data has also been studied for different geographies (Dribe, Olsson, and Svensson, 2012), for example corvée data in Sweden (Olsson, 2002, 2006), and serf data in Russia proper (Dennison, 2005; Nafziger, 2019; Stanziani, 2009), and Bohemia (Klein and Ogilvie, 2019).

[23] A supplement drafted in 1716 is used in some cases (see Ungern-Sternberg, 1912).

Figure 3.6: Plague deaths, 1710-2



Sources: plague deaths based on hand-collected archival plague reports (see example page in Appendix Figure B.4) and secondary sources (Bērziņš, 1935; Konks, 1961); troop movement (Fainstein, 1960); roads (Holterman et al., 2022).
Notes: at manor level. Modern-day borders of Estonia and Latvia. The spread of the plague initially accompanied the movement of troops in the Great Northern War.

level. What is striking is the wide range of plague mortality rates. Some manors did not experience any plague deaths, while in others every serf died from the plague. It is apparent that there are more plague deaths in the proximity of the 1709-10 troop movement from Riga to Tallinn and from Riga across the ice to the island of Saaremaa. This troop movement represented the final stage of the Great Northern War in Estonia and culminated in the capture of Tallinn. Little actual fighting took place since the troops, both Swedish defenders and Russian attackers, themselves experienced numerous plague deaths (Kroll and Krüger, 2006).[24] In the empirical strategy (Section 3.4), I demonstrate that while the distance to troop movements mattered on a large scale for plague deaths, it cannot explain deaths at the local

[24]The Russian troops faced no resistance in Pärnu as most Swedish soldiers had perished from the plague.

(parish) level. Similarly, revolts during the war (Fainstein, 1960) did not affect plague deaths.

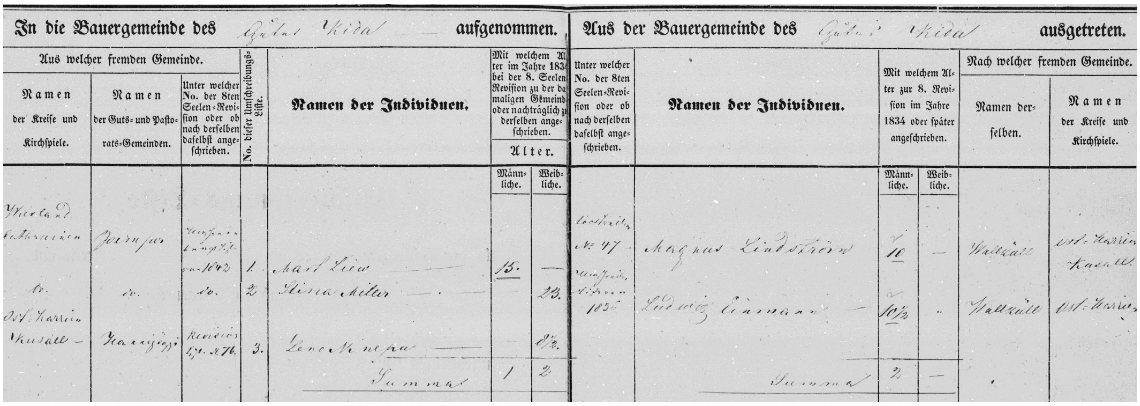
Did the plague affect certain demographic groups more than others? In Appendix Figure B.5, I investigate differences in mortality based on sex, age, and whether serfs were allotted land. None of the groups experiences significantly different rates of mortality. This implies that the 1710-2 plague, unlike other plagues and pandemics, was an 'indiscriminate killer', which is consistent with qualitative evidence in Estonia (Bruiningk, 1914) and elsewhere (Frandsen, 2010). For the purposes of this research, this implies that plagues drive overall labor scarcity, without changing the composition of the population.

3.3.3 Data on the consequences of coercion

The second part of this paper is concerned with studying the effects of coercion on various developmental outcomes. To this end, I collect the following data:

- *Education* (birth cohorts: 1776-1855): data on literacy at the manor level is available starting with the birth cohort of 1776-95, which corresponds to the schooling cohort of 1786 to 1805. The data come from the Russian army, which recruited random young men among the population of the manor. The original military records were synthesized in Aarma (1990)
- *Migration* (1836-51): Internal migration was legalized with the abolition of serfdom (1816-9), however, former serfs who wanted to migrate had to register their move, both origin and destination, with the police; see the example below in Figure 3.7 and Appendix Table B.1. Therefore, "unlike all but a very few peasantries elsewhere, the Estonian population continued to be precisely enumerated by state authorities even after the abolition of serfdom in 1816-1819" (Palli, 1983, p.290). I transcribe these records and obtain migration matrices between manors.

Figure 3.7: Migration data example, 1836



Source: EAA.1864.2.VIII-76.
Notes: left: 3 incoming migrants are recorded, right: 2 outgoing migrants.

– *Industry* and *infrastructure* (1909-13): Estonia experienced an industrial boom, mainly in distilling, towards the end of the 18th century and with the opening of the first railroad in 1870 (Pönicke, 1973). Conventional industrial surveys in the Russian Empire only capture the few (mainly heavy and mainly urban) industries in Estonia. As a remedy, I rely on a detailed set of address books (Richter, 1909, 1913). These books contain detailed information on the economic activities of each manor, ranging from beekeeping to distilling spirits to iron smelting. For all manors, it is reported whether they use windmills, watermills, or steam engines. The address books also report on the distance of the manor to infrastructure, such as doctors and shops.

– *Trust* (2013): Forced labor regimes have been associated with present-day trust (Nunn and Wantchekon, 2011). I provide the first evidence of the effect of serfdom on trust. I obtain access to the 2013 Estonian Social Survey (ESS, Statistics Estonia, 2019), which, as part of the EU-SILC, asks respondents how much they trust others, the political and the legal system. The data is provided with geographic identifiers at the extremely fine-grained area code level (N = 4,713); see Appendix Figure B.13. This allows for a very clean mapping from the historical manor level, at which plague deaths and coercion intensity were recorded.

3.3.4 Additional data

I collect numerous additional data that is used in heterogeneity analyzes and as controls.

- *Manor ownership*: Manors were owned by either nobles, the state, or the church. I code which noble family member owned a manor at a given point in time or whether it was owned by the state or the church from a variety of primary and secondary sources, see Table B.1. I also collect information on which manors were nationalized by the Swedish Crown and when they were re-privatized. The ownership data also allows me to investigate variations in serfs' outside options, which decrease when the same noble family owns multiple adjacent manors.

- *Plague deaths among manor owners*: The death of manor owners during plagues provides important insights into the effects of plagues. I match the name of the manor, collected in the above-mentioned manor ownership data, to their profiles on crowd-sourced genealogy websites (mainly `geni.com`). These profiles contain the individual's vital events and death location. Due to a great interest in Baltic-German genealogy, the match rates are very high, exceeding 95%. I code owners as having died from the plague when the plague is mentioned as their cause of death of if they died within the Baltics during plague years. Plotting death years of noble owners in Appendix Figure B.8, it is clear that there were pronounced mortality peaks in plague years.

3.4 Empirical strategy

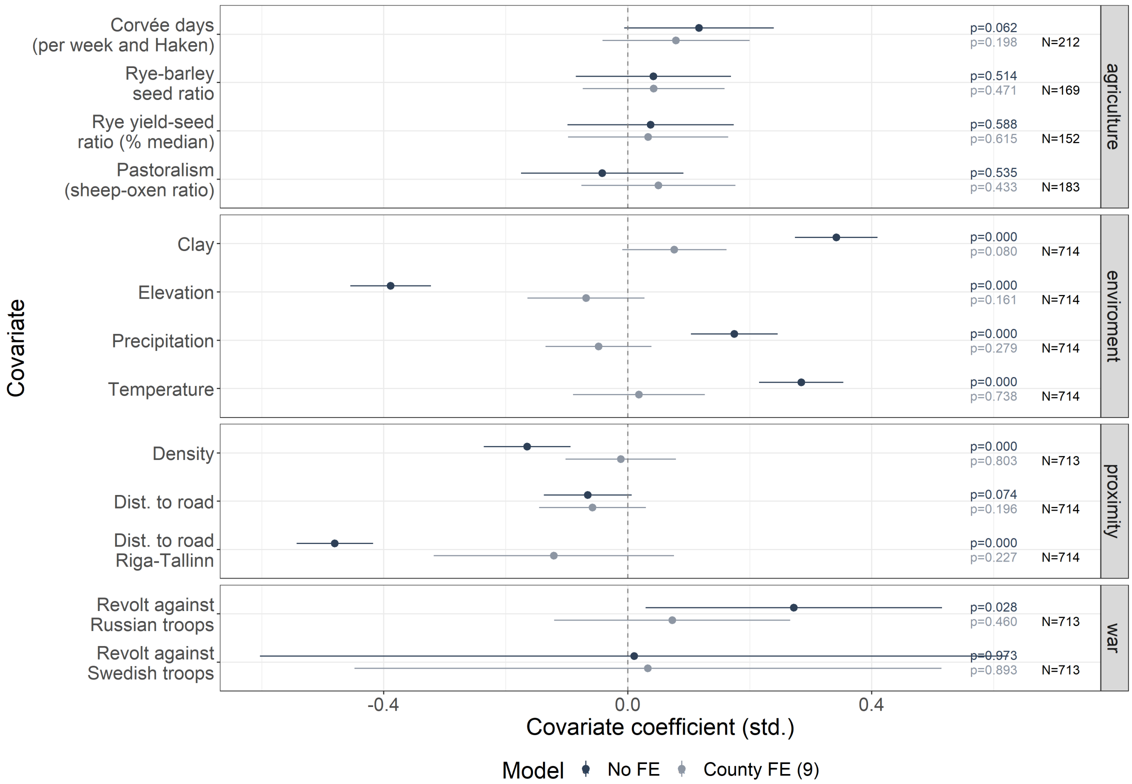
The empirical strategy relates coercion as an outcome Y to labor scarcity S and a vector of controls C for manor i in year t in an OLS specification:

$$Y_{it} = \beta_0 + \beta_1 S_{it} + \theta C`_{ict} + \epsilon_{it} \tag{3.1}$$

I define labor scarcity S as the negative of the growth rate of a manor's population P between periods:

$$S = -\left(\frac{P_{it} - P_{it-1}}{P_{it}}\right) \tag{3.2}$$

Figure 3.8: 1710-2 plague deaths and 1680s covariates



Sources: corvée and agriculture estimates based on 1680s *Wackenbücher*. For environmental variables, see Appendix B.3.4. Revolts based on Fainstein (1960).
Notes: Covariates are hypothesized drivers of the spread of the plague the plague (e.g. Benedictow, 2004). Most covariates appear to be balanced in the county (and municipality) FE specification. Haken≈ 6ha, avg. HH .25-.5 haken.

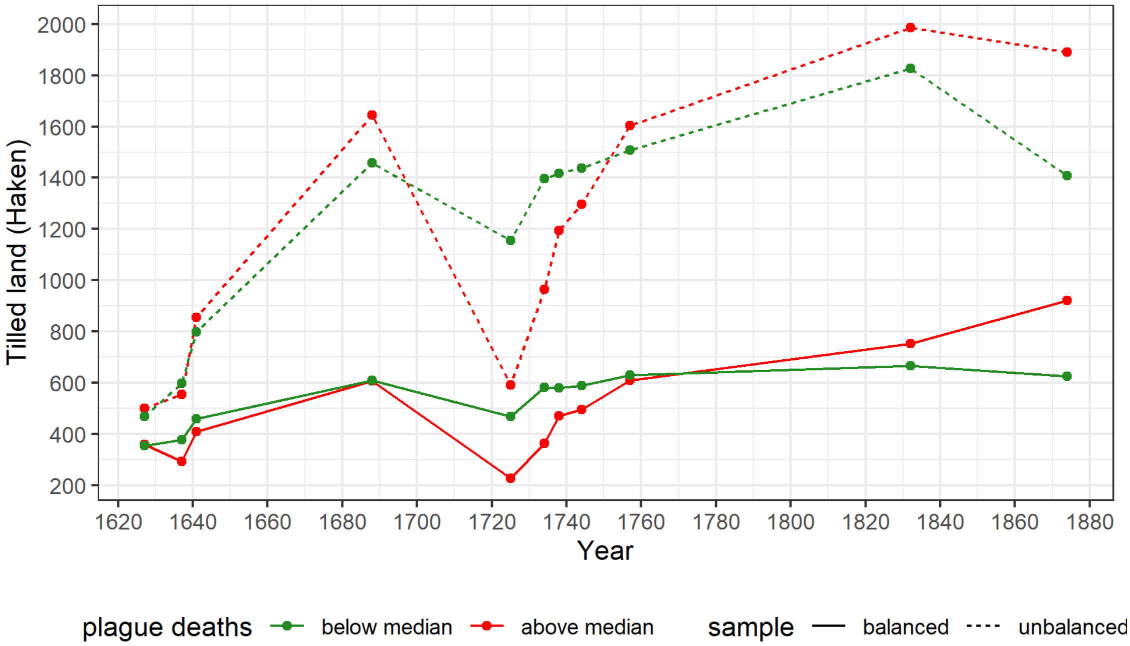
In most specifications, S is calculated for $t-1$ as the latest available data wave before a plague and t as the most immediate wave after a plague.[25] For the 1710-2 plague, I observe plague deaths directly. In this case, I instrument S with plague deaths and substitute $\widehat{S}$ in Equation 3.1, which then becomes the second stage.

To allow for a causal interpretation of my estimates, plague deaths ought to be quasi-exogenous at the local (county) level. This claim is supported by qualitative evidence that notes the apparent randomness of plague outbreaks (Bērziņš, 1935). I also test for the quasi-randomness of plague by correlating it to a large number of covariates. These covariates cover all the hypothesized drivers of the spread of the plague (Benedictow, 2004), such as density, distance to the roads, and the presence of animals. I hand collected rich information on the manor and its serfs as reported

[25]I also consider a version of S where it is simply calculated between adjacent data waves in the absence of plagues.

in the 1680s *Wackenbücher*. I add data on revolts during the war (Fainstein, 1960) as well as rich environmental data on soil conditions and climate (see Appendix B.3.4). I find that none of these covariates can predict the share of plague deaths at manors when applying county fixed effects; see Figure 3.8.

Figure 3.9: Tilled land, Northern Livonia, 1627-1881



Sources: Johansen (1933) and Stryk (1877, 1885).
Notes: As for population, plague leads to substantial drops in tilled land. Manors with below-median plague deaths follow very parallel pre-plague trends compared to those above.

In addition to the above evidence on local plague exogeneity, I also show evidence of parallel pre-trends in the amount of tilled land of manors before the outbreak of the 1710-12 plague (Figure 3.9). To this end, I split the sample into manors above and below the median of plague deaths (53%). While they followed similar trajectories before the 1710-2 plague, afterwards manors with above-median plague deaths experienced a notably more pronounced and lasting decline in tilled land.

3.5 Findings

I first focus on labor scarcity as a cause of the intensity of labor coercion (Section 3.5.1). Second, I study the consequences of serfdom on several short- and long-term outcomes (Section 3.5.2).

3.5.1 Testing Domar (1970): plagues, labor scarcity, and coercion

Table 3.1: Effect of labor scarcity on coercion

	Corvee days/haken/week			
	1638	1688	1732	1732 IV
Δ% pop reduction 1601-6 plague	0.068***			
	(0.023)			
Δ% pop reduction 1657 plague		0.384**		
		(0.184)		
Δ% pop reduction 1710-2 plague			4.307***	9.390**
			(0.455)	(4.543)
N	99	240	460	391
Adj R^2	−0.060	0.000	0.050	0.060
Mean dep var.	7.086	24.102	27.495	26.855
SD dep var.	4.409	12.335	9.253	8.045
Mean exp. var	−0.235	−0.758	0.354	0.345
SD exp var	3.354	1.422	0.514	0.565
F-stat 1st stage				11.44

Notes: At manor level. Clustered standard error and fixed effects at the parish level. IV: reduction in land is instrumented by 1710-2 plague deaths. Haken≈ 6ha, avg. HH .25-.5 haken. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

To study the effects of labor scarcity on the intensity of coercion, I estimate Equation 3.1. Table 3.1 shows the results. The outcome variable is the number of corvée days per *Haken* per week, which represents the coercive rent serfs had to pay for their allotted land. The corvée days had to be worked on the fields of the manor lord. The explanatory variable is the *negative* population growth (Equation 3.2) between the pre- and post- plague period. Columns 1 to 3 in Table 3.1 represent separate regressions for the population decline during different plagues (1601-6, 1657, 1710-2), with the intensity of coercion taken from *Wackenbücher* in 1638, 1688, and 1732, respectively.

As hypothesized by Domar (1970), plague-induced labor scarcity is associated with a significant increase in coercion. The magnitudes of the coefficients are quite different across the different plagues. In Column 4, I instrument the negative growth rate of population with recorded plague deaths. Relative to the OLS estimate (Column 3), the estimate more than doubles in magnitude. This could be due to post-plague in-migration that partially offset the change in population.[26]

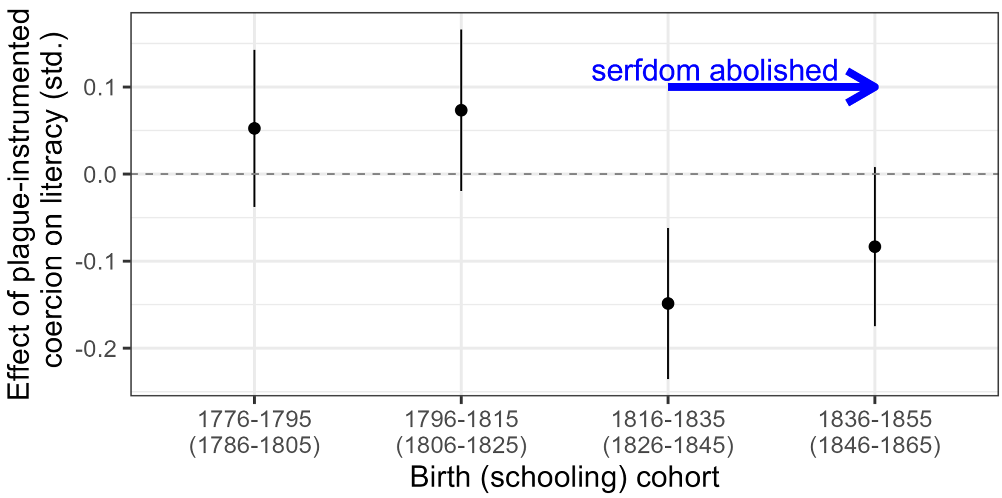
3.5.2 Consequences of coercion

I now turn to the consequences of coercion under Estonian serfdom. I focus on migration (after abolition), education (before and after abolition), and trust (in 2013). To obtain causal identification, I use the exogenous variation in coercion created by the 1710-1 plague (column 4 in Table 3.1).

I construct migration moves based on police registrations. Post-abolition, migration was legal, but registration (with the origin and destination manor) was an absolute necessity. Crucially, the abolition did not ban the corvée days, which were coercive and much disliked by the (former) serfs.

I find that corvée days are important for migration. On average, former serfs move to manors with, on average, 2.28 *fewer* corvée days per *Haken* per week than in their manor of origin. Viewed differently, migrants are motivated by cheaper (less coercive) land rents.

Figure 3.10: Effect of plague-instrumented coercion on literacy of recruits born 1776-1855, Estonia



Source: based on military recruit data collected by Aarma (1990). Recruits are randomly drawn from the draft-eligible population.
Notes: Plague-instrumented coercion has a negative effect on literacy only after the end of serfdom.

[26]Migration of serfs was strictly banned without the lord's consent. However, there is evidence of migration following plagues. Furthermore, in Estonia, serfs were also sold and traded by manor lords. However, this occurred to a more limited degree than under slavery.

These migration patterns are important in rationalizing the effect of instrumented coercion on education. I show that higher instrumented coercion leads to lower literacy (Figure 3.10) only *after* the abolition of serfdom. I argue that this can be explained by the above finding that higher coercion leads to more outmigration after abolition. As migrants tend to be more literate relative to non-migrants, this can explain the lower literacy rates post-abolition.

Table 3.2: Effect of instrumented coercion on trust in 2013

	Trust in (std.)		
	Others	Political system	Legal system
Coercion (std).	-0.08^{***}	-0.04	-0.06^{**}
	(0.03)	(0.03)	(0.03)
Male (0/1)	-0.14^{***}	-0.16^{***}	-0.15^{***}
	(0.05)	(0.04)	(0.05)
Age (years)	-0.00^{***}	-0.01^{***}	-0.01^{***}
	(0.00)	(0.00)	(0.00)
Russian speak. (0/1)	-0.56^{**}	-0.80^{***}	-0.46^{*}
	(0.26)	(0.21)	(0.25)
County FE	Y	Y	Y
Education	Y	Y	Y
Income	Y	Y	Y
Adj. R^2	0.04	0.10	0.08
N	1822	1761	1727

Notes: IV regressions on the individual level based on Estonian Social Survey 2013. IV: coercion in 1732 is instrumented by 1710-2 plague deaths. Outcomes are 0-10 indexes that have been standardized. Standard errors clustered by county. *p<0.1; **p<0.05; ***p<0.01

The last finding is the effect of instrumented coercion on trust in 2013. I draw on the 2013 Estonian Social Survey, which is part of EU-SILC. This survey provides very detailed geographic information on the domicile of the respondents that allows me to map it to historic manors.

I follow the same strategy as above and use plague-instrumented coercion as the explanatory variable. The outcome variables are the respondent's trust in others, the political system, and the legal system on a 0 to 10 scale, which I standardize. The findings are reported in Table 3.2. Trust in others and in the legal system is significantly reduced, while the effect on trust in the political system is also negative and similar in magnitude, but statistically insignificant. Note that this magnitude (0.08 and 0.06 of a standard deviation) is comparable to the effects of exposure to the slave trade reported in (Nunn and Wantchekon, 2011). The results regarding trust in the legal system may stem from the long legacy that Baltic Germans had in controlling the courts and law-making.

3.6 Conclusion

A fundamental notion in economics is that when a factor of production becomes scarcer, its rewards should increase. It is commonly thought that the holder of this factor will reap these higher rewards. Therefore, a worker shortage should lead to higher wages. However, in the presence of coercion, this basic relationship can break down. Instead of paying a higher wage, employers force employees to work for a below-market wage and reap the rewards.

Focusing on labor shortages after plagues in Estonia, I provide the first causal evidence of this mechanism. Coercion, as measured by the number of serf labor days, increased substantially following each of the three studied plague waves (1605-6, 1657, 1710-2). These findings support the influential hypothesis of Evsey Domar (1970). Domar (1970) argued that the increase in the land-labor ratio following the Black Death (1346-53) led to the intensification of serfdom (the so-called Second Serfdom) in Eastern Europe. I argue that the limited availability of outside options in Estonia that was created and maintained by an oppressive Baltic German elite can explain this response. In other settings, e.g., Western Europe, the average response might be different (Acemoglu and Wolitzky, 2011; Brenner, 1976).

To the extent that similar mechanisms are present today, authorities should particularly investigate contexts where outside options are limited (like they were under Estonian serfdom). A recent literature in labor economics (e.g. Caldwell and Harmon, 2019; Jäger et al., 2022; Schubert, Stansbury, and Taska, 2021) shows that also today employee wages are low when outside options are limited. However, employers may also use coercion in these contexts to keep wages even lower, particularly following worker shortages. The institutional framework is key when analyzing coercion and its response to shocks.

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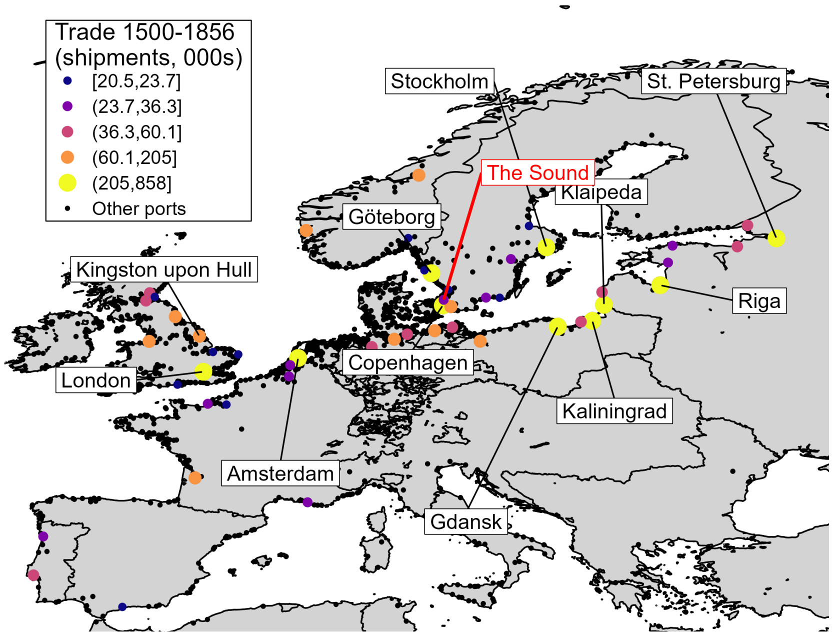
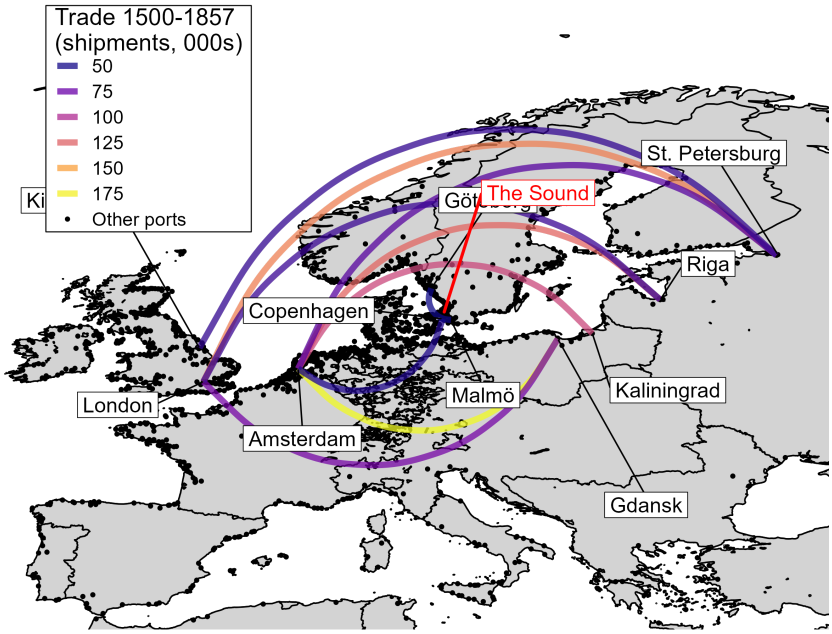
Figure A.1: Trade geography - number of shipments as alternative measure

(a) Largest ports



(b) Largest trade routes



Source: author (Sound Toll)

Notes: Link to animations. The largest ports include London, Amsterdam, Copenhagen, Szczecin, Gdansk, Kaliningrad, Riga, and Saint Petersburg. Amsterdam-Gdansk is the largest trade route, carrying a substantial share of the grain trade. Similar conclusion for the number of shipments as an alternative measure of trade, see Appendix Figure 1.5.

Appendix A

Appendix to "Breaking the ice: The persistent effects of pioneers on trade relationships"

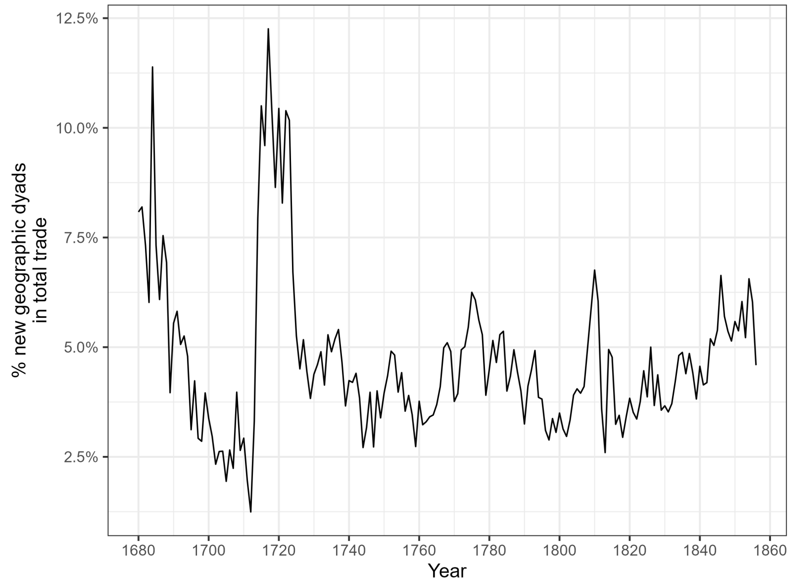
A.1 Additional Figures

Figure A.2: Captains' voyages through the Sound, 1497-1856

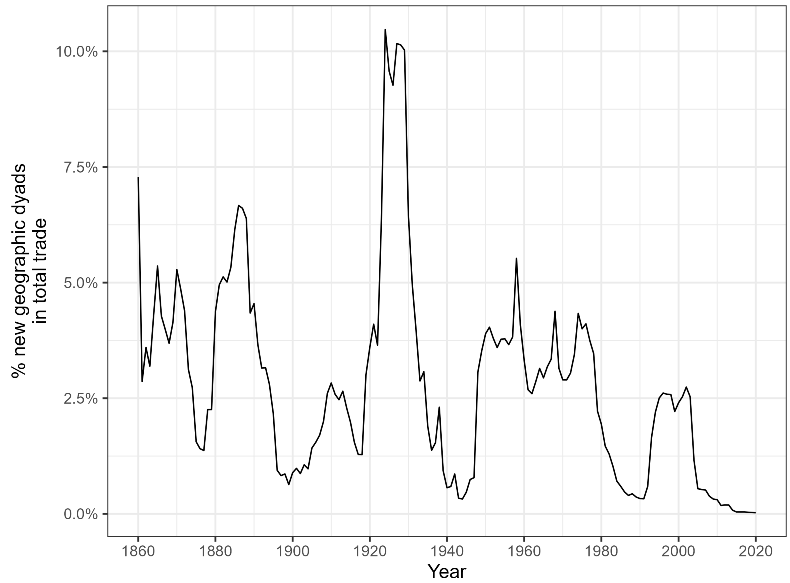
Source: Sound Toll
Notes: Figure shows annual voyages through the Sound. The general trends are comparable to the evolution of trade value (Figure 1.4). The three phases of Baltic trade are clearly visible: (i) expansion (1540-1650), (ii) contraction and volatility (1650-1760), and (iii) renewed growth (1760-1860), see Section 1.3.2.1 for details.

Figure A.4: Share of geographic pioneering in total trade

(a) Baltic trade, 1680-1856



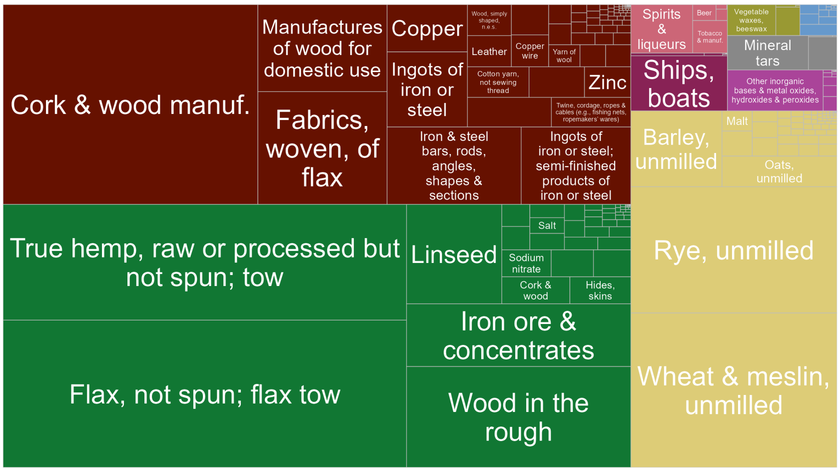
(b) World trade, 1860-2020



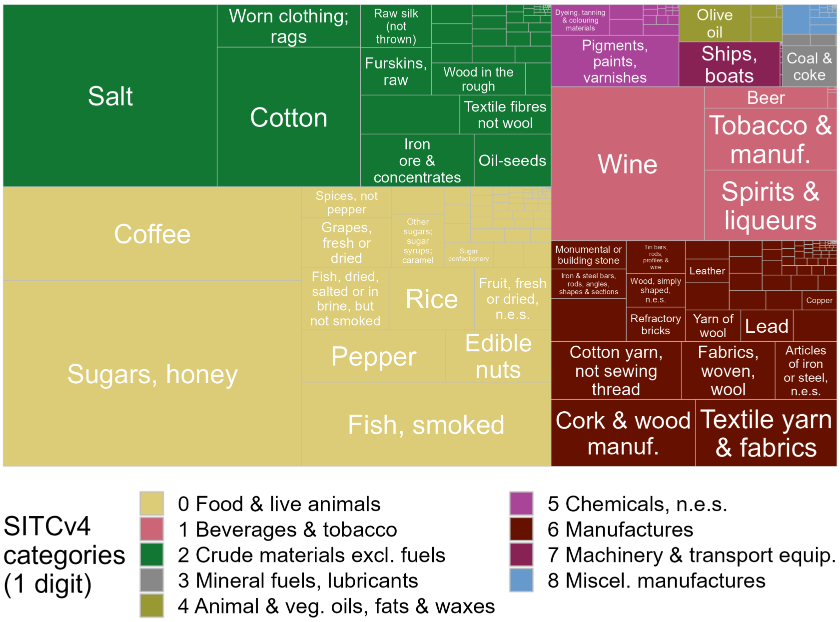
Sources: Panel A.4a: Sound Toll, Panel A.4b: 1827-1947: Fouquin and Hugot (2016), 1948-1961: Conte, Cotterlaz, and Mayer (2022), 1962-2020: Comtrade (COMTRADE, 2023)
Notes: For a decomposition of all types of pioneering, see Figure 1.3.

Figure A.3: Product mix by value, 1500-1856

(a) Baltic exports

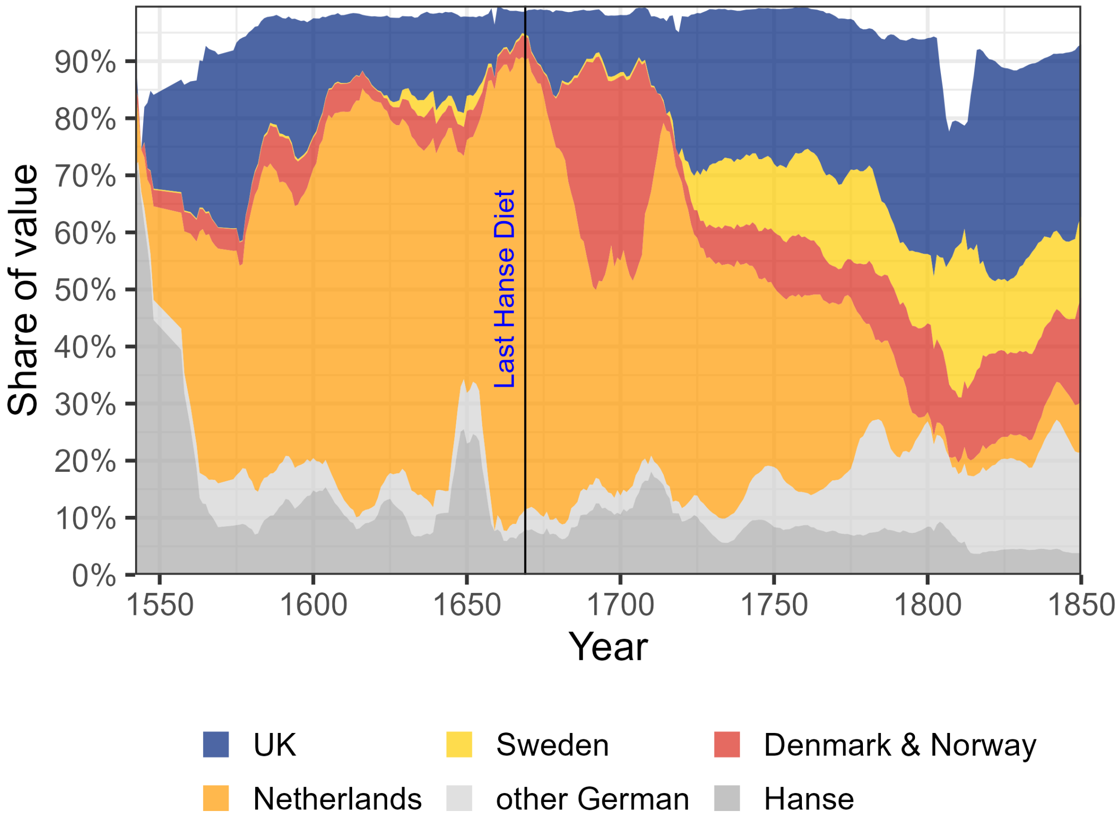


(b) Baltic imports



Source: author (Sound Toll).
Notes: Classification according to SITCv4, 4-digit level with colors corresponding to the 1-digit level. For product mix by value, see Figure 1.6.

Figure A.5: Baltic trade by flag, 1540-1850



Source: author (Sound Toll)

Notes: Decomposition by captain domicile. Hanse if the captain's domicile is Hanse town, see Appendix A.8. The vertical line denotes the year of the last Hanse Diet (1669). For a similar-looking decomposition by number of shipments, see Figure 1.7.

A.2 Additional Tables

Table A.1: Captain panel – summary statistics

Variable	N	Mean	Median	Std. Dev.	Min.	Max.
Career length (voyages)	144,546	7.79	4.00	11.05	2.00	100.00
Career length (years)	144,546	5.96	3.00	7.44	0.00	50.00
Month voyage (median)	144,546	7.14	7.00	1.51	1.00	12.00
Jan-Apr (% voyages)	144,546	0.13	0.00	0.19	0.00	1.00
Jan-Apr (# voyages)	144,546	1.03	0.00	1.93	0.00	42.00
Tax amount (mean, daler)	126,768	49.92	26.03	91.96	0.00	3,159.32
Number ports	120,907	5.89	4.00	4.66	1.00	50.00
Number Baltic ports	120,907	2.65	2.00	2.13	0.00	23.00
Number non-Baltic ports	120,907	3.23	2.00	2.98	0.00	38.00
Number non-directional dyads	120,907	4.61	3.00	4.87	1.00	61.00
Years since last voyage	116,675	1.24	0.60	1.75	0.01	30.28
Number unique product types	120,907	10.08	6.00	11.56	0.00	130.00

Notes: Data first aggregated from voyage to captain level.

A.3 Additional Findings and Robustness Checks

Table A.2: Oncoming ships from new ports and pioneering

	First in 50y		First ever	
	Non-dir	Dir	Non-dir	Dir
% ships from new	0.006^{**}	0.007^{**}	0.010^{***}	0.013^{***}
	(0.002)	(0.003)	(0.003)	(0.004)
# voyages	-0.000^{***}	-0.000^{**}	-0.000^{*}	-0.000^{**}
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Y	Y	Y	Y
Origin town FE	Y	Y	Y	Y
Mean dep. var.	0.012	0.017	0.014	0.020
SD dep. var.	0.026	0.031	0.034	0.040
Mean exp. var.	0.988	0.988	0.988	0.988
SD exp. var.	0.047	0.047	0.047	0.047
N	1,170,817	1,170,817	1,000,376	1,000,376
Adj. R^2	0.056	0.058	0.082	0.083
Adj. R^2 w/o FE	0.000	0.000	0.000	0.000

Notes: At voyage level. Table shows that encountering larger share of ships at the Sound coming from new ports increases likelihood of pioneering. SEs clustered at origin town. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Table A.3: Encounters with captains, pioneering, and subsequent trade - CF

	Shipments in t	
	PPML	PPML-CF
Pioneer t-1	0.37^{***}	4.47^{***}
	(0.02)	(0.13)
Resid. 1. stage		-4.12^{***}
		(0.14)
Dyad FE	Y	Y
Year FE	Y	Y
Origin FE	Y	Y
Dest. FE	Y	Y
Mean dep. var.	0.93	0.93
SD dep. var.	10.93	10.91
Num. obs.	4,208,864	4,208,864
Deviance	6,692,755.43	6,661,243.23
Log Likelihood	−3,767,862.23	−3,752,106.13
Pseudo R^2	0.77	0.78

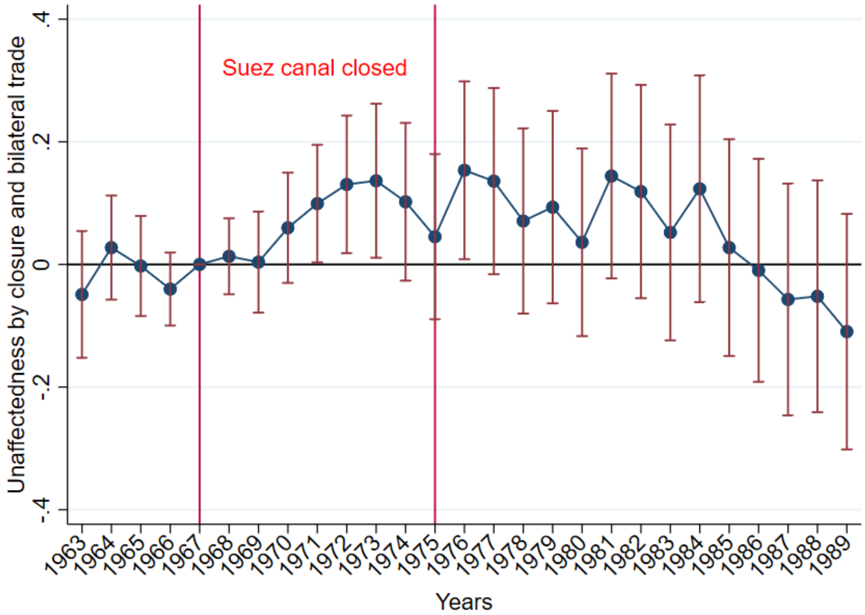
Notes: At voyage level. Control function approach with encounters with oncoming captains from new ports. Table shows that control function approach leads substantially larger estimates of the effects of pioneering on trade in the next period. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

A.4 20th-century trade rerouting - the 1967-1975 Suez Canal closure

This section presents a brief exercise that demonstrates how trade is rerouted following temporary rerouting. To this end, I build on the analysis of Feyrer (2021) who studies the unexpected closure of the Suez Canal in 1967-1975, which substantially increased the bilateral distance of certain country pairs. Feyrer (2021) demonstrates that the closure caused sizable reductions in trade and GDP.

I take this setting and extend Feyrer, 2021 analysis to investigate if countries that were *unaffected* by the closure trade more even after the canal was reopened in 1975. In Figure A.6, I use Chaisemartin and d'Haultfoeuille, 2023 event-study difference-in-differences estimator and define treatment as with unaffectedness by the closure as the treatment variable, that is, countries whose shortest sea connection does not rely on the Suez Canal. It is apparent that trade between countries that do not rely on the Suez Canal increases *vis à vis* those who do rely on it after its 1967 closure. This effect persists in the immediate aftermath of the 1975 reopening of the canal.

Figure A.6: Rerouting of trade to countries pairs unaffected by 1967-75 Suez Canal closure



Source: based on data by Feyrer (2021).
Notes: Chaisemartin and d'Haultfoeuille, 2023 event-study difference-in-difference. Treatment is unaffectedness of country pair by Suez Closure, i.e. countries whose shortest sea connection does not rely on the Suez Canal. The red lines mark the years of the Suez Canal closure (1967-1975).

A.5 Encounters instrument

Table A.4 shows that the port of origin of oncoming shipments at the Sound determines the destination port choice. This finding is consistent with historical evidence (Ojala, 2017) that the Sound is an important information hub. Crucially, it implies that, by recording oncoming shipments, the Sound Toll captures an important determinant of destination choice. This is the first step in constructing the *encounter* instrument that uses the influence of encounters with oncoming captains from new ports on captains sailing to those ports, thereby becoming pioneers.

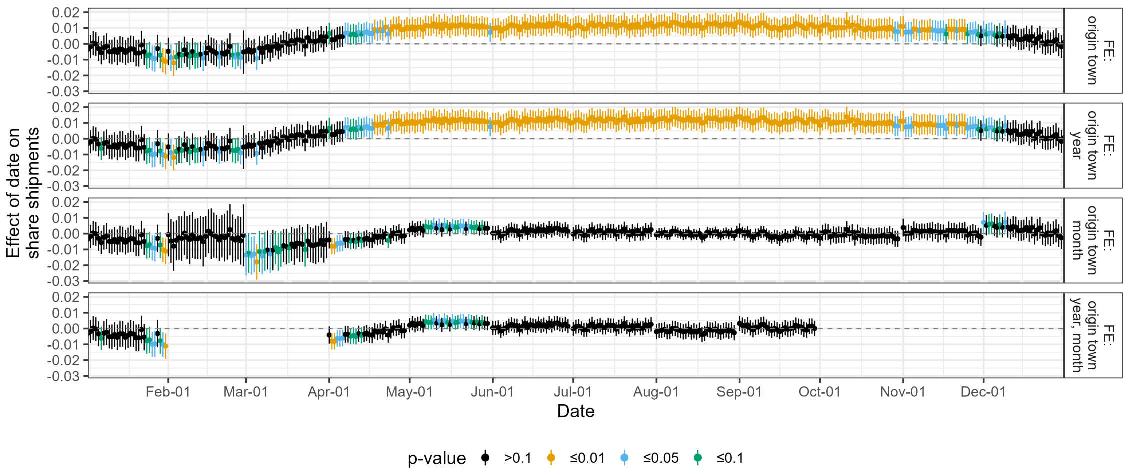
Table A.4: Origins of shipments at Sound correlate with destination port choice

	% shipments to port on day				
	1	2	3	4	5
% shipments from port on day	0.18***				
	(0.00)				
% shipments from port on last 3 days		0.43***	0.28***	0.37***	0.19***
		(0.00)	(0.00)	(0.00)	(0.00)
constant	0.07***	0.06***			
	(0.00)	(0.00)			
Mean dep. var.	0.09	0.10	0.10	0.10	0.10
SD dep. var.	0.02	0.05	0.09	0.06	0.09
Mean exp. var.	0.09	0.09	0.09	0.09	0.09
SD exp. var.	0.12	0.13	0.13	0.13	0.13
N	145,977	298,469	298,469	298,469	298,469
Adj. R^2	0.03	0.12	0.32	0.15	0.36
Adj. R^2 w/o FE			0.06	0.09	0.03
# FE year			290		290
# FE date				366	366

Notes: OLS regression at daily origin and destination port level. Table shows that there is a strong positive relationship between the share of oncoming shipments from a port and the share and the share of shipments going to that port on the same day/last 3 days at the Sound. This provides evidence that the Sound acts as an important information hub that shapes destination choice. Robust standard errors. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

For the effect of oncoming ships from new ports on destination choice to be a valid instrument, it needs to be the case that it is quasi-random from which ports ships are oncoming on a given day at the Sound. Figure A.7 supports this claim by showing that when using month fixed effects and origin town fixed effects (Panel 3), individual dates in a year do not systematically predict the shares of the 30 largest trading ports.

Figure A.7: Top 30 ports daily share



Notes: Figure shows the coefficients of regressions of the share of port in the daily number of shipments at the Sound on date dummies. The panels show results for different (combinations of) fixed effects. All regressions use port fixed effects. The sample is restricted to the 30 ports with the most overall shipments. The third panel demonstrates that for origin town and month fixed effects, individual dates do not predict the share of a town, which suggests that it is quasi random. The estimation fails for months with a low number of shipments when using origin town, month, and year fixed effects. Robust standard errors.

A.6 Construction of Sea Ice Instrument

A.6.1 From basin to port level

To translate the ice information on the day of the basin to the more granular port level, I compile data on ice breakup recorded at hundreds of ports beginning in the early 19th century.[1] The data comprises primary sources that I transcribed, as well as data provided by various national weather and environmental services. Figures A.9 and A.10 map all weather stations in the sample. Across all sources, ice breakup is a well-defined concept defined as the day when navigation first becomes possible in a season, which corresponds to a nearly complete disappearance of sea ice.

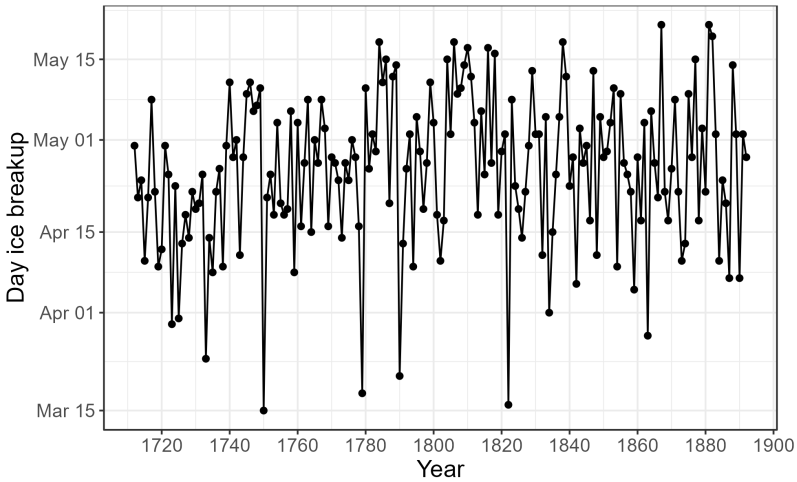
Given that with a few exceptions, ice breakup data is not available for my study period (1500-1856), I first establish the relationship between basin-level ice extent (Hansson and Omstedt, 2008) and ice breakup for each station for the years when both data sources are available (c. 1900-2022). To this end, I take the extent of ice

[1] Satellite data is only available from the 1980s and it proved more difficult to derive ice breakup from it.

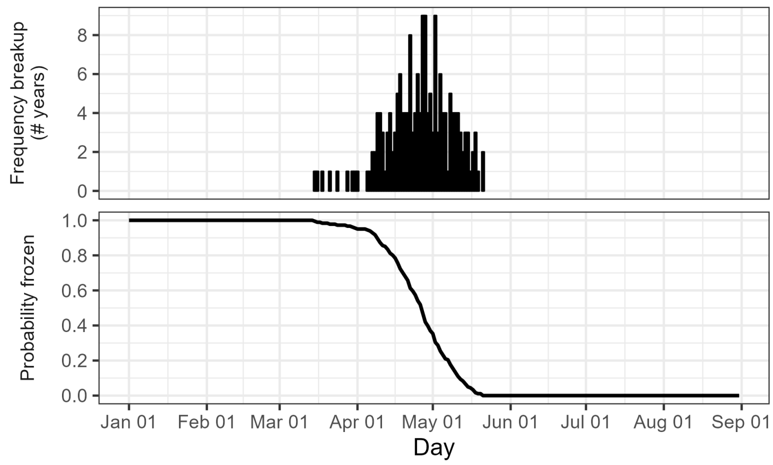
at the basin level (see Figure 1.12 in the main text) on the day of ice breakup at the station for each year before averaging across all years. In the last step, I determine which weather station is closest to a port in the Sound Toll. Often, the weather station is right in the port. The resulting port-level data reflects well-established facts, for example, that shallower ports or those closer to rivers unfreeze comparatively late.

Figure A.8: Example of ice observation data - Stockholm

(a) Observed annual ice breakup dates, 1712-1892



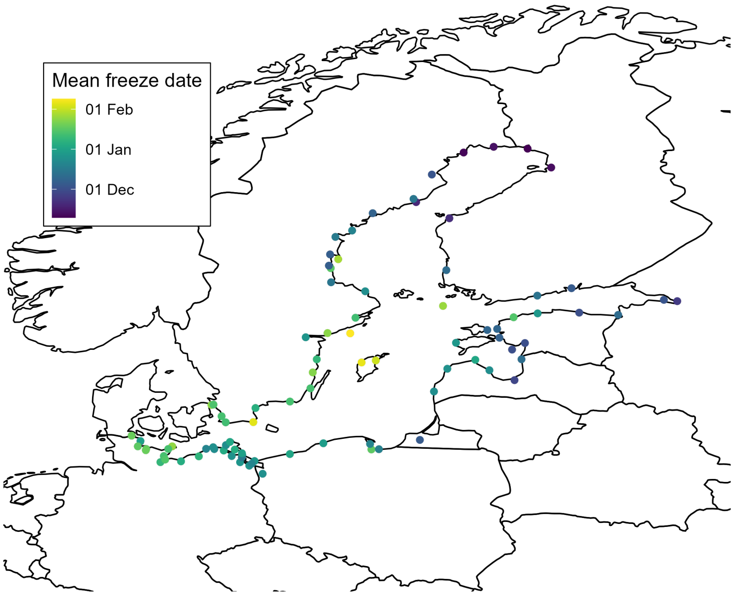
(b) Distribution of ice breakup dates and probability of ice



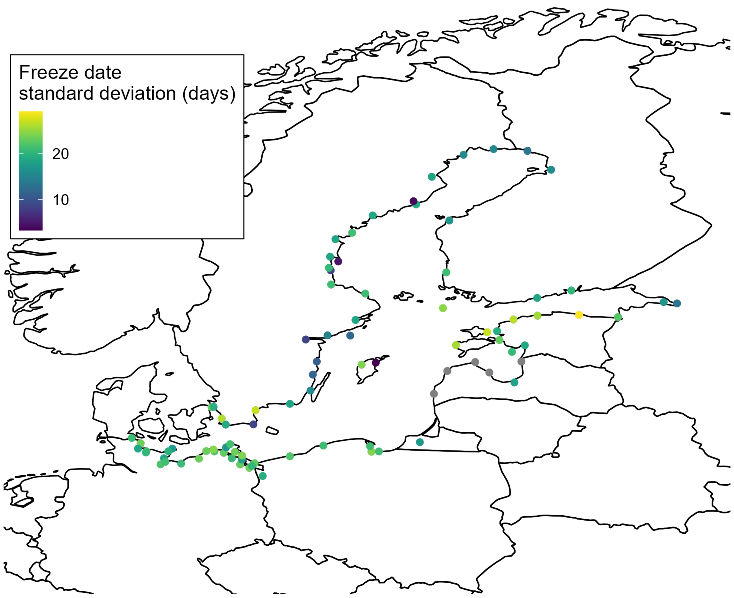
Source: based on data by Leijonhufvud et al. (2010). I collect ice observations for many ports (see Appendix Figures A.9 and A.10).
Notes: Panel A.8a shows a large annual variation in ice breakup in Stockholm, ranging from March 15 to past May 15. This variance mirrors that of the reconstructed maximum Baltic Sea ice extent (Figure 1.11). Transforming these ice breakup observations into the probability that the Stockholm harbor is frozen, Panel A.8b demonstrates that there is a non-negligible period during which captains face an intermediary probability ice.

Figure A.9: Port-level freezing observations

(a) Mean



(b) Standard deviation

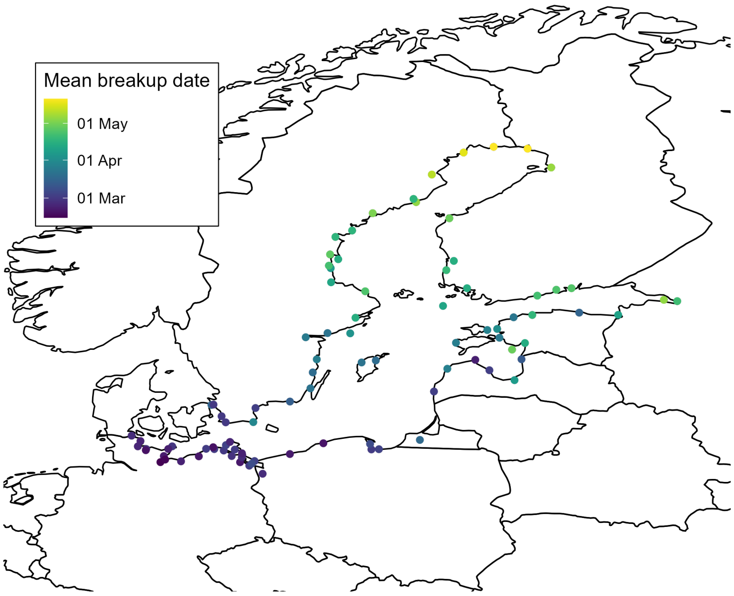


Sources: Deutsches Hydrographisches Institut (1961), Estonian Environment Agency (2023), Federal Maritime and Hydrographic Agency of Germany (2023), Girjatowicz (2007), Jevrejeva et al. (2004), Kļaviņš, Avotniece, and Rodinovs (2016), Leijonhufvud et al. (2010), Norrgård (2022), Rykachev (1887), Sharma et al. (2023), Speerschneider (1915), Swedish Meteorological and Hydrological Institute (2023), Tarand and Nordli (2001), Thorslund (1966), Westring (1995), and Östman (1937)

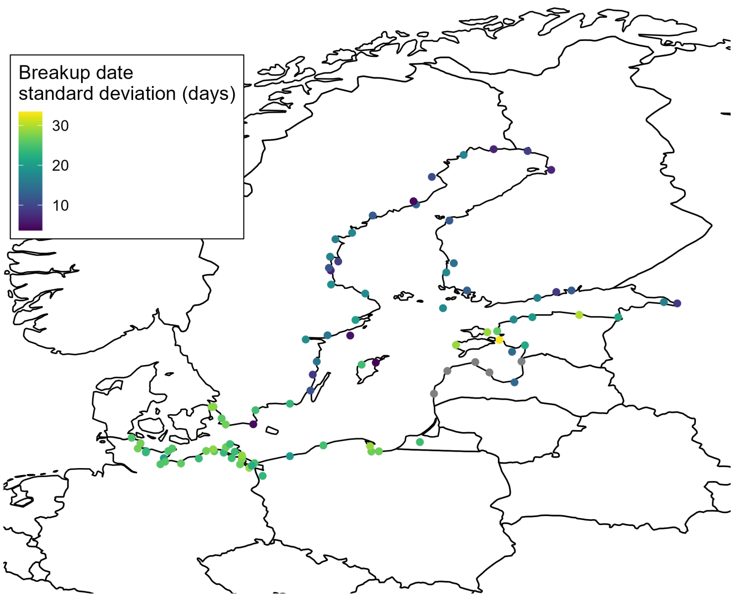
Notes: Sample is not balanced, therefore, the values are only indicative. Stations with fewer than 20 years of ice-breakup observations were excluded.

Figure A.10: Port-level ice breakup observations

(a) Mean



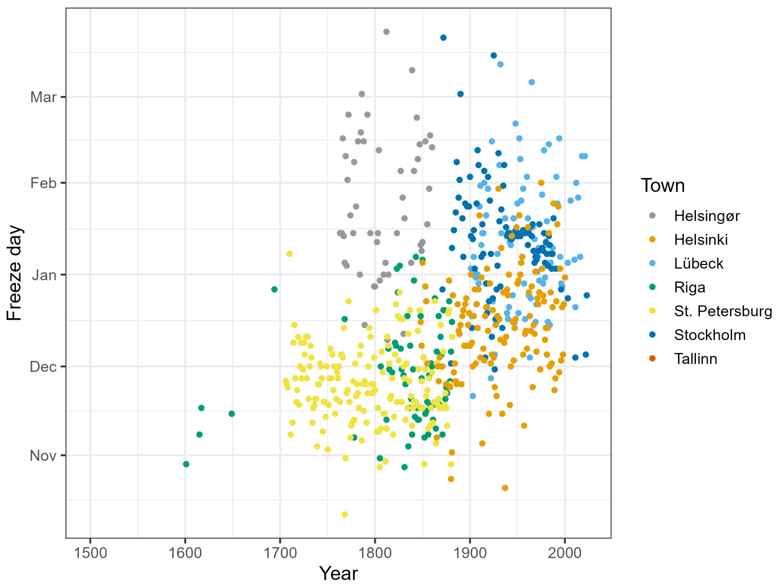
(b) Standard deviation



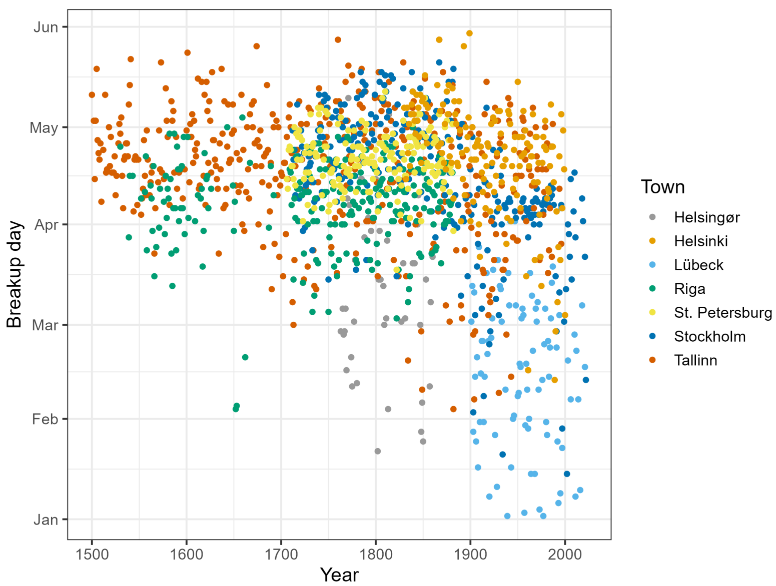
Sources & Notes: see Figure A.9.

Figure A.11: Freezing and breakup at selected locations

(a) Freezing



(b) Breakup



Sources: see Figure A.9.
Notes: Selected towns in the sample first shown in Figure A.9.

Table A.5: Influence of max ice extent on station-level freeze and breakup dates

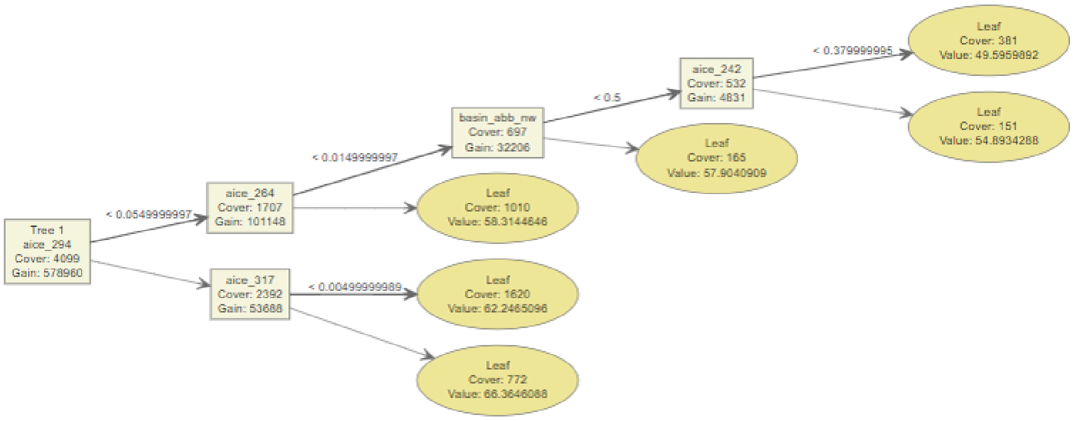
	Freeze date	Breakup date
	1	2
Max ice extent [0-1]	-12.820^{***}	34.148^{***}
	(1.244)	(2.330)
Port FE	Y	Y
Mean dep. var.	141.844	248.052
SD dep. var.	23.003	26.642
Mean exp. var.	0.609	0.612
SD exp. var.	0.224	0.223
N	4,910	6,194
# Port FE	82	86
Adj. R^2	0.579	0.705
Adj. R^2 w/o FE	0.020	0.161

Notes: At port-year level. Table shows that a higher maximum extent of ice leads to earlier freeze and later ice breakup dates in the same season. Freeze and breakup dates counted as days from August 1. SEs clustered at port level, $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

As expected, Table A.5 shows that a higher maximum reconstructed extent of ice (Hansson and Omstedt, 2008) correlates strongly with *earlier* freeze dates (negative coefficient) and with *later* breakup dates (positive coefficient), that is, it predicts a longer ice season. The magnitudes are comparable to the effect of the maximum ice extent on the timing of shipping (Table A.11).

Figure A.13 evaluates, at the annual port level, predicted freezing (Panel A.13a) and breakup observations (Panel A.13b) against those observed at ports (Appendix Figures A.9 and A.10). There is a good correspondence, which means that the predictions are very accurate.

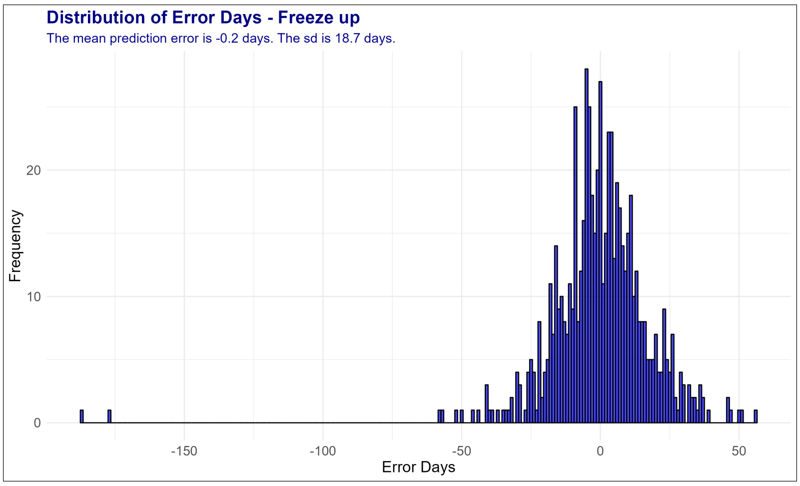
Figure A.12: Decision tree of breakup date prediction



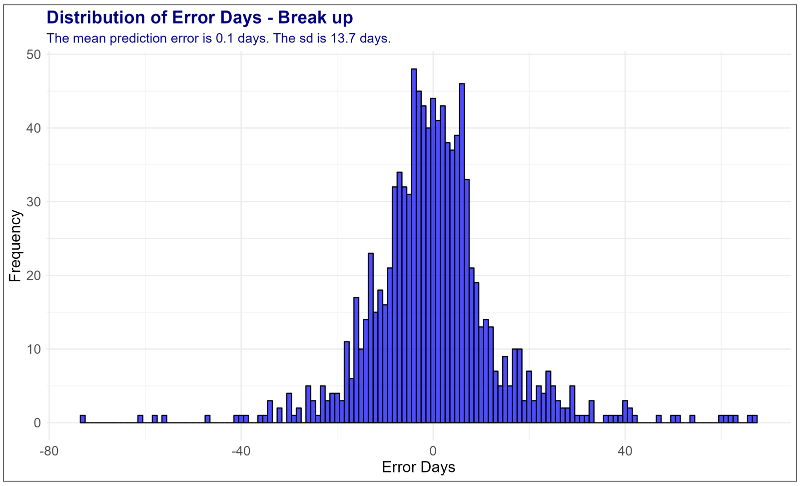
Sources: Predictions derived from own machine learning climate model using Omstedt, 2011 reconstructions and hand-collected port-level data; see Figure A.9.
Notes: Days counted from August 1, the beginning of the season.

Figure A.13: Machine learning prediction accuracy

(a) Freezing



(b) Breakup

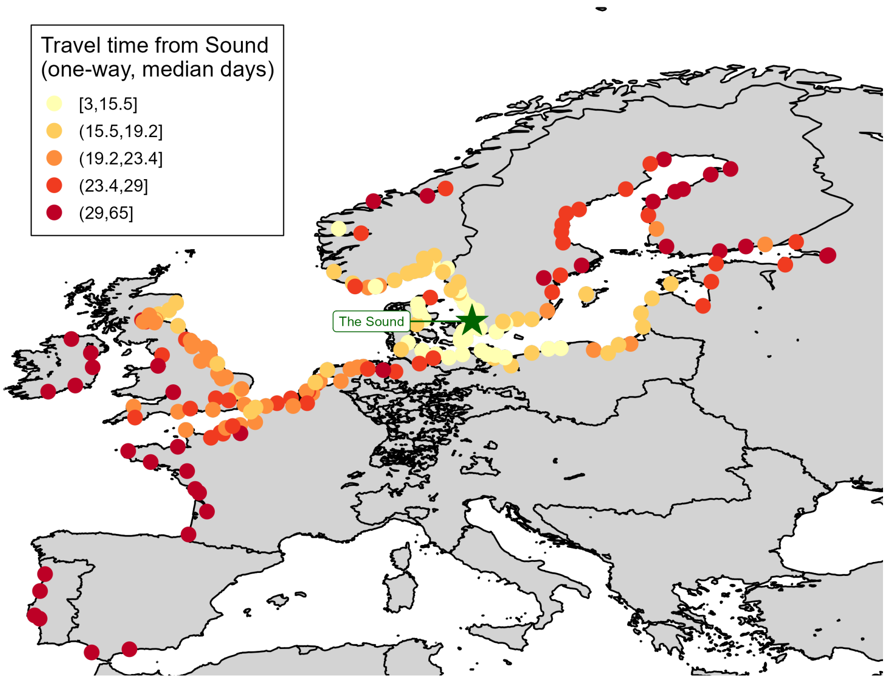


Sources: Predictions derived from own machine learning climate model using Omstedt, 2011 reconstructions and hand-collected port-level data; see Figure A.9.
Notes: At port-season level. Good correspondences between observed freeze and breakup dates and those predicted by the climate model. Days counted from August 1, the beginning of the season.

A.6.2 Travel speed

In order to predict when captains will arrive at ports after passing through the Sound, I estimate their average per-kilometer travel speed. To this end, I take advantage of the captain panel (Section 1.4.2) which reveals both the time between two passages through the Sound and the distance covered. Figure A.14

Figure A.14: Travel time from Sound to destination



Source: author (Sound Toll).
Notes: For captains returning from stated destination in same calendar year.

To obtain a precise estimate of the speed of sailing in the Baltic, I regress the number of days a captain spends in the Baltic between two passages through the Sound (Hours in Baltic) on km to destination port multiplied by 2 (to account for travel there and back) and year fixed effects:

$$\text{Hours in Baltic}_{vt} = \alpha(\text{km to destination port}_v * 2) + \phi_t + \epsilon_{vt} \tag{A.1}$$

Table A.6: Estimated travel speed within the Baltic Sea

	Hours in Baltic between Sound passages		
	1	2	3
km to destination port ×2	0.193***	0.207***	0.197***
	(0.001)	(0.003)	(0.003)
constant	589.496***		
	(1.995)		
Year FE		Y	Y
Captain domicile FE			Y
Mean dep. var.	1,071.698	1,071.698	1,071.698
SD dep var.	294.974	321.699	335.705
Mean exp. var.	2,497.163	2,497.163	2,497.163
SD exp. var.	1,527.573	1,527.573	1,527.573
N	136,398	136,398	136,398
Adj. R^2	0.370	0.440	0.475
Adj. R^2 w/o FE		0.411	0.302
# Year FE		242	242
# Captain domicile FE			1,097

Notes: At captain level. Column 2 shows that average speed is 0.207 h/km = 4.83 km/h. Sample restricted to captains domiciled outside Baltic and whose declared origin town matches declared destination town on previous voyage. SEs clustered on year level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

The results of estimating Equation A.1 are shown in Table A.6. α is estimated at 0.207 h/km, or 4.83 km/h, which is similar to the typical speed of vessels at the time and to previous estimates (Rönnbäck, 2018). Note that this estimate (α) only includes the effects of distance and not of time spent in the harbor. This is all that is needed to predict the arrival day at a (iced) Baltic port.

A.7 Validation of Sea Ice instrument

A.7.1 First stage ice IV

Table A.7: Ice in historically visited ports and ex-ante pioneering

	First in 50y		First ever	
	Non-dir	Dir	Non-dir	Dir
Days till breakup of existing destinations	0.00011***	0.00018***	0.00015***	0.00020***
	(0.00004)	(0.00004)	(0.00004)	(0.00005)
F-stat	31.14860	53.28235	41.75177	52.17461
Mean dep. var.	0.01000	0.01415	0.01184	0.01685
SD dep. var.	0.02028	0.02519	0.02825	0.03422
Mean exp. var.	2.17546	2.17546	2.32419	2.32419
SD exp. var.	9.18586	9.18586	9.66607	9.66607
N	579854	579854	463306	463306
# FE origin city	713	713	690	690
# FE year	137	137	137	137
# FE month	12	12	12	12
Adj. R^2	0.04014	0.04409	0.06650	0.06903
Adj. R^2 w/o FE	0.00005	0.00009	0.00009	0.00011

Notes: At voyage level. Table shows that when ice conditions are more pronounced in historically-visited ports the likelihood of pioneering increases. Sample restricted to non-Baltic origin towns. SEs clustered at origin town. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

A.7.2 Absence of interannual relation of sea ice extent

Table A.8 shows that lagged sea ice conditions do not predict current ice conditions, which is in line with the mentioned short thermal memory of the Baltic Sea.

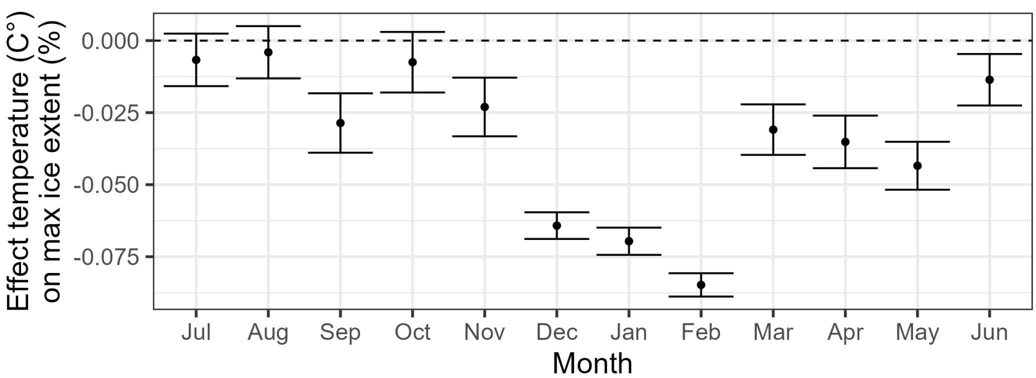
Table A.8: Testing for an interannual relationship of the maximum ice extent

	Max ice extent in t [0-1]			
	(1)	(2)	(3)	(4)
Max ice extent in t-1	0.08	0.07	0.06	0.06
	(0.05)	(0.05)	(0.05)	(0.05)
Max ice extent in t-2		0.06		0.05
		(0.05)		(0.05)
Max ice extent in t-3		0.08		0.07
		(0.05)		(0.05)
constant	0.57***	0.49***		
	(0.03)	(0.05)		
Century FE	N	N	Y	Y
Mean dep. var.	0.62	0.62	0.62	0.62
N	355	353	355	353
Adj. R^2	0.00	0.01	0.01	0.01
Adj. R^2 w/o FE			0.00	0.00
# Century FE			4	4

Notes: At year level. Annual maximum ice extent is not significantly related to its lag(s), demonstrating that there is no systematic interannual relationship. Robust SEs. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Figure A.15 shows that temperatures strongly predict the annual maximum extent of ice only late in the year.

Figure A.15: When do monthly temperatures predict annual max ice extent?



Sources: temperature: Omstedt (2011), ice extent: Hansson and Omstedt (2008).
Notes: At annual level (1501-1856). A negative relationship between mean monthly temperatures and max ice extent is detectable from September. For example, in November, warmer temperatures of 1 °C predict 2.5% less maximum extent of ice. This effect continues to grow stronger until February.

A.7.3 Effect of sea ice on harvest date

Sea ice is closely correlated to winter temperatures, as both are determined by the North Atlantic Oscillation. Tarand and Kuiv (1994) collected data on the beginning of rye harvest for 250 years between 1671 and 1949 in Estonia. In Table A.9, I correlate this data with the maximum extent of the ice (Hansson and Omstedt, 2008). The results show there is only a small relationship; moving from no ice to a fully frozen Baltic Sea delays the beginning of the rye harvest by about only 7 days. The real effects are even smaller, given that the range is only 31 to 98% with a standard deviation of 22%. The effect of ice breakup in Tallinn Harbor (Tarand and Nordli, 2001) on the beginning of rye harvest is similarly small, with a passthrough of just 8%.

Table A.9: Ice and rye harvest begin in Estonia

	Begin rye harvest (days since July 1)	
	1	2
Max ice extent [0-1]	7.675***	
	(2.625)	
Breakup day Tallinn		0.080***
		(0.029)
constant	32.618***	14.198*
	(1.783)	(8.463)
Mean dep. var.	37.307	37.470
SD dep var.	1.682	1.817
Mean exp. var.	0.611	290.560
SD exp. var.	0.219	22.687
N	250	233
R^2	0.032	0.036

Notes: At year level. The harvest begin and ice breakup dates are counted as days from July 1. Robust SEs. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

A.7.4 Further evidence on the effect of sea ice on Baltic trade

This section provides evidence on how ice affects Baltic shipping in addition to the main findings (Section 1.6). It again confirms that ice dramatically affects shipping. There is a close correspondence between the ice reconstruction (Hansson and Omstedt, 2008; Omstedt, 2011) and the Sound Toll. This relationship is not 'mechanical' since the ice reconstructions do not use the Sound Toll data as an input.

Table A.10 shows that trade in years with more ice was only reduced between January and April and not throughout the year. While the empirical strategy relies on *within-year* comparisons, it is nevertheless important that trade in icy years did not differ systematically.

Table A.10: Ice and aggregate trade

	Number voyages		Value (000s rigsdaler)	
	Jan-Apr	Year	Jan-Apr	Year
Max ice extent [0-1]	−1137.024**	4530.798	−538.515	14710.817
	(474.202)	(4071.420)	(993.661)	(11681.722)
constant	3359.288***	17609.701***	3683.329***	26195.960***
	(312.644)	(2598.744)	(657.455)	(7366.954)
Mean dep. var.	2652.071	20432.061	3348.818	35347.870
SD dep. var.	240.142	958.295	113.904	3116.112
Mean exp. var.	0.622	0.623	0.621	0.622
SD exp. var.	0.211	0.212	0.212	0.212
N	309	310	307	308
R^2	0.018	0.004	0.001	0.005

Notes: At year level. Table shows that ice only affects trade in the early season (January to April) and only the number of shipments, not trade value. Trade throughout the year is not affected by ice. Robust SEs. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

Table A.11 shows that the first day of Baltic imports and exports is substantially delayed in years with more ice. Notably, the magnitude of this delay in Baltic exports (c. 33 to 36 days) is similar to the magnitude of the effect of the ice extent on ice breakup at ports (Table A.5.) This suggests that ships leave immediately when ports unfreeze, which matches descriptions by historians and contemporaries: "Ice-free navigation [in Stockholm] was usually possible by April, and as soon as the ice broke shiploads of iron were rushed southward" (Evans and Rydén, 2007, p.93).

Table A.11: Ice and date at Sound

	First shipm. from town at Sound			
	Baltic imp	Baltic imp	Baltic exp	Baltic exp
Max ice extent [0-1]	22.32***	22.36***	33.53***	36.10***
	(1.54)	(1.50)	(3.10)	(2.77)
Number shipments	−0.14***	−0.13***	−0.16***	−0.14***
	(0.03)	(0.05)	(0.03)	(0.02)
constant	70.73***		64.32***	
	(1.79)		(2.79)	
Origin town FE	N	Y	N	Y
Mean dep. var.	78.93	78.93	77.17	77.17
Mean exp. var.	0.62	0.62	0.61	0.61
SD exp. var.	0.21	0.21	0.21	0.21
N	3,904	3,904	2,507	2,507
Adj. R^2	0.16	0.28	0.16	0.29
Adj. R^2 w/o FE		0.12		0.15

Notes: At origin town-year level. Table shows that both Baltic imports and exports are substantially delayed as the maximum extent of ice increases. SEs clustered at origin town. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Next, I present evidence on rerouting to different ports. I distinguish two types of rerouting, ex-ante (Table A.12) and ex-post (Table A.13). For both types, ice is impactful. It causes captains to declare destinations that are less far into the Baltic Sea ex-ante. Additionally, captains report ex-post (i.e. on their west-bound return voyage) origin towns that are less far into the Baltic Sea.

Table A.12: Ex-ante rerouting

	Stated km traveled			
	Jan-Apr	Jan-Apr	Whole year	Whole year
Max ice extent [0-1]	-117.29^{***}	-100.63^{***}	10.53	24.22^{**}
	(40.63)	(22.76)	(24.11)	(11.06)
constant	796.02^{***}		884.34^{***}	
	(61.24)		(61.40)	
Origin town FE	N	Y	N	Y
Mean dep. var.	726.18	726.18	890.89	890.89
Mean exp. var.	0.60	0.60	0.62	0.62
SD exp. var.	0.21	0.21	0.21	0.21
N	276,361	276,361	1,812,756	1,812,756
Adj. R^2	0.00	0.20	0.00	0.20
Adj. R^2 w/o FE		0.00		0.00

Notes: At voyage level, sample restricted to Baltic imports. Table shows that captains sail to destinations that are less far into the Baltic Sea between January and April in years with a larger annual maximum ice extent. Throughout the year, this effect of ice is insignificant or reversed. SEs clustered at origin town. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Table A.13: Ex-post rerouting

	Actual-stated km traveled			
	(1)	(2)	(3)	(4)
Days until breakup	-4.05^{***}	-3.94^{***}	-3.53^{***}	-1.97^{**}
at stated dest.	(1.23)	(1.24)	(1.18)	(0.91)
constant	136.98^{***}			
	(34.56)			
Year FE	N	Y	Y	Y
Origin town when entering FE	N	N	Y	Y
Captain domicile FE	N	N	N	Y
Mean dep. var.	136.19	136.19	136.19	136.24
Mean exp. var.	0.20	0.20	0.20	0.20
SD exp. var.	2.46	2.46	2.46	2.46
N	282,758	282,758	282,758	282,595
Adj. R^2	0.00	0.01	0.07	0.20
Adj. R^2 w/o FE		0.00	0.00	0.00

Notes: At voyage level. Table shows that more ice at stated destinations leads captains to reroute to closer actual destinations as reported on their way out of the Baltic. Sample restricted to captains entering and leaving the Baltic in the same year. SEs clustered at origin town when entering Baltic. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

A.8 Hanse

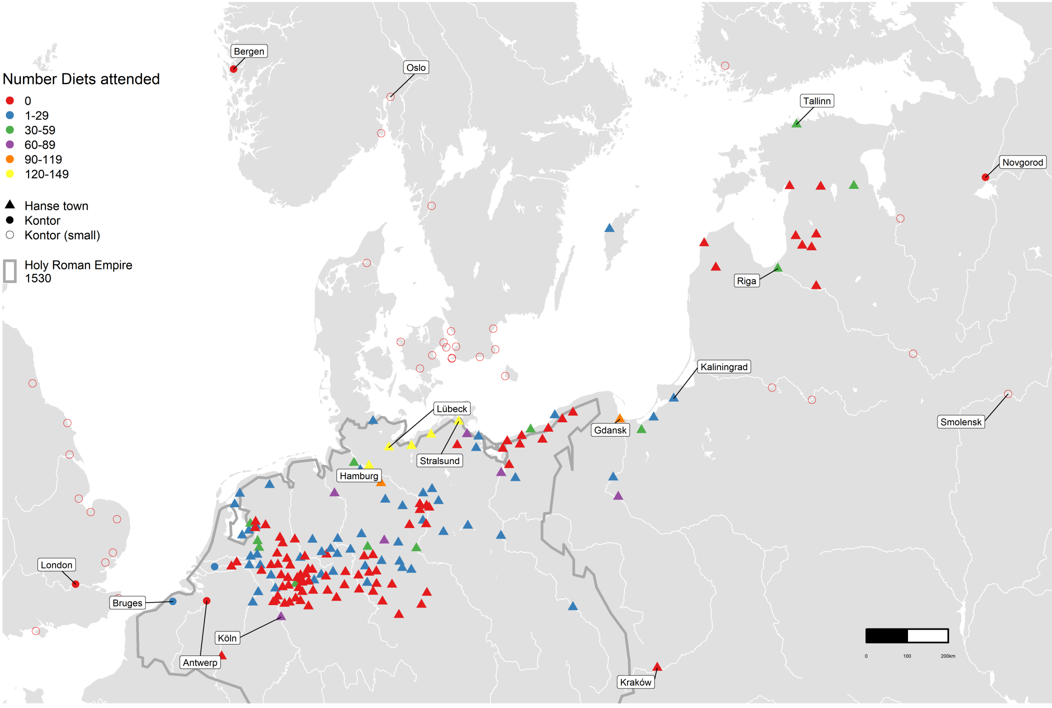
1st Commercial Revolution

- 11thc. — **Geniza/Maghribi traders:** role of trust and gossip (Greif, 1989) - debated (Edwards and Ogilvie, 2012; Goldberg, 2012)
- 1096 - 15thc. — **Republic of Genoa**
- c.800 - 1600 — **Republic of Venice:** constraints on the executive gradually erode (Puga and Trefler, 2014)
- 12thc. - c.1669 — **Hanse:** this paper + qualitative research

2nd Commercial Revolution

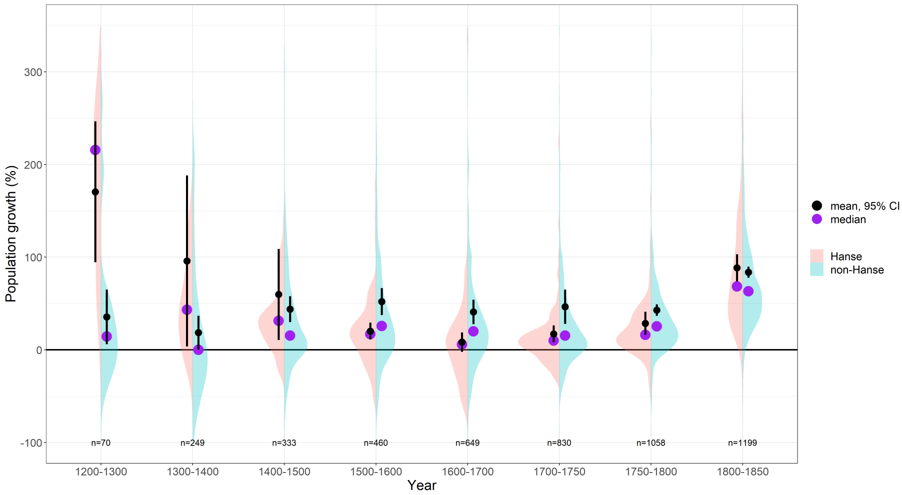
- 1580s - ? — **Dutch merchants** (Gelderblom, 2009)
- 1600 - 1857 — **British East India C.** (Hejeebu, 2005)
- 1602 - 1799 — **Dutch East India C.** (Gelderblom et al., 2013)

Figure A.16: Hanse Diet attendance by town, 1356-1669



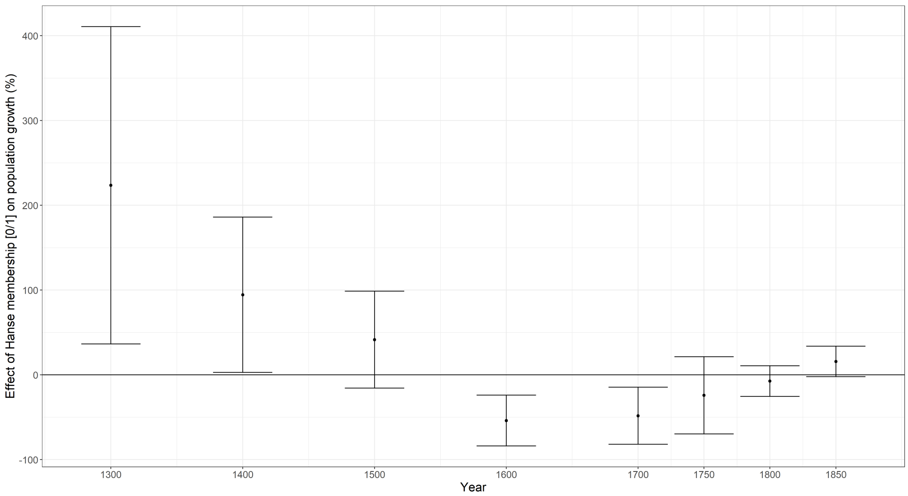
Source: Diet attendance: Hanserecesse and -handschriften, classification: Iwanov (2016).
Notes: Some Hanse towns, particularly smaller ones that are far from Lübeck, never attend Hanse Diets but rather participate in smaller regional Diets. Hanse maintains important trade embassies (Kontor) in non-member towns, particularly in Antwerp, Bergen, Bruges, London, and Novgorod. Important non-Hanse towns include: Amsterdam, Haarlem, Leiden, Utrecht, Rotterdam, Leeuwaarden, Emden, Oldenburg, all in Schleswig Holstein (except Kiel), Potsdam, Leipzig, Posen, Marienburg, Memel, Ragnit, and Narva.

Figure A.17: Hanse vs. non-Hanse population growth rates, 1200-1850



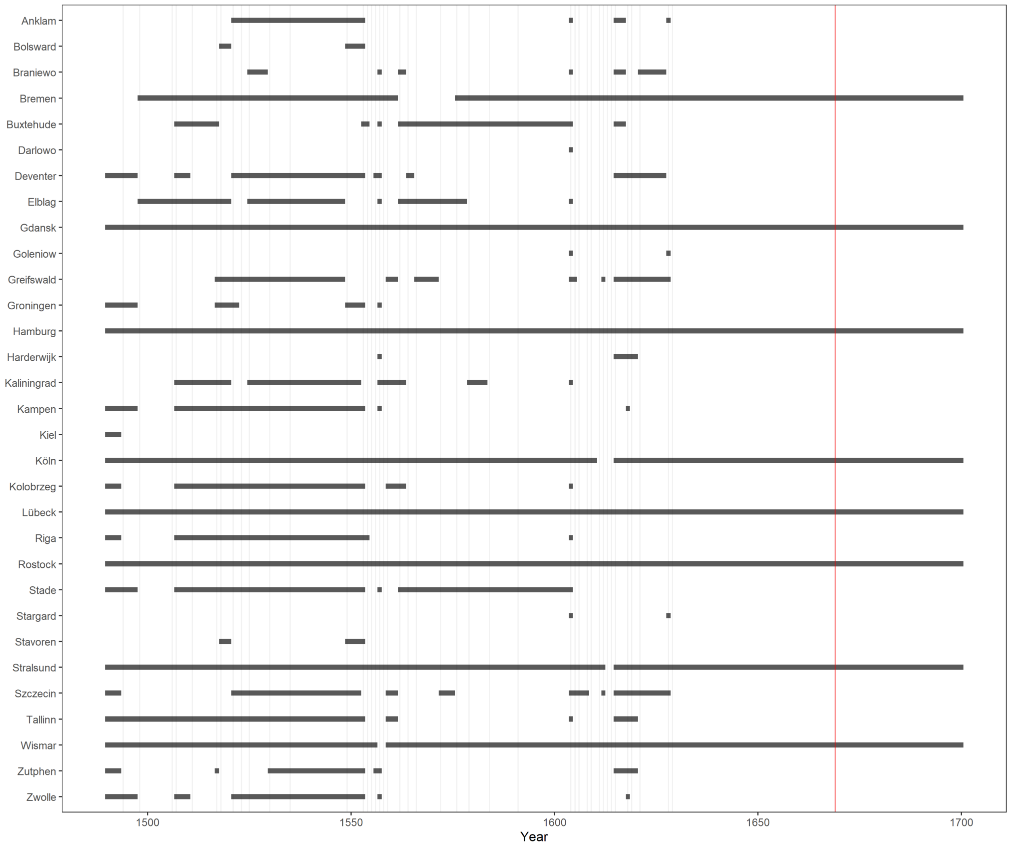
Notes: Figure plots β_1 in regression: $pop\_growth_{ijt} = \beta_0 + \beta_1 Hanse_{ij} + \beta_2 pop_{ijt} + \gamma_j + \epsilon_{ijt}$ for town i, region j in period t, with 95% confidence interval. $Hanse = 1$ if the town was ever a member of the Hanse.

Figure A.18: Effect of Hanse membership on population growth, 1300-1850



Sources: population: Städtebücher,Bosker, Buringh, and Van Zanden (2013) and Paping (2014), Hanse membership: Iwanov (2016).
Notes: Figure plots β_1 in regression: $pop\_growth_{ijt} = \beta_0 + \beta_1 Hanse_{ij} + \beta_2 pop_{ijt} + \gamma_j + \epsilon_{ijt}$ for town i, region j in period t, with 95% confidence interval. $Hanse = 1$ if the town was ever a member of the Hanse.

Figure A.19: Hanse Diet participation timeline by town, 1356-1669



Notes: If a town did not participate in **2** consecutive Diets the line is interrupted starting from the next Diet.

A.9 Examples of voyages

This section provides examples of captain voyages that have been reconstructed by researchers by combining the Sound Toll with additional sources, e.g. port books.

- *"Captain IJsbrand Mouthaan of the Johanna en Pieter mustered a crew of eight on 24 April 1770 intended to sail from Amsterdam to Saint Petersburg and back. Mouthaan arrived at the Sound three weeks later, on 15 May. The cargo consisted of a wide range of products, from sugar and exotic spices, to brazilwood, planks, bales of cotton, Turkish yarns, salted lemons, prunes, cheese, wines and vinegar, peas and fish. He returned three months later, on 22 August, at the Sound with a consignment of hemp, canvas and sail cloth, candles, Russian leather and furs." (Vliet, 2015)*

- *"Captain Eldert Brandaris mustered a crew on 31 May 1770 for a voyage to St. Petersburg and Marseilles. Two weeks later he arrived at the Sound with a* *varied cargo of sugar, indigo, planks, paper, yarns, cotton and linen, vinegar, wine and cheese. On 23 August Brandaris again called at the Sound, this time with a load of iron, hemp and sail cloth destined for Marseilles."* (Vliet, 2015)

- *"Captain Cornelis Sleswijk of Lemmer came from Riga when he registered at the Sound with a mixed cargo of hemp and rye bound for Amsterdam. He mustered a crew in Amsterdam on 2 August for a return voyage to Riga. Two weeks later he arrived at the Sound with nothing to declare, the ship sailed in ballast. A month later he again sailed from Riga to Amsterdam when he declared a cargo of balks, spars and masts, hemp and rye at the Sound."* (Vliet, 2015)

A.10 Examples of pioneers

The list below provides examples of pioneers of trade with the Baltic.

- Buonvisi of Lucca, the Lucchini of Bologna and other Italian merchants ordering grains for the first time from Gdansk in 1590s (Braudel, 1972; Braudel and Romano, 1951)
- Jehan Henrich, Dutch-Nantes trade from c. 1600 (Bruyn Kops, 2007)
- Sion Luis and family, Sephardic Jewish merchants in Amsterdam and later Livorno: pioneer of Russian-Mediterranean trade from c. 1600 (Engels, 1997; Kotilaine, 2005)
- Hugh Montgomery, merchant in Glasgow: Baltic-Scottish iron trade in 17th century (Smout, 1968)
- Francis Jennings, merchant in Stockholm: Stockholm-western Britain (rather than London or Hull) iron trade after 1719 (Evans and Rydén, 2007)
- Export of furs from North America to Russia from 1669 (Rich, 1955). Furs were marketed on the established Russian fur market.

A.11 Examples of Forced Wintering and Rerouting due to Sea Ice

The list below provides examples of forced wintering and rerouting due to ice in the Baltic.

- John Quincy Adam's voyage to Russia "*[October 10, 1809] It has now become very doubtful whether it will be possible for us to reach Cronstadt before the winter sets in with ice. We have not gained one league ahead these five days. I proposed to the captain to go into the little island Christiansöe and wait for a wind, but he thought it could not be done without endangering the ship. He himself proposed to turn back and go and winter at Kiel-and to proceed to Petersburg in the spring.*" (Adams and Adams, 1874, p.40)

- John Quincy Adam's voyage from Russia to Ghent: *"[May 16, 1814] We had not even got outside of the harbor before we saw in the gulf floating masses of ice, so large and so close together that the captain was apprehensive we should be obliged to return. But there was no wind until towards evening, when a light breeze sprang up from the northwest, as directly ahead as it could blow. Notwithstanding the difficulty of beating against a head-wind amidst the floating ice, the captain, at my desire and that of Mr. Zandelin, made the attempt to reach Baltic Port, about twenty miles distant from Reval, but without success. [...] The ice ahead was in such quantities, and with such narrow passages between the floats, that it was impossible to proceed, although in sight of Baltic Port. The wind was fresh, and about eleven in the morning we came to anchor again in the harbor of Reval, where we lay the remainder of the day."* (Adams and Adams, 1874, pp.626)

- *"THE ISLAND OF RUNO is situated almost in the middle of the Gulf of Livonia,and surrounded by a sand-bank, which is shallow; off each end is a rock; the north rock has 4 feet over it, the south rock 6 and 7 feet; this is also called the Great Ground, close to it are 6, 9, and 11 fathoms; vessels in the spring sometimes go to the eastward of Runo, thereby avoiding the ice, and thence up to Pernau, but the Western Channel, or that between Domesness and Runo, is more commonly used."* (Norie, 1826, p.37)

- "*In the winter of 1432–3 several ships were caught in the ice at the mouth of the Vistula. [...] The vessel had sailed from Livonia with flax and was destined* *for Lübeck."* (Frankot, 2012, p.180)

- *"In the fall of 1708 the Anna Maria was loaded with sawn pine planks, copper plates, iron and blister steel, packed in casks, intended for Lisbon, Portugal. [...] On her way south from Stockholm, the Anna Maria's crew dropped anchor at Dalarö [30km from Stockholm]. It was normal to make stop here waiting for the right weather, taking pilot and similar (Ahlström 1995:77, 1997:107). During their halt in Dalarö the weather changed, the temperature fell, and the ship became icebound. The Anna Maria, together with seven other ships, had to overwinter where they lay.[...] It is also easy to imagine just how boring it would be to spend the dark Nordic winter-months on board an ice-bound ship. In order to make the best of the situation the crew invited the crew from another of the trapped ships for dinner on board the Anna Maria. After eating, smoking and shaving, they went for a beer at the local inn."* (Eriksson, 2014, pp.78)

- *"Extract from the 'Eysbuch' (courtesy of City of Lübeck Archives) giving details of part of the river Trave in the winter of 1739/40. The ships were ice-bound throughout the winter right into spring."* (Koslowski and Glaser, 1995, p.81)

- *"Beginning of January 1706, 30 ships attempted to reach Amsterdam, but the cold and the ice made this venture too dangerous; the ships waited until February 18 in the harbor of Medemblik to then try again."* (Royen, 1987, p.55)

- *"In a bay on the western side of Sariwalla, 5/8 miles from Kareinos, vessels have found their winter refuge if they couldn't reach Cronstadt due to ice."* (Klint, 1816, p.110, translated from German)

- *"Middelfart-Snoghøj was originally located on the Copenhagen-Hamburg mail route, established by Christian IV in 1624. However, the main route was already redirected to Assens-Årøsund in 1653. Only during harsh winters, the mail was occasionally redirected from Assens to Middelfart."* (Dragsbo and Hansen, 1996, translated from Danish)

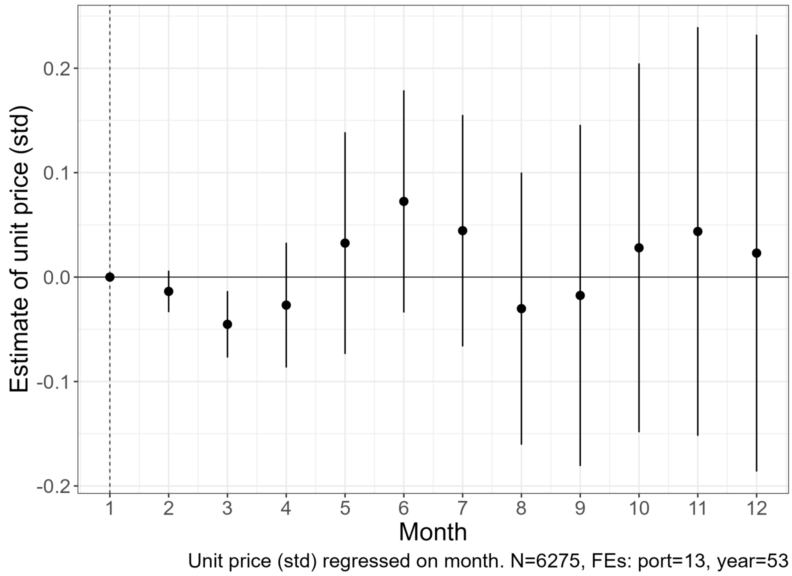
A.12 Prices Observed at Ports

I supplement the analysis of monthly prices in the Sound Toll with prices observed at ports in the Baltic and North Sea areas, combining various sources (Andersson and Ljungberg, 2015; Hout, 2023; Jacks, 2004). The analysis below leads to the same conclusion as in the main text that early-season was particularly profitable:

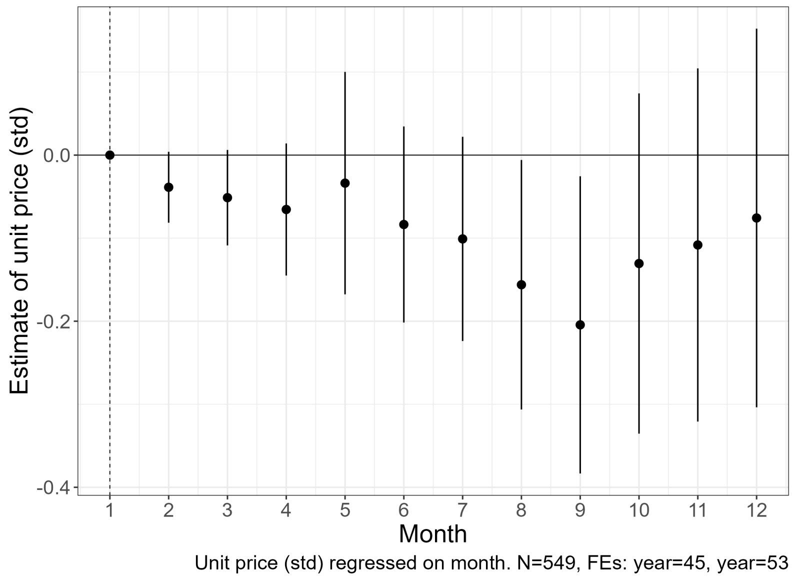
the purchase prices of grains in the Baltic were lower (Figure A.20a) and the sales prices in the West were higher (Figure A.20b). It is also apparent that purchase prices in the Baltic are highest just before the harvest begins in August and prices drop. A similar post-harvest price drop is observed in the West.

Figure A.20: Port-level price data

(a) Rye prices at Baltic ports



(b) Wheat prices in London



Source: based on monthly price data data from Andersson and Ljungberg (2015).
Notes: Panel A.20a shows that grain prices at Baltic ports were lowest in the early season. Panel A.20b shows that wheat prices in London are low in August and September, which are the main harvest months in the Baltic. Combined, this shows that captains were motivated to sail during the early season to benefit from lower purchase and higher (based on Figure 1.8b) or not lower sales prices.

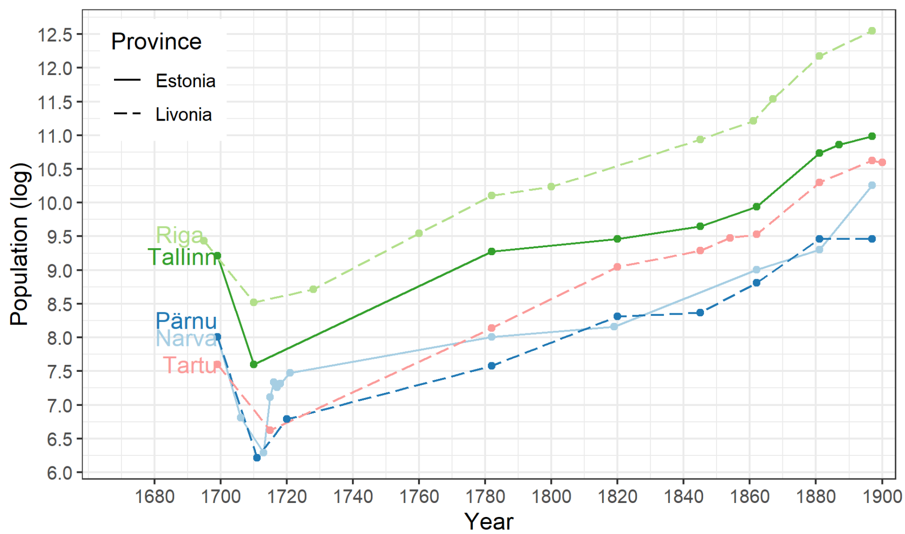
Appendix B

Appendix to “Contagious Coercion: The Effect of Plagues on Serfdom in the Baltics”

B.1 Additional Figures

Figure B.1: Population of towns, Estonia and Livonia, 1696-1922

(a) Large towns



(b) Small towns

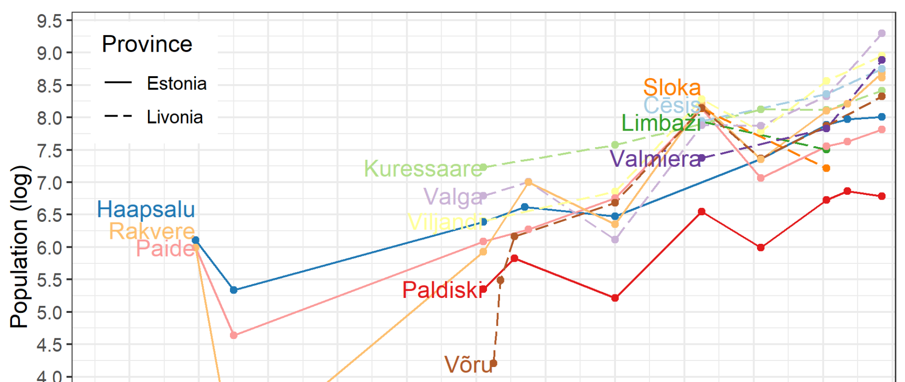
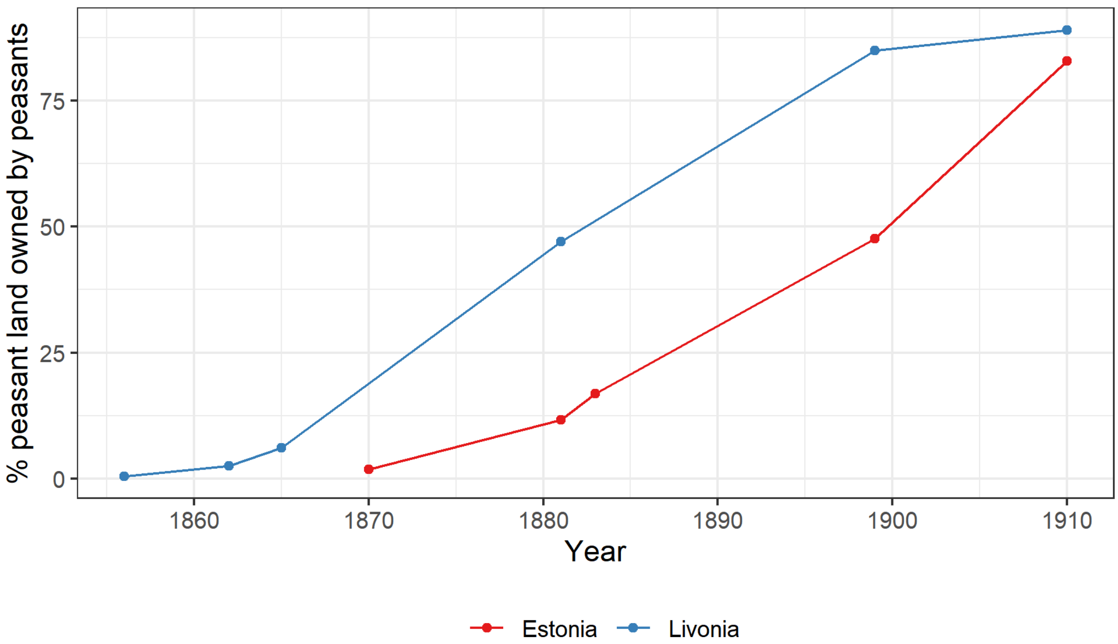
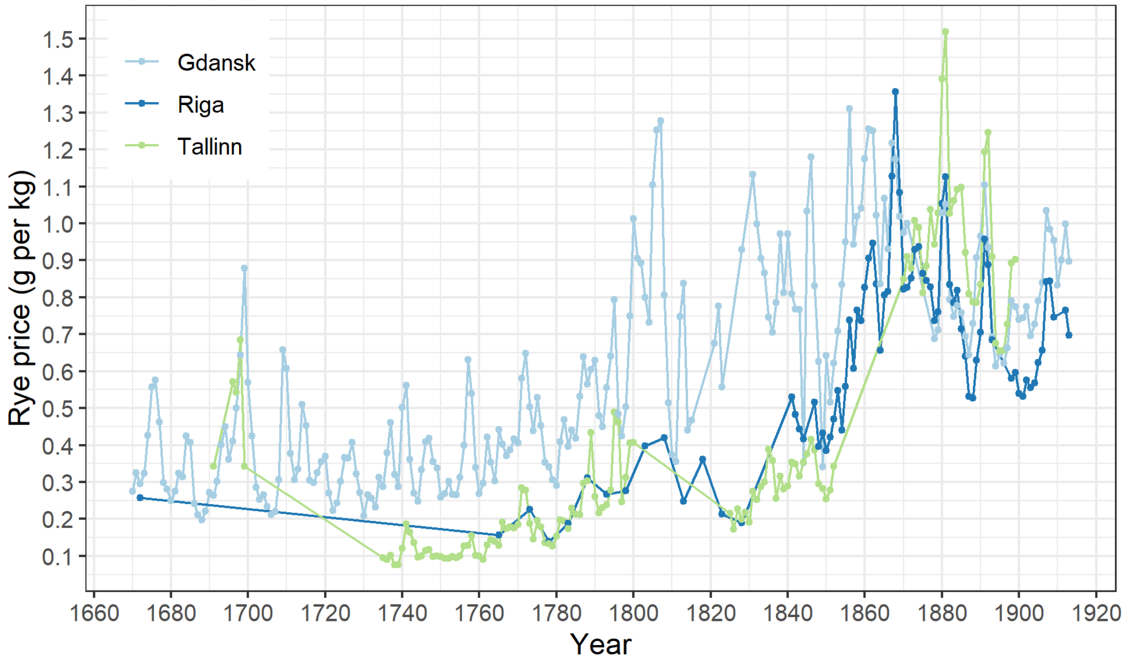


Figure B.2: Peasant landownership, Estonia and Livonia, 1856-1910



Source: Zimmermann-Schulze (2004).
Notes: The purchase of land by peasants progressed very slowly in both provinces, even many years after the abolition.

Figure B.3: Rye prices, Gdansk, Tallinn and Riga, 1660s-1910s



Sources: Seppel (2015) and Vinnal (2013).
Notes: Rye prices spike during the famine 1695-7.

B.2 Key historical events

1207 Baltic German crusaders settle and gradually enserf natives:

- strict mobility ban
- prohibit landownership
- dues (corvée days, in-kind, money) as rent for allotted land, determined by inter-generational tit-for-tat + shocks

1558 Territory falls to Sweden, but Baltic Germans remain powerful

1711 Russia invades during Great Northern War, plague kills > 56%

1816-9 Abolition of serfdom initiated by Baltic Germans

1858 Estonian peasant revolts convince Alexander II to implement more 'peasant-friendly' abolition in Russia proper

1919 Baltic Germans expropriated; 1940 UDSSR collectivization

B.3 Data construction

B.3.1 Main sources overview

Table B.1 provides an overview of the main archival and secondary sources used in this research.

Table B.1: Sources overview

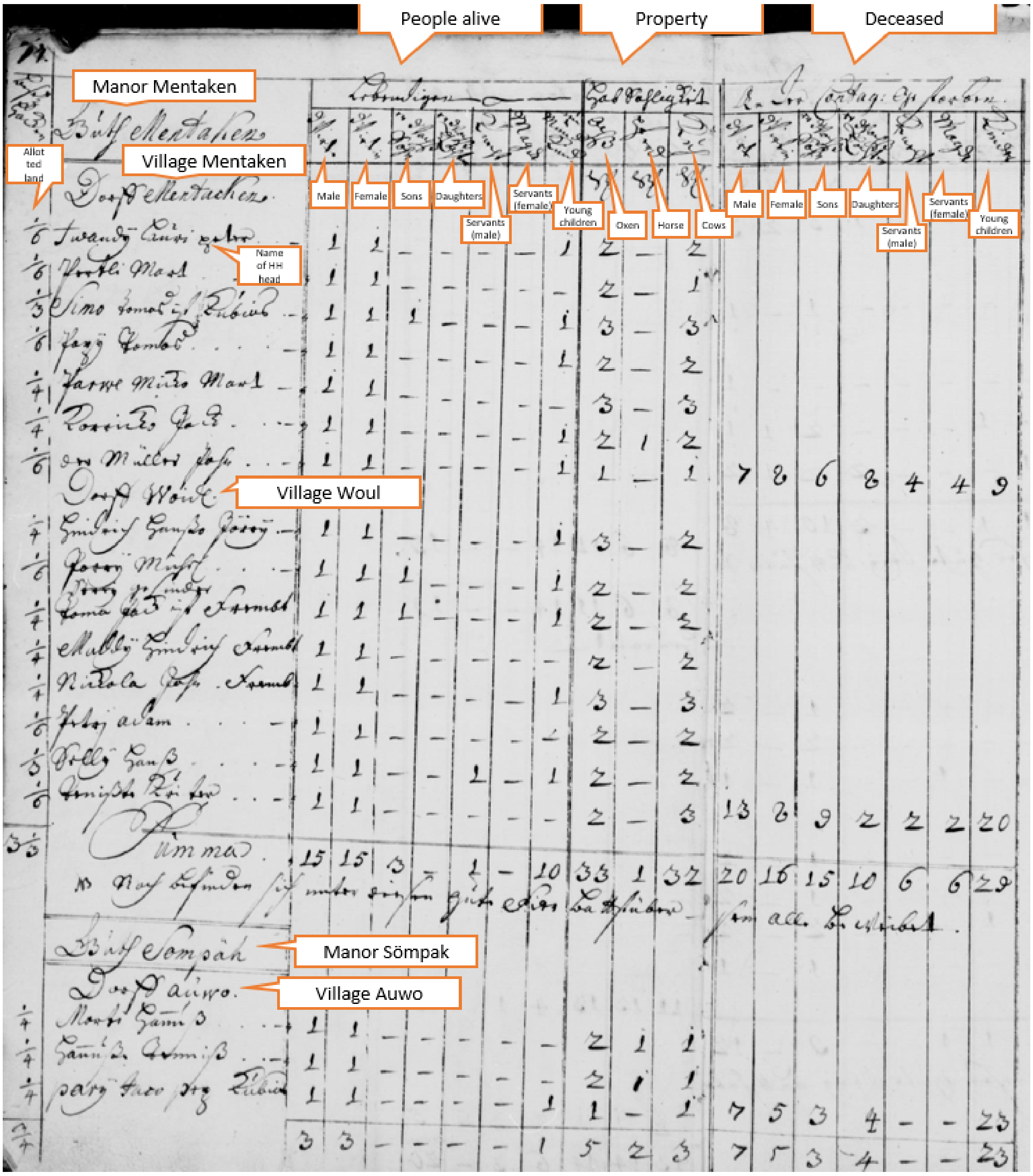
Year(s)	Province/region	Sources	coercion	pop.	plague	manor owner
1586	Estonia	Koit (1975)		1		
1601	Livonia	Roslavlev (1967)		1		1
1624/37	Livonia	Roslavlev (1965a,b)	1	1		1
1627, 1637, 1641, 1688, 1725, 1734, 1738, 1744, 1757, 1832, 1874	Livonia	Stryk (1877)		1		
1637	Jerwen	Johansen (1933)		1		
1638	Livonia	Rebane (1941) and Roslavlev (1969)	1	1		1
1640	Estonia	EAA.854.2.1619, LVVA.7349.1.217	1	1		
1688	Estonia	RGADA.274.1.1614, RGADA.274.1.1614/1, RGADA.274.1.1614/3-11, EAA.1.2.940-2				
1688	Livonia	SRA 55410/35-39				
1688, 1750, 1765	Livonia	Hupel (1782)		1		
1688, 1765, 1774	Estonia	Hupel (1782)		1		
1690	Saaremaa	AM.20.1.26		1		
1710-2	Estonia	EAA.3.1.445, EAA.3.1.448			1	
1731	Saaremaa	EAA.311.1.89				
1731, 1756 (all), 1645, 1726, 1766, 1845 (private)	Saaremaa	Buxhöwden (1851)		1		
1782	Saaremaa	Hupel (1782)		1		

1816, 1834, 1852	Estonia	Uexüll (1853)		1	
1839	Estonia	EAA.854.1.1291-1308	1	1	
1842	Saaremaa	Hagemeister (1843)		1	
1881	Estonia	Jordan (1884)			
continious	Livonia	Stryk (1877)			1
continious	Järva	Schilling (1970)			1
continious	Harju, Viru	Paucker (1847)			1
continious	Lääne				1
continious	Coastal Estonia	Russwurm (1855)			1
continious	Saaremaa	Buxhöwden (1851)			1
1721, 1726, 1853	Estonia	Uexüll (1853)			1

Notes: The archives acronyms are as follows: AM = Estonian History Museum, EAA = National Archives of Estonia, LVVA = Latvian State Historical Archives, RGADA = Russian State Archive of Ancient Documents, SRA = Swedish Military Archives

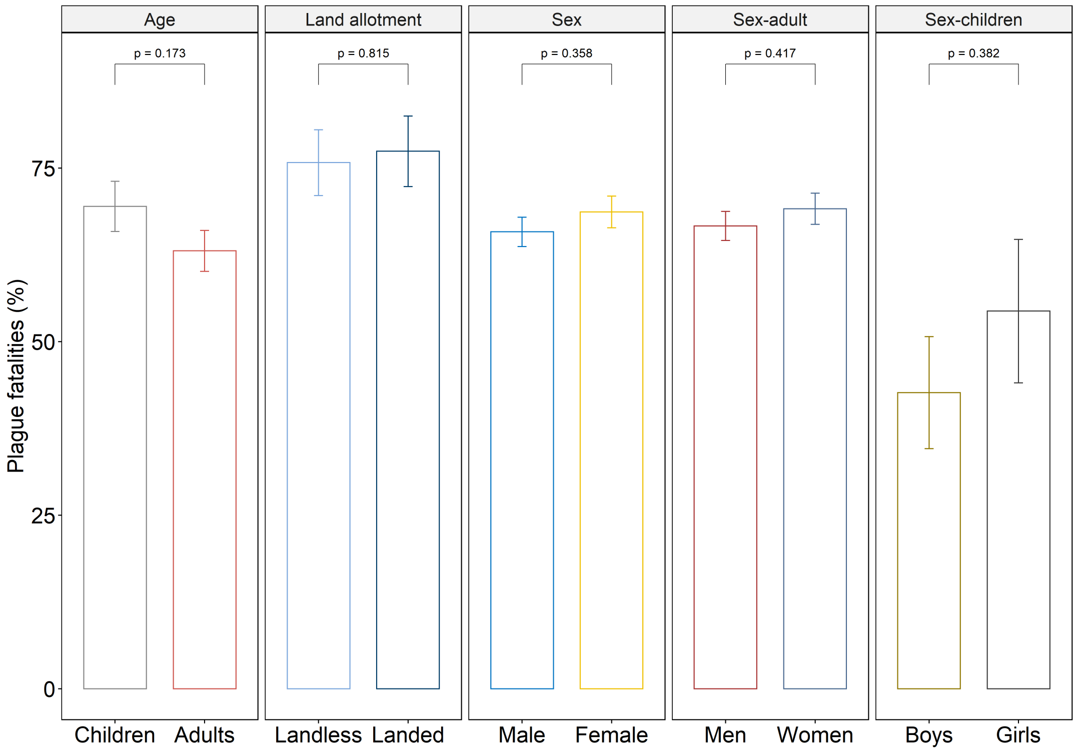
B.3.2 Plague data and further descriptive statistics

Figure B.4: Example of plague record



Source: EAA.3.1.448, annotation by author.
Notes: Age, sex and relationship to household head of people alive and those who died of plague. Farm wealth and land holding information is also provided.

Figure B.5: Plague mortality by age, land allotment, and sex, Estonia 1710-2



Sources: author, based on primary sources at Estonian National Archives.
Notes: Plague mortality does not differ significantly by age, land allocation, or sex. Differences between facets are partly due to data availability.

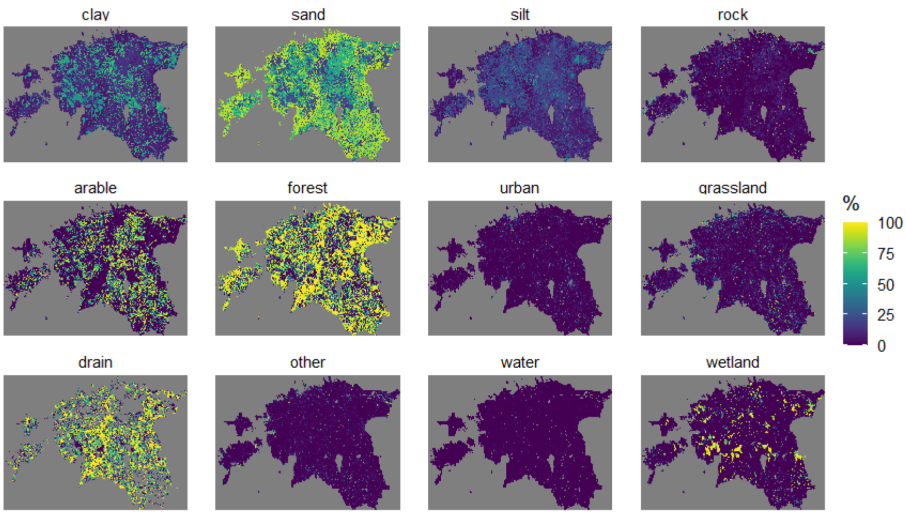
B.3.3 Manor spellings and location

I compile a dataset of the location of all Estonian manors and villages. To this end, I draw on the Place Names Database KNAB (KNAB) (www.eki.ee/knab), and Feldmann, Zur Mühlen, and Westermann, 1985 encyclopedia of Baltic places. In a few cases, I supplement missing coordinates or spelling variants by drawing on online sources. For Latvia, I draw on online sources[1]

The dataset provides numerous spellings of locations and has very complete coverage, also for geolocations. In total, it covers more than 2,600 manors and more than 19,000 villages. Most manors and villages in the primary and secondary sources can be matched to this database, given that they often specify the parish and given the near complete coverage of spelling variants in the dataset.

B.3.4 Environmental variables

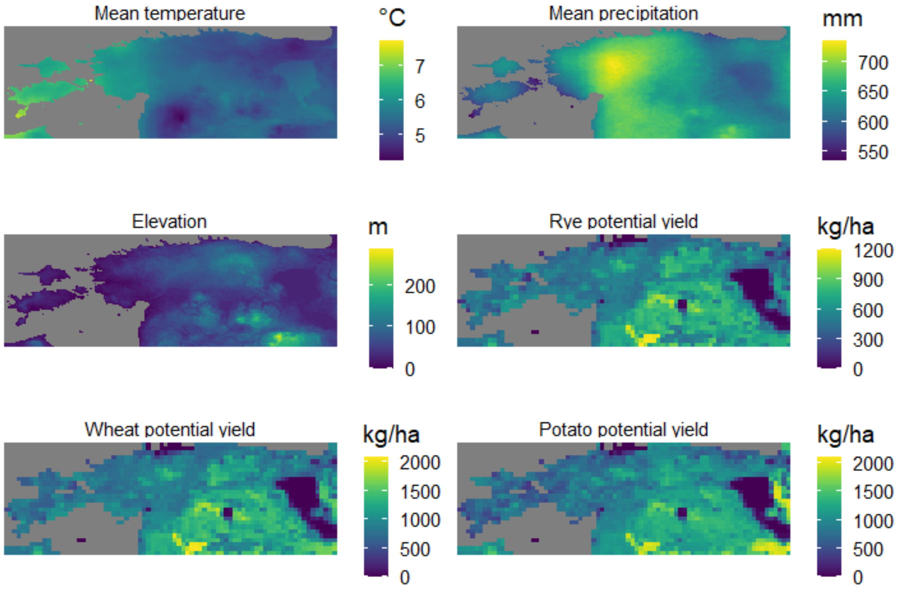
Figure B.6: Eco-hydrological variables



Notes: based on Kmoch et al., 2021 extrapolation of soil samples.

[1]Particularly http://manasvietas.blogspot.com/p/pilis-un-mui.html.

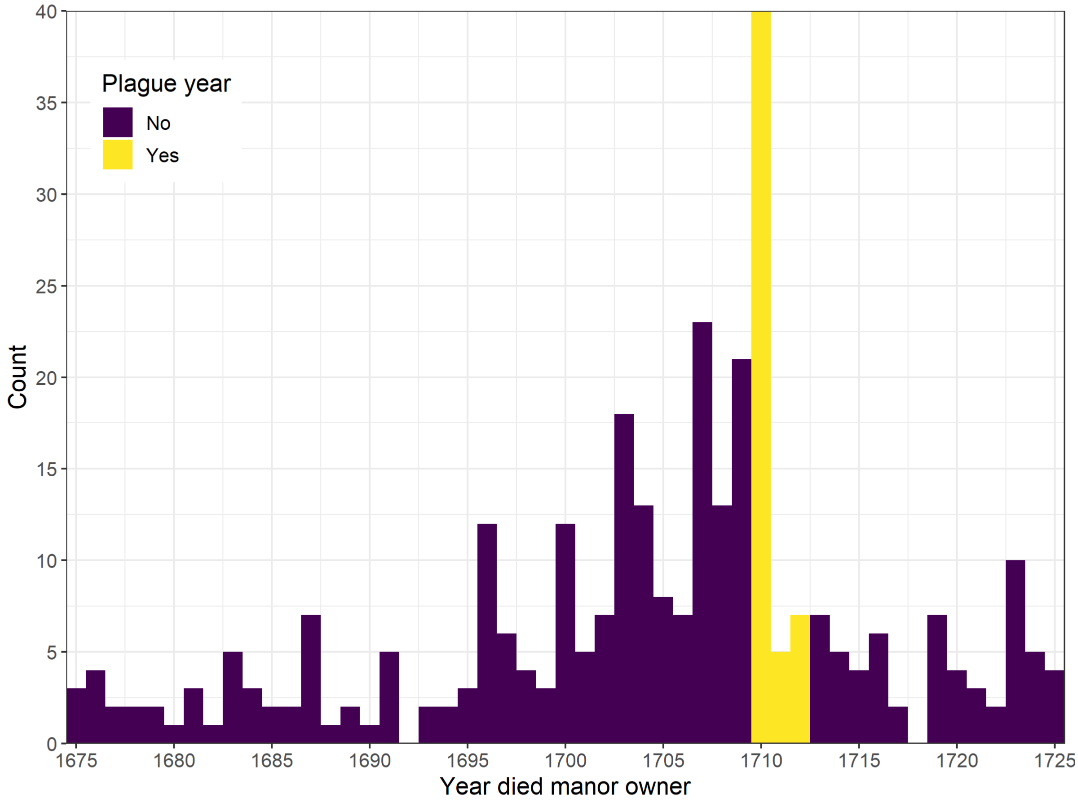
Figure B.7: Temperature, precipitation, elevation and crop yields



Notes: Based on Fick and Hijmans (2017) and FAO and IIASA (2023, for low input, rain-fed, historical climate).

B.4 Mechanisms

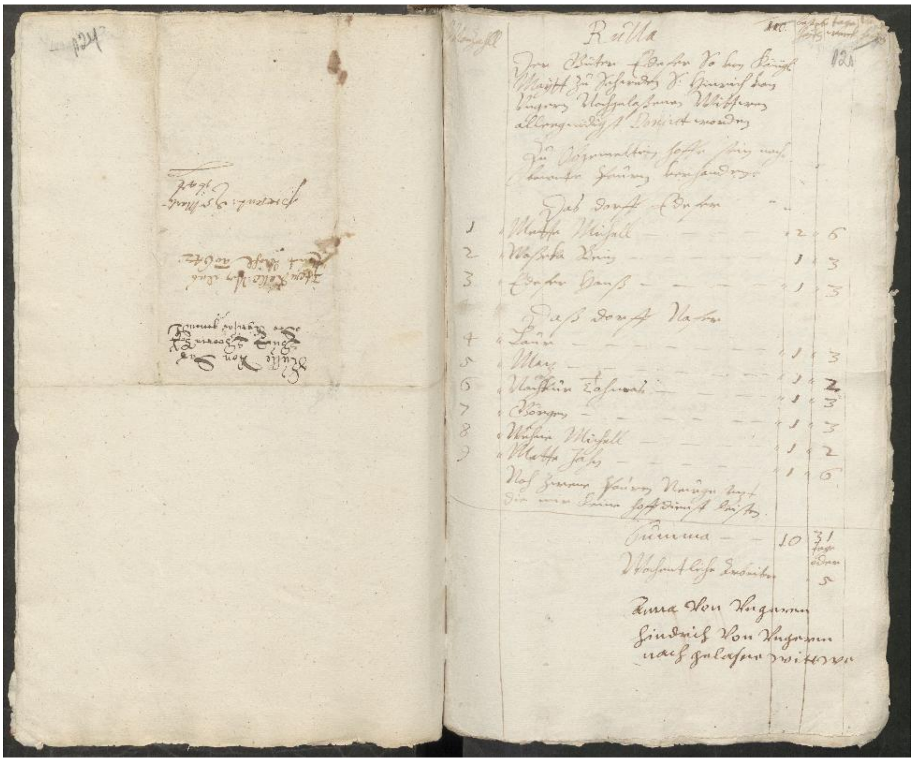
Figure B.8: Plague mortality of manor owners



Sources: Manor owners as identified in *Wackenbücher* or manor owner sources (see Table B.1). Manor owner death is either obtained from those same sources or by matching to genealogy websites.
Notes: Figure shows a marked spike in mortality of manor owners in plague years.

B.5 Coercion measurement

Figure B.9: Coercion data: example of a Wackenbuch in 1638



Source: LVA7349.1.217

The total extent of dues, i.e. labor coercion, is expressed as the rubles aggregate of its components: labor dues (corvée), in-kind dues, and money payments. Head and post taxes are also added in case the manor does not cover them.

I also construct price indexes, using the same price series with which I convert in-kind dues to rubles. The ruble total of dues is then deflated by the index to allow for comparison across periods.

1839 – All dues are recorded. Additionally, the wages of farm hands are stated, who are all paid in clothing[2] and, in most cases, also in grain. A few farm hands also receive money. When the type of grain is not mentioned, an equal split between the 3 most common types (rye, barley, oats) is assumed, as this is the case when it is specified.

[2]The clothing provided by the lords is assumed to be the same across manors and is priced at 10 loof rye (Hueck, 1845, p.192). I do not consider maids since they are predominantly paid in (more varied) clothing items, which complicates quantifying their wage.

B.5.1 Prices

To calculate the total amount of dues, I price in-kind and labor dues, before adding monetary dues. Prices are taken from various primary and secondary sources (Andersson and Ljungberg, 2015; Hagemeister, 1836; Jacks, 2004; Vinnal, 2013). Among these, local sources, particularly sales receipts, give the most accurate valuation.

I convert volume measures to kilograms using the FAO/INFOODS, 2012 density database. All monetary amounts are first expressed in silver rubles, with conversions from banco rubles and other currencies based on Denzel (2017), before converting them to their grams of fine silver equivalent.[3]

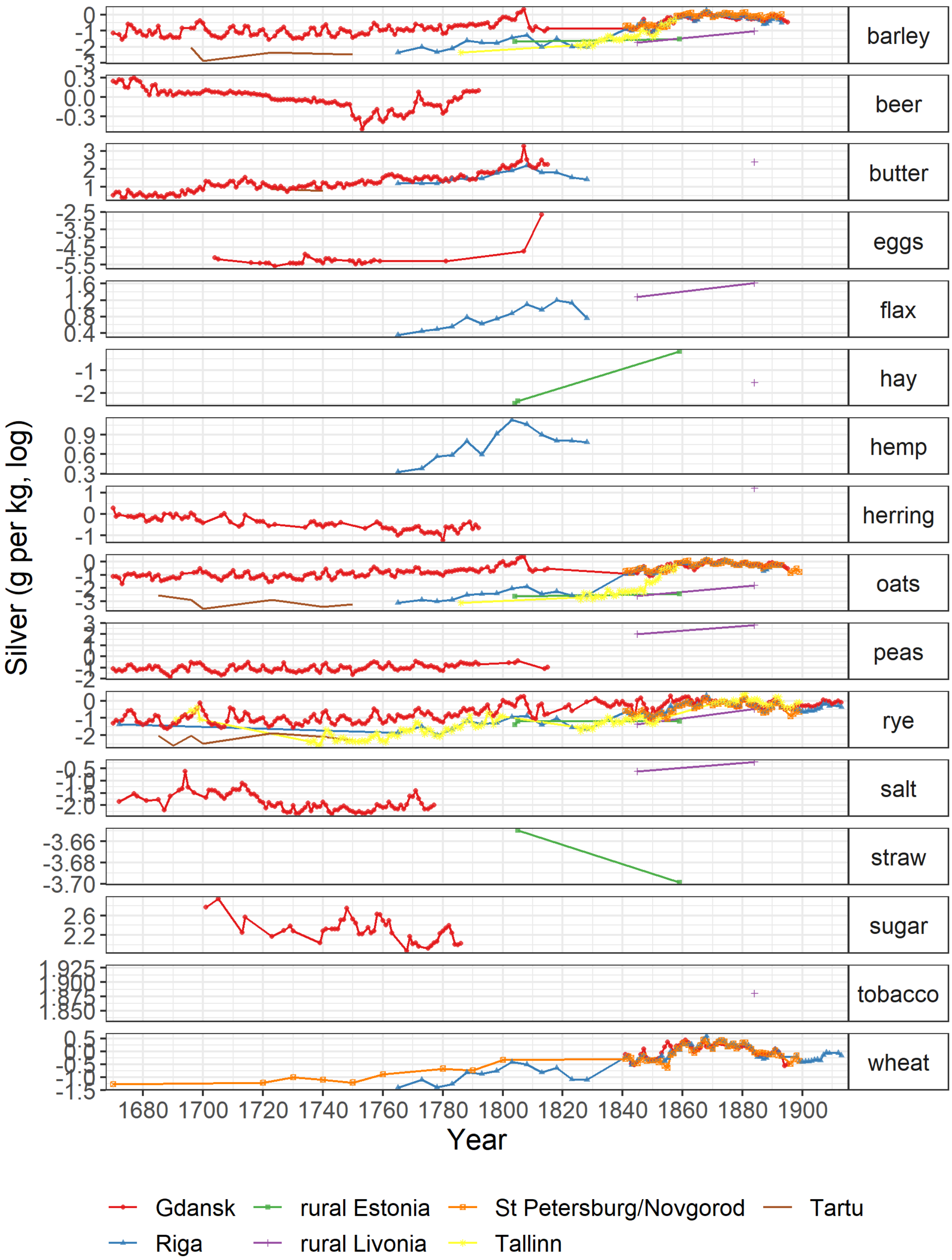
Pricing corvée days is difficult, but a number of sources have dealt with this challenge. Various sources suggest that a human corvée day is counted as half of an animal corvée day (Blagoveshchenskii, 1861). In 1804, Uexüll (1853, p.91) estimates that a animal and human corvée day are worth 0.176 and 0.08 ruble, respectively, which also indicates , a view that is also shared by Blagoveshchenskii (1861).[4] I count extra human corvée days during summer, i.e. during harvest, as 1.5 times a regular weekly

$$\begin{aligned}\text{1 animal corvée day} &= \text{1.5 irregular human corvée days in summer}\\ &= \text{2 irregular human corvée days in winter}\\ &= \text{2 human corvée days}\end{aligned}$$

[3]The silver content of the ruble is taken from http://gpih.ucdavis.edu/files/Russia_Ag_content_ruble_1535-1913.xls

[4]Blagoveshchenskii (1861, p.98) puts animal days, summer human days, and winter human days at 21, 15, and 9 pounds rye, respectively.

Figure B.10: Goods prices, 1670-1914



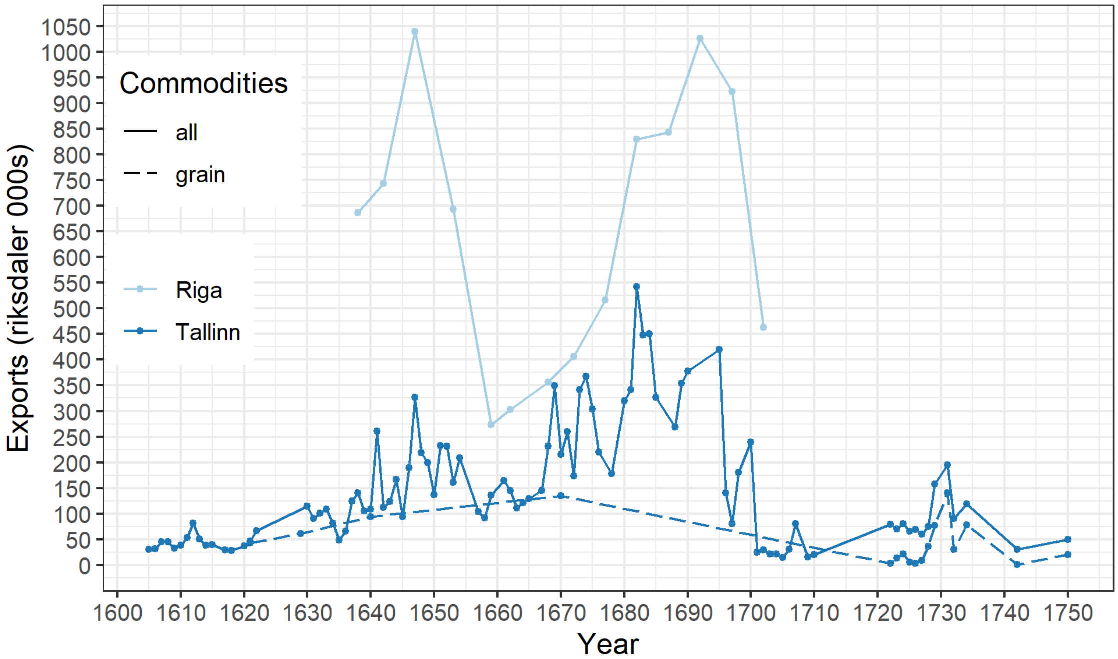
Sources: Andersson and Ljungberg (2015), Bodisco (1902), Edvinsson and Söderberg (2010), Fremdling and Hohorst (1979), Hagemeister (1836), Jacks (2004), Richter (1858), Uexüll (1853), and Vinnal (2013) and GPIH.
Notes: Prices across towns are mostly comparable across towns in overlapping periods.

B.5.2 Task distribution of corvée

B.6 Trade

Trade has the potential to increase labor coercion (Dippel, Greif, and Trefler, 2020; Malowist, 1957; Saleh, 2023). Specifically, for the Baltic context, Malowist (1957) has argued that the vast grain exports to the European West tightened serfdom in the East, where lord were producing grains on their estates.

Figure B.12: Exports of Tallinn and Riga, 1605-1750

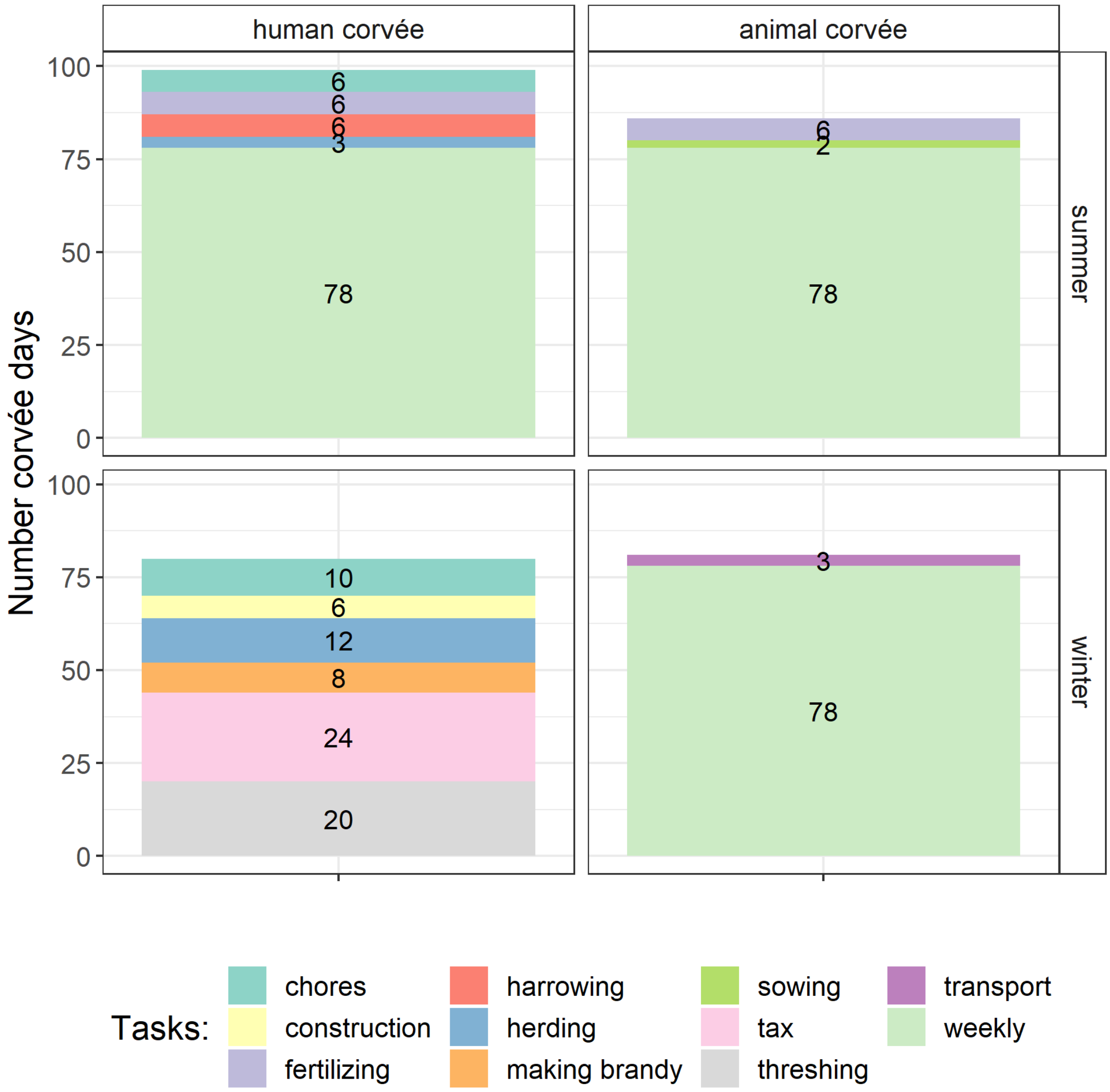


Sources: Doroschenko (1985) and Küng (2019).
Notes: Exports of Tallinn do not appear to be affected by plagues in 1605-6, 1657, and 1710-2.

B.7 Modern-day outcomes

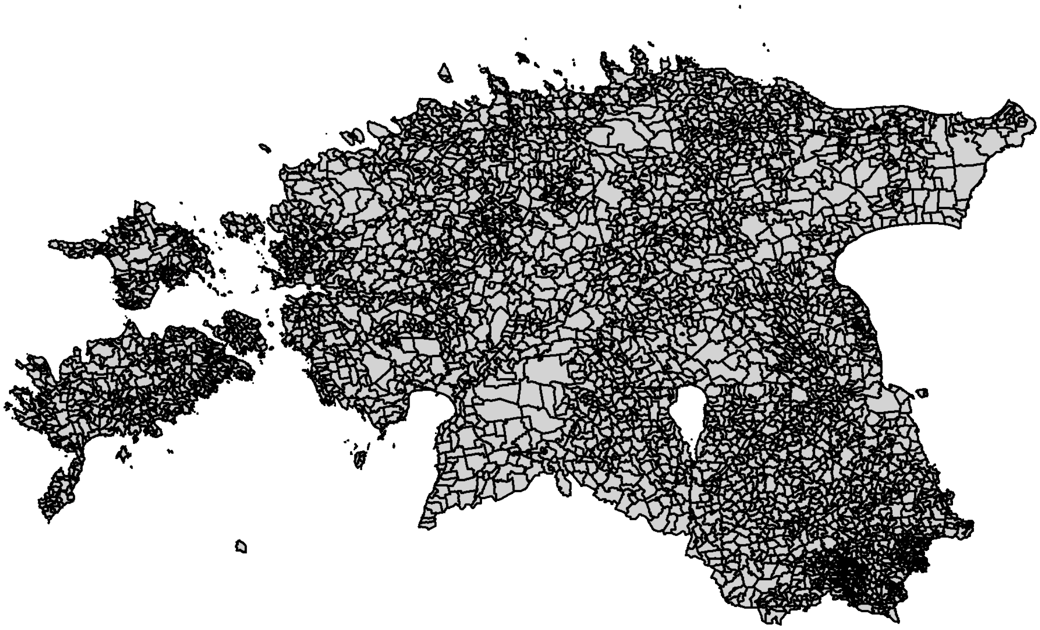
I access fine-grained modern-day data from Statistics Estonia to estimate the effect of labor coercion on trust. Figure B.13 shows the fine geographic level (area codes) to which households are linked in the data.

Figure B.11: Example of the task distribution of a serf household's annual corvée days, Estonia c. 1845



Source: based on Hueck's (1845, p.160) estimates of the corvée dues of a representative serf household. Numbers represent days per year.
Notes: Weekly corvée primarily consists of general field work in summer (c. 23. April - 29. September) and logging in winter. The remainder of corvée days are required more periodically, e.g., during harvest. In this representation, the serf household pays taxes in corvée to manor which pays state, rather than a direct, in-kind or money payment to state.

Figure B.13: Level of geographic details in the Estonian Social Survey: area codes



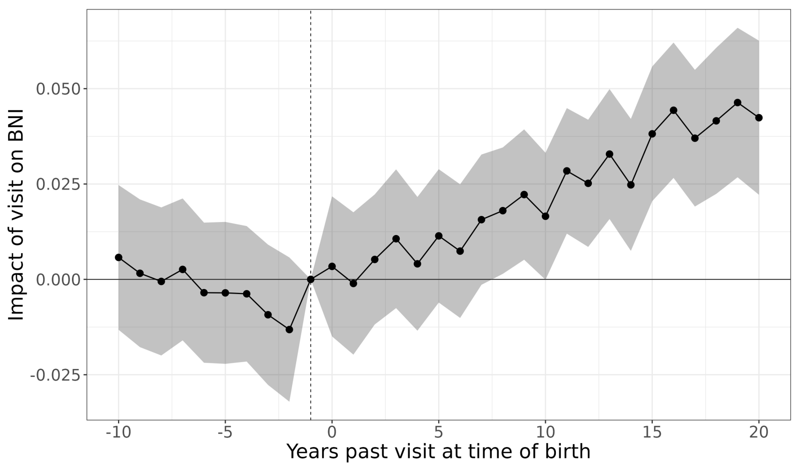
Source: Estonian Social Survey (Statistics Estonia, 2019)
Notes: Map shows all 4,713 Estonian area codes across 79 municipalities. Area codes are the most granular level of geographic detail in the Estonian Social Survey.

Appendix C

Appendix to "From Vagabonds to Virtues: The Ideological Roots of Entrepreneurship"

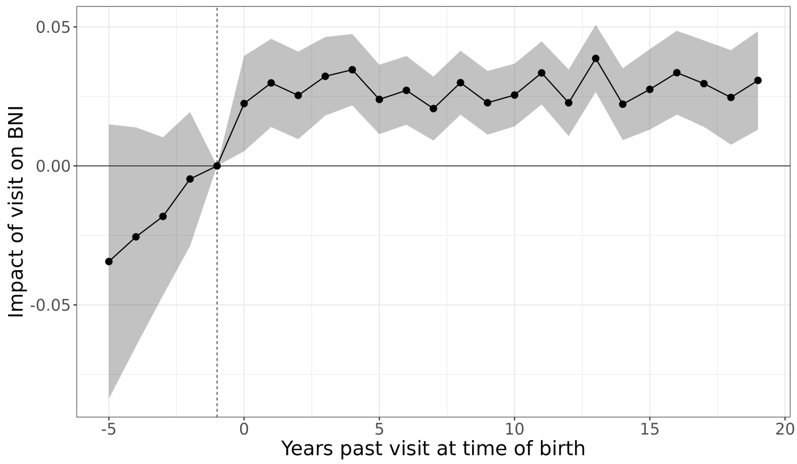
C.1 Additional Tables and Figures

Figure C.1: Effects of visits by the *Vagabonds* on Bourgeois Values with minimal controls



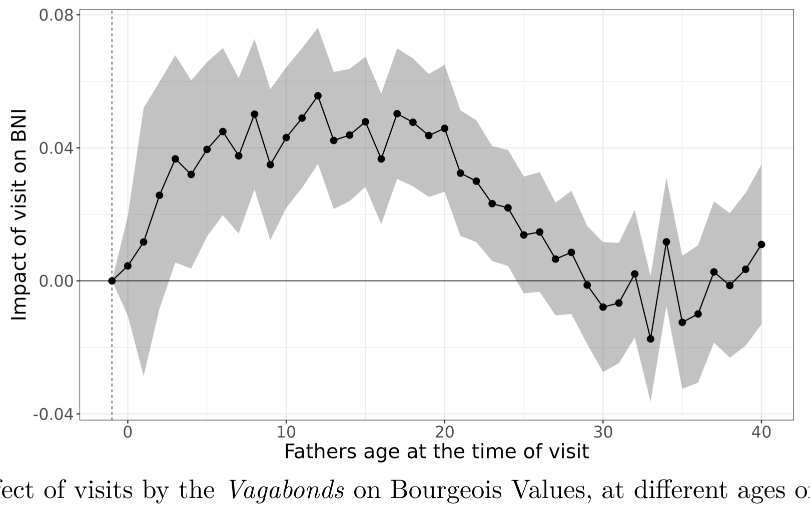
Notes: Event study of the effect of visits by the vagabonds on Bourgeois Values. Bourgeois Values are measured by the BNI of children born in a given year. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it. Specification includes controls for race and fixed effects for county and birth year/state. For information on data selection, see note in figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Figure C.2: Effects of visits by the *Vagabonds* on Bourgeois Values during formative years with minimal controls



Notes: Event study of the effect of visits by the *Vagabonds* on Bourgeois Values. Bourgeois Values are measured by the BNI of children born in a given year. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it during their for. Specification includes controls for race and fixed effects for county and birthyear/state. For information on data selection, see note in figure 2.5 For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Figure C.3: Effects of visits by the *Vagabonds* on Bourgeois Values differentiated by age - Minimal Controls



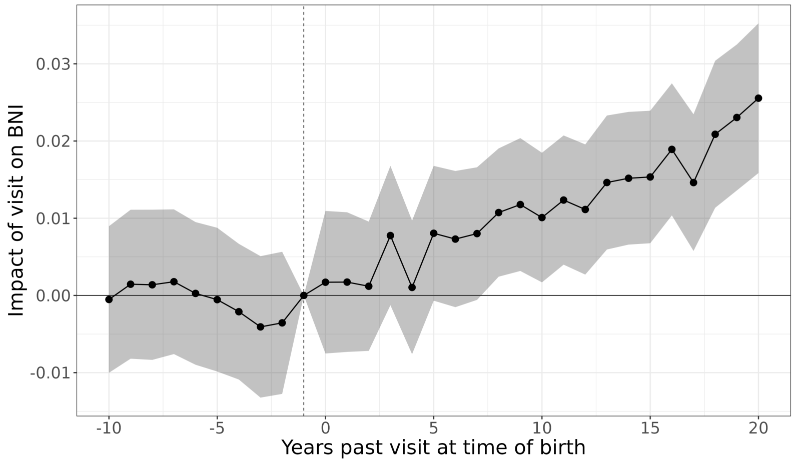
Notes: The effect of visits by the *Vagabonds* on Bourgeois Values, at different ages of the father at the time of visit. Bourgeois Values are measured by a dummy taking the value 1 if children are named "Henry", "Thomas", or if the values of BNI are above the median. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it. The specification includes controls for race and fixed effects for county and birth year/state. For information on data selection, see note in Figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Table C.1: Effect of Vagabond Visits on Bourgeois Values - with Vagabond Names

	Bourgeois Name Index			
	Did	Did	Did - Formative Years	Did – Formative Years
Vagabond visit	0.004***	0.005***		
	(0.002)	(0.002)		
Father visited formative years			0.037***	0.021***
			(0.002)	(0.002)
Born after visit	0.006*	0.006*	0.005	0.006*
	(0.004)	(0.003)	(0.003)	(0.003)
Black	−0.056***	−0.022***	−0.056***	−0.022***
	(0.004)	(0.004)	(0.004)	(0.004)
Other race	−0.038***	−0.013	−0.037***	−0.013
	(0.013)	(0.011)	(0.013)	(0.011)
Lives on farm	−0.044***	0.042***	−0.044***	0.042***
	(0.001)	(0.002)	(0.001)	(0.002)
Number siblings		−0.016***		−0.016***
		(0.000)		(0.000)
Father earning score		0.002***		0.002***
		(0.000)		(0.000)
Mean dep. var.	0.549	0.548	0.549	0.548
SD dep. var.	0.078	0.103	0.079	0.103
N	8,520,007	6,068,683	8,261,745	6,068,683
# FE birth year x State	462	462	462	462
# FE county	503	503	503	503
Adj. R^2	0.024	0.043	0.025	0.043
Adj. R^2 w/o FE	0.002	0.020	0.002	0.020

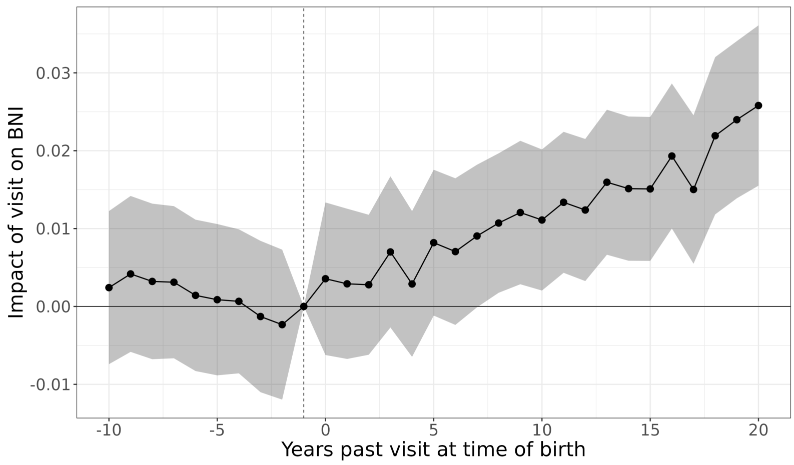
Notes: At individual level. Table shows that *Vagabond* visits increase bourgeois naming. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1940. Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Figure C.4: Effect of *Vagabond* visit on bourgeoisie naming - Alternative BNI



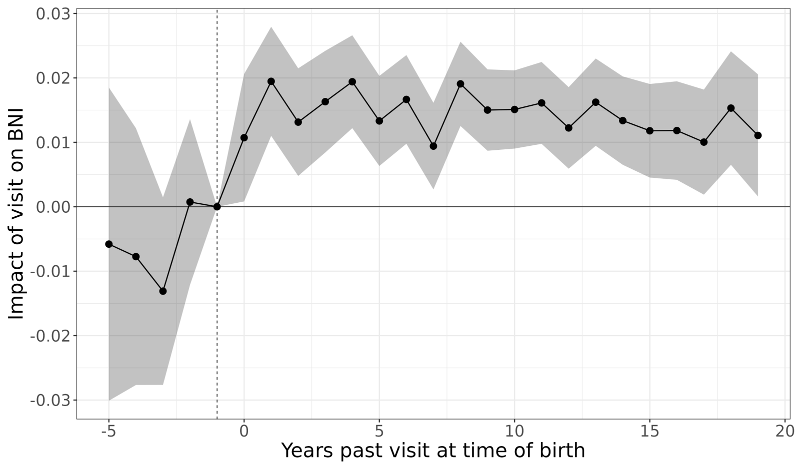
Notes: Event study of the effect of visits by the vagabonds on Bourgeois Values. Bourgeois Values are measured by a dummy variable taking the value 1 if children are named “Henry”, “Thomas”, or if the values of BNI is above the median. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it. Specification includes controls for race, number of siblings, earnings of the father and fixed effects for county and birth year/state. For information on data selection, see note in figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Figure C.5: Effect of *Vagabond* visit on bourgeoisie naming - Alternative BNI and minimal controls



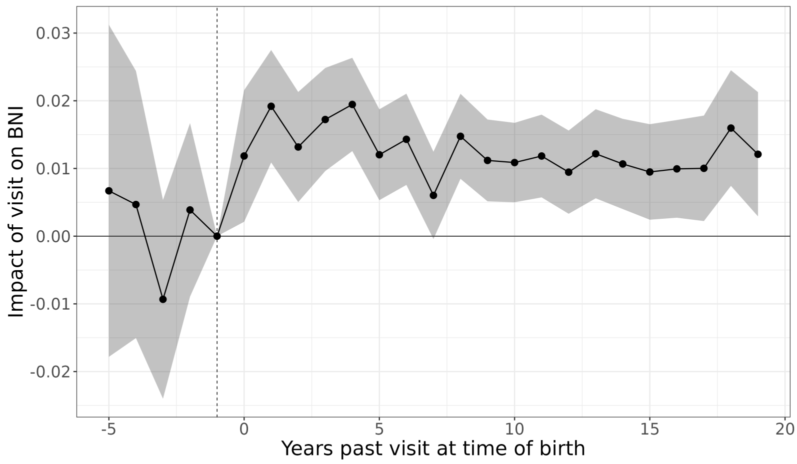
Notes: Event study of the effect of visits by the vagabonds on Bourgeois Values. Bourgeois Values are measured by a dummy variable, taking the value 1 if children are named “Henry” or “Thomas” or if the values of BNI are above the median. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it. Specification includes controls for race and fixed effects for county and birth year/state. For information on data selection, see note in figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Figure C.6: Effects of visits by the *Vagabonds* on Bourgeois Values during formative years with minimal controls - Alternative BNI



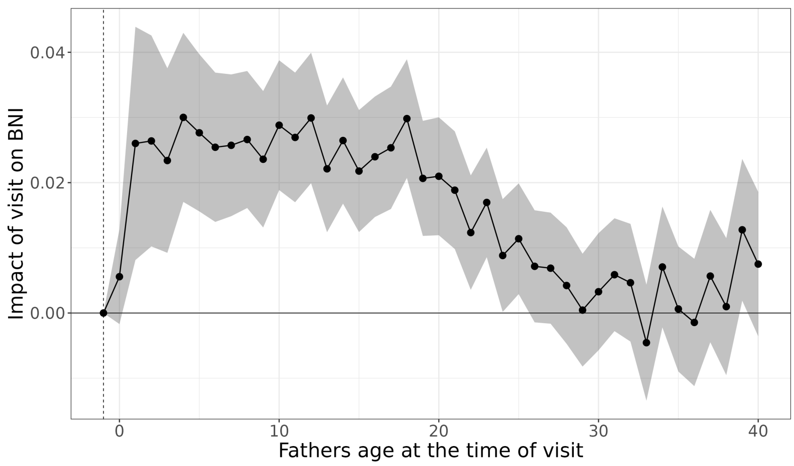
Notes: Event study of the effect of visits by the vagabonds on Bourgeois Values. Bourgeois Values are measured by a dummy variable taking the value 1 if children are named “Henry”, “Thomas”, or if the values of BNI is above the median. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it during the formative years (14-24) of the father.Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it during the formative years (14-24) of the father. Specification includes controls for race and fixed effects for county and birth year/state. For information on data selection, see note in Figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Figure C.7: Effects of visits by the *Vagabonds* on Bourgeois Values during formative years - Alternative BNI



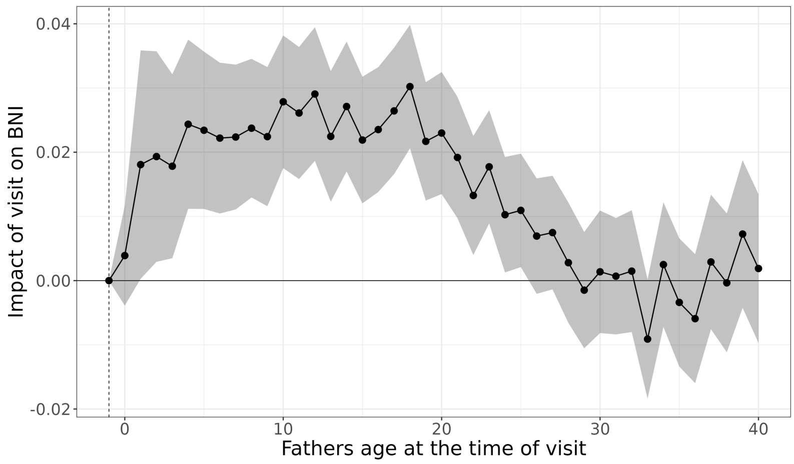
Notes: Event study of the effect of visits by the vagabonds on Bourgeois Values. Bourgeois Values are measured by a dummy variable taking the value 1 if children are named “Henry”, “Thomas”, or if the values of BNI is above the median. The reference year is set to the first year before visits by the *Vagabonds*. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers of it during the formative years (14-24) of the father. Specification includes controls for race and fixed effects for county and birth year/state. For information on data selection, see note in figure 2.5. For descriptions of the construction of BNI and census and family linking, see the main text. Standard errors are clustered at the enumeration district.

Figure C.8: Effects of visits by the *Vagabonds* on Bourgeois Values differentiated by the age of Fathers - Alternative BNI



Notes: The effect of visits by the *Vagabonds* on Bourgeois Values, at different ages of the Father at the time of visit. Bourgeois Values are measured by the BNI of children born in a given year. The reference year is set to minus 1. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers. Specification includes controls for race, number of siblings, earnings of the father and fixed effects for county and birthyear/state. For information on data selection, see note in Figure 2.5

Figure C.9: Effects of visits by the *Vagabonds* on Bourgeois Values differentiated by age of the Father - Alternative BNI and minimal controls



Notes: The effect of visits by the *Vagabonds* on Bourgeois Values, at different ages of the Father at the time of visit. Bourgeois Values are measured by the BNI of children born in a given year. The reference year is set to minus 1. Individuals in a location are counted as visited if the *Vagabonds* passed within 20 kilometers. Specification includes controls for race, number of siblings, earnings of the father and fixed effects for county and birthyear/state. For information on data selection, see note in Figure 2.5.

Table C.2: Effect of bourgeois virtues on becoming a manager

	manager employer			
	OLS	1st stage – IV	2nd stage – IV	Reduced form
Bourgeois name index	0.006***			
	(0.000)			
Bourgeois name index (fit)			0.042	
			(0.036)	
Vagabond visit		0.016***		0.001
		(0.004)		(0.001)
Black	−0.019***	−0.340***	−0.006	−0.021***
	(0.001)	(0.018)	(0.012)	(0.001)
Other race	−0.010	−0.039	−0.008	−0.010*
	(0.006)	(0.051)	(0.006)	(0.006)
Lives on farm	−0.012***	−0.127***	−0.008*	−0.013***
	(0.001)	(0.005)	(0.005)	(0.001)
F-stat 1st stage			14.432	
Mean dep. var.	0.021	0.000	0.021	0.021
SD dep. var.	0.017	0.158	0.016	0.016
N	641,605	641,605	641,605	641,605
# FE county	495	495	495	495
# FE census year	2	2	2	2
# FE age	40	40	40	40
Adj. R^2	0.013	0.024	−0.051	0.011
Adj. R^2 w/o FE	0.003	0.004	−0.062	0.001

Notes: At individual level. Table shows that bourgeois virtues (instrumented by Vagabond visits) increase the probability of becoming a manager. Sample restricted to fathers who had their son after a Vagabond visit and employed and aged 20-60 in 1940. Standard errors clustered at enumeration-district level. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.