The Industrious Revolution and Early Modern Colonial Goods Trade: Evidence from the Soundtoll Online Database

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Abstract

This article presents preliminary evidence of the volume of coffee trade tolled at the entry to the Baltic Sea, ca. 1700-1850, using the Soundtoll Registers Online Database (www.soundtoll.nl). The results are interpreted in the light of the “Industrious Revolution” hypothesis (De Vries 2008). The large increase of coffee trade at the Sound during the 18th century suggests an increasing availability of consumer products creating an incentive to work more hours in the presence of constant or even declining real wages (Allen 2001). The second contribution of this paper is methodological: Hurdles to access the Soundtoll Registers are, among others, heterogeneous measurement units, changing city names, and unstandardized commodity classifications. I therefore provide a detailed road map of how to arrive at results using standard Excel procedures and three Matlab scripts.

Keywords: Early modern trade, Baltic Sea, colonial goods, industrious revolution, Soundtoll registers, Denmark

JEL-Codes: N73

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Introduction

In this paper I provide empirical evidence to test the Industrious Revolution hypothesis. The source material are customs registers at the Danish sound, where almost all ships entering or leaving the Baltic Sea from the middle of the 16th to the middle of the 19th century had to pay a toll to the Danish king.

The concept of the Industrious Revolution was first formulated by Jan de Vries (2008) and states in a nutshell that before the Industrial Revolution in Europe there was an increase at the demand side of the market for consumption goods, and through the connection of households a related change at the supply side on the labour market. In particular, a larger variety of consumption goods such as colourful textile products and coffee, sugar and cocoa created an incentive to earn money on the labour market. Thus, households had an incentive to work more hours per year, despite stagnating or even declining labour productivity and real wages in the second half of the 18th century (Voth 1998).

One necessary ingredient for an empirical underpinning of this story is of course knowledge of the total volume of colonial goods imports to Europe. A second step then is to document that the share of colonial goods increased relative to the volume of total trade, otherwise an increase of the variety of consumer goods would be difficult to defend. Evidence so far is relatively scarce, as no aggregate import-export volumes for Europe or its nations are available for the 18th century. Pfister (2012) provides evidence for the port of Hamburg, which handled approximately 25-30% of imports to the relevant (mostly German) hinterland at this time. Since he combines the volume observations with prices at the Hamburg stock exchange for 44 product groups he can show that coffee imports increased
substantially in levels but also as a share of total trade between the 1730s and the 1790s. Sugar is shown to retain its status as the most important import product, while the development of other colonial goods are of lower relevance due to their small shares of total trade.

This paper aims at providing a new gauge into historical European trade by measuring the flow of trade as measured at the Danish Sound, which for centuries was used by the resident king to toll the passing ships. Since the database I use is relatively new, there are so far no estimates of the level and development of absolute trade volumes or values for all goods combined. Scheltjens (2012) has estimated trade volumes in ton-kilometers between 1784 and 1795, which is however not an appropriate comparison for my volumes of the coffee trade, since they do not feature the distance part. Also, I am missing adequate price information. Thus, in this paper I provide a time series of the absolute volume of coffee per year only, and can so far not state anything about the development of coffee trade relative to total trade. However, based on Scheltjens (2012) it is likely that such estimates will be made in the future.

There is one more contribution by this paper: The documentation of the various ways to deal with difficulties encountered when working with the database may help future researchers in their own work, and even function as a road map for research, e.g. in the context of a master thesis on a related topic.

In the next section, I will document in detail how I used the online database, explain the various assumptions I made and the possible implications. Then I will present and discuss the results and wrap up in a conclusion with some suggestions for future research.
Methodology

The way I obtained and constructed the results consists of two parts: First, inquiring the online database and shaping the csv-tables into readable form in Excel, and second, aggregating and plotting the data in Matlab.

1. TAPPING THE ONLINE DATABASE

In order to understand the challenges a researcher is faced with when using the Soundtoll Registers, a short description of the database is needed. The original documents can be best understood when visualizing their function: When a ship entered the Sound, it would be scrutinized by customs in order to determine the appropriate toll. For this, a list of the load would be needed, and then the sum of toll to be paid could be determined.

In addition to the load and the amount of toll, the papers would also record the name of the skipper, his origin, as well as the origin and destination of the load as well as the date of passage.

The databank therefore consists of four tables, which are connected by unique identifiers of each passage. The first is called “Passages”, containing the date, name of the shipmaster, and the toll paid, and the second is called “Cargoes”, consisting of a description and quantification of each good tolled (and may therefore be more than one per passage) plus the origin and destination of the passage. The third table is called “Taxes,” containing the additional charges paid per passage other than the toll independent of the actual cargo loaded. The last one is called “Images,” leading to the scans of the original records.

For the purpose of measuring the aggregate volumes of a certain product over time, the first step is to make the appropriate database enquiries. This task is
complicated particularly by the fact that each product was recorded in various ways, combining different names, languages and spellings, which changed considerably over time. Also, often products were recorded in groups together with related or unrelated products, which makes incorporating these observations for the analysis of single goods virtually impossible.

The different names under which a certain product was recorded can be found by using two helpful devices: First, the “List of products2.pdf”,¹ which provides translations for a number of products in five different languages (English, French, Danish, Dutch, and Frisian). For coffee, the list, which is continuously updated, currently provides three translations (“koffie” (Dutch), “kaffe” (Danish), and “coffee”). However, the French “café”, the German “Kaffee”, and especially the Italian “caffè” are missing. This shows that the list is not yet exhaustive.

For augmenting the information in the list a second device is helpful: the full list of cargoes.² Scanning this list, which can be done letter by letter, has two advantages: First, variations of the good in question may come up that would otherwise had been overlooked, and second the total number of the respective spelling is provided guiding the researcher to the most relevant naming variation.

In the case of coffee, I settled on the four variations “kaffe*”, “coffee*”, “caffe*”, and “cafe*”, where the first includes both the German and the Danish translation by use of the wildcard “*”. Furthermore, all observations including additional words such as “bonner” or “boenner” (which stands for beans) will be covered as well.

² Note that the website requires a registration with an email address, which however is not connected to providing any personal information or affiliation.
Next, the following sequence consisting of six steps has to be repeated for each naming variety:

1. Open http://dietrich.soundtoll.nl/public/advanced.php and search for the respective name with suitable wildcard *. To make sure that no passages out of the Baltic Sea become part of the aggregate, choose “The Baltic” from the dropdown menu “Destination – Big region.” In case the search result exceeds 10,000 observations the search can be restricted to a certain period, which was necessary in the case of “caffè*” for example.

2. After clicking “Download query result” choose “Special Download” and open the resulting csv.file in MS Excel.

3. Mark column A, and use the “Text to Columns” function in the “Data” ribbon to convert the file to a table. Make sure to choose “Delimiter” first and then tick the box “Semicolon” before finishing.

4. From the resulting table delete the columns E to I, since they tend to make the file unreadable for Matlab. When the name or origin of the skipper should be of interest, another solution has to be found for this problem. In some cases, the columns J and K may cause the same problems and may be deleted for now as well.

5. MS Excel tends to replace the cell format from “Number” to “Date.” If the value is “1/2” the cell shows “2-Jan” for example depending on the default date format. Overriding this automatic function by manually changing the format back to “Normal” is in my experience fruitless. One solution is to replace all cells with

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3 This does not identify our variable of interest perfectly as for example Gothenburg is still not excluded. However, it is by far the easiest way to exclude most of the reverse traffic which anyway is very small in the case of coffee.

4 Note also that there is a function planned using standardized names. Disaggregating the trade flows by origin would possibly allow for understanding better their variations of coffee trade flows over time.
the value “1/2/2013” by “0 1/2”.

6. The last step before saving is to filter the observations by units observed. There are volume and value observations, the former in “pund”\(^5\) or an indefinite number of alternative measurements that I decided to ignore, however. This can be easily done using the “Filter” function on the “Data” ribbon and then choosing only “Pund” from the pull-down menu that appears when clicking the little triangle at the top of column “maat” meaning “amount” in Dutch.\(^6\) The result needs to be copy-pasted into a new table in order to keep only the filtered observations. I save them in Excel 95-2003-format with an “.xls”-ending, since my version of Matlab does not read in “.xlsx”-files yet.\(^7\)

For the value observations, I go back to step 5, and filter all monetary units such as “Rd.”, “Rd”, “Rigsdaler”, and so on. I save this as a separate file with the ending “_value.”

2. Aggregation in Matlab

After repeating those six steps four times, I arrive with eight .xls-files, two for each naming variety. What needs to be done next is to aggregate these observations annually, so an evenly spaced time series is the result with the total volume (or value) of coffee in each respective year. I wrote a script for each file performing this task, and finally saving the volume, the toll paid, and the years, in which observations appear at all in a dedicated folder. (The scripts can be obtained from the author upon request.)

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\(^5\) The weight of the “pund” depends most likely on the origin of the ship. Throughout this paper, however, I assume the “pund” to be the Danish pound of 0.478 kg.

\(^6\) In some cases, observations of unwanted goods with similar names but different units can be filtered out as well. An example is “kaffa”, which is a textile good, not wanted, but identifiably because it is not measured in pund. When searching for “kaffe*” as I did, however, “kaffa” observations will not be part the query result anyway.

\(^7\) I use Matlab on a Mac, and it therefore misses MS Excel for Windows for full functionality.
The scripts for value-observations differ from the ones for volume-observations. It is not entirely clear how the underlying but unobserved volumes are related to the toll and the load value observations.

Two ways are possible to conclude about the unobserved volume: Either a fixed toll ratio can be assumed, such that the toll paid can be scaled up with this factor or a price can be assumed, such that the value can be transformed into a Pund-observation.

The script does both and compares the results in a figure. In the middle panel the figure shows what follows for the toll ratio from assuming a fixed price of 0.5 rigsdaler per Pund. The results are calculated by dividing the actual toll paid by the volumes derived from dividing the value observations by 0.5. Finally, the lower panel shows what is implied for the price for a Pund of coffee when assuming that the toll ratio was 0.005 rigsdaler per pound (or a half rigsdaler, i.e. 24 skilling for 100 Pund).

Note that the scripts identify outliers and delete them automatically. These are observations above the 99th percentile (or even the 99.9th), and can be assumed to be results of mistakes during recording, transcribing or digitalizing. This procedure could however also be used as a first step for a more thorough investigation of the data. Instead of deleting the outliers automatically, one could go back to the

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8 There are two observations in the databank with this price: Firstly, the passage of Gerrit Marcus of Amsterdam on 07/07/1755 sailing from Molde to the Baltic carrying, amongst other things, 36 pounds of coffee beans worth (‘w.’) 18 Riksd. Secondly, the passage of Simon Hillers of Bremen sailing from Bremen to Libau on 5/10/1754 carrying, amongst other things, 100 pounds of coffee worth (‘werdi’) 50 rigsdalers. I thank Maarten Draper for pointing this out to me.

9 Scherer (1845) documents the old and the new tolls (p. 216), with the old one being used from 1643/1645 until 1841. The new toll from 1842 on was based on an assumed price of coffee of 12.5 rigsdaler per 100 pound (or 0.125 per pound), one fourth of the price we found in the data. This is consistent with the stipulated reduction of the toll by 75% and a 1-percent VAT toll spanning the complete period under study.
original scans, and then decide to keep if it is genuine.

Finally, all results are aggregated into one single time series by use of the script “consolidate_coffee.m”. This programme loads all coffee observations and places them in a matrix with rows representing time and columns the four different naming variations. For each year, the columns are then added up for the final time series. The value observations are hereby transformed into volume observations by assuming a constant toll instead of a constant price, since this can be inferred from the literature (Scherer 1845), while a constant price is likely but without any hard evidence. The results are then presented in three graphs illustrating the relationship of value- and volume-observations, the relevance of different notations for coffee, and finally the time series of total coffee trade itself.

Results

Figure 1 shows the annual volumes in two panels: The complete series is in the upper panel and covers the years 1727 to 1857. The lower panel zooms into the first years until 1770, since the observations are an order of magnitude lower than the later ones and cannot be observed properly in the upper graph.¹⁰

Figure 1 about here

First, we can observe a striking increase of the trade volume between the 1730s and the 1780s. In 1732, the volume was about half a metric ton¹¹ (1100 pund), ten years later the volume had been increased by a factor of hundred (121,000 pund) peaking a year later at 193,000 pund or about 100 metric tons. Ten years after a temporary decrease volumes started to rise again exceeding the 1743 value in 1751 and peaking in 1756 at about 400,000 pund or roughly 200 metric tons. After

¹⁰ Table 1 provides the figures.
¹¹ 1100 pund * 0.478 kg/pund * 1/1000 t/kg = 0.5258 t.
another setback in the 1760s, the 1770s finally heralded a new era of coffee trade with volumes now reaching the millions of pund. The peak was reached with more than seven million pund (ca. 3,400 metric tons) in 1787 followed by a U-shaped development until the turn of the century, with a trough in 1793 at about 2.5 million pund (ca. 1,200 tons).

There were two more upward movements to follow with severe setbacks in between. The first climb started at the beginning of the 19th century reaching its peak in 1805 at about 12.5 million pund (ca. 6,000 tons) falling only three years later to below 400,000 pund. At the end of the 1810s the earlier peak was reached again where it stayed (with short breaks) for a decade before a long and deep descend set in. Its trough was reached in 1839 at below 2 million pund or 1,000 tons, and was followed by the third and final ascend in the series. The previous summit of more than 12 million pund was reached in the year 1849 and then climbed further to more than 16 million pund (7,700 tons) in 1855 before the numbers declined at the end of our observation period decisively.

A tentative explanation of this development would be to interpret the three climbs as expressions of increased demand for colonial products in the Baltic Sea area probably combined with improving supply. The setbacks in between would be most easily explained by wars that on the supply side interrupted international trade in various ways and thus increased trade costs. On the demand side they potentially depressed real incomes and thus the market for colonial goods.

Campaigns within the context of the War of the Austrian Succession (1740-48) may have been the reason for the decline in the early 1740s, while the second fall of trade in the late 1750s may be connected to the Seven Years’ War (1756-1763).
The next setback in the 1790s was maybe a result of by the French Revolutionary Wars (1792-1802), while the steepest decline in 1808 may have been a consequence of the War of the Fourth Coalition (1806-1807) during which the British bombed the city of Copenhagen.

Only the last and most persistent descend in the 1830s cannot be easily connected to war activity. It remains to be seen if for example trade to the Baltic was diverted away from the Sound to other routes such as through Hamburg and overland routes. This would be consistent with trade liberalization and improved transport infrastructure in early 19th century Germany (Uebele 2011, Uebele and Gallardo-Álbarran 2013, Scherer 1845, p. 74).

There are only a few estimates in the literature with which to compare these findings. Scherer (1845, p. 74) discusses a new toll regime that started in the year of 1842. In order to document a trade diversion effect away from Hamburg into the Sound he produces figures of 570,000 pound (“Pfund”) on average per year in the period before and 3.5 million pound after that.

These figures appear much too low compared to the ones I found. Given the difficulties I explained above and considering the fact that Scherer did not have a full database at hand, it is not surprising that a considerable gap appears. However, it remains to be clarified in what exactly this difference is routed in.

For the 18th century, Pfister (2013, p. 41) provides volumes of coffee imports at the port of Hamburg. Figure 2 shows the comparison of amounts entering Hamburg and passing the Sound. For Hamburg, data cover only the 18th century and are not given continuously. However, they convey a remarkable similarity to the flows at
the Sound. Thus, I will compare the levels, the long run developments as well as the short run fluctuations of the two series.

The level of coffee trade was always higher in Hamburg than at the Sound at least in the years observed. This may be an expression of the relative sizes of Hamburg’s hinterland and the market accessible through the Sound. This discussion is however beyond the scope of this short paper. Of course Hamburg also forwarded coffee to the Baltic via the Sound (Pfister 2013, p.6) and such double counting should be subtracted for a more meaningful comparison.

The long-run trends look similar at first glance but note the very low levels of trade through the Sound until the 1770s compared to Hamburg’s. This makes for a much an extremely steep rise of trade through the Sound (remember the growth factor of 100 between 1732 and 1742 mentioned above). This may hint to a downward bias in my figures. However, from the 1770s the trends are more like each other even though a divergence occurs in the 1790s when Hamburg peaks at 17 million pound (1795).

Finally, the short run fluctuations exhibit at least one instance of negative correlation. The peak at the Sound in 1787 is met by a substantial fall of Hamburg’s trade by 18 per cent in the previous year. This would hint at a competition between the two trade routes to Central European markets. However, the patchy evidence for Hamburg does not allow for a conclusion at the moment.

**Conclusion**

This paper presents preliminary evidence of coffee trade flows through the Danish Sound, 18th and 19th centuries. It relies on the Soundtoll Registers online databank

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12 For Hamburg, Pfister (2013, pp. 4) presents the latest discussion of the size of Hamburg’s hinterland.
to do so. In line with the Industrious Revolution hypothesis coffee volumes rose strongly in the 18th century and through the 19th century, but were probably interrupted by the many wars fought in Europe at the time. The results are not consistent with contemporary evidence (Scherer 1845), but seem to be at the right order of magnitude when compared to Hamburg’s coffee trade (Pfister 2013).

The paper presents in detail a way to retrieve results from the online database and aggregate them to a time series. However, the results presented here should not be treated as final yet, as the Soundtoll Registers may still contain passages with coffee loaded missing in the simple approach presented here. However, a more thorough analysis and comparison with alternative results from studies being conducted in parallel will result in more definitive answers in the near future.
References


Table 1: Volume of Coffee Passing the Danish Sound, 1725-1857. Units: Pund (exact weight depends on origin of the cargo).

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Figure 1: Annual volume of coffee trade in Danish pounds at the Danish sound, 1727–1857.
Figure 2: Comparison of Coffee Trade Flows, Danish Sound and Hamburg, 1727-1857. Sources: Pfister (2013, p. 41) and Soundtoll Registers Online Database, for details see text.