Technology through The Danish Sound

Machinery imports to Russia 1815—1853: evidence from the Sound Toll Registers Online and the foreign trade statistics of the Russian Empire

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Abstract

The introduction of novel online databases in the 2000s has increased the revisitation of research topics such as early modern transportation, trade, and the early origins of industrialization. This thesis uses the Sound Toll Registers Online -database for the study of the spread of the first industrialization by investigating the machinery imports to the Russian Empire between the years 1815 and 1853. The foreign trade statistics of the Russian Empire (Государственная внешняя торговля в разных ее видах) are also used as a secondary source material to support the analysis. Machinery imports to Russia also relate to the concept of technology transfer. Russia is traditionally regarded as a backward economy and a late comer in terms of industrialization in the early 19th century. Transferring technology from abroad was the main driver for the technological change in the Russian industrial production in this period. This thesis aims to utilize the potential of STRO and to investigate the general development and structure of machinery imports to Russia.

Machinery trade is investigated first in the context of the entire Baltic Sea and then the focus moves on the machinery imports to Russia. Special dataset is derived from STRO and the data collecting process is described in detail. Relevant data from Russian foreign trade statistics is also used in the analysis. Descriptive time series are utilized for the observation of general developments. Frequency tables reveal the basic structure of machinery trade. Eventually, non-parametric statistics are applied for statistical comparison of the values of the machinery cargos according to the ports of departure and to the home ports of the shipmasters.

The results mostly support the view that significant technological development in Russian industry originates already decades before the Emancipation of the serfs. Even though considerable industrialization in Russia began relatively late, machinery imports increased substantially from the 1830's towards the early 1850's. The most significant trade route for machinery went from the British port of Kingston upon Hull to Saint Petersburg. The port of Antwerp also stands out as a significant port of departure for machinery shipments. The inspection on the shipmasters that participated in the machinery imports to Russia indicates that British shipmasters dominated the trade, but there was no considerable specialisation among individual shipmasters. In addition, the potential of STRO in a study of machinery trade has been demonstrated and plausible result can be produced by using the online database. The database has various possibilities between micro and macro level analysis. Still, cautious source criticism is required as the database has several shortcomings.

Keywords Economic history, machinery imports, technology transfer, The Sound Toll Registers Online, Russia

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Tiivistelmä

Uusien elektronisten tietokantojen ilmestyminen 2000-luvulla on lisännyt uutta kiinnostusta varhaismodernin ajan liikenteeseen, kaupankäyntiin ja teollistumisen alkuvaiheisiin. Tässä tutkielmassa hyödynnetään Juutinrauman tullitilien verkkotietokantaa (The Sound Toll Registers Online) ensimmäisen teollistumisen leviämisen tutkimiseen. Tutkimuskohteena on koneiden tuonti Venäjän keisarikuntaan vuosien 1815–1853 välillä. Venäjän keisarikunnan ulkomaankauppatilastoja (Государственная внешняя торговля в разных ее видах) käytetään sekundäärisenä lähdeaineistona analyysin tukena. Koneiden tuonti Venäjälle liittyy myös teknologian siirron käsitteeseen. Venäjä on perinteisesti mielletty taloudellisesti takapajuisena ja myöhäisenä teollistujana 1800-luvun alussa. Teknologian siirto ulkomailta oli keskeisin tekijä venäläisen teollisuuden teknologisessa muutoksessa kyseisellä aikakaudella. Tutkielma tähtää tullitilien verkkotietokannan potentiaalin hyödyntämiseen koneiden tuonnin yleisen kehityksen ja rakenteiden selvityksessä.

Aluksi koneiden kaupankäyntiä tarkastellaan koko Itämeren kontekstissa, jonka jälkeen huomio siirretään varsinaisesti koneiden tuontiin Venäjälle. Juutinrauman tullitilien verkkotietokannasta on kerätty erityinen osa-aineisto, ja koko tiedonkäsittelyprosessi on kuvattu mahdollisimman tarkasti. Tarpeellinen aineisto on kerätty niin ikään Venäjän keisarikunnan ulkomaankauppatilastoista. Yleisen kehityksen tarkasteluun on käytetty kuvailevavia aikasarjoja, ja frekvenssitaulut puolestaan osoittavat mahdolliset rakenteet koneiden kaupassa. Lopulta konerahtien arvojen vertailuun lähtösatamien ja kapteenien kotisatamien välillä on käytetty tilastollisia parametrittomia menetelmiä.

Tulokset sopivat yhteen niiden näkemysten kanssa, jotka korostavat teknologista kehitystä ennen maaorjuuden lakkauttamista. Vaikka varteenotettava teollistuminen alkoi Venäjällä verrattain myöhään, koneiden tuonti kasvoi merkittävästi 1830-luvulta 1850-luvun alkuun. Keskeisin kauppareitti koneille kulki brittiläisen Kingston upon Hullin satamasta Pietariin. Antwerpenin rooli niin ikään korostui aineistossa merkittävänä koneiden lähtöpaikkana. Koneita kuljettaneiden laivojen kapteenien tarkastelu osoitti, että brittiläiset kapteenit dominoivat koneiden kuljetusta, mutta varsinaista erikoistumista koneiden kuljettamiselle ei esiintynyt kapteenien keskuudessa. Lisäksi tullitilien verkkotietokannan potentiaali koneiden kaupan tutkimuksessa on osoitettu mahdolliseksi ja uskottavia tuloksia tuottavaksi. Tietokanta mahdollistaa monipuolisen analyysin sekä mikro- että makrotasoilla. Silti huolellinen lähdekritiikki on välttämätöntä, sillä tietokannalla on lähdeaineistona niin ikään lukuisia heikkouksia.

Asiasanat taloushistoria, koneiden tuonti, teknologian siirto, The Sound Toll Registers Online, Venäjä	
Säilytyspaikka Jyväskylän yliopisto	
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1. INTRODUCTION

1.1. Aim of the Study

The introduction of novel and easily approachable online databases in the 21st century has increased the interest towards the themes of transport and trade in the major economic and business history journals and books. In addition, the early origins of industrialisation have been a hot topic for discussion in early modern economic history.[1] Online databases such as the Sound Toll Registers Online enable more efficient utilization of the source material with a variety of possibilities. Research that would have required considerable effort before is now made substantially easier by the methods of digital humanities.

The purpose of this thesis is to explore the potential of the Sound Toll Registers Online (hereafter referred as STRO) and to examine the machinery imports to Russia between the years 1815 and 1853. A special dataset for the purposes of this study is derived from the STRO. To support the analysis, imported machines and devices are also tracked from the foreign trade statistics of the Russian Empire (rus. Государственная внешняя торговля в ее разных видах). STRO enables the analysis of the machinery trade in the Baltic Sea on macro level, that would not be possible in the same scale by using other source materials. Such an analysis might provide new insight on the mechanisms behind the transnational diffusion of technology in the early phase of the European industrialisation.

As the industrialisation took off in Britain, the world faced fundamental changes in the ways of production, trade, and in the economic activity in general. Probably the most symbolic to the industrialisation or to the "industrial revolution" was the mechanization of production and the introduction of various machines in factories. Steam engine represented a general-purpose technology that was highly efficient and tireless compared to the work effort of a human being. Machines led the world to the modern era and caused exceptional economic growth that is still considered as normal in the present. The spread of novel industrial machinery from Britain also caused the development that eventually

[1] Ojala & Scheltjens & Taipale 2022, 103.

created inequality between European countries by dividing them into early developers and late comers.[2]

Saint Petersburg became an important seaport for the Baltic trade during the 18th century. It was the most eastern port of the Baltic Sea and a gateway to the huge Russian hinterland.[3] Together with Riga, Saint Petersburg covered over 80 per cent of Russia's overseas commodity trade by 1800.[4] Machinery imports as a topic relates strongly to the process of Russian industrialisation. Russia is traditionally regarded as backward in the early 19th century and as a late comer in terms of industrialization.[5] Technological development in Russian industries was mostly depended on the imports of foreign machinery. Studying machinery imports in the first half of the 19th century might provide insight to the continuation or discontinuation of the early industrialization and to the international connections behind the industrial activity in Russia.

According to widely cited theory of Alexander Gerschenkron, the role of the state in the industrialisation process depends on the relative backwardness of a country. For example, in the Russian case, state should have had an essential role in promoting industrialisation to make the process successful.[6] Gerschenkron stresses discontinuity in Russian industrial development. Also, according to his view, actual industrial development in Russia began in the 1860s after the abolition of serfdom. On the other hand, soviet scholars among others have emphasized more continuous nature of Russian industrial development.[7] In the West, William Blackwell has described pre-industrial Russian economic development as "preparatory".[8] However, according to Olga Crisp, the development in the 1840s was more than merely preparatory and Russia has been regarded as the greatest beneficiary of the abolishment of the export ban of British machinery.[9]

The reforms of Peter I in the 18th century are described as significant to the Russian industrialisation and modernization in broader sense. The reforms of Peter I strongly

[2] See e.g. Allen 2011, 27–28; Ahonen 2002, 155-156; Mokyr 1990, 83.
[3] E.g. Kaukiainen 2021, 490.
[4] Dixon 1999, 243.
[5] See e.g. Gerschenkron 1962. Ahonen 2005, 45.
[6] Kasza 2018, 146–148. Gerschenkron 1962, 73, 353–354.
[7] Falkus 1972, 20-21.
[8] Blackwell 1970, 403.
[9] Crisp 1991, 261-262.

represent state-led and forced industrialisation. As more industries emerged, Russia had shortage for technical skill, that had to be imported from abroad.[10] In the early 19th century Russian economy was in trouble due to the Napoleonic Wars, but towards the middle of the century, preparatory industrial development can be recognized which appears in the number of mechanized factories and in the growing productivity in industrial production. Interestingly, the role of the state in industrial development was rather passive in the decades before the abolishment of serfdom which differs essentially from the role of the state during the reign of Peter I or in the end of 19th century.[11]

Machinery imports also relate closely to the concept of technology transfer. Broadly, technology can be defined as a form of knowledge for solving problems and as the artifacts that encompass this knowledge.[12] Machines represent here the artifacts of hardware technology that is transported over borders. The concept of technology transfer refers to a process where technology can move between continents, countries, or industries as ideas, skills, processes, or as physical artifacts such as machines and devices.[13] Different phases and channels are usually identified in the process of technology transfer.[14] For example, according to the Hayami-Ruttan theory, machinery imports represent the first phase of technology transfer where objects of the transfer are mainly artifacts of technological hardware. After the first phase, technology would be transferred as models and knowledge, and the recipient becomes capable of constructing technology based on foreign model and finally on the model of the recipient.[15]

1.2. Source material

Danish crown controlled one of the most important trade routes during the early modern period. The route through the Danish Sound has basically been the only practical route to the Baltic Sea, and the toll was levied on every vessel passing the Sound apart from few exceptions. The information on the levied toll was recorded in the Sound Toll Registers.

[10] E.g. Blackwell 1970, 16-17; Falkus 1972, 20-24.
[11] Falkus 1972, 31-34.
[12] Grodal & Krabbe & Chang 2022, 2-3.
[13] Jörberg 1991, 2; Seely 2003, 8.
[14] For phases see e.g., Hayami & Ruttan 1973; Hodne 1991, 159-160; Beatty 2003, 172-192. For channels, see e.g., Myllyntaus 1991.
[15] Hayami & Ruttan 1973; Hodne 1991, 159-160.

Vessels sailing under certain privileges were able to pass the Sound without paying the toll for the cargoes. However, a specific toll for vessels was levied anyway on every single vessel passing the Toll, and thus, a great deal of the maritime traffic through the Sound can be captured in the registers. The oldest of the records contain only information on the captain of the vessel, their home ports, and the toll paid. Later, the officials started to record information on the cargoes of the vessels. Approximately from the 1660s until the abolishment of the toll, the contents of the records became established to a certain extent.[16]

The original Sound Toll Registers are described as a unique source material especially for economic and transport history studies, for they contain vast amount of detailed information on the shipping to and out of the Baltic Sea over a long period between 1497 and 1857.[17] In total, roughly 1.8 million vessels are recorded in the registers. Apart from being a relatively well-preserved source material, since the original series have been preserved practically without disturbance from 1574 to 1857, the vast material has been digitalized into an online database.[18] STRO is easily available for anyone with access to internet. However, the reliability of the original registers and the online database based on that must be carefully inspected. Also, the processing of the data affects directly to the results. The greatest advantage of STRO is that it provides information on the entire Baltic trade, which could not be reached otherwise with a single source material.

The registers are a fiscal source, and their main purpose has been the production of statistics of the toll levied for the crown of Denmark. Jan Willem Veluwenkamp, Werner Scheltjens and Siem van der Woude have raised three main source critical issues related to the original material. Firstly, the Danish Sound is not the only route to the Baltic Sea. There are alternative routes such as the Little Belt, the Great Belt, the overland routes, the sea route to Russia via the North Cape and from the 1784, the Schleswig-Holstein Canal.[19]

[16] Gøbel 2010, 308.
[17] E.g. Scheltjens, Veluwenkamp & Van der Woude 2018, 2.
[18] Gøbel 2010, 305.
[19]The Little Belt and the Great Belt have been considered as difficult routes to navigate and thus their importance might have been greater to local transport rather than international shipping. There were also similar toll tariffs applied in these routes. The possible routes through canals were useful mainly for smaller vessels and overland routes were relevant only for light cargoes. The sea route to Russia via the White Sea was the only one of the kinds before the establishment of Saint Petersburg, after which the port of Archangel basically began to lose its importance as the main seaport of the empire. According to Veluwenkamp, Scheljens & van der Woude, none of these routes offered serious alternative to the Sound,

Secondly, the possibility of fraud or simple errors in the declarations of the commodities carried through the Sound needs to be noted.[20] Thirdly, the fact that certain ships sailing under certain flags were exempted from the customs duties at times has affected the contents of the source material.[21] As Erik Gøbel has noted, the information in the records can be correct in principle but incomplete.[22]

Regarding the online database, it must be considered that it is an interpretation of the original Sound Toll Registers. It is possible that the database contains errors. There were certain error rates in the data entry process, and despite of the constant checking of the data, some of the errors most likely remained. However, it is always possible for a researcher to check the information from the original scanned folio. It is also necessary to note that the original source material had to be fitted into the database environment, which has affected the very structure of the source. Only the toll collection entries have been entered in the database and thus a large quantity of additional information was omitted. This is mostly due to the strict format of the database. The omitted additional information may contain, for example, the addressee of part of the cargo or a notion if the ship has been stranded. However, it is mentioned in the database if such additional information can be found in the original document. These notions enable a researcher to check the original scanned folio of a passage for further information.[23]

Naturally, the reliability of STRO has been a subject to source critical estimations. For example, Jari Ojala, Lauri Karvonen, Maria Cristina Moreira and Jari Eloranta compared the information of STRO with the information of customs records of Sweden and

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but together they need to be considered when analysing the trade flows. Veluwenkamp & Scheltjens & van der Woude 2021, 154.

[20] Sailing through the Sound without paying the toll was practically impossible due to the royal guard observing the strait. It is widely agreed that every vessel passing the Sound has been recorded. However, since the customs officers did not always search the vessels, shipmasters might have offered false information on the cargo of the ship with an intention to evade the payments. Especially expensive and rarely transported commodities could have been more subject to fraud. It seems that fraud happened between 25 and 50 percent during the period 1580-1618. Since then, however, more systematic inspections of the cargoes were carried out by customs officers. Veluwenkamp & Scheltjens & van der Woude 2021, 155.

[21] Danish ships sailed without paying the toll for the whole period of existence of the toll and for example Swedish ships and commodities were duty-free from 1650 to 1710. These exempted passages were, however, recorded but without specific information on the cargo. Veluwenkamp & Scheltjens & van der Woude 2021, 155; Gøbel 2017, 511; Degn 2017, 140-145.

[22] Gøbel 2010,

[23] Veluwenkamp & Scheltjens & van der Woude 2021, 156.

Portugal. In brief, the statistical tests applied in their research showed that there were no major differences between the sources, and STRO provides quite accurate information on trade in general. Mostly, the differences emerged in the cases of rarely transported commodities. Thus, the overall picture of macro level trade is accurate enough but in micro level the data must be used with caution.[24]

Pavel Demchenko has investigated the problem related to imbalance between inbound and outbound traffic of the Baltic Sea. This problem is mostly based on the issue, where for some vessels, the customs officers simply entered "The Baltic Sea" as the destination. Such entries cause some unbalance in the trade of single ports as the number of inbound and outbound vessels do not match. Due to specific bureaucratic practises in the customs, it is possible, for example, that a vessel departed from port A, stayed for a while in port B before arriving to the Sound, and yet, the port A was recorded as the port of departure for this certain vessel.[25] Also, ships might have stayed in the Sound waiting for information on the market prices before determining the most profitable destination.[26] In this case, the exact port of destination was not defined in the records. In addition, STRO does not contain information on the traffic within the Baltic Sea, which is the main reason to include foreign trade statistics of the Russian Empire as an additional source material in this study.

Official foreign trade statistics of the Russian Empire presumably cover the information on imports that is missing in STRO. There is no such source material that could be used to study the trade of technology in macro level with an absolute precision. Thus, scholars need to establish their interpretations on the different pieces of information that has been produced in history. The results of this study will be undoubtedly approximate. However, a supporting source material such as Russian foreign trade statistics could make the approximate estimations more precise.

The official annual reports of the foreign trade statistics (hereafter referred as the annual reports) were published annually from 1802 to 1915 except for the years between 1808 and 1811, when Russia participated in the Continental Blockade. The statistical collection

[24] Ojala & Karvonen & Moreira & Eloranta 2018.
[25] Demchenko 2020, 480–487.
[26] Ojala 1997, 343.

was published under different titles during its existence.[27] The main reason for the collecting of the statistical information on foreign trade was the control and accounting of custom incomes for the Empire. The importance of the foreign trade for the Russian economy was also recognized in state level.[28]

The annual reports cover information on the different aspects of foreign trade of the Russian Empire. Some regions, practically included in the Empire, however, are treated as separate regions in the statistics. These regions are, for example, Finland, Bessarabia, and Poland. Changing borders of the regions under taxation, of course, affects the comparability of different reports. The most central information that the reports provide is the information on imports and exports. The statistics are divided between "European" trade and "Asiatic" trade. The initial division of the trade routes was based on the place through which the commodities were transported. Also, the statistics have been separated between the sea routes (Baltic Sea, White Sea, Black Sea) and overland routes. For each grouping, the recorded information covers the exports and imports, their cost and after 1806 also their quantity.[29]

Since 1812, apart from the territory-based sorting of imports and exports, a customs-based sorting was introduced. Practically, the information on imports and exports was limited only to the "main" customs offices and to the "main" commodities. Even though the list of the "main" products was rather limited, it covered 82 per cent of the imports and 81 per cent of the exports in 1824. In 1863, 77 per cent of the exports and 85 per cent of the imports in European trade were covered in the list. In 1827, the publication of the statistics changed significantly for the quantity of the products and their values were added to the statistics.[30]

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[27] From the beginning the title was "Trade of the Russian Empire in its various types" (rus. Государсвенная торговля в разных ее видах). From 1812 the publication went under the title "Foreign trade of the Russian Empire in its various types" (rus. Государственная внешняя торговля в разных ее видах). From 1863 to 1869 the titles were "Types of the foreign trade of the Russian Empire" (rus. Виды государственной внешней торговли) and "Types of foreign trade of Russia" (rus. Виды внешней торговли России). Finally, from the year 1870 the title was once again changed to "Review of foreign trade of Russia with European and Asian countries" (rus. Обзор внешней торговли России по европейским и азиатским границам). Dvoretsky 1979, 355.

[28] Dvoretsky 1979, 349.

[29] The categorization is not based on geographical factors, but on the borderlines through which the trade occurred. Dvoretsky 1979, 356-357.

[30] Apart from the import and export statistics, the annual reports also provide information on shipping and transport in general. The customs statistics registered the number of ships that visited in Russian ports,

Historians have been aware of the foreign trade statistics of the Russian Empire, but due to the vast volume and complexity of the material, the wide utilization of it is relatively challenging. To construct long series of foreign trade dynamics, a researcher would need to collect the data from each collection separately and finding a complete series of the annual reports is difficult. It seems that the only complete set of the material can be found in the National Library of Russia in Saint Petersburg.[31] Scanned volumes of the years 1827-1865 are available on the website of the library of Russian geographic society.[32]

As the original annual reports are available only partially online as digitized copies, the data for this study is derived from a thematic electronic resource compiled by a project led by Russian historian Timur Valetov that is called "Statistics of foreign trade of the Russian Empire". The project was implemented in Lomonosov Moscow State University in 2016 and it was supported by supported by the Russian Humanitarian Foundation.[33] The data is presented as part of a former project on Russian Empire historical statistics[34] The data for imports is divided between different subgroups and the most relevant import subgroup for this study is the group of "Machines and Apparatus". The data for machines and apparatus is presented as simple time series of the value of imports in silver roubles as in other subgroups. In addition, original annual reports that are available online are used for the elaboration of the information on machinery imports.[35]

Apart from the problems caused by the availability and complexity of the source material, the annual reports have gone through several changes during their publication. For example, the composition of the tables and the methods for processing information and collecting data has undergone major changes.[36] The nomenclature of the products was based on customs tariff lists. Various commodities were first combined into larger categories and then separated into smaller ones. In some cases, the figures are not comparable for the entire period. There were also changes in the methodology of

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their affiliations, and the amount of cargo. In addition to maritime transport, various information on overland transport is registered as well. There are figures for the number of carts, rafts and, for the lake and river borders, vessels. Also, the number of horses, oxen and cattle is registered. Dvoretsky 1979, 364.

[31] Valetov 2017.

[32] rus. Библиотека Русского географического общества.

[33] Valetov 2017.

[34] rus. Динамика экономического и социального развития России в XIX – начале XX вв.

[35] For example, the routes of imports are separated in the original annual reports.

[36] Valetov 2017.

accounting the cost of exports and imports. Different units of measurements used for certain goods also make the long-term analysis of trade challenging. In addition, the changing custom borders of the Russian Empire need to be considered if one is going to analyse the whole trade dynamics of the Empire. Probably the most detailed inspection of the shortcomings of the source has been done by E. V. Dvoretsky.[37]

For this study, the essential figures in the annual reports and in the dataset constructed by Valetov are the imports of "machines and apparatus" or more precisely "various machines" (rus. машин разных) as they are described in the source. The electrical library of the Russian geographic society contains almost every report published between 1827-1865. This enables the creation of series of imports of this class of commodities. The comparison with the machines detected from STRO might still be rather difficult due to the different nature and structure of the sources. The possible changes in the methodology of processing the information and collecting the data needs to be carefully inspected, even though the period that the available material enables is rather limited. For the purposes of this study, however, the information in the foreign trade statistics should be consistent enough.

1.5. Previous research

Technological progress has been a widely discussed topic in the field of history and economics throughout the 20th century. Joseph Schumpeter theorized the dynamics of capitalism with the influence of technical progress.[38] David Landes has explored the specialities of European technological progress and the spread of industrialization from Britain to other parts of the European Continent.[39] The works of Joel Mokyr and Nathan Rosenberg have also concentrated on the aspects of technological progress and industrialisation.[40] Rosenberg has stated that regarding the questions of technical process, historians have focused for decades on the history of invention rather than the diffusion process. When considering the economic impact of new technology, it is the diffusion

[37] Valetov 2017; Dvoretsky 1979, 346-381.
[38] E.g. Schumpeter 1942.
[39] E.g. Landes 1969.
[40] E.g. Rosenberg 1982; Mokyr 1990.

process that matters. However, Rosenberg also mentions that the importance of this has been widely realized and the diffusion process has become rather popular subject in economic history.[41]

Research on technology moving across borders relates strongly to the research on technology transfer. Earlier research on technology transfer related to the spread of industrialization from Britain to the United States. Then, in the second half of the 20th century, the interest of scholars turned to the industrialisation of Soviet Union and Japan, where technology transfer was considered as an essential factor. The impact of technology transfer to former European colonies in Asia, Africa, and America has also been studied. In the 1990s, the interest turned to the industrial development in more developed countries such as Finland, Germany and Scandinavia in general.[42] The modern research has focused on technology transfer especially from the West to the East.[43] In the context of the 19th century, especially the spread of British technology to European continent and to the United States has inspired scholars.[44] Technology transfer has also been connected to the industrialisation of Scandinavia and Finland.[45]

The spread of technologies has also received attention in the major economic and business history journals during the 21st century.[46] The theme has usually been studied as case studies which mostly concentrate on the adoption of specific technologies than on the general dynamics of the trade of technologies. Discussion on the spread of technologies in the journals relate to, for example, the adoption of textile technology[47] and the role of patents in technology transfer.[48] Still, the number of studies on the trade of machinery in macro level appears modest so far.

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[41] Rosenberg 1982, 19.
[42] Seely 2003, 20-22.
[43] Högselius & Dazhi 2017, 75-76.
[44] E.g. Jeremy 1973; Fremdling 2003.
[45] E.g. Bruland 1991; Myllyntaus 1991.
[46] Apart from the major business and economic history journals, there are special academic journals that are dedicated to technology transfer. *The Journal of Technology Transfer* is published by The Technology Transfer Society, and it provides multidisciplinary ground for international discussion especially on the management and strategy of technology transfer. *The Comparative Technology Transfer and Society* was published in the early 2000s, and it was also multidisciplinary journal, although more related to social sciences. See e.g. springer.com; muse-jhu-edu.ezproxy.jyu.fi; Seely & Klein & Klinger 2003, 1-2.
[47] Leunig 2001; Allen 2009; Saxonhouse & Wright 2010; Hutkova 2017.
[48] Burhop 2010; Donges & Selgert 2019.

In the Russian context, the importance of foreign technology has been recognized in the literature concerning the early industrialisation of the Empire. Also, research on technology transfer between the West and the East during the Cold War has interested scholars widely.[49] In the West, research on early Russian industrialisation and economic development in the early 19th century has been done by William L. Blackwell, M. E. Falkus, and Anneli Aer among others.[50] Especially more generally oriented works of Blackwell and Falkus, that provide the main context for this study, have paid attention to the developments in the first half of the 19th century, and they emphasize the continuous nature of the industrialisation process in Russia. In addition, Ian Inkster has discussed the role of technology transfer in the Russian industrialisation, though, concentrating in the second half of the 19th century.[51]

Regarding the earlier utilization of the source material, STRO has become famous among historians and the original registers were also rather well known before the introduction of the online database. During the 20th century, the tables of Nina Ellinger Bang and Knut Korst[52] were widely used as the usage of the original registers was an exhausting task. The tables were used especially for the studies of the Baltic trade both in broader sense and in more specified cases.[53] Original Sound Toll Registers have also been used, for example, by Kalevi Ahonen in his research on the trade between Russia and the United States.[54] After the introduction of the online database, similar work to that of Ahonen has been made substantially easier. STRO has been utilized in various ways since, and the usage of the database is usually described in detail.[55]

As far as it is known, neither STRO nor Russian Empire foreign trade statistics has been used for the study of machinery trade in macro level. This is presumably the first time when these two source materials are used together to investigate the nature of the trade of specific capital goods. Despite that the machinery imports are well noted in previous

[49] Högselius & Dazhi 2017, 76; Autio-Sarasmo & Miklóssy 2011.
[50] Blackwell 1970; Falkus 1972; Aer 1995.
[51] Inkster 1998.
[52] Bang & Korst 1906-1953.
[53] For the Baltic trade in broader sense, see e.g., Unger 1959; Rasch 1965. For the Baltic wine trade, see Biziére 1972.
[54] Ahonen 2005.
[55] For the usage of STRO, see e.g. Scheltjens 2015; Tiainen 2018; Karvonen 2020.

research of the Russia economic development in the early 19th century, this study aims to provide a deeper understanding of these imports.

1.5. Research questions and methods

With the relatively novel digital source material, this study analyses the machinery imports to Russia. As it is mentioned, STRO enables the study of machinery trade in macro level that has not been studied before due to the lack of proper source material. The macro level analysis might provide wider insight and knowledge on machinery trade in general as the nature, patterns, and the structure of this trade have remained obscure according to Kristine Bruland and Keith Smith.[56]. The topic relates strongly on technology transfer, maritime transport, and international connections. To understand the machinery imports to Russia, this thesis seeks answers to following questions:

1. How significant were the Russian ports as destinations for machinery shipments in the Baltic Sea?
2. How the volume and value of machinery imports to the Russia evolved between 1815 and 1853?
3. Is there any recognizable structure in the machinery imports to Russia?

To seek answer for the first question, the entire Baltic Sea region is examined. The role of the Russian Empire as an importer of technology is investigated by comparing the destinations of the machinery shipments transported through the Danish Sound. The second question relates to the general development of the machinery imports which could be analysed by using descriptive time series of the number of machinery shipments and the values of machinery cargos. Both STRO and Russian Empire foreign trade statistics can be used for the analysis of general development. The third question on the other hand requires more of the potential of STRO. The structure of the machinery imports can be examined by analysing different trade routes, the composition of the machinery shipments, and the actors behind the shipping such as the shipmasters. With a proper dataset derived from the original database, it is possible to analyse the international connections of this trade. In addition, as STRO is presumably first time used as a source

[56] Bruland & Smith 2010, 68.

material for the study of technology trade to Russia, the strengths and the weaknesses of it will be evaluated throughout the thesis.

The main focus of this research is on Baltic ports of the Russian Empire. The region to be investigated is determined as the integral parts of the Russian Empire. This means that the Grand Duchy of Finland and the Kingdom of Poland are excluded from "Baltic Russia". The exclusion is justified as also in the Russian Empire Foreign trade statistics these autonomous parts of the Empire are regarded separately as part of foreign trade.[57] Thus, in this study Baltic Russia roughly includes the region around Saint Petersburg, Estonia, Latvia and Lithuania. By this definition, the comparability of the two source materials is made slightly more reasonable. Present day Kaliningrad, that is part of the Russian Federation, is referred here as Königsberg that was part of Prussia during the period under investigation. In general, it needs to be noted that the concept "Russia" used in this thesis refers to the integrated parts of the Russian Empire in the Baltic region in the early 19th century, and not to the entire Russian Empire or to the present-day Russian Federation. However, the entire region of the Russian Empire provides context in some cases as the annual reports of the foreign trade statistics refer mostly to the entire region. Also, references to "Germany" in this context do not refer to the present-day nation of Germany, but to the region of the German Confederation that was created by the Congress of Vienna in 1815.

The new political order in Europe created in the Congress of Vienna also represents the starting point of this study. The time frame of this study is set between 1815 and 1853 simply to exclude the years of Napoleonic and Crimean wars that affected harmfully on the Baltic trade and on the customs practises in the Danish Sound and thus on the reliability of the Toll registers.[58] Still, the time frame covers almost entirely the first half of the 19th century. It also covers the last decades of the Sound Toll as it was abolished in 1857. The years from 1815 to 1853 are available in STRO without disturbance. Also, the general data gathered by Valetov covers the entire period. However, the data gathered directly from the digitized pages of the annual reports start from 1826 as earlier reports were not available.

[57] Dvorestky 1979, 355.
[58] E.g. Ahonen 2005, 26.

Regarding the essential role of Russia in Baltic Sea and the underdevelopment of Russian industries in the early 19th century, it is often assumed that Russia was a major importer of industrial machinery. Considering this interpretation, a hypothesis that Russia would be a major importer of machinery in the Baltic Sea will be tested in the first part of the analysis by comparing Russian ports to other Baltic ports as destinations for machinery shipments. Also, when considering the preindustrial development in the early 19th century and the increasing need for novel industrial machinery in the Russian economy, second hypothesis would suggest that the volume of machinery imports to Russia increased between 1815-1853.

Before the analysis, the data processing is described in detail as it is a crucial for the reliability of the results. The third chapter provides general context for the early 19th century Russian Empire and the importance of the machinery imports. After this, the data is analysed on descriptive level in two phases. In the analysis, the data is first used for source critical examination of the machines that are recorded in the Sound Toll Registers. The machines are the core targets in this study, and it is necessary to analyse the nature of the machinery cargoes. In the first part of the analysis, the machinery trade is examined in the context of the entire Baltic Sea region. In the second part, the focus is moved on the Russian perspective and the machinery imports to Russia are investigated. Simple time series and frequency tables are employed for the analysis of the volume, value, and the routes of the machinery trade. In the final part of the analysis, non-parametric statistical methods are employed for the further investigation of the ports of departure and the home ports of the shipmasters. A non-parametric Kruskal-Wallis test is proved to be suitable for the finding of significant differences of the values of the machinery cargos between different test groups.

2. COMPILING DATA FROM STRO

2.1. The Creation of STRO database

There has been attempts to make the Sound Toll Records more approachable before the online database. In the 1890s, a project for summarizing the information of the registers into tables was initiated by historian Nina Ellinger Bang. She directed the project from the 1890's and economist Knut Korst continued the work after Bang's death. Their enormous effort produced The Sound Toll Tables that consists of seven volumes published between 1906 and 1953.[59] The tables are, however, merely summaries of the original information, and thus, they do not contain information as diverse as the original registers do. Also, the tables cover the period only until 1783.

The Sound Toll Tables has received criticism due to certain erroneous interpretations of the editors. For example, Bang believed that the information on the home ports in the registers referred to the vessels and not to the shipmaster. Additionally, it has been claimed that the detailed information in the original material was not easy to transform into the form of the tables, and the interpretation of the editors, especially in the case of transported commodities, was crucial.[60] However, some defensive notions has been made. For example, according to Manish Kumar, historians have misunderstood the nature of the information in the Tables, at least in the case of timber products.[61] Despite of all the critical notions, The Sound Toll Tables has been extensively used by scholars during the 20th century.[62]

A significant effort in turning the information of the original Sound Toll Registers into an electrical database was initiated by Hans Chr. Johansen. He gathered information form the years 1784-1795 into a database, thus continuing the work of Bang and Korst, whose summary tables reached the year 1783.[63] This pioneering effort was continued in the 2000s, when a project aiming to create a complete online database of the Sound Toll Registers was initiated. The project was directed by the University of Groningen, Tresoar,

[59] Bang & Korst 1906-1953.
[60] Gøbel 2010, 321-322.
[61] Kumar 2018.
[62] See for example: Unger 1959; Rasch 1965; Biziére 1972.
[63] Johansen 1983.

and the Frisian Historical and Literary Centre in Leeuwarden in cooperation with the Danish National Archives. Key actors behind this project to be mentioned are Jan Willem Veluwenkamp, Siem van der Woude and Erik Gøbel. The entire financing of the project has been practically of Dutch origin.[64] The Dutch effort in promoting the online database is understandable, as the Baltic trade has been considered essential to the early modern Dutch economy.[65]

The project team form Tresoar and the University of Groningen directed the work of data entry in two phases. In the first phase, from 2009 to 2013, the data entry was carried out in a workplace called Breed. The quality of the data was checked first with two percent error rate and later with five percent since the first standard appeared to be unnecessary high. Accepted data was also corrected and then added to the database. In the second phase of the database construction, the cooperation with Breed ended and the work was continued by volunteers using a data entry application created for this purpose. The entry of the data was still supervised, and the volunteers were instructed by the specialists and directors of the project. By now, the database is completed, and it is easily available for everyone with a computer and access to internet.[66]

To avoid errors of interpretation, the entered data was supposed to follow the original Danish text as it is in the original records including all possible early modern spelling variations. The standardization is still a great challenge in the database, and so far, it is mainly carried out in the geographical names appeared in the registers. The different spellings of geographical names still exist in the transcription, but specific standard codes have been applied to the names referring to the same place. Thus, users of the database can select information of all the voyages bound to certain places despite of the different spellings.[67] A further effort to homogenize, standardize and convert the STRO data has been carried out at least by Werner Scheltjens.[68]

[64] Gøbel 2010, 322.
[65] Tielhof, 2002, 1-5.
[66] Gøbel 2010, 322-323; Veluwenkamp & Scheltjens & van der Woude 2021, 147, 149-150.
[67] Gøbel 2010, 323.
[68] Scheltjens has compiled a dataset called “Tetradas” of tonnage estimates of trade from 1670 until 1856 from STRO database. See Scheltjens 2021.

The online database contains information on, for example, the passage date, the shipmaster's name, the shipmaster's home port, the port of departure, the port of destination, the cargo and the toll paid for each passage and each part of the cargo. The database has been divided into four different tables, each containing different information on the passages. The *passage* table contains information on the date, shipmaster, and shipmasters home port. The *cargo* table contains information on the commodities carried, their port of departure, port of destination and the tax paid for each commodity. These are the main tables used in this study. The other two tables contain information on the taxes levied per passage and scans of the original source. Passage and cargo tables are connected by a specific identification number.[69]

2.2. Collecting and processing the data

A special method for the data collection and processing was generated for this study. A dataset was compiled from STRO for the purposes of the research setting. General aim of the method was the detection of relevant hardware technology in the database and the application of the geographical terms and time frame that were determined in the research setting. First, to gather satisfactory set of data from the database, specific search terms were determined, and the data was exported from the database. Next step was the necessary modification of the raw data. Finally, certain modifications were made in terms of the further requirements of data usage. Each of these steps are described below. Detailed description of the data processing is necessary, for it eventually affects the reliability of the data.[70]

The first phase of the compiling of the dataset was the determination of relevant search terms for the search engine of the online database. The relevant search terms for commodities were derived from the source material. A substantial effort was required to find all possible commodities in the database referring to hardware technology that would result a sample of satisfactory size. Also, strict limitations had to be made due to the broad meaning of the concept of technology. The most essential targets of the study were

[69] Veluwenkamp & Scheltjens & van der Woude 2021, 151.
[70] About the data usage and standardization, see e.g. Sheltjens 2015, 141-149.

clarified as “machines” that could be found in the database in Danish as “maskineri”[71]. This concept, with all its spellings, proved to be frequent enough for the purposes of this study, and it can be understood as a technological artifact unambiguously. Determining other search terms apart from “maskine” would be based mostly on questions of definitions or interpretations and it is intentionally omitted as an unpractical and unnecessary task in this study. A practical approach was chosen as the variety of the miscellaneous commodities in STRO is vast.

Beside the commodity search, the search engine of the database is designed to enable the framing of geography and time. The time frame of the search was set between 1815 and 1853 according to the time frame of this study.[72] Geographical framing was omitted at this point, so the dataset would include as diverse information on the shipping through the Sound as possible. The extraction of specific geographical areas can be done with the exported data at later point. Including the whole shipping of machinery through the Sound also enables the examination of the whole machinery trade in the Baltic Sea in the first part of the analysis. This is necessary for the investigation of the significance of the Russian ports as destinations for machinery shipments compared to other ports.

In total, STRO provides information on 565,079 passages between the years 1815 and 1853. The search terms used for the data collection in the database and the number of results they produced were:

mask_n (659 results)

mach_n (42 results)

mash_n (9 results)[73]

Three different search terms had to be generated for the maximization of the quantity of the results. In total, these search terms produced data with information on 710 vessels that

[71] According to Swedish Academy Dictionary (Svenska Akademiens Ordbok), the word “maskin” refers to a “mechanical device composed of fixed or moving parts”. The device is used to facilitate certain work. “Maskin” transforms supplied energy either into certain mechanical work or into energy of a kind other than that supplied. The definition of the word in the dictionary is supported by literature examples between 17th and 20th centuries. See: saob.se

[72] To include year 1853, the time frame had to been set between years 1815 and 1854 in the search.

[73] Wild card (*) stands for zero, one or several marks and the line (_) stands for one mark. Due to the limitations of these wild cards and on the other hand the plurality of the different spellings, there was need for more than one search term.

have carried unspecified machines through the Sound between 1815 and 1853. The results were exported from the database as text files (csv). The data processing was technically carried out by using both Microsoft Excel and statistical computing environment "R".[74] All the data processing and coding was performed by the author.[75] Each passage- and cargo -table for each search term were combined and eventually the passage and cargo tables were merged into one dataset by the common identification number.[76] After this, the dataset was checked for corrupted data. The geographical names in the dataset were standardized and uniformed according to the information that is available in soundtoll.nl.

The base units of the merged dataset are the commodities, and all other information is built around them. For all 710 passages in the dataset, there are 2,815 rows of commodities in total. For each commodity, there is information on the tolls paid for the commodity and for the ship, shipmaster, measurement units of the commodity, ports of departure and destination, and other additional information. Further modification of the data included the manual extraction of the machines from other commodities. A dummy variable was generated for the commodities with the values one for the machines and zero for other commodities. By this extraction, the dataset can be limited further to include only the machines. From all 2,815 commodities in the dataset, only 713 refers to machines.

Finally, as there are specific units of measurement for the commodities in STRO, the units of measurement for the machines were inspected. STRO has the units of measurements in two forms. There is the main unit of measurement (dan. "maat") and alternative unit of measurement (dan. "maat_aantal"). It turns out that almost all machines in the merged dataset have a monetary unit of measurement in either of these categories. The values of the machinery cargos were thus derived either from the main or from the alternative unit of measurement for the analysis.

[74] R is an integrated suite of software facilities for data manipulation, calculation, and graphical display.
[75] Apart from the data processing, the figures used this thesis are also created with R.
[76] Tables were merged by the merge -function "merge()" in R.

3. TECHNOLOGY IMPORTS AND THE RUSSIAN EMPIRE IN THE EARLY 19TH CENTURY

3.1. Industrial development and the machinery imports

The Russian economy in the early 19th century has been traditionally considered as backward especially when compared to the Western economies. Serfdom is usually regarded as one of the most crucial factors that obstructed western-like industrial development in the Russian Empire. Other factors such as the challenging geography and the poor transport system are also significant issues that caused a delay in economic development. Although the Russian economic development in general remained behind that of the West, it is often emphasized that significant technological, economic, and cultural changes took place already in the early 19th century.[77]

Due to the Napoleonic Wars, the Russian economy faced considerable difficulties in the early decades of the 19th century. Economic activity in general was rather low and the competition from the developing industrial nations in Western Europe was severe. However, from the 1830's economic activity in the Russian Empire increased which was apparent both in domestic and foreign trade, and the manufacturing industry grew significantly. The number of manufacturing establishments increased, and the labour force expanded substantially from the beginning of the century to the 1860's.[78]

The most progressive industries were cotton and cloth. In general, these progressive consumer industries used hired labour in mechanized factories. The main centres of spinning were in Moscow and Saint Petersburg. Other textile industries remained backward and primitive. Also, the heavy industry remained backward and stagnant throughout the early 19th century.[79] Scholars have argued that the Russian cotton industry grew mainly due to the tariff protection, lower costs of English yarn imports and the better availability of imported British machinery after 1842.[80] The mechanization of the spinning industry relied heavily on the imported British technology.[81]

[77] Crisp 1991, 262; Ahonen 2005, 45-46.
[78] Falkus 1972, 31-32; Riasanovsky 2000, 343.
[79] Blackwell 1970, 39-40.
[80] Falkus 1972, 39.
[81] Blackwell 1970, 44; Aer 1990, 40.

In general, the mechanization of manufacturing increased in the early 19th century. Machinery was mostly imported but domestic production was also developing. Russian machine building industry began to grow by the middle of 19th century, and it was mainly centred in St. Petersburg. Local machine production was not, however, satisfactory enough to meet the technical needs of other Russian industries. Thus, other Russian industries relied strongly on European chemicals and machinery.[82]

In the early phase of the European industrialisation, it was especially the British machinery and expertise that was exported to the other parts of Europe. The diffusion of the steam engine represents well the spread of industrial technology. At first, the engine was mainly an artifact of specialty that was not widely used. When the interest towards the application of the steam engine increased, the manufacture of the machinery began in other parts of Europe first following the instructions of British specialists and later independently in local factories. In the early 19th century, steam engines in the Europe clearly imitated British models, but by 1825, local production had started in France, German, Belgium and even in Saint Petersburg in Russia.[83]

British engineering industry developed mostly in the manufacturing towns of Manchester, Leeds, London, Birmingham, and Tyneside. In Scotland, important centres for engineering were Glasgow, Greenock, and Dundee. Typical examples of engineering products in the early 19th century were steam engines, waterwheels, transmission machinery, textile machinery. By 1851, the manufacturing of tools, engines, and machines was concentrated in the cities of Glasgow, Newcastle, Bradford, Leeds, Oldham, Sheffield, Liverpool, Manchester, Birmingham, and London.[84]

Exports of machinery were not considered as beneficial in any way to the British economy. British technological superiority created political debate that led to the prohibition of machinery exports and emigration of skilled workers in the 1780s. This mercantilist policy aimed to protect the British superiority but eventually the prohibitions proved to be impossible to control. The prohibition of the emigration of people was dissolved in 1824 and the prohibition of machinery exports in the early 1840s.[85] During

[82] Blackwell 1970, 40; Riasanovsky 2000; 343.
[83] Landes 1969, 147-148; Ahonen 2002, 156.
[84] Hume & Oglethorpe 1987, 136–139.
[85] Berg 1980, 9-19; Ahonen 2002, 155.

the prohibitions, there were still attempts to import British machinery from Belgium, where British industrialists had established factories simply to evade the export ban.[86] Dissolvement of the export ban created a major increase in machinery trade in general.[87]

3.2. Foreign trade

In the early 19th century, Russia mainly traded with European countries, and mostly with Britain. The ports of Saint Petersburg and Riga were most important for the Empire's foreign trade. Russian exports consisted mainly of grain, linen, hemp, and iron. The imports consisted of, for example, cotton thread and other manufactured goods mostly from Britain. The Napoleonic Wars affected greatly on Russia's foreign trade in the early 19th century. The disruption of the trade with Britain due to Napoleon's Continental system led to the growing importance of the Russian ports in the Black and the Azov Seas to the foreign trade of the Empire. Also, the trade with America increased at the same time.[88]

Russia lowered its import duties substantially in 1816. The liberal tariff policy caused a state of virtual free trade towards the end of 1820's. British manufacturers flowed to the Russian market and Russian industries faced growing competition from the countries in Western Europe. The policy was catastrophic in the perspective of Russian economy and industries, and consequently, new protectionist tariffs were adopted in 1822 including several prohibitions. These new tariffs remained practically unchanged until 1857.[89]

As the commercial bonds with Europe strengthened during the early 19th century, Russia signed several trade agreements with European countries and the United States. By signing the agreements, Russia soke more equal rights for Russian merchants and shippers participating in the trade with the West. As the trade with industrially more developed countries increased, the Russian economy ended up following the business cycles of the Western countries. Economic crises that swept through the Western countries had serious impact also on the Russian economy. To certain extent serious

[86] Jörberg 1991, 192-193.
[87] Bruland & Smith 2010, 68.
[88] Blackwell 1970, 81-84.
[89] Blackwell 1970, 172-173; Falkus 1972, 31; Ahonen 2005, 48.

foreign trade related crises that affected the Russian economy in the first half of the 19th century were at least the crises of 1839 and 1847.[90]

The crisis of 1839, that originated in Britain in 1836 and spread first to the United States, reflected also on the Russian foreign trade as these countries were significant trading partners. The crisis affected mostly in the prices for imported and exported goods and then reflected on the industry. The development of the Russian industry was interrupted in 1840 and 1841. For example, the growing imports of textile machinery stopped after 1838 and declined until 1843 when the machinery imports started to rise rapidly. The crisis of 1847 was complicated by a political crisis in Europe.[91]

3.3. The Industrial policies

Alexander Gerschenkron's interpretation on the Russian industrialization is one of the most well-known. His model based on an idea of relative backwardness. The latecomer economies lacked the favourable preconditions for industrial development that occurred in the first industrialized countries such as Britain. These latecomers experienced, however, rapid economic growth spurts that the model would explain by the relative backwardness. According to Gerschenkron, the latecomers could substitute the lacking preconditions, for example, with foreign entrepreneurs, capital intensive machinery, state capital formation or foreign investments. The role of the state was crucial for the development of Russian industry in Gerschenkron's model.[92] However, in Gerschenkron's analysis, the role of the state was examined in the conditions after the emancipation of serfs in 1861, and thus, it mainly concerns the industrial development in the late 19th century. In the early 19th century, the role of the state in promoting industrialisation was rather different.

Blackwell characterizes the industrialization debate in the early 19th century Russia as the struggle between westernizers and nationalists, and on the other hand, between industrializers and traditionalists. Neither of the two sides were organized or had any organized program concerning the issue of industrialization. In general, the views of the

[90] Blackwell 1970, 88; Iakovlev 1955.
[91] Iakovlev 1955.
[92] Gerschenkron 1962, 16-21; Gregory 1991, 64-65.

officials were diverse. The division of the views into these two groups is, however, reasonable to some extent for they represent the general debate. The westernizers and industrializers wanted to follow the Western model of industrialization to transform Russia from an agrarian to an industrial society. There was a concern that Russia would not keep up with the development of the West and if Russia would not industrialize, it would become dependent of the West. The nationalists and traditionalists emphasized the uniqueness of Russian development. This development meant slower pace in industrialization with respect to the traditions of Russia.[93] Only few state officials were extremely conservative and opposed the idea of industrialization in general or would accept it in necessary matters such as in military.[94]

Both the westernizers and the more traditional nationalists had views that would emphasize the preservation of the social order in Russia. Most of the westernizers wished rapid industrialization but within the existing social order and especially the traditionalists spoke for slow and gradual industrialization that would take place according to the unique Russian development rather than to the Western model.[95] Nevertheless, despite the diverse views among state officials, no comprehensive program for industrialization in Russia was formulated in the early 19th century. Thus, state did not have significant intended effect on the industrial development of the Russian Empire in the first decades of the 19th century.

The early 19th century also witnessed the publication of the first Russian manifesto on invention privileges in 1812. In the manifesto, the invention was certified as a property of the person mentioned in the privilege. In many ways, the Russian manifesto on invention privileges followed the French definition of the concept. Privileges were also granted for inventions imported from abroad. These privileges were revisited in the Privilege Statute of 1833. In the new statute, the rather vague regulations concerning the privileges on the imported inventions in the first manifesto were specified and the granting of such privileges became exceptional. The number of the privileges granted for

[93] Blackwell 1970, 126.
[94] For example, Count Egor Frantsevich Kankrin represented rather strict resistant view on industrialization in Russia. Kankrin generally did not wish Russia to industrialize, and he did not believe that it would happen. Blackwell 1970, 141-144.
[95] Blackwell 1970, 126.

machines, for example, increased steadily throughout the early 19th century, and in the middle of the century, most of the privileges were granted to foreigners.[96]

3.4. Foreign entrepreneurs

Even though the Russian trade with Europe was practically controlled by foreigners based in the port of Saint Petersburg, most of the manufacturing plants were still owned by Russians in the early 19th century.[97] Still, the influence of foreign factory owners on the development of Russian industry was significant. Especially the machine industry in Russia was dominated by foreigners until the 1850's.[98]

Considering the early 19th century, Russia was not particularly the most favourable environment for foreigners to operate. Especially during the reign of Nicholas I, the bureaucracy, police surveillance, and different restrictions made foreign participation in business challenging. In addition, the legal protection of the foreign entrepreneur was weak. Despite the various difficulties set by the system, it was possible for some foreigners to make substantial profits in Russia. Most of the foreign industrial entrepreneurs operating in the Empire had become Russian subjects by the 1840's to overcome the restrictions introduced by the reign of Nicholas I. Nevertheless, the system also offered some features that attracted foreign entrepreneurship. The protectionist tariff set in the 1822 was beneficial for foreign entrepreneurs as well. After the lifting of the ban of the exports of British machinery in the 1840's, it was possible for British entrepreneurs to establish firms in Russia with superior machinery and efficient managerial staffs from Britain. These firms were able to expand rapidly with the help of British technical knowledge and imported machinery.[99]

Most of the foreign entrepreneurs in Russia were British, French, or German in the early 19th century. The most important effort on the Russian industrial development was made by English and Scottish technicians and capitalists. British influence was remarkable in

[96] Aer 1990, 31-32, 46, 51.
[97] The definition of "foreign" entrepreneur operating in Russia is not always unambiguous. See Blackwell 1968, 242-246.
[98] Blackwell 1970, 246.
[99] Blackwell 1970, 247-248.

the mechanization of the Russian cotton industry and these foreign experts dominated the Russian machine industry in the early 19th century. Technical proficiency and the knowledge on industrial machinery were the most important features of British entrepreneurs in Russia in the early 19th century.[100]

One example of a significant foreign industrialist operating in Russia was Charles Baird from Scotland. The first steam machine factory in Russia was established in 1792 by Baird together with his associate. Baird was one of the wealthiest British machinists in Saint Petersburg during the early 19th century. Russia's first steam engines were built in Baird's factory. Also, Russia's first steamship was produced by the same factory in 1815. Steam transport between Saint Petersburg and Kronstadt was monopolized by Baird as sailing vessels could not compete with steamships in this route.[101]

Despite that the most of the important machinery producers were British, some significant factories were established by other nationalities such as the state-owned Aleksandrovsk locomotive and railroad car plant near Saint Petersburg. For the first railroad in Russia, the Tsarskoe Selo, the locomotives and other required equipment were imported from Britain and Belgium. The Tsarskoe Selo railroad was completed in 1837 and it merely connected the city of Saint Petersburg and suburban regions of Tsarskoe Selo and Pavlovsk. For the Saint Petersburg-Moscow Railroad, a different approach was needed. There was a concern that importing all the required equipment would make Russia dependent on foreign suppliers in the long run. The most beneficial alternative for the development of independent Russian railway industry was thus the employment of foreign specialists to build railway equipment and facilities in Russia. An American locomotive firm Harrison, Eastwick, and Winans offered to build all the required equipment, engines, and rolling stock in Russia. The locomotive factory was established in the existing Aleksandrovsk iron foundry near Saint Petersburg and the construction of the railway equipment began in the 1840s. The American firm supplied their tools and machines for the work by importing them duty free. The raw materials for railroad

[100] Blackwell 1970, 249-250.
[101] Blackwell 1970, 251-252.

equipment were also mainly imported, and the role of Russian iron industry remained supplementary.[102]

4. MACHINERY TRADE IN THE BALTIC SEA 1815-1853

In this section, the shipping of machinery detected in STRO is examined in macro level without specified geographical framework. Thus, the analysis includes every port including in machinery trade that appear in STRO. The main target for this general observation is to investigate the significance of the Russian ports as destinations for machinery shipments. First, before analysing the machinery trade, I believe it is necessary to examine the nature of the machines we are dealing with. After this mainly source critical section, general descriptive observations of the machinery trade in the Baltic Sea are made.

4.1. The "Machines" in STRO

Since STRO is not a statistical source material, the commodities in the cargoes are not labelled uniformly. To get a decent understanding of the data used, it is necessary to inspect the various spellings of the machines that the specific search terms have produced.[103] In general, the different spellings of the machines are rather similar, despite of minor spelling variations with a difference of a few letters. Danish cargo descriptions "Maskinerie", "Maskinerier", and "Maskineri" cover over 50 per cent of all different spellings referring to machinery. Also, other spellings listed in the Table 1. represent rather similar spelling structure.[104]

There are, however, a vast number of unique spellings in the dataset. While most of the spellings refer to general word "machine", there are cases where the machines are described more precisely. For example, in 1817 shipmaster Anders Wiberg from

[102] Blackwell 1970, 274, 303-306; Blanchard 2000, 107-108.
[103] There was one spelling in the results that did not refer to a "machine" of any kind. "Ubr. Lammaskind" ended up in the list due to similar word stem "maskin". This entry was deleted from the dataset.
[104] All commodity entries in the data are presented in Appendix I.

Helsingborg transported a chopping machine[105] worth 100 riksdalers from Höganas to Stockholm.[106] Shipmaster Richard Cheed from Kingston upon Hull apparently transported steam engines[107] worth 6,750 riksdalers in his cargo from Kingston upon Hull to Königsberg in April 1820.[108] Other more detailed descriptions of the machines include, for example, washing machines, copy machines and tobacco machines.[109] These spellings already indicate that the selection of different machines in STRO is vast.

TABLE 1. THE MOST FREQUENT SPELLINGS OF THE MACHINES IN STRO

Spelling	Freq	Share
Maskinerie	142	19.9 %
Maskinerier	138	19.4 %
Maskineri	103	14.5 %
Machinerier	15	2.1 %
Maskiner	15	2.1 %
Maskinerie etc	15	2.1 %
Maskinerier etc	14	2.0 %
Maskinere	13	1.8 %
Maskineer	12	1.7 %
Maskineri etc	12	1.7 %
Others	233	32.7 %
Total	712	100 %

Source: STRO

Usually, each commodity entry is presented separately in the database. However, in some cases the machines are recorded together with other commodities, probably due to the miscellaneous nature of the commodities. For each commodity in the cargo, there are announced either the quantity or the value of the product and information on the toll paid. Many of the uncertain and combined entries for the machines are recorded as "Kjøbmanswarer og maskinerie" with, again, various spellings. This entry refers to miscellaneous goods and machines. For example, in June 1845, shipmaster E. J. Gust

[105] Danish text in STRO: "Hakkelse machine".
[106] STRO passage id: 1080983.
[107] Danish text in STRO: "Dampmaskiner".
[108] STRO passage id: 1056042.
[109] Danish text in STRO: "Bademaskine", "copiemachine", "tobaksmaskine". Translations are made by the author. For the list of different spellings for machinery found in STRO, see Appendix 1.

from Groningen transported these unspecified trade goods and machines, worth together 7,251 riksdaler, among cotton, indigo, and cheese from Antwerp to Saint Petersburg.[110]

The composition of the cargos containing machinery varied from one commodity entry to 44 commodity entries in a single cargo. The median number of different entries in all cargos was three entries. Thus, machinery was mostly transported in cargos together with merely few other commodities.[111] The largest cargo with 44 commodities was transported by shipmaster E. B. Eraldson from Ystad in 1844. Eraldson transported this large selection of products from Hamburg to three different destinations, Malmö, Ystad and Helsingör. Other products were destined to the ports of Malmö and Ystad while machinery was destined to Helsingör.[112] The most common products appearing in the cargos with machinery were cotton and coal, which were main imported goods to the Russian Empire in the 19th century.[113]

Unfortunately, only little can be said about these machines that are the focus of this study. More descriptive commodity entries in the database are rather unique. Customs officers did not specify different machines that were carried through the Sound, for machines were not common commodities to record at the customs office. Presumably, "machines" were not on the official tariff list of Elsinore, and thus, they were registered under the same category as other miscellaneous goods.[114] Similar problem exists in the Russian foreign trade statistics, where the group "machines and devices" includes practically technology of any kind.[115] Despite the relatively good data on the values of machinery cargos in riksdalers, the estimation of actual values of single machines is difficult due to the problematic combined entries such as "miscellaneous goods and machines". It is also impossible to say which part of the toll paid refers to the machines and not to other miscellaneous goods. To overcome this difficulty, the focus of this study needs to be

[110] STRO passage id: 1454038.
[111] Presumably, towards the middle of the 19th century the capacity of the ships transporting machines and other products became higher.
[112] STRO passage id: 1418810.
[113] E.g. Ahonen 2005, 47.
[114] Ahonen 2005, 27.
[115] However, towards the end of the 19th century, the subgroups of machines and devices in the annual reports became more diverse. Valetov 2017.

broadened from single transported machines to cargos of unspecified machinery. By this source critical specification, the analysis is directed to more abstract level.

4.2. General patterns of the machinery trade in the Baltic Sea

With the data collection method described above, a total of 709 machinery shipments were detected in STRO between the years 1815 and 1853.[116] According to STRO, the number of the machinery shipments increased through the first half of the 19th century. The number was rather modest before the 1830's as there were merely a few machinery-carrying ships that passed the Danish sound each year. The 1830's witnessed a clear increase in the number of the shipments, and after a slight decline in the end of the 1830's, the number of shipments began to grow significantly. The absolute peak of the sampling of this study was reached in 1853 with a total of 79 shipments. The growth after the 1830's was evident, however, the dispersion in the number of the shipments was sixfold between years 1830 and 1853 compared to the first decades of the century. The difference would suggest that despite the growing number in the machinery shipments, the annual frequency of the shipments became more irregular towards the middle of the century.[117]

As the number of the machinery shipments increased significantly between 1815 and 1853, the share of these shipments from the total number of shipments recorded in STRO increased as well. Machinery trade represents merely a fraction of the total trade in the Baltic Sea, for the number of ships carrying machinery cover no more than 0.13 per cent of the total number of ships sailing through the Danish Sound between 1815 and 1853. Still, a clear increase can be detected, as the share of the machinery shipments was around 0.01 per cent before the 1820's and over 0.2 per cent after the 1850's.[118]

Machinery shipments detected in STRO were mostly bound to the Baltic Sea. Over 95 per cent of the ships carrying machinery had their destination in the Baltic Sea region between 1815 and 1853. Most of the ships that were carrying machines out of the Baltic

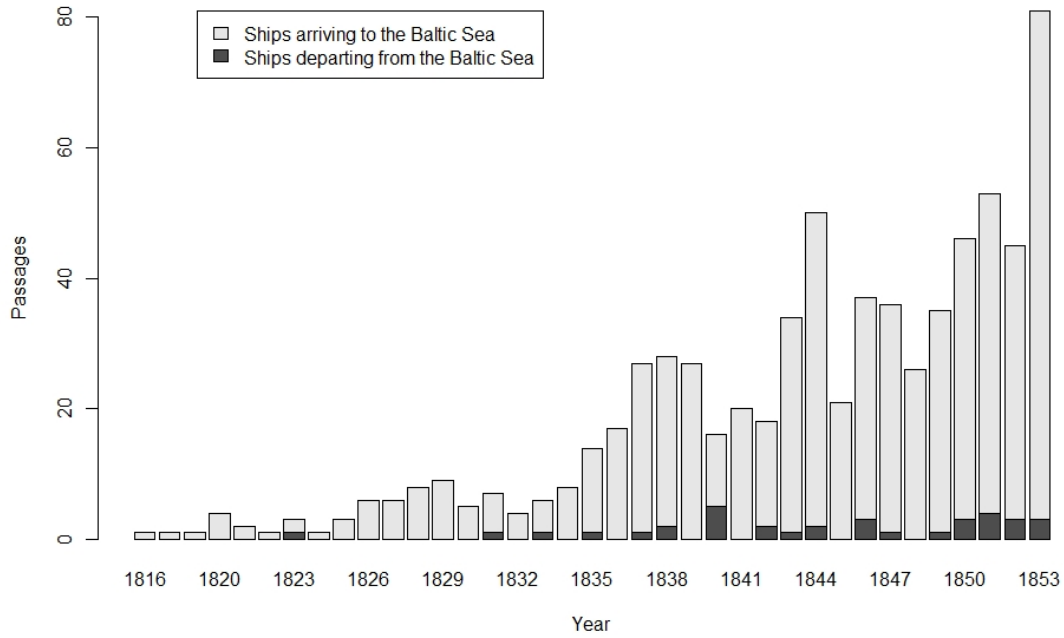
[116] One passage from previously mentioned 710 passages was discarded as irrelevant. Also, two out of all 709 entries lacked the information on both port of departure and destination. Thus, in some parts of the analysis, there are only 707 or less shipments to observe.
[117] The standard deviation in the number of shipments before 1830: 2.98, and after 1830: 18,06.
[118] See Appendix II.

Sea, were heading to the western parts of Sweden or to the United Kingdom. Only in a few cases these ships were heading to long-distance destinations. For example, shipmaster H. R. Boman from Stockholm transported a machine worth 100 riksdaler among iron rods and steel from Stockholm to Rio de Janeiro.[119] E. Erick from Stettin (that is modern Szczecin in Poland) transported machines worth 14,867 riksdaler from Stettin to Odessa at the Black Sea.[120] Other long-distance destinations were "Russian America" (that is Alaska) and the Russian port of Arkhangelsk at the White Sea.[121]

Most of the machinery shipments departed from a British port. Six out of ten most frequent port of departure located in the Great Britain. These ports of departure covered almost 60 per cent of the machinery shipments. Kingston upon Hull was the most important port of departure for the machinery shipments. Its share of the machinery shipments is over twofold compared to the next most frequent British port of departure, that is, Liverpool. Another significant region of departure for machinery shipments was in Glasgow-Leith-Dundee belt in Scotland. In addition to the dominating ports of Britain, the port of Antwerp in Belgium was the second most important port of departure for the machinery shipments. Also, it is worth noting that Dutch ports of Amsterdam and Rotterdam are well represented in the data. Altogether, almost 80 per cent of all ships carrying machinery departed from a British, Belgian, or Dutch port.[122]

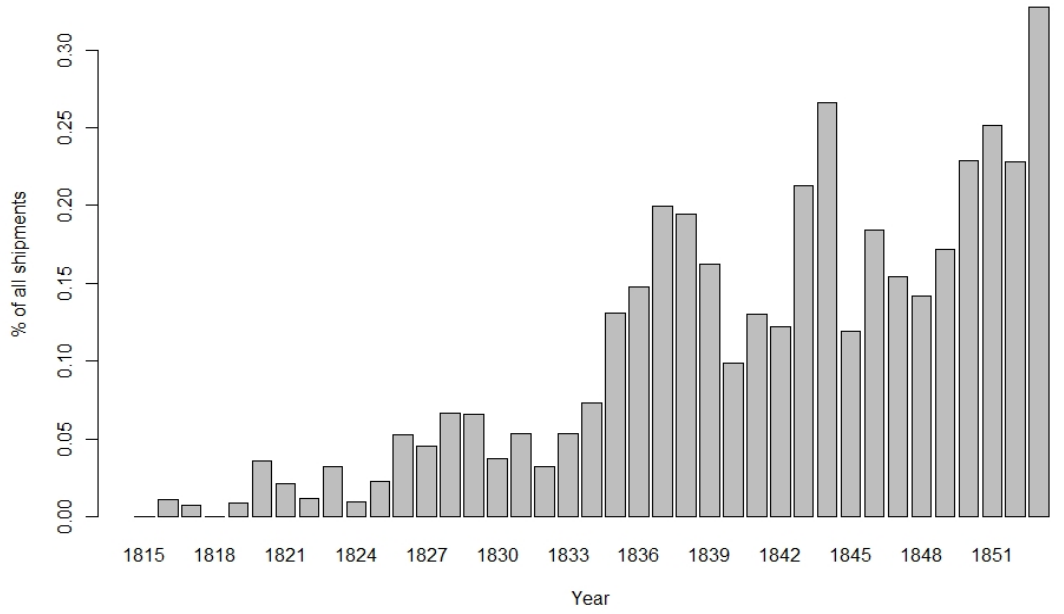
[119] STRO passage id: 1507375.
[120] STRO passage id: 1457359.
[121] STRO passage id: 1577413; 1589586.
[122] For all ports of departure, see Appendix III.

FIGURE 1. MACHINERY SHIPMENTS THROUGH THE SOUND 1815-1853



Source: STRO

FIGURE 2. THE SHARE OF MACHINERY SHIPMENTS FROM ALL SHIPMENTS TRANSPORTED THROUGH THE SOUND 1815-1853



Source: STRO

TABLE 2. THE MOST FREQUENT PORTS OF DEPARTURE FOR MACHINERY SHIPMENTS 1815-1853

Port	Frequency	Share
Kingston upon Hull	169	23.9 %
Antwerp	112	15.9 %
Liverpool	80	11.3 %
London	57	8.1 %
Newcastle	56	7.9 %
Dundee	31	4.4 %
Leith	25	3.5 %
Rotterdam	20	2.8 %
Amsterdam	10	1.4 %
Havre	10	1.4 %
Others	136	19.3 %
Total	706	100.0 %

Source: STRO

TABLE 3. THE MOST FREQUENT PORST OF DESTINATION FOR MACHINERY SHIPMENTS 1815-1853

Port	Frequency	Share
Saint Petersburg	210	29.7 %
Danzig	64	9.0 %
Kronstadt	64	9.0 %
Riga	48	6.8 %
Copenhagen	41	5.8 %
Stettin	40	5.6 %
Helsingør	30	4.2 %
Königsberg	20	2.8 %
Narva	20	2.8 %
Stockholm	16	2.3 %
Others	155	21.9 %
Total	708	100.0 %

Source: STRO.

It is not surprising that most of the machines departed from a British port. Britain was the major producer of industrial machinery in the early 19th century and the countries following the British example imported necessary machinery mainly from Britain.[123] The port of Kingston upon Hull has been an active trading port in the eastern coast of Britain since the Middle Ages. It has been important port especially for the British trade in the

[123] Ahonen 2002, 156.

Baltic Sea.[124] The geographical location of the port of Hull with close access to the channel of the Humber made it a noteworthy port for exporting various machinery from the cities in its hinterland such as Leeds and Sheffield that were significant centres for machinery construction.[125] In general, the most frequent British ports of departure were either the manufacturing centres of machinery or significant ports that were located near such centre.

To some extent, the relatively important role of Antwerp as a port of departure could be explained by the British ban of the machinery exports. According to Lennart Jörberg, British industrialists tried to evade the export ban by establishing manufacturing plants in Belgium and exporting machinery from Belgian ports.[126] The abolishment of the export ban of British machinery in 1842 is also visible in the data as a sharp increase in machinery shipments in 1843.

There might still be more reasons for the position of Antwerp in the list of ports of departure. Belgium was, after all, the first follower of Britain in the process industrialisation in the Continent. In the Congress of Vienna, the Netherlands and Belgium were combined into one state and Antwerp was an important port of the United Kingdom of the Netherlands. Belgium had, however, taken a lead over the Netherlands already in the 1820's.[127] The port of Antwerp started to recover from 1816 after the difficulties caused by the Napoleonic wars. In the early years of the 19th century, the port received grain mainly from Riga and Saint Petersburg and wood from the Scandinavian countries.[128] In the 1830's, the value of exported steam engines from Belgium was sevenfold to the value of imported engines.[129] Thus, it seems that Belgium was a relatively significant exporter of machinery in the early 19th century.

Regarding the ports of destination in the Baltic Sea region, it is evident that the port of Saint Petersburg was essential for the machinery trade. Together with the port of Kronstadt, which is located at the very offshore of Saint Petersburg, these ports covered

[124] East 1931, 190, 201.
[125] Hume & Oglethorpe 1987, 136–139.
[126] Jörberg 1991, 193.
[127] Philips & Buyst 2021, 49, 54.
[128] Veraghtert 1988, 449-451.
[129] Pollard 1973, 641.

almost 40 per cent of the recorded destinations of all machinery shipments transported through the Sound between 1815 and 1853. Also, as it is shown in table 2, at least four out of ten most frequent ports of destination of machinery shipments were integrated parts of the Russian Empire in the early 19th century. According to the data, the probability of a machinery cargo to be transported to the region of the Russian Empire was almost 50 per cent. Other remarkable destinations for machinery shipments were Poland, Denmark, Sweden, and eastern Prussia. In general, the destinations of the machinery shipments seem to be rather concentrated, for ten most frequent ports of destination cover almost 80 per cent of all machinery shipments.[130]

The data confirms at least that the Russian Empire is a justified target for the study of technology imports in the Baltic Sea region. There are several explanations for the role of the Russian Empire as a major technology importer as it was explained in chapter 3. The Russian Empire was technologically backward compared to the Western countries where the industrialization had already taken off to a considerable extent by the middle of the 19th century. The development of the Russian industry was depended on the western, and mostly British, technology that had to be imported. Also, Saint Petersburg was a significant destination for shipping in general. The Russian cities in the Baltic Sea, especially the capital, were appealing for foreign entrepreneurs to do business and the factories established by these foreigners had special demand for the latest industrial technology.

In summary, these figures imply that the machinery trade in the Baltic Sea clearly increased between 1815 and 1853 and the role of Saint Petersburg and Baltic Russia in general was essential in this trade. The flow of technology was also strongly directed from the Atlantic Ocean to the Baltic Sea in this period. Most of the machinery shipments had their port of departure in Britain. It is plausible, that the increase of machinery shipments after 1840's was partly a result of the abolishment of the export ban of British machinery.[131] Also, it is presumable that it took some years for European economies in the early 19th century to recover from the Napoleonic wars, which could explain the lower number of passages in the beginning of the century. It is evident that the Baltic trade in

[130] For all ports of destination, see Appendix IV.
[131] Berg 1980, 9-19, 205; Ahonen 2002, 155.

general increased at the same time as the number of machinery shipments did.[132] However, the increase of the share of machinery shipments from the total number of shipments implies that, even as it was rather marginal, the machinery trade grew substantially, and it should not be explained only by the growth of Baltic trade in general.

Still, as it is well known, ports of departure recorded in the Sound Toll Registers do not necessarily refer to the actual port where the cargo was originally loaded. If the ship visited other ports before sailing through the Sound, it is possible that the cargo identified with the last port the ship visited rather than the original port where the cargo was loaded.[133] This should not have effect on the general picture, however, as the difference between some ports is merely one or two shipments, it is possible that the order of the ports in the tables 2 and 3 does not represent the exact reality. The insecurities related to the reliability of the ports of destinations need also be considered. It is difficult to confirm that the ship eventually sailed to the destination that was announced at the Toll without the support of additional source material. On the other hand, capital goods such as machines were presumably transported to the announced destination as there were hardly any reason to look for more favourable destinations. The demand for industrial machinery was naturally more exclusive than for bulk commodities.

5. MACHINERY IMPORTS TO RUSSIA 1815-1853

The data gathered from STRO implies that most of the machinery shipments in the Baltic Sea were bound to a port belonging to the Russian Empire. Thus, in the following section, the analysis is focused on the Russian Empire and the machinery imports are inspected from the perspective of both the foreign trade statistics of the Russian Empire and STRO. First, the overall amount of machinery imports to Russia will be inspected by using the available data from both sources. After this, the main trade routes of the machinery imports are investigated. Russian foreign trade statistics provide insight on the trade routes of the machinery shipments to the Russian Empire in general, while STRO can be

[132] See Appendix II.
[133] Demchenko 2020, 480–487.

used for more detailed detection of trade routes between Northern Europe and Russia. Finally, STRO is utilized for the inspection of the machinery imports to the Russian Empire from the perspective of the shipmasters.

5.1. Trade volume

According to the dataset constructed by Valetov from the foreign trade statistics of the Russian Empire, the share of the machinery imports from the total imports to the Russian Empire increased substantially between 1815 and 1853. Years from 1815 to 1830 did not show any significant changes in the machinery imports and the volume was rather modest in general. From the early 1830's, the machinery imports to the Russian Empire began to increase and the annual value of the machinery imports in the sampling of this study peaked in 1853. According to the data, it seems that the 1840's and early 1850's are the decades of substantial growth in the machinery imports to the Russian Empire. The increase is truly remarkable as the share of machinery imports from total imports remained below one per cent until 1844, and in the peak year of 1853, the share exceeded four per cent. Similar trend can be seen in the increase of the machinery imports in silver roubles and in the increase of the number of machinery shipments detected from STRO.

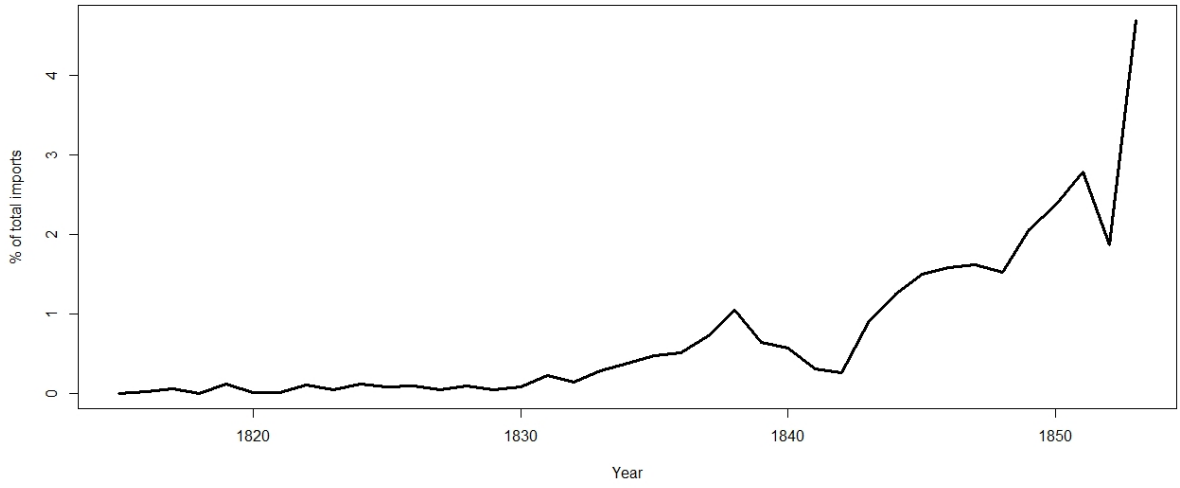
Despite the apparent growth of the machinery imports to Russia, the figures were not increasing throughout the entire period. From the end of the 1830's the value of machinery imports in silver roubles declined sharply. The decline is also visible in the share of machinery imports from the total imports to the Russian Empire. The value of total imports to the Russian Empire shows as well apparent decline for the same period.[134] Also according to STRO, the number of machinery shipments decreased at the same time.

This significant decline in the machinery imports could be explained with the economic crisis of 1839 that spread from Britain and the United States to Russia affecting explicitly on the foreign trade of the Empire. The crisis affected mostly in the prices for imported and exported goods and then reflected on industry. According to Iakovlev, some significant consequences of the crisis were that the development of Russian industry was interrupted in 1840 and 1841. Also, the growing imports of textile machinery stopped

[134] For the value of total imports, see Appendix V.

after 1838 and declined until 1843, when the machinery imports again started to rise rapidly.[135] The international economic crisis would explain the decline in the figures. The relative increase in the machinery imports was even more rapid than can be observed in figure 3, as the total imports to Russia seem to grow rather modestly compared to the level of the decade before the crisis of 1839.

FIGURE 3. THE SHARE OF MACHINERY IMPORTS OF THE TOTAL IMPORTS TO THE RUSSIAN EMPIRE 1815-1853

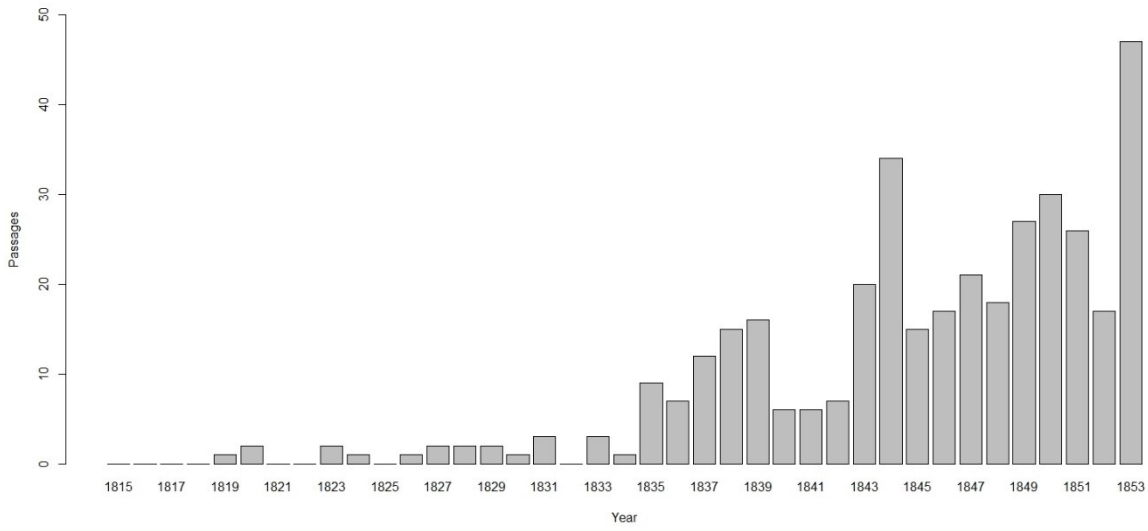


Source: Statistics of foreign trade of the Russian Empire by Valetov

The imports of machinery decreased slightly also in the early 1850's. According to Iakovlev, the cotton production faced a deep depression between 1850 and 1852. The decline of the price of yarn before 1852 was caused by the spread of mechanical spinning and by the decline in the price of cotton abroad.[136] The influence of the depression to the Russian spinning industry undoubtedly affected to the demand for the machinery.

[135] Iakovlev 1955.
[136] Iakovlev 1955.

FIGURE 4. MACHINERY SHIPMENTS TO RUSSIA 1815-1853



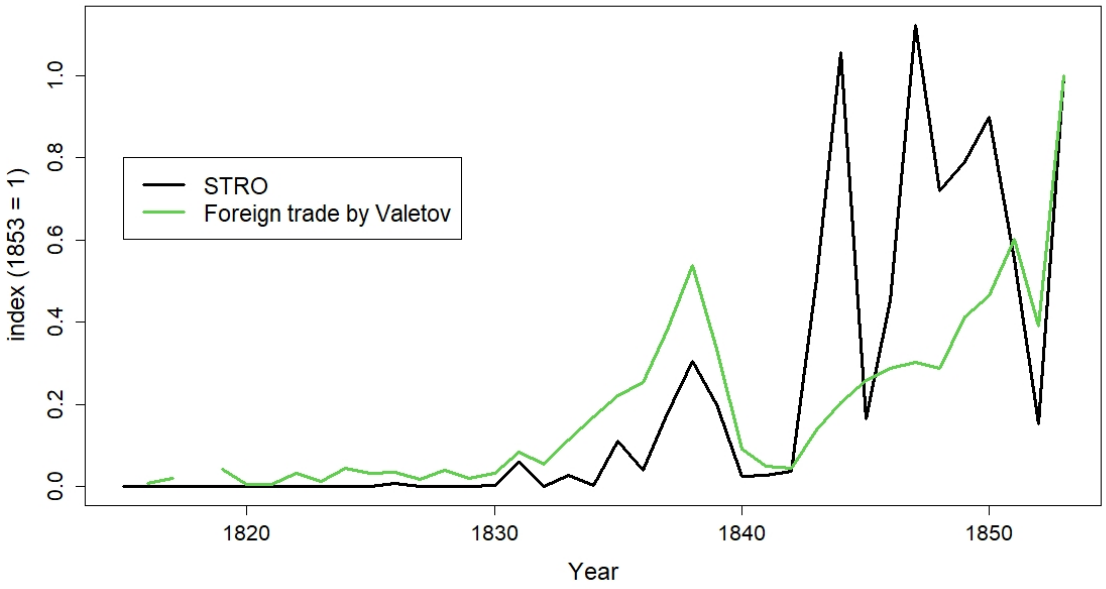
Source: STRO

It is already mentioned above that STRO contains information on the measures of the commodities in the cargos. In the case of machinery, the unit of measurement is available in riksdalers for almost every shipment. Of all 318 entries for machinery imported to Russia in the dataset, a total of 313 has a value in riksdalers. Of course, the data for the values of the machinery cargos in STRO is not directly comparable with the data of the official foreign trade statistics due to the different nature of the source materials. Still, some general implications can be made regarding the rates of development of both time series.

The development of the values of the machinery imported to the Russian Empire according to both sources are presented in figure 5. The evident differences in the indexes of the values are presumably due to the different natures of the source materials. The official foreign trade statistics cover the information on the machinery imports from the Baltic Sea region that cannot be detected in STRO. They also cover the imports through other trade routes than the Baltic Sea. The relatively strong increase in the values of machinery cargos in STRO in the 1840's can be explained by the increase of shipping of the machinery through the Danish Sound due to the lifting of the British export ban. Despite the obvious differences between the source materials, the overall value of the machinery imports increased significantly in the 1830's and from the 1840's the values

began to increase substantially towards the early 1850's according to both sources. The declines caused by the crises of 1839 and early 1850's are also visible in both sources. The correlation between the samples is 0.7 which also speaks for the congruence of the two source materials in this context.

FIGURE 5. THE DEVELOPMENT OF THE VALUE OF THE MACHINERY IMPORTS TO THE RUSSIAN EMPIRE 1815-1853 ACCORDING TO STRO AND THE RUSSIAN EMPIRE HISTORICAL STATISTICS



Source: STRO; Statistics of foreign trade of the Russian Empire by Valetov

Apart from the economic crises, the figures reflect the general industrial development in The Russian Empire in the early 19th century. As the local machine industry did not satisfy the technical needs of other Russian industries, they had to rely on foreign sources of machinery.[137] The substantive growth of the Russian spinning industry began in the 1830's and even more rapid growth followed the abolishment of the export ban of British machinery. The mechanization of the spinning industry in the 1830's relied heavily on the imports of English spinning machines. Earlier growth of the industry in the 1820's was rather due to the cheap price of English cotton yarn and the high import tariff on cotton cloth than to the mechanisation of the industry.[138] Significant cotton-spinning

[137] Blackwell 1970, 39-40, 42.
[138] Blackwell 1970, 44; Aer 1995, 40.

enterprises were established in Russia by Stiegliz, Maltsev and the Russian Cotton Spinning Company in the 1830's, and these establishment were mostly equipped with Belgian, Russian, and especially British machinery after the lifting of the export ban.[139] Cotton manufacturing was mechanizing rapidly compared to other industries. New techniques were adopted, and in general the mechanical spinning spread considerably in the late 1830's.[140]

The increase in the machinery imports to the Russian Empire in the 1830's thus indicates the growing mechanisation of Russian factories, and thus, the increasing need for new machines. From the data it is easy to conclude that at least by the 1830's the significance of Western technology was recognized in the Russian Empire either by local or foreign entrepreneurs. Also, the lifting of the export ban of British machinery presumably accelerated the imports of machinery in the 1840's and remarkable technological projects such as the building of the railways influenced the demand for the machinery. Even though there was not substantial Western-like industrialisation or technological change in the Russian Empire in the early 19th century, some efforts for the mechanisation of production were made. In addition, increasing machinery imports towards the end of the period of this study indicates that local production of industrial machinery did not gain ground significantly in the Russian Empire during the early 19th century.

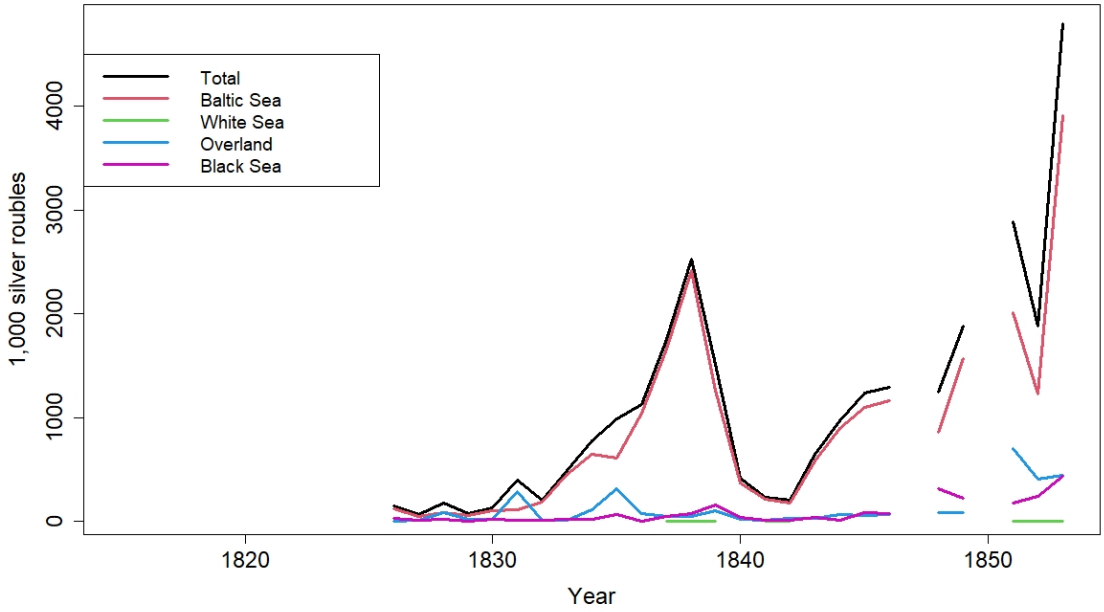
5.3. Trade routes

The inspection of the machinery trade between the Baltic Sea and the Northern Europe proved that the ports of the Russian Empire were recorded as the destination for over 50 per cent of the ships that were carrying machines in their cargos. From the perspective of the Russian Empire, the Baltic Sea was also the dominating route for the machinery imports as figure 6 shows. According to the foreign trade statistics of the Russian Empire, machinery imports carried through the Baltic Sea covered roughly from 80 to 90 per cent of total machinery imports to Russia. In 1831 however, the relative significance of the overland routes exceeded the significance of the Baltic Sea in machinery imports. The shares of these two alternatives from total amount of machinery imports seem to draw

[139] Blackwell 1970, 387.
[140] Aer 1990, 38.

almost symmetrical figures throughout the early 19th century as figure 7 demonstrates. This implies that the two main routes were substitutive for each other to some extent. The routes through the White Sea and the Black Sea represent merely a marginal compared to the Baltic Sea and overland routes.

FIGURE 6. THE ROUTES OF MACHINERY IMPORTS TO RUSSIA 1815-1853[141]



Source: Russian Empire Foreign trade statistics (rus. Государственная внешняя торговля в разных ее видах) years 1826–1853

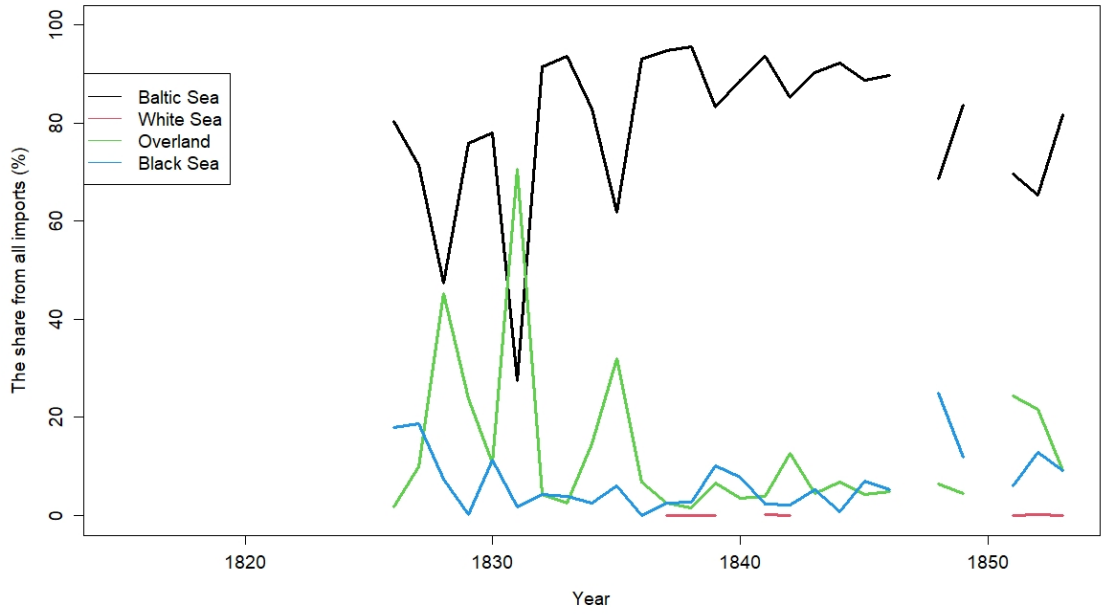
In the early 19th century, overland routes were undoubtedly inefficient option for transporting such capital goods as machinery. However, sea routes were not always the safest or in other ways unproblematic. According to Yuta Kikuchi, the alternative trading routes to shipping were usually selected according to the nature of the commodities transported. Also, shipping was strongly affected by seasonality, and thus, overland routes were more suitable especially during winters. Whenever traffic by sea became challenging, the overland alternative became a considerable option.[142]

It is challenging to examine the overland routes to Russia any further, for the information on the imports by the overland routes is collected in the customs offices in the borders of

[141] Original collections of Russian foreign trade statistics were only available online from the year 1826 at www.elib.rgo.ru.
[142] Kikuchi 2018, 101, 109, 111.

the Russian Empire, and the imports of unspecified machines and devices are presented in summarized tables in the official foreign trade statistics. It could be assumed, however, that the overland routes were more suitable for machinery trade only if the shipping by the sea was simply too difficult for some reason, and if the distances of this overland trade were short. In the early 19th century, the volume of the machinery imports was altogether rather modest compared to the total imports of the Russian Empire. When the machinery trade grew substantially in the 1840s and afterwards, the role of overland routes decreased to around ten per cent.

FIGURE 7. THE SHARES OF THE DIFFERENT ROUTES OF MACHINERY IMPORTS TO RUSSIA 1815-1853



Source: Russian Empire Foreign trade statistics (rus. Государственная внешняя торговля в разных ее видах) years 1826–1853

The Baltic Sea was also the most straightforward route from Britain to Saint Petersburg. Saint Petersburg was the most important seaport of the Russian Empire in the early 19th century and a significant manufacturing centre in the Russian Empire where the major Russian machine and cotton spinning industries were concentrated in.[143] It was also highly favoured by foreign entrepreneurs. British industrialists, among others, eagerly established manufacturing plants in the city and applied modern production methods from

[143] E.g. Blackwell 1970, 110; Falkus 1972, 38.

the West.[144] By the influence of the foreign industrialists, the city of Saint Petersburg was one of the most rapidly industrialising regions in the Russian Empire in the early 19th century, which made it a favourable destination for machinery imports, as the local production of machinery did not satisfy the needs of the mechanising industries.

As it is already mentioned, most of the machinery shipments departed from a British port and were heading to a port belonging to the Russian Empire during the early 19th century. According to STRO, the most frequent trade route for the machinery shipments went from Kingston Upon Hull to Saint Petersburg. Over 22 per cent of all machinery shipments went through this route. Also, the route from Antwerp to Saint Petersburg stands out in the data. In general, the routes for the machinery shipments were rather recurrent as seven most frequent trade routes in table 5 cover over half of all machinery shipments. Other routes cover slightly over 40 per cent of all shipments and they seem more occasional as merely seven or less machinery shipments were carried through each of these routes between 1815 and 1853.[145]

In the machinery shipments to Russia, British ports were rather well represented as ports of departure throughout the whole period compared to others as figure 8 shows. Those few machinery shipments that were bound to Russia in the first decades of the 19th century mostly departed from a British port. In some exceptions, machinery exports from Britain were possible despite the export ban of British machinery before 1843. Steam engines and machine tools, for example, were exported under special licence.[146] Machinery imports from Belgian ports became more frequent in the 1830's and their volume remained below ten shipments annually towards the early 1850's. The substantial increase in the machinery imports in the 1840's seems to be mostly due to the increasing number of machinery shipments especially from British ports. In addition, the number of machinery shipments from Dutch, German, French, and American ports were rather marginal and to some extent occasional according to STRO data.

The role of German ports, however, must not be neglected as they are located both in the North Sea and in the Baltic Sea. Only the ports in the North Sea are represented here as

[144] Blackwell 1970, 249-257; Stearns 2007, 92.
[145] For all routes between the ports, see Appendix VI.
[146] Landes 1969, 148.

ports of departure for machinery shipments to Russia. It is possible and likely that the machinery trade between German ports and Russia was more important than the data suggests. It is more likely that most of the trade between German and Russian ports was carried through the ports within the Baltic Sea. Evading the Danish Sound means that all possible machinery imports from Germany, or from other country in the Baltic Sea, cannot be detected in the Sound Toll Registers. Those few machinery shipments from Germany to the Baltic Sea, that were detected from STRO, came from Hamburg that has direct access to the North Sea. In these cases, it is presumable that it was simply more beneficial to transport these machines through the Danish Sound and to pay the customs, than to transport them first through overland routes to, for example, the port of Lübeck in the Baltic Sea and then to the overseas destination.

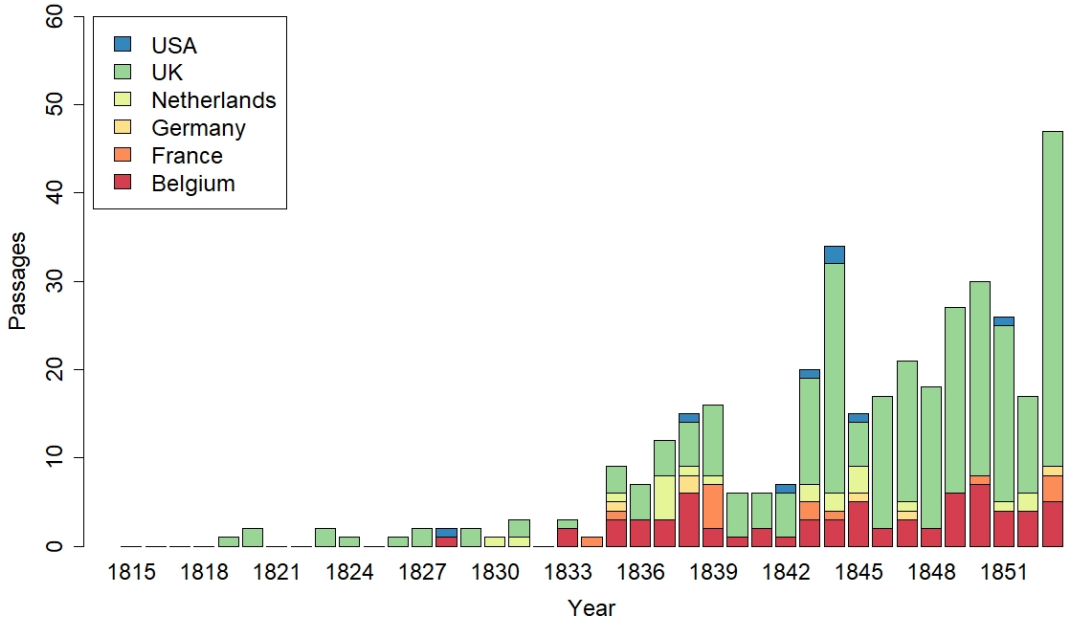
The data from STRO suggests that there was some concentration in the routes for machinery imports to the Russian Empire. Almost 60 percent of all machinery shipments to the Russian Empire followed a route either from Britain, Belgium, or Netherlands to the ports of Saint Petersburg, Kronstadt, Riga or Narva. The route from Kingston upon Hull to Saint Petersburg was still the most dominant one. Of course, as it is mentioned this apply only for the trade between the Northern Europe and the Baltic Sea as the trade within the Baltic Sea cannot be detected in STRO.

TABLE 4. THE MOST FREQUENT ROUTES FOR MACHINERY SHIPMENTS TO RUSSIA 1815-1853

From	To	Freq	Share
Kingston upon Hull	Saint Petersburg	88	22.2 %
Antwerp	Saint Petersburg	39	9.8 %
Liverpool	Kronstadt	18	4.5 %
Liverpool	Saint Petersburg	17	4.3 %
Antwerp	Riga	17	4.3 %
London	Saint Petersburg	14	3.5 %
Kingston upon Hull	Riga	12	3.0 %
Rotterdam	Saint Petersburg	11	2.8 %
Kingston upon Hull	Narva	10	2.5 %
Newcastle	Kronstadt	8	2.0 %
Others		162	40.9 %
Total		396	100.0 %

Source: STRO

FIGURE 8. THE SHARES OF THE PORTS OF DEPARTURE 1815-1853



Source: STRO

In summary, the Baltic Sea was the main road for the machinery imports to the Russia in the early 19th century. Britain was clearly the main exporter of the machinery and the main trade road for the machinery shipments went from the port of Kingston upon Hull to Saint Petersburg and Kronstad. The main destinations for machinery shipments were at the same time the most active trading ports of the Russian Empire. Thus, the data does not indicate any special structure for machinery trade that would be distinguishable from other trade in general. British machinery construction was also concentrated in some of the most frequent ports of departure or in the very hinterland of these ports.

5.4. Shipmasters

The shipmasters behind the machinery imports to Russia are examined to find out if there was any specialization in the shipping of machinery. According to STRO, most of the shipmasters included in machinery imports to Russia had their home port in Britain. Almost 60 per cent of all machinery shipments to Russia were transported by a British shipmaster. The most frequent home port recorded for the shipmasters was Kingston Upon Hull. Ten most frequent home ports of the shipmasters were recorded for slightly

over 50 per cent of all machinery shipments to Russia and, as table 5 shows, eight of ten most frequent home ports are British. Among these most frequent home ports are the port of Papenburg in Germany and the port of Rotterdam in Netherlands.[147]

It seems that the shipmasters included in the machinery shipments to Russia were mainly from the same regions where the machines were departed. However, the role of German shipmasters differs substantially from the role of German ports of departure or destination in the machinery trade. As mentioned before, German ports within the Baltic Sea cannot be detected in STRO, and thus, the role of German ports in the machinery imports to Russia in general cannot be concluded by solely using the data from STRO. It seems, however, that German shipmasters were relatively active in transporting machinery. Belgian ports on the other hand are not well represented as the home ports of the shipmasters even though the port of Antwerp was the second most important port of departure for machinery shipments to Russia.

TABLE 5. THE HOME PORTS OF THE SHIPMASTERS IN STRO

Port	Freq	Share
Kingston upon Hull	83	22.4 %
Dundee	26	7.0 %
Newcastle	18	4.9 %
Papenburg	13	3.5 %
Leith	12	3.2 %
Sunderland	9	2.4 %
Goole	8	2.2 %
Montrose	8	2.2 %
London	7	1.9 %
Rotterdam	7	1.9 %
Others	179	48.4 %

Source: STRO

Russian ports are almost as well represented in the data as the home ports of the shipmasters as Dutch ports. Even though Russia did not have considerable merchant fleet of its own, it seems that shipmasters from Estonia, Lithuania and Latvia were included in the machinery trade to some extent. Russian shipmasters had their home ports mostly in Saint Petersburg and Archangelsk. Finland is considered here as a separate part of the Russian Empire and Finnish shipmasters are relatively well represented in the data.

[147] For all home ports of the shipmasters, see Appendix VII.

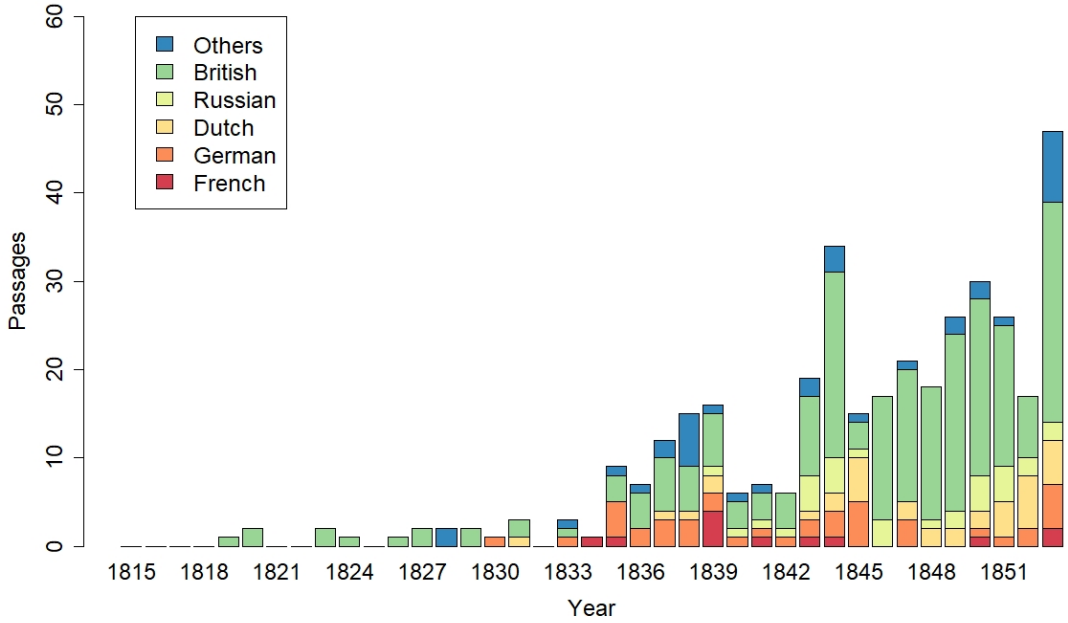
Finnish shipmasters transported machines more frequently than the shipmasters from Saint Petersburg and Archangelsk together.[148] The role of Finnish shipmasters in the foreign trade of the Russian Empire is not surprising as most of the ships under the Russian flag were owned by Finns or Greeks in the end of the 1840's.[149]

Most of the shipmasters included in machinery imports to Russia had their home port either in the Baltic Sea region or in Western Europe. However, some of the home ports located behind longer distances such as the ports in the United States or in Archangelsk. Eight shipmasters had their home ports in the United States, most of them in Boston. Each of these American shipmasters transported machinery to the Russian Empire only once during the period under investigation. Two shipmasters, C. Drichell and M. P. Melfs, had their home ports in Archangelsk. Drichell transported machinery from Antwerp to Riga in 1843[150] and Melfs transported a copying machine from Newcastle to Kronstadt[151].

British shipmasters were transporting machinery to Russia almost throughout the whole period from 1815 to 1853. After the substantial increase in the number of machinery shipments in the 1840's, the role of British shipmasters became even more significant, similarly to the role of British ports of departure. The role of other nationalities increased first in the end of 1830's, then again in the mid-1840's, and then again towards the mid-1850's. British shipmasters dominated the machinery imports to Russia which understandable as most of the imported machines were constructed in Britain and Britain was the most important trading partner of the Russian Empire in the early 19th century. Without a considerable merchant fleet of its own, Russia was depended on foreign merchant shipping.

[148] A total of ten machinery shipments to Russia were transported by a Finnish shipmaster as Russian shipmasters transported seven.
[149] Blackwell 1970, 82.
[150] STRO passage id: 1378261
[151] STRO passage id: 1456404

FIGURE 9. THE NATIONALITY OF THE SHIPMASTERS IN STRO 1815-1853



Source: STRO

Despite the dominating role of the British shipmasters in the machinery imports to the Russian Empire, there was not recognizable specialization in transporting machinery among the shipmasters. Regarding the machinery imports to Russia, a total of 371 shipments had their shipmaster specified in STRO. As table 6. shows, ten most frequent shipmasters transporting machinery cover merely seven per cent of all machinery shipments. Almost 90 per cent of the shipmasters transported machinery only once during the period between 1815 and 1853. Most frequently participating in the machinery imports to Russia was A. Donaldson from Kingston Upon Hull. Donaldson transported machinery seven times from Kingston Upon Hull to Saint Petersburg between 1840 and 1853. Second most frequent shipmaster participating in the machinery imports to Russia was J. Young from Dundee. Young transported machinery three times from Dundee to Libau between 1841 and 1846. Apart from these two, only fourteen shipmasters in the data transported machinery twice and all others had machinery in their cargos only once during the period under investigation.[152]

[152] For the list of all shipmasters, see Appendix VIII.

TABLE 6. THE MOST FREQUENT SHIPMASTERS TRANSPORTING MACHINERY TO RUSSIA 1815-1853

Shipmaster	Homeport	Freq	%
A. Donaldson	Kingston upon Hull	7	1.9 %
J. Young	Dundee	3	0.8 %
D. Pepper	Goole	2	0.5 %
G. Harrison	Kingston upon Hull	2	0.5 %
J. Bell	Kingston upon Hull	2	0.5 %
J. J. Priest	Kingston upon Hull	2	0.5 %
J. Wharton	Kingston upon Hull	2	0.5 %
L. S. Pinksterboer	Veendam	2	0.5 %
R. Duncan	Dundee	2	0.5 %
S. Duncan	Leith	2	0.5 %
Others		345	93.0 %

Source: STRO

According to STRO, A. Donaldson was closely participating in the trade with Russia in general, not merely in the machinery trade. There are 105 entries in STRO for shipmaster A. Donaldson from Kingston upon Hull between 1820 and 1853. Over 90 per cent of Donaldson's shipments occurred between Kingston Upon Hull and Saint Petersburg. Thus, the seven shipments of unspecified machinery represent merely a fraction of all Donaldson's shipments. Donaldson transported mostly commodities such as cotton yarn, cotton, steel, woollen yarn, and unspecified merchant goods (dan. kjøbsmanskaber) from Kingston upon Hull to Saint Petersburg. Most common commodities transported from Saint Petersburg to Kingston upon Hull were hemp, tallow, linseed, planks for ships, and flax.[153]

In summary, the home ports of the shipmasters participating in machinery imports to Russia were concentrated strongly in Britain. There was not, however, any recognizable specialization in transporting machinery among individual shipmasters. The home ports of the shipmasters were mainly located in the same places as where the machinery had departed, except for the German shipmasters who were well represented in the data despite of the obvious lack of German ports as ports departure for machinery shipments. Ships carrying machinery to the Russian Empire were participating in Russia's foreign trade already in broader extent, as the case of Donaldson proves. Thus, there is no

[153] Further details on A. Donaldson were derived from soundtoll.nl and were not included in the dataset compiled for this study as it contains merely the machinery shipments.

evidence that transporting machinery was a field of speciality in Baltic shipping in the early 19th century.

6. NON-PARAMETRIC COMPARISONS

As it is mentioned above, not much can be said about the machines detected in STRO, apart from the cargo description and the unit of measurement. Cargo descriptions have proved to be practically useless for studying the nature of imported technology. However, some implications can be made regarding the values of the machinery cargos as most of them have their unit of measurement in riksdalers. It is possible, for example, to examine the dispersion of the values of the machinery cargos in riksdalers and take a step towards more comprehensive understanding of machinery imported to Russia and how different factors affect the values of the machinery cargos.

For the following examination of the values of machinery cargos in STRO, the dataset has been fixed to contain machinery unambiguously. This is necessary as some of the entries of the machinery cargos are combined with other commodities such as miscellaneous goods. For example, J. Suerken from Papenburg transported machinery and miscellaneous trading goods (dan. Maskinerier og kjøbmandsvarer) worth together 15,888 riksdalers from Antwerp to Kronstad in 1844.[154] D. Webster from Dundee transported machinery with bricks worth together 6,561 riksdalers in 1843.[155] By the exclusion of the combined entries, the riksdaler values in the dataset should refer only to unspecified machinery cargos and not to other commodities. Still, the general picture remains similar enough as over 75 per cent of the entries refer only to machinery. This modification of the dataset outlines the possibility that other miscellaneous goods among machinery would twist the results.

First in this section, the main features of the values of the machinery cargos detected in STRO are described. Then, a non-parametric Kruskal-Wallis rank sum test is performed to find out if there is significant differences between the values of the machinery cargos according to the ports of departure, and to the home ports of the shipmasters. The Kruskal-

[154] STRO passage id: 1397195.
[155] STRO passage id: 1396812.

Wallis test should indicate if at least one of the compared groups is significantly different from others. The non-parametric Kruskal-Wallis test is applied here as the test samples do not fulfil the assumptions of the equivalent parametric tests.[156] Boxplot figures are used to visualize the differences of the dispersions of different groups as they show efficiently the medians, upper and lower quartiles as well as the maximum values of each group of the sample.

6.1. The values of the machinery cargos in STRO

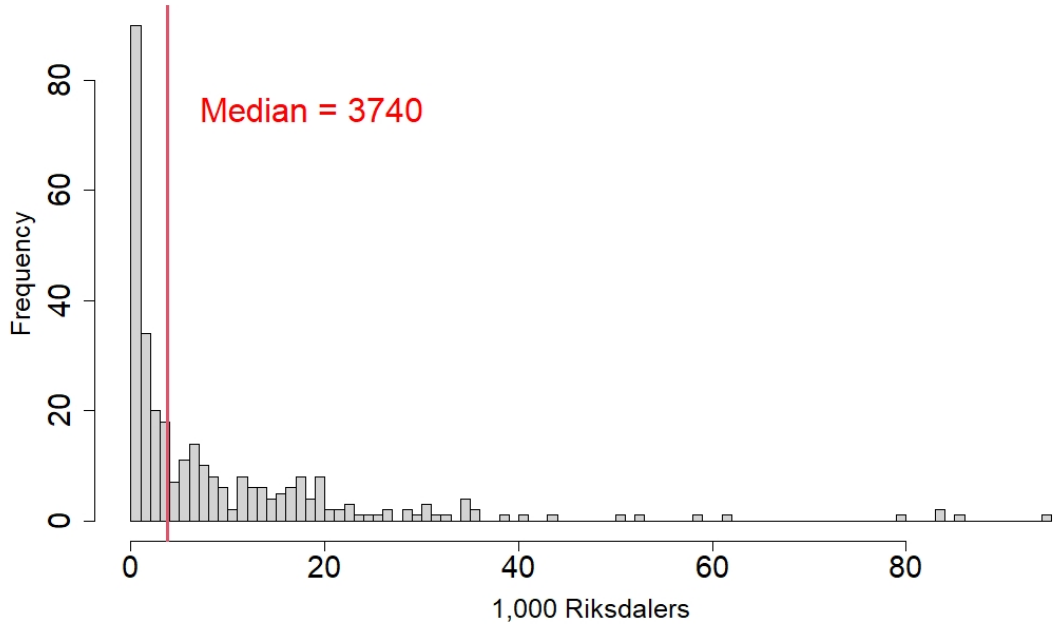
In the fixed dataset, the values of the machinery cargos transported to Russia between 1815 and 1853 varied from ten riksdalers to 94,388 riksdalers. In two cases the transported machinery was worth only 10 riksdalers. Shipmaster A. P. Rønning from Reval (present day Tallin) transported a sawing machine[157] worth 10 riksdalers from Newcastle to Reval in September 1844.[158] J. Vanselow from Danzig transported a box, as it is described in the registers, of machinery worth 10 riksdalers from Liverpool to Saint Petersburg in August 1853.[159] The most valuable cargo of machinery was transported by L. Grotrian from Saint Petersburg. Grotrian transported machinery worth 94,388 riksdalers from London to Saint Petersburg-Kronstadt region in October 1844.[160] The median value for all machinery cargos in the fixed dataset is 3,740 riksdalers which implies that the values are generally centred on lower values and machinery cargos worth over 40,000 riksdalers are rather exceptional as can be seen in the histogram in figure 10.

It is impossible to speculate the value of a single machine when the machines are recorded in plural as in the cases of Vanselow and Grotrian. The case of Rønning represents an example where cargo presumably contains only a single unspecified machine and the value of the machine in riksdalers can be defined. In Vanselow's shipment, an alternative

[156] Most of the test samples are not normally distributed according to the Shapiro-Wilk normality test that was performed with R. The Shapiro-Wilk normality test and the Kruskal Wallis test results are summarized in Appendix IX.
[157] dan. sav maskin. In the database, the commodity was spelled as "saai maskin". With the help of the original page of the register and Danish Ordbok Over Det Danske Sprog (ordnet.dk), the transported commodity is considered as a sawing machine by the author.
[158] STRO passage id: 1418172.
[159] STRO passage id: 1595624.
[160] STRO passage id: 1419298.

unit of measurement is mentioned. Boxes[161] and other similarly vague units of measurement help to concretize the cargos containing machinery to some extent. Unfortunately, the alternative units of measurement are recorded only in a few cases, such as in Vanselow's case. Thus, the most precise method for the examination of the machinery might be considering them simply as "cargos".

FIGURE 10. HISTOGRAM OF ALL VALUES OF MACHINERY CARGOS TRANSPORTED TO RUSSIA 1815-1853



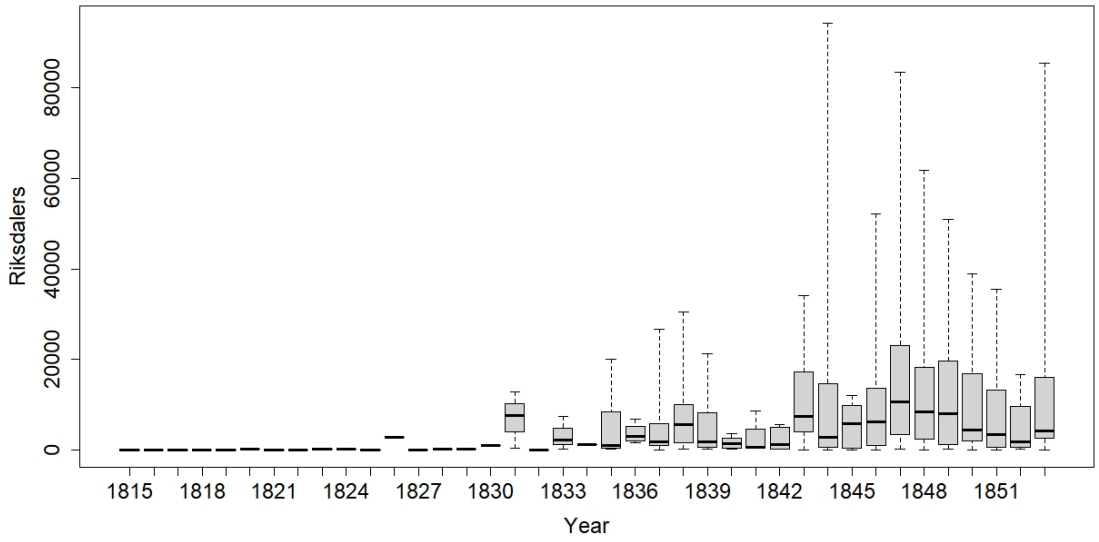
Source: STRO

In general, the overall dispersion in the values of the machinery cargos increased during the period under examination. As the number of shipments, the dispersion in the values is modest in the 1810's and 1820's. Of course, the annual figures of the values before the 1830's is practically non-existent as there were only a few machinery shipments in general. When the shipments became more frequent, the dispersion of values of the machinery cargos increased as well, and more expensive cargos were shipped. Despite the obvious increase in the dispersion of the values from the 1830's onwards, the annual median value of the machinery cargos remains rather stable throughout the whole period. In the 1840's the extreme values, such as the value of the machinery carried by Grotrian

[161] dan. Kister.

in 1844, begin to appear, but most of the machinery cargos were still worth below 20,000 riksdalers. The median values of the machinery cargos seem to slightly increase in the 1840's and decrease towards the early 1850's. Also, the number of the machinery shipments to Russia according to STRO decreased at the same time. Apart from the high volume of machinery imports to Russia in the 1840's, it seems that the cargos were relatively more valuable in the same decade. Decreasing volume of the machinery imports in the early 1850's, on the other hand, meant also relatively lower values of the machinery cargos.

FIGURE 11. THE DISPERSION OF THE VALUES OF THE MACHINERY CARGOS TRANSPORTED TO RUSSIA 1815-1853



Source: STRO

6.2. Comparison between the ports of departure

In the first performance of the Kruskal-Wallis rank sum test, the test groups were formed by the national framework. The Kruskal-Wallis test requires five or more observations for each test group and thus the ports of departure had to be combined by a common factor which, in this case, would be the national framework. The six test groups are Belgian ports (n=47), French ports (n=11), German ports (n=6), Dutch ports (n=17), British (n=225), and the ports from United States of America (n=7). Each of these groups has five or more observations. However, the groups are highly unbalanced as there were over 200 machinery shipments from British ports and, for example, six from German ports and

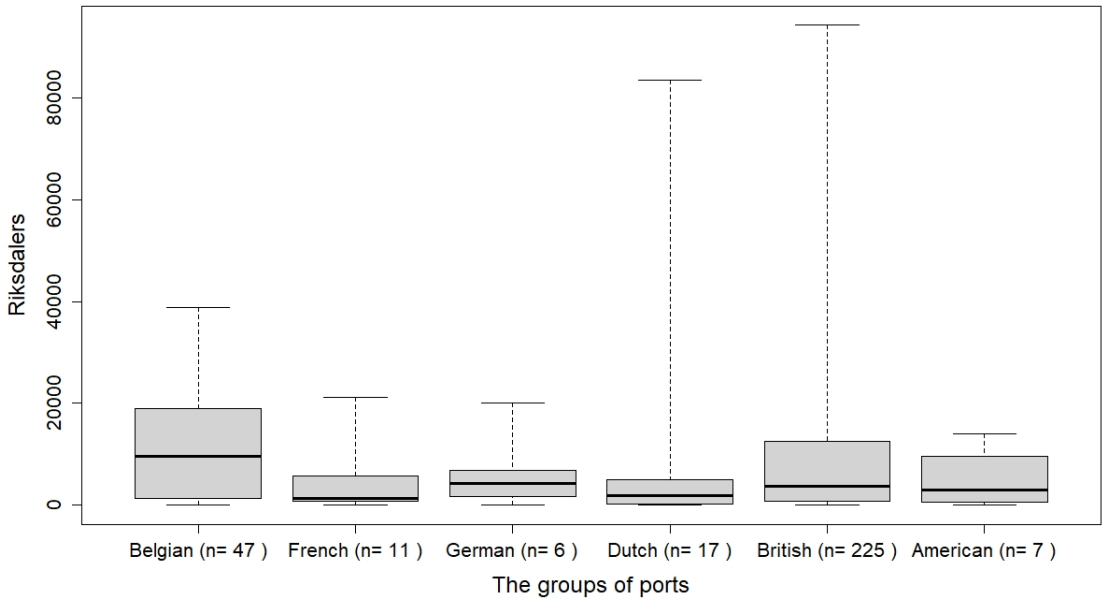
seven from the ports of the United States. Despite that the balance between the samples is not required in the applied test statistics, the unbalance needs to be noted in the interpretation of the results.

The null hypothesis of the test suggests that there are no significant differences between the compared groups. According to the results of the first performance of the Kruskal-Wallis test (chi squared= 8.8336, df = 5, p-value = 0.1159), the null hypothesis is not rejected as the p-value is higher than the critical value of 0.05, and thus, there is no evidence of significant differences between the groups. None of the compared groups has relatively higher or lower values of the machinery cargos.

The median values of the machinery cargos transported from different countries to the Russian Empire vary from 1,334 riksdalers in French ports to 9,523 riksdalers in Belgian ports. It can be interpreted from the boxplots in figure 12 that the median values of each port groups are practically on the same level. However, it seems that slightly more valuable machinery cargos were transported from Belgian ports to Russia. The median value for machinery cargos transported from Belgian ports seems to be on higher level compared to others, even though there are no statistically significant differences between the groups.

Even though the median values of each group remain below 10,000 riksdalers, the spread of the values is rather different between the groups. The maximum values of the machinery cargos vary from 14,035 riksdalers in American ports to 94,388 riksdalers in British ports. Dutch ports represent another example of exceptionally high value of 83,574 riksdalers. These higher values clearly stand out in the data, but as it can be interpreted in the boxplots in figure 12, they are rather exceptional in the data. Most of the values of the machinery cargos transported to Russia remain below 20 000 riksdalers. Also, the shapes of the boxplots in figure 12 indicate that the values are strongly concentrating on lower values as the lower tails are practically non-existent.

FIGURE 12. THE DISPERSION IN THE VALUES OF THE MACHINERY CARGOS GROUPED BY THE COUNTRY OF ORIGIN



Source: STRO

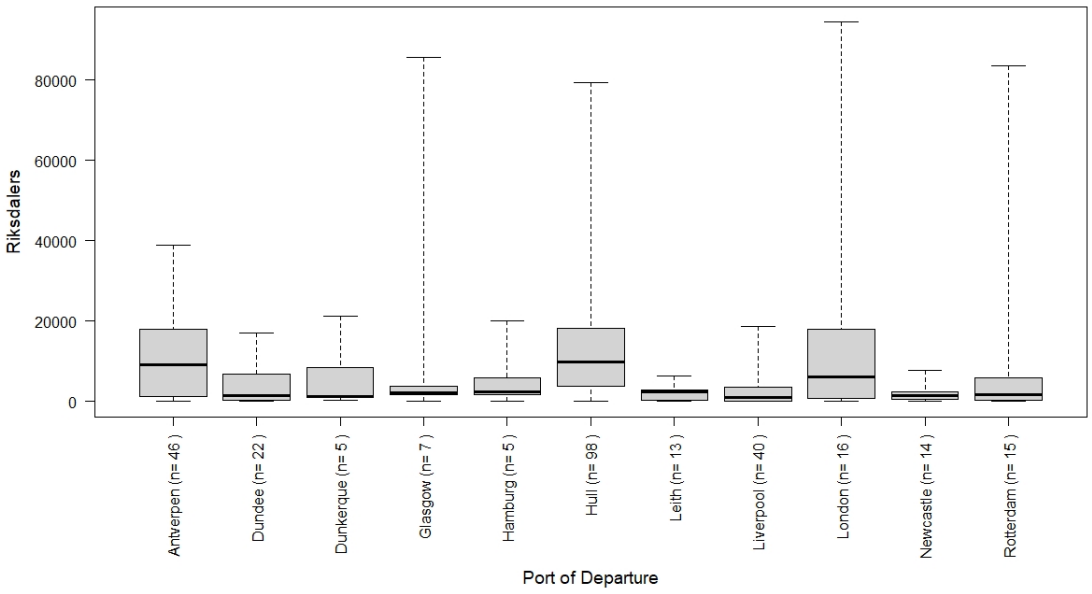
It seems that the machinery cargos transported from Belgian ports to the Russian Empire were more valuable in average compared to other groups of ports. However, the Belgian ports in the dataset consist of only the port of Antwerp with 46 shipments and Gent with only one shipment of machinery departed, and the national perspective might thus be misleading to some extent. Still, the most valuable machinery cargos departed from British ports and the number of the cargos is also substantially higher compared to other groups. The number of British ports participating in the machinery exports was also the highest compared to others.

Due to the imbalance between the number of ports between different nationalities, it might be necessary to move the inspection from the national level to more local level. Comparison between the individual ports of departure provides further information on the significance of these ports to the values of the machinery imports. The second Kruskal Wallis test was performed to discover significant differences between the ports of departure that have five or more observations of departed machinery shipments. The ports to be compared were Antwerp (n=46), Dundee (n=22), Dunkerque (n=5), Glasgow (n=7), Hamburg (n=5), Kingston upon Hull (n=98), Leith (n=13), Liverpool (n=40), London

(n=16), Newcastle (n=14), and Rotterdam (n=15). The null hypothesis suggests again that there are no significant differences between the groups.

According to the results of the second test (chi-squared = 55.506, df = 10, p-value = 2.541e-08) the null hypothesis can be rejected as the p-value is substantially below the critical value of 0.05. Thus, the test suggests that there are significant differences between the ports of departure. The inspection of the boxplots of each port in figure 13 reveals that there are three ports of departure that have distinguishable median values. It seems that machinery cargos that departed from Antwerp, Kingston upon Hull, and London were more valuable on average than the cargos that departed from other ports in this sample.

FIGURE 13. THE DISPERSION OF THE VALUES OF THE MACHINERY CARGOS GROUPED BY THE PORT OF DEPARTURE



Source: STRO

From the Krukal-Wallis tests performed, one could conclude that there are no significant differences between the ports of departure on national level, but when the ports are compared directly with each other, the differences become more evident. As the machine construction was geographically relatively concentrated in Britain, it is natural that some ports exported more machinery than others. In this case, it was the main ports of Britain that exported the most valuable cargos of machinery to Russia.

6.3. Comparison between the home ports of the shipmasters

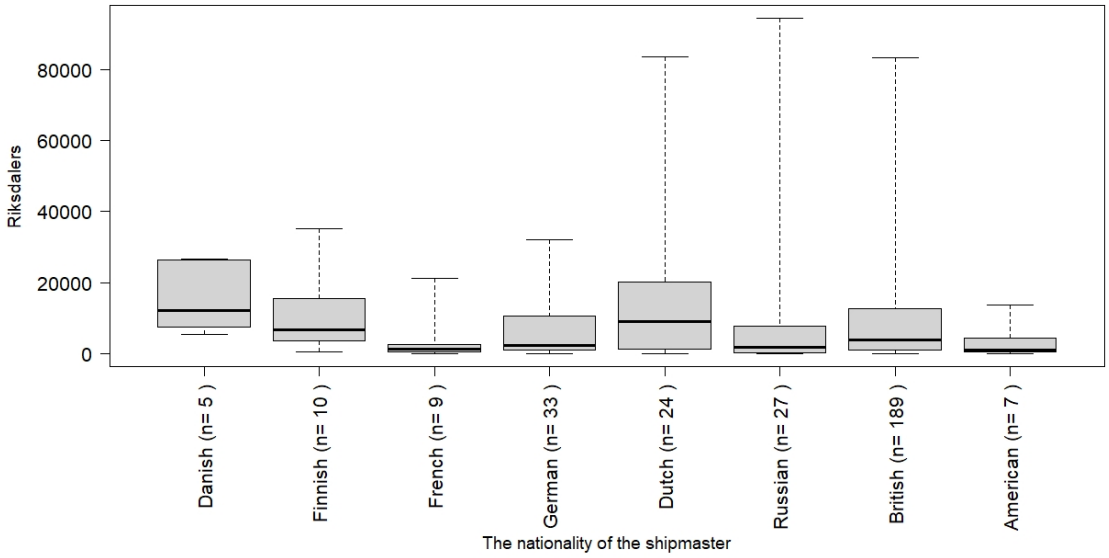
As for the ports of departure, the values of the machinery cargos can be compared to each other according to the home ports of the shipmasters. Once again, the Kruskal-Wallis rank sum test was performed to reveal possible differences between the groups of the values of machinery cargos. Significant differences between the groups would suggest that shipmasters of certain nationality would have transported systematically more or less valuable machinery cargos compared to others. As in the previous test. The null hypothesis suggests that there are no significant differences between the groups. The groups were formed by the presumed nationality of the shipmasters according to the geographical location of their recorded home port. The comparable groups were Danish (n=5), Finnish (n=10), French (n=9), German (n=33), Dutch (n=24), Russian (n=27), British (n=189), and American (n=7) home ports of the shipmasters.

Kruskal-Wallis rank sum test results (chi-squared = 18.431, df = 12, p-value = 0.1032)[162] indicate that there are no significant differences between the groups as the p-value exceeds the critical value of 0.05. Thus, the null hypothesis is not rejected. None of the nationalities of the shipmasters stands out in the data as a transporter of significantly more or less valuable machinery cargos than others.

The spread of the boxplots in figure 14 shows some variation between the nationalities of the shipmasters. The most valuable machinery cargo of 94,388 riksdalers was transported by a Russian shipmaster L. Grotrian from Saint Petersburg who has been already mentioned above. Machinery cargos of relatively high value were transported also by Dutch and British shipmasters. Still, most of the machinery cargos were worth below 20 000 riksdalers. Despite that the groups are highly unbalanced, no significant conclusions can be made regarding the dependence of the values of machinery cargos on the nationality of the shipmaster. As in the comparison of the ports of departure, the nonexistence of the lower tails in the boxplot figures indicate that, again, the values are concentrated on lower values.

[162] Kruskal-Wallis rank sum test is executed with R environment. R provides exact p values.

FIGURE 14. THE DISPERSION OF THE VALUES OF THE MACHINERY CARGOS GROUPED BY THE HOME PORT OF THE SHIPMASTER



Source: STRO

Non-parametric Kruskal-Wallis test results indicate that the values of the machinery cargos in riksdalers are not depended on the assumed nationality of the shipmaster or on the place of loading of the cargo on national level. Statistically speaking, the values seem to originate from the same population. However, the differences become evident when the values are compared between the individual ports of departure. Certain ports stand out with relatively higher median values of machinery cargos departed. Still, interpretations can be made from the boxplots of the values of machinery cargos even though the test results would not indicate significant differences. There is an essential difference between statistical and historical significance. Here the non-parametric tests proved useful as they confirm, in certain performances, that the values are not from the same population. The highly unbalanced sample sizes in the comparisons require still specific evaluation of the historical significance. This evaluation mainly made the second performance of the Kruskal-Wallis test interesting.

7. CONCLUSION

The main purpose of this thesis was to utilize the relatively novel source material of the Sound Toll Registers Online for the study of machinery imports to the Russian Empire between 1815 and 1853. The data for the analysis was derived from the online database and modified for the special requirements of this study. The foreign trade statistics of the Russian Empire were used to add some aspects to the analysis of the machinery imports that could not be captured with STRO. These two source materials were used for the analyse of the general development and structure of machinery imports to the Russian Empire. The selection of the geographical focus of this study was also justified by indicating the relative importance of the Russian Empire as a receiver of machinery in the Baltic Sea region.

In general, the number of the machinery shipments to the Baltic ports of the Russian Empire increased during the period as did the total value of machinery imports according to both STRO and official foreign trade statistics of the Russian Empire. The number of the machinery shipments was rather modest in the first decades of the 19th century but began to increase in the 1830's and especially in the 1840's after the lifting of the export ban of British machinery. As the literature suggests, there were at least modest mechanization in Russian industries, especially in the Saint Petersburg region, from the 1830's that would explain the growing demand for foreign technology. The mechanization of the Russian industries was initially mostly due to the influence of foreign entrepreneurs. Machinery shipments were transported almost annually to the Baltic ports of the Russian Empire. Machinery imports were also influenced by international economic crises that affected on the imports in general as can be seen at the turn of the 1840's and early 1850's.

Machinery imports to the Russian Empire between 1815 and 1853 do not show any significant signs of a special trade structure that could be separatable from other trade. The most common trade routes for machinery were the same routes for Russian foreign trade in general. It is evident that machinery was mostly imported to the Russian Empire through the Baltic Sea. The foreign trade statistics of the Russian Empire show that there are records of machinery imported through overland routes or through the southern ports of the Empire in the Azov and Black Seas, but the value of the machinery imported

through these routes was rather marginal compared to the value of machinery imported through the Baltic Sea.

Unquestionably, most of the machinery shipments departed from Britain. The most important route went from the port of Kingston upon Hull to Saint Petersburg which represent two significant trading ports for the Baltic trade in general. Most of the machinery that was transported to Russia was loaded in the ports of Britain, Belgium, and Netherlands. The countries that industrialized relatively early exported most of the machinery to Russia. These countries, especially Britain, had developed their machine construction industry to the level that could not face serious competition in the other parts of the European continent.

Machinery imports to the Russian Empire did not show considerable specialization among the shipmasters. Most of the shipmasters transported machinery in their cargos only once during the period under examination. Machinery was mainly transported to Russia among other more common products by the shipmasters that were already participating in the trade with Russia. Most shipmasters, that transported machinery to Russia, had their home ports in Britain. Thus, data gathered from STRO suggests that Britain mostly dominated the machinery imports to Russia in the early 19th century. The results seem plausible, and thus, it is justifiable to argue that with proper methods STRO can be used for the study of machinery trade.

The indisputable strength of STRO is that it can be used for both macro and micro level examination of machinery imports in various ways. Descriptive analysis of the number of the machinery shipments and the frequency of trade routes was accomplished with relative ease by using the data from STRO. Apart from the macro level analysis, the data enabled making references to individual shipmasters and their cargos. However, as a fiscal source material STRO has its shortcomings with the descriptions of the cargos. Machinery is an example of miscellaneous group of products that is not described in further detail in the original registers. It is practically impossible to study the nature of the machines any further without additional source material. More descriptive entries of the machinery such as “steam engine” or “chopping machinery” can be detected in STRO but merely as exceptional cases. The targets of this study had to be broadened from “machinery” to more abstract “cargoes of machinery” as different machines could not

have been separated in the records. Such method enables macro level examination of the movement of the cargos containing machinery between different locations on different sides of the Danish Sound.

A step closer to a further understanding on the factors affecting the machinery cargos was taken by the comparison of the values of these cargos in riksdalers. Most valuable machinery cargos were transported from Britain. The number of the machinery cargos transported from Britain and by British shipmasters was also the highest. Despite of the British domination, the values of the machinery cargos were not systematically different on average between different countries of departure or between the nationalities of the shipmasters. However, statistically significant differences were detected between the individual ports of departure, which implies that the values of the machinery exports varied more on the local level rather than on the national level. The analysis proves that the values of the cargos detected in STRO can be utilized to some extend to provide further information on the nature of these cargos. However, in the case of unspecified machinery, it is difficult to make other than general conclusions based on the values of the cargos.

Cautious conclusions on the general patterns and development of machinery imports can be made by using STRO. Still, when studying machinery imports to Russia, it is obvious that STRO cannot capture all machinery that was imported. The role of German ports has been mentioned above. German ports in the Baltic Sea are understandably non-existent in the data as the ships sailing from these ports to Saint Petersburg or Kronstadt never passed the Toll. Also, according to Russian foreign trade statistics, overland routes had at least substitutive role for machinery imports to Russia especially in the early years of 19th century. Thus, it is impossible to capture the entire nature of machinery imports to Russia by using merely the data gathered from STRO. Additional source materials, such as the foreign trade statistics of the Russian Empire, are required for more comprehensive analysis.

This thesis is a demonstration of the potential of STRO in a study of the trade of a specific product. Russian foreign trade statistics provided useful context for the machinery imports as well as a comparison point for STRO. Without any attempts to make serious comparison between these two source materials, it can be said that they provide rather

similar interpretation of the general development of machinery imports to Russia. Both source materials have their strengths and shortcomings. What is common in both STRO and Russian foreign trade statistics, is that machinery is not specified any further. In macro level analysis on the flows of hardware technology, one must rely on the categorizations of unspecified machines and devices. Regarding machinery imports however, the categorization might be satisfying enough for the analysis of the macro level changes of volume and trade patterns. More detailed information on the imported machinery or the micro level mechanics of technology transfer would be the matters for further research. As an interpretation of the original source material, STRO still enables the inspection of the original scanned pages of the original registers. Of course, this is not possible with the Russian foreign trade statistics that are also a secondary source material as a compiled statistical work.

Regarding potential further research, the purpose of the data compiling method used here was to gather all necessary information on the machinery from STRO into one dataset. The dataset was based on the commodities in the cargos with diverse information that STRO has to offer. With more sophisticated information handling methods, the data from STRO could be applied for various forms of regression analysis, for instance. In this study, the potential of STRO was utilized mainly on descriptive level apart from the non-parametric comparisons of the values of the machinery cargos. Still, the difficulties with the unstandardized nature of the names of the commodities and ports remain when the data is downloaded from the online database. The standardization of the name data is also a matter for further information handling methods. On the other hand, the search engine of the online database in soundtoll.nl should be enough for a researcher to make conclusions for more exclusive research purposes of smaller scale.

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Appendices

Appendix I. The spellings of the “machines” in STRO

Spelling	Frequency
Maskinerie	142
Maskinerier	138
Maskineri	103
Machinerier	15
Maskiner	15
Maskinerie etc	15
Maskinerier etc	14
Maskinere	13
Maskineer	12
Maskineri etc	12
Maskine	9
Kjøbmandsvarer og maskineri	7
Kjøbmandsvarer og maskinerie	5
Machinerie	5
Mashinerier	5
Maskenerie	4
Maskinerer	4
Maskinier	4
Copiermaskine	3
Machine	3
Machiner	3
Maskeneri	3
Maskenerier	3
Maskindele	3
Maskinerie og kjøbmandsvarer	3
Palmolie og Maskeneri	3
Tærskemaskine	3
Copier maskine	2
Dampmaskine	2
En maskine	2
Machinerie etc.	2
Maskineer etc	2
Maskineerer	2
Maskineri og kjøbmandsvarer	2
Maskinerie og kjøbmandskaber	2
Maskinerier etc.	2
Maskinerier og bøger	2
Maskinerir	2
Maskinnerier	2
Maskinnier	2
Bademaskine	1
Ballast og maskinerier	1
Bedærvede karte og spindemaskindele	1
Blikplader og maskinerie	1
Cigarer og maskineier	1
Coginsmaskine	1
Copiemachine	1
Copiesmaskine	1
Dampmachinerie	1
Dampmaskiner	1
Dampmaskinerie m m	1
Dampskibe maskiner	1
Esemaskiner	1
Filtreremaskine	1
Filtvare maskiner steen	1
Filtveermaskiner	1
Hakkelse machine m m	1
Hakkelsemasken	1
Hakkelsemaskine	1
Hakkelsmaskine bio 44 Sp.	1
Hole og en kornrensnings maskine	1
Jern maskinere	1
Jernmaskinerier	1
Kastemaskinn	1
Kjøbmands varer og maskineri	1
Kjøbmandskaber og maskineerie	1
Kjøbmandsv maskinerier	1
Kjøbmandsv og maskineri	1
Kjøbmandsv og maskinerie	1

Kjøbmandsvarer i maskineri	1
Kjøbmandsvarer maskineri muursteen	1
Kjøbmandsvarer maskinerier	1
Kjøbmandsvarer og maskiner	1
Kjøbmandsvarer og Maskineri	1
Kjøbmandsvarer og maskinerier	1
Kjøbmanswarer og maskinerie	1
Kjobmandsvarer og maskiniri	1
Komrenesningsmaskiner	1
Kopiermashine	1
Kopiermaskine	1
Kormachines	1
Kornmachiner	1
Liniermaskine	1
Linierrmaskine	1
Machineri etc.	1
Machinerie og mahognitrae	1
Machinerie og minralvand	1
Machinerien	1
Machinerier etc	1
Machinerier og vin paa boutl etc	1
Machinner	1
Machinnerier etc	1
Mashine	1
Mashiner	1
Mashinerie og bøger	1
Maskenenier	1
Maskenere	1
Maskeneren	1
Maskeneri etc	1
Maskenerie etc	1
Maskenierer etc	1
Maskenirier	1
Maskin (1 stk)	1
Maskineer frÃ¸ etc	1
Maskineere	1
Maskineerer m m	1
Maskineerir m m	1
Maskiner etc.	1
Maskiner etc. retournerer	1
Maskiner og kjøbmandsv	1
Maskinere etc	1
Maskinere og kjøbmandsvare	1
Maskinere og kjobmandsvarer	1
Maskinere og tagsteen	1
Maskineri i kjøbmandsv	1
Maskineri kjøbmdv	1
Maskineri og C	1
Maskineri og farve	1
Maskineri og ildfs muursteen	1
Maskineri og kjøbmandskaber	1
Maskineri og kjøbmandsv	1
Maskineri og manuseritur varer	1
Maskineri og muursteen	1
Maskinerie etc.	1
Maskinerie møllesteen	1
Maskinerie og bøger	1
Maskinerie og bygningssteen	1
Maskinerie og bygningsteen	1
Maskinerie og file	1
Maskinerie og glasvarer	1
Maskinerie og minesteen	1
Maskinerie strendel	1
Maskinerien	1
Maskinerier a 1 1/4 %	1
Maskinerier bøger og karter	1
Maskinerier ildfaste muursteen og cement	1
Maskinerier og kjøbmandsvarer	1
Maskinerier og marmerarbeide	1
Maskinerier og muursteen	1
Maskinerier og vin paa bouteiller	1
Maskinerier tagsteen etc	1
Maskinerier tinn Kangmasker	1

Maskinerier uldkradford og bøger	1
Maskineriir	1
Maskinerin	1
Maskinerine	1
Maskinerrie	1
Maskinervin	1
Maskinevier	1
Maskinhjul	1
Maskinier m m	1
Maskiniri	1
Maskiniri etc	1
Maskinirie etc	1
Maskinneer	1
Maskinner	1
Maskinner etc	1
Maskinnere	1
Maskinneri	1
Maskintraad	1
Messing themaskiner	1
Muursteen indenlandske tampmaskiner etc. indenlandsk	1
Muursteen maskinerier	1
Muursteen og maskinerier	1
Papiermaskine	1
Proppemaskine	1
Raasemaskine	1
Saaerensnings maskine	1
Saai Maskine	1
Spindtmaskenirier	1
Stalkejord maskinerie	1
Tærske maskine	1
Thee machine	1
Tobaksmaskine	1
Vampmaskins	1
Vin bouteiller karter og maskine	1
Vin paa boutellier maskinner etc	1

Appendix II. Machinery shipments in STRO 1815-1853

Year	Bound to Russian ports	Bound to Baltic ports	All shipments bound to Baltic in STRO	Share of machinery shipments from all shipments bound to Baltic
1815	0	0	8952	0.000 %
1816	0	1	8966	0.011 %
1817	0	1	13272	0.008 %
1818	0	0	12816	0.000 %
1819	1	1	10956	0.009 %
1820	2	4	11133	0.036 %
1821	0	2	9377	0.021 %
1822	0	1	8662	0.012 %
1823	2	3	9407	0.032 %
1824	1	1	10775	0.009 %
1825	0	3	13386	0.022 %
1826	1	6	11421	0.053 %
1827	2	6	13322	0.045 %
1828	2	9	13509	0.067 %
1829	2	9	13728	0.066 %
1830	1	5	13395	0.037 %
1831	3	7	13181	0.053 %
1832	0	4	12396	0.032 %
1833	3	6	11252	0.053 %
1834	1	8	10939	0.073 %
1835	9	14	10680	0.131 %
1836	7	18	12207	0.147 %
1837	12	27	13515	0.200 %
1838	15	28	14379	0.195 %
1839	16	27	16649	0.162 %
1840	6	16	16173	0.099 %
1841	6	20	15388	0.130 %
1842	7	18	14719	0.122 %
1843	20	34	15969	0.213 %
1844	34	50	18782	0.266 %
1845	15	21	17665	0.119 %
1846	17	38	20609	0.184 %
1847	21	36	23306	0.154 %
1848	18	26	18366	0.142 %
1849	27	35	20401	0.172 %
1850	30	46	20106	0.229 %
1851	26	54	21455	0.252 %
1852	17	45	19757	0.228 %
1853	47	79	24108	0.328 %

Appendix III. The ports of departure for machinery shipments 1815-1853 (STRO)

Port	Freq
Hull	169
Antverpen	112
Liverpool	80
London	57
Newcastle	56
Dundee	31
Leith	25
Rotterdam	20
Amsterdam	10
Havre	10
Dunkerque	9
Hamburg	9
Glasgow	8
Göteborg	8
Rouen	6
Boston i Am.	5
Stockholm	5
Grangemouth	4
Kirkaldy	4
Newyork	4
Petersborg	4
Charlestown	3
København	3
Riga	3
Rønne	3
Stettin	3
Aberdeen	2
Belfast	2
Bordeaux	2
Goole	2
Helsingborg	2
Höganäs	2
Königsberg	2
Neath	2
Stockton	2
Thisted	2
Abo	1
Alloa og Grangemouth	1
Altona	1
Boston	1
Bristol	1
Charleston i Amer.	1
Danzig	1
Dundee og Wemyss	1
England	1
Flanelly	1
Fyenoord	1
Gent	1
Gloucester	1
Grimsby	1
Hayle	1
Hull og Hartlepool	1
Hull og Newcastle	1
Ipswich	1
Kylly	1
København Holnis	1
London og Hartlepool	1
London sidst fra Harwich	1
Lubeck	1
Malmö	1
Nantes	1
Newyork og charlestown	1
Norrköping	1
Nyköping	1
Pillau	1
Poole	1
Rönnebeck	1
Stettin og Kjøbenhavn	1
Storehedinge	1
Wolgast	1
Ystad og Landskrona	1

Appendix IV. The ports of destination for machinery shipments 1815-1853 (STRO)

Port	Freq
Petersborg	210
Danzig	64
Kronstadt	64
Riga	48
København	41
Stettin	40
Helsingør	30
Königsberg	20
Narva	20
Stockholm	16
Memel	12
Gefle	8
Libau	8
Norrköping	7
Göteborg	6
Lubeck	6
Pillau	5
Svinemunde	5
Hull	4
København Petersborg	4
London	4
Pernau	4
Rostock	4
Wyborg	4
Baltic Sea	3
Christinestad	3
Wiborg	3
Wolgast	3
Abo	2
Helsingfors	2
Höganäs	2
Landscrona	2
Malmö	2
Nyköping	2
Pori	2
Reval	2
Sundet	2
Sundswall	2
Warberg	2
Wismar	2
Aalborg	1
Amsterdam	1
Antwerpen	1
Archangel	1
Arensborg	1
Bergen	1
Calmar	1
Carlshamn	1
Christiania	1
Christianstad	1
Cronstadt Petersborg	1
Danzig Liverpool	1
Flensborg	1
Frederiksund	1
Fridriksværn	1
Glasgow	1
Greifswald	1
Halmstad	1
Hamburg	1
Haparanda	1
Hapsal	1
Helsingborg	1
Husom	1
Jacobstad	1
København Baltic Sea	1
Leith	1
Norge	1
Nyköping Norrköping	1
Odessa	1
Reval eller Cronstadt	1
Rio Janeiro	1
Russisk Amerika	1
Stavanger	1
Stralsund	1
Sverigsberg	1
Sønderborg	1
Trondhjem	1
Wisby	1

Appendix V. Machinery imports to the Russian Empire via different routes (silver roubles). Foreign trade statistics of the Russian Empire and the data by Timur Valetov

Year	White Sea	Baltic Sea	Overland	Black Sea	Total	Machinery imports by Valetov	Total imports by Valetov
1815	NA	NA	NA	NA	NA	0	113 778 000
1816	NA	NA	NA	NA	NA	35000	129 337 000
1817	NA	NA	NA	NA	NA	96000	167 194 000
1818	NA	NA	NA	NA	NA	0	181 218 000
1819	NA	NA	NA	NA	NA	209000	177 094 000
1820	NA	NA	NA	NA	NA	30000	245 172 000
1821	NA	NA	NA	NA	NA	23000	208 038 000
1822	NA	NA	NA	NA	NA	157000	156 476 000
1823	NA	NA	NA	NA	NA	64000	160 386 000
1824	NA	NA	NA	NA	NA	219000	178 724 000
1825	NA	NA	NA	NA	NA	156000	191 306 000
1826	NA	119522	2588	26625	148735	171000	193 502 000
1827	NA	45280	6262	11845	63387	85000	207 874 000
1828	NA	81740	78258	12790	172788	187000	200 987 000
1829	NA	57245	17986	203	75434	93000	215 917 000
1830	NA	102245	13972	14885	131102	153000	198 133 000
1831	NA	109978	282405	7314	399697	400000	176 996 000
1832	NA	182605	8445	8422	199472	267000	196 037 000
1833	NA	453455	12270	18830	484555	545000	193 108 000
1834	10	641425	113305	20020	774760	815000	218 093 000
1835	NA	611102	316697	59504	987303	1065000	222 766 000
1836	NA	1044884	76775	603	1122262	1217000	237 251 000
1837	40	1662915	46033	44967	1753955	1821000	251 757 000
1838	290	2415789	41296	69823	2527198	2579000	247 715 000
1839	470	1261046	99675	154095	1515286	1599000	249 152 000
1840	NA	366222	14603	32143	412968	441000	78 128 000
1841	242	214735	8784	5536	229297	244000	80 802 000
1842	2	172477	25702	4361	202542	217000	84 593 000
1843	NA	583001	28432	34122	645555	665000	75 028 000
1844	1103	889796	65953	7505	964357	975000	78 480 000
1845	NA	1097490	52497	85866	1235853	1241000	83 161 000
1846	NA	1158930	64052	68536	1291518	1377000	86 996 000
1847	NA	NA	NA	NA	NA	1445000	89 182 000
1848	NA	854082	80574	310121	1244777	1380000	90 778 000
1849	NA	1570548	84121	224121	1878790	1982000	96 247 000
1850	NA	NA	NA	NA	NA	2221000	93 918 000
1851	505	2007870	704544	174126	2887045	2887000	103 738 000
1852	2455	1227775	407299	240700	1878229	1879000	100 864 000
1853	2336	3916412	441899	435655	4796302	4796000	102 287 000

Appendix VI. Trade routes for machinery shipments to Russia 1815-1853 (STRO)

From	To	Freq	Share
Hull	Petersborg	88	12.4 %
Antverpen	Petersborg	39	5.5 %
Liverpool	Danzig	22	3.1 %
Antverpen	Danzig	21	3.0 %
Liverpool	Kronstadt	18	2.5 %
Liverpool	Petersborg	17	2.4 %
Antverpen	Riga	17	2.4 %
Newcastle	Stettin	14	2.0 %
London	Petersborg	13	1.8 %
Hull	Riga	12	1.7 %
London	København	11	1.6 %
Rotterdam	Petersborg	11	1.6 %
Hull	Narva	10	1.4 %
Hull	København	9	1.3 %
Newcastle	Kronstadt	8	1.1 %
Antverpen	Stettin	8	1.1 %
Leith	Kronstadt	7	1.0 %
Dundee	Libau	7	1.0 %
Hull	Gefle	6	0.8 %
Hull	Helsingør	6	0.8 %
Dundee	Kronstadt	6	0.8 %
Glasgow	Kronstadt	6	0.8 %
Newcastle	København	6	0.8 %
Dundee	Riga	6	0.8 %
Hull	Kronstadt	5	0.7 %
Dunkerque	Petersborg	5	0.7 %
Hamburg	Petersborg	5	0.7 %
Newcastle	Petersborg	5	0.7 %
London	Danzig	4	0.6 %
Newcastle	Danzig	4	0.6 %
Liverpool	Helsingør	4	0.6 %
Dundee	Kaliningrad	4	0.6 %
Leith	Kaliningrad	4	0.6 %
Antverpen	Kronstadt	4	0.6 %
Antverpen	København	4	0.6 %
Boston i Am.	Petersborg	4	0.6 %
Havre	Petersborg	4	0.6 %
Leith	Petersborg	4	0.6 %
Newyork	Petersborg	4	0.6 %
Amsterdam	Riga	4	0.6 %
Hull	Stettin	4	0.6 %
Liverpool	Stettin	4	0.6 %

Hull	Stockholm	4	0.6 %
Newcastle	Stockholm	4	0.6 %
Amsterdam	Helsingør	3	0.4 %
Rønne	Hull	3	0.4 %
Kirkaldy	Kaliningrad	3	0.4 %
Grangemouth	Kronstadt	3	0.4 %
London	Lubeck	3	0.4 %
London	Memel	3	0.4 %
Antverpen	Narva	3	0.4 %
Leith	Narva	3	0.4 %
Dundee	Petersborg	3	0.4 %
Newcastle	Rostock	3	0.4 %
London	Stettin	3	0.4 %
Newcastle	Svinemunde	3	0.4 %
Hull	Wiborg	3	0.4 %
Hull	Wyborg	3	0.4 %
Liverpool	Christinestad	2	0.3 %
Havre	Danzig	2	0.3 %
Hull	Danzig	2	0.3 %
Rouen	Danzig	2	0.3 %
Helsingborg	Göteborg	2	0.3 %
Antverpen	Helsingør	2	0.3 %
Hamburg	Helsingør	2	0.3 %
Havre	Helsingør	2	0.3 %
London	Helsingør	2	0.3 %
Rotterdam	Helsingør	2	0.3 %
Stockholm	Höganäs	2	0.3 %
London	Kaliningrad	2	0.3 %
Rotterdam	Kronstadt	2	0.3 %
Liverpool	København	2	0.3 %
Petersborg	London	2	0.3 %
Antverpen	Memel	2	0.3 %
Dundee	Narva	2	0.3 %
Liverpool	Narva	2	0.3 %
Hull	Norrköping	2	0.3 %
Hull	Nyköping	2	0.3 %
Antverpen	Pernau	2	0.3 %
Goole	Petersborg	2	0.3 %
London	Pillau	2	0.3 %
Antverpen	Pori	2	0.3 %
Liverpool	Riga	2	0.3 %
Rotterdam	Riga	2	0.3 %
Rouen	Riga	2	0.3 %
Antverpen	Stockholm	2	0.3 %
Höganäs	Stockholm	2	0.3 %

London	Wolgast	2	0.3 %
Riga	Aalborg	1	0.1 %
Hull	Abo	1	0.1 %
London	Abo	1	0.1 %
Riga	Amsterdam	1	0.1 %
Riga	Antwerpen	1	0.1 %
Stettin	Archangel	1	0.1 %
Rotterdam	Arensborg	1	0.1 %
Dundee	Baltic Sea	1	0.1 %
Hull	Baltic Sea	1	0.1 %
London og Hartlepool	Baltic Sea	1	0.1 %
København	Bergen	1	0.1 %
Göteborg	Calmar	1	0.1 %
Hull	Carlshamn	1	0.1 %
Hull	Christianstad	1	0.1 %
Hull	Christinestad	1	0.1 %
London	Cronstadt Petersborg	1	0.1 %
Dunkerque	Danzig	1	0.1 %
Flanelly	Danzig	1	0.1 %
Hamburg	Danzig	1	0.1 %
Ipswich	Danzig	1	0.1 %
Leith	Danzig	1	0.1 %
Nantes	Danzig	1	0.1 %
Neath	Danzig	1	0.1 %
London	Flensborg	1	0.1 %
Stettin og Kjøbenhavn	Frederiksund	1	0.1 %
Nyköping	Fridriksværn	1	0.1 %
Liverpool	Gefle	1	0.1 %
London	Gefle	1	0.1 %
København	Glasgow	1	0.1 %
Newcastle	Greifswald	1	0.1 %
Lubeck	Göteborg	1	0.1 %
Stockholm	Göteborg	1	0.1 %
Wolgast	Göteborg	1	0.1 %
Ystad og Landskrona	Göteborg	1	0.1 %
Malmö	Halmstad	1	0.1 %
Petersborg	Hamburg	1	0.1 %
Hull	Haparanda	1	0.1 %
Amsterdam	Hapsal	1	0.1 %
London	Helsingborg	1	0.1 %
Antverpen	Helsingfors	1	0.1 %
London	Helsingfors	1	0.1 %
Belfast	Helsingør	1	0.1 %
Charlestown	Helsingør	1	0.1 %
Dundee	Helsingør	1	0.1 %

Dunkerque	Helsingør	1	0.1 %
Gloucester	Helsingør	1	0.1 %
Rouen	Helsingør	1	0.1 %
Kaliningrad	Hull	1	0.1 %
Göteborg	Husom	1	0.1 %
Hull	Jacobstad	1	0.1 %
Amsterdam	Kaliningrad	1	0.1 %
Dunkerque	Kaliningrad	1	0.1 %
Glasgow	Kaliningrad	1	0.1 %
Grangemouth	Kaliningrad	1	0.1 %
Hull	Kaliningrad	1	0.1 %
London sidst fra Harwich	Kaliningrad	1	0.1 %
Rotterdam	Kaliningrad	1	0.1 %
Alloa og Grangemouth	Kronstadt	1	0.1 %
Bristol	Kronstadt	1	0.1 %
Charlestown	Kronstadt	1	0.1 %
London	Kronstadt	1	0.1 %
Poole	Kronstadt	1	0.1 %
Aberdeen	København	1	0.1 %
Boston i Am.	København	1	0.1 %
Charleston i Amer.	København	1	0.1 %
Havre	København	1	0.1 %
Kirkaldy	København	1	0.1 %
Leith	København	1	0.1 %
Newyork og charlestown	København	1	0.1 %
Thisted	København	1	0.1 %
Hamburg	København Baltic Sea	1	0.1 %
Hull	København Petersborg	1	0.1 %
London	København Petersborg	1	0.1 %
Thisted	København Petersborg	1	0.1 %
Göteborg	Landscrona	1	0.1 %
London	Landscrona	1	0.1 %
Pillau	Leith	1	0.1 %
Grimsby	Libau	1	0.1 %
Danzig	London	1	0.1 %
Kaliningrad	London	1	0.1 %
Antverpen	Lubeck	1	0.1 %
Charlestown	Lubeck	1	0.1 %
Liverpool	Lubeck	1	0.1 %
Göteborg	Malmö	1	0.1 %
Hull	Malmö	1	0.1 %
Aberdeen	Memel	1	0.1 %

Dundee	Memel	1	0.1 %
Dunkerque	Memel	1	0.1 %
England	Memel	1	0.1 %
Glasgow	Memel	1	0.1 %
Hull	Memel	1	0.1 %
Liverpool	Memel	1	0.1 %
Stettin	Norge	1	0.1 %
Antverpen	Norrköping	1	0.1 %
Göteborg	Norrköping	1	0.1 %
Hull og Hartlepool	Norrköping	1	0.1 %
Leith	Norrköping	1	0.1 %
Newcastle	Norrköping	1	0.1 %
Göteborg	Nyköping Norrköping	1	0.1 %
Stettin	Odessa	1	0.1 %
København	Oslo	1	0.1 %
Belfast	Pernau	1	0.1 %
Liverpool	Pernau	1	0.1 %
Bordeaux	Petersborg	1	0.1 %
Dundee og Wemyss	Petersborg	1	0.1 %
Gent	Petersborg	1	0.1 %
Rouen	Petersborg	1	0.1 %
Rönnebeck	Petersborg	1	0.1 %
Stockton	Petersborg	1	0.1 %
Hull	Pillau	1	0.1 %
Leith	Pillau	1	0.1 %
Newcastle	Pillau	1	0.1 %
Hull	Reval	1	0.1 %
Newcastle	Reval	1	0.1 %
Rotterdam	Reval eller Cronstadt	1	0.1 %
Boston	Riga	1	0.1 %
Leith	Riga	1	0.1 %
Newcastle	Riga	1	0.1 %
Stockholm	Rio Janeiro	1	0.1 %
London	Rostock	1	0.1 %
Abo	Russisk Amerika	1	0.1 %
Storehedinge	Stavanger	1	0.1 %
Bordeaux	Stettin	1	0.1 %
Hamburg	Stettin	1	0.1 %
Havre	Stettin	1	0.1 %
Hayle	Stettin	1	0.1 %
Leith	Stettin	1	0.1 %
Neath	Stettin	1	0.1 %
Rotterdam	Stettin	1	0.1 %
Antverpen Göteborg	Stockholm	1	0.1 %
Göteborg	Stockholm	1	0.1 %

Liverpool	Stockholm	1	0.1 %
Stockton	Stockholm	1	0.1 %
London	Stralsund	1	0.1 %
Antverpen	Sundet	1	0.1 %
London	Sundet	1	0.1 %
Göteborg	Sundswall	1	0.1 %
Hull og Newcastle	Sundswall	1	0.1 %
Newcastle	Sverigsberg	1	0.1 %
Antverpen	Svinemunde	1	0.1 %
Liverpool	Svinemunde	1	0.1 %
Newcastle	Sønderborg	1	0.1 %
København Holnis	Trondhjem	1	0.1 %
Kylly	Warberg	1	0.1 %
Stockholm	Warberg	1	0.1 %
Norrköping	Wisby	1	0.1 %
Amsterdam	Wismar	1	0.1 %
Liverpool	Wismar	1	0.1 %
Leith	Wolgast	1	0.1 %
Newcastle	Wyborg	1	0.1 %

Appendix VII. The home ports of the shipmasters (STRO)

Port	Freq	Share			
Hull	83	22.4 %	Scarbro	2	0.5 %
Dundee	26	7.0 %	Stralsund	2	0.5 %
Newcastle	18	4.9 %	Wilderfang	2	0.5 %
Papenburg	13	3.5 %	Wyborg	2	0.5 %
Leith	12	3.2 %	Yarmouth	2	0.5 %
Sunderland	9	2.4 %	Althagen	1	0.3 %
Goole	8	2.2 %	Apenrade	1	0.3 %
Montrose	8	2.2 %	Arendal	1	0.3 %
London	7	1.9 %	Barth	1	0.3 %
Rotterdam	7	1.9 %	Beaumaris	1	0.3 %
Memel	6	1.6 %	Belle Isle	1	0.3 %
Oude Pekela	6	1.6 %	Berlin	1	0.3 %
Riga	6	1.6 %	Blyth	1	0.3 %
Emden	5	1.4 %	Boness	1	0.3 %
Liverpool	5	1.4 %	Bordeaux	1	0.3 %
Petersborg	5	1.4 %	Boston	1	0.3 %
Veendam	5	1.4 %	Braake	1	0.3 %
Boston i Am.	4	1.1 %	Brake	1	0.3 %
Dunkerque	4	1.1 %	Brussel	1	0.3 %
Arbroath	3	0.8 %	Cowes	1	0.3 %
Danzig	3	0.8 %	Daendorff	1	0.3 %
Groningen	3	0.8 %	Dornumerzyhl	1	0.3 %
Havre	3	0.8 %	Drogheda	1	0.3 %
Libau	3	0.8 %	Dumfries	1	0.3 %
Lubeck	3	0.8 %	Dunbar	1	0.3 %
Pernau	3	0.8 %	Fahrsund	1	0.3 %
Reval	3	0.8 %	Fanø	1	0.3 %
Aberdeen	2	0.5 %	Finsterwolde	1	0.3 %
Anstruther	2	0.5 %	Flanelly	1	0.3 %
Archangel	2	0.5 %	Frederikshamn	1	0.3 %
Belfast	2	0.5 %	Frederiksværk	1	0.3 %
Boston (i Am.?)	2	0.5 %	Gefle	1	0.3 %
Brahestad	2	0.5 %	Grimsby	1	0.3 %
Bremen	2	0.5 %	Guernsey	1	0.3 %
Exeter	2	0.5 %	Hamburg	1	0.3 %
Harlingen	2	0.5 %	Hartlepool	1	0.3 %
Kinkardine	2	0.5 %	Helgoland	1	0.3 %
Leer	2	0.5 %	Helsingfors	1	0.3 %
Nantes	2	0.5 %	Hogezand	1	0.3 %
Narva	2	0.5 %	Honfleur	1	0.3 %
Rostock	2	0.5 %	Horsens	1	0.3 %

Irwine	1	0.3 %	Nyborg	1	0.3 %
Jacobstad	1	0.3 %	Oostwold	1	0.3 %
Jersey	1	0.3 %	Peterhead	1	0.3 %
Kincardine	1	0.3 %	Providence	1	0.3 %
Kirchdorff	1	0.3 %	Purmerend	1	0.3 %
Kokkola	1	0.3 %	Rønne	1	0.3 %
København	1	0.3 %	Salem i Am.	1	0.3 %
Lampbough	1	0.3 %	Sapmeer	1	0.3 %
Lemmer	1	0.3 %	Shields	1	0.3 %
Liebau	1	0.3 %	Stockton	1	0.3 %
Lonvain i Belgien	1	0.3 %	Tønsberg	1	0.3 %
Lovisa	1	0.3 %	Wasa	1	0.3 %
Lübeck	1	0.3 %	Whitby	1	0.3 %
Lynn	1	0.3 %	Winschoten	1	0.3 %
Miuden	1	0.3 %	Winschoterzyl	1	0.3 %
Neustadt	1	0.3 %	Wisby	1	0.3 %
Newquay	1	0.3 %	Wormerveen	1	0.3 %
			Zappemeer	1	0.3 %

Appendix VIII. The shipmasters and their homeports (STRO)

Shipmaster + home port	Freq	Share
A. Donaldson Hull	7	1.9 %
J. Young Dundee	3	0.8 %
D. Pepper Goole	2	0.5 %
G. Harrison Hull	2	0.5 %
J. Bell Hull	2	0.5 %
J. J. Priest Hull	2	0.5 %
J. Wharton Hull	2	0.5 %
L. S. Pinksterboer Veendam	2	0.5 %
R. Duncan Dundee	2	0.5 %
S. Duncan Leith	2	0.5 %
S. Frost Hull	2	0.5 %
T. Marshall Hull	2	0.5 %
W. Amery Hull	2	0.5 %
W. Shepherd Hull	2	0.5 %
W. W. Schofield Hull	2	0.5 %
Z. G. Pearson Hull	2	0.5 %
- Bourgain Dunkerque	1	0.3 %
- Leroux Havre	1	0.3 %
- Liard Honfleur	1	0.3 %
- Saux Bordeaux	1	0.3 %
- Tolange Havre	1	0.3 %
A. Bertelsen Fanø	1	0.3 %
A. Bockhoff Papenburg	1	0.3 %
A. Bommelaer Dunkerque	1	0.3 %
A. C. Lemmeshirt Pernau	1	0.3 %
A. Dove Liverpool	1	0.3 %
A. H. Dade Lubeck	1	0.3 %
A. Howe Newcastle	1	0.3 %
A. Jost Riga	1	0.3 %
A. L. Sarnow Memel	1	0.3 %
A. Largie Montrose	1	0.3 %
A. Lindsay Montrose	1	0.3 %
A. Maingourd Nantes	1	0.3 %
A. Malm Kokkola	1	0.3 %
A. Mury Frederikshamn	1	0.3 %
A. P. Rønning Reval	1	0.3 %
A. R. Andersen Arendal	1	0.3 %
A. Rattray Dundee	1	0.3 %
A. S. Boyack Dundee	1	0.3 %
A. Smith Liverpool	1	0.3 %
A. Swanback Brahestad	1	0.3 %
A. Watson Montrose	1	0.3 %
A. Yale Kinkardine	1	0.3 %
Ant. Scott Leith	1	0.3 %
B. Collins Hull	1	0.3 %
B. H. Theissing Papenburg	1	0.3 %
B. L. Brongers Wilderfang	1	0.3 %
B. Lancaster Hull	1	0.3 %
C. Drichell Archangel	1	0.3 %
C. E. Erling Brahestad	1	0.3 %
C. Frost Hull	1	0.3 %
C. Gill Boston i Am.	1	0.3 %
C. Gueller Belle Isle	1	0.3 %
C. J. Lindeboom Papenburg	1	0.3 %
C. J. Valley Gefle	1	0.3 %
C. L. Kofod Narva	1	0.3 %
C. Niemann Althagen	1	0.3 %
C. O. Groot Winschoterzyl	1	0.3 %
C. Pearson Hull	1	0.3 %
C. S. Knight Hull	1	0.3 %
C. S. Salisbury Exeter	1	0.3 %
C. Shimells Hull	1	0.3 %
C. Thompson London	1	0.3 %
C. Walter Stralsund	1	0.3 %
C. Woodberry Salem i Am.	1	0.3 %
D. A. Zylstra Emden	1	0.3 %
D. Cumming Montrose	1	0.3 %
D. Ewan Peterhead	1	0.3 %
D. H. Botje Hogezand	1	0.3 %
D. H. Duit Oude Pekela	1	0.3 %

D. Leslie Arbroath	1	0.3 %
D. M. Nordhoek Rotterdam	1	0.3 %
D. McNabb Belfast	1	0.3 %
D. Menzies Montrose	1	0.3 %
D. Mitchell Dundee	1	0.3 %
D. P. Halladay Hull	1	0.3 %
D. Robson Newcastle	1	0.3 %
D. Rodgers Arbroath	1	0.3 %
D. Rolofs Papenburg	1	0.3 %
D. Smith Dunbar	1	0.3 %
D. Uffen Emden	1	0.3 %
D. Webster Dundee	1	0.3 %
D. Young Dundee	1	0.3 %
Daniel Warren London	1	0.3 %
David Gosman Dundee	1	0.3 %
David Theel Lonvain i Belgien	1	0.3 %
E. Bennington Petersborg	1	0.3 %
E. Bolwin Riga	1	0.3 %
E. Caseley Goole	1	0.3 %
E. F. S. Dejoie Nantes	1	0.3 %
E. Frost Hull	1	0.3 %
E. H. Hornveld Oude Pekela	1	0.3 %
E. H. Sjøholm Wasa	1	0.3 %
E. J. Gust Groningen	1	0.3 %
E. Koutschack Libau	1	0.3 %
E. Malmberg Lovisa	1	0.3 %
E. Sargent Boston i Am.	1	0.3 %
E. Stief Memel	1	0.3 %
E. Ulting Hull	1	0.3 %
F. Dewar Dundee	1	0.3 %
F. E. Pahnke Danzig	1	0.3 %
F. H. Bonjer Emden	1	0.3 %
F. Hunter Hull	1	0.3 %
F. W. Dieckert Reval	1	0.3 %
F. W. Nordling Wyborg	1	0.3 %
F. White Hull	1	0.3 %
G. Broadhead Hull	1	0.3 %
G. Brose Libau	1	0.3 %
G. Davey Hull	1	0.3 %
G. Dorward Newcastle	1	0.3 %
G. Foreman Shields	1	0.3 %
G. H. Broadhead Hull	1	0.3 %
G. H. Lodewyks Rotterdam	1	0.3 %
G. J. Otten Leer	1	0.3 %
G. J. Schulte Papenburg	1	0.3 %
G. M. Gnodde Wormerveen	1	0.3 %
G. Matz Kait Riga	1	0.3 %
G. Newbold Newcastle	1	0.3 %
G. Pattie Dundee	1	0.3 %
G. Slovie Jersey	1	0.3 %
G. Woodlass Leith	1	0.3 %
G. Young Newcastle	1	0.3 %
George Banks Dundee	1	0.3 %
George Dorward Newcastle	1	0.3 %
George Kidd Dundee	1	0.3 %
H. A. Lombke Rostock	1	0.3 %
H. Abrams Riga	1	0.3 %
H. B. Voss Emden	1	0.3 %
H. Baselow Rostock	1	0.3 %
H. Becken Memel	1	0.3 %
H. C. Jonge Dornumerzyhl	1	0.3 %
H. C. Politz Lubeck	1	0.3 %
H. Commell Hull	1	0.3 %
H. G. Mintes Lubeck	1	0.3 %
H. H. Bakker Oude Pekela	1	0.3 %
H. H. Koop Papenburg	1	0.3 %
H. H. Krop Papenburg	1	0.3 %
H. H. Potjer Sapmeer	1	0.3 %
H. J. Muller Libau	1	0.3 %
H. Krak Braake	1	0.3 %
H. Kreiger Hull	1	0.3 %
H. Kustner Jacobstad	1	0.3 %
H. L. Freericks Riga	1	0.3 %
H. L. Wilcke Berlin	1	0.3 %
H. Mitchell Newcastle	1	0.3 %

H. Niemann Daendorff	1	0.3 %
H. Schildwach Pernau	1	0.3 %
H. T. Bahlruhs Barth	1	0.3 %
H. Tate Hull	1	0.3 %
H. W. Meyer Papenburg	1	0.3 %
J. A. Schuring Winschoten	1	0.3 %
J. Abrahann Papenburg	1	0.3 %
J. Amery Hull	1	0.3 %
J. B. Dohrmann Bremen	1	0.3 %
J. Bametson Leith	1	0.3 %
J. Barkson Hull	1	0.3 %
J. C. Bøwadt Liebau	1	0.3 %
J. C. Johansen Narva	1	0.3 %
J. C. Peters Kirchdorff	1	0.3 %
J. Cavins Leith	1	0.3 %
J. Clark Belfast	1	0.3 %
J. Clarkson Hull	1	0.3 %
J. Cleet Newcastle	1	0.3 %
J. Cousins Leith	1	0.3 %
J. Davids Reval	1	0.3 %
J. Dobson Hull	1	0.3 %
J. Donaldson Sunderland	1	0.3 %
J. Duncan Dundee	1	0.3 %
J. Dunkerley Hull	1	0.3 %
J. E. Scott Boston i Am.	1	0.3 %
J. F. Pattullo Dundee	1	0.3 %
J. Fowler Scarbro	1	0.3 %
J. Gowans Montrose	1	0.3 %
J. Grønholm Wyborg	1	0.3 %
J. Groenewold Memel	1	0.3 %
J. H. Ford Hull	1	0.3 %
J. H. Kramer Papenburg	1	0.3 %
J. H. Mulder Veendam	1	0.3 %
J. H. Verspecke Havre	1	0.3 %
J. H. Walker Sunderland	1	0.3 %
J. Hatson Hull	1	0.3 %
J. Heibner Bremen	1	0.3 %
J. Hibbs Goole	1	0.3 %
J. Humphrey Sunderland	1	0.3 %
J. J. Balk Harlingen	1	0.3 %
J. J. Kjær Apenrade	1	0.3 %
J. J. Koster Finsterwolde	1	0.3 %
J. Jackson London	1	0.3 %
J. Joss Whitby	1	0.3 %
J. Kelsey Hull	1	0.3 %
J. Kontermowitz Petersborg	1	0.3 %
J. L. Neve London	1	0.3 %
J. Lee Dundee	1	0.3 %
J. Leng Newcastle	1	0.3 %
J. Louftrough Hull	1	0.3 %
J. Lubken Brake	1	0.3 %
J. Mackie Aberdeen	1	0.3 %
J. Messenger Liverpool	1	0.3 %
J. Moffat Newcastle	1	0.3 %
J. Murray Hull	1	0.3 %
J. Newby Hull	1	0.3 %
J. Ontjes Riga	1	0.3 %
J. P. Hildebrandt Lübeck	1	0.3 %
J. P. Holm Boston i Am.	1	0.3 %
J. P. Reetzke Danzig	1	0.3 %
J. P. Scherpbier Oude Pekela	1	0.3 %
J. Peters Dundee	1	0.3 %
J. Priest Hull	1	0.3 %
J. Retucke Memel	1	0.3 %
J. Richards Newcastle	1	0.3 %
J. Roach Sunderland	1	0.3 %
J. S. Jackson Hull	1	0.3 %
J. Schipman Papenburg	1	0.3 %
J. Smith Sunderland	1	0.3 %
J. Stewart Hull	1	0.3 %
J. Suerken Papenburg	1	0.3 %
J. T. Kruger Hull	1	0.3 %
J. Thomas Flanelly	1	0.3 %
J. Vanselow Danzig	1	0.3 %
J. W. Buchanan Leith	1	0.3 %
J. W. Tarey Newcastle	1	0.3 %
J. Wallece Sunderland	1	0.3 %

J. Welville Montrose	1	0.3 %
J. Willken Stralsund	1	0.3 %
J. Wood Goole	1	0.3 %
James Fyffe Dundee	1	0.3 %
James Kobertiøn London	1	0.3 %
James Millar Boston (i Am.?)	1	0.3 %
James Scotland Kinkardine	1	0.3 %
John Adamson Anstruther	1	0.3 %
John Crackel Hull	1	0.3 %
John Dishman Boston	1	0.3 %
John Dyson Hull	1	0.3 %
John Lowery Hull	1	0.3 %
Jonas Jonassen Fahrsund	1	0.3 %
Joseph Verrun Dunkerque	1	0.3 %
K. J. Wyk Oostwold	1	0.3 %
K. P. Heeges Zappemeer	1	0.3 %
Klaas Pybes Oude Pekela	1	0.3 %
L. Dejonghe Dunkerque	1	0.3 %
L. Deyer Rotterdam	1	0.3 %
L. Grotrian Petersborg	1	0.3 %
L. H. Carl København	1	0.3 %
L. J. Jonge Lemmer	1	0.3 %
L. Odman Wisby	1	0.3 %
L. Overgaanso Rotterdam	1	0.3 %
L. Overgaauw Rotterdam	1	0.3 %
L. Overgauw Rotterdam	1	0.3 %
L. Peyer Rotterdam	1	0.3 %
L. Røttgess Helgoland	1	0.3 %
L. W. Byder Petersborg	1	0.3 %
M. Dukes Newcastle	1	0.3 %
M. P. Madsen Rønne	1	0.3 %
M. P. Melfs Archangel	1	0.3 %
N. Michelsen Frederiksværk	1	0.3 %
N. Miechelsen Horsens	1	0.3 %
O. J. Cedar Helsingfors	1	0.3 %
O. J. Kuiper Oude Pekela	1	0.3 %
O. K. Axelsen Nyborg	1	0.3 %
P. Berriman London	1	0.3 %
P. H. Hazewinkel Veendam	1	0.3 %
P. Hansen Tønsberg	1	0.3 %
P. J. Knudsen Pernau	1	0.3 %
P. Johnson Hull	1	0.3 %
P. McKiddie Dundee	1	0.3 %
P. Rickert Neustadt	1	0.3 %
Peter J. Boer Hamburg	1	0.3 %
R. Anderson NA	1	0.3 %
R. Brereton Yarmouth	1	0.3 %
R. Cooper Dundee	1	0.3 %
R. Day Hull	1	0.3 %
R. Dorkin Yarmouth	1	0.3 %
R. Errington Hartlepool	1	0.3 %
R. Fox Hull	1	0.3 %
R. Ivens Cowes	1	0.3 %
R. J. Brons Groningen	1	0.3 %
R. M. Sawyer Hull	1	0.3 %
R. Mankman Hull	1	0.3 %
R. McLaren Boness	1	0.3 %
R. Owen Irwine	1	0.3 %
R. Peck Guernsey	1	0.3 %
R. Rounding Hull	1	0.3 %
R. Russell Lampbough	1	0.3 %
R. S. Knowles Hull	1	0.3 %
R. Spencer Goole	1	0.3 %
R. Tranmer Hull	1	0.3 %
R. Tranner Hull	1	0.3 %
R. W. Peacock Newcastle	1	0.3 %
R. Williams Beaumaris	1	0.3 %
Robert Sinclair Leith	1	0.3 %
S. G. Oostra Veendam	1	0.3 %
S. Heron Hull	1	0.3 %
S. J. Jackson Lynn	1	0.3 %
S. Webster Dundee	1	0.3 %

T. A. Vries Brussel	1	0.3 %
T. Breasley Goole	1	0.3 %
T. Cannell Liverpool	1	0.3 %
T. Clark Dundee	1	0.3 %
T. Donaldson Leith	1	0.3 %
T. Dunn Blyth	1	0.3 %
T. Glasgow London	1	0.3 %
T. Glenday Dundee	1	0.3 %
T. J. Hazewinkel Wilderfang	1	0.3 %
T. Jones Newquay	1	0.3 %
T. K. Mulder Harlingen	1	0.3 %
T. Leach Boston (i Am.?)	1	0.3 %
T. W. Brewer Hull	1	0.3 %
Th. Shipmann Leer	1	0.3 %
Th. Thomson Leith	1	0.3 %
The. Marshall Hull	1	0.3 %
Thomas Mellanby Stockton	1	0.3 %
Thomas Muir Scarbro	1	0.3 %
Thomas Taylor Anstruther	1	0.3 %
W. A. Boer Groningen	1	0.3 %
W. Amery Grimsby	1	0.3 %
W. Brice Liverpool	1	0.3 %
W. Cape Hull	1	0.3 %
W. Culberds Arbroath	1	0.3 %
W. Eufsler Petersborg	1	0.3 %
W. F. Fenenga Miuden	1	0.3 %
W. Faber Purmerend	1	0.3 %
W. Falkner Montrose	1	0.3 %
W. Fortune Newcastle	1	0.3 %
W. Gibson Newcastle	1	0.3 %
W. Gray Newcastle	1	0.3 %
W. Hare Hull	1	0.3 %
W. Harper Hull	1	0.3 %
W. Lamb Sunderland	1	0.3 %
W. Lindsay Leith	1	0.3 %
W. Mallory Exeter	1	0.3 %
W. Maquire Drogheda	1	0.3 %
W. Marks Memel	1	0.3 %
W. McDonald Dundee	1	0.3 %
W. Milburn Sunderland	1	0.3 %
W. Murdoch Dumfries	1	0.3 %
W. Powdrell Hull	1	0.3 %
W. R. Gardner Providence	1	0.3 %
W. Robinsen Newcastle	1	0.3 %
W. Shephud Hull	1	0.3 %
W. Tumley Hull	1	0.3 %
W. Walker Papenburg	1	0.3 %
W. Wood Sunderland	1	0.3 %
W. Wyler Kincardine	1	0.3 %
Willem Mennen Emden	1	0.3 %
Wm. Hare Hull	1	0.3 %
Wm. McGregor Aberdeen	1	0.3 %
Wm. Rockett Goole	1	0.3 %
Wm. Wharton Hull	1	0.3 %
Z. C. Pearson Hull	1	0.3 %

Appendix IX. The summaries of the test statistics

The first performance of Kruskal-Wallis (The ports of departure by the nationality)

		Shapiro-Wilk normality test		**Kruskal-Wallis rank sum test**		
Group	N	W	p-value	chi-square	df	p-value
Belgian	47	0.88378	0.0002276	8.8336	5	0.1159
French	11	0.70776	0.0005887			
German	6	0.80657	0.06729			
Dutch	17	0.53026	2.37E-06			
British	225	0.61883	< 2.2e-16			
USA	7	0.80926	0.05052			

The second performance of Kruskal-Wallis (The individual ports of departure)

		Shapiro-Wilk normality test		**Kruskal-Wallis rank sum test**		
Group	N	test	p-value	chi-square	df	p-value
Antwerp	46	0.87536	0.0001507	55.506	10	2.54E-08
Dundee	22	0.77538	0.0002111			
Dunkerque	5	0.77922	0.05428			
Glasgow	7	0.49227	1.32E-05			
Hamburg	5	0.77562	0.05053			
Kingston upon Hull	98	0.79701	2.66E-10			
Leith	13	0.88454	0.08218			
Liverpool	40	0.68982	6.66E-08			
London	16	0.64327	4.27E-05			
Newcastle	14	0.76478	0.001891			
Rotterdam	15	0.56382	1.21E-05			

The third performance of Kruskal-Wallis (The home ports of the shipmasters by nationality)

		Shapiro-Wilk normality test		**Kruskal-Wallis rank sum test**		
Group	N	test	p-value	chi-square	df	p-value
Danish	5	0.82785	0.134			
Finnish	10	0.81149	0.01999			
French	9	0.55768	3.05E-05			
German	33	0.77115	9.52E-06	18.431	7	1.03E-01
Dutch	24	0.71901	1.82E-05			
Russian	27	0.57344	1.02E-07			
British	189	0.66621	< 2.2e-16			
American	7	0.75446	0.01412			